UNIT 20 POLICY ANALYSIS: METHODS AND TECHNIQUES – I

Structure

20.0 LEARNING OUTCOME

After studying this Unit, you should be able to:

- Understand the concepts of social cost-benefit analysis and input-output analysis;
- Explain the different alternative choices available to the policy analyst; and
- Discuss the criteria for selecting alternative policy choices.

20.1 INTRODUCTION

In Unit 19 while discussing the policy analysis process, we have identified that the policy analyst may use different techniques and methods for evaluating alternative policies; displaying and distinguishing them; and monitoring and evaluating implemented policies. In this Unit, we will discuss these methods and techniques, namely, Social Cost-Benefit Analysis (CBA) and Input-Output Analysis. The CBA is widely used in evaluating policy alternatives and comparing them, and Input-output analysis is used in evaluating policy alternatives.

20.2 SOCIAL COST-BENEFIT ANALYSIS

The CBA is one of the methods used in economic evaluation of policy analysis. This method permits policy analysts to compare and advocate policies by quantifying their total monetary costs and benefits. While CBA can be used prospectively to recommend policy actions, it can also be used retrospectively to evaluate policy performance. CBA is also known as 'rate of return' analysis and the procedure followed to compute is similar to that of ordinary investment policy evaluation.

For example, a machine costs Rs.1,10,000 and yields an annual constant income of Rs.1200 and has a life expectancy of 10 years, and the rate of return of investing this machine is equal to 3 pel-cent.

20.2.1 The Rationale of Using CBA

The CBA tries to estimate net social welfare changes (the difference between social benefits and social costs) as a result of policy. In a standard CBA, social welfare is measured in terms of net benefits of the policy. A policy is said to be efficient if it maximises the net benefits available to the society.

Although, the CBA is not specifically designed to evaluate the equity, it can be used to track down the costs and benefits among various strata of beneficiaries. The policy analyst may attempt to determine how benefits are distributed among different, stratified on the basis of age, sex, income, religion, geographic location, etc. The distribution may also be done for different time periods. Both economic efficiency and equity are built into the framework of evaluation of the benefits of social welfare. The concepts of economic efficiency and equity are discussed below.

i) **Economic Efficiency**

This is a measure of net benefits accruing through a policy to the society. This is designed to answer whether the redistribution of resources implied by apolicy results in a betterment of society. For example, in the implementation of a health programme the government may advise its citizens to go for health insurance. Alternatively,it can build hospitals in the public sector and offer health services or take preventive health measures. Each of these would have differential costs to the government as well as to the people. The benefits accrued can also be measured.

The policy analyst is confronted with the challenge of devising criteria to determine the relative "efficiency" or optimality of alternative policies in a given situation. The Pareto criterion helps (discussed in Unit 17) policy analysts in recommending policies that maintain social equity.

ii) **Equity**

As we have seen earlier the economic efficiency seeks aggregate monetary gains accrued to the society. The equity seeks to determine if costs and benefits are systematically reallocated in ways that favour people least able to protect themselves than the people who are already in an advantageous position. There are instances where the policies prove to be more economically efficient, but are not equitable. In our example of health policy, the government may decide to subsidise the health insurance. This policy may benefit all people in the society irrespective of their income levels. However, the policy may be more ideal for the families whose income falls below the poverty line and are not able to meet their basic needs. Instead of giving subsidy uniformly to all the people in the society the policy analyst may recommend a different alternative. One such alternative consists of stratifying the population according to their income levels, and then apply different levels of subsidy for different income strata on the basis of need.

20.2.2 Advantages and Limitations of CBA

CBA has a number of advantages and limitations in practice. The advantages are: a) It enables the policy analyst to work out the actual costs and benefits of alternative policies. In this process, the costs and benefits that have not been part of the discussion may come to light; the costs **and** benefits are measured in monetary terms, **and** this permits the policy analyst to subtract costs from benefits; we can compute the net benefits for each policy alternative and then compare them; and the CBA allows us to compare different programmes like health, environment, education etc.

The disadvantages of CBA are as follows:

i) It puts exclusive emphasis on economic efficiency. The efore, the equity criterion is meaningless unless we compute CBA for different strata of the population.

ii) The monetary value is an inadequate measure of responsiveness, since the actual value of money varies from one person to another. For example, an extra income of Rs.100 may have more value for a poor person than rich.

iii) When the actual market prices are not available, the policy analyst is forced to use shadow prices that are in practice subjective and arbitrary.

20.2.3 Identification of Costs and Benefits

In order to arrive at the best cost-benefit estimates, it is important to identify all costs and benefits and measure them in rupee term. In practice, it is very difficult in many situations. However, the policy analyst should try to minimise the error in estimating the costs and benefits by including all of them. For this, we classify the costs and benefits into: (a) internal and external, (b) tangible and intangible, (c) direct and indirect, and (d) net efficiency and redistributional.

i) **Internal and External Costs and Benefits**

The costs and benefits can be either internal or external to a given policy or project target group or jurisdiction. What is internal or external to apolicy or project depends upon how the policy analyst draws the boundaries to that policy around the target group or jurisdiction. If the policy aims at the society as a whole then there are no external costs or benefits. If the policy aims at a sub-population or a particular geographical area then there are external costs and benefits in addition to the internal costs and benefits. For example, construction of a factory in a particular geographical area may provide employment opportunities to some people in the locality of the factory. The pollution released from the factory may affect not only local people but also people living down the stream. Therefore, while calculating the costs and benefits of a policy, the policy analyst should take into account all the costs and benefits that may be internal or external to the policy.

ii) **Tangible and Intangible Costs and Benefits**

Tangible costs and benefits are those that can be quantified in monetary terms, such as, cost of land, operating cost, savings, avoidance of future costs, etc. Intangible costs and benefits are those that cannot be measured in monetary terms. Improved quality of the life of people because of clean air is one such intangible cost and benefit. In this case, the policy analyst may attempt to estimate the shadow prices by making subjective judgments about the monetary value of costs and benefits. For example, the analyst may try to estimate the opportunity costs and benefits in terms of improved health and higher productivity of people because of clean air and the lower costs on health care. Thus, many of the intangible effects are difficult to quantify.

iii) **Direct and Indirect Costs**

Any policy or project generates costs and benefits directly as well as indirectly. Here, the question is whether the costs and benefits are direct or indirect to the policy or project. For example, the costs borne by government or people in health insurance programme are classified. Indirect costs and benefits are those that do not relate to the objectives of a programme. For example, the amount of leisure time or other indirect outcomes of the health programme are indirect costs and benefits. However, for the policy analyst the indirect costs and benefits are not of much importance. Therefore, the analyst considers only direct costs and benefits.

iv) **Net Efficiency and Redistributional Benefits**

Here, the question is whether the total costs and benefits create an aggregate net benefits or they have the effect of simply redistributing the income among different groups of population'? Earlier, you have learned that the net efficiency maximises the net benefits. The redistributional benefits are those that redistributes the income among various groups of population without maximising the net benefits. The net efficiency benefits and redistributional benefits are also called real benefits and pecuniary benefits respectively. For example, the net benefit of establishing a factory may produce Rs.100 million in net efficiency benefits. Suppose a new market has come up in a local area, it will have redistributional benefits since the loss of a nearby market is the gain of this new market.

20.2.4 Commonly Used Cost-Benefit Measures for Policy Comparisons

Several cost benefit measures are employed to determine the net efficiency of projects. These measures are pay back, discounted pay back, net present value, benefit-cost ratio, and internal rate of return (IRR).

In this section we will discuss in detail each of these measures, how to calculate, and compare them.

i) **Pay back**

This is the simplest among all the cost-benefit measures, It simply calculates benefits from a capital project, the number of periods it takes in future (and what amount it costs in each period) to repay the initial investment. For example, we examine two capital projects A and B with their cost-benefit flows as given in table 20.1.

Table 20.1: Cost-Benefit Flow of A and B Capital Projects

Year	Cost Benefit Flow (in Rs.)	
	Project - A	Project - B
0	-10,00,000	-10,00,000
1	4,00,000	3,00,000
2	3,00,000	3,00,000
3	4,00,000	3,00,000
4'	2,00,000	2,00,000
5	2,00,000	-2,00,000

Each project has the initial investment of Rs.10,00,000 at the beginning. There is a positive cash flow from both the projects A and B up to 4 years and the total flow is the same, This does not mean that both the projects are equal, There is a negative flow for project-B in the 5th year. Although we can make a statement that project-A is superior to project-B since A has a positive total cost benefit flow, but we should not come to this conclusion, since it does not take into accbunt the time factor in estimating the value of the costs. Therefore, this measure may not be consistent for comparing projects and is not normally recommended.

Many of the public projects or policies have impacts that will be felt for many years. Like individuals, the public agencies tend to have a preference for benefits sooner rather than later. For example, we could have a strong preference of having Rs.80 today rather than having Rs.100 after two years, that means we are taking into accaunt the interest (opportunity costs). Therefore, we try to discount the future money to the present. That is to say, in the above example, it is worth receiving Rs.80 today, rather than receiving Rs.100 two years later.

ii) Discounted Pay back

The shortcoming of the pay back method can be rectified by incorporating the time value of the money. The cost-benefit flows are discounted to incorporate the time value of the money. We discount future value of money to present value by using an appropriate discount rate (r). The present value of the future money is computed using the following formula.

$$PV = FV\left(\frac{1}{1+r}\right)^n$$

Where, PV = Present value of the future money

FV = Future value of the money

r = Discount rate usually expressed in percentage

n = Number of years (from year 0)

Suppose in our example we assume that the discount rate is 6 per cent. For example, for project A, the FV at year 5 is Rs.2,00,000. The rate of discount we assumed is 6 per cent.

Therefore, $PV = 2{,}00{,}000\left(\frac{1}{1+0.06}\right)^5 = 2{,}00{,}000\left(\frac{1}{1.06}\right)^5 = 2{,}00{,}000(0.9434)^5 =$ $2{,}00{,}000 \times 0.7473 = 1{,}49{,}460$. The discounted cost-benefit flows for projects A and B are shown in table 20.2.

Table 20.2: Discounted Cost-Benefit Flow for Project A and Project B

Year	Project A		Project B	
	Cost-Benefit Flow (Rs.)	Discounted Cost-Benefit Flow (Rs.)	Cost-Benefit Flow (Rs.)	Discounted Cost-Benefit Flow (Rs.)
	-10,00,000	-10,00,000	-10,00,000	-10,00,000
	2,00,000	1,88,680	3,00,000	2,83,020
2	3,00,000	2,67,000	3,00,000	2,67,000
3	4,00,000	3,35,840	3,00,000	2,51,880
4	2,00,000	1,58,420	2,00,000	1,58,420
5	2,00,000	1,49,460	-2,00,000	-1,49,460

Observe the table 20.2, the returns from Project B do not pay back the initial investment, but the returns from project A pay back in the 5th year. While the discounted pay back method is consistent —since it takes into account the time value of the money — it fails to take into account all the cost benefit flows generated by each project.

The discounted costs benefits can also be computed using discount table given at the end of this Unit. For example, if you want to calculate discounted future benefits for the following data:

FV = Rs.5,500

n = 4

r = 6%

Then, PV = Rs.5,500x0.7921 = Rs.4356

iii) **Net Present Value (NPV)**

The NPV method takes all the discounted cost-benefit flows into account. This method yields one value for each project that can be interpreted easily. The NPV for each project is computed by totalling all the discounted cost-benefit flows. If the NPV is positive, the project yields benefits that exceed costs. If the NPV is negative, we say that the costs exceed benefits. If NPV is zero, we say that the project neither yields benefits nor losses. The discounted costs and benefits are computed using the same formula for discounted pay back method.

NPV = total discounted benefits + total discounted costs.

Remember that as a standard practice the discounted costs are expressed in terms of minus (-) values. Table 20.3 shows an example of NPV. Note that in this example a discount rate of 8 per cent is assumed.

Table 20.3: Computing NPV for Project-I and Project-I1

Year	Project-I		Project-I1	
	Cost-Benefit Flow (Rs.)	**Discounted Cost-Benefit Flow (Rs.)**	**Cost-Benefit Flow (Rs.)**	**Discounted Cost-Benefit Flow (Rs.)**
0	-10,000	-10,000	-10,000	-10,000
I	4,000	3,704	2,000	1,852
2	4,000	3,429	3,000	2,572
3	4,000	3,175	4,000	3,175
4	4,000	2,940	5,000	3,675
5	4,000	2,722	5,000	3,403
	NPV	5,970	–	4,677

Both the projects have positive NPVs. However, project-I has higher NPV than project-11. The comparison of projects help us when we have to choose among alternatives. Since the NPV method allows us to take care of the time value through discounting, this method is consistent. Also, different discount rates can be tried for the same project and then compare them to understand the projected risk of each project.

iv) **Cost-Benefit Ratio**

The cost-benefit ratio is simply the ratio of discounted benefits to discounted costs.

$$CBR = \frac{\Sigma DB}{\Sigma DC}$$

Where, CBR = Cost-Benefit Ratio

Σ DB = Total of all discounted benefits

ΣDC = Total of all discounted costs

Observe that the CBR will have a numerical value of 1 when both discounted costs and benefits are equal. The CBR will have a numerical value higher than 1 if the benefits are more than the costs, and CBR less than 1 if the benefits are less than the costs. When we compare several projects, we choose aproject that has the highest CBR. We will illustrate CBR with an example, which is represented in Tables 20.4(a) and (b). It is assumed that there is a discount rate of 6 per cent.

Table 20.4(a): Discounted Cost Benefits for Project A

Year	Costs (Rs.)	Discounted Costs (DC) (Rs.)	Benefits (Rs.)	Discounted Benefits (DB) (Rs.)
0	10,000	10,000	0	0
1	0	0	5,000	4,717
2	0	0	5,000	4,450
3	0	0	5,000	4,198
4	2,000	1,584	5,000	3,960
5	0		5,000	3,736
Total		11,584	–	**21,061**

CBR for project A = Total of DB/Total of DC = 21,061/11,584 = 1.82

Table 20.4(b): Discounted Cost-Benefits for Project-B

Year	Costs (Rs.)	Discounted Costs (DC) (Rs.)	Benefits (Rs.)	Discounted Benefits (DB) (Rs.)
0	10,000	10,000	0	0
1	0	0	4,000	3,774
2	0	0	4,000	3,560
3	0	0	5,000	4,198
4	0	0	5,000	3,960
5	0	0	8,000	5,978
Total		10,000	-	21,470

CBR for Project-B =Total of DB/Total of DC= 21,470/10,000=2.15

Both Project-A and Project-B have higher CBR. However, Project-B will be preferred because it has higher CBR than Project A.

v) Internal Rate of Return (IRR)

This is another cost-benefit method being used. In earlier cost-benefit methods we assumed a discounting rate that will bring the future costs and benefits to the present value. It is often difficult to determine the rate at which future benefits should be discounted to the present value. In addition, decision makers are often more comfortable with value expressed in terms of percentage rather than by some other calculus. The IRR computes a discount rate at which discounted benefits equal discounted costs. The IRR is the method that does not depend on the assumption of discount rate and determines a value in terms of a percentage. In other words, the discounted present value of costs minus present value of benefits equal to zero. To compute IRR, we equate initial investment with discounted (r) future benefits and then find r, that is, termed as IRR.

Suppose we have invested initially Rs.10,000 in year 0, and from year 1 to year 4 we are expecting the benefit of Rs.5,000 each year. This can be expressed mathematically as:

$$10000 = 5000\left(\frac{1}{1+R}\right)^1 + 5000\left(\frac{1}{1+R}\right)^2 + 5000\left(\frac{1}{1+R}\right)^3 + 5000\left(\frac{1}{1+R}\right)^4$$

In order to find r we need a financial calculator, or computer worksheet, that is, beyond the scope of this Unit.

In this Unit, we will discuss how to interpret IRR, compare with NPV, which is widely used in cost-benefit analysis, and understand the limitations of IRR in choosing the projects. Consider the example given in table 20.5.

Table 20.5: Cost-Benefit Flows for Project-X and Project-Y

Year	Project-X		Project-Y	
	Cost-Benefit Flow (Rs.)	Discounted Cost-Benefit Flow (Rs.)	Cost-Benefit Flow (Rs.)	Discounted Cost-Benefit Flow (Rs.)
0	-10,000	-10,000	-10,000	-10,000
1	5,000	4,630	1,000	926
2	5,000	4,287	1,000	857
3	5,000	3,969	1,000	793
4	5,000	3,675	20,000	14,700
NPV	–	6,561	–	7,276

In table 20.5, we assumed a discount rate of 8 per cent for computing NPV for Project-X and Project-Y. For the sake of convenience, we have shown costs and discounted cost by using minus symbol. This symbol is not used while computing IRR. Simply take all numbers as positive. Suppose you have computed IRR for Project-X and Project-Y using a financial calculator or a computer worksheet, you may get IRR roughly 35 per cent for Project-X and 25 per cent for Project-Y. You have already seen NPV for Project-X as 6,561 and for Project-Y as 7,276. As per the NPV criteria you have choosen Project-Y because it has higher NPV. But as per the IRR criteria, you choose Project-X because it has higher IRR. This is clearly an inconsistency. The results must also have surprised you. Can you guess what happened? If you look closely at benefit flows for both the projects, Project-X has constant flow of benefits and is higher than Project-Y, especially for the first 3 years. For Project-Y, there are lower benefits in the first 3 years and suddenly the benefits shoot up 4 times higher than that of Project-X for the 4^{th} year. The IRR assumes reinvestment of the benefits at an internal rate of return rather than at the cost of investment as in NPV. Therefore, the IRR will be higher for the Projects that generate higher benefits in the initial years.

When the decision maker has a fixed capital budget and cannot exceed the ceiling even if a project yields higher positive returns, we call it as capital rationing. In such cases, selecting IRR method to compare projects will be inappropriate. Thus as explained earlier, the IRR assumes the reinvestment of benefits at an internal rate of return rather than at the cost of investment in NPV. Consider data from the example, presented in table 20.6:

Table 20.6: NPV and IRR on Investment

Project	Investment (Rs.)	NPV	IRR
I	1,000,000	60,000	22%
II	10,000,000	800,000	17%
III	20,000,000	2,000,000	15%

If there is no capital rationing, we may choose all the projects since the NPV are positive and IRR are at an acceptable level. In case, the decision maker faces capital rationing of say Rs.20 million, then the choice of project depends on the IRR. Since Project-I and Project-II have higher IRR the decision maker may choose either of them. On the other hand, if you look at NPV he may choose Project-III since it gives higher NPV than Project-I and Project-II put together.

While it is not difficult to compute the IRR, it suffers from two limitations. First, the element of inconsistency limits the usefulness of the IRR method. Second, when there are negative cost-benefit flows the computation of IRR becomes difficult and one has to use a modified IRR method, a discussion of which is beyond the scope of this Unit.

20.2.5 Choosing a Cost-Benefit Method

In section 20.2.4, we have introduced a number of cost-benefit methods. Each of these methods has some advantages and disadvantages in choosing the superior projects. The pay back and discounted pay back methods may be simple to compute, but are not acceptable for any project selection. Hence, these two methods are not used by most of the policy analysts.

The IRR method has some limitations in situations like capital rationing and scale differences (scale differences refer to the relative size of the cost-benefit flows). The cost-benefit ratio is fine for finding the project, that is, most efficient. But this method does not work when there is capital rationing.

The NPV is the only method, that is, widely used and is mostly preferred to IRR and CBR. Also, NPV is much easier to compute than IRR and offers a simple basis to accept or reject a project. The only disadvantage of the NPV is that it favours large projects. Many policy analysts do not suggest reliance on any single, but instead measure a variety of criteria or a combination of them for evaluating projects.

20.3 INTER-SECTORAL INPUT-OUTPUT ANALYSIS

Inter-Sectoral Input-output analysis derives its name from the work of Wassily Leontief. This work earned him the Nobel Prize in economic science in 1973. Leontief is well known for his scepticism about abstract economic modelling and respected for his concern with concrete data acquired through careful observation and measurement. Leontief's aim is to analyse in a systematic way the inter-dependence of a country's industrial sectors. For this reason, sometimes the term inter-industry analysis is used for input-output. The input-output analysis is also known as Economic Effects Analysis or Economic Impact Study Analysis.

The principle behind inter-sectoral input-output analysis is simple. It assumes that there is an interdependence among various sectors of the economy like industrial, governmental, and household sectors. Each industry or sector requires the output of others as input in their production process. For example, in order to produce one ton of iron, we need x_{11} tons of scrap iron, x_{21} tons of iron ore, x_{31} tons of coke, and x_{41} kilo watts of electricity, etc. Here the product iron is called output and the ingredients like iron ore, electricity, etc. are called inputs. The inputs x_{11}, x_{21}, x_{31} ... are also called production coefficients that reflect underlying casual relationships between the production and consumption of goods and services.

Inter-Sectoral input-output analysis seeks to explain and predict the interdependence among various sectors of the economy. Input-output analysis has been applied to a variety of forecasting problems like implications of alternative taxation programmes for industrial growth; effects of industrial growth on the demand for water resources; effects of industrial growth on the consumption of energy resources, etc. One of the most important applications of input-output analysis is the formation of a national income accounting matrix. The information from the input-output tables is used for economic planning.

In practice, the number of sectors included in the basic input-output table can vary from a few to hundreds or even thousands, depending on the desired level of disaggregation and the problem at hand. Therefore, the data collection and compilation for input-output tables is an expensive and time-consuming process. In addition, the large computational requirements of input-output analysis is a handicap. However, with the widespread use of computers this problem has been eliminated. The input-output analysis method is widely used as a tool in policy evaluation. The United Nations recommends input-output analysis as a planning tool for developing countries and has sponsored a standardised system of economic accounts for the development of input-output:models.

20.3.1 Transactions Table

The transactions table is one of the principal analytic tools of inter-sectoral input-output analysis showing the relations in monetary terms among consuming and producing units in society. This table provides us the information about the inputs and outputs actually employed in the production and consumption processes of the economy. Table 20.7 provides a highly simplified transactions table that shows hypothetical monetary values of various sectors of an economy, namely, agriculture, manufacturing, and labour services. The distribution of each industry's output in the economy is found by reading horizontally across the relevant row. For example, the total output of agriculture sector is Rs.300 billion of which Rs.40 billion goes to agriculture sector itself and Rs.190 billion goes to manufacturing sector as inputs. The rest, Rs.70 billion, is the final demand. Similarly, the origin of each industry's inputs can be found by reading vertically down the corresponding column. For example, out of the total inputs Rs.125 billion from the agriculture sector, Rs.40 billion inputs are consumed by the agriculture sector itself, Rs.60 billion comes from manufacturing sector, and Rs.25 billion from labour services as inputs. An industry may buy its own product (output) as an input. For example, the manufacturing sector consumes Rs.40 billion (the cell value in the second row and second column). All the main diagnal cells represent these flows. These transactions are also known as intra-industry flows.

An industry also sells final demand. For example, manufacturing industry sells Rs.80 billion final demand. Apart from inter-industry flows, a sector can use other non-industrial inputs, such as, labour services in our example. The total output equals the total inputs.

Table 20.7: Hypothetical Inter-industry Transactions Table (Rs. in billions)

		Inputs			
		Agriculture Sector	**Manufacturing Sector**	**Final Demand**	**Total Output**
Outputs	**Agriculture** sector	40	190	70	300
	Manufacturing sector	60	40	80	180
	Labour services	25	55	0	80
	Total **input**	125	285	150	560

20.3.2 Production Coefficients in Input-Output Analysis

The second analytic tool used in inter-sectoral input-output analysis is the input-output coefficient matrix representing inter-dependencies between consuming (input) and producing (output) sectors. Table 20.8 explains the technical coefficients for the data given in table 20.6 (Transactions table). Each coefficient expresses the numerical ratio of inputs required from particular sector to produce the total'outputof a sector, The coefficients are calculated using the following formula.

$$a_{ij} = \frac{I_{ij}}{O_j}$$

Where, a_{ij} = input-output coefficient corresponding to the i^{th} column and j^{th} row of the production coefficients matrix table.

I_{ij} = input in terms of monetary value corresponding to the i^{th} column and j^{th} row of the transactions table.

O_j = total output of the j^{th} row of the transactions table.

For example, $a_{21} = I_{21}/O_1$ = Rs.190 billion/Rs.300 billion = 0.63

Here I_{21} represents the inputs required by agriculture sector (Rs.190 billion) from manufacturing sector. The total output by agriculture sector is Rs.300 billions, What does it mean for us? The production coefficient indicates that the agriculture sector takes Rs.190 billion worth of inputs from the manufacturing sector to produce Rs.300 billion worth of output. In other words, the coefficient 0.63 indicates that to produce 100 units of agriculture product, we need 63 units of manufacturing product. Also, observe that every sector consumes (inputs) a portion of its own product (output) in order to produce further outputs. For example, from table 20.8 it can be seen that the agriculture sector consumes (input) 13 units of its own product (output) in order to produce 100 units of output.

Table 20.8: Production Coefficients in Input-Output Matrix

		Inputs			
		Agriculture Sector	**Manufacturing Sector**	**Final Demand**	**Total Output**
Outputs	Agriculture sector	0.13	**0.63**	0.23	1.00(300)
	Manufacturing sector.	0.33	**0.22**	0.44	1.00(180)
	Labour services	0.31	**0.69**	0.00	1.00(80)
	Total input	125	**285**	150	560

20.3.3 Forecasting — Using Input-Output Production Coefficients

Using the input-output production coefficients matrix (as shown in table 20.8), the policy analyst can attempt a variety of forecasts. For example, if policy makers have allocated funds to simulate a 20 per cent growth in manufacturing sector, the total output in manufacturing sector increases from Rs.180 billion to Rs.216 billion (that is, Rs.180 billion + 20% of Rs.180 billion). Since the production coefficient for agriculture and manufacturing sector is 0.33 (cell in column 1 sow 2, table 20.8) the agriculture sector input to manufacturing sector increases to Rs.71.28 billion (0.33xRs.216 billion) from the current Rs.60 billion (table 20.7).

20.4 CONCLUSION

In this unit, we have presented cost-benefit and input-output methods for evaluating proposed policies or projects by the policy analyst. We have also discussed the merits and disadvantages of each cost-benefit method. The NPV is the most widely used method of social cost-benefit analysis for comparing and choosing alternative projects or group of projects. The cost-benefit ratio is another method for decision-making for comparing and choosing a project. The IRR is also useful for project evaluation, but it has some limitations. To sum up our discussion on the cost-benefit methods, it is always recommended to use more than one method and draw the inferences that will help the decision makers to choose the right project.

Economic efficiency and equity are useful criteria in project appraisal. Various kinds of cost and benefits are classified to have a clear understanding on what to include or not in computing the costs and benefits. Although this Unit relies heavily on numerical analyses, we have tried to minimise them keeping in mind the needs of learners. Obviously more emphasis is placed on inferences from the results of numerical analyses.

Inter-sectoral input-output analysis explains the inter-dependencies among different sectors of the economy. By analysing data from the input-output table, we can understand how inputs contribute to output within a sector or across other sectors. The policy analyst can also plan for changes in other sectors on the basis of expected output changes in each sector.

20.5 KEY CONCEPTS

Capital Rationing : This refers to the fixed capital budget, with an inability to exceed the budget limits even if the chosen projects would yield positive returns.

.,Cost-Benefit Ratio : The ratio of discounted benefits to discounted costs.

Discounted Rate : The estimated or assumed rate at which the future benefits decline to the present value.

Economic Efficiency : This is a measure of net benefits accruing through a policy to the society.

Equity : Equity seeks to determine the systematic reallocation / redistribution of costs and benefits in ways that favour people ('least able to protect themselves) than the people who are already in an advantageous position.

Input-Output Matrix : A table that represents the inter-dependencies between input-output units of different sectors of the economy.

Internal Rate of Return : The rate at which discounted costs equal to discounted benefits.

Net Present Value (NPV) : It is the sum of discounted future values to the present value.

Scale Difference : This refers to the relative size of the cost-benefit flows.

Transaction Table : Inter-sectoral input-output table showing the relationships in monetary terms among various sectors of the economy.

20.6 REFERENCES AND FURTHER READING

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20.7 ACTIVITIES

1) Critically evaluate the usefulness of cost-benefit analysis in public policy analysis.
2) Define the terms economic efficiency and equity and assess their importance in cost-benefit analysis.
3) Describe the various methods of cost-benefit analyses used in policy evaluation. Compare and explain which is better and why?
4) Compute the net present value for the following 4 projects. (The costs and benefits are given in million rupees).

Year	Project-A		Project-B		Project-C		Project-D	
	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits
0	1,000	0	10,000	0		0	10,000	0
1	0	200	0	2,500	0	200	0	2,500
2	0	200	0	3,000	0	200	0	3,000
3	0	200	0	3,000	0	200	0	3,000
4	100	150	0	3,500	100	150	0	3,500
5	0	200	0	4,000	0	200	0	4,000
	Discount rate = 6%		Discount rate = 6%		Discount rate = 8%		Discount rate = 8%	

If you are a policy analyst, which project would you recommend to the decision-maker? Why?

5) A policy analyst has evaluated the following three projects by computing the IRR for each project. The investment is the same for all the projects. Draw your inferences in selecting a superior project.

Project	A	B	C
IRR	20%	27%	15%

6) How do the inter-sectoral input-output tables help in policy analysis ? And also explain the limitations of this method.
7) Using table 20.8, forecast the following:
   a) The policy maker wants to increase the agriculture output to Rs.350 billions. What will be the corresponding increase in manufacturing sector?
   b) Consider the production coefficient of 0.69 noted in column 2 and row 3. What does it explain?

Present Value of Rs.1:

(The coefficients in this table gives the value today (Present Value) to me in the year n (Future Value), if the discount rate is r%.

Discount Rate (r)

Year (n)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	15%	20%	25%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.86%	0.8333	0.8000
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7561	0.6944	0.6400
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.83%	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6575	0.5787	0.5120
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	05718	0.4823	0.4096
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	05674	0.4972	0.4019	0.3277
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	05346	0.5066	0.4323	0.3349	0.2621
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227	05835	05470	0.5132	0.4817	0.4523	0.3759	0.2791	0.2097
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3269	0.2326	0.1678
9	0.9143	0.8368	0.7664	0.7026	0.6446	05919	05439	0.5002	0.4604	0,4241	0.3909	0.3606	0.2843	0.1938	0.1342
10	0.9053	0.8203	0.7441	0.6756	0.6139	05584	0.5083	0.4632	0.4224	03855	0.3522	0.3220	0.2472	0.1615	0.1074
11	0.8963	0.8043	0.7224	0.64%	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2149	0.1346	0.0859
12	0.8874	0.7885	0.7014	0.6246	05568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.1869	0.1122	0.0687
13	0.8787	0.7730	0.6810	0.6006	05303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.1625	0.0935	0.0550
14	0.8700	0.7579	0.6611	0.5775	05051	0.4423	03878	0.3405	02992	0.2633	0.2320	0.2046	0.1413	0.0779	0.0440
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	03624	0.3152	02745	0.2394	0.2090	0.1827	0.1229	0.0649	0.0352
16	0.8528	0.7284	0.6232	05339	0.4581	0.3936	03387	0.2919	0.2519	02176	0.1883	0.1631	0.1069	0.0541	0.0281
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.0929	0.0451	0.0225
18	0.8360	0.7002	0.5874	0.4936	0.4155	03503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.0808	0.0376	0.0180
19	0.8277	0.6864	05703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	-0.1635	0.1377	0.1161	0.0703	0.0313	0.0144
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584	02145	0.1784	0.1486	0.1240	0.1037	0.0611	0.0261	0.0115
21	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0531	0.0217	0.0092
22	0.8034	0.6468	05219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0462	0.0181	0.0074
23	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0402	0.0151	0.0059
24	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0349	0.0126	0.0047
25	0.7798	0.6095	0.4776	0.3751	0.2953	0,2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0304	0.0105	0.0038
30	0.7419	0.5521	0.4120	0.3083	02314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0151	0.0042	0.0012
40	0.6717	0.4529	0.3066	02083	0.1420	0.0972	0.0668	0.0460	0.0318	0.0221	0.0154	0.0107	0.0037	0.0007	0.0001
50	0.6080	0.3715	0.2281	0.1407	0.0872	0.0543	0.0339	0.0213	0.0134	0.0085	0.0054	0.0035	0.0009	0.0001	0.0000