CHAPTER 2

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2.1 DEVELOPING THE CONCEPT OF COST-BENEFIT ANALYSIS

2.1.1 The success of an administrative machinery be it in government or otherwise depended on the effectiveness of its decision in the employment of scarce resources. This needed the requisite technique for programme analysis and its evaluation. Economists have for this purpose, always concerned themselves with the study of allocation of scarce resources for the satisfaction of human wants, thus helping the administrative machinery through the development of requisite techniques. In the wake of industrial revolution, the economic activity of community under went a sea change, creating enormous distributional problems. Government machinery could no longer remain a mute spectator concentration of economic power in the hands of a few at the cost of the larger part of community. The result and change in political and social structure brought in through government controls, thus witnessed the emergence of the concept of welfare states. The economists had to share their part of the responsibility of this socio economic change and had to develop the requisite technique to meet the changing structure of economic activities of community. As a result of particular branch of applied welfare economics was developed which had its roots in the technique of cost benefit analysis.
2.12 Mianeh based his concept of cost benefit analysis on the application of allocation theory. This originating from Pigott (1924) was elaborated by Seliner and Mix (1939) in the form of welfare tests. The same was restated in the form of Potential Pareto improvements which meant an economic change in which gains are so distributed in the community as to make every one better off.

2.12 Little and Mirfield Concept of cost benefit analysis was particularly useful for economic planning particularly in developing countries. The technique of calculating the accounting prices of traded goods and unskilled labour often suffered with inadequacy of reliable statistical data, which limited the scope of applying sophisticated techniques of planning. To overcome this drawback, these authors have attempted to develop the technique and formulate cost benefit rules for improvised rule of thumb and sober guess work in planning, where these could lead to economic improvements. Waiting for availability


Pareto improvement means an alternative in the prevailing rate of interest to a more competitive one, or a change from an existing competitive interest rate to a lower one that is justified by reference to external diseconomics as argued by G. Maglin, "The social rate of discount and optimal rate of investment" Quarterly Journal of Economics, Feb. 1933. In either circumstances a change in appropriate shadow rate of interest would be one meeting the destination of Potential Pareto Improvement.


In calculation of traded good, it is just possible, that errors are caused met out of any conscious departure from allocative rules, but simply because not sufficient thoughts are given to the matter.
Of more reliable data would have otherwise deferred the planning activity indefinitely. Of course their concept of cost benefit analysis particularly the rules regarding pricing of traded goods and labour are not without criticism.

2/ Herberger propagated the technique of cost benefit analysis as one of the basic postulates for the framework of applied welfare economics. His criticism regarding application of consumer surplus analysis appears to be well founded. The basic drawback of consumer surplus analysis in welfare economics is that it does not take into account the changes in income distribution by action being analysed. It also had its limitations of application in situations of general equilibrium or where large changes are envisaged. In this paper 'On measuring the social opportunity cost of labour', the author has successfully employed his concept of cost-benefit analysis to demonstrate that a high wage rate in effect produces a rise in the social opportunity of cost of labour. Applying the concept of cost-benefit some times leads us to results which are opposed to the normally accepted and obvious cut comes achieved through traditional techniques of economic analysis. Herberger has amply demonstrated this by proving that chronic unemployment often increases the opportunity cost of labour to a higher level than what we otherwise would calculate.


2.2 APPLICATION OF COST-BENEFIT ANALYSIS

2.21 The technique of cost benefit analysis has emerged out as one of the most effective tools of decision making. It has found wide application into the field of human endeavour covering subject like evaluation of investment decision, development of health and community services, transportation, utilization of natural resources, even pollution abatement. In fact the volume of literature on cost-benefit study is increasing every day disproportionately covering areas like research and development projects. Defence, community, housing and recreational facilities and evaluation of large variety of public and commercial projects which could not be earlier subjected to that close a scrutiny of analysis through conventional methods.

2.23 The inherent advantages of cost benefit analysis techniques where the direct and indirect benefits and cost could both be brought within its ambit in measurable quantities and where these could be related to a time base has put this technique to an enviable position for project analysis and evaluation. No doubt, the technique has its limitations too, but the frequency with which this technique is finding its application in evaluation of large size projects, only goes to prove that its limitations are more in the nature of its structure rather than of character. Yoram Brazel has successfully used this technique to develop a timing problem model to decide the most opportune time for taking an investment.

decision for a large project is when its net present value first exceeds zero. Actual investment of course will have to be deferred to a later period of socially optimal time due to free competitive entry of rivals resulting into duplication of efforts or and prematurely investments.

3.23 With the help of cost benefit approach, Mishan has made an attempt to evaluate even the human life and limb. On the face of it, his approach appears to be consistent with the Pareto base of existent allocation theory and cost benefit analysis. Often the evaluation of projects through cost benefit analysis fails to take into consideration the losses or gains arising from incidence of deaths occurring as a consequence of the project. Mishan's study should be useful to determine the excess benefit of a scheme or project over the plausible estimates of the evaluation of increased risk to which people might be exposed as a result of the project.

3.24 A large number of studies have been carried out on human capital investment decision. Such studies like that of Teh Wei Hu et al. and Harry N. Heinemann and Edward Mussana


are particularly useful for public investment decision in educational institutions and formation of educational policies by Government. Heineman has used differential periods for cost and benefit estimation as the pattern of net benefits in educational endeavours follow an asymptotic character, after the costs have been recovered. For the evaluation of desirability of investment, the internal rate of return has been used to balance the real costs and benefits. A similar study conducted by Courtney Riordon for choosing the time and size of investment for addition in urban water supply system used an existing model of investment pricing decision. The use of cost-benefit technique helped Riordon to establish that despite of the limitation of empirical data, a multistage marginal cost pricing approach to the investment pricing decision, might yield an improvements in total net benefits over those provided by average cost pricing models. 

2.25 The advantage with which the important externalities or third party effects can be dealt with through quantifications of incommensurables and imputed monetary values through cost benefit analysis makes the technique particularly suited as a tool for rational decision making in areas of transportation, planning, pollution control and natural resources

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management like water or forest wealth management. The studies of Paul F. Dienemann et al. on transportation system technology has concerned itself mainly with assessment of the effect on third party i.e. the people other than the user and the operator. The analysis was mainly aimed at finding the major environmental and social cost impact of the operation of a set of transportation systems. Impact of externalities like noise, air pollution, safety, traffic congestion, were considered to arrive at the cost and benefits emerging from the transportation system under examination. Though the present value of the net benefits of the alternatives under study was not calculated, the results achieved could be depended for making a rational decision regarding the acceptability of combination of the system from the consideration of benefit to public at large.

2.26 In fact the flexibility of application offered by the technique makes its employment universal and that is the reason that thousands of problems are being subjected to this mode of analysis for a rational decision making process. The widest application in a single field of human endeavour that the technique of cost, benefits analysis has found its maximum use, is in the field of project evaluation and analysis, both by Government agencies as well as by the private sector. In

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most of economic evaluations of projects we want to know whether benefits exceed the cost. On the social platform the intention is to determine the distribution effect of the project under consideration. In other words we want to know how benefits and costs are distributed by characteristics of target population. For this it is essential to develop a clear concept and understanding of what these terms mean in the context of the particular ax project. The project under evaluation should also be examined in depth to analysis so as not to leave out any item which is relevant to the decision making just because it was not measured or measurable.

2.27 Mishra & Beyer have successfully applied the technique of cost-benefit analysis to assess the yield of social returns on the investment of Ratnagiri Fisheries Project. The case study of Ratnagiri Fisheries Project provides a useful training medium and a model case for application of cost-benefit technique to public projects in planning milieu. During this study, authors have adopted the cash flow statements and financial rate of return criteria for assessing the private profitability of the project. They have also used the technique for analysing the project alternatives through assessment of aggregate consumption benefits, values of costs and benefits at market prices and using social discount rate of 10 percent.

2.28 The technique of cost-benefit analysis has also been widely applied to assess the requirement of road network and

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regional transport requirements. The National Council of Applied Economic Research, New Delhi has applied this technique to estimate the contribution of Tourism to national income, total employment and tax revenues accruing to the Government. The cost-benefit study of Tourism conducted by the Council, measures the impact of the tourism on the economy of Jammu and Kashmir in particular. The study has clearly brought out that while total income impact of domestic tourist in the has been more than that of International tourist, the additional income generating effect of foreign visitors was more than that of Indian visitors. This study also makes an effort to analyse the costs and benefits of investment in five star, four star, three star, two star and one star hotels. The study concludes that rate of return on four and five star category of hotels was better than other categories.

Ajit Das Gupta and D.W. Pearce have well investigated the system of rules that help us to adjudge the social worth of a policy in their "Theory and practice of cost-benefit analysis". The authors have investigated the limitations of prescriptive rules desired from the theory of welfare economics of 40's and highlighted the limitations and usefulness of cost-benefit analysis in dealing with the problems associated with public goods. The authors have successfully demonstrated the


application of cost-benefit study for assessing the choice of a site for a particular project and evaluation of a project which is already in operation. Through these case studies, the authors have been successful in highlighting their point of view that there will always be conceptual difficulties in evaluating the project benefits. It was not easy to find an answer to the conceptual problems from within the framework of cost-benefit analysis itself unless one was conscious of these difficulties. However, these case studies do illustrate the application of the technique of cost-benefit analysis in project evaluation and how the benefits can be estimated under difficult conceptual situations.

2.3 COST-BENEFIT ANALYSIS AS A TOOL FOR PROJECT EVALUATION.

2.3.1 A judgement of allocation of resources for satisfaction of human wants in the modern multifaceted Governmental and business organisations, makes a serious demand on the decision makers to strike a balance between their intuitional and analytical capability. For making an effective decision on resource allocation and evaluation of the programme, warranting a systematic study and quantitative evaluation, the decision maker needs a technique for analysis of the past and future programme warranting a systematic study and quantitative


evaluation of the past and future, while analytical approach
to decision making is more reliable, it is also more expensive
as it costs effort. This additional cost and effort works
against the application of the analytical approach in the
decision making process and as a result most decisions are a
result of hunches and intuitions based on the past memories,
and future estimates of the decision maker.

32 Unfortunately intuitions are liberally spiced with
instinctive judgement. Their application in the choice of
alternatives out of complex economic activities, involving
wide implications and strategies, is therefore limited. Analy-
tical method involving quantitative evaluation of benefits and
costs of alternative programmes would on the other hand produce
a more rational result, where such analysis is technically
feasible and economically warranted. Cost-benefit analysis is
thus one such tool in the hands of decision maker which helps
him to achieve the most of what is desired of him with the
given quantum of resources used. Through the cost-benefit
analysis, the decision maker gets the information which he
requires to take a decision and then gets ahead to taking a
decision.

2.33 Every process of decision making involved taking certain
amount of risk. The larger the size of a project for which an
alternative has to be chosen greater will be the element of
risk involved in the decision making process. Unfortunately in
most situations the analysis is not the decision taker. In some

18/ James L. Riggs "Concept of Economic Decision: Economic
Decision Model for Engineers & Economists".

19/ Ralph Turvey "On the Development of Cost Benefit Analysis"
cases however the cost-benefit analysis may reject a solution on presumption that the decision taker himself would reject them. But all the same every decision making process based on cost-benefit analysis involves two broad aspects. One is the formulation of alternatives and the enumeration, quantification and valuation of relevant costs and benefits of each of the alternatives. The second aspect involves the decision algorithm and the preference function of the decision taker. While the cost-benefit analyst concerns himself with the first aspect of the process, the second aspect is purely the prerogative of the decision taker.

3.34 All decisions on resource allocation in our system are aimed at producing maximum benefits to the community. It is therefore, important that the consequences of such decisions are made as comprehensive as possible. Unfortunately the accuracy of such allocations are adversely affected by the irreversibility of the allocation process, and inadequacy of the available resources. It is not easy to convert the fixed real capital, back to its original form of resources, after conversion has been affected. The decision making process, therefore, has to cater for all eventualities, through which it can eliminate the possibilities of unsatisfactory decisions. At the same time, the in built mechanism of the process should ensure that the resource allocation decided upon is the one producing maximum benefit to the community under the available set of condition.

3.35 An important means to achieve this, is through an elaborate method of quantification and determination of benefits,
of the resource allocation within the system. The benefits are likely to be affected by decisions taken in future dates as well as those taken in regard to the other parts of the system. It is, therefore, important that for the sake of reliability, the decision making process should adopt an elaborate method for determination of long term decisions, so as to optimise it, for all parts of the system simultaneously. The crux of the problem in optimising the resource allocation for a system comprising of a number of interdependent components as in case of datamatics, therefore, lies in identification and isolation of independent benefits from the interdependent benefits of the system.

2.4 PROJECT EVALUATION UNDER UNCERTAINTY.

2.4.1 Most situations force a decision maker to make a choice of project under a large number of uncertainties. The decision maker is faced with the problem of making a choice from the single valued estimates of costs and benefits of a particular project from that of a range of possible answers. The risks which matters in such situations is not the one attached with a single project but that which is attached with the whole set of projects. The choice, however, becomes easier to make, when the net benefit from each of the projects is uncorrelated from the rest of projects as in such cases the individual risk of the projects are unlikely to influence the benefits of each other. But this unfortunately is rarely the case. The major uncertainty lies in the realisation of the objective through the choice of a particular project. The objectives are normally constrained by our knowledge of science and technology and past experience of similar situations. The main uncertainty in such
situations is whether the constrained objective can be achieved through the project regardless of its important resources. While it is possible to identify the alternatives and estimate the outcomes of our decisions, it is not possible to get a clear idea of the relative likelihood or a particular occurrence in such situations. In real life the nature and the social environment both play a part in increasing the uncertainty of the outcome of the chosen project. To take account of such uncertainties, therefore, we must qualify the outcome of analysis through estimate of probabilities. This is best achieved by applying subjective estimates made by experts in the field. Consensus of judgement could be achieved by widening the number of experts consulted.

2.42 At times it may be felt that through a systematic process of evaluation, a chosen project could achieve or the attainment of the objective only partially. Effect of the partial attainment of objective is not easy to appportion on the benefits analysis in a simple proportional manner. Benefits in such situations are sensitive to the cost inputs. The effect of partial fulfilment of objective in this situation would therefore call for a separate analysis. Often the situations of uncertainty creates a condition in which the benefits themselves have to be qualified by some factors to allow for such uncertainty. (A good example is the extreme antipathy of the labour and trade unions towards automation due to fear of dislocation

and unemployment. The increased benefit of the community achieved through increased output through automated production and better living standard has to be qualified in the light of the uncertainty to employment caused to the dislocated labour force.

2.5 RANKING OF PROJECTS.

2.51 The cost-benefit analysis offers a special advantage in all such situation by offering a means to rank the various projects under consideration on the basis of their benefit-cost ratio. It is important, however, in comparing the projects that all analysis is done on similar basis. In evaluating the projects the probability of technical and commercial success takes into account the uncertainty associated with the accruable benefits from the projects. In fact these probabilities are only the indication of the confidence level of the estimates of benefits. The examples cited in literature making use of benefit-cost ratio for ranking purpose are of two types

\[
\text{(1) \quad \text{Project No. } = \frac{P + X \cdot P_c \cdot (P - c) \cdot X \cdot V \cdot L}{\text{Total cost}}}
\]

Where \( P \) = Probability of Technical Success
\( P_c \) = Probability of commercial success
\( P \) = Price, \( c \) = cost, \( V \) = annual sale volume
\( L \) = Life of project


(ii) Second example takes into account the discounted cost of the project. This method could be considered more beneficial in ranking of projects like the one of dataamation where the total cost might lead to misleading result.

\[
\text{Project No.} = \frac{\text{Total discounted cost of dataamation}}{P_i \times P_e \times \frac{I_1}{1+r} \times \frac{I_2}{(1+r)^2} \times \frac{I_n}{(1+r)^n}}
\]

where \( r \) = discounted rate  
\( I_1 \) = net income in the end of 1st year  
\( I_2 \) = net income at the end of 2nd year  
\( I_n \) = net income in the year \( n \).

2.59 The techno-economic estimation of service offered by the project like that of automatic data processing should cover the return on capital inclusive of project. Usually it will be assumed that the capital invested has been adequately rewarded after the year 'n'.

2.6 DECISION MAKING THROUGH COST-Benefit ANALYSIS.

2.61 Cost benefit analysis shows us the way of deciding what society prefers. In other words it is to decide the worth of a project involving public expenditure, where it is possible to choose one opinion from series of option, the cost-benefit analysis informs the decision maker as to which opinion is socially most preferred.

2.62 The importance of social preference in the choice of a project lead us to accept the Pareto's rule as the basis of all cost-benefit analysis. According to this rule "If every one prefers \( x \) to \( y \) then \( x \) is a socially acceptable policy. The
scope of this rule is further widened a little in that the policy x is still socially preferred if a number of individuals are indifferent between x and y. But Pareto principle does not apply if even one percent disfavors the project.

2.63 Where Pareto's rule did not apply, Kaldor and Hicks have used the compensation principle underlying the cost-benefit analysis to achieve the net social gains of a project where the losers are compensated by the gainers. In such situation where the gainers can pay the compensation to the loser to make good the losses and still have something to left over, then there will be a net social gain, in that some people will prefer "y" while the losers having been fully compensated must be indifferent between x and y.

2.64 If the monetary value of benefits exceeds the monetary value of the cost then the gainers (Recipients x of benefits) can hypothetically compensate the loser (Those who bear the cost) and still have some gains left over. Kaldor-Hicks principle does not require actual payment of compensation. Saitovsky however observed the paradox of reversability of the Kaldor-Hicks principle, and as such its blind adoption in the process of decision making cannot be without its pitfalls. These oddity of reversal is illustrated from the position of the statics at y and contemplated move to x (Fig. 2.64) when 1 gains and 2 losses at w, 1 is better off and 2 no worse or compared to situation at y. Similarly at z, 2 is better off and 1 no worse or compared to situation at x. If v can be reached from x and v is Pareto in superior to y, it follow that x is Pareto superior to
FIG: 2.54.

ODDITY OF REVERSAL OF KALDER-LICKS PRINCIPLE.
The paradox is that move from \( x \) to \( y \) is socially preferred and move back from \( y \) to \( x \) is also socially preferred.

2.65 The cost benefit analysis can indicate the consequences of distribution and allows the decision maker to apply his own weight to gains and losses of various sections of community. Given a social welfare function of Pareto form and observing that some of the elements of the functions will be positive and some negative, a set of weights \( \alpha_1, \alpha_2, \ldots, \alpha_n \) are applied to gains and losses such that

\[
SW = SW[\alpha_2 R_1 (X), \alpha_2 R_2 (X), \ldots, \alpha_n R_n (X)]
\]

2.66 The gains of individual 1 are weighted by some factor \( \alpha_1 \). Individual 2 may lose and his losses are weighted by \( \alpha_2 \). If decision maker considers individual 2 more deserving then individual 1, he will weight 2's losses more heavily than 1's gains i.e. \( \alpha_1 < \alpha_2 \). The most straightforward form such welfare function is an additive one i.e. money values are placed on \( R_1, R_2, \ldots, R_n \) say \( u_1, u_2, \ldots, u_n \) and \( \alpha_1, \alpha_2, \ldots, \alpha_n \) are derived from the decision maker own judgement so that

\[
SW = \alpha_1 U_1 + \alpha_2 U_2 + \ldots + \alpha_n U_n
\]

2.67 As already brought out cost-benefit analysis provides a means to identify policies which society prefers. According to Arrow the societies preference is a process which states a corresponding social ordering of alternatives for each set of individuals ordering \( R_1, \ldots, R_n \) of alternatives.

2.68 While Arrow showed that the welfare of economics did not meet the criteria of the reasonableness, the cost benefit analysis also rested on the compensation criteria for its foundation. To that extent, it also contradicted the Arrow
condition of social welfare.

2.69 The critics of cost benefit analysis however felt that the difficulties involved in reaching an agreed ranking of social objectives, limits the applicability of cost-benefit analysis to a strictly limited range viz. to the relative appraisal of project with one common objective, CBA is thus regarded essentially as applying only to a choice of technical problems within a relatively homogeneous programmes.

2.70 The facilities for econometrics estimation of structural relationships in an economy as a whole, and scope of quantitative analysis of the consequences of different sets of weights being given to different objectives, not only acknowledges the applications of CBA to multiplicity of objectives but also can attempt to estimates the trade off between them.

2.71 Cost-Benefit Analysis can thus be an extremely useful tool of decision making, when considered that value judgement are inescapable in reaching policy decision and that such value judgement can themselves be rationally argued about. Thus there cannot be a better tool to guide the decision making process in datamation, where value judgement coupled with multiplicity of objectives plays the most important part in selection of alternatives.