BENEFIT - COST ANALYSIS

INTRODUCTION

Benefit-cost analysis involves a problem choice in making decision for appropriate environmental policy from the economic point of view the choice for the policy measure could be the one that gives maximum benefit and minimum cost or, the policy choice should be such that gives balance between the cost and benefit. For example in controlling water pollution, whether tradable permit or technology based standards are good in terms of benefit cost comparison? We can answer this question by analytical tools of benefit-cost analysis. This analysis begins with identifying and monetizing environmental benefits and cost and in turn it helps us to set estimate for adjustment and systematic comparison to arrive at decision. This process limits the benefit and cost-estimates to decision rule accomplish the strategic process of benefit-cost analysis.

The estimated values are necessary, for they give us marginal costs and benefits to make adjustments, but they are not realized immediately, it takes a period of years. In this regard there are two consideration: (1) The future costs and benefits have to be adjusted downwards to be comparable to those incurred in the present, and (2) The values must be adjusted for expected changes in the price level over time. Without these modifications, the benefit-cost-analysis would yield baseless results, and any policy decision based upon them would be misguided.

However once the benefit and cost estimate are corrected for time differences, they must then be compared to one another.

The growing prominence of benefit cost analysis as a risk management strategy is an important reason for understanding what its perspective is, and how it has come to be recognized as important by the government in major policy decisions.

(1) TIME ADJUSTMENTS TO ENVIRONMENTAL BENEFITS AND COSTS

In any environmental benefit-cost analysis reconciling the timing of benefits and costs is critical. This is due to two reasons. (1) Benefits and costs do not necessary accrue at the same time and (2) even if they accrue at the same time, they are not realized immediately. The effects of environmental policy typically extend well in to the future. Consequently, decision makers must be forward thinking in their evaluation of a policy proposal and must make projection about its future implications.

In order to support these forecasts, benefits and cost estimates must be adjusted to account for the fact that the value of a dollar is not constant over time. In this regard two types of time oriented modifications are necessary.

(1) The present value determination, which accounts for the opportunity cost of money

(2) The inflation correction, which adjusts for changes in the general price level.

We can examine each of these procedures as under

(a) Present Value Determination

The concept of opportunity cost is one of the most pervasive concepts in economic thinking. It means the best next alternative foregone or given up for one you go for. It arises in production, consumption or even surely financial transactions.

To understand this concepts we take in to consideration the following example.

Supposing a friend asks to borrow -$ 200 today. Promising to pay back the loan one year from today. The concept of opportunity cost in terms of alternative given up, gives an economic thinking in the sense that if you had invested $ 200 you would have earned 5 percent return and the appropriate payback would have been $ 210 numerically it can be shown as ($ 200 + [$ 200]0.05]). Technically, this calculation represents the conversion of the loan value in the present period in to its value in the future period.

Mathematically, the conversion for a one-year period is achieved using the simple formula:

$FV = PV + r(PV) = PV (1 + r)$

FV = future value

PV = present value

r = rate of return

This equation shows that the future value (fv) of a dollar is equal to its present value (pv) + the opportunity cost of not using the dollar in the present period (r/pvl). If the future valuation has to account for more than one time period (t) the formula becomes:

$FV = PV (1 + r)^t$

Where t = 0, 1, 2,..... T is the number of period

Inverting the problem we argue that $ 210 received one year from now is equivalent to having @ 200 today, or ($ 210/[1+0.05]). This conversion procedure is called Present value determination because it involves discounting a future value (fv) in to its present value (pv). Mathematically the calculation is performed using a rearrangement of the first formula:

$PV = Fv (1/[1+r])$

In this form of equation, r is called the discount rate and the term 1/(1+r) is called the discount factors. If the discounts involves more than one time period (t), the formula is written as:

$PV = FV (1/[1+r]^t)$

Where $(1/[1+r]^t)$ is the discount factor. Discounting is the procedure economists use to adjust the value of environmental benefits and costs accruing in the future.

The discount rate (r) is very important variable in determining the present value. There is an inverse relationship between the PV and the (r) i.e. increase in (r) decrease the PV and vice Versa. Since the magnitude of the (r) affects the conversion, hence its selection is critically important to benefit cost analysis. The environmental policy development is directly officiated by (r), as to determine which proposals meet the given criterion and need to be dropped or rejected. This discount rate (r) and its selection is much debated in the literature on present value analysis.

The question is this, that how this rate is selected? The answer is that in public policy question it should be selected in the basis of *social opportunity* cost and according to the funds should be allocated. The social opportunity cost in this context is important because the initiatives of public policy are perceived

as a transfer from private sector. Hence the discount rate used for public policy all it a social discount rate should reflect the rate of return that could be realized through private spending on consumption and investment, assuming the same level of risk.

The policy makers are preferring this social discount rate ought to be between 3 to 9 percent for it captures, the social opportunity cost of funds and the society could earn maximum percent return through private investment. The conceptual problem is, what should determine this, rate, for which there is no clear consensus.

(b) Inflation correction

Basically the benefit - cost-estimates should be modified in accordance to changes in the general price level. Where we follow the inflation correction, i.e. changes in general price level and its effect on benefit cost-estimates, then it refers to inflation correction. To adjust a dollar amount in the present period for expected inflation in the next future period, the value must be converted to its nominal value for that period. The conversion uses a measure of price, such as the consumer price index (CPI), shown as :

Nominal value $_{\text{period } x+1}$ = Real value $_{\text{period } x}$ (CPI $_{\text{Period } x}$ + 1/CPI $_{\text{period } x}$.)

or

Nominal value $_{\text{period } x+1}$ = Real value $_{\text{period } x}$ (I+P)

Where P is the rate of inflation between period x and x + 1. The more generalized formula for any number of (t) periods is :

Nominal value $_{\text{period } x+1}$ = Real value $_{\text{period } x}$ $(I+P)^t$

Inverting the formula allows for the conversion of a nominal value to its real value as follows,

Real value $_{\text{period } x}$ = nominal value $_{\text{period } x+1}$/ $(I+P)^t$

This conversion procedure, sometimes called deflating, is used to assess changes over a period during which there has been inflation.

(C) Summary of Deriving Time-Adjusted Benefits and Costs.

The time adjusted magnitudes for incremental benefits and costs are called the present value of benefits (PVB) and the present value of costs (PVS), respectively. These are defined in real terms as

PVB = Equation (no equation)

PVC = Equation

Where R_S is the real social discount rate, incremental real benefits, b_t is incremental nominal benefits, B_t is incremental real cost, and C_t is incremental nominal costs.

In brief, (PVB) is the time-adjusted magnitude of incremental benefits associated with an environmental policy change, while (PVC) is the time adjusted magnitude of incremental costs associated with an environmental policy change.

(2) THE FINAL ANALYSIS COMPARING ENVIRONMENTAL BENEFITS AND COSTS

The final phase of any benefit cost analysis involves comparing the time adjusted incremental benefits and costs and arriving at a decision based on their relative values. In the broader context of environmental policy, this final phase is typically used to set a policy objective or to select a control instrument. The analysis would be carried out over a series of possible options and used to identify the "best" solution among them. Benefit-cost analysis is also used to evaluate an existing policy initiative.

Two steps generally comprise this final phase of benefit-cost analysis and they are:

1. Determine whether or not an option is feasible from a benefit-cost-perspective.

2. Evaluate all feasible options based on a decision rule, and then select a single "best" solution.

(a) Step one: Determining feasibility

Feasibility Test

To distinguish feasible options from infeasible ones, the analyst must compare the time adjusted value of incremental benefits and incremental costs for each option under study. A common way to do this is to form a *benefit-cost-ratio* of (PVB/PVC) and compare the result to 1. If the ratio for a policy option exceeds 1, that option is among the feasible solutions, If not, It is rejected:

IF (PVB/PVC)> 1 for a given option, the option is considered feasible.

An equivalent test for feasibility is to find the *present value of net benefits (PVNB).* Which is (PVB-PVC), and compare the result to zero. If this differential is greater than zero, the policy option is feasible, if not, and it is rejected.

If (PVB-PVC) > 0 for a given option, the option is considered feasible.

These both rules communicate that feasibility is implied if the benefits associated with a policy proposal outweigh the costs incurred.

(1) How the Tests Differ

The two measures namely (PVB/PVC) > 1 and (PVB-PVC) > 0 and necessary for analyzing benefit- cost conditions. But they differ, firstly the numerical value of the PVB/PVC ratio conveys the benefits of policy option per dollar of cost incurred, while the value of (PVB-PVC) measures the dollar value of excess benefits. Secondly the either of the measure that we use to get best solution is incorrect. More over the attempts to use the benefit = cost- ratio for any kind of ranking among options will: lead to ambiguous results

(b) Step two: Selecting among Feasible Options

In practice, the decision - making process used to select among feasible options is guided by one of the following economic criteria: *allocative efficiency* or cost-effectiveness. Adding the dimension of time to these criteria, we arrive at the following decision rules.

To achieve allocative efficiency: Maximize the present value of net benefits (PVNB).

To achieve cost-effectiveness: Minimize the present value of costs (PVC) based on a reestablished benefit objective.

Both rules involve some types of optimization to guide the selection of the "best" available option.

(1) Decision Rule: Maximize the Present Value of Net-Benefits (PVNB)

This decision rule calls for choosing the option that gives society the highest amount of excess benefit after adjusting for time effects. The point at which total benefits exceed total costs by the greatest amount corresponds to where MB = MC, or where resources are efficiently allocated.

(2) Decision Rule: Minimize the present value of costs (PVC)

The decision rule to minimize the present value of costs (PVC) guides the policy-maker to select the least-cost option among those capable of achieving some reestablished objective. This is an explicit directive to set-policy based on criterion of cost - effectiveness and of the two decision rules this one is more common. The reason is that the law often predetermines the level of environmental benefit to be achieved through its definition of an environmental quality objective. This means that the PVB is essentially fixed only PVC as a decision variable.

(3) RESERVATION ABOUT BENEFIT- COST ANALYSIS

There are two major drawbacks of benefit cost analysis mainly: (1) Measurement problems and, Equality Issues. They can be described as under:

(1) Measurement Problems

In benefit-cost analysis it is not merely to identify all the benefits of a policy proposal is challenging but also to assign a dollar value to these gains. Secondly, capturing implicit costs poses the biggest challenge. And finally, the selection of the social discount rate, which affects the present value of both benefit and cost estimates, is the subject of much debate, even among proponents of the benefit cost approach.

(2) Equity Issues:

The decision rules do not consider how the benefits and costs are distributed across segment of society. There is possibility that the distribution of benefits might be unequal, so that some group of consumers or some industrial sector, receives less than its fair share. Similarly the Burden of the cost might be borne more by some and less by others. There is no guarantee that the same inequality occurs on both the benefit side and the cost side. The policy matters have to make some adjustment for such potential inequities associated with benefit-cost analysis.

Government Support of Benefit = Cost Analysis

Government's support comes for benefit cost analysis only when it finds that benefits exceed the cost and then the funds are released.

In other words the funding to project is decided by feasibility rule based on (PVB-PVC) > 0. This rule is general for many public policy setting and according the funds are released by the governments.

In most of the public policy settings, it is explicitly called for meeting economic criteria in regulating actions, and by and large the criteria such as *Allocative efficiency* and cost-effectiveness are followed.

CONCLUSIONS

Fundamentally the environment policy aimed at minimizing society's risk of exposure to environmental hazards. The entire society is involved in public policy development, most of the detail of formulation, implementation, and monitoring regulatory provisions falls in the hands of public officials. And this fact supports the need for analytical tools such as benefit-cost analysis to guide the decisions that define environmental policy.

Benefit - cost analysis, though not free from drawbacks, is useful strategic, approach to environmental decision making, its main object is helping officials to evaluate the social gains and the opportunity costs of their decisions.

The main point is deciding the opportunity cost of one policy in terms of another policy for out of given, if more is used for one policy, leaves less for other policy. This is the dilemma that every society confronts.

The purpose of benefit -cost-analysis is to provide guidance for decision making. In this chapter we have seen that how this analytical tool accomplishes, implemented and how it fails to achieve the primary objectives of environmental policy. These days, benefit = cost-analysis is becoming a more dominant force in public policy decisions, it is critical that we comprehended how it influences environmental regulations and how, in so doing, it affects the quality of life.