

**(Cost benefit analysis and cost-effectiveness analysis)**

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# Cost–benefit analysis and cost effectiveness analysis tools

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## Introduction

Cost–benefit analysis (CBA) is an economic technique applied to public decision–making that attempts to quantify and compare the economic advantages (benefits) and disadvantages (costs) associated with a particular project or policy for society as a whole. The appeal of CBA is that by monetising the benefits of the policy, it is possible to compare and/or aggregate many different categories of benefits with one another, and with the costs of the policy. Out of a number of alternative programs being examined, CBA would recommend choosing the one with the largest net benefits, where net benefits are defined as the benefits minus the costs. Cost–benefit analysis – or more specifically, the estimation of costs and benefits that is required to perform a CBA – also allows one to determine the socially optimal size of the program or project, i.e., the one that maximises net benefits. At the socially optimum program, the marginal benefits of the program will be equal to its marginal costs. There are some concerns with respect to the application of CBA, as described in the textbox Main concerns related to the application of CBA.

Cost–effectiveness analysis (CEA) seeks to find the best alternative activity, process, or intervention that minimises the costs of achieving a desired result. Analysts and agencies perform CEAs when the objectives of the public policy have been identified and the only remaining question is to find the least cost–option of arriving at these objectives. CEA, therefore, does not ask, nor attempts to answer, the question whether the policy is justified, in the sense that its social benefits exceed its costs.

## Role of CBA/CEA in an integrated assessment

The main role of CBA in an integrated assessment is in Phase III (analysis) by supporting the comparison of alternative options. In a relatively well–structured problem, CBA could also be used to support target setting (Phase II) if it is possible to quantify costs and benefits to a sufficient degree. CBA can also be used in Phase IV as an ex post assessment of a certain policy (see also the discussion on ex post use of CEA below).

CEA can be used in Phase III (analysis) of an integrated assessment to assess the expected impacts of alternative policy measures before they are implemented (ex–ante), and in Phase IV (follow–up) of an integrated assessment to assess the effectiveness of a policy measure that is already in place (ex–post). While the approach and the methods used are the same for ex–ante and ex–post CEAs, the purpose of the instrument is different. Ex–ante CEA is used up front, at an early stage in the policymaking process, to identify the path of action that promises to be most cost–effective. By contrast, the ex–post CEA aims to assess whether a problem has been tackled effectively through the policy measure or project investigated. In other words, it provides a measure for the efficiency of policy implementation. To achieve this, a (counterfactual) comparison with alternative paths of actions is one possibility: with the benefit of hindsight, would there have been cheaper/more efficient ways of reaching the same target?

## Main concerns related to the application of CBA

The application of CBA in an integrated assessment poses a number of questions. First, CBA measures costs and benefits on the basis of (subjective) individual preferences given objective resource constraints and technological possibilities. Whether or not a project or policy that maximises (subjective) individual preferences is ‘sustainable’ is an open question – and should probably be answered on a case–by–case basis.

Second, CBA is often criticised for its apparent insensitivity to issues of intra– and intergenerational equity.

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With respect to the issue of intra-generational equity, CBA is insensitive as to the distribution of cost and benefits over different individuals, as long the 'winners' could, in principle, compensate the 'losers' (but CBA does not require that this compensation actually takes place). With respect to intergenerational equity, the correct practice of CBA to discount future costs and benefits to their present values has been criticised on the grounds that it would thus neglect the welfare of future generations. While the critique on discounting in CBA has sometimes been less than rational, it is true that the choice of a particular discount rate (or discount function) will strongly influence the net present value of long-term sustainability policies such as climate change policies. In academics as well as in policy, some consensus seems to be emerging to discount potentially irreversible environmental damages in the very long term (> 100 years) at the lowest possible rates.

Third, in CBA uncertainty and risk are treated in a classical fashion. If certain future effects are uncertain, the correct procedure is to assess the (discounted) expected utility of the effects. In this approach, the probability and the size of the effects play a role, but also the rate of risk aversion of the relevant population. In CBA, future low probability – high impact events are more important for current policy making, the higher the probability of occurrence, the higher their potential damage, the lower the discount rate, and the higher the rate of risk aversion.

Fourth, certain costs and benefits that are in the social and environmental domains of sustainable development may be difficult to quantify and to value in monetary terms. There are observers who object in principle (or on moral grounds) to the notion that every 'value' can be traded for a price. But putting these moral objections aside, in the practice of CBA advanced 'valuation' tools have been developed that are capable of inferring individuals' preferences over both market and non-market (e.g. environmental) goods (a number of non-market valuation methods are listed in Table 1).

## Choosing between CBA and CEA and valuation methods in a CBA

CEA is sometimes used as a second-best option when a full-blown CBA would be desirable, but many benefits cannot easily be monetised. CEA and CBA can be seen as parts of a continuum of monetary assessment tools, with CBA as the most extensive and elaborated option, and CEA as a somewhat less extensive procedure.

Table 1: Selection criteria for non-market valuation methods for a cost-benefit analysis

Method	Suitable for...	Type of values	Conditions
<i>Stated-preference approaches</i>			
<u>Contingent valuation</u>	Virtually any public policy or program; extremely flexible	Use values, Non-use values	Design and administration of the questionnaire are difficult, a number of biases are possible that can be limited through careful construction and pretesting of the survey instrument.
<i>Revealed-preference approaches</i>			
<u>Travel costs</u>	Only for amenities, natural resources (e.g., beaches, bodies of water, national parks or wildlife reserves) or cultural sites (monuments) that people actively visit.	Use values	Travel cost can be subject to measurement error, especially if the researcher wishes to include the opportunity cost of time. It may be difficult to identify substitute sites. Questions about trips taken under hypothetical conditions may be necessary to

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<u>Hedonic pricing</u>	Only for changes in environmental or urban quality that can be captured into housing markets; only for job risks that are captured into compensating wage differentials.	In theory, both use and non-use	trace out the demand function at post-policy conditions. Individuals are assumed to be perfectly aware of the environmental, urban quality, job risks. Market must be clear. Sufficient transactions must be observed to estimate the hedonic regression, and sufficient variability in environmental or urban quality or job risks must exist to identify their effect. Difficult to separate the effect of these variables from other factors that can influence housing prices or wages.
<u>Averting expenditures</u>	Human health effects or other effects (e.g., materials damage) from which people can protect themselves	n/a	Possible when individuals can document actions and expenditures incurred to reduce risks. In some cases, it is possible to engage in actions that reduce risks (e.g., staying indoors in days with high air pollution) but it is not easy to place a monetary value on these actions. Fails to capture the value of the discomfort of being sick.
<u>Cost of illness</u>	Human health effects	n/a	Relatively easy to perform, but fails to capture the value of the discomfort of being sick.

When deciding to use CBA as tool to compare different policy options, a variety of valuation techniques is available to monetise benefits. Table 1 above shows how certain valuation tools may be used to measure which non-market impacts under what conditions. A distinction is made between so-called 'revealed preference' and 'stated preference' methods:

- In 'revealed preference' methods such as Hedonic Pricing and the Travel Cost Method, economic preferences for environmental goods are inferred from observable market behaviour of consumers and/or producers. For example, the Travel Cost Method makes use of information on time and money that people spend to visit nature sites, to infer their (minimum) willingness-to-pay for recreation at that site. The Hedonic Price method infers environmental preferences from market prices of goods and services whose values are (partially) related to environmental characteristics (such as a higher price of a house in a nicer natural environment).
- 'stated preference' methods, such as Contingent Valuation and various Choice Models, make use of survey techniques to illicit environmental preferences of the population.

While 'revealed preference' methods have the advantage that they measure what people do instead of what people say they will do, 'stated preference' methods have the advantage that their area of application is much wider than that of 'revealed preference' methods. For certain classes of preferences, such as preferences for the mere existence of environmental goods, 'stated preference' methods are virtually the only alternative.