GENERAL GUIDANCE FOR
Cost-Benefit Analysis

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Preface

Cost–benefit analysis (CBA) is an important tool for use in the ex ante assessment of policy options. It is a systematic information tool for surveying and evaluating the advantages and disadvantages of a policy measure from the perspective of society as a whole. This supports decision-making on proposed measures so that policy decisions can be as objective as possible. CBA can be applied to all sorts of measures in all policy fields.

This general CBA guidance describes, step by step, how to carry out a CBA and the criteria to be met by the various components of the CBA. Besides providing rules and guidelines, where necessary this new guidance leaves various aspects open for development in more detail in CBA handbooks for specific policy fields. The emphasis is more on the correct application of the underlying principles rather than on the rigid implementation of a fixed set of procedures. This general CBA guidance thus provides a minimum set of requirements that should be met by each CBA.

Attention is given to the preliminary work of translating the policy problem into terms suitable for a CBA and how the results of the CBA should be presented and interpreted.

A CBA begins with an assessment of the effects of a project or measure. Impact measurement is therefore of crucial importance and the CBA itself stimulates further research into the nature and magnitude of effects. A CBA in which all the effects can be calculated accurately and given a monetary value is an ideal situation that can probably never be achieved in practice. The degree to which this is possible will vary between projects and policy fields. Whatever the case, CBAs are useful, even if important effects can only be measured but not valued.

This general CBA guidance was prepared by CPB Netherlands Bureau for Economic Policy Analysis and PBL Netherlands Environmental Assessment Agency at the request of the Committee for Economic Affairs, Infrastructure and the Environment (CEZIM).

The preparation of this guidance was supervised by the interdepartmental CBA committee on behalf of the CEZIM. CBA experts, government policy officers and CPB and PBL staff members contributed to the writing of this document during several workshops. The research was led by an Academic Advisory Committee consisting of Professors Luca Bertolini, Werner Brouwer, Pierre Koning, Carl Koopmans (Chair), Dinand Webbink, Bert van Wee and Aart de Zeeuw.

Laura van Geest   Maarten Hajer
Director of CPB   Director of PBL

Summary

Government policy is about making choices. Policy measures often have many different effects and the numerous different advantages and disadvantages of these effects have to be weighed up before a decision can be made.

Cost–benefit analysis (CBA) is an important tool for use in the ex ante assessment of policy options. It is an information tool that supports decision-making on policy measures or alternatives to allow decisions to be as objective as possible. CBA provides an overview of the effects, risks and uncertainties of a measure and the resulting costs and benefits to society as a whole. By quantifying these advantages and disadvantages as much as possible and assigning values to them (in euros), CBA provides insights into the social-welfare effects of the measure expressed as the balance in euros of the benefits minus the costs. This balance also reflects the costs and benefits of the effects on those aspects of social welfare for which there is no market price, such as nature, landscape, community safety, cultural heritage and social cohesion. Expressing effects in monetary terms as much as possible makes it possible to compare them and present the results in an easily understandable form that can be used to weigh up the pros and cons of a measure. This allows us to answer the question of whether the economic and social costs of a measure outweigh the economic and social benefits. CBA does not put a value on the degree to which various groups in society experience the costs or benefits of a measure, but it can reveal and describe these distributional effects.

CBA is not only useful for judging whether a decision to proceed or not with a policy measure can be justified on the basis of the balance of benefits and costs, but it can also be used to structure the policy preparation itself. Questions such as 'What is the problem?', 'What will happen if we do nothing?' and 'What possible solutions are there?' help to make the discussion about the proposed measures as objective as possible. This is true for all policy fields and all policy measures. To make a good CBA requires not only knowledge of welfare economics, but also a thorough understanding of the policy field under investigation.

Sometimes there may be doubts about whether it is desirable or even possible to carry out a CBA. Doubts about the desirability of doing a CBA may arise if economic efficiency is of little or no importance, for example when the main consideration is about human dignity or moral values (e.g. abortion, euthanasia, slavery). In such cases a CBA is not considered to be appropriate. In addition, the degree to which it proves possible to actually determine the relevant costs and benefits will vary between CBAs.[1] This depends on the availability of good empirical impact studies. The lack of such information is not a shortcoming of the CBA tool itself, but it means further empirical research into the effects will be needed before the CBA can be completed. Should the information available about the effects may be too uncertain to permit any useful quantification of those effects, CBA can serve a useful purpose by

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[1] The effects of very complex measures are sometimes particularly hard to determine, for example because they have many interrelated effects in many different areas of society, or because some effects will only occur in the distant future.

identifying in a structured manner what we do know about a proposed measure and what we do not know, thus helping to structure the decision-making process and make it as objective as possible.

The guidance document on the evaluation of infrastructure projects (*Overview of the Effects of Infrastructure (OEI)*, Eijgenraam et al., 2000) is a widely endorsed set of guidelines on preparing a CBA for transport infrastructure projects in the Netherlands. Since its publication in 2000, it has been further developed and expanded through the production of supplements, handbooks and additional guidelines, and in CBAs that have been carried out. The number of fields in which the guidelines can be used has also been expanded, and more continue to be added. These developments have created a need for new guidance on preparing CBAs. This new guidance document meets this need. It pulls together the expertise and experience gained in recent years and makes them available for use across a broad range of policy fields in the form of a general guidance on social cost–benefit analysis, or 'general CBA guidance'.

This general CBA guidance describes how to carry out a CBA and the requirements for the various elements of the CBA, with particular attention to the role of CBA in the decision-making process. We discuss the various types of CBA and when these different types can best be used. And because this new general CBA guidance is widely applicable, we also explain the theory underlying CBA. This can be consulted when questions arise over the correct use of CBA, particularly when the policy fields or proposed measures are not usually associated with CBA. Besides setting out some rules and guidelines, this new guidance leaves various aspects open for development in more detail in CBA handbooks for specific policy fields. The emphasis is therefore more on the correct application of the principles rather than on the rigid implementation of a fixed set of procedures.

At the same time, the broad applicability of this guidance means that it is impossible to fully describe all aspects of CBA for all policy fields. Instead, we focus on those elements of the CBA methodology that apply to all policy fields. The principles contained in this guidance apply to all policy fields and, in turn, the preparation of policies in all fields can benefit from the principles underlying CBA. This general CBA guidance therefore provides a general set of minimum requirements that should be met by each CBA. The guidance also provides the basis for preparing sector-specific handbooks.

In the rest of this summary we examine the role of CBA in decision-making and how CBA can be used to greatest effect (Section S1). We then discuss, in Section S2, the theoretical principles underlying CBA. In Section S3 we describe the steps that need to be taken to prepare a CBA, along with the relevant rules and guidelines. Finally, Section S4 sets out the requirements for reporting and presenting the results of the CBA.

S1. The role of CBA in decision-making

The essence of a CBA is weighing up different project or policy alternatives by comparing their welfare effects on society as a whole: the economic and social costs and benefits calculated at the national level. The CBA therefore addresses the question 'How does total social welfare change?' An additional important question is 'How are the costs and benefits distributed?' The role of CBA in decision-making is to make discussions about policy as objective as possible.

The decision-making process can be broken down into a number of stages, from problem identification and problem analysis via the formulation of policy objectives and measures to their assessment and evaluation, followed by the political decision. CBA is often used in the final stages of the decision-making process: the assessment and appraisal. However, CBA does not have to be restricted to the assessment of a measure; it can also be useful in the earlier stages of the decision-making process.

To make good use of a CBA it is important to integrate the tool properly into the decision-making process. The measures being considered must respond to the identified problems. If they do not, the CBA cannot answer the policy question. An important lesson from the experience gained with CBA during policy preparation is that the person or organisation conducting the CBA (the CBA compiler) must establish whether or not the proposed policy measures correspond to the problem analysis and what this means for the relevance of the CBA.

The decision-making process will benefit from a CBA not only if it addresses the problem at hand, but also if it can count on stakeholder approval. A potential problem is that CBAs are often thought of as black boxes. To ensure that stakeholders perceive the CBA to be a tool that brings structure to the decision-making process and supports the appraisal, there must be full transparency about the way in which the proposed measure is assessed in the CBA. The CBA can also be used to optimise policy measures, which can be useful for all involved. It is therefore advisable to involve all stakeholders in the CBA at an early stage. To generate understanding of and support for the CBA it is important to inform all stakeholders about the CBA process, the effects investigated and the chosen policy alternatives. The stakeholders can then agree on the type of questions the CBA can answer and the sort of outcome that can be expected. Moreover, acceptance of the CBA can be improved by presenting the costs and benefits for all the relevant social groups in a coherent overview. It is also important to state the assumptions made when preparing the CBA and how these influence the outcome of the CBA.

Nevertheless, the usefulness of CBA for the decision-making process has its limits. If the most important effects cannot be adequately measured or monetised, a CBA can only provide sketchy information of limited reliability and relevance. On the other hand, the principles of CBA can then be used as a conceptual framework to help structure the decision-making process. However, using CBA as a conceptual framework alone will not result in an actual CBA and it cannot therefore be called a CBA.

Finally, experience with previous CBAs teaches us that guidance alone is not enough to guarantee a good CBA, and that a quality assurance mechanism is also needed.

S2. Principles and background to CBA

CBA is grounded in economics, in particular in welfare economics. The welfare economics principles underlying CBA provide CBA researchers and users with a frame of reference when reflecting on which effects of policy measures should be included in a CBA, the consequences of those measures for social welfare and how the costs and benefits of the measures can be determined.

The welfare changes caused by policy measures are expressed through the willingness of people to pay for the effects of the measures. Willingness to pay is an indication of the value someone puts on the services or goods directly or indirectly generated by the proposed project or policy measures. When effects are negative, the willingness to pay to avoid these effects is used to calculate the economic and social cost. If the costs of the measure are lower than the willingness to pay for the effects, the measure increases welfare; conversely, if the costs are higher than the willingness to pay, it reduces welfare.

When making such a calculation it is important to take all the effects of a policy measure into account and define the markets for goods and services in which these effects are felt and may be measured. This is because willingness to pay is expressed in the demand for services or goods in markets. In this context we interpret 'markets' in a very broad sense to include missing markets for services that are not actually bought or sold, but for which individuals do have a willingness to pay. This means that welfare changes can be determined on the basis of changes in the volumes and prices on relevant markets, existing or otherwise.

This broad concept of markets means that CBA also makes use of a broad concept of welfare which includes things that people value, but which are not traded on markets, such as environmental quality, health and safety. These are things that people not only attribute a positive value to, but which they also pay for, either directly or via the government. In these cases, however, there is no clearly defined, complete market on which the willingness to pay can be measured (via the market price). This positive valuation means that these elements make a positive contribution to the CBA balance, but that their monetary value is sometimes difficult or impossible to determine.

This is one of the reasons why the ideal CBA, in which all effects are correctly identified, described and monetised, is almost never achieved. In practice, there are often effects we cannot determine or monetise with any accuracy, if at all. But this is no reason to simply abandon the idea of carrying out a CBA. Even in such cases CBAs can still be useful to present in a structured manner what we know about a measure. A CBA can help to structure the decision-making process and make it as objective as possible.

A separate issue is the distribution of welfare among people, regions, etc. It is evident, for example, that income distribution matters very much to people and is an important political issue, but it is extremely difficult to ascertain whether a change in income distribution increases or reduces welfare. This is primarily a political issue. If distributional effects are an important element in the objectives of a measure, or even the overall goal, those effects will be revealed in the CBA, for example through changes in purchasing power per income group, but without any value judgment being attached to them.

Finally, we stress that knowledge of welfare theory is a necessary but not a sufficient requirement for drawing up a CBA. It is also necessary to have a good understanding of the policy field and the workings of the policy instrument. It is important that CBA compilers can draw on their experience with CBAs and their knowledge of the context of the measure under investigation to make practical and professional judgments, and that they can justify those decisions. In doing so, they must decide how the various effects should be assessed from a welfare economics point of view, which markets are directly affected by the intervention, and in which other markets relevant effects can also be expected.

S3.   Drawing up a CBA

Drawing up a CBA proceeds in a number of steps. In general, the process can be broken down into the following steps:

Steps in a CBA

Step		Questions	Leeswijzer
1.	Problem analysis	• What is the problem or opportunity and how is it expected to develop? • What is the policy objective in response to this? • What are the most promising options?	
2.	Establish the baseline alternative	• Most likely scenario in the absence of a policy • Effect = policy alternative – baseline alternative	Ch. 5
3.	Define policy alternatives	• Describe the measures to be taken • Unpick packages of measures to identify individual elements • Define several alternatives and variants	
4.	Determine effects and benefits	• Identify effects • Quantify effects • Value (monetise) effects	Ch. 6, 7, 8
5.	Determine costs	• Resources consumed to implement the solution • Costs may be one-off or recurring, fixed or variable • Only costs additional to the baseline alternative	Ch. 9
6.	Analyse variants and risks	• Identify the main uncertainties and risks • Analyse the consequences for the outcomes	Ch. 10
7.	Overview of costs and benefits	• Calculate all costs and benefits discounted to the same base year and calculate the balance • Present all effects, including non-quantified and/or non-monetised effects	Ch. 11
8.	Presentation of results	• Relevant, understandable and clear • Explain: transparency and reproducibility • Interpret: what can the decision-maker learn from the CBA?	

Source: CPB/PBL, 2013

The first three steps are the preparatory phase of the CBA and are discussed in Section S3.1. The core of the CBA is the determination of the effects, costs and benefits. These steps are described in Section S3.2. The analysis of variants and risks, part of the strategy for handling risks and uncertainties, is dealt with in Section S3.3.

The requirements for presentation and interpretation of the results are treated in Section S4, where we also describe how to draw up an overview of costs and benefits.

S3.1   Preparatory phase of the CBA

In the preparatory phase of the CBA the policy question is cast in a form suitable for CBA, taking care to ensure that the CBA addresses the decision to be taken. The preliminary phase of the CBA consists of three main steps:

- the problem analysis;
- defining the baseline alternative;
- defining the policy alternatives;

The problem analysis …
… ensures that the CBA addresses the policy issue under investigation. To this end the problem analysis seeks to identify what problem would arise without any government intervention (or what opportunity would remain unexploited), what policy issue arises as a result and the options available for achieving the policy objective. Although the problem analysis is not a part of the CBA, it is important that the CBA compiler makes sure that the problem analysis provides a sufficient basis for drawing up a meaningful CBA. The CBA compiler must also establish whether the design of the CBA reflects the problem analysis and whether any relevant measures have been overlooked.

The baseline alternative …
… is the most likely situation that would develop in the markets relevant to the CBA if the measure under consideration were not implemented. The baseline alternative is determined in the first instance by exogenous factors. In addition, the baseline alternative takes account of existing policies, proposed measures (in so far as their implementation is virtually inevitable) and smaller interventions that partly resolve or mitigate the problem but which are not part of any policy alternative.

Policy alternatives …
… contain the measure to be investigated. The policy alternatives and the baseline alternative must be chosen so that the CBA will provide an answer to the policy question. A policy alternative is defined as the smallest possible package of complementary measures that is expected to be technically and legally possible, economically feasible and have a credible relation with the problem identified in the problem analysis.

S3.2 Determination of effects, benefits and costs

A CBA stands or falls on the degree to which the effects of a measure can be determined. The extent to which it is possible to determine the effects varies between measures and between policy fields. The more precisely the effects can be measured and valued, the more fit for purpose the CBA will be as a decision-support tool.

Determination of effects

The main methods for determining effects are behavioural models, business cases, empirically determined price elasticities, experiments and index numbers. The methods used to determine effects must meet the following requirements:

- The method must be scientifically verified and regularly reappraised.
- The method must be suitable for identifying the effect under investigation.
- The more important an effect is for the outcome of the CBA, the more detailed the research method needs to be.
- All uncertainties relating to the use of a method must be mentioned and analysed.

In practice, the effects of a measure are often determined by using a behavioural model or empirical relationships and index numbers from the literature. However, such models, empirical relationships and index numbers will not necessarily be suitable for use in analysing the issue under investigation because the information on which they are based will not always be relevant to it. If that is the case (for example, in the case of the labour market or the education sector), it would be better to conduct an experiment designed to generate information about the problem at hand. This may be a randomised experiment, although this will not always be feasible, in which case a good alternative is a natural experiment (an empirical study based on available data in which external factors are accounted for as much as possible). Such studies are also designed specifically to investigate the measure at hand.

Valuation of effects

The valuation of effects must make as much use as possible of (observed) market prices. For non-priced effects, the consumer willingness to pay can be calculated in various ways:

- Revealed preference methods derive the value of non-priced effects from the purchasing behaviour of consumers in related markets. They include the hedonic pricing method and the travel cost method. The advantage of these methods is that they are based on observed behaviour. A disadvantage is that the related market from which the observations are obtained does not always correspond well with the effect to be valued, with the risk that the effect will only be partially valued.
- Stated preference methods derive the value of a non-priced effect from questionnaire or interview surveys of individuals. They have the advantage that in principle people can be asked all sorts of questions covering a large range of topics. The disadvantage of these methods is that what respondents say is not always consistent with what they do or would do. This can lead to bias in the valuations.
- The stated preference method is suitable for determining the existence value or intrinsic value of goods. The CBA compiler must establish whether the method is being used correctly.

Distributional effects

The principles underlying the CBA methodology imply that distributional effects are not in included in the CBA balance; they have no effect on the outcome. However, the distribution of costs and benefits is an important topic in many policy debates. If the distributional effects are substantial, it will be necessary to determine not only the net outcome, but also how the benefits and costs are distributed across the various groups in society.

If the distributional effects are to be identified and described in the CBA, this should be done in a balanced way. The CBA compiler must therefore decide whether or not to include distributional effects in the results, and if so, for which groups. The obvious ways to illustrate distributional effects are to show the distribution of costs and benefits among different income groups, among the main winners and losers, and among the various groups of those directly affected.

Long-term effects

In various policy fields (health care, education, environment) there is a debate about whether the discount rate for long-term effects is too high, leading to these effects being underrated in CBAs. A solution has been found for environmental effects which involves reducing the risk premium. The question is whether the official discount rates and risk premiums are appropriate for all policy fields. Both questions can be looked into further during the next review of the discount rate.

Building blocks for a CBA: welfare analysis and impact studies

The function of a CBA is to support the appraisal of policy options. CBA provides a way of structuring all the available information and a framework for weighing up all the different effects. The crux of a CBA is a combination of the determination of effects and a welfare

analysis. Even if the next step of valuing the effects to obtain a CBA balance cannot be taken, or at least not yet, the systematic overview of the effects of a measure is in itself of great value.

Varying amounts of experience have been gained in the use of CBA in different policy fields. Even in policy fields where little experience has been gained, there are still often impact studies available. Although these studies may not be sufficient to obtain a full CBA, they may provide insights into several important relationships and thus provide objective arguments to support the policy preparation process. Experiences in policy fields in which CBA has become a standard tool show that systematic use of CBA in a policy field stimulates the further development of quantitative policy information. Use of CBA stimulates impact measurement studies, research into valuation and the development of procedures to embed CBA within the policy process.

Not all CBAs have to be at the same level of detail in order to generate relevant – and sometimes decisive – policy information. Ideally, CBAs should contain specific impact studies for all the important effects and valuations of these effects. However, such studies are costly and time-consuming. In many cases a reasonably accurate picture of the economic and social costs and benefits can be compiled using insights from existing research. Indeed, most CBAs have been carried out in this way. This also means that the accuracy of CBAs can vary and the CBA compiler must provide a reasoned explanation of the information sources used and the accuracy of the data. The determination and valuation of effects must always be based on empirical evidence.

This also means that a review of existing academic research or the results of a dedicated study can quickly lead to an improved insight into the economic and social costs and benefits of a measure, which is particularly important in policy fields where CBA is a relatively unfamiliar tool and where there is no existing body of knowledge on carrying out CBAs. Such CBA-type analyses can be used to quickly generate structured information on the policy options. For a number of policy fields we have ascertained the available information and impact studies and investigated how CBA can be used. This has revealed, for example, that analyses of labour market policy should take account of the differences in productivity and wages between employees.

Costs

The costs of a measure are made up of the costs of the resources required to implement and sustain it. In a CBA the costs are calculated in accordance with the principles of welfare economics. In practice, calculating the costs correctly is fraught with difficulties, which makes it even more important to investigate the costs in a systematic way. This guidance contains a series of steps for doing this. Several aspects of the method for calculating costs still need further study, particularly the relevance and magnitude of the marginal cost of public funds.

S3.3   Risk and uncertainty

The future is uncertain, and so estimates of the costs and benefits of a measure will also be uncertain. This uncertainty means that ex ante estimates of costs and benefits are not exact, but are subject to a margin of uncertainty. The longer the time period, the wider the margin of uncertainty. There are three types of uncertainty:

• knowledge uncertainty;
• policy uncertainty;
• future uncertainty.

The first two types of uncertainty can be assessed by carrying out sensitivity analyses of the uncertain knowledge and any important policy uncertainties. Future uncertainty is mainly an issue for long-term effects. These are revealed by drawing up scenarios of possible developments in the future and applying a general risk premium to the discount rate.

Uncertainty and risk can also be included in the decision-making process by defining policy alternatives that anticipate uncertain future developments to a greater or lesser extent, for example by estimating the advantages of postponing the measure, considering the consequences of a phased introduction of the measure, or adapting the measure to different future circumstances. Such flexibility has the advantage of not locking in losses or locking out benefits.

S4.   Presenting the results of a CBA

No matter how good a CBA is, if the report is inadequate, the policy preparation will not fully benefit from the insights gained and the decision-makers may be wrong-footed. A good CBA report meets the following criteria:

1. The results are clear and presented in a user-friendly way.
2. The report gives readers the basic information they need to answer the questions most relevant to the decision-making.
3. The report must interpret the outcome of the CBA: what can the decision-maker learn from the CBA?

To this end, a CBA report should preferably cover the following topics:

I   Description of the CBA

a   The design of the CBA
        •   the problem analysis
        •   the baseline alternative
        •   the proposed measure or measures and variants/alternatives
        •   relevance to the decisions to be made: the questions the CBA answers
        •   the costs of the policy measures
        •   choice of scenarios (short or long term)
b.   Effects included in the CBA (definition of the markets)
C.   Results of the CBA
d.   Distributional effects

II   Methodology

a.   Scoping, determination and valuation of effects
b.   Determination of costs
c.   Knowledge uncertainties: sensitivity analyses
d.   The main knowledge gaps and how they have been addressed
e.   Preparation of the CBA, the people/organisations involved and their input

III   Interpretation of the CBA

a.   How does the outcome of the CBA inform the decision to be taken?
b.   What are the key factors that determine the results?
c.   What options are available for improving the policy measures (including phased introduction,
        postponement and alternative measures)?

IV   Summary and conclusions

a.   A self-contained and well-written *policy letter* stating the main results and conclusions (including a
        short explanation of the basis for these conclusions) and an interpretation of their significance for
        the decision process
b.   A table showing the expected effects of each policy variant, the associated benefits and costs, and
        the overall balance, as well as important unquantified or non-monetised effects and the important
        uncertainties

1   Introduction

Policy-making involves making choices. Policy measures often have a range of effects and so decisions on these measures involve weighing up various disparate advantages and disadvantages. Cost–benefit analysis (CBA) is a tool that provides a systematic overview of the advantages and disadvantages of measures, where possible quantified in euros and presented as the sum of the benefits minus the costs.

The OEI guidance document on the evaluation of infrastructure projects *Overzicht Effecten Infrastructure* (Eijgenraam et al., 2000) is a widely accepted set of guidelines on preparing CBAs for infrastructure projects in the Netherlands. Since its publication in 2000, the procedure has been further developed and expanded, with additional handbooks, guidelines and complete CBAs. The number of policy fields to which the procedure can be applied has also been expanded and continues to grow.

There is now a need to consolidate the insights gained and methodological developments made in recent years and make them suitable for use across a broad pallet of policy fields, including those where little experience has yet been gained with CBA, such as health care, education and social policy. The first requirement is a new general guidance document on cost–benefit analysis that sets out the theoretical background and principles for the use of CBA in each policy field.

At the end of 2011 it was decided that a general guidance document on cost–benefit analysis ('general CBA guidance') would be drawn up by CPB Netherlands Bureau for Economic Policy Analysis and PBL Netherlands Environmental Assessment Agency .[2]

In this general CBA guidance we describe how to prepare a CBA and present the theoretical foundations of CBA. From the theory and best practices we derive a number of rules and guidelines for CBAs, while remaining flexible enough to allow the guidance to be used in all policy fields. The emphasis is therefore on the correct application of the underlying principles of CBA rather than on the rigid implementation of a fixed set of procedures.

The general CBA guidance can form the basis for compiling handbooks on preparing CBAs in specific policy fields, and possibly for individual policy measures. Such handbooks are already available for several policy fields, including transport, environment and area development. It may be necessary to review these handbooks against the latest insights contained in this new general CBA guidance. For policy fields in which the CBA is a relatively unfamiliar tool, this new guidance will provide the basis for drawing up sector-specific handbooks. This general CBA guidance document is therefore not just a set of guidelines, but a reference work as well.

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[2] The terms of reference for the preparation of this general CBA guidance are included in Appendix A. The preparation of the guidance by CPB and PBL was supervised by the CBA core team and an Academic Advisory Committee. The remit, composition, duties and findings of the Academic Advisory Committee are set out in Appendix B

In the remainder of this introduction we describe the intended readership and the purpose of this guidance document (Section 1.1), how it can be used (Section 1.2), how the information is arranged, and the steps to be taken when drawing up a CBA (Section 1.3).

1.1   Purpose and nature of the general CBA guidance

The purpose, status, nature and scope of this general CBA guidance are set out in the following six points.

1. The general CBA guidance improves the quality of the development of and decision-making on a broad range of policy measures. It makes available a widely endorsed and accepted method for analysing the economic rate of return to society of projects and measures across a broad range of policy fields.
2. The general CBA guidance is a practical document with a methodological basis and is intended for use by CBA compilers and their clients who have some previous knowledge of or experience with CBAs. The guidance describes the essential elements of a CBA, the purpose and use of CBA in the decision-making process, and the background to and nature of CBA. However, it is not a scholarly reference work on the detailed methodology of CBA; neither is it a cookbook for ready-made CBAs.
3. The general CBA guidance covers the topics in the CBA methodology that apply to all the policy fields of interest to central government. The guidance therefore provides a general set of minimum requirements that should be met by each CBA and is not sector-specific. It covers those topics that must be addressed by every CBA irrespective of the subject matter, but also topics that are relevant to a great many (but not all) fields of application. The guidance promotes the use of clear terminology and the consistent application of CBA in an expanding number of policy fields, with the aim of facilitating and improving the use of CBA to support decision-making. To this end the guidance sets out the *steps for preparing a CBA* and the *necessary background information* in a clear and comprehensible manner.
4. The relation between the general CBA guidance and the policy-specific handbooks on CBA is illustrated in Figure 1.1.

   The general CBA guidance sets out the basic methodology.

   • This guidance is the basis for the preparation of sector-specific handbooks that interpret and refine the methodology for use in different policy fields. This may involve adapting existing handbooks or drawing up new ones. The handbooks must be aligned with the general CBA guidance.
   • CBAs are inconceivable without empirical knowledge on effects and valuations in the form of models, impact studies, rules of thumb and index numbers. This body of knowledge is depicted as a knowledge cloud which all CBAs can draw from.[3]

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[3] Such a knowledge cloud for transport and area development is hosted by the Rijkswaterstaat Support Centre for Economic Evaluation (SEE).

Figure 1.1   Position of the general CBA guidance

Knowledge Cloud

Handbook:
CBA in …

CBA in the
education sector

CBA in the
health sector

General CBA
Guidance

CBA for
environmental
policy

Framework CBA
for Infrastructure
and Planning

CBA for area
development

CBA for labour
market policy

pbl.nl / cpb.nl
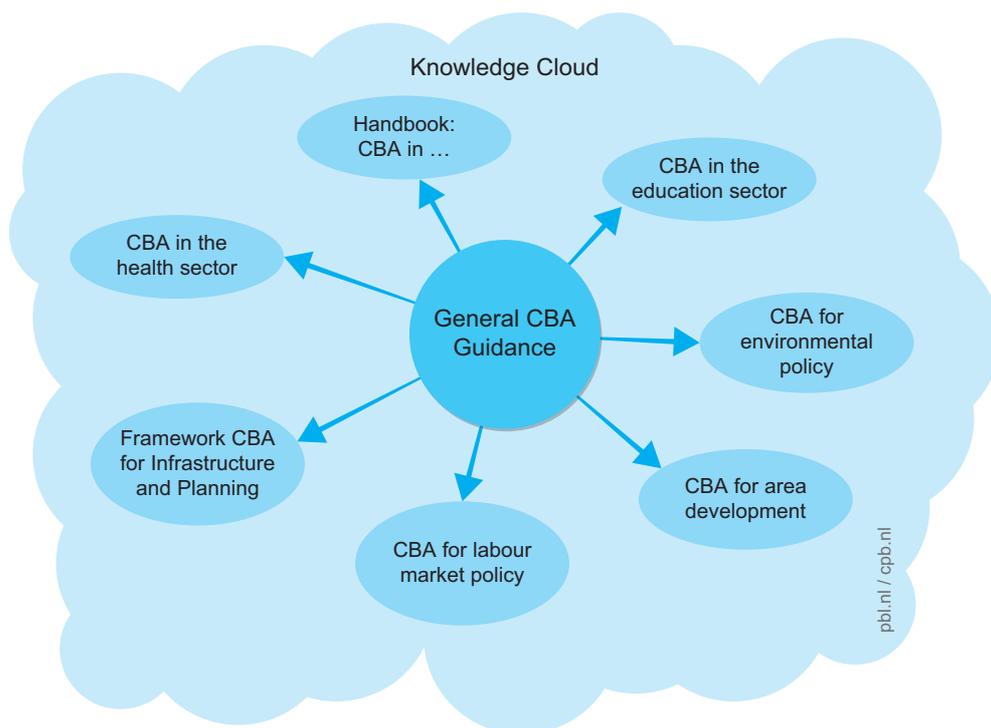
Source: CPB/PBL, 2013

a The titles included here are examples of existing and potential future handbooks.

5. The general CBA guidance is based on existing knowledge and gives a good picture of current CBA methodology. The information used to prepare this guidance has been drawn from the current national and international literature.[4]

6. Finally, the CBA guidance…

  • examines disputable issues that can cause confusion or lead to discussion. Where possible it takes a stand, but where that is not possible it makes no decision, noting the different opinions and their implications.

  • does not contain any new studies to fill in knowledge gaps. These gaps are noted and a brief description is given of the nature and implications of these gaps. The general CBA guidance does not provide a platform for further research and does not contain an agenda for the further development of CBA.

  • assumes that it will be worked up into handbooks for specific policy fields.

  • does not go into the causal relationships between measures and effects or the valuation of effects. This is the subject of empirical research, the results of which will become available in the 'knowledge cloud' or in the handbooks on the use of CBA in specific fields.

  • does not examine issues specific to individual policy fields, unless this is for illustrative purposes. That is the job of the CBA handbooks.

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[4] We draw heavily from the OEI guidelines, the advice, guidelines and handbooks based on this method, and from completed CBAs. The OEI guidelines is a literature source (Eijgenraam et al., 2000) for the new guidance document.

1.2   Applicability of the guidance

The general CBA guidance can be used in all policy fields. There are no objections in principle to such a broad applicability, although it can be questioned whether CBA can be a useful option in all cases and whether enough knowledge and information will always be available to carry out a CBA.

The guidance must also be applicable to various types of policy instruments. A feature of investment projects is that the costs (investments) are incurred up front and the benefits accrue over a period of time. The types of policy instruments that can be assessed by CBA include legislation and regulations, standards and guidelines, taxes and subsidies. There seem to be no restrictions in principle to the type of instrument that can be investigated using CBA, but it is necessary to have an evidence-based impact study in order to make a reasoned appraisal of the policy effects. In some cases this may present problems, for example when assessing the effects of voluntary agreements between government and industry, because the effects of these are often difficult to demonstrate. In general, CBA makes heavy demands on the availability of empirical research results, and these are not yet available to the same degree for all types of policy measures or policy fields.

Although there seems to be little objection to using CBA across a broad range of policy fields and policy measures, the CBA method used may vary somewhat between policy fields or types of measures. A recurrent theme throughout this guidance, therefore, is the *interpretation of general principles for use in different applications.*

1.3   Structure of the report

This guidance seeks to make available a widely endorsed and accepted method that can make a useful contribution to the policy preparation and decision-making process across a broad range of policy fields. We examine the key building blocks of CBA, give widely applicable definitions, explain concepts and terms, and discuss the requirements and criteria for estimating causal relationships and valuations, how to deal with uncertainties and how a CBA should be presented.

This guidance does not include causal relationships, valuation indices and cost information. These are the subject of separate studies or detailed supplements to the general methodology, which may be different for different policy fields. The topics dealt with in this guidance relate to the various steps in the process of drawing up a CBA.

In this section we briefly describe the contents of the general CBA guidance, which are covered in more detail in the subsequent chapters. The chapters are as follows:

1. Introduction
2. The role of CBA in decision-making
3. Principles of cost–benefit analysis
4. Steps in the preparation of a CBA
5. Preliminary phase of a CBA
6. Determination of effects
7. Determination of benefits
8. Building blocks and applications
9. Estimating costs
10. Uncertainty and risk
11. The outcome of a CBA: Reporting, presentation and interpretation

Chapters 2 and 3 provide the theoretical framework for CBA. In Chapter 2 we discuss why CBA is a useful tool in the policy process, what its limitations are and how the pros and cons of CBA compare with other evaluation tools. We look at the various fields of application and types of policy measures, and comment on the limitations of CBA: when is a CBA of use and when is it not? We also look at the use of CBA as a conceptual framework to help structure the decision-making process.

In Chapter 3 we examine the welfare economics foundations of CBA. A list of project effects is available for the appraisal of infrastructure projects, but when CBA is used in other policy fields confusion can easily arise about how to approach the welfare economics assessment of project effects: what markets are affected? Chapter 3 provides users with a 'welfare economics toolkit' for deciding how to determine welfare effects. An important point is the role of professional expertise in making a CBA: what is relevant and where can simplifying assumptions help to demarcate the analyses?

In Chapters 4 to 8 we discuss the steps in the preparation of a CBA. Chapter 4 describes the steps in outline and how they hang together. The steps are illustrated in the following figure:

Figure 1.2   Steps in the preparation of a CBA

Leeswijzer

Step	Details	Chapter
1. Problem analysis	• What is the problem or opportunity and how is it expected to develop? • What is the policy objective in response to this? • What are the most promising options?	
2. Establish the baseline alternative	• Most likely scenario in the absence of a policy • Effect = policy alternative – baseline alternative	Ch. 5
3. Define policy alternatives	• Describe the measures to be taken • Unpick packages of measures to identify individual elements • Define several alternatives and variants	
4. Determine effects and benefits	• Identify effects • Quantify effects • Value (monetise) effects	Ch. 6, 7, 8
5. Determine costs	• Resources consumed to implement the solution • Costs may be one-off or recurring, fixed or variable • Only costs additional to the baseline alternative	Ch. 9
6. Analyse variants and risks	• Identify the main uncertainties and risks • Analyse the consequences for the outcomes	Ch. 10
7. Overview of costs and benefits	• Calculate all costs and benefits discounted to the same base year and calculate the balance • Present all effects, including non-quantified and/or non-monetised effects	Ch. 11
8. Presentation of results	• Relevant, understandable and clear • Explain: transparency and reproducibility • Interpret: what can the decision-maker learn from the CBA?	

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Source: CPB/PBL, 2013

From Chapter, 5 we go into the steps in more depth. In Chapter 5 we discuss the preliminary phase: the problem analysis, the determination of the baseline alternative and project alternatives, and the assessment of relevant external factors (scenarios). These topics do not differ conceptually very much from the OEI guidance document on the evaluation of infrastructure projects, although there are many new insights. We take a closer look at the problem analysis, the identification of promising solution strategies and the role of the baseline alternative and its importance in formulating relevant policy alternatives. Another important issue is how the CBA addresses the policy question. Here again the skills of the CBA compiler are an important factor, along with the economic, policy and administrative context of the project.

In Chapters 6 to 9, we deal with the determination and valuation of the effects of a measure. Crucial for the preparation of a CBA is the availability of relevant empirical information on the effects of an intervention, as well as methods for valuing these effects. In these chapters we review in general terms the information, models and techniques needed.

Chapter 6 covers the determination of effects and Chapter 7 the valuation of effects. In Chapter 8 we illustrate methods for measuring, identifying, determining and valuing effects in a number of policy fields. For policy fields in which CBAs are infrequently used, we discuss in broad terms what knowledge is available to answer policy questions using the CBA approach. This chapter also picks up on issues from previous chapters:

- What can be done if the size of important effects cannot be determined or valued (Chapter 2)?
- What makes an effect a welfare effect (Chapter 3)?
- How far do the effects go towards solving the identified problem (Chapter 5)?

Chapter 9 deals with the estimation of costs. Much can go wrong with the estimation of costs and many errors are made in practice, not only in the determination of the size of the costs themselves, but also in how these cost estimates are used in the analysis. Overruns and shortfalls are the rule rather than the exception.

Chapter 10 is about dealing with future uncertainties. The presentation of uncertainties, and the factors underlying those uncertainties, is crucial. It is essential to identify uncertainties and the underlying causes of uncertainties, because this shows how robust the CBA results are under different assumptions. Revealing and describing uncertainties makes it possible to assess the risks facing the various stakeholders as a consequence of a measure. There are various sorts of uncertainty and different methods to determine uncertainties.

The steps described in Chapters 5 to 10 lead to an overview of costs and benefits for use in making a cost–benefit analysis. Finally, in Chapter 11 we discuss the importance of compiling a balanced and comprehensive report and give advice on how to do that. The main output is often a balanced presentation of the key results in an easy to comprehend table. But if the CBA is to be a useful tool in policy preparation, this will not be enough. Besides the results table, the outcome of the CBA must include an explanation and a reasoned interpretation of the results to help the decision-makers decide what they can or should conclude from these results. This must include a discussion of the main factors underlying the results, any significant uncertainties and options for improving the policy alternative.

2   The role of CBA in decision-making

Cost–benefit analysis is an information tool that supports the policy process and political decision-making on a measure or policy alternative. Expressing effects in monetary terms as much as possible makes it possible to compare them and present the results in an easily understandable form for weighing up the advantages and disadvantages of the measure. In principle, CBA can used in almost all policy fields and for almost all types of policy measures. However, there are limits to the use of CBA.

CBA is used during the stage of the decision-making process when measures have to be appraised. The CBA approach can also be used in earlier stages of the decision-making process, for example during the problem analysis and the identification of potential policy responses.

To ensure a CBA is as useful as possible, the following points must be borne in mind:

- Choose a suitable form for the CBA. This will depend on the stage of decision-making and the available knowledge about the main effects of the measure. Sometimes it will be possible and necessary to carry out a full CBA in which all aspects are worked out in detail. Sometimes a broader brush indices CBA will be adequate (or it may be the only feasible option).
- Consider doing a cost-effectiveness analysis (CEA) if all the measures to be investigated have the same (main) effect.
- If the main effects cannot be properly measured or monetised, use the principles of CBA as a conceptual framework. This will help to structure the decision-making, but will not result in a CBA and may not be called a CBA.
- Involve all relevant stakeholders and social groups in the design and input to the CBA to generate support for its implementation.
- When preparing handbooks for specific policy fields include instructions on the role of CBA in the decision-making process, the quality control measures and involving stakeholders in the CBA.
- When the distributional effects are significant, determine not only the welfare effects, but also distribution of costs and effects across the relevant groups in society.

2.1   Introduction

The government is responsible for defining the social parameters within which individuals and companies can act. This involves choices about the use of tax revenues, the level of taxes and how taxes are raised. It also involves making decisions about what policy measures should be adopted to uphold these social parameters. Policy measures can have all sorts of beneficial and adverse effects. The government has to take these into account and must therefore have information about these advantages and disadvantages in order to come to balanced decisions. CBA provides a means of comparing a wide range of disparate advantages and disadvantages by converting them into a common currency. This chapter is about the role of CBA in the decision-making process.

In Section 2.2 we describe how CBA fits into the decision-making process, the CBA methodology, its place in the process and how it can be used to support the decision made about a policy measure. A full CBA is not always necessary or useful for all stages of the decision-making process. The complexity and level of detail of a cost–benefit analysis can and must be tailored to the needs of the decision-making process itself. The various types of CBA are described in Section 2.3. Section 2.4 explores the limits of CBA and the conditions under which it is no longer helpful to use CBA.

2.2   CBA in the decision-making process

Government intervention must comply with the requirements of legitimacy, effectiveness, efficiency and equity. CBA is geared primarily to determining efficiency, but can also help with the appraisal of the other criteria for government intervention. Decision-making on a measure is well served by making a thorough problem analysis, which should also consider the issue of legitimacy and effectiveness. The outcome of a CBA shows whether intervention will solve the problem or make it even worse, and throws light on the question of whether intervention would be economically justified (legitimacy). The impact measurement needed to determine the welfare effects will also indicate whether the measure is effective. CBA can take equity issues on board by revealing distributional effects and it may be useful to look at various categories of distributional effects, such as income distribution and distribution by region.

Decision-making will benefit from a CBA that addresses the problem at hand and has the confidence of the stakeholders. However, CBAs are often thought of as black boxes, which does nothing to help their cause. The involvement of stakeholders and other actors in the decision-making process is often a key factor in the use of CBA (see Bertolini, 2013).

In this section we look in depth at the role of CBA in the decision-making process. We first describe the role of CBA in the economic assessment of policy measures (Section 2.2.1.) before exploring the value of using the thinking behind CBA in various other stages of the decision-making process. The decision-making process can be broken down into a number of steps (see text box below). As there is much in common between the steps in a decision-making process and the steps in a CBA (see Section 1.3), the principles of CBA can be of use in all the steps in a decision-making process. Section 2.2.2 deals with CBA and the problem analysis and the later stages of decision-making are taken up in Section 2.2.3. Section 2.2.4 looks at the impact of CBA on political decision-making.

Steps in a decision-making process

Every decision-making process is unique, but is usually a systematic process involving a number of steps based on a process design, as shown below:

Source: CPB/PBL, 2013

An ideal decision-making process begins with the identification of a problem (1), followed by an analysis of this problem (2), including consideration of the seriousness of the problem and the role of government. This analysis forms the basis for the formulation of policy objectives (3) and various options and alternatives for achieving these objectives (4).

In this stage the proposed plan is examined to determine whether it still provides a solution to the problem and whether it can be adapted to improve its efficiency and/or effectiveness. Ex ante evaluations, including CBA, play an important part in this evaluation and seek primarily to identify and describe the effects of the proposed measures and any possible course corrections. The aim of this is to provide valuable input in support of a balanced political decision in step (5) of the decision-making process.

This is followed by implementation of the plan (6). If required, an ex post evaluation can be conducted sometime after the project or measure has been implemented (7). This ex post evaluation seeks to determine how effective the plan has been in achieving the objectives and the context within which it was implemented.

In practice, these steps are not always implemented in the order given here. Some steps may not be considered necessary, sometimes they run in parallel and sometimes it may be necessary to repeat one or more steps. Steps may have to be repeated if the ex ante evaluation reveals that the plans need to be adapted, for example, or even that the problem needs to be redefined. These processes also tend to have several (implicit) decision moments and options.

2.2.1   CBA: Economic assessment in the decision-making process

Cost–benefit analysis is a tool that supports the policy process and political decision-making on a policy measure or policy alternative by presenting information about its effects, risks and uncertainties, the consequences of these for its costs and benefits and for social welfare, and information about who benefits and who experiences adverse effects.

The essence of a CBA is that different project or policy alternatives can be assessed by comparing their effects on the welfare of society as a whole: the economic and social costs and benefits. CBA is firmly anchored in economic welfare analysis (see for example, Boardman et al., 2006), in which all the relevant advantages and disadvantages of a policy measure are identified and quantified as far as this is possible. Expressing these advantages and disadvantages in monetary terms whenever possible (monetisation) makes them cross-comparable and allows them to be added up and subtracted. The result is a set of straightforward data that can be used to weigh up the advantages and disadvantages of a measure. This information also includes the costs and benefits of effects for which there is no market price, such as environmental impacts and safety implications. The balance of benefits and costs indicates whether a measure increases total welfare or not.

In essence, the CBA gives an indication of the economic efficiency of a measure: do the benefits outweigh the costs? The CBA also provides insights into the effectiveness of a measure (to what extent does it solve the problem and are there any other effects?) and into the legitimacy of government intervention (is government intervention necessary and justified?). This philosophy is appealing. CBAs provide politicians and stakeholders with information they can use to help them come to a balanced decision, which makes CBA an important input to the decision-making process.

CBA can be used in almost all policy fields for almost all types of measures to investigate whether a measure is cost-effective from a welfare economics point of view, to compare different alternatives and to reveal the implications for the decision to be taken on the measure. CBA is mostly used in this way towards the end of the decision-making process. It can also be used in the earlier stages of the decision-making process to investigate how a problem can be tackled and how to improve measures for tackling the problem. Although in these stages little empirical information is available on the expected effects of the measure, the principles of the CBA methodology can be used to structure the decision process, identify potential solutions and determine what empirical information will be needed later on in the decision-making process to evaluate the policy measure.

2.2.2   Problem analysis and use of the principles of CBA

A problem analysis reveals (i) the nature of the problem (what is the predicament or what opportunity is being wasted) and how it is expected to develop, (ii) whether government intervention is necessary and justified ('legitimate') and (iii) what options could be effective in solving the problem. The problem analysis helps to control risks in the policy process so that the final decision contributes to solving the problem in the most efficient way. A good problem analysis is therefore a key part of the decision-making process and should preferably be done as early as possible in the process. The problem analysis is not part of the CBA itself, but – as we shall explain later – the principles of CBA can be useful in structuring the analysis. Moreover, a good problem analysis is essential for ensuring that the CBA ties in well with the decision-making process (see Chapter 5), because the problem analysis forms the basis for defining the policy objective. The relation between the policy objective and the CBA is described further in the text box 'Policy objective and CBA'.

It makes sense, therefore, to reflect critically on the problem analysis, and this is made easier by having CBA expertise available at an early stage. The converse is also true: it makes sense to have subject matter expertise available at the beginning of the CBA process. Such expertise is essential for defining the problem with precision, evaluating the design of policy alternatives and formulating new ('better') alternatives.

Economic legitimacy
If markets work properly, market forces lead to the best possible welfare outcome for society as a whole. In such well-functioning or efficient markets government intervention will lead to a loss of economic welfare. Only when markets are not working properly do market forces not lead to the best possible outcomes ('market failure'), and in such cases government intervention can generate economic welfare benefits to society. The measure can then be said to be justified by being in the public interest.[5] This is called the welfare economics justification for the measure.[6]

A CBA can be used to investigate whether government intervention could prevent market failure or whether it would actually make the problem worse or lead to new problems elsewhere ('government failure'). This means that CBA experts can also be of help during the problem analysis stage – when no CBA has yet been carried out – in determining whether intervention would be justified and would help to rectify market failure, or whether government failure would be an impediment to successful intervention.

Effectiveness
Besides legitimacy, effectiveness is also a criterion for considering a potential solution or not. Effectiveness is about whether the policy measure makes a contribution to solving the problem.

Efficiency
Finally, at this stage a CBA can provide an initial indication of the efficiency of certain aspects of the measure, expressed in 'orders of magnitude' of the expected costs and benefits. Identifying the aspects or components of the measure that need to be improved at an early stage in the process makes it possible to improve the plan as a whole.

Thinking in CBA terms can be helpful when selecting promising options or alternatives on the basis of effectiveness and efficiency. What options are available and what alternatives are worth considering? Which options should be dropped? A global assessment of the costs and benefits of a large number of alternative measures can give an impression of their economic efficiency and effectiveness in achieving objectives, making it easier to identify the more promising options. Moreover, carrying out an outline form of CBA at this stage can prevent rejecting relevant alternatives too soon and keeping irrelevant alternatives alive for too long

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[5] Teulings et al. (2003) discuss the legitimacy of government policy, markets, market failure and government failure.
[6] There may be reasons other than economic efficiency for the government to intervene, such as distribution and equity: is welfare distributed fairly or do some people have too little? This could be a reason for deciding that a more equitable distribution of welfare is needed. A CBA could reveal the loss of economic welfare resulting from such a policy. For example, the level of welfare could be compared with the distribution of welfare, or the policy could address issues like 'equal opportunities' or equal access to education or care services. A CBA can be of help in these cases too. We do not go into this here.

during the policy preparation stage. An important added value of CBA thinking, therefore, is that concrete measures are not decided on too quickly, but that the palette of options is kept broad enough so that later on in the decision-making process the relevant policy options are still available.

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Policy objective and CBA

Cost–benefit analysis assesses whether a measure delivers a positive rate of return, not whether it will achieve the policy objective or not. It is not impossible that the main benefits in a CBA will have nothing to do with the policy objective, which means that a measure may not achieve the policy objective but still be economically efficient. The converse can also be true: a measure may achieve the policy objective but not be economically efficient.

For the decision-maker it is important to gain a deeper understanding of the relation between the policy objective and CBA. In the first place, to conduct a CBA it is essential to determine the effects of a measure. This will show whether, and to what extent, the measure contributes to achieving the policy objective. What is more important, though, is the part played by the policy objective in the design of the CBA. In this guidance we emphasise the importance of good preparation in the form of a problem analysis, identification of promising solution strategies, drawing up a suitable baseline alternative and defining policy alternatives. This embeds the CBA in the policy issue and allows it to make the greatest possible contribution to the development of policy.

The ability to achieve the policy objective is one of the criteria for the selection of promising options and policy alternatives. The CBA then determines whether or not the policy alternatives are economically efficient. If the measure under investigation makes little or no contribution to solving the problem, the benefits associated with the policy objective identified in the CBA will also be slight. The CBA compiler must then note that the policy measure does not contribute towards achieving the policy objective.

Linking the alternatives to the policy objective also makes it much more likely that all the relevant policy alternatives will be investigated, rather than one solution being seized upon too early: the range of policy alternatives for investigation is kept broad. On the other hand, linking the alternatives to the policy objective is also a way of limiting the number of policy alternatives to be investigated. Ossokina & Eijgenraam (2010) state that 'the presumption that a project is only worthwhile if it achieves its main objective allows the maximum number of possible projects to be considerably reduced'.

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2.2.3   CBA in the later stages of the decision-making process

Once the problem analysis has been completed, the next step is to identify the best policy instrument to use and what its consequences will be for individuals, the business sector, government and the environment. Assuming government intervention is desirable, the possible alternatives are described and the realistic options identified. The final decision on which alternative to use should be based on a comprehensive appraisal of a number of plausible policy alternatives, taking into account the opportunities and risks of each instrument. The final choice may still be to not adopt any new policy or measure at all (baseline alternative). In this stage of the decision-making, ex ante evaluations may be carried out, including CBA.

The further refinement of the policy measures[7] should address not only their effectiveness in achieving the policy objectives, but primarily the efficiency of the plan. In principle, the efficiency of a measure can be measured as the balance of the economic and social costs and the economic and social benefits: the CBA balance. The aim is to select and compare several alternatives, identify the 'useful' or profitable options and select the most promising of these

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[7] For area development this refinement of policy measures is called the planning stage.

for further study. CBA is the ideal tool for this. CBA can have the following functions in the decision-making process:

- determining the need for and value of a policy alternative;
- prioritising policy alternatives;
- optimising policy alternatives.

Assessing the consequences of a measure will also reveal unintended and sometimes undesirable side effects. This can be a reason to amend or refine a certain policy alternative or measure, or take compensating measures. Ex ante evaluations may reveal that the plan no longer offers a solution to the problem or that it requires further improvement (optimisation) or revision. In the most extreme cases, the 'problem' to be solved may in fact have changed during the course of the exercise, leading to a mismatch with the plan or solution. This may happen, for example, if further information has come to light during the course of the planning or decision-making process, altering the problem analysis and maybe even moving other or supplementary objectives centre stage.

Using CBA to prioritise measures

Sometimes there is a need to draw up a list of priorities setting out which of a series of measures should be implemented (or implemented first) and which should not be implemented (or implemented later), for example when the budget is not enough to cover all the policy objectives. In principle it is possible to use CBA to prioritise the options.

In practice, though, this is often difficult because different CBAs are not always comparable, especially when the CBAs have been carried out for measures in different policy fields. But even within the same policy field, CBAs may differ in their approach, scope and level of detail, and use different models with different assumptions, for example with respect to the baseline alternative or scenarios. These differences may be because the CBAs were carried out at different times and the differences are the result of advances in knowledge and understanding. It is often impractical to correct these differences. Prioritising measures in this way therefore requires carrying out CBAs on all the measures at the same time and basing them all on the same assumptions

During these stages of the decision-making any distributional effects may also be investigated, because the distribution of welfare (who experiences the benefits and disadvantages) can be just as important for the decision-making process as the welfare effect itself (what is the net outcome of the policy measure?) The effectiveness of a measure in achieving its objectives may also be an issue at this stage of the decision-making (see Section 2.2.2). Distributional effects and goal achievement are supplementary to the CBA as inputs to the decision-making process.

2.2.4   CBA and decision-making

When making a political decision, decision-makers are keen to have all the information they need to describe, quantify and evaluate the social effects as accurately as possible. The goal is to make the pros and cons of an issue as understandable as possible so that decision-makers can come to a balanced decision. That is precisely what CBA does. A CBA includes all the available information, including information from all the impact studies that have been

carried out, such as environmental impact assessment (EIA) or strategic environmental assessment (SEA), transport studies, cost estimations and business cases, and economic impact studies. A CBA also indicates where information is lacking or unreliable. Politicians must be able to trust the quality of the CBA, and so quality assurance is a necessary part of a CBA (see text box 'Quality assurance of CBA').

Quality assurance of CBA

CBA is intended to inform decision-making in the interests of the whole population. In view of this, a good CBA used properly depends on the CBA compiler being independent of the commissioning body. Essential in this regard is a quality assurance mechanism in which the quality of CBAs is assessed by an independent party.

Without adequate quality assurance mechanisms, CBA compilers will be able to push the boundaries of the guidance or handbooks to obtain the most favourable possible outcome for their clients. It is not always possible to guarantee that the CBA compiler is fully independent of the client.

Political decision

The final decision on the implementation of a measure is a political one. If the CBA balance is negative or if part of the measure delivers a negative rate of return, the political decision-makers must decide between implementing the measure anyway, rejecting the measure, or deciding that the measure must first be amended (optimised) before a decision can be made. This means that the decision-makers, after considering the evidence from the various sources available to them, must be able to choose, in all conscience, to disregard a study or CBA (whether it has a negative or a positive outcome). When a CBA is negative (either entirely or in part) it is possible to use additional arguments to make a case for not basing the decision on the outcome, or vice versa.

In such cases, decision-makers can decide to introduce a measure that reduces welfare on grounds other than economic efficiency because they consider this loss of welfare to be more than compensated for by other effects. A good example is balancing economic efficiency and equity: it may be considered politically justified to sacrifice some welfare in the interests of a fair division of income. Financial constraints or lack of public support may be reasons to cancel a project. In practice, the final decision is by no means always entirely consistent with the outcome of the CBA (see text box 'Influence of the benefit–cost balance on the decision').

Finally, care must be taken not to use the CBA after the fact to justify a decision that has already been taken. If, for example, the decision-making process is already far advanced and the politicians responsible have already more or less committed themselves to a particular solution strategy, a negative CBA would be unwelcome and the objectivity of the study could come under severe pressure. CBA should only be used when it is an appropriate tool: as an objective appraisal made in advance of any decision to assess the efficiency of a measure and investigate possibilities to optimise it. To this end it is important that the CBA is carried out as early as possible in the decision-making process.

The influence of the benefit–cost balance on decision-making

Research shows that the majority of decisions are in line with the outcome of the CBA. However, sometimes a measure is introduced despite the CBA resulting in a negative benefit–cost balance. Two recent studies give an impression of the influence of the CBA outcome on the decision-making process for major development and infrastructure projects: Rienstra (2008) evaluated 46 infrastructure projects; Hanemaayer et al. (2010) evaluated the role of CBA in the assessment of 23 projects to decide which would be eligible for funding from the budget for the implementation of the National Spatial Strategy.

Rienstra (2008) looked at the relation between the decision ('go' or 'no go') and the CBA balance. In almost two-thirds of the cases (65%) the decision was in line with the CBA balance, in 47% of the cases a decision to proceed was accompanied by a positive or neutral CBA balance, and in 18% of the cases a decision not to proceed was accompanied by a negative CBA balance. In 30% of the cases, the projects went ahead despite a negative CBA. In only 5% of the cases was a 'no go' decision accompanied by a positive CBA.

Rienstra also examined the size of the CBA balance and concluded that the greater the negative CBA balance, the more likely the decision is to be negative, but 'in all cases decisions were also made to proceed with other projects in the same category with a similar negative score'. In sectors other than infrastructure positive decisions have also been taken despite a negative CBA.

From document studies, interviews and a web questionnaire, Hanemaayer et al. (2010) found that the CBAs of the 23 National Spatial Strategy projects had played a part in central government decision-making. They concluded that the CBA 'did not have substantial consequences, in the sense that projects were rejected. Neither did most of the CBAs lead to major changes in the project plans, even in those projects with a negative CBA.' They qualify these conclusions by stating that the government had already committed itself to the projects. Besides, the majority of the plans selected for funding from the National Spatial Strategy budget were already in an advanced stage of development. This appeared to be the main reason for the modest impact of the CBAs found by Hanemaayer et al.: the greater the existing commitment to a plan and the more advanced the project is, the smaller the chance that a CBA will have an influence on decision-making.

Process and support

CBAs are often thought of as black boxes (Savelberg et al., 2008; Annema et al., 2007). Government decision-makers do not always think their plans are properly represented in the CBA (Romijn and Renes, 2013) and the method is not always comprehensible to non-economists. CBA therefore sometimes meets with resistance.

In general, the first requirement for facilitating a social and political debate is to make the CBA comprehensible for all those involved. CBA is a complicated tool and usually involves a fair number of assumptions and uncertainties. It is important to make this clear so that professionals and other stakeholders are able to properly interpret the outcome of the CBA. Presentation, interpretation and explanation can be of help (see Chapter 11), but can never put right what may have gone wrong earlier in the process. The emphasis in this guidance is on making the principles of CBA applicable to new policy fields and available for new applications, not on laying down rigid guidelines. A crucial part of this is having good agreements on communication between the various actors.

A number of recommendations are pertinent here:

1. To improve understanding of the analysis and thus increase support for the CBA, and at the same time make use of local knowledge, it is advisable to involve several relevant social groups and stakeholders right from the start of the analysis. These may include the

target group of the measure under investigation, the various tiers of government involved, civil society organisations, the relevant business sectors, residents, interest groups, etc. Involving them in the CBA, sharing information, drawing on knowledge of the problem 'from the field' and reporting back on the outcome of the CBA will strengthen acceptance of the CBA as a source of relevant information (but separate from acceptance of the outcome of the CBA or of the implications of this for the decision-making). The CBA can then rationalise the discussion and encourage joint fact finding by the stakeholders, decision-makers and experts.

2. Generic guidelines on how to involve stakeholders and actors in the CBA and decision-making process cannot be given. We recommend preparing methods specific to individual policy fields in the handbooks. In the field of infrastructure and area development much research has already been done into the need to involve actors in the CBA (see for example, Bertolini, 2013).

3. It is recommended that any implicit effects in the costs and benefits should be made explicit, particularly when these effects are of importance in the appraisal of policy options. A criticism of the CBA approach is that it does not take account of all effects, such as spatial quality or the social value of public transport. This criticism is made in academic publications (e.g. Beukers et al., 2012) as well as in more policy-oriented publications (e.g. Duivesteijn, 2011). However, economists have shown that these 'forgotten' effects are in fact usually taken on board in CBAs (e.g. Bakker and Zwaneveld, 2009), although they are often more or less implied, described in only general terms or included as optional extras, which makes it impossible for non-experts to judge the CBA on its merits.

4. In this guidance we state that if the distributional effects are considerable, it will be necessary to determine not only the balance of costs and effects, but also how they are distributed across the relevant groups in society. This makes communication with the various groups and the client much easier. Moreover, the groups involved will often have an idea of what the costs and benefits will be for them or for others. If these distributional effects are not included in the CBA, the analysis will be less meaningful to these groups and seem much more like a black box, which will in turn affect their confidence in the outcome of the CBA. Section 7.5 discusses ways of revealing distributional effects in more depth.

2.3   Types of CBA and their use

A full cost–benefit analysis is not always necessary, useful or possible for all stages of the decision-making process or for all types of measures. To be as widely applicable as possible, the complexity and level of detail of a CBA must therefore be tailored to the needs of the decision-making process at hand. In this section we explore various types of CBA. In Section 2.3.1 we discuss the level of detail in a CBA. In Section 2.3.2 we look at cost-effectiveness analysis, a type of appraisal derived from CBA. Section 2.3.3 examines the use of CBA as a conceptual framework.

2.3.1 Broad brush or detailed?

A CBA must tie in well with the decision-making process. The different stages of the decision-making process make different demands on a CBA. As we stated in Section 2.2.2, at the beginning of the process it is important to carry out a global analysis of a large number of alternatives, which will often still be incomplete or sketchy. Once it has become clear in which directions the research is heading, the relevant alternatives should be worked out in more detail for more thorough analysis. Such step-by-step decisions make it possible to identify the key sources of costs, benefits and uncertainties at an early stage, which in turn provides leverage for optimising solutions. These opportunities must be exploited, because once the final CBA has been produced there will often be little if any opportunity to amend plans and make new CBAs. A CBA should also be appropriate to the field in which it is used, as the availability and quality of information will vary considerably between different fields of application. Analyses can go into much greater depth in policy fields in which much is known about the determination and valuation of effects than in policy fields in which this information is less readily available, where by necessity analyses will be much less exhaustive.

The requirements placed on a CBA therefore vary according to the stage of the decision-making process, while the possibilities for drawing up a CBA depend on the information available. In practice, we can distinguish between two types of CBA: comprehensive CBAs and indices CBAs. In a comprehensive CBA all the research steps are carried out in full and all effects are identified, measured and valued as accurately as possible. This type of CBA contains the best available information and offers decision-makers the most detailed insights into the advantages and disadvantages of a measure. The main disadvantage of such CBAs is the amount of research involved, which can make the study lengthy and costly to carry out.

In an indices CBA the determination of effects and valuations is less precise and is based on rules of thumb and index numbers. The advantage of indices CBAs is that they are quicker and cheaper to do than comprehensive CBAs, which makes them feasible for smaller measures as the cost of the study can be kept in proportion to the cost of the measure itself. The lower research costs of indices CBAs also make them a useful tool when there are many project alternatives to be investigated. The disadvantage of indices CBAs is that the information they provide is less detailed and of poorer quality than comprehensive CBAs. [8]

As more information about a measure and its effects becomes available, the CBA becomes increasingly like a comprehensive CBA. However, there will usually always be some less important effects that can be assessed using index numbers or described in qualitative terms on the basis of a hypothesis.

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[8] A variant of the indices CBA is a CBA in which estimates of causal relationships or valuations are made on the basis of assumptions. This variant can also be used if no estimates of the main effects are available or can be made on the basis of empirical research. But at the same time this is the danger of this variant: it is not clear whether the assumed affects will actually occur, which means the results are hypothetical.

What type of CBA is used in the decision-making process and how it is used depends on the context, the actors involved and the policy field. Instructions have been drawn up for several policy fields in the form of guidelines and handbooks; an example is presented in the text box 'Example of a CBA in the decision-making process: the Multi-Year Plan for Infrastructure, Spatial Planning and Transport (MIST)'. But these rules do not mean that each CBA does not follow its 'own' series of steps and procedures. Those involved are advised to decide right from the start exactly what they want the CBA to contribute to the decision-making process. A point to remember here is that the CBA is a tool to support the decision-making process and must therefore deliver information where it will be of use. Sometimes only rough indications from a limited analysis may be all that is required. Whether this is actually possible will have to be verified, but if that is indeed the case a detailed analysis would unnecessarily hold up the decision-making process. This is the principle of 'sensible analysis' proposed by the advisory committee on faster decision-making on infrastructure projects in its report 'Faster and Better' (*Sneller en beter*).

2.3.2   Cost-effectiveness analysis

A special form of cost–benefit analysis is cost-effectiveness analysis (CEA). These analyses focus on a single (non-monetised) effect and compare the costs of different policy options for achieving this effect.[9] This means that the goal of the policy is not at issue and is not a subject of study. A CEA can therefore be considered to be a CBA with a fixed effect; in other words the degree to which the policy objective is achieved is fixed in advance. However, the general structure of a CEA is not much different from a CBA and the research techniques and

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[9] Or conversely, they look for the most effective policy option for a fixed cost. In both cases the effect is calculated per euro.

principles are the same. There is a grey area between CEA and CBA according to how narrowly the goal to be achieved is defined. A CBA in which the alternatives (including the null alternative) are designed to achieve a narrowly defined goal is actually a CEA.

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Alternative assessment methods

Besides CBA there are many other methods for assessing policy measures. The most commonly used are multi-criteria analysis (MCA) and impact assessment. In an MCA politicians and/or policy-makers determine the weights to be attached to the various effects of a policy. The method is therefore subjective and in principle open to manipulation by playing with the weights to influence the outcome. Moreover, unlike CBA, MCA is susceptible to double counting (Rouwendal & Rietveld, 2000). The biggest advantage of MCA is that it is possible to include effects that cannot be given a monetary valuation. In addition, the involvement of policy-makers in the study is sometimes considered to be a positive thing. However, a CBA is a better tool for making an independent appraisal of a policy than an MCA.[a]

Impact assessment (IA)[b] only reveals the effects without comparing them in any way. The advantage of this method is that no (possibly subjective) weighting is necessary. On the other hand, the impacts are not comparable and cannot be added up and so there is often no clear indication of which policy options perform best.

As the number of effects in a CBA cannot be monetised increases, especially the important effects, the CBA starts to look more like an IA.

[a] Sometimes it is argued that the best approach is a combination of a CBA for monetisable effects and an MCA for the other effects (e.g. Sijtsma, 2006; Duivesteijn, 2011). However, this does not resolve the issue of subjectivity.
[b] There are many imaginative names for these methods, such as Scorecard Analysis, (Community) Impact Analysis, Balance Sheet Analysis, Performance Matrix and Key Performance Indicators.

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2.3.3   CBA as a conceptual framework

The ability of CBA to provide a quantitative evidence base for a policy measure depends on the degree to which effects can be measured and monetised. If there is no known information about the effects or their valuation, the conceptual framework of CBA can still be of considerable use. Working through the steps of a CBA can give structure to the decision-making process. Moreover, the emphasis in CBA is on the *welfare effects* (even when the CBA is only used as a conceptual framework). As policy measures are financed from taxes levied on households, the welfare benefits of a measure – even if we cannot measure them – must be expected to be higher than the costs so that households get 'value for money'. To demonstrate or at least provide some evidence of the welfare effects of a measure, they must be defined or operationalised or quantified in some way so that different project alternatives can be compared. CBA as a conceptual framework can also be used early in the decision-making process when there is not yet much information available. This use of CBA as a conceptual framework delivers no quantitative evidence base for a policy decision and in practice may not be referred to as a CBA.

2.4   Practical constraints on conducting a CBA

In principle every type of policy measure can be subjected to a CBA. Besides investment projects, CBA can be used to assess measures such as amendments to (mainly) publicly financed regulations and rights (social care, education, income insurance/protection), legislation (smoking regulations, building regulations, working conditions legislation),

revision of standards (speed limits, flood risk) and initiatives designed to influence behaviour (advertising/information campaigns, public-private agreements). However, there are practical limits to the use of CBA.

- If the size and/or valuation of one or more important effects of a measure are not known, a CBA can only provide sketchy information of limited reliability and relevance. In such cases, there comes a point when the costs of the study may no longer be in proportion to the value of the outcome, because it will not deliver much information. In Section 2.3 we already pointed out the possibility of considering using lighter versions of CBA to limit costs.
- The same reasoning applies to the question of whether the effort required to conduct a CBA can be justified by the importance of the subject at hand. The less important the measure, for example when the government resources earmarked for the measure are limited, the benefits of a CBA (insight into the costs, effects and benefits) may not outweigh the costs of the study.
- CBA can be used to reveal the welfare economics consequences of a change. It cannot be used to evaluate a situation in itself.

3 Principles of cost–benefit analysis

In this chapter, we examine the welfare economics principles underlying CBA. These principles help to structure welfare analyses and interpret abstract issues in non-standard CBAs in a manner consistent with welfare theory.

The key principles are:

- CBA is based on the social welfare function, which aggregates the welfare of individuals to obtain an expression for the welfare of society as a whole.
- All the effects of a measure, whether these involve priced or unpriced goods and services, have an influence on individual welfare and thus on the CBA balance.
- The welfare changes caused by policy measures are expressed through people's willingness to pay for the positive effects of the measures, such as a good or service.

Besides these principles, the practical, professional aspects of CBA are important. CBA compilers must draw on their experience with CBAs and their knowledge of the context of the measure under investigation when weighing up options and making decisions, and they must justify those decisions. In this chapter we present a number of rules for conducting a CBA.

The most important of these rules are:

- The effects of a measure are calculated from their influence on markets. We distinguish between existing markets (for *priced* goods and services) and missing markets (for *unpriced* goods and services).
- A distinction must be made between direct effects in markets where the intervention is made and indirect effects in related markets considered to be relevant for the CBA. This definition of the relevant markets for the study is one of the most important steps in a CBA.
- The benefits are calculated from the consumer surplus.
- When determining the benefits the 'rule of half' is used.

Based on these rules, the key guidelines for the preparation of a CBA are:

- Each handbook and each CBA should be consistent with the theoretical principles.
- Each handbook and each CBA should also be in line with the rules in this general CBA guidance.
- The CBA compiler must be competent. Anything can be calculated, but the key issue is what the figures actually mean. In other words, the CBA compiler is required to familiarise himself with the policy measure and the policy field under investigation.

3.1 Introduction

A CBA investigates whether or not the advantages of a government intervention outweighs its disadvantages. It is a systematic method for identifying the costs and benefits to society of government policies. If the total benefits to society are greater than the total costs, the result is that society as a whole benefits. A negative balance of benefits and costs indicates that a measure reduces social welfare, and from that point of view should not be implemented.

CBA is grounded in economics, in particular in welfare economics. In this chapter we examine the principles of welfare economics underlying CBA to provide CBA researchers and users with a reference frame when thinking about what effects to include in a CBA, the consequences of those measures for social welfare and how the benefits of the measures can be determined. We provide a methodological framework for preparing and carrying out a

CBA that will help the user to structure social welfare analyses and interpret abstract issues in non-standard situations in a manner consistent with welfare theory.

At the core of welfare theory is the social-welfare function, in which individual welfare is aggregated to obtain an expression for the welfare of society as a whole. In principle, this social-welfare function contains everything that is of value to people; nothing is ruled out in advance.[10] This is called a broad welfare concept. CBA is based on the idea that social welfare increases when those people who see their welfare increasing as a result of a policy measure can compensate those who see their welfare falling.[11]

People's willingness to pay is the key measure in determining the benefits of policy measures. How much is someone willing to pay for the services (and goods) directly or indirectly generated by the policy measures?[12] When estimating this amount it is important to determine what effects the policy measures will have and in which markets these effects will be felt and can be measured. 'Markets' are here interpreted in a broad sense, to include missing markets for services that are not actually bought or sold, but for which individuals are willing to pay. This broad welfare concept means that the effects of a measure contain all the changes of importance to individuals. These are called the *social effects*. 'Social' indicates that they include not only priced effects on existing markets, but also non-priced effects in non-existent markets.

We show that from this it follows that welfare changes can be measured by means of the consumer surplus on existing or non-existing markets. In turn this means that welfare changes are linked to volumes and prices on those markets and the changes in these prices. In this chapter we also show how the principle of a broad welfare concept – which includes all goods and services (priced and non-priced) that people value – can lead to a limited number of effects on a limited number of markets, and that these two things are not at odds with each other.

In this chapter we also emphasise the part played by the expertise and professionalism of the compiler of the CBA. A CBA cannot be based solely on welfare economics theory. It is also a craft in the sense that the compiler of a CBA must use the tools available to produce the best possible piece of work. This requires contextual knowledge of the policy field concerned and experience relevant to the policy proposal, and it requires choices to be made on the basis of this knowledge and experience when using the CBA tools available. How should we examine the various policy effects from a welfare economics perspective? What markets are affected? What is relevant and where can simplifying assumptions help to define the boundaries of the

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[10] For more information on the broad welfare concept and its relation with economic politics, see Hennipman (1977).
[11] This is called the Kaldor-Hicks compensation principle. This compensation does not have to actually take place, and in practice it usually does not.
[12] The willingness to pay is the maximum amount of money people are willing to pay for a positive welfare effect, such as a good or service. The minimum amount people are willing to accept as compensation for an adverse effect is called the 'willingness to accept'. The willingness to accept an adverse effect and the willingness to pay to prevent the same adverse effect should be the same amount because they are both about the same thing. In practice, however, there appear to be differences between willingness to accept and willingness to pay (see Chapter 6).

analyses? With these questions in mind, we look at a number of standard practices, such as the division of markets into direct and indirect effects and use of the 'rule of half'.

In this chapter we explain the key principles and consequences of welfare economics theory in terms useful to compilers and users of CBAs; we do not go into the theory itself in any great depth. The chapter is structured as follows. In Section 3.2 we describe the theoretical basis of CBA under the assumption of perfect markets. In Section 3.3 we expand this to include the situation in which markets do not work perfectly. This means that there are also missing markets: markets for services for which there is a willingness to pay but for which for one reason or another (market failure) supply and demand cannot be brought together. In Section 3.4 we discuss how the relevant markets are chosen and we define different types of effects. In Section 3.5 we go into the objections to the principles underlying CBA and the constraints these principles impose on the use of CBA as a basis for decision-making.

3.2   The welfare economics foundations of cost–benefit analysis

In this section we examine the welfare economics foundations of CBA. We show how individual consumer preferences are translated into demand for goods and services and how welfare changes can be measured via the consumer surplus. This means that welfare changes can be calculated from the changes in prices and volumes on *relevant* markets. The term 'markets' is here used in a broad sense to cover not only existing, efficient markets, but also markets that do not function well, for example because of market imperfections or regulatory price or supply constraints. Some of these markets may for all practical purposes not even exist, but in welfare economics are nevertheless thought of as markets for the purposes of the analysis (we then talk of a 'missing market', such as the market for safety or clean air). The effects of a measure depend heavily on whether there is an efficient market or there are various impediments to its proper functioning. When basing a CBA on willingness to pay and markets, it should always be borne in mind that the functioning of a market has an influence on the way in which a measure has an effect. Thinking in terms of markets can make this explicit.

Markets can be defined for all goods and services included in the social-welfare function. In this section we first explain how this works in markets that function well, concentrating on the idea of markets as a framework for thinking about welfare and CBA effects. What we understand by welfare and how that relates to individual preferences is explained in Section 3.2.1. In Section 3.2.2 we take a closer look at the relation between the demand for goods and services, welfare and the consumer surplus. This culminates in Section 3.2.3 in practical instructions for measuring welfare changes: the rule of half. In Section 3.2.4 we examine the role of the government budget balance and company profits in determining the social-welfare effects as additional factors to the consumer surplus.

3.2.1   Preferences, utility and welfare

Individual preferences lie at the heart of welfare economics. These preferences are described using the concept of 'utility'. An individual's utility is the degree to which their preferences are met (the pleasure or satisfaction derived from this situation).[13] In welfare economics an individual's level of utility is equal to their 'welfare'.

Individual utility is influenced by the choices a person makes. These choices concern the allocation of the resources available to the individual for the consumption (or use) of goods and services. These choices are not restricted to the expenditure of financial resources – in many cases income – but also include the use of human capital in the form of time, knowledge, experience and talent. The obvious assumption is that individuals try to maximise their utility by making choices that will deliver them a relatively high level of utility in relation to the resources spent. CBA is a tool for measuring the collective utility of all individuals in a society: 'social welfare'. Social welfare can be represented as the (weighted) sum of the utilities of all the individuals in the society.[14] We call a policy measure *welfare-increasing* if the total social welfare increases, even if this is not the case for every individual.

The changes in the level of utility resulting from a policy measure can be measured as the maximum amount someone is prepared to pay for a positive change in their utility (or the minimum they are prepared to accept in compensation for a negative change in their utility). This is called the *willingness to pay* for the measure concerned. The CBA balance for a measure is the sum of the willingness to pay of all individuals in a society for the changes in utility resulting from the implementation of a measure. This is the welfare economics basis of a CBA. In principle, this can be used to determine whether a measure has, on balance, a beneficial or adverse effect on society. At an intuitive level, a measure increases welfare if the advantages (the increase in the welfare of those people who benefit from it) outweigh the disadvantages (the loss of welfare of those people who are adversely affected by it).

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[13] This is why utility is also seen as a measure of individual 'welfare' or 'happiness'. Chapter 6 of the Macro Economic Outlook 2008 (CPB, 2007) discusses the connections between happiness ('subjective welfare'), welfare and income. Stolwijk (2010, CPB Memorandum 245) contains a discussion of the welfare concept used in policy evaluations.
[14] The social-welfare function is based on a number of principles; see, for example, Rouwendal and Rietveld (2002), Boadway (2006) and Boardman et al. (2006).Berson (1938) and Samuelson (1947) are considered to be the originators of the social-welfare function.

The scope of CBA

A CBA describes the consequences of a measure for the welfare of all the individuals in a society. But who belongs to the society and who does not? Three questions are important in deciding where to draw this line.

- Who makes the decision about the measure? Which tier of government is responsible for the final decision on whether to proceed with a measure or not?
- Who pays for the measure? Which tier of government provides the financial resources for the measure, either in the form of public funds or via regulatory power and political capital?
- Who is affected by the measure? Which individuals are affected, either positively or negatively? Besides the effects of the measure, this also includes the financial aspects.

In an ideal world, the individuals affected by a measure would agree among themselves how the financial aspects should be arranged and 'elect' a government or public authority with the mandate to decide whether to proceed with the measure or not. The answer to the three questions is then the same 'society'. In practice, though, there will be distinct, but layered jurisdictions from local to supranational scales (e.g. neighbourhood and district councils, municipalities, provinces, water boards national government, eurozone, European Union) with varying political mandates for measures that have effects and financial responsibilities that do not always correspond with these jurisdictions.

A CBA at the national level will address the welfare of all the inhabitants of the country. This is not a matter of principle, but the obvious choice for national policies. Another consideration is that many policies and projects are often financed in whole or in part by the national government, which means that all taxpayers in the country contribute. This is a reason for wanting to establish whether the measure will increase total welfare for the country as a whole or not, which requires a CBA at the national level. However, if the effects of a measure are largely regional in scope, it is worth considering whether it would be better to limit the 'society' to the residents of that region. In this case, the measure should also be financed by the region. However, as regional tax revenues tend to be limited, regional measures are often financed by central government and so the CBA should also be national in scope. Regional decisions may be suboptimal from the national standpoint (regulatory competition) and this should be taken into account in regional decision-making.

Restricting the scope of the analysis to the national population means that effects (positive or negative) that do not affect the residents of the country have no effect on the CBA balance. Nevertheless, a CBA could conceivably include welfare effects on foreign citizens, even though they did not count towards the national CBA balance. If such effects are substantial, it would in fact be desirable to include them in the CBA. In an EU context, this would give some insight into the degree to which national policies affect other EU Member States and whether the EU should have an input to the development of the proposed national policy, for example in the form of EU subsidies for national policies if these policies also benefit citizens of other EU Member States.

3.2.2 Willingness to pay and consumer surplus

Individual preferences cannot be measured directly, which means the principle of willingness to pay cannot be applied in a straightforward way to obtain the CBA balance of a policy measure. However, individual choice behaviour (based on individual preferences) does lead to observable outcomes in the demand for goods and services, expressed in the markets for those goods and services in the form of transaction volumes and prices.

The connection between demand and the preferences of individuals is the willingness to pay for the use of goods and services. The greater someone's preference for a certain good or service, the greater their willingness to pay for it will be. If the price someone must pay for a certain good or service is higher than their willingness to pay, that individual will not decide to purchase and consume that good or service. This is because the income the individual would have to relinquish to purchase it is worth more to them than the additional utility gained from the good or service. Only if the price is lower than the willingness to pay will the individual decide to purchase or use the good or service – a decision which is reflected in the demand for that good or service.

There is therefore a connection between the demand for a good or service and the transaction price. This connection is driven by the preferences of individuals and so it provides a vehicle for measuring welfare changes. In general, demand for a good or service rises as the price falls. This is shown in the left-hand graph in Figure 3.1.

Figure 3.1   Willingness to pay for a good or service and the consumer surplus
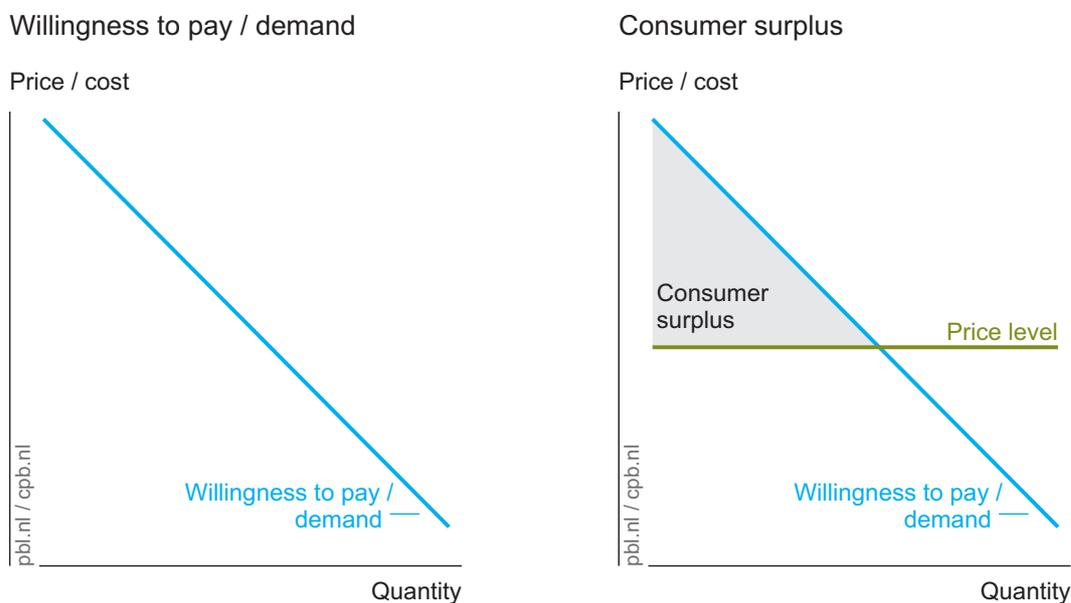
Source: CPB/PBL, 2013

If an individual elects to purchase – and thus exerts demand – the willingness to pay for the purchase of a good or service is at least as high as the price. The difference between the willingness to pay and the price is called the consumer surplus. As the consumer surplus is the balance of the benefits of the purchase (the willingness to pay) and the costs of the purchase (the price), it is a measure of the individual's welfare gain from the purchase. In general, the willingness to pay for the last nit of a product that an individual buys is equal to the price of the product. The willingness to pay for all other units of the product that the individual buys is higher than the price. The sum of the willingness to pay minus the actual price for all purchased units is the consumer surplus, a measure of the welfare gain from the

purchase.[15] The right-hand graph in Figure 3.1 shows the how the demand for a good or service and its price determine the consumer surplus.

Aggregate demand

The individual demand for a good or service can be aggregated to obtain the total demand for a good or service from society as a whole by adding up the demand from every individual at each price. This means adding up the demand from individuals with very different preferences. The total demand for a good or service from society as a whole is called the aggregate demand: the total amount of a good or service all individuals want to purchase or use at a certain price. For most goods and services the aggregate demand also falls as the price rises.

Analogous to individual demand, the aggregate demand reflects the willingness to pay for the purchase or use of different amounts of the product or service, but for society as a whole. The difference between the aggregate willingness to pay and the price is called the aggregate consumer surplus: the welfare gain to society as a whole from the consumption of a certain good.

3.2.3   Calculation of consumer surplus: the rule of half

The welfare effects of a policy measure are caused by the influence the measure has on the choices made by individuals. This influence is manifest in the changes in consumption volumes and changes in attributable costs or market prices for these goods or services. The resulting welfare balance (CBA balance) can be calculated as the sum of the changes in the consumer surpluses in the various markets influenced by the policy measure.

As stated in Section 3.2.1., policy measures can affect markets in different ways, for example by lowering or raising prices, or restricting or expanding supply. Below we discuss a number of possible effects – a reduction in price, an increase in supply, an improvement in the quality of supply and a change in income – and explain how the consumer surplus is calculated.

A reduction in price

Suppose that a measure reduces the price of a good, for example through the provision of a subsidy. This is shown in Figure 3.2 as a reduction in the price of the good from p_0 to p_1, which results in demand rising from q_0 to q_1.

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[15] How the consumer surplus reflects welfare is explained in Chapter 10 of Varian (1992).

Figure 3.2   Change in consumer surplus: the rule of half
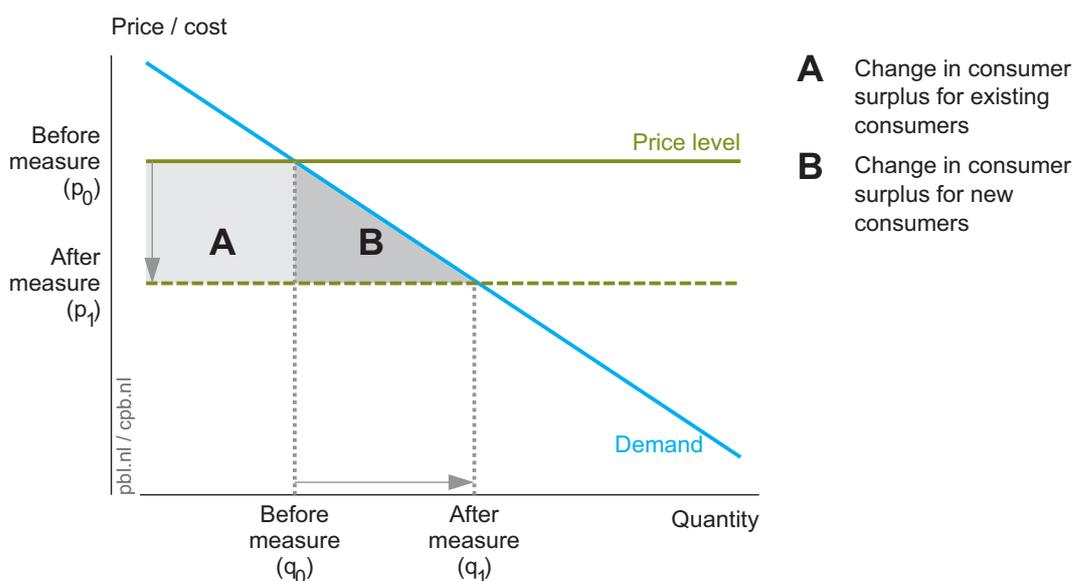
Source: CPB/PBL, 2013

The reduction in price leads to an increase in the consumer surplus equivalent to the areas A and B. Area A is the advantage consumers gain from the lower price for the old level of consumption. However, the reduction in price also leads to an increase in consumption, which adds to the total change in welfare. For the first additional unit consumed the consumer surplus is almost equal to the price reduction for the old level of consumption. For the last addition unit consumed the surplus is almost nil. Between these two points the decrease in willingness to pay is often assumed to follow a straight line, as shown in Figure 3.3.[16] Triangle B is therefore the gain in welfare. The shaded area B can be calculated using the following formula:

$$(p_0 - p_1)q_0 + \tfrac{1}{2}(p_0 - p_1)(q_1 - q_0) = \tfrac{1}{2}(p_0 - p_1)(q_1 + q_0)$$

The last expression is referred to as the 'rule of half' and it is the standard formula for calculating the welfare benefits of measures.[17] The expression represents the change in consumer surplus and thus the welfare effect of the measure for the consumer. The rule of half shows that to calculate this it is only necessary to know the volumes and prices in all the relevant markets and how these change as a result of the measure.

An increase in supply

The second example is a market for services generated by a forest, which provides ecosystem services.[18] Visitors to the forest consume these services and exhibit a certain

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[16] The demand function is not always a linear relation between price and quantity. See Besseling and Van 't Riet (2009, CPB Discussion Paper 130) and Van 't Riet (2011, CPB Discussion Paper 199) for a discussion of the problems that arise when a linear demand function is not realistic.

[17] If the described market has no further imperfections, the subsidy generates a welfare gain for consumers in areas A and B (rule of half). The cost incurred by the government is $q_1(p_0-p_1)$. In this case, netting out the consumer gain against the government loss leads – if the market is efficient – to a social loss from the subsidy of $\tfrac{1}{2}(q_1-q_0)(p_0-p_1)$.

[18] Under ecosystem services we mean things such as recreational value. However, a forest provides other services as well, such as timber production, water management, removal of particulate matter and CO_2 sequestration. If we extend these services to include the services provided by nature, all these services are what is meant by 'ecosystem services'.

willingness to pay for them. The visitors do not to pay to enter the forest – access is free to everyone – but there are costs in the form of the time taken to travel to the forest. These costs increase as the number of visitors increases (more time spent in busy traffic or traffic queues and walking further from the car park). Moreover, increasing visitor pressure reduces the quality of the ecosystem services. To obtain the same utility from a trip to the forest, visitors must therefore incur higher costs, for example by staying longer in the forest. This is shown in the curved visitor costs lines in Figure 3.3.[19]

Figure 3.3   Change in consumer surplus as supply increases
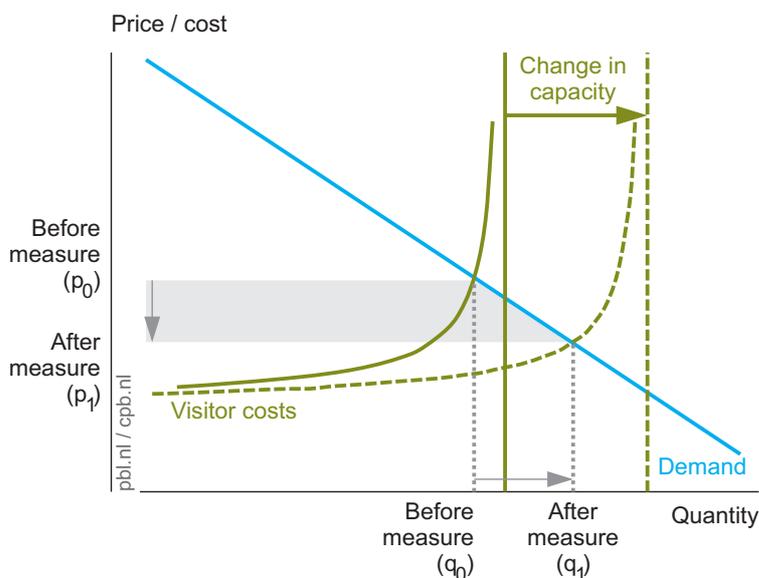
Source: CPB/PBL, 2013

A nature conservation measure will increase the size of the forest and/or improve the quality of the forest ecosystem, enabling the forest to generate more ecosystem services. Figure 3.3 shows the resulting welfare effects (with the exception of the effects on other markets). As the capacity of the forest to generate ecosystem services increases, the costs to visitors decrease (the quality of the forest and ecosystem services increases). The amount of services consumed rises from q_0 to q_1 and the costs to visitors fall from p_0 to p_1. The shaded area is the resulting welfare gain (additional consumer surplus) and it can be calculated using the rule of half.

An increase in the supply of social care or education services can be analysed in a similar manner. In these cases, though, the specific circumstances in which these markets operate must be reflected in the changes in demand, the costs to the user and the supply. Additional factors to be taken into account are market failure and the effects of government interventions, such as taxes, subsidies and regulatory price or supply constraints.

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[19] This visitor costs method takes no account of the existence value of nature. This existence value of nature can also be included in a CBA. See Chapter 7.

An improvement in the quality of supply

Policies for social care and education often seek to improve the quality of services on offer (better treatments, smaller class sizes). This can be seen as an increase in quality-adjusted supply. The measure can then be analysed in the same way as in the previous examples.

However, there is not always a readily available measure of quality-adjusted supply. In such cases an alternative is to take a simpler supply standard (number of lesson hours, number of treatments). The improved quality per lesson hour or treatment is then expressed as a higher willingness to pay per unit. In Figure 3.3 this would be represented by a shift in the demand curve towards the top right if demand remains the same.

Change in income

A measure that changes people's incomes also affects the choices available to them, and so it has an effect on welfare. In principle, these welfare effects could also be estimated from the changes in consumer surpluses, but this is not practical because a change in income leads to a change in consumer surplus in all markets, which means the effects in all markets would have to be measured. However, this problem can easily be circumvented. The willingness to pay for a change in income is exactly equal to the change in income: the willingness to pay to prevent a 10 euro loss in income is 10 euros. The welfare effect of a change in income is therefore equal to the change in income.

3.2.4   Producers and government in CBA

We have seen above how the rate of return of a measure can be determined from changes in consumer surplus in the relevant markets. Besides consumers ('families' or 'natural persons') an economy also consists of businesses and government and these parties also exert a demand for products and services. Policy measures can therefore have an effect on the costs to businesses and/or government and on company profits and/or the government budget balance – but producers and government play no part in the social-welfare function on which CBA is based. In this section we describe the situations in which changes in the producer surplus and in the budget balance *can* be included in a CBA.

Income, profit and budget balance

Company profits provide income for consumers (who are ultimately the owners of the companies). Budget deficits and surpluses are also reflected in family incomes via higher or lower taxes (or changes in other transfer payments, such as subsidies and benefits). Changes in profits and in the budget balance therefore have consequences for family incomes. As we have seen in Section 3.2.3., changes in individuals' incomes are direct welfare effects and so there is no need to determine the changes in consumer surplus. In practice, when calculating welfare effects the changes in producer surplus and the budget balance are identifiable as separate categories.

In many cases the producer surplus is not really relevant because there is a state of healthy competition (between existing competitors or because new suppliers can easily enter the market) which keeps the 'profit' at a normal level of recompense for labour and the capital of

the owners.[20] In specific cases there may be a producer surplus, for example when there are decreasing returns to scale, restrictions on supply or monopoly profits.[21] Finally, public services and publicly financed services often operate at a loss, including services such as public transport, public broadcasters, schools, health and social care providers, theatres and theatre companies. The companies that provide these services can only continue to do so because they receive government subsidies. In such cases a measure will not only have an effect on the consumer surplus but also on the producer surplus.

Intermediate goods and cost advantages and disadvantages to companies

The demand for a good or service can also come from a producer or the government (as producer of public goods and services) in the form of an input to the production process. As the production of goods and services is based on consumers' willingness to pay for the goods and services produced, the demand for inputs to the production of goods and services can be traced back to consumers' demand for and willingness to pay for the goods and services produced using those inputs. The welfare effect of a measure aimed at an intermediate good can be determined by examining the changes in consumer surpluses in all markets in which the intermediate good can be found. Under the influence of competition, the producer's cost advantage is eventually passed on to the consumer and leads to an increase in consumer surplus. It is not always easy to calculate these effects on consumer surplus because many different markets may be involved. In such cases the initial cost advantage to the producer can be used as a measure of the eventual increase in consumer surplus. If the producer increases production as a result of a cost advantage and this increases his demand for the intermediate good, the advantage can be calculated again using the rule of half.

Although the use of cost advantages and disadvantages to calculate welfare effects appears to be very similar to calculating a change in the producer surplus, in this case it is simply a form of measurement. If the markets are assumed to be efficient there will not be an actual producer surplus.[22]

Oranges and orange juice

There is a demand for oranges from consumers and from the producers of orange juice. The welfare effect of a measure that affects the price of oranges (for example, an import restriction) can be determined by adding up the effect on the consumer surplus in the market for oranges and the effect on the consumer surplus in the market for orange juice. However, the latter effect can be calculated directly from the cost advantage or disadvantage to the producers of orange juice. The advantage of this is that only the market for oranges has to be analysed.

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[20] If a producer makes a profit after subtracting the normal capital costs, this is called 'excess profit' or 'super-normal profit': a welfare gain for the producer, also referred to as the producer surplus. The producer surplus is eventually returned as income to the individuals who own the producer.
[21] In many markets there is some degree of monopolistic competition via product differentiation. Businesses try to gain an advantage over the competition and win customers through innovation and unique product positioning. Product differentiation leads to a certain degree of monopoly power for businesses that are successful at it. However, these businesses do not enjoy a monopoly profit because they must pay the costs of producing and marketing their differentiated product variant.
[22] If cost advantages and disadvantages are not passed on to consumers, or only partly passed on, for example due to a monopoly power, there will be effects on the producer surplus. As we have seen, these also have to be included in the calculation of welfare gain. It therefore does not matter whether the cost advantages or disadvantages are passed on in full or in part to consumers; the entire cost advantage or disadvantage is the welfare gain.

This approach using the cost advantages and disadvantages to producers is also used for less tangible or marketable services, such as ecosystem services (see footnote 18). For example, as ecosystem services can influence agricultural production, the welfare effects obtained from the use of the ecosystem could be determined by measuring the change in consumer surplus on the consumer markets for agricultural products. However, with efficient markets for agricultural products, the same welfare gain can be measured by examining the cost advantages or disadvantages to the agricultural sector itself. This is often more practical.

3.3   Market failure

The description of the welfare economics foundations of CBA in Section 3.2 was based on the assumption of efficient markets. If there are efficient markets for all goods and services that are valued by individuals, market forces will ensure that welfare is maximised. Prices will reflect all costs society must make to produce a good or service, and individual choices will reflect individual preferences. Goods and services will only be purchased or used if the willingness to pay is higher than the social costs. A CBA can then be based on market outcomes (see Sections 3.2.3 and 3.2.4). Moreover, there will be no need for the government to prepare and implement policies to make the economy more efficient, because it already works perfectly well without government intervention.

However, not all markets work efficiently. This is called market failure, a situation in which market forces alone do not act to maximise total social welfare. Market failure can take on various forms, the most important being externalities, market or monopoly power, and problems of access to information. These different types of market failure are explained in the text box 'Types of market failure'.

Combating the negative welfare effects of market failure is a reason for government to intervene in the operation of the market. If it is possible to draw up policies to combat the negative welfare effects of market failure, consideration can be given to adopting and implementing these policies. However, these policies must not unduly distort the workings of the market in other ways. If they do, the cure will, in effect, be worse than the disease, a situation referred to as government failure.[23] To make an economic case for government intervention, therefore, it is necessary to state what form of market failure the government is trying to rectify. A CBA can reveal the effects that elude market forces in order to assess whether government intervention can rectify the market failure, and if so to what degree, and what new problems may be introduced by the government intervention. The CBA balance will encompass both the advantages of combating market failure and the disadvantages of government failure. This is a specific application of CBA.

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[23] Identifying market failure and welfare-generating solutions in which government failure presents little problem can be seen as the core welfare-economic challenge of the problem analysis (see Chapter 2).

Types of market failure (a)

Externalities

An externality occurs when one party's actions impose uncompensated benefits or costs on another party. For example, when production causes environmental pollution that is not compensated for by the producer.

Externalities often relate to so-called non-excludable and non-rival goods and services. Orange sellers may decide not to sell any oragnes to consumers, for example, when they consider the price offered to be too low. They cannot do so, however, in cases of non-excludable goods, which (without government intervention) prevents the supply by market parties. Oranges are also a rivalrous good; once eaten by one consumer, an orange cannot be eaten by another. In contrast, consumption of non-rival goods and services do not prevent their consumption by others. Some examples are provided in the table below. Although clear distinctions cannot always be made, for CBAs it is important to think about the nature of an externality.

Rivalry and excludability: classification of goods and services

	Rivalrous goods and services	Non-rival goods and services
Excludable goods and services	Market goods and services All priced goods and services	Club goods and services - Internet, mobile communication - Banking and insurance services
Non-excludable goods and services	goods and services for general social use - Natural resources without clear ownership rights, such as fishing grounds and nature areas (*commons*) - Many public services have this legal status, such as roads infrastructure, and parts of the educational and health care systems - Transport infrastructure and the human environment - Radiospectrum	Public goods and services - National defence (defence) - Rule of law (judiciary) - Public safety (police) - Water safety (delta works) - Fundamental scientific research - Clean air / clean surface waters, etc.(safe human environment)

Market or monopoly power

A company is said to exercise market or monopoly power if it keeps its production level deliberately low in order to drive up the price. This does not occur in a competitve market, as competition always drives prices down to cost level. However, under certain market circumstances, an artificially low production level may occur. For example, when economies of scale give one producer the advantage of being able to eliminate others on the market. In such cases, the government may decide to allow the monopoly, while regulating the prices. In addition, there are cases of market or monopoly power in a basically competitive market when companies form a cartel. And then there are situations in which a certain degree of market power could be desirable, in order to enable the production of public goods, such as innovation patents. Finally, the government itself could create a monolopy.

Problems regarding information

Market failure may result from problems to do with information. If good information about the quality of a product or the availability of a substitute is not available, or if the available information cannot be processed properly because this would take too much time or be to complex, people make choices that may not perfectly suit their preference. There may also be a certain asymmetry in the information that is available on a product, when its seller knows more about the quality than the purchaser and, therefore, paints a picture that is too rosy. In many cases, problems related to information can be reduced to acceptable levels when markets regulate their own information supply; for example, through advertisements, or via consumer organisations. In other cases it may be appropriate for the government to, for example, set legal quality standards and general conditions that protect consumer rights.

(a) This text box is partly base on Circular A-4 of the United States' Office of Management and Budget.

In this section, we explore what market failure is and how it can be dealt with in a CBA. We concentrate on externalities and introduce the concept of the 'missing market'. Public goods fall within the externalities category of market failure described in the text box. They are goods or services from which people cannot be excluded and their consumption has no consequences for others.

Missing markets are markets in which there is no market price. They are found mainly for non-excludable goods and services, but this does not prevent there being a demand for such goods or services. If the government intervenes in a missing market, for example by increasing the supply, there will be non-priced welfare effects, in contrast to priced effects on actual markets. An example is a market for clean air. This market does not exist (you cannot buy an ounce of clean air in the supermarket), but there is a willingness to pay to keep the air clean and policy measures can have effects on air quality. It is therefore possible to identify supply and demand in this non-existent market, which in turn provides a basis on which to find ways of valuing effects on such markets for use in CBA.

In Section 3.3.1 we look at the relation between externalities (including public goods) and missing markets. We show that welfare effects in missing markets can, in principle, be identified and measured in the same way as in normal markets. However, market outcomes (prices and transaction volumes) in a missing market cannot be observed, which means it is often much more difficult to obtain a clear picture of the effects of any measures taken on the supply side of such markets and on the willingness to pay. In Section 3.3.2 we describe how the effects of measures in a missing market can be determined.

3.3.1   Non-excludable goods and services and missing markets

Externalities are an important cause of market failure. An externality is when an individual economic agent's consumption or production has consequences for third parties that are not reflected in the price. Externalities result in inefficiencies if people do not take the consequences of their behaviour for others into account in their decisions.

For a long time, economists thought that externalities could only be managed through government intervention, such as subsidising behaviour that generates beneficial externalities or taxing behaviour that generates adverse externalities. However, Coase (1960) pointed out that a socially desirable allocation of resources can be achieved even in the presence of externalities through a process of free bargaining among market participants. To ensure that the market can bring about the socially desirable allocation of resources, it is necessary for the government to establish without doubt the initial allocation of property rights.

Internalising externalities does not therefore always require government intervention; the market can sometimes be relied on to do the job. What Coase meant by bargaining, however, is only feasible if the transaction costs of this bargaining are not too high, because otherwise it will not happen. Teulings et al. (2005) stated that when externalities cannot be

internalised via free bargaining between market participants, they can be considered to be complex externalities. Thus, complex externalities lead to a missing market.[24]

This also applies, for example, to public goods, which, by their very nature, are provided by government. For these goods there is no market information on households' willingness to pay, because there are no actual prices. How the benefits of policy measures can be calculated in missing markets is illustrated by the following examples. The environmentally polluting production mentioned in the 'Types of market failure' text box is an example of a negative externality of production. Because the people adversely affected by the environmental pollution are not compensated by the producer, the price of the product does not reflect the full costs of production. This situation is illustrated in Figure 3.4. At a market price p_0 the number of units of the product sold is q_0. Because this price is lower than the economic and social costs (p^*), more units are sold than the socially optimum level of consumption (q^*). There is thus an additional consumer surplus of $\frac{1}{2}(p^*-p_0)(q^*+q_0)$, but this comes at the cost of environmental damage amounting to $(p^*-p_0)q_0$. The associated welfare loss is the shaded triangle to the right (equal to $\frac{1}{2}(p^*-p_0)(q_0-q^*)$).

Figure 3.4   Welfare loss resulting from a negative production externality

Source: CPB/PBL, 2013

A measure that has the effect of increasing production leads to a welfare gain in the market for the product, but this is accompanied by non-priced environmental pollution. Both effects must be accounted for in a CBA. To put a value on non-priced effects, a non-existing market is simulated from which a shadow price can be derived for the adverse impact on those

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[24] In 2012 the Netherlands Council for Public Administration published an essay on the relation between government, market and society. From an economic perspective, the essence of the argument is that because market failure and government failure occur simultaneously, formal or informal civil society organisations have a part to play, and that their role becomes more important as the trust in the market and in government decreases. The Netherlands Scientific Council for Government Policy (2012) has also analysed the relations between the market, government and society from a not exclusively economic perspective. How should the public interest be defined? What are the responsibilities of government? What should be left to market participants? And what is up to society?

affected by the externality. The additional pollution affects the provision of environmental services, which leads to a loss of welfare in the market for environmental services.[25]

Another example is home maintenance. Home owners pay to maintain their home and benefit by having a better home as a result. Moreover, a well-maintained home improves the general appearance of the street, which also benefits the neighbours. This is a positive consumption externality and it is illustrated in Figure 3.5. If the neighbours pay some of the maintenance costs in proportion to the amount they benefit (p_0-p^*) the cost to the home owner is p^* and the demand for maintenance is q^*. If the neighbours do not contribute to the costs, the cost to the owner is equal to the market price p_0 and restricts his demand for maintenance to q_0. The resulting welfare loss is the shaded triangle. This loss occurs because when the home owner decides how much maintenance work to carry out he does not consider the effects on the neighbourhood.

Figure 3.5   Welfare loss resulting from a positive consumption externality
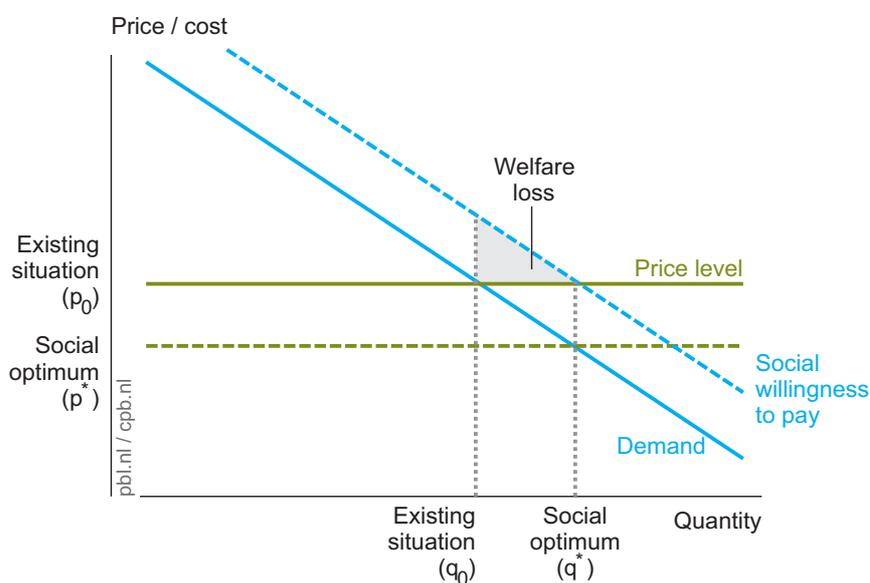
Source: CPB/PBL, 2013

A CBA of a measure to promote home maintenance must not only take account of the benefits to the owner, but also the benefits to the neighbourhood. The benefits to the neighbours can be seen as the neighbours' willingness to pay for the wider improvements in the overall quality of the neighbourhood. The externality in the market for home maintenance can be considered to be an impact on the market for the wider improvements in the overall quality of the neighbourhood. This market, too, is a missing market.

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[25] Here we have reduced environmental pollution to a reduction in supply on the market for environmental services. Figure 3.5 shows that the demand for environmental services takes the same form as the demand for many market goods. The willingness to pay falls as the number of environmental services increases (as environmental quality increases). It is assumed that the supply of goods and services is not subject to costs for environmental services, but that these are limited to a certain maximum. Instead of a market for environmental services (a 'good'), in this example it is possible to work with a market for reducing environmental damage (a 'bad'). The willingness to pay for reducing the damage increases as the level of damage increases.

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In the examples of environmentally polluting production and home maintenance, the measures are directed at existing markets with knock-on non-priced effects or externalities in missing markets. However, a measure may also be directed at a non-existent market, an example being the improvement in the quality of the forest in Section 3.2.3.[26]

To analyse the welfare gains or losses resulting from non-priced effects we simulate the non-existent markets for these effects. In our examples these are the markets for environmental services and for the wider effects of home maintenance on the general quality of the neighbourhood. These are missing markets, but their effects have just as much of an impact on social welfare as the effects on existing markets.[27] This underlines the analogy with existing markets. The examples clearly show that some missing markets are more elusive than others and not as easy to define in concrete terms for analysis. It is up to the compiler of a CBA to determine the nature of the non-priced effects or externalities and state on what basis the willingness to pay for preventing or promoting the effects – and thus any welfare effects – can be calculated. Identifying missing markets provides a vehicle for valuing the effects that occur in those markets, which is the subject of the next section.

3.3.2   The valuation of non-priced effects

In the previous section we saw that we can, in theory, simulate a missing market for non-priced effects. This gives us a framework for valuing non-priced effects. The first thing we need is information about the scale of the effects, information which in practice will not always be available.

To determine the willingness to pay for non-priced effects we need to know the demand for services on these markets. There are various methods for doing this which measure the willingness to pay from revealed preferences or stated preferences. These methods are based on consumer willingness to pay.

Revealed preference

Methods based on consumers' preferences use observed market behaviour in an existing market as an indication of willingness to pay in a missing market. Of course, there must be a relation between the existing and the missing market. Examples are hedonic price analysis and the travel cost method. We discuss these methods in more detail in Chapter 7.

The main advantage of hedonic price analysis and the travel cost method is that they are based on choice behaviour. An important disadvantage is that the information provided by the methods becomes less useful when a characteristic has less influence on the market decisions being analysed (buying a house, accepting a job, deciding on a journey, etc.) or cannot easily be distinguished from other characteristics. There is also a danger that only part of the non-priced effects will be valued, leaving the non-use value unaccounted for.

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[26] Because visitors to the forest experience the visitor costs themselves and respond to them, this is not an externality but a non-monetary effect. Visitor costs are not actually costs in the form of a money payment for entry, but costs in the form of time and effort. The visitor 'internalises' these costs not via income, but via time and effort.
[27] The addition of missing markets is based on the broad concept of welfare in which people do not obtain welfare only from the consumption of goods and services for which there are market prices. In the literature missing markets are also referred to by the term 'non-market goods'.

Stated preference

The second group of methods for valuing the costs of negative externalities are not based on actual market behaviour, but on answers to questions about the expected market behaviour of individuals under hypothetical conditions. This group of methods includes contingent valuation and conjoint analysis. Contingent valuation is a survey-based technique in which respondents are asked to assign a value to an externality. Conjoint analysis is a survey method that tries to avoid direct valuation of externalities by presenting respondents with a number of combinations of the externality and other non-monetary variables, such as free time and accident risks. The monetary value of the externality is then determined from the stated preferences of the respondents and the linkage between some of the non-monetary variables and monetary values. Non-use values can be measured using these methods.

Sometimes neither the stated preference nor the revealed preference method can be used. In such cases negative externalities (nuisance) can be valued using estimates of avoidance costs, often abandoning the principle of willingness to pay altogether. Avoidance costs are the costs of measures that have to be taken to avoid or counter the effect; in most cases they bear little or no relation to consumer willingness to pay. Avoidance costs are not always good estimates of the value of effects and are not suitable for calculating benefits.

3.4   Defining the relevant markets

In the previous sections, we have established that the welfare effects of a policy option can be determined by looking at changes in consumer and producer surpluses in markets, whether they are efficient or not. As markets are connected, an impact on one market will have knock-on effects in other markets, which means that a policy measure will eventually have an impact on all (existing and missing) markets in an economy.

A CBA values all the effects of a measure by taking account of the welfare consequences in all existing or missing markets, without duplication.

However, it is not practical to investigate the consequences of an intervention for all the markets in an economy. That would require a general equilibrium analysis, which is often simply not feasible. Besides, unless a measure is so radical that it drastically alters the whole structure of the economy, it is not necessary to ascertain all the consequences of the measure. In many of the markets the measure will have negligible welfare consequences and these can safely be left out of consideration in a CBA. It is therefore important to define the relevant markets and focus the study on those markets.[28]

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[28] This is not a free choice, it is an objective judgement on what is relevant and what is not relevant, although there are no fixed criteria for determining what is or is not important. The CBA compiler must make a professional decision in the interests of preparing the most objective possible CBA, and must also justify those choices (see Section 3.4.4).

How can we do this? First, the primary effects of the measure must be identified and described, and then used to identify any additional effects. In the next two sections (3.4.1 and 3.4.2) we discuss two ways of identifying the primary effects. Section 3.4.1 is about the business case. Section 3.4.2 goes into the distinction between direct and indirect effects. In this section we also explain how this distinction can help with the identification of the relevant markets and prevent double counting of effects. How markets are identified and defined makes no difference for the welfare return on a measure; the main objective is to provide a starting point for the analysis and comprehensible categories for the outcomes. In Section 3.4.3 we take a separate look at the labour market, because this is central to the economy and is often the reason for government intervention in the first place, and because policy-makers and politicians attach great importance to this market. In Section 3.4.4 we turn to the role of the CBA researcher. Identifying and defining markets is not an exact science and the judgment of the CBA researcher on the nature of the issue at hand is crucial.

3.4.1   Private-sector profitability

In some cases there will be a business case (profitability analysis) available and this is often a useful starting point for a CBA. If there is no business case and it is reasonable to expect that one can be drawn up, the compiler of the CBA should ask for a detailed business case.[29] This will ensure that at least some of the research costs will be borne by the private party enjoying the benefits (or avoiding the costs) as a result of the measure. A business case is often much simpler than a CBA. If it shows that the private profitability is high enough (and if any negative externalities are not too large), a government contribution will not be needed (and a CBA will therefore be unnecessary. Only if a government contribution is required in order to raise the private-sector returns to the level required on the markets, will a CBA be needed to assess whether the government contribution is justified in the public interest.[30]

The business case therefore gives an impression of the private effects of a measure – but only an impression: in many cases the business case will not have been presented in comparison with a (correct) baseline alternative or will not contain a set of relevant policy alternatives. Business cases therefore have to be adapted in a number of ways to make them suitable for use in a CBA. An expert in CBA will be able to use the business case to identify which other non-priced effects may be expected to occur. In various policy fields (including social and health care) use is made of social business cases, in which the private costs and benefits of a measure for a charitable or public-welfare institution are set against the extent to which these costs and benefits influence the contribution they make towards their social objectives.

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[29] In various policy fields (including health care) use is made of 'social business cases', in which the private costs and benefits of a measure to a charitable or public-welfare institution are set against the extent to which this influences the contribution they make towards their social objectives.
[30] More information about business cases and their use in evaluating the role of government can be found in Wortelboer-Van Donselaar and Lijesen (2008) and Wortelboer-Van Donselaar et al. (2009).

3.4.2 Direct and indirect effects

Another way to define the scope of the effects is from the nature of the measure. In this method a distinction is made between the direct effects in the markets directly affected by the measure and indirect effects in all other markets. Like the distinction between private and non-market effects, this has no welfare economics significance, but helps to define the relevant markets and prevent double counting of effects.[31]

Direct effects

Effects in the market where the intervention is made are called direct effects. If this is a missing market, the result will be non-priced direct effects. Defining the market in which the direct effects occur can be done with reference to the problem analysis for the measure. However, defining the market is not always a simple task because various goods and services will to some extent be substitutes for or complementary to each other.

How direct effects should be defined depends on the sort of measure involved. An investment in a house building project is different from a measure relating to mortgage interest relief.

Externalities

When defining the relevant markets a distinction must be made between direct effects and indirect effects. In practice, however, we also encounter externalities. Infrastructure developments are a good example of this. In this policy field it is standard practice to include effects such as air quality impacts under externalities. However, when evaluating policy measures for improving air quality the same effects are of course counted as direct effects. Both direct and indirect effects can be non-priced (occur in a missing market), making them externalities – but this is not significant for the definition of the relevant markets. This means that identifying externalities in addition to direct and indirect effects is of no use in a general CBA guidance, because a CBA only distinguishes between direct and indirect effects. The CBA of a transport project will therefore categorise an air quality impact as a non-priced direct effect.

Indirect effects

Direct effects have secondary impacts in all other markets in the economy. These impacts are called indirect effects. Defining the relevant markets for the CBA boils down to making a distinction between indirect effects that are relevant to the analysis and need to be included in it and indirect effects that are not relevant.

Relevant indirect effects always include secondary impacts in markets with significant consequences for welfare. This is the case if an indirect effect is substantial and occurs in a market in which market failure exists. Such indirect effects may then have additional welfare effects because they will exacerbate or ameliorate existing market inefficiencies. These are called additional indirect effects. Additional indirect effects are always relevant for CBA and should therefore always be included in the analysis. Indirect effects that occur in reasonably

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[31] Dividing effects into direct and indirect effects is a good starting point for a social cost–benefit analysis. It gives information on where effects occur and where they can have secondary impacts. When defining markets it may help to make use of microeconomic consumer choice models. Riet (2013), for example, does this for the market for child care services. Developing such a model with a closed accounting system will not only prevent effects being overlooked or double counted, but also reveal the effects on different groups, the effects in the market where the main intervention is made and the indirect effects in other markets.

efficient markets have no additional influence on welfare, because in an efficient market consumer willingness to pay for a (small) increase in supply is equal to the extra costs to the producer of making this increase. The example of 'The tale of the peanut butter factory' (see text box) shows that in efficient markets indirect effects cannot be added up with the direct effects, because this results in double counting. Such indirect effects are called transferred indirect effects.

Transferred indirect effects have no consequences for the CBA balance and can therefore be ignored. However, there are two reasons for bringing transferred indirect effects to light. First, they lead to a redistribution of direct welfare gains. If one or more indirect effects are of an appreciable size they can certainly influence the distribution of welfare gains and losses between different groups. This can be a reason to make such effects visible in the CBA. In addition, transferred indirect effects can also be revealed if they occur in markets where the initiators of a measure want to make a big impact. All other markets can be ignored for the purposes of the analysis because any indirect effects are small and/or the CBA compiler assumes that these markets all function efficiently enough to prevent indirect effects generating any additional welfare effects.

Finally, the definition of markets must not be confused with the determination of willingness to pay for non-priced effects. It may be necessary to derive this willingness to pay from the indirect effects on other markets. An example would be if the valuation of the renovation of a park is calculated from the increase in house prices in the surrounding area, or if the valuation of improvements to the quality of educational and training courses is calculated from the expected future increases in the salaries of the students taking the courses. The impacts on house prices and salaries are transferred indirect effects resulting from the direct effects on the markets for education/training and parks. Whereas the direct effects are non-priced, the indirect effects are priced and so they can be used, to a certain extent, to value the direct effects (see Chapter 7 where we discuss these types of valuation techniques). It should be borne in mind though that this is not about two distinct effects, but the valuation of a non-priced effect via a priced transferred indirect effect. The priced indirect effect must not be added up with the non-priced direct effect.

Intended effects and side effects
Besides direct and indirect effects, distinguishing between intended effects and side effects can also be of help when defining the relevant markets. Intended effects are effects that contribute to achieving the policy objectives. They follow from the problem analysis, the policy alternatives to be investigated and the baseline alternative (the preliminary phase of the CBA; see Chapter 5). However, there will also be side effects: unintended negative or positive effects. These side effects may occur in existing markets (priced effects) or in missing markets (non-priced effects) and they may be direct or indirect. Side effects should also be considered when defining the relevant markets.

In practice, the intended effects will be related to the main policy goal or the core topic of the problem analysis. Mostly, but not always, these effects occur in the markets where the intervention is made. They receive the most attention and are the most precisely quantified, and considerable care is given to the way in which they are valued. Side effects are less precisely quantified and their valuation is often based on index numbers, under the assumption that they are relatively unimportant – although this is not always the case and their importance should be determined on the basis of the analysis.

Distinguishing between direct and indirect effects is the main method for defining the relevant markets. Looking at the intended effects and side effects as well provides an extra check to ensure that no relevant effects have been overlooked. Determining the direct effects involves answering the question 'In which market are we intervening?' Determining the intended effects involves answering the question 'Which markets do we want to influence

through the intervention?' In both cases the next question – with respect to indirect and side effects – is 'In which other markets can we expect relevant effects? Direct effects may be intended, but not necessarily so. The same goes for indirect effects. Intended effects and side effects can be both direct and indirect.

3.4.3   Labour market effects

The labour market is extremely important for economic development. For decision-makers and politicians creating jobs and removing obstacles to employment growth are therefore important aspects in almost all policy measures. This means that labour market effects should almost always be clearly stated in CBAs.

Direct labour market effects

Measures aimed at the operation of the labour market (such as reducing the tax 'wedge' between labour costs and net take-home pay, the size of benefit payments, and reducing protection against dismissal) and increasing labour productivity (training) or the labour supply (immigration policy, employment measures) have a direct effect on the labour market. Such labour market measures lower the equilibrium unemployment so that at a given labour supply more people actually have a job. Productivity rises as a result, because employees are on average unemployed for a shorter period. Measures aimed at labour productivity have similar effects. An increase in labour productivity is a welfare gain.

An increase in labour productivity has another effect too; it makes paid employment more attractive, with consequences for the labour supply, because higher labour productivity is reflected in higher wages. This means that when people weigh up the pros and cons of time spent in paid work versus free time they are encouraged to devote more time to paid work,[32] because the higher wages mean the monetary rewards are greater. In other words, leisure becomes more expensive. However, this extra labour supply does not lead to extra welfare, because the additional time spent on work and the wages it generates is balanced by a loss of leisure. At the margin there is no net welfare gain for the employee because welfare has already been maximised and so the additional wages and the loss of leisure are equal in value. However, decisions to work more are influenced by the value of the net wages earned. Employees do not consider the fact that as a result of their decision the government receives more taxes and social security contributions (the tax 'wedge' between gross labour costs and net pay). This amount is the welfare gain. Income tax introduces a market imperfection and the external effect of this, government tax revenues, are welfare effects.

A similar line of reasoning applies to measures aimed at increasing the labour supply, for example by raising the costs of not working (benefit levels, childcare subsidies) or raising the benefits of working (productivity gains from training or improved health, for example). The resulting increase in the labour supply is at the expense of leisure. The welfare gain from the additional production must be set off against the value of the leisure that has been lost.

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[32] This may be a decision to start work or not (participation decision or extensive margin) or a decision to work more or less (intensive margin).

Indirect labour market effects

Measures that are not directed at the functioning of the labour market, raising labour productivity or raising the labour supply, have only indirect effects on the labour market. In most cases there is a shift in the labour market. Additional employment created in a certain area or sector of the economy as a result of the measure will be at the expense of employment elsewhere, not because economic activity shifts, but because the labour supply shifts. There will only be a welfare gain if measures have an effect on labour productivity, for example when there are agglomeration benefits (see Chapter 8).

This means that the labour market effects of non-labour market related measures generally have no effect on employment at the national scale. The only exceptions are situations involving involuntary unemployment (see below).

Involuntary unemployment

The above discussion is based on the assumption that the labour market works efficiently, with the exception of wage taxes. In such a market the difference between the actual level of employment and full employment is due to individual choices to work part-time or not to work at all, and to the natural friction in the labour market caused by the heterogeneity of jobs and workers, which means it takes time to change jobs or for employers to find suitable workers. In an imperfect labour market there will be involuntary unemployment in addition to that caused by natural friction. Labour market measures can then considerably increase the level of welfare because the value of leisure to the involuntarily unemployed is equal to the wages they could earn. If there is cyclical unemployment, each measure that increases the demand for labour can generate (temporary) welfare gains in the labour market.

3.4.4 The judgment of the CBA compiler

When defining the markets relevant to the analysis we abandon the fixed contours of the welfare economy and enter a territory where the CBA compiler plays a leading role in deciding what is and what is not relevant for drawing up a good CBA. A good CBA is not simply a case of properly applying the principles of welfare economics. A good CBA uses these welfare economics principles to obtain the best possible answer to the policy questions at hand. This begins by asking what the problem actually is and what policy responses could help to solve that problem. Decisions then need to be made about which policy alternatives and baseline alternative to choose. To carry out a meaningful CBA, markets for direct and indirect effects must be defined so that the main effects of the measures are clearly revealed (and are not lost in a sea of unimportant or largely irrelevant indeterminable or unquantifiable items). Finally, a good CBA depends on the right choices for revealing the most important sensitivities and uncertainties.

For all these decisions, the principles of welfare economics provide few answers. The list of possible options is endless and inexperienced CBA compilers or those not schooled in the policy field in question can easily lose their way. The danger is that a CBA that is perfectly sound from a welfare economics point of view will still give an unsuitable answer to the – possibly incorrect – question. Policy measures are made in response to a particular problem

and are embedded within a certain political context shaped by what has already been decided, what has yet to be decided and the financial parameters. A CBA cannot be seen in isolation from this context. CBA compilers can only make a good analysis if they have sufficient knowledge of the context and possess the capacity to ask critical questions about baseline assumptions. This aspect of CBA is particularly important if it is to be used successfully in policy fields in which little experience with the use of CBA has been gained, and it is what distinguishes good CBAs from less successful ones. Moreover, a CBA places high demands on the research and the researcher. Zerbe et al. (2010) note that CBA is an art as well as a science; it requires creativity, experience and objectivity from the authors. They must evaluate the options and base their choices and decisions on their knowledge and experience. In this capacity, the CBA compiler is more of a professional than a scholar, and this role goes much further than just defining the relevant markets. At various places in this guidance document we delve deeper into this role of the CBA compiler.

> **Individual preferences and the existence of species**
>
> With regard to nature, some critics of the use of individual preferences as a basis for decision-making argue that animal and plant species have 'intrinsic rights', which sets them apart from any analysis based on human preferences (unless people are assumed to takes these rights into account when expressing their personal preferences). For this reason they consider the use of a CBA to support decision-making that involves valuing nature to be unacceptable.
>
> Others believe that individuals are poorly informed about nature and its importance for our survival. Any policy based on human preferences would therefore endanger other social objectives, and possibly even threaten the survival of humanity itself.

3.5 Objections to the principles underlying CBA

In this section we examine a few of the objections to the use of CBA or the underlying principles of welfare economics.

Some authors are critical of CBA because they consider its theoretical basis, social welfare derived from individual preferences, to be an ethical concept (utilitarianism) (see, for example, van Wee, 2011). For this reason in some policy fields CBA will always be controversial. Examples are the use of CBA to determine optimum safety levels or put a value on human lives, health or nature (see text box).

CBA is used primarily to determine the economic efficiency and effectiveness of a measure and is not suitable for evaluating essentially moral issues (slavery, abortion) but some people stress that values such as freedom and moral judgment should be considered as well. Others say that 'moral goods' should not be included in CBA. For example, Dworkin (1979) shows that a CBA of the abolition of slavery would not necessarily give a positive balance. There is much debate about the ethical aspects of including or excluding moral goods. For example, should the value a burglar places on the property he has stolen be included in a CBA? Zerbe and Bellas (2006) point out that some CBAs do take account of moral judgments.

Decisions can be made on whether to include moral values or not when the occasion arises. The reasons for this decision must be clearly stated, but there is little evidence of this in current practice. Equity effects can be expressed in the form of distributional effects, but such effects are not valued. Other concepts of justice are not necessarily always consistent with the assumed social-welfare function used in CBA. If, for example, Rawls's theory of justice is taken as the conceptual basis, the welfare function takes on a different form (see, for example, Boadway, 2006). The idea of adding up the utility of all individuals, which is the basis of the social-welfare function used in this guidance document, must then be abandoned. If another concept of justice is used, identifying and describing the distributional effects will not provide a solution.

A final objection to using individual preferences as a basis for decision-making is the difficulty of dealing with 'endogenous preferences' (preferences formed in response to the social context of decision-making), other people's behaviour, institutions and social conditioning. The problem is that an individual's preferences are not constant (fully formed); they cannot be taken as given and at any moment are not therefore their 'real' preferences. It means that people who have never been confronted by a certain problem or question have little idea about how they will react or what they will think about it. They have to find this out, and this learning process is affected by the context and the external state of affairs in which they learn. A related point is derived from behavioural economics. Kahneman and Tversky and other psychologists point to people's inability to accurately assess the value of things. This means that our assumption that willingness to pay is a good indicator of value for the purposes of CBA may not necessarily be the case. But there is no real alternative. A counterargument to this objection is that people tend to act on their preferences, irrespective of how these preferences are formed (or how they may change in the future). This means that CBAs are still a reflection of what people think is important.

4 Steps in the preparation of a CBA[33]

Drawing up a CBA involves a number of steps. In general, the process can be broken down into the following steps:

Steps in a CBA

			Leeswijzer
1.	Problem analysis	• What is the problem or opportunity and how is it expected to develop? • What is the policy objective in response to this? • What are the most promising options?	
2.	Establish the baseline alternative	• Most likely scenario in the absence of a policy • Effect = policy alternative – baseline alternative	Ch. 5
3.	Define policy alternatives	• Describe the measures to be taken • Unpick packages of measures to identify individual elements • Define several alternatives and variants	
4.	Determine effects and benefits	• Identify effects • Quantify effects • Value (monetise) effects	Ch. 6, 7, 8
5.	Determine costs	• Resources consumed to implement the solution • Costs may be one-off or recurring, fixed or variable • Only costs additional to the baseline alternative	Ch. 9
6.	Analyse variants and risks	• Identify the main uncertainties and risks • Analyse the consequences for the outcomes	Ch. 10
7.	Overview of costs and benefits	• Calculate all costs and benefits discounted to the same base year and calculate the balance • Present all effects, including non-quantified and/or non-monetised effects	Ch. 11
8.	Presentation of results	• Relevant, understandable and clear • Explain: transparency and reproducibility • Interpret: what can the decision-maker learn from the CBA?	

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Source: CPB/PBL, 2013

4.1 Introduction

In the first part of this guidance, we have sketched the overall framework for carrying out a social cost–benefit analysis: the part it plays in policy preparation (Chapter 2) and the theoretical foundations (methodology) of CBA (Chapter 3). Having clarified what CBA is and how it can be used, the second part of this guidance describes how a CBA should be carried out (Chapters 5 to 11). But first, in this chapter we review the steps that need to be taken to prepare a CBA. This chapter is therefore an introduction to the second part of the CBA guidance. In Section 4.2 we present the steps in the preparation of a CBA. In Section 4.3 we say how these steps are described in more depth in the rest of this guidance document.

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[33] This chapter draws heavily on Faber and Mulders (2012).

4.2   The steps in the study

Drawing up a CBA proceeds in a number of steps. These steps are shown in Figure 4.1. The steps for preparing a CBA have been chosen so that they run more or less in parallel with the policy preparation process. In practice they are often used in this way and have proved to fit in well with policy preparation. This is no coincidence. During the policy preparation process, decision-makers are given the information they need to weigh up the options and a CBA can help them to structure the arguments. This applies to all stages of policy preparation. It therefore makes sense to use the available CBA expertise in all stages of the policy preparation process, even when this does not lead immediately to the preparation of a CBA. The steps also open up all the relevant aspects of the CBA to discussion.

The order of the main steps is also logical, although they do not always have to be carried out in a strictly linear sequence. Sometimes it will be necessary to go back and review an earlier step after completing a later step, for example because circumstances have changed or new insights have come to light.

Steps 4 to 7 are usually considered to be the heart of the CBA. However, it is possible to make a technically perfect CBA for a specific measure that does not actually give an answer to the relevant policy question or which does not consider relevant alternatives. Such a CBA will usually not be much use and will be called into question or invite criticism. Because CBAs should give an answer to the right question and makes the best possible input to the preparation of policy, this guidance contains a clear description of the preliminary stages of the CBA. This preliminary phase consists of steps 1, 2 and 3 – the problem analysis, establishment of the baseline alternative and the definition of policy responses – and these steps must be an appropriate response to the policy question at hand.

Finally, however good an analysis may be, if the report is not up to scratch the policy preparation process may not benefit from the insights gained from the CBA. Step 8 is therefore just as important as the seven previous ones.

4.2.1   Step 1: Problem analysis

The problem analysis describes the problem (constraint or opportunity) for which a solution or response is being sought, the causes of the problem and how it is expected to develop in the future. The 'problem' is not always negative – an obstacle or difficulty; it can also be about taking advantage of an opportunity. It is also important that the problem is clearly delineated and an explanation given of why the government should act and what role the government could play. As a corollary, the problem analysis should contain a description of the objectives of the policy measures to be developed in response to the problem. This should not anticipate the specific nature of the policy instrument to be adopted, because this could foreclose the option of deploying other potentially effective solutions. Finally, the problem analysis describes the parameters within which the problem should be solved (European legislation, for example).

4.2.2 Step 2: Establish the baseline alternative

The baseline alternative describes the most likely scenario without the introduction of any new policy initiatives. The baseline alternative is often based on the assumption that existing policies will remain in force, but other assumptions are also possible. The baseline alternative serves as a reference against which to measure the effects of new policy. Effects are determined by comparing the situation that will arise under the new policy or measures (policy alternative, see step 3) with the baseline alternative. The baseline alternative makes it possible to identify which effects can be attributed specifically to the new measure and thus avoid overestimating the effects. The baseline alternative is therefore just as important as the policy alternatives.

4.2.3 Step 3: Define policy alternatives

A policy alternative is a description of a measure which is expected to help solve the problem and which will be analysed in the CBA. The description contains at least the following elements: the actions/measures to be taken, the resources required and the expected results. It must be clear exactly what is included in the policy alternative and what is not. To this end the package of measures must be unpicked as much as possible to reveal the individual elements.

It is often advisable to define several policy alternatives or variants to improve the chances of finding the best solution. In many cases it will be possible to find additional projects or project variants, such as a stripped down variant ('baseline-plus') and a phased implementation variant.

4.2.4 Step 4: Determine effects and benefits

The determination of effects and their associated benefits takes place in three steps: identifying the effects, quantifying the effects and valuing the effects.

Identification of effects

A CBA should include *all* the effects of a measure. The identification of effects involves establishing what effects a measure has and then determining which of these are of significance for the CBA and which are not. To identify the effects, the relevant markets have to be defined. These can be existing markets (priced effects) or missing markets (non-priced effects or externalities). The first step is to identify the market or markets affected by the measure – the direct effects. The next step is to identify the markets in which significant secondary impacts may be expected – the indirect effects. Making this distinction between direct and indirect effects is a devise to make it easier to uncover all the effects. It is also necessary to check whether the intended effects of the policy or measure do indeed occur and there are no unintended side effects.

When identifying and describing the effects it is advisable to ascertain the distributional effects to identify the winners and losers. This is valuable information for the political decision-makers.

Quantification of effects

The effects are quantified by comparing the changes in the identified markets caused by the introduction of the measure with the situation in the baseline alternative. Various methods are available for determining these effects.

The effects should be quantified as much as possible because this gives the results of the CBA greater weight. However, not all effects can be quantified with any certainty because there may simply be too little information about the relevant causal relationships or because the effect does not lend itself to quantitative expression. Effects that cannot be quantified must be described in qualitative terms in the outcome of the CBA. Often it will be possible to establish whether the effect is positive or negative, or (in a smaller number of cases) if it is large or small.

Valuation of effects (monetisation)

The benefits of a measure are represented by the household willingness to pay for the effects of the measure: the amount in euros that must be allocated to the effects of the measure. Valuing the effects in this way makes the different types of effects cross-comparable and allows a comparison with the costs. This, in turn, makes it possible to determine whether the benefits outweigh the costs. It also allows comparison of different variants.

The more effects that can be valued, the better the comparisons will be. Many quantifiable effects will be able to be expressed in euros. Effects on existing markets can be quantified with reference to market prices. For effects on missing markets there is of course no market price, but other techniques are available that can be used to establish the value of effects, in many cases in the form of valuation indices. Nevertheless, in some cases it may not be possible to value a quantified effect.

4.2.5   Step 5: Determine costs

When determining the costs the aim is to identify the resources committed by the government and other stakeholders (private parties) to implement the solution. Costs may be one-off or recurring and fixed or variable. It is important to count only the costs that arise in addition to the baseline alternative, although this is not always the case for fixed costs. Costs cannot always be defined unambiguously: there is a grey area between negative benefits and costs. Costs may depend in part on the effects achieved (the cost of a fiscal stimulus measure to get more people into work increases as more people make use of it). Moreover, it is perfectly possible that the costs of a measure can only be calculated with any accuracy once the effects have been quantified.

4.2.6   Step 6: Analyse variants and risks

A CBA is based partly on assumptions, for example about how a problem will develop over time. It is therefore advisable to assess any risks and the impact they have on the cost–benefit analysis and to incorporate the findings into the CBA. The greater the level of uncertainty about how the situation will develop and what the effects are, the more

important it is to take account of these uncertainties in the CBA. Scenarios can be a useful tool for doing this.

4.2.7   Step 7: Overview of costs and benefits

Costs and benefits seldom occur at the same time. For a meaningful comparison their value must be calculated back to a common base year, such as the year in which the measure is introduced, by applying a discount rate to obtain a present value. The present value of all the costs and effects can then be added up to obtain the balance of costs and benefits in the base year. This is the CBA balance and it shows whether a measure increases economic welfare (positive balance) or not (negative balance).

The balance is important, but it is not the last word. Some effects may not be quantifiable or may be impossible to value and so will not be included in the balance. Decision-makers must weigh up these non-valued effects against the effects that have been valued (the balance). Also, even when the balance is positive, there may be losers as well as winners. The positive balance simply means that the winners' gains are larger than the losers' losses. Decision-makers may come to the conclusion that the losses of the losers weigh more heavily than the gains of the winners and reject the measure. The converse is also possible.

4.2.8   Step 8: Presentation of results

To make good use of the insights gained from the CBA in the policy preparation process, the results must be clear, user-friendly and reproducible. This can be done by presenting the most important results in a table showing the expected effects of each policy variant, the associated benefits and costs, and the overall balance. Important unquantified or non-monetised effects should also be included in the results table, as well as the important uncertainties.

The reasoning behind the table and the explanatory notes as just are important as the table itself for the presentation of results, because decision-makers must be able to consider the analysis behind the figures when coming to their decision. Lastly, the report must contain a *policy letter* stating the key findings of the CBA, their consequences for the decisions to be taken and the reasoning behind these conclusions.

4.3   Overview of Part II

Steps 1, 2 and 3 make up the preliminary phase of the CBA. We describe these steps in Chapter 5. Step 4 is often the crux of the CBA and is treated in Chapters 6, 7 and 8. Chapter 6 deals with the determination of effects. The topic of Chapter 7 is the valuation of the effects and the resulting benefits of a measure. Chapter 8 illustrates the process of identifying, describing and valuing the effects of a measure in a number of policy fields, and discusses in general terms what sort of information is available for using the CBA approach to answering policy questions in policy fields in which CBAs are infrequently used. The determination of costs (Step 5) is the subject of Chapter 9. The analysis of variants and risks is part of the

strategy for handling risks and uncertainties and is dealt with in Chapter 10. Drawing up the overview of costs and benefits (Step 7) is treated in Chapter 11, which also goes into the requirements for the presentation and interpretation of the results (Step 8).

5   Preliminary phase of the CBA

In the preliminary phase of a CBA the policy question is cast in a form suitable for CBA, ensuring that the CBA properly reflects the decision to be taken. However well a CBA is carried out, if it does not give an answer to the policy questions, it will be of little use. The preliminary phase of the CBA consists of three main steps:

• the problem analysis;
• defining the baseline alternative;
• defining the policy alternatives.

The problem analysis ensures that the CBA addresses the policy issue under investigation. To this end the problem analysis seeks to identify what problem would arise (or what opportunity would remain unexploited) without any government intervention, what policy issue this presents and the available options that have a good chance of achieving the policy objective. An early analysis of the problem will provide useful information for defining the baseline alternative and the policy alternatives.

Although the problem analysis is not part of the CBA, it is advisable to involve a CBA specialist in this analysis. It is important that the CBA compiler establishes with certainty that the problem analysis provides a sufficient basis for drawing up a meaningful CBA. The CBA compiler must also establish whether the design of the CBA is consistent with the problem analysis and whether any relevant measures have been overlooked.

The handbooks should include the criteria to be met for making an effective problem analysis.

The baseline alternative is the most likely situation that would develop in the relevant markets for the CBA if the measure under consideration were not implemented. The baseline alternative is determined in the first instance by exogenous factors. It also takes account of existing policies, proposed measures (if their implementation is virtually inevitable) and smaller interventions that partly resolve or mitigate the problem but which are not part of any independent policy alternative.

Policy alternatives contain the measures to be investigated. The policy alternatives and the baseline alternative must be chosen so that the CBA will provide an answer to the policy question. A policy alternative is defined as the smallest possible package of complementary measures that is expected to be technically and legally possible, economically feasible and have a credible relation with the problem identified in the problem analysis.

To ensure the CBA is as useful as possible, the following points must be borne in mind during the preliminary phase:

• Check whether the problem has been properly described, including the plausibility of the baseline scenario.
• Check whether the most relevant solution strategies have all been identified and incorporated into suitable policy alternatives. Where necessary, introduce new policy alternatives.
• Analyse the plausibility of the policy theory behind the selected options: why do they help to solve the problem and what mechanisms are expected to come into play? It may be a good idea to discuss the underlying mechanisms with the actors involved.
• The CBA compiler should not be distracted by the views of those submitting the policy alternatives.
• Do not include too many proposed policies in the baseline alternative.
• Do not define the policy alternatives so broadly that uneconomic aspects of the measures are carried by the cost-effective elements in the policy alternative.

5.1 Introduction

Cost–benefit analysis identifies the welfare effects of measures to be taken. A CBA can be done for any measure, but the question is whether this is the right way to uncover all the relevant policy information. The purpose of a CBA is to inform decision-makers so that they can make the best possible decision on how to tackle a problem, and this means that the CBA must cover all relevant solutions. It is not sufficient simply to find a measure that delivers a positive economic return to society, because another option could deliver a better balance of benefits and costs. If this option is not included, the information available will be suboptimal and the final decision may also be suboptimal as a result.

But how should the policy alternatives or policy measures to be included in the CBA be selected? How can the problem be defined? What problems do the measures resolve? How can we be sure that all relevant solutions have been identified? And how can we ensure that irrelevant solutions are quickly dispensed with? These questions are crucial for the design of the CBA and must be addressed during the preparatory stages of the CBA. In this phase the key issues are the policy issue, the associated policy theory and how these are addressed in the CBA. The purpose of the preliminary phase is not only to ensure that the CBA provides an answer to the policy question, it also has a separate objective: to ensure that all stakeholders (decision-makers, policy-makers, experts, CBA compilers and civil society organisations) agree on the nature of the problem, the solution strategies to be investigated and their expected effects.

The preliminary phase consists of the first three steps in the procedure set out in Chapter 4: the problem analysis, establishing the baseline alternative and defining policy alternatives, including an appraisal of the expected effects of the policy measures. These steps are interconnected.

The problem analysis examines the issue that cannot be resolved without government intervention or the developments (opportunities) that will take place without government intervention. Solutions are formulated as the basis for policy alternatives that will eventually be assessed in a CBA. It is important to ascertain how the problem would develop without intervention by the government or how opportunities would be lost in the absence of government action. What would the world look like without any intervention? This is the world that is described in the baseline alternative, which serves as a reference point when determining the effects of the proposed policy alternatives. The problem analysis was looked at in Chapter 2 from the viewpoint of the requirements of the CBA. In this chapter we look at how the problem analysis affects the preparation of the CBA. It is particularly helpful to analyse the problem early in the process (see Chapter 2). A good problem analysis also provides insight into the way in which the policy alternatives are defined and provides focus for the development of the baseline alternative. The problem analysis is therefore a decisive factor in defining the question to be answered by the CBA and in designing the CBA.

The policy alternatives to be assessed in the CBA are derived from the options identified for solving the problem. They are not developed by the CBA compiler, but by policy-makers,[34] and must meet a number of requirements for the cost–benefit analysis to be meaningful. The effects of the policy alternatives are measured against the baseline alternative.

It is important to ascertain whether and how the proposed policy measures contribute towards solving the identified problem or realising the available opportunities. The aim at this stage is not to determine the effects of a measure in detail (see Chapter 6); this would require an impossibly large amount of research. Rather, the aim is to determine whether a project or measure has sufficient potential to create the conditions required for the intended effects to occur.

In practice, it is not always easy to satisfactorily define a baseline alternative, or to operationalise the policy alternatives. Before the baseline alternative and the policy alternatives can be described it is necessary to obtain a picture of the exogenous developments. Often use is made of existing scenarios, such as those of the study on Welfare, Prosperity and Quality of the Living Environment (WLO) or climate scenarios. The estimation of exogenous developments is a distinct research step and as such is not included in the step-by-step procedure in Chapter 4. However, the choice of scenarios used, or perhaps the decision not to use any scenarios, must be justified.

The order of the steps in the preliminary phase is not set in stone. Sometimes it is evident that a certain measure will have no effect on the identified problem. In such cases, part of the assessment of expected effects can be made before the baseline alternative or policy alternatives have been decided upon.

In the rest of this chapter we first discuss the problem analysis (Section 5.2) and then set out the requirements for the baseline alternative (Section 5.3) before describing the definition of the policy alternatives (Section 5.4), the options for assessing the expected effects (Section 5.5), and the assessment of exogenous developments and the use of scenarios (Section 5.6).

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[34] Additional policy alternatives may be formulated during the course of the CBA. These often involve the phased introduction or postponement of the policy. Smart combinations of alternatives may also be proposed.

5.2 The problem analysis

A cost–benefit analysis identifies the social effects of a policy measure. It answers the question 'Will the proposed solution increase net welfare? but does not indicate the degree to which the problem to be addressed by the policy measure will be solved. There is therefore a risk that a CBA that is technically sound in all respects may not actually be relevant to the questions that need to be answered during the decision-making process. The problem analysis should ensure that the CBA properly addresses the policy issue under investigation.

The problem analysis addresses the following questions:

- What is the problem? What problem would arise or what opportunity would remain unexploited without any government intervention? How big is the problem or opportunity? How is it expected to develop in the future?

- What are the roles of market and government in solving the problem or exploiting the opportunity?
- What does the government want to achieve? What are its policy goals?
- What are the most promising options for achieving these goals?
- Have all the relevant options been identified? Have any potential solutions been overlooked? Have all the irrelevant options been eliminated?

Although the problem analysis is not a part of the CBA, the CBA compiler must have a good understanding of the problem analysis and investigate whether and how it provides pointers for drawing up a CBA that will generate information about the proposed policy measure. The CBA compiler must also investigate whether and how the design of the CBA (the policy alternatives to be investigated, the baseline alternative, the time horizon, the sensitivity analyses to be carried out) is consistent with the problem analysis. This may mean that the problem analysis will have to be reconsidered, supplemented and/or improved where necessary; for example, because relevant solution strategies have been overlooked. It may also be useful to involve the CBA compiler in the problem analysis (see also Chapter 2).

It is also advisable to involve various stakeholders in the preparation of the problem analysis in order to include as many different perspectives on the problem as possible. This will reveal the different interests involved so that attempts can be made to reach a consensus on the nature and the urgency of the problem and joint efforts made to explore promising solution strategies. Such a shared problem analysis can also provide a platform for involving all the relevant groups in setting up the CBA so that, despite their different interests, they will share the same idea about how the CBA will be carried out and what it will cover, and have the same expectations about the questions it will answer and the types of costs and effects it will describe. Nevertheless, the CBA compiler will always have the final responsibility for the structure and content of the CBA.

Although it is not possible to draw up a general set of criteria for a sound problem analysis, the above questions provide a good framework for drawing up an effective problem analysis, with the additional requirement that it should be up to date. The criteria to be met for making an effective problem analysis should be included in all the handbooks.

5.2.1 Problems and opportunities

The problem analysis forms the basis for a CBA. The problem analysis establishes what problem has to be solved or what opportunities can be exploited. It also indicates how the problem is expected to develop in the baseline alternative, if we 'do nothing', or almost nothing.[35] This analysis should clarify the policy objectives to be achieved by the project or measure and, not unimportantly, whether the problem and/or opportunity really does exist.[36]

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[35] The baseline alternative is dealt with in Section 5.3.
[36] For the remainder of this guidance we assume that there is indeed a problem.

The next question is whether the government has a role to play in solving the identified problem: the question is one of the legitimacy of government intervention and, by extension, which government authority is responsible.[37] The possible involvement of private parties can also be looked into. Private parties will certainly have a part to play in complex interventions, such as integrated area development, but also for things such as the implementation of a social security scheme.

5.2.2   Solution strategies

In the preliminary phase an inventory is made of the various possibilities for achieving the goal of the policy issue. In the first instance the range of possible options is kept as wide as possible. The various solution strategies should be sufficiently different to ensure that all the angles are covered.[38]

The scope of the solution strategies should also be borne in mind: where are the boundaries of the effect? This is known with a fair degree of accuracy for current infrastructure investments and area development projects. For example, network effects are taken into account in infrastructure projects and, for area development projects, negative (sometime positive) effects in surrounding areas are investigated. For policy fields where CBA is a lesser known tool, the scoping of policy alternatives should be included in the handbooks. The general principle for defining the limits of effects is described in Chapter 3 (Section 3.4).

5.2.3   Consequences of a weak or missing problem analysis

The handbooks and guidelines on the implementation of CBAs in different policy fields all emphasise the importance of a thorough problem analysis. The need for and value of a good problem analysis as the starting point for a CBA would therefore seem to be incontrovertible. Nevertheless, the problem analysis is not always given the attention it deserves. This is often because CBA compilers are brought into the process at a late stage, long after the promising solution strategies have been identified, when there is no time and little interest in subjecting the options to another critical examination. However, in the interests of the integrity of the analysis and the responsibilities of those carrying out the CBA, questions should be asked about why some options have been dropped and why others are expected to deliver positive results.

A weak problem analysis, or the absence of one altogether, carries the risk of embarking on a time-consuming study in which potential solutions are investigated that eventually prove to be untenable. A good example of this is the lengthy process leading up to the decision not to build the Zuiderzee Line rail connection (see text box 'The problem analysis for the Zuiderzee Line'). A major problem in this process was that the instruction to examine the

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[37] Government also has a role to play in exploiting opportunities. For example, by stimulating positive externalities or solving coordination problems the government can stimulate positive developments that would be difficult for individuals or groups in society to bring about on their own.
[38] The solution strategies may be very different in nature and so knowledge of their effects may also vary considerably. In such cases it may be tempting to investigate options about which much is already known and to drop the options about which little is known. This is not a desirable course of action. The best approach is to include the options about which little is known in the analysis and do the best you can. It is the task of the CBA compiler to point out the existence of such potential solutions.

problems facing the north of the country was only given after many years of study into the effects of the various solution strategies.

Another consequence of not having a sound problem analysis is that not all solution strategies will be explored early on in the process. As a result, much time may be spent investigating an option without a clear idea of what problem has to be solved, relevant options may be not be examined, or unrealistic options may be kept alive for far too long.

The problem analysis for the Zuiderzee Line

In 1997 the Langman Commission concluded that the economy in the north of the Netherlands was lagging behind the rest of the country. The subsequent Langman Accord of 1998 included the Zuiderzee Line rail connection on the assumption that it would strengthen the regional economy in the north. In 2001 the Government decided to conduct a planning study on the Zuiderzee Line. Various studies were carried out which mainly addressed the question of which variant would be best for the north, the 'northern wing' of the Randstad and for the Netherlands as a whole: a maglev line, a high speed train and a standard intercity train.

In 2004 the Temporary Commission on Infrastructure concluded that there was too little evidence of the economic and spatial development benefits of a Zuiderzee Line. The spatial vision for the Zuiderzee Line (*Structuurvisie Zuiderzeelijn*), published in 2006, stated that the proposed rail connection did not offer clear prospects of a solution to the problems in the north. The problem is not primarily one of poor accessibility, but that the regional economy is weak. A rapid public transport connection to the Amsterdam region will not help to strengthen the economy of the north. Quite apart from the enormous cost of this 'solution', which could never be recovered, the Zuiderzee Line itself would not be a solution to the economic problems facing the region.

An analysis of other solution strategies showed that regionally based options would be more effective than the Zuiderzee Line. In November 2007 the House of Representatives voted not to proceed with the construction of the Zuiderzee Line.

5.3   The baseline alternative

A CBA provides information to support decision-making on a measure by giving the most accurate and detailed picture as possible of the relevant effects of the measure and its welfare economics consequences. The effects are the differences between a world in which the measure is implemented and a world in which it is not. The latter is called the baseline alternative. To measure the size of the effects of a measure, therefore, the baseline alternative is just as important as the policy alternative. In this section we describe the criteria to be met by an appropriate baseline alternative and how to draw one up (Section 5.3.1). We then discuss two additional topics: the baseline-plus alternative (Section 5.3.2) and the time horizon of the baseline alternative (Section 5.3.3).

5.3.1   The development of the baseline alternative

The baseline alternative describes the world without the measure under investigation. The 'world' in question includes the markets relevant to the study, as discussed in Chapter 3. The baseline alternative therefore describes how the relevant markets would develop in the absence of the measure. When formulating these trends it is important to bear in mind that the purpose of the baseline alternative is to ensure that the outcome of the CBA is as realistic

as possible. The problems must not be exaggerated in any way, nor must they be played down. The key is to strike the right balance between false precision and playing it safe.

The baseline alternative is the most likely situation that would develop in all the relevant markets for the CBA if the measure under consideration were not implemented.

The baseline alternative as benchmark

A suitable baseline alternative can be seen in isolation from the policy alternatives. For example, if measure A give a positive CBA balance compared with a chosen baseline alternative, but measure B gives a better CBA balance compared with the same baseline alternative, measure A is not profitable from the perspective of welfare economics because there is a better alternative (B). This approach fits in well with the economic definition of costs as *opportunity costs*, or the value of the best possible alternative use (see Chapter 9).

The baseline alternative is essentially a benchmark (analogous to zero degrees on the Celsius temperature scale) against which all relevant policy alternatives are measured (a). To a certain extent, it does not matter how the baseline alternative is chosen. As long as all relevant policy alternatives – including the possibility of doing 'nothing' or 'little' – are examined in the analysis, one of these alternatives can be selected as the reference and all other alternatives compared with it. If none of the alternatives gives a positive welfare balance compared with the chosen reference alternative, the reference is the most profitable alternative. If there are alternatives that do give a positive welfare balance compared with the reference, the alternative with the highest positive balance is the most profitable alternative. In this approach there is no real baseline alternative, but only alternatives, and the CBA provides the decision-makers with the information they need to choose the best alternative.

In practice, however, it is often more convenient to choose as a reference an alternative that reflects a situation in which it is not considered necessary to deal with the problem or in which no action is actually taken to address the problem – in other words, a baseline alternative. There are two reasons for this. The first is that in many cases it is simply not feasible to investigate all possible alternatives. A well-chosen baseline alternative, possible supplemented with a baseline-plus alternative, can ensure that just a limited number of relevant alternatives have to be investigated. In addition, choosing a proper baseline alternative is more convenient for presenting the results, because it makes it easier to interpret the results of the policy alternatives. Besides, if an alternative is less socially cost-effective than an option that looks like 'not intervening or minimal intervention' it will obviously be a bad idea, whereas a project alternative that appears to be less effective than another project alternative may still (unjustifiably) seem to be a good idea anyway because it still increases welfare.

To avoid any misunderstandings, therefore, it is always worth making the effort to look into the possibility of defining a baseline alternative.

(a) In a strict interpretation of welfare economics theory, a project or measure must be assessed against the most valuable alternative use of the resources needed to realise the measure or project. In this strict approach a total social welfare level can be determined for each alternative. Comparing these welfare levels against each other reveals which of the alternatives is the best. The welfare balance of all the other alternatives is negative, because they have to be compared with the best possible alternative. Only the welfare balance of the best alternative is positive because its social welfare level is compared with the next best alternative. In the example, project A would serve as the baseline alternative and it would be immediately obvious that project B deliver the best welfare return because its welfare balance is positive. Moreover, if we wanted to assess project A, we would use project B as the baseline alternative, against which project A has a negative balance..

The developments in all the markets relevant to the CBA are determined in the first place by the trends in external factors, as described in scenario studies, for example (see Section 5.6). These concern not only the market or markets in which one or more interventions are made, but also markets expected to be significantly affected by developments elsewhere through the reactions by private parties. These exogenous developments also apply to the policy alternative. In addition, the baseline alternative is based on determining what policies *will* be developed in the *absence* of the measure. In practice this tends to generate considerable

discussion, partly because the parties involved in implementing the measure often find it difficult to imagine a world without the measure. The definition of the baseline alternative given above implies that consideration must be given to the most likely policy if the measure is not implemented. This is not necessarily the same as a 'do nothing' option or 'maintain existing policy'. According to Eijgenraam et al. (2000, p.27), the most likely change in policy in the absence of the measure is the best alternative to the measure. However, this must not be taken so far that the baseline alternative becomes an alternative measure comparable with the policy alternatives under investigation.

In practical terms, the baseline alternative should contain the following:

- Existing policy, including measures agreed upon but not yet implemented.[39]
- Planned measures: the decision-making process for these measures are so far advanced that their introduction is more or less unavoidable. However, there will inevitably be a certain margin for discussion: not everything that has been approved has to be included in the baseline alternative, because there are occasions when proposed planned policy introductions eventually do not go through. [40]
- Small interventions that partly resolve or mitigate the problem. If the problem is expected to get much worse it is unlikely that the government and the public will not respond. In such cases, mitigating measures will probably be taken to curb the worst effects of the problem. If no account is taken of this in the baseline alternative, it will be defined too narrowly and overestimate the seriousness of the problem, and thus the effects of the measures being evaluated. On the other hand, the baseline alternative must not contain any initiatives of such a scale and effect that they take on the proportions of an alternative measure of similar magnitude, scope and effectiveness as the measure being evaluated. The extent to which mitigating measures belong in the baseline alternative and whether a policy-plus or baseline-plus alternative is required depends on the judgment of the CBA researcher. When considering this it is helpful to consider the following statement:[41] 'The baseline alternative does not so much answer the question *What would we do in this situation?* but rather the question *What would happen in this situation?* The answer to the question *What would we do* would be a description of an alternative measure.'

The detailed composition of the baseline alternative varies according to the type of problem and the type of policy measure and also depends on existing policy and the possibilities for limited interventions that could partially resolve the problem. For further details on the composition of the baseline alternative we refer the reader to the handbooks. Knowing how best to formulate the baseline alternative is one of the skills in the art of CBA and requires knowledge of the subject matter pertaining to the problem and possible solutions. Essential

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[39] This sounds very logical, but is not without its dangers. For example, maintaining existing rules on index-linking the income tax bands will mean that eventually everyone would be taxable under the top rate, leading to an increase in the tax burden. In its long-range studies the Netherlands Bureau for Economic Policy Analysis generally assumes that in this area 'existing policy' means that the average tax burden does not rise and that the tax bands should be adjusted accordingly.
[40] For example, in the period 2006–2011 infrastructure investments were calculated on the assumption that road user charging would be introduced.
[41] From Ecorys and Witteveen+Bos (2009).

for this, in turn, is a sound problem analysis and a fairly expansive study of promising solution strategies, as well as information on how far already proposed policies really are irrevocable and on any other contextual matters.

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The baseline alternative for the Government Regional programme Amsterdam–Almere–Markermeer (RRAAM)

The RRAAM (2012) is a development programme for the Amsterdam–Almere–Markermeer region drawn up by central and provincial government. The baseline alternative for the CBA for the RRAAM included the investments planned in the PHS programme for high frequency rail services in the rail corridor between Schiphol and Lelystad (SAAL corridor). These investments will improve the rail services between Almere and Amsterdam. One of the purposes of the subject of this CBA, the proposed construction of the 'IJmeer line', was also to improve the rail services between Almere and Amsterdam.

This is an example of a CBA in which a broad interpretation of the baseline alternative (with PHS SAAL) can have a negative effect on the economic return to society of the measure under investigation (construction of the IJmeer line). This interpretation was criticised in the second opinion on the CBA (see Romijn et al., 2012), which argued that the baseline alternative contained a project (PHS) of about the same size as the project being evaluated. If the project in the baseline alternative were to be implemented, it could be concluded that the identified problem would be solved. If the project described in the baseline alternative is still under preparation, it would be better for the CBA to include this as a project alternative, even if the decision to proceed with it has in effect been made (in this case it was by no means certain that this project would go ahead). This approach would allow the two projects to be compared, adapted and improved.

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5.3.2   Avoided costs and a baseline-plus alternative

The costs avoided by a policy alternative are the costs incurred in the baseline alternative that are negated if the measure is introduced. Avoided costs can be offset against the costs of the measure itself or can be entered as benefits. It makes no difference to the balance. According to the definition of costs in Chapter 9, however, avoided costs are one of the outcomes of a measure and are not necessary to put it into effect. Looked at in this light, they are benefits of the measure.

However, the costs incurred in the baseline alternative are made for a reason and have an effect. Moreover, because the implementation of the measure means these costs no longer have to be incurred they probably have the same objective as the measure itself. They can then be seen as representing an alternative measure and it may be sensible to analyse this alternative measure in the CBA, for example as a 'baseline-plus alternative'.[42] This will have consequences for the baseline alternative against which the measure, its variants and the baseline-plus alternative are evaluated.

Presenting the avoided costs in the baseline alternative as benefits of a measure entails an important risk. Avoiding these costs also means that their benefits are missed and these missed benefits can easily be overlooked. This risk can be addressed by analysing a baseline-plus alternative.

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[42] Not to be confused with the 'baseline-plus alternative' in environmental impact assessments, which has a specific meaning in that context.

When avoided costs make a substantial contribution to the benefits of a measure, the alarm bells should ring. It could mean the baseline alternative is not well chosen or that an additional policy alternative should be analysed.

5.3.3   The time horizon of the baseline alternative

The time horizon of the baseline alternative is a key decision in the preliminary phase of the CBA. This time horizon is determined, among other things, by the period in which the problem is expected to develop and have an effect or the period in which the opportunities will be available. Economic growth can make problems worse over time, but it is also conceivable that a problem will eventually disappear of its own accord. The time frame in which the effects of the measures under investigation will be felt is also an important factor when defining the period to be covered by the baseline alternative. This requires insights into the general economic, demographic and other social trends, for which use can be made of existing scenarios (see Section 5.6). The time horizon we choose for evaluating the CBA depends in part on the type of policy measure (short v long term) and the way uncertainties and risks are dealt with. We will come back to this in Chapter 10.

The baseline alternative always covers a long period with regard to investments.[43] This is because we always assume that investments in infrastructure and area development projects will be recouped over a long period. It is much less important to prepare a baseline alternative specifically for policy interventions with short-term effects, particularly if the interventions can be reversed at no cost. In such cases the baseline alternative will literally be a 'do nothing' scenario.

5.4   The policy alternative

In the problem analysis stage, solution strategies are formulated for the policy issue (problem or opportunity). These solution strategies provide the basis for preparing, concrete policy alternatives (measures, investments) for use in the CBA. In this section we discuss the requirements a policy alternative must meet. First, the definition:

A policy alternative is the smallest possible package of complementary measures that is expected to be technically and legally possible, economically feasible and have a credible relation with the problem identified in the problem analysis. [44]

This definition states that the policy alternatives to be investigated in the CBA must be not too big, but also not too small. A policy alternative must be more or less self-contained and is the smallest unit on which a meaningful and independent decision can be made. The options formulated during the problem analysis in response to the policy issue will not always satisfy the definition of a measure or project that must be observed in the CBA. It is therefore one of

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[43] An alternative is to measure the costs and benefits in a horizon year, as the CPB did for road user pricing. This is only possible if the costs and benefits have the same temporal distribution.
[44] This definition is based on Eijgenraam et al. (2000). In the light of the considerations in Chapter 2 (text box 'Policy objective and CBA'), this has been modified by adding the effectiveness of the policy alternative in achieving the objectives. For this the problem analysis has to be sound (see Section 5.2).

the tasks of those preparing the CBA to adapt the plans and proposals available to them so that they satisfy the definition, otherwise the CBA will not be valid.[45]

The definition gives rise to several criteria that must be met by each policy alternative:

1. The policy alternative must be irreducible: further reduction or division into constituent parts is not possible or warranted.
2. The policy alternative must seek to meet the policy objective.
3. The policy alternative must be technically and legally practicable.
4. The policy alternative must be economically feasible.

We examine each of these criteria in turn below, before exploring the synergy between the components of a policy alternative and what this means for defining the scope of the policy alternatives. Finally, we briefly consider who should be responsible for defining the scope of policy alternatives.

5.4.1   Inseparable

If a policy alternative consists of several measures or components, the CBA researcher should consider whether these measures are inseparably bound up with each other or could be investigated separately. Separate measures must meet the definition of a 'policy alternative': they must be technically and economically separable and able to be implemented separately so that separate decision can be taken for each of them.

Treating the components of the plans at hand as distinct policy alternatives makes it possible to separate the more promising components from the less effective ones. Making the policy alternatives as small as possible will avoid the negative balances from one component being hidden by a bigger positive balance from another component. The problem analysis provides the basis for deciding which components should be included in the policy alternative.[46]

5.4.2   Goal-oriented

It is advisable to only analyse those policy alternatives that solve the observed problem or exploit the identified opportunity (see the 'Policy objective and CBA' text box in Chapter 2). The policy alternatives must therefore address the formulated policy issue.[47]

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[45] In some cases policies are implemented via voluntary agreements between government and specific industries or economic sectors. These agreements (or 'covenants') are often about doing things differently. In principle, such agreements can also be seen as measures that can be evaluated in a CBA, as long as they meet the requirements for the definition of a policy alternative stated here. However, the question is whether the parties to the agreement are able to comply with all the conditions, and if so, whether they actually do so, and what sanctions are in place when parties do not comply with the agreement.

[46] There is a certain conflict of interest between the political imperative to make trade-offs in a composite or comprehensive package of measures and the analytical imperative to assess each component in its own right. Investigating the various components separately in a CBA will allow politicians to make these trade-offs transparent.

[47] Here we assume that a policy issue is formulated on the basis of the problem analysis and responds to the identified problem, but that it also allows a certain degree of freedom in the design of the solution.

5.4.3   Technical and legal practicability

Policy alternatives should be technically and legally practicable. Of course, judgments of this nature will require inputs from relevant experts. Those responsible for the CBA must in turn assess the plausibility of these judgments.

5.4.4   Economic feasibility

A policy alternative must be economically feasible. More precisely, in the opinion of the CBA compiler the policy alternative must have a chance of success on economic grounds. This decision on economic feasibility has to be based on a personal assessment of the potential benefits of the solution to the problem (or exploitation of the opportunity) and a personal assessment of the potential costs of the proposed policy alternative:

- A CBA compiler can decide not to include an alternative or component of an alternative in the CBA if they consider the benefits will probably not outweigh the costs. Such a decision is in effect a judgment that the solution is not economically promising.
- Sometimes a policy alternative will almost certainly perform worse than other policy alternatives, which can be a reason for not including the alternative in the analysis.
- Finally, solutions may be so costly that they exceed the budgets available and so cannot be implemented.

By excluding a policy alternative on the basis of a negative assessment of its economic feasibility in advance of the analysis, CBA researchers open themselves to the accusation of prejudice or bias. This 'prejudgement' of the alternative must therefore be reported and explained. Moreover, this prejudgement must be revisited during the process to check whether it is supported by the results of the analyses of the measures or components that *are* included in the CBA.

5.4.5   Reveal synergy effects

In general it is useful, as far as possible, to divide policy measures into component parts on which meaningful separate decision can be taken. The promising components can then be separated from the less useful ones. However, breaking down the original proposals as submitted may not always be well received by the authors of these plans. Politicians and/or civil servants are often afraid that the positive synergy effects between the various components of a measure will then not be taken fully into account. This objection can be addressed by making a CBA of the proposal as a whole in addition to the CBAs of the various component parts to reveal the advantages and disadvantages of implementing the component parts together.

Comparing the outcomes of the various components of a proposal with the outcome of the proposal as a whole reveals the synergy effects, which can be seen in the degree to which the CBA balance of the whole is larger or smaller than the sum of the CBA balances of the separate components. This provides insight into the degree to which the various components of a proposal strengthen each other (positive synergy) or work against each other (negative

synergy). However, synergy effects are not a separate category of effects in a CBA, but are contained within all other effects.

5.4.6   Responsibility for defining policy alternatives

Correctly describing a policy alternative is the job of the person or organisation requesting the CBA (client). When the CBA is for a policy measure, it is the responsibility of the client to make or commission an analysis of the problem the policy measure is intended to solve. This problem analysis forms the basis for a description of the policy alternative and its objectives. The CBA compiler must check that the policy alternative is not too big or too small, that all policy alternatives have been included and that there is a clear distinction between the policy alternative and its environment, and report back to the client, who must carefully consider these findings.

5.5   Verification of expected effects

An important part of the preliminary phase of a CBA is aligning it with the world of the policy-makers. The CBA must be prepared in such a way that it provides information that supports the decision-making. The problem analysis and policy alternatives must tie in with the plans drawn up by the policy-makers. Policy-makers base their choice of alternative policy options on a policy theory[48] to identify those alternatives that can reasonably be expected to be effective in achieving the policy objectives. Critically examining the expected effects is an important part of the preliminary phase of the CBA. In consultation with the parties involved, the CBA compiler critically examine the objectives and expected effects in order to prevent tunnel vision by any or all of the parties.

At this stage the aim is not to determine the effects of a measure, but to verify in advance whether the measure can indeed have the expected effects. Verifying the policy theory is partly a question of common sense, but there are methods that can be used to support this process. Some of them are described briefly in the text box 'Tools to help with preparing a CBA' (Section 5.2).

The verification of the policy theory can throw up some conflicts between the policy process and the CBA methodology. Cost–benefit analysis is designed to identify welfare effects, not policy effects, and not all policy effects are welfare effects. In practice, there is often much discussion between politicians/civil servants and CBA compilers about which effects should or should not be included in a CBA. Romijn and Renes (2013) say that for urban development projects it is important to analyse all the effects considered relevant by policy-makers and in a separate step to explain why these have or have not been included in the CBA. Effects may not be included in the CBA for the following reasons:

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[48] Policy theory is a public administration concept. A policy theory is not a scientific or academic theory, but contains the assumptions and hypotheses of policy-makers about why a measure will contribute to solving a problem. See further van Hoesel et al. (2005).

1. The intended policy effects will not materialise.
2. The intended policy effects will materialise, but:

    a. they are not welfare effects;
    b. they are welfare effects, but:
        i.   there is no empirical information about their magnitude ('for the record' item);
        ii. there is double counting with other welfare effects (transferred indirect effects);
        iii. there is also a similar but opposite welfare effect of the same magnitude (redistribution effect).

This conversion of expected policy effects into welfare effects in is an important part of the CBA in all policy fields and for all types of measures. The conversion processes for specific cases can be detailed in the handbooks.

5.6   Assessment of relevant exogenous developments

Many aspects of a CBA will depend on having information or insight into relevant exogenous trends. Such insights may be needed for the preparation of the baseline alternative and the policy alternatives. Also, the costs and scale of project effects depend on future developments in the economy and in society. The relevant developments can be assessed through the use of scenarios.[49]

The power of a scenario is that the trends in all the variables fit together logically: a scenario tells a story. For example, a scenario may describe the changes in the size and composition of the population and the trend in economic growth, or how political developments affect which countries are trading partners or not, or whether the government is interventionist or takes a laissez-faire approach. Determining the effects within such a scenario gives the measure and the effects a context. Of course, a set of scenarios must be used that describe the exogenous developments relevant to the measure under investigation, or from which the relevant exogenous developments can be derived.

*   The Welfare, Prosperity and Quality of the Living Environment scenarios ('WLO scenarios'; see CPB, MNP and RPB,[50] 2006), for example, are suitable for transport projects and planning policy, including spatial policies for nature and the environment. A more recent version of the WLO scenarios with a more pronounced differentiation in spatial development trends can be found in the publication *Ruimtelijke Verkenning 2011* [Spatial Development Trends 2011] (see Hilbers et al., 2011).

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[49] In principle, it is also possible to obtain a picture of the relevant exogenous developments without the use of scenarios, for example by making use of observed trends instead, or other more or less advanced predictive techniques. This is a good option for measures that have effects primarily over the medium to long term (five years), for which scenarios are often not suitable. When projected over a long time horizon, trends and developments from the past lose their predictive power and scenarios provide a better solution, especially if they are embedded in a set of different futures that cover the fundamental uncertainties.
[50] In 2008 the Netherlands Environmental Assessment Agency (MNP) and the Netherlands Institute for Spatial Research (RPB) were merged to form PBL Netherlands Environmental Assessment Agency.

- The WLO scenarios are derived from the macroeconomic scenarios *Vier Vergezichten op Nederland* [Four Futures for the Netherlands] (Huizinga and Smid, 2004). Supplemented with labour supply scenarios (Roodenburg and van Vuren, 2004), they comprise a set of scenarios suitable for social policy, labour market policy and education policy.
- The 'Four Futures scenarios' have also been adapted for the government and the health care sector in Bos et al. (2004). The study into the future of health care (van Ewijk et al., 2013) contains four scenarios of the future of heath care: 'four futures of health care'.
- Energy and climate policy (including flood protection) require a combination of KNMI (Royal Netherlands Meteorological Institute) climate scenarios and the WLO scenarios.
- For aviation policy, specific scenarios have been developed based on the Four Futures scenarios (Ministerie van Verkeer en Waterstaat, 2006).
- In some cases use can also be made of European Commission scenarios. The European Commission makes scenarios for each policy field, for example for energy, transport and climate.[51]

Scenarios are not only used to describe the relevant exogenous developments, but also to test the robustness of outcomes in the light of uncertain future developments. This second use of scenarios is discussed in Chapter 10.

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[51] See, for example, *Global Climate Policy Scenarios for 2030 and beyond* (Russ et al., 2007), *EC Energy Roadmap 2050* (Commission Staff Impact Assessment Working Paper) and *A sustainable future for transport* (EC DG for Energy and Transport, 2009). These studies do not always make a clear distinction between autonomous trends and policy effects.

6   Determination of effects

A CBA stands or falls on the degree to which the effects of a measure can be determined and valued. The better that can be done, the more useful the CBA will be in supporting the decision-making. This chapter provides the CBA compiler with a set of rules and guidelines. We set out the requirements to be met when determining effects and the advantages and disadvantages of the various methods for doing this.

The most important conclusions are:

- All the effects of a measure are felt in markets, efficient or inefficient, existing or missing, in the form of changes in volumes and prices.
- The main methods for determining effects are behavioural models, information from business cases, empirically determined price elasticities, experiments and index numbers. The methods used to determine effects must meet the following requirements:
  - They must be empirically verified and regularly validated.
  - They must be suitable for identifying the effect under investigation.
  - The more important an effect is for the outcome of the CBA, the more detailed the research method needs to be.
  - All uncertainties relating to the use of a method must be stated and analysed.

In the light of this, the CBA compiler must establish that the method used is indeed suitable for measuring the effect under investigation.

The most important rules for determining effects in a CBA are listed below:

- The determination of effects should be based as far as possible on traceable, verifiable and falsifiable studies.
- The CBA compiler should ascertain that the methods used are suitable and produce plausible results. If there is any doubt, a second opinion on the outcome must be obtained, for example by recalculating the effects using a competing method or using alternative assumptions and premises (sensitivity analysis).
- Effects whose size and/or value cannot be determined are no less important and must be included in the CBA. The CBA compiler must state clearly how important the effect is considered to be for the outcome of the CBA as a whole.
- A qualitative effect determination in which those involved or affected are asked to estimate the effects of the policy measures is not a suitable method for use in a CBA.
- A CBA based mainly on assumptions rather than empirically measured effects cannot be used in support of decision-making.
- If there are large differences in the degree to which different groups in society benefit from a measure or the distribution of costs and benefits is a major issue in the policy debate, the distributional effects must be considered in addition to the benefit/cost balance.

6.1   Introduction

A CBA stands or falls on the degree to which the effects of a measure can be determined and valued. The better that can be done, the more useful the CBA will be in supporting the decision-making. The determination of effects involves three steps: (1) defining the markets in which the relevant welfare effects of a measure occur; (2) determining the effects occurring in these markets (volume changes); and (3) determining the valuation of these effects (willingness to pay, prices and price changes).

Step 1 has been dealt with in Chapter 3 (Section 3.4) and step 3 is the main topic of Chapter 7. Step 2 is the subject of this chapter, which provides the CBA compiler with practical guidance on determining effects. We set out the requirements to be met when determining effects and the advantages and disadvantages of the various methods for doing this (Section 6.2). The aim is to give CBA compilers an overview of the methods available for determining effects and their advantages and disadvantages.

In practice, effects are determined in a number of different ways, including behavioural models, information from the project itself (e.g. business cases) and empirical information on the causal relationships. A general guidance document is not the place for descriptions of the precise techniques for determining these effects, because this is something for experts in the specific fields relevant to the analysis. The determination, use and interpretation of effects is a subject for the detailed handbooks on CBA for the various policy fields.

In this general CBA guidance we provide a number of criteria that methods for determining effects must meet to ensure the CBA contains suitable information to support the decision-making. We also take stock of the methods for determining effects and their advantages and disadvantages. We first list the various methods and the criteria for their use in CBA and then discuss the different methods in turn, illustrating their use with examples from various policy fields. We also discuss the qualitative determination of effects: what can a CBA compiler do if there is no quantitative information about an effect? In short, this chapter provides the CBA compiler with practical guidance on the possibilities available for determining the effects of a measure.

6.2   Methods for determining effects

The most widely used methods for determining project effects are:

- Behavioural models, such as LMS/NRM (transport), TIGRIS XL (spatial planning), chronic illness model (health), MIMIC (labour market)
- Business cases (e.g. land development, port operation)
- Empirically determined price elasticities and other elasticities from the scientific literature
- Experiments
- Index numbers

These methods are discussed below.

A number of general principles can be defined for the use of these methods:

- Effects and the methods used to determine them must be based on empirical evidence and scientifically sound causal relationships.

- Methods for determining effects must be empirically verified and regularly validated. This means that when a method is used by different researchers for the same problem it should give the same results. As a consequence, CBA results will be reproducible, improving the transparency and acceptance of the outcomes.
- Methods must be geared to identifying the effect under investigation. In particular, they must match the time horizon and scope of the effect to be investigated: a short-term effect cannot be determined using a long-term elasticity, neither can a localised effect be determined by a method that makes use of a national average. Macroeconomic methods are often unsuitable for describing effects on a specific group in society. Methods may be developed for determining effects under certain conditions, but may not be suitable for use in other situations.
- The more important an effect is for the outcome of the CBA, the more detailed the research method needs to be.
- All methods make use of assumptions and involve uncertainties. This knowledge uncertainty must be stated and, if possible, described through the use of sensitivity analyses (see Chapter 10).

Ideally, CBA compilers should carry out an experiment designed specifically to investigate the problem at hand (preferably a randomised experiment) in order to determine without question what the causal effects of a measure are. If this is not possible, which is often the case, the next best option is to carry out a natural experiment (an empirical study based on available data in which external factors are accounted for as far as possible). Such studies are also designed specifically to investigate the measure at hand (see, for example, Ossokina and Verweij, 2011). If a natural experiment is also not possible, the CBA compiler can use a behavioural model or empirical relationships and index numbers obtained from the literature. Both of these options incorporate knowledge derived from previously conducted randomised or natural experiments. If a model is used this will include feedback loops (which will also have to be estimated). Such methods will therefore not necessarily always be suitable for the issue under investigation. The availability of behavioural models that combine as much knowledge as possible will reduce the need to carry out additional specific research, which will much improve the cost-effectiveness of carrying out a CBA.

6.3 Behavioural models

Behavioural models contain empirical and theoretical knowledge about how people or organisations behave in certain situations or policy fields. They model how people or companies react to changes in certain markets. This gives CBA compilers information about one or more markets relevant to the analysis, and thus insight into important policy effects.[52]

Besides this bundling of knowledge, the biggest advantage of behavioural models is the consistency they provide. All knowledge and assumptions are modelled within a consistent

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[52] In addition to behavioural models, technical models are used that describe the relationships between environmental variables in which human behaviour plays no role. An example is a model that describes how an increase in the concentration of CO_2 in the atmosphere leads to a certain degree of global warming or to a rise in sea level.

and comprehensive framework and all effects follow from the premises, assumptions and workings of the model. No effects can be missed – at least no effects that could arise within the world as modelled. Outcomes that appear to be illogical can either be traced back to illogical assumptions or the model will reveal that these outcomes are in fact more logical than they appeared at first sight. This phenomenon is called 'isolating the unexpected'.[53]

When using a model it is essential to check whether it is suitable for the issue under investigation and whether the assumptions are compatible with the conditions. Moreover, most behavioural models were developed for purposes other than CBA and so the outcome will not always be entirely what is needed. The use of such models may then be limited and some additional interpretation may be required.

In some policy fields there are models available to reveal the relevant effects, especially in the fields of transport, health care, flood protection and the labour market.

6.4　Business cases

Business cases are available for several policy fields. Business cases are prepared for the operators and/or initiators of a project, often for public transport projects, ports and airports or integrated area development projects. Business cases weigh up the private returns to the initiator/developer from the sale of project services against the costs, including the operating costs of the project. If these returns exceed the costs, the initiator/operator will make a profit: there will be a private welfare gain. In addition to this private welfare gain for the initiator/operator, there may also be non-priced effects on third parties, which together with the gains for the initiator/operator determine the social-welfare gains. The difference between the private welfare gain for the initiators/operators and the social-welfare gains is an indication of the legitimacy of government intervention.

In some policy fields the business case is an important source of information for the CBA, but this information must be reviewed for plausibility, for example by comparing it with a business case of a comparable project. A database of business cases can be used to determine whether the order of magnitude of the calculated effects is plausible.

An example of a business case is the business case for land development. CBAs of area development projects are usually based on information from these business cases, although this information will usually require some adaptation. Fakton, Buck Consultants and SEO Economische Onderzoek (2012) have drawn up a roadmap describing how the information from a land development business plan can be made suitable for use in a CBA. This exercise generates the effects of the project on, for example, the number of homes, business parks, amenities and facilities included in the plan. Land development business cases take no account of a baseline alternative and nor are side effects identified. If the investments in an

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[53] A good example of this is the housing market study by Donders et al. (2010). Differences in the nature of government intervention in the rented and owner-occupied housing markets mean that an increase in controlled rents leads to a reduction in house prices.

area lead to changes in the existing urban area, these will also have to be investigated, separately. The points to be considered regarding the use of information from land development business cases in CBAs are also relevant to business cases in many other fields.

Business cases may also be available in other policy fields than infrastructure and area development; for example, for decentralised energy generation by wind turbines and solar panels, and social business cases are sometimes used in the health care sector.

6.5   Empirical information about causal relationships

When determining project effects use can also be made of empirical relationships from the scientific literature, often concerning price elasticities. The proposed measures for evaluation will either raise or lower the prices and costs of a good or service and so the price elasticity can be used to measure the changes in use or demand. Use is often made of microeconomic empirical evidence. Much empirical evidence is available on labour market measures in particular, for example on the effects of wages and subsidies on the chances of obtaining work, the length of unemployment and on female labour market participation. Price elasticities can also be used, for example, to estimate the effects on mobility of increases in fuel duty.

Besides price elasticities, other sorts of empirical relationships can also be used in the determination of effects, such as empirical information about the spatial relationships between the locations of homes and of work and amenities in area development.[54] For many subjects there is empirical information available, but no behavioural models. In such cases, price and other elasticities can be useful for determining causal relationships, and in these cases they are essentially used as mini behavioural models. However, behavioural models can be used under a wider set of conditions than empirically determined elasticities and for this reason CBA compilers should be more careful in considering the suitability of using empirical elasticities for the effect under investigation.

6.6   Experiments

Experiments are also used to directly measure the effects of measures. It is important that experiments are carefully designed to ensure that causal effects can indeed be isolated and corrections can be made for self-selection. A well-known example is the clinical trial used in the health sector to determine the effectiveness of treatments (medicines). Experiments are also used in economics. These experiments can be divided into laboratory experiments and quasi-experimental research, the latter often being used to determine project effects from existing (individual) data.

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[54] See, for example, Vermeulen and Van Ommeren (2009), De Graaf and Raspe (2012) and Romijn and Renes (2013).

Clinical studies

The clinical studies that are commonly used in the health sector (randomised controlled trials, RCT) are carried out under controlled conditions. The participating patients are randomly divided into an experimental group and a control group. The experimental group receive the treatment being tested, such as a medicine, and the control group receive an identical looking substance that has no therapeutic effect (placebo).

The RCT format – which is used not only for medication, but also for surgery and psychotherapy – ensures that the differences in results between the two groups can be ascribed with certainty to the treatments received. According to many researchers in the health sector this is the only way to convincingly demonstrate the causality of effects.

Economic experiments

Economic experiments can be divided in two categories: quasi-experimental research and laboratory experiments.

Quasi-experimental research does not involve randomisation or double-blind tests. Instead, a group of participants subjected to a certain intervention are compared with a control group without the intervention. The participants are not randomly assigned to the groups, but both groups must be comparable with respect to a number of relevant characteristics, often involving age, gender, education and the nature of the problem, for example length of unemployment. The effect can be determined by comparing these two groups (with and without the intervention).

Economic laboratory experiments are used to discover new economic patterns or regularities in a more inductive way. Economic laboratory experiments are eminently suitable for exploring the consequences of new types of policy initiative. Without making any assumptions about people's behaviour, reactions to changes in the economic situation can be studied rigorously and systematically. The studies can be replicated to test the robustness of the findings. Experiments offer the opportunity to study issues about which existing theoretical models cannot provide any solutions, such as behavioural responses when markets are not in equilibrium. An important question concerning this experimental method is how generalizable the results are. In other words, how representative are the participants in the study of the population as a whole (population validity), and how appropriate is the experimental design (external validity)?

Pilot studies

A special type of experiment is the pilot study (or pilot project or field experiment). Pilot studies differ from scientific experiments in that they generally do not involve a control group, no account is taken of external factors, and no other scientific checks and balances are performed. Pilot studies are small-scale preliminary studies to test a measure in the real world. The idea is that while various factors can be controlled in a scientific setting, it is only

possible to establish whether a measure is really feasible and will actually work by subjecting it to uncontrolled conditions in the real world. There is something to be said for this. Initiatives that have been well thought out on the drawing board do not always turn out to be very workable in practice, however sound the theoretical or empirical knowledge is that suggests they will work well. At the same time, this is also the drawback of the pilot study. The degree to which a measure appears to work or not may be down to the measure itself, but it may also be down to the characteristics of the environment in which it is being tested.

The question that arises is whether the results of pilot studies can be generalised or not. The design of pilot studies means that clear arguments for and against generalising the results cannot always be made. Using the results of pilot studies as evidence of the effects of broader measures is therefore risky.

Finally, if a pilot study indicates that a measure has a certain effect, it is always possible to extend the pilot study. In effect, this turns the pilot into a phased introduction of the measure, but motivated by knowledge uncertainty rather than future uncertainty (see Chapter 10).

6.7   Index numbers

Simpler methods are often used to calculate side effects than to calculate effects relevant to the main objective of the measure. For example, the effect on air quality in a CBA of an environmental measure (e.g. the introduction of – or more stringent – standards for particulate matter concentrations) will be determined with greater accuracy than in a CBA of an infrastructure project. In the CBA of the particulate matter standards, air quality is the main objective and main source of benefits; in the infrastructure CBA, accessibility is the main objective and air quality is a side effect and will be a relatively minor issue in quantitative terms. When calculating side effects use if often made of index numbers. An overview of the main environmental quality index numbers is given by Wever and Rosenberg (2012), and the SEE Support Desk for Economic Evaluation website contains a large number of index numbers for spatial planning, environment, transport and accessibility.[55] The use of index numbers avoids the need for expensive impact and valuation studies and their judicious use makes CBA studies more comparable.

Using index numbers also has several disadvantages. It is not always clear which markets or effects the index number describes. Neither is it always clear whether the effect is completely

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[55] See: http://www.rijkswaterstaat.nl/zakelijk/economische_evaluatie/overzicht_effecten_infrastructuur/. The review of methods by Wever and Rosenberg (2012) can also be obtained from this website. For some environmental qualities, such as the quality of spatial design, the welfare consequences of changes in environmental quality are not known with any accuracy. For other environmental qualities, the method for determining the magnitude of the welfare effect has not yet been worked out in sufficient detail and/or a valuation or price has not yet been attached to it. SEE shows what the current state of the art is. Besides index numbers for use in determining effects, the SEE database also contains index numbers for the valuation of these effects.

and correctly described. If a side effect becomes quantitatively significant in the CBA, an analysis using index numbers will probably no longer be adequate.

This can be illustrated by the use of an example. The effects of an increase in mobility on air quality and road safety are often based on the number of vehicle-kilometres, which are converted using technical parameters into particulate matter emissions (measured in kg) and number of accidents (deaths and injuries).[56] Such calculations can always be carried out, but entail the risk of losing sight of the markets – and thus the effects – which really matter. For example, measuring particulate matter in kilograms and attaching a price per kilogram detracts from the real effect of particulate matter: the effect on the health of people exposed to high concentrations. The effect of particulate matter can also be measured by monitoring the number of asthma patients (SEE, 2012), but this is a restricted representation of the health effects of particulate matter.

When using index numbers it is important to know that the relationship between the policy measure and the effect has been determined in a correct manner, or at least that this has been checked. This may require unravelling the whole chain of effects (as in the above example of particulate matter), especially if the effect is important, to prevent any overlap between different effects.

6.8   Qualitative determination of effects

What should you do if no empirical information is available to determine the causal relationships between a measure and its effects? If this concerns a relatively unimportant side effect, the CBA compiler should report the nature of the effect, indicate whether this adds or detracts from the CBA balance (if known) and establish within reasonable doubt that the effect has a limited effect on the CBA balance. The effect must be included in the report with a qualitative indication of the nature and limited importance of the effect ('a small plus'). This also applies when the magnitude of the effect can be determined but not its value, in which case it is important that at least the magnitude or scale of the effect is reported.

Such qualitative descriptions of effects are less suitable for more important effects that have a greater influence on the outcome of the CBA. If the magnitude of an effect can be estimated, a break-even valuation can be made in order to determine at what valuation of the effect the CBA balance is zero. If the magnitude of the effect is also not known, the CBA will have reached the limit of its usefulness as an analytical instrument, in which case the CBA can be used only as a conceptual framework to help structure the discussion. In practice, in such situations qualitative methods are often used (see text box 'Tools to help with preparing the CBA' in Chapter 5) in which experts and stakeholders are asked to make assessments of the effects of policy measures. This information is of a different order than the methods described above for assessing project effects. The estimates obtained are often based on

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[56] Air quality effects are also determined for use in the environmental impact assessment (EIA). Where possible, information about these effects in the EIA can be used in the CBA. However, the scope of an EIA and a CBA are different. Besides, an EIA will not always be drawn up or the EIA may not be available at the time the CBA is being prepared.

experience and are not scientifically tested, and repeating the experiment with other equally qualified people will probably result in very different estimates. The results will therefore not be reliable, which is why the method has not been included in the list of methods for determining project effects suitable for use in a CBA.

7 Determination of benefits

This chapter provides the CBA compiler with a set of rules and guidelines for valuing the effects of a measure or project. The most important are:

- The valuation of effects must make as much use as possible of (observed) market prices. For non-priced effects, this is clearly not possible and the consumer willingness to pay must be calculated in another way:
  - o Revealed preference methods derive the value of non-priced effects from the purchasing behaviour of consumers in related markets. They include the hedonic pricing method and the travel cost method. The advantage of these methods is that they are based on observed behaviour. A disadvantage is that the related market from which the observations are obtained does not always correspond well with the effect to be valued, with the risk that the effect will only be partially valued.
  - o Stated preference methods derive the value of a non-priced effect from questionnaire or interview surveys of individuals. These methods have the advantage that in principle people can be asked all sorts of questions covering a vast range of topics. The disadvantage is that what respondents say is not always consistent with what they do or would do. This can lead to bias in the valuations.
  - o The stated preference method is suitable for determining the existence value or intrinsic value of goods. The CBA compiler must establish with certainty that the method used is state of the art.
- There are large differences in the availability and quality of valuations between policy fields and effect clusters.
- CBA compilers must be sure that the valuation used is correct. Especially when using the outcome of stated preference methods and index numbers, they should check whether these are indeed applicable to the analysis at hand.
- Effects for which a valuation cannot be made are no less important and must be included in the CBA. The CBA compiler must state clearly how important the effect is considered to be for the outcome of the CBA as a whole.
- The avoidance costs approach is less suitable for the valuation of non-priced damage or loss, unless the CBA compiler can show that it will deliver a meaningful valuation of willingness to pay.
- Valuation indices are not always suitable for use in situations in which they were derived or for which they were obtained. CBA compilers must ascertain how suitable these figures are for use in each particular case.

7.1 Introduction

In Chapter 6, we looked at the volume effects of measures on the markets relevant to the analysis. To determine the benefits it is necessary to value these volume effects. We need to know the willingness to pay for the old and new volumes, or in other words, the levels of and change in price on the relevant markets.[57] This chapter examines the various methods that can be used to do this.

In some cases, the methods used to determine the volume effects also generate the relevant prices and price changes, in which case no separate valuation of the effects has to be made. This applies, for example, to some behavioural models. If the prices and price changes are not determined along with the volume effects, a distinct valuation step is needed. In

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[57] Measures can also be designed specifically to reduce prices (see Section 3.2.3) and such measures also have volume effects, which are determined using techniques described in Chapter 6.

principle, market prices should be used as far as possible. [58] However, this approach does not work for effects in inefficient markets – in which market prices are not good reflections of value – or when effects occur in missing markets and there are therefore no market prices. There are various methods for determining the willingness to pay for these non-priced effects.[59] We examine the advantages and disadvantages of these methods in Section 7.2.

The information about the valuation of non-priced effects these methods give is often available in the form of valuation indices. For example the website of the SEE Support Desk for Economic Evaluation reports valuation indices in the fields of spatial development and transport. Witteveen+Bos (2006) report valuation indices for nature, water, soil and landscape. We examine the advantages and disadvantages of using valuation indices in Section 7.3.

When calculating benefits, the period of time taken into account is also important. The benefits of investments are often only felt some time into the future. How these long-term benefits should be calculated is discussed in Section 7.4.

When determining benefits and costs, consideration must be given not only to the size of the change in welfare, but also to how these benefits and costs are distributed: who are the winners and who are the losers? This is the topic of Section 7.7.

7.2   The valuation of non-priced effects

The valuation of non-priced effects[60] can be based on revealed preference methods or stated preference methods. Both types of methods are based on consumer willingness to pay. Sometimes even these methods cannot provide an answer and in such cases use can be made of estimated avoidance costs for negative non-priced effects (nuisance), abandoning the principle of willingness to pay altogether.

Revealed preference
Methods based on preferences use observed market behaviour in an existing market as an indication of willingness to pay in a missing market. Of course, there must be a relation (preferably a strong relation) between the existing and the missing market.

Hedonic price analysis derives a price for a differentiated market good from the willingness to pay for the various characteristics of the good. These may be characteristics of the good itself, but may also include circumstances surrounding the good.[61] Hedonic pricing analyses are carried out for a range of things, such as the influence of noise nuisance on house prices

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[58] It is important that all effects are priced in the same way; in other words, not using factor costs (market price excluding VAT) to price one effect and market prices including VAT to price another effect. The easiest way to do this is often by using real market prices, which include the effect of indirect taxes (including VAT) and cost-reducing subsidies. See Zwaneveld et al. (2011) for further details.
[59] The valuation of non-priced effects for CBA must be based on willingness to pay. This means that valuations based on expert judgements are not acceptable, as these may contain personal a bias.
[60] In this section we draw heavily on Chapter 10 and Part II of Eijgenraam et al. (2000).
[61] Rosen (1974) was the first to develop a full economic theory for this topic.

and the influence of safety on wage levels. By analysing the prices of a large number of different houses for which the main price-determining factors are known (features of the house and environmental characteristics such as noise nuisance, odours or air pollution and the proximity of amenities), the contribution made by each individual factor to the price can be estimated. The implicit price of an environmental factor can then be used as an indicator of the willingness to pay for it. In a similar way, wages can be compared and the value of positive or negative aspects of a job (e.g. safety aspects) can be estimated.

The *travel cost method* determines the travel costs (including travel time) visitors are prepared to incur to visit areas with differing qualities. This method is frequently used to estimate the value of recreational sites and nature reserves or parks as a whole, or the value of the environmental quality of part of such sites, such as the quality of water bodies for swimming or fishing. Visitors to a forest do not pay to go into the forest, but they do incur costs, including the travel costs. If the costs to the visitors are reduced, the number of visits will increase. If another forest of higher quality can be visited at the same cost, that forest will attract a higher number of visitors. The demand for recreational ecosystem services can therefore be determined from information about visitor costs and the numbers of visitors. This estimated demand can then be used to calculate the change in consumer surplus arising from an increase in quality.

The main advantage of hedonic price analysis and the travel cost method is that they are based on observed choice behaviour. A major disadvantage is that the information provided by the methods becomes less useful when a factor has less influence on the market decisions being analysed (buying a house, accepting a job, deciding on a journey, etc.) or cannot easily be distinguished from other factors. There is also a danger that only part of the non-priced effects will be valued. Forests are not only valued by visitors, but also for their beneficial influences on the water regime (flood protection) and the removal of airborne particulate matter (health). If only visitor travel costs are taken into account, these other services provided by the forest are left out of the equation, as well as the value people put on the very existence of the forest without making any direct use of it (the non-use value). Likewise, a hedonic price analysis of homes to value a historic town centre ignores the value put on the heritage qualities by visitors from outside the town.

In fact, both hedonic price analysis and the travel cost method measure the value of a non-priced effect in a complementary market. To enjoy the forest we first have to get there; the journey is complementary to the visit to the forest. To make use of the facilities in the town centre, we have to live in the neighbourhood; the home is complementary to visiting the town centre. To obtain an accurate valuation a choice has to be made about which complementary market and good to use. This is also part of the CBA compiler's craft. There are also examples of hedonic price analysis in which environmental characteristics play no part at all, such as the effects of urban amenities on office rents. This does not mean that environmental aspects are not valued, but that the office tenants do not value them. In such cases the complementary market has not been chosen well.

Stated preference

The second group of methods for valuing non-priced effects are not based on actual market behaviour, but on how respondents say they would behave under hypothetical market conditions. This group of methods includes *contingent valuation* and *conjoint analysis.* Contingent valuation is a survey-based technique in which respondents are asked to assign a value to a non-priced effect. Conjoint analysis is a survey method that tries to avoid direct valuation. Respondents are presented with a number of combinations of the non-priced effect and other non-monetary variables, such as free time and accident risks, and the monetary value of the non-priced effect is determined by attaching money values to some of the non-monetary variables.

An advantage of this group of methods is that they allow greater leeway in the design of the research than methods based on revealed preferences, opening up opportunities to avoid partial valuation in the hedonic pricing method and the travel cost method, including the determination of non-use value. This in turn creates the possibility of obtaining a picture of the total economic value.

The main disadvantage is that in a non-committal and artificial situation, respondents may give answers that do not reflect what they would in fact do. This distortion can be made worse by strategic answering behaviour or by preference forming, leading to embedding or framing problems because respondents have no real idea about the issue being discussed.[62] This is why some researchers have doubts about the use of stated preference methods as a matter of principle (see for example Hausman 2012). Zeeuw et al. (2008) acknowledge many of the problems, but are less sceptical about the value of stated preference studies. They believe that much progress has been made in solving these problems.[63]

However, the stated preference method is the only workable method for obtaining monetary values for some economic and social costs and benefits. These are mostly the existence values or intrinsic values of goods, a term used in environmental economics for values not derived from the actual or potential use of a good. They are also referred to as non-use values. These values are expressed in the preferences arising from the simple existence of the good. Examples of this are the values attributed to nature, heritage and culture.

Despite its methodological weaknesses (biases), the stated preference method cannot simply be rejected. Although is being increasingly accepted in some academic disciplines (e.g. economics) and policy circles, it will always remain a controversial method. Opponents of a certain policy or policy decision will always attack the methodological weak points of the method, such as the construction of values for environmental goods and services. For this reason it is very important that use of the method is state of the art and that weak points are made explicit much as possible – although this will not remove the problems altogether.

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[62] Such distortion can be severe. This may come to light by calculating both the willingness to pay for a good and the willingness to accept not receiving the same good. Although both measure the same thing, the values will be very different.
[63] According to Zeeuw et al. (2008) this can also be put down to a less than fully rational *homo economicus.*

It appears to be generally accepted that the closer stated preference studies reflect people's everyday experiences, such as time valuation studies for travel behaviour, the more reliable the results will be. But other factors also affect the reliability of these studies.

Finally, an obvious weakness of valuation studies is that they are time-consuming and costly. Moreover, they are specific to the situation and location and the degree to which the results of studies obtained in a specific region or situation can be generalised and applied to other regions or situations is still under discussion.

This means that CBA compilers must take great care when using the outcomes of stated preference studies in a CBA and must certainly not use these results indiscriminately. However, carrying out a stated preference study especially for a CBA will often be too time-consuming or costly.

Costs of avoidance, control or restoration of negative non-priced effects

In some cases non-priced effects cannot be valued using any of the methods mentioned above. In such cases, the costs of avoidance, control or restoration are sometimes used as an alternative to valuation. However, avoidance costs[64] are not equivalent to willingness to pay for reducing real damages. The damage itself may be valued much higher or lower than the costs of prevention or restoration. Avoidance costs are therefore not always good estimates of the value of effects and are not always suitable for calculating benefits. Working with avoidance costs can therefore lead to an incorrect picture of the merits of a measure. Rather than create a false picture by using avoidance costs, it will usually be better to state that the value of the damage is not known. If avoidance costs *are* used, this must be made clear in the report, stating why avoidance costs were used and providing a reasoned argument why they nevertheless give a reasonable estimate of the willingness to pay.

Among the available techniques is the *elimination method* or *shadow cost method*: determining the minimum cost required to achieve a certain mitigation of the negative non-priced effect or not exceed a previously established standard. The *shadow project method* also falls into this category. This method estimates the costs of a measure to restore or compensate for the damage caused by implementation of the proposed measure. Only if the damage is fully compensated for by the shadow project will the CBA be accurate, because then there will be no damage to be valued. But even then, the costs of the compensatory measures cannot be considered to be a valuation of the damage that would remain without the compensation. Putting the compensating measure into the equation is in effect creating a variant of the original measure.

7.3 The use of valuation indices

In practice, much use is made of valuation indices for valuing non-priced effects. These indicators are often obtained using one of the techniques mentioned in Section 7.2. However,

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[64] By avoidance costs we mean all the costs of avoidance, control or restoration.

the willingness to pay for a non-priced effect will in many cases probably decline as supply in the market increases. A measure that has an effect on such a missing market will then, as in an existing market, not only have consequences for the consumed volume but also the shadow price. Using a single valuation index will distort the estimated change in the consumer surplus in the market caused by the measure. This means that, in principle, using a single valuation index will not be adequate. Instead, the change in value resulting from the change in supply should be taken into account (see Figure 7.1a)

Figure 7.1   Overestimation of welfare gains by valuation indices

a. Standard calculations
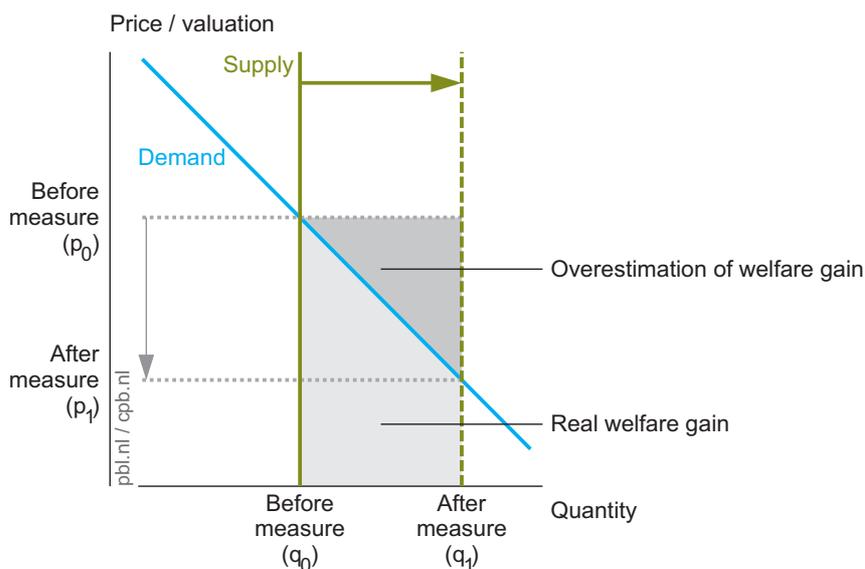
b. Small change in volume
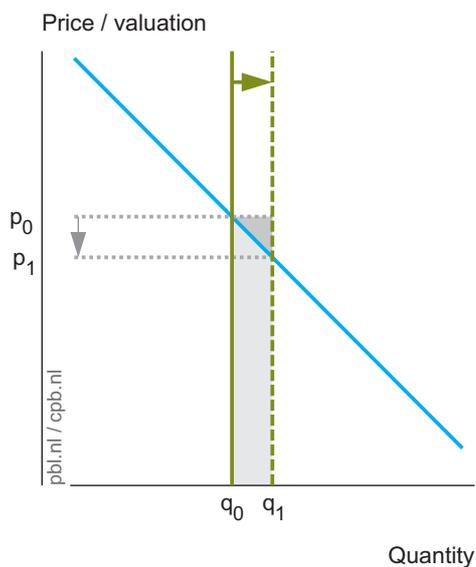
c. Elastic demand
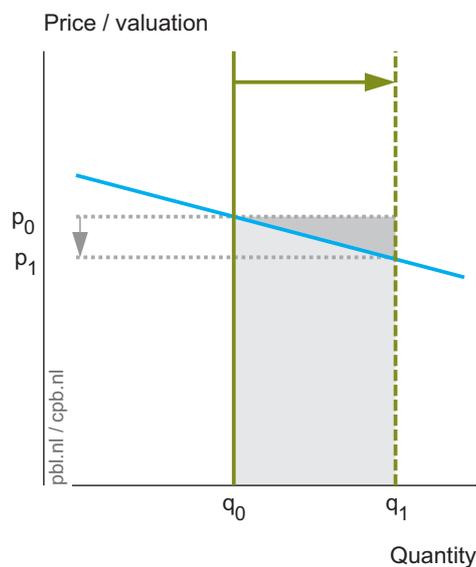
Source: CPB/PBL, 2013

However, there are conceivable situations in which the use of a single valuation index would be adequate. An example is when the change in supply is relatively small in relation to the market as a whole. The effect is then marginal, the change in price is small and the valuation index is a reasonable approximation (see Figure 7.1b). The second situation is when the willingness to pay hardly falls as the supply increases. In this case the price elasticity of demand is high (see Figure 7.1c). Finally, the use of a single valuation index number can give a quick, and thus cheap, estimate of the value of an effect.

Even if there are non-priced side effects of limited size, the use of a valuation index can be justified, also from the point of view of the research effort and costs involved in preparing a CBA. However, due consideration must be given to whether a valuation index is indeed applicable to the specific case at hand (see text box on benefit transfers).

For CBAs of measures whose main effects are non-priced, a more extensive analysis of the valuation of non-priced effects will be needed. A single valuation index will not be adequate in these cases. Nevertheless, if a single valuation index is used, a reasoned case must be made for its validity.[65]

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Benefit transfers (a)

Benefit transfer involves using a valuation index (or value function) for an unpriced good estimated in an original or primary study to value a similar benefit arising as a consequence of the new policy.

Benefit transfer is attractive because it considerably reduces the need to carry out original (or 'primary') studies into non-priced effects. Benefit transfer also offers a way out when it is not possible to carry out an original study. If benefit transfer were a valid procedure, a database of 'off the shelf' valuation indices could be built up for use in the evaluation of new policies. The index numbers provided by SEE and Witteveen+Bos (2006) are moving in this direction. They are accompanied by guidelines to help users determine whether the figures are suitable for use in their particular CBA.

However, benefit transfer is also risky in that it is not always clear whether a valuation index obtained for one situation can simply be used unaltered in another situation. Sometimes it is clear that it can and sometimes it is clear that it cannot, and why not. In other cases, however, it is not clear whether benefit transfer can be used or not. Benefit transfer may therefore lead to an incorrect estimate of effects. CBA compilers must be careful about using benefit transfers and determine as far as possible whether benefit transfer is valid in each particular case.

(a)   The information in this text box is based on Section 17.1 of Pearce et al. (2006).

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[65] Moreover, valuation of effects must take into account the difference between an average valuation (the valuation of the average user or a product or service) and the marginal valuation (the valuation of the last user). An example is the value of travel time. Studies of travel time valuation always look at the value of *travel time saved*, not the value of the travel time itself. This is a marginal valuation and therefore does not shed any light on the shape of the demand curve.

7.4   Long-term aspects of determining benefits

This CBA guidance can in principle be used for all types of policy measures. When long-term effects are expected, from investments for example, consideration should be given to benefits and costs arising in the future.

This has a number of practical consequences. In the first place, the costs and benefits will be subject to inflation and must be corrected for it. In this section we briefly describe how changes in prices should be accounted for when calculating benefits (Section 7.4.1). In addition, the benefits and costs occurring at various times over a long period into the future have added up. Given that people put greater value on the same products and services in the present than in the future (time preference), the benefits and costs have to be corrected for this difference in timing (present values: Section 7.4.2). Finally, we look at the choice of time horizon (Section 7.4.3).

7.4.1   Price level

All effects are valued in constant prices in a given base year. A change in the general price level is recorded as inflation, and costs and benefits have to be corrected for this inflation. However, the value ascribed to certain effects may increase at a faster or slower rate than the general price level. This change in relative prices must be calculated in the CBA.[66] Amounts corrected for changes in the general price level are called 'real values', expressed in 'base-year euros' or 'general base-year price level'.

7.4.2   Discount rate and present value

Costs and benefits occurring at different moments in time cannot simply be compared with each other. A euro in the future is not only worth less due to inflation, but also because most people put more value on having a euro now than having it in the future. Consumers therefore place less value on benefits and costs the further in the future they lie.

The present value of future costs and benefits is calculated using a suitable (annual) discount rate. Unless benefits and costs occur at the same time (in which case the analysis can be done for the year of the time horizon) all future values are discounted to obtain the present value in one year. This may be the same base year chosen for the inflation correction, but it does not have to be. For example, the results of a CBA may be measured in 'million euros, 2012 present value, 2010 price level'. In the Netherlands the Government sets the real discount rate for CBAs and revises it periodically. In Chapter 10 we discuss the value of the discount rate in more depth.

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[66] In Chapter 9 on cost estimation we examine relative price changes in greater depth.

Discounting

The discount rate can be seen as an individual's required rate of return to postpone spending income for a year (saving). Utility is generated by consumption paid for from income. Postponing such spending therefore means postponing utility. People are prepared to save a euro if the saved euro buys just as much utility in a year's time as the present utility of consumption now, but consumers' value future consumption less than present consumption: the difference is the time preference rate. To be able to generate a similar utility in a year's time, the saved euro has to deliver a return equal to the time preference rate corrected for the marginal utility of income. That is the discount rate. The connection between time preference, marginal utility of income and consumption is expressed in its most fundamental form in the Keynes–Ramsey rule (see, for example, Chapter 10 in de Zeeuw et al., 2008).

The discount rate is influenced by uncertainty: the more uncertain the amount of money someone will get over a year becomes, the higher the discount rate they will want as compensation for the risk. This mark-up on the discount rate is called the risk premium. The (real) discount rate therefore consists of the (real) risk-free discount rate and the risk premium.

A discount rate is expressed as a percentage per year. If the discount rate is d, then the present value someone puts on a benefit gained from a euro in a year's time is equal to $1/(1+d)$; a euro in two years' time is now worth $1/(1+d)^2$, etc. This is called discounting. The resulting value today of a future euro is called the present value.

Discounting is a controversial issue and so is the discount rate. De Zeeuw et al. (2008) and Harrison (2010) discuss several aspects of the principle of discounting, the size of the discount rate and the use of the risk premium.

7.4.3   Time horizon

In principle, CBAs work with an infinite time horizon. This makes it necessary to have a complete timeline of all costs and benefits for each year in the future. To create this timeline the effects of the measure have to be calculated for each year in the future. Because this is often simply not feasible in practice, the detailed analysis of effects is limited to a time horizon of one or two years. Whatever the case, the structural effects of any measures under investigation have to be identified. One of the time horizons must be so far in the future that it can safely be assumed that the effects will have reached their structural level. A growth curve of effects is then interpolated for the years between the introduction of the measure and the structural time horizon and the structural level of effects is extrapolated from the years after the year the time horizon ends. An additional time horizon between the first year and the structural year of the time horizon may be desirable if the trend in the effects is not even.

In practice, you often have to make do with what you have, and the time horizons are chosen to match the availability of assessments of external factors, such as the reference years in scenarios.

Measures without structural effects or measures designed mainly to resolve temporary problems cannot be properly analysed using this time horizon approach. An example is the redevelopment of disadvantaged neighbourhoods in shrinkage areas. Demolition of rented accommodation has only a temporary effect because after a certain time each home will be fully renovated, rebuilt or demolished. Measures for labour market participation and productivity also only have temporary effects, which die out when the generation in which

these measures were invested retire. Neither is there much point in looking for structural effects in CBAs of treatments and medicines. The effects of such measures on QALYs (quality-adjusted life years) are temporary if we assume that, after a time, better treatments and medication will become available, and only the generation at that time will profit from them. Indicentally, these may be important benefits, nevertheless.

7.5   Distribution of costs and benefits

A principle of CBA is that a measure increases welfare if the gains to the winners are greater than the losses to the losers (see Chapter 3). The CBA balance indicates whether society as a whole benefits, but says nothing about how the costs and benefits of a measure are distributed across the various groups in society, and who gains and who loses. The principles underlying the CBA methodology also mean that distributional effects have no effect on the CBA balance. This avoids having to make any normative judgments about what is good for society with respect to equality.

However, the distribution of costs and benefits is an important issue in many policy debates. If the distributional effects are substantial, it will be necessary to determine not only the balance of costs and effects, but also how they are distributed across the various groups in society. Policy-makers can then decide for themselves how much weight to give to the welfare effects accruing to the various groups. The outcome of this exercise can then provide a basis for deciding, for example, that a measure that delivers a negative rate of return should still go ahead because of its distributional effects. Conversely, CBA can be used to rank measures intended to bring about a more favourable distribution of income or welfare according to their economic welfare impact.

Identifying distributional effects is not essential in a CBA. It is an option. If the distributional effects are to be identified and described in the CBA, this should be done in a balanced and consistent manner.[67] Determining distributional effects requires additional research. A further complication is that the impacts of a measure in other fields may mean that the distribution of direct effects can be very different from the final distribution of effects after all these ripple effects have had their impact (this is illustrated by *The tale of the peanut butter factory* in Chapter 3). When determining the economic welfare costs and benefits, only the direct effects and important indirect effects are taken into account. Showing the distributional effects may mean that the definition of relevant markets includes markets in which indirect effects have a major impact on the distribution of costs, benefits, gains and losses.

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[67] This extends also to the representativeness of the various groups. There will always be some people who get an enormous advantage or disadvantage, but the question is how representative this is for a broader group in society.

Finally, there are many possibilities of identifying different groups, and a choice will have to be made on which to use.[68] The CBA compiler must decide whether or not to include distributional effects in the results, and if so, for which groups. This choice must be made beforehand in consultation with the policy-makers (and others involved). It is the responsibility of the CBA compiler to inform the policy-makers of any important distributional effects and to make sufficient provision in the research agenda to investigate these distributional effects.

Below we discuss a few of the more obvious options for presenting distributional effects.

Income distribution effects

Income distribution (purchasing power) and solidarity ('the broadest shoulders should carry the greatest burden') are topics that always come up in policy debates. However, CBA makes no distinction between a 100 euro cost for someone on social assistance benefit and someone earning three times median income. This principle of 'a euro is a euro' has the advantage of clarity. The disadvantage is that the loss of 100 euros has a much greater impact on the budget of someone receiving social security benefit than on someone earning three times median income. However, society may have a preference for measures that benefit the lower income groups more, or at least have a neutral effect on income distribution. Or even have an opposite effect. It may therefore be necessary to determine the effects of a measure on various income groups.[69]

Besides income distribution effects, consideration can be given to 'specific egalitarianism' (see Tobin, 1970), the idea that many people are not really bothered about income inequality ('general solidarity'), but do think that everyone should have enough food and water, a roof over their heads and adequate health care.[70] For policy fields that need to consider this specific egalitarianism it may be necessary, besides welfare effects, to identify how far a measure gives people access to these basic needs.

Winners and losers

If a CBA shows that a measure makes society as a whole better off, any losers can be compensated for their losses by the winners.[71] This is sufficient for the CBA. The compensation does not have to actually take place, and in practice usually does not. Even if the CBA indicates that the measure increases total welfare, some people may experience a

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[68] Options include the residents of province P or municipality M, old people, young people, children, single people, employees in sector S, people on low incomes, municipality M, motorists, people in disadvantaged neighbourhoods, companies in sector X, tax payers, tenants, parents, central government, people re-entering the labour market, unemployed people, people with a disability, province Y, small businesses, middle incomes, sports clubs, families with children, the chronically ill, entrepreneurs, students, commuters, home owners, classical music lovers, etc.

[69] It can be argued that in a well-functioning democracy all society's preferences regarding the distribution of income, opportunities and capital have already been accounted for in the existing system of institutions, legislation, taxes and benefits. These choices implicitly reflect the importance attached to the interests of the different groups in society by society itself. Assuming such an optimised system (although this will alter over time), an extra euro for one person has the same social value as an extra euro for another person. The reasoning is that an individual's marginal utility per euro may differ but that this is corrected for by the weighting of individual utilities in the social-welfare function *from the viewpoint of society as a whole*.

[70] These are people's basic needs. They are precisely the things that are provided first of all as emergency aid to people affected by natural disasters or wars, followed by education. The right to a decent standard of living (adequate health care, food, clothing, housing) and the right to education are two of the articles in the Universal Declaration of Human Rights.

[71] This is called the Kaldor-Hicks compensation principle. See for example, Eijgenraam et al. (2000) or Boadway (2006).

loss of welfare. Clearly, it makes sense to reveal the distributional effects for the groups that lose most because of the measure, which in turn raises the question of which groups are the main beneficiaries. With this information, the policy-maker can decide whether a welfare-increasing policy measure imposes too much of a burden on some groups in society. In some cases there may be sufficient reason to compensate the losers.

Even if there are only winners, the distribution of welfare improvements can provide valuable insights. For example, one group may receive the lion's share of the welfare gain while the vast majority of the population benefit to a much lesser extent.

The directly affected

CBA aims to describe the effects of a measure on society as a whole as accurately and objectively as possible, without exaggerating or downplaying the consequences for any particular groups. However, there will always be groups in society which are affected much more heavily by a measure than others, at least in the first instance.

The advantage of a CBA that not only reveals the effects on society as a whole, but also the effects on those directly affected by a measure is that it can relate the arguments for and against a measure to the interests of these groups. As the different groups will have different interests in the measure going ahead or not, expressing the effects on different groups in unmistakeable terms will make the CBA more credible (Loomis, 2012). It will also make it easier to communicate the results of the CBA, because those involved will often have an idea of what the costs and benefits will be for themselves or for specific groups, making the CBA more convincing and the results more easily accepted. Without such insights, the CBA all too easily appears to be little more than a 'black box'.

This can be done by building the CBA from the bottom up, starting with the effects on individual groups. In this approach, the various groups are identified (such as government, tax payers and the target groups of the measure) and the implications and effects of the measure are investigated for each of these groups in turn. The outcomes for each group are then added up to obtain a total picture of the costs and benefits of the measure, showing that in some cases one person's gain is another person's loss. This also makes it clear why some effects are not welfare effects, but only the result of shifts in welfare, such as transfers or indirect effects. This bottom-up approach has been used to good effect (for the *OV-chipkaart*, the Dutch public transport smart card, by Nieuwenhuis et al., 2003 and for childcare benefit by Kok et al., 2011) and the *MKBA-handreiking voor beleidsmakers* (Rijksoverheid, 2012) emphasises the importance of clear information for those directly affected. The text box 'Distribution of effects' illustrates the outcome of such an approach.

Distribution of effects

The table below is an example of a results table showing the outcome of a CBA compiled from the effects on various different groups. The CBA compiler must first define the relevant groups to be considered. This example is taken from Kok et al. (2011) and is for a 650 million euro cut in the budget for childcare.(a)

Saving 650 million euros in childcare benefits costs 350 million and delivers free time

	Child	Parents	Providers of formal care	Providers of informal care and playgroups	Employer	Government	Other society	Total
Ex ante savings		-650				650		
Cost of formal care			380					380
Cost of informal care				-130				-130
Payments for formal care		380	-380					0
Payments for informal care		-110		110				0
Payments for playgroups		-5		20		-15		0
Reduction in childcare benefit		-95				95		0
Production					-740			-740
Wages	TBD	-740			740			0
Taxes		150				-150		0
Benefit costs		30				-30		0
Tax rates		175				-550	375	0
Economic stimulus		45					95	140
Subtotal material effects	TBD	-820	0	0	0	0	470	-350
Value of free time		380						380
Total	TBD	-440	0	0	0	0	470	30

Source: SEO Economisch Onderzoek

+ = benefit; - = costs; amounts in million euros per year

The table shows the costs and benefits for different groups. It also shows that the benefits to one group are costs accruing to another group and so for society as a whole they cancel out. Examples are the ex ante savings and the payments for formal childcare. The table also shows that a reduction in clientele for the formal childcare sector leads to a loss of income to the providers of formal childcare, which (eventually) leads to cutbacks in the sector (job losses and closures) of the same magnitude.

(a) This table is presented as an illustration only of the bottom-up approach; no responsibility is claimed for the figures themselves. The source document contains an explanation of how the sums were calculated.

8   Building blocks and applications

Varying amounts of experience have been gained in the use of CBA in different policy fields. Drawing on several examples, we show here how the effects of measures can be identified, determined and valued. At the same time, this shows what information is needed to provide answers to policy questions using the CBA methodology. Experiences in policy fields in which CBA has become a standard tool indicate that systematic use of CBA in a policy field stimulates the further development of a quantitative evidence base. Use of CBA also stimulates impact measurement studies, research into valuation and the development of procedures to integrate CBA into the policy process.

In this chapter we do not formulate any rules, but rather present a number of ideas to promote the use of CBA:

1. The general principles of this guidance apply to all policy fields and, in principle, the preparation of policies in every field can benefit from the principles underlying CBA.
2. This guidance is broad enough to make CBA applicable in all policy fields. Our prime concern is the correct application of the principles and not the rigid implementation of a fixed set of procedures. The chapter analyses several examples in policy fields where CBA is not an established analytical tool.
3. The many applications and subject-specific techniques make it necessary to further develop the general principles contained in this guidance in handbooks for each of the fields of application. These handbooks will provide the additional information needed to draw up guidelines for a specific policy field.
4. Different policy fields and policy applications can benefit from each other's experience regarding the development of instruments for applying CBA and the productive use of CBA in the policy process.

8.1   Introduction

In this chapter we examine the use of methods for identifying, determining and valuing the effects of measures in a number policy fields and how these methods can be integrated into the CBA methodology. The purpose of CBA is to inform policy decisions. It provides a method for structuring all the available information and a framework for weighing up all the different effects. The crux of a CBA is getting the right mix of effect determination and welfare analysis. Even if the step of monetising the effects to obtain a CBA balance cannot be taken, or at least not yet, the systematic overview of the effects of a measure is in itself an important step in substantiating policy options.

As we shall see, the availability of methods for determining and valuing effects and the suitability of these methods for use in CBA vary considerably between policy fields. These differences cannot all be described in a general guidance document such as this, which again underlines the need to develop handbooks which expand on the general guidelines given in this document and provide detailed guidelines for specific policy fields. Moreover, the abundance of different effects, markets, methods for determining and valuing effects and their various strong and weak points emphasises the importance of the judgment and professionalism of the CBA compiler.

Despite this, in this chapter we do discuss several policy fields. The point of this is to provide some insights into the types of measures used in different policy fields, how the relevant

markets are defined and the use of the various methods for determining and valuing effects. This illustrates the methods and procedures described in previous chapters in more concrete terms and provides an opportunity for synergy between different disciplines and policy fields. We discuss the following policy fields: transport and mobility (Section 8.2), area development (Section 8.3), health and social care (Section 8.4), flood protection (Section 8.5), energy and environment (Section 8.6), nature conservation (Section 8.7), education (Section 8.8), labour market policy (Section 8.9).

We begin with policy fields in which the amount of experience that has been gained with CBA is relatively large, and end with policy fields in which CBA has been used much less. The list of policy fields we cover here is not exhaustive, nor do we provide exhaustive information for the preparation of CBAs in specific policy fields, as this is the job of the handbooks. Our aim here is to give an impression of methods that can be practical building blocks for the preparation of CBAs.[72]

8.2   Transport and mobility

Cost–benefit analysis has become a standard tool in the field of transport. Measures often involve investments in infrastructure, which are assessed by means of a CBA. Many of these are investments in a road with the aim of increasing capacity and thus reduce congestion. However, measures may also be about making better use of existing infrastructure, such as road pricing schemes. This policy field also includes measures/investments in waterways and ports, airports and public transport.

A road widening project

The main effect of a road widening project is usually shorter journey times, which reduces journey costs for travellers. These costs – also called the generalised travel cost – include travel time, fuel costs and things such as parking costs and the value of travel time uncertainty. This can be seen as the price of travel. The measure has an effect on the market for travel, because it lowers the price, thus, leading to an increase in the demand. This in turn is expressed as an increase in the number of journeys. These effects are measured not only for the newly constructed infrastructure, but throughout the whole network. In practice this is done by looking at the markets for all journeys, including effects on travel by other modes of transport.

This means that works between junction A and junction B are seen as an intervention in the market for all journeys, including journeys that make no use at all of the section of road between junction A and junction B. The message is that the degree to which other goods and services are closer substitutes for the narrowly defined market in which the intervention is made, increases in the effects that can be expected on the markets for these close substitutes. These effects must then be included in the CBA as direct effects.

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[72] This chapter contains brief discussions of several actual CBAs, with an emphasis on how they dealt with various aspects of the determination of effects. In discussing these CBAs the authors make no comment, implied or otherwise, about their quality.

Finally, investments in roads often have side effects on the noise burden, air quality, road safety and the landscape. These are all (non-priced) direct effects on the missing markets for noise annoyance, clean air, road safety risks and landscape quality.

Public transport

Investments in public transport (PT) routes have similar effects and associated side effects on the travel markets as road schemes. Besides, the purpose of PT projects is often to provide an alternative to other more polluting forms of transport, and so environmental impacts can hardly be called side effects. In addition, the operating balance of the PT company is an important element in CBAs of investments in PT infrastructure. The text box 'Operating balance of public transport' explains how and why this is included in CBAs based primarily on consumer willingness to pay.[73]

Effects and determination of effects

The main effects of transport measures are travel time and number of journeys. These can be calculated using transport models such as the Dutch National Model System (*Landelijk Model Systeem*, LMS) and the Netherlands Regional Model (*Nederlands Regionaal Model*, NRM). The LMS is used to make national forecasts of traffic on the trunk road network and rail passenger numbers; the NRM is comparable to the LMS, but delivers forecasts at the regional level. Various big cities have their own municipal transport models and Dutch Railways (NS) has a transport model for the rail network. There is also a model for the civil aviation sector.

> ### Operating balance for public transport
>
> Public transport is operated by various companies, such as bus companies, railway companies and city transport companies. The difference between the cost of providing public transport services (cost per timetable hour) and the benefits from the sale of tickets is the operating balance: this is the operating profit or loss of these companies. These profits or losses add to or reduce the income of the owners of these companies and thus have an effect on welfare. It does not matter whether these companies are in public or private ownership. Changes in these profits and/or losses can therefore be seen as changes in welfare.
>
> In many cases the operating profit is negative. These losses are compensated for by the government to ensure the company can continue to operate the service.
>
> A public transport project can lead to a change in the operating balance of the public transport companies. Projects often involve an increase in the number of services to be operated. The costs of these additional services are at the expense of the operating balance, but they bring in additional fare income. The changes in the operating balance of public transport companies as a result of a project or measure make up a welfare effect in the CBA of that project or measure.

Other effects, such as effects on road safety, emissions and noise annoyance, are generally derived from vehicle-kilometres using an index number and not calculated separately in a model. Although these models are available, they are not used as a matter of course when

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[73] The main direct effects of investments in ports, locks (including the Gent–Terneuzen Canal, the IJmuiden locks that provide access to the Port of Amsterdam, the Maasvlakte II expansion of the Port of Rotterdam) and airports (including expansion at Amsterdam Schiphol) are also on the market for transport in the form of savings in travel or transport costs. Investments in navigation channels and ports mainly benefit freight transport. Freight transport is affected to an extent by investments in other modalities, but the main effects are on passenger transport. In all cases, aspects such as noise annoyance and air quality are also included, as well as the balance for the port or airport operator.

assessing transport measures, because the effects on emissions and noise are small and proportionate to the effects on mobility.[74]

8.3   Area development

Area developments are investment programmes for the development of a package of land uses in a defined area, the 'plan area'. Many of them are in urban areas[75] and so they include homes, offices, business parks, facilities and amenities (retail, hospitality establishments, public space, cultural facilities, education, care facilities, utilities, etc.).

Effects
The effects of such investments are measured on the markets for housing, office space, industrial land and facilities. To define effects more in terms of markets and welfare effects it may be more useful to start from the activities that take place in urban areas.[76] People and businesses develop activities that lead to demand for land (for housing, business accommodation, public space, etc.) and facilities/amenities. Changes in the supply of land and facilities (investments) lead to welfare effects. Property markets are derivatives of this supply and demand. Because many of the markets for land and facilities do not exist, real estate markets are useful for determining welfare effects because the services provided by land (development) and facilities are capitalised in property values.

Area development also causes effects outside the plan area, because the investments lead to some displacement of activities. Older industrial estates or offices may become empty, for example, or new housing in the area generates more demand for restaurants, bars and cafes in surrounding urban areas. These effects are also included as direct effects and can be expressed through the use of and valuation of the existing real estate outside the plan area: not only in the surrounding area, but also in the whole the country.

Finally, area development projects often have side effects on environmental quality. Environmental quality can be characterised as a collection of services that determine the state of the environment. These are almost always services on missing markets. Wever and Rosenberg (2012) describe aspects of environmental quality frequently encountered in area development: besides accessibility (as side effect), these are air quality, noise burden, various types of safety, archaeology, ecology, soil quality and water quality.[77]

Agglomeration benefits
Major spatial investments such as area development and infrastructure projects may create agglomeration benefits. Agglomeration benefits are economies of scale created by an

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[74] As well as impacts on air quality, noise and biodiversity impacts are determined from information from the environmental impact assessment (see previous footnote). A model has also been developed for road safety, from which the effects on the number of deaths and injuries of various infrastructure measures can be determined.
[75] Some area development projects are for rural areas. These put greater emphasis on nature conservation and landscape issues. They also often associated with plans to provide a stimulus to the rural economy.
[76] See Romijn and Renes (2013), *Plannen voor de Stad*.
[77] In addition, other environmental qualities may be involved, such as spatial quality and liveability. See also the website of the SEE Support Desk for Economic Evaluation.

increase in economic density,[78] combined with network effects from the clustering together of manufacturing, services and knowledge. A distinction can be made between the economies obtained from increasing densities of many different types of activities, similar activities and related activities. For example, the regional labour market becomes more efficient because more employees can choose from a larger pool of jobs and more employers can choose from a larger pool of employees. This leads to better matches between employers and employees, resulting in higher labour productivity. Productivity also rises because an increase in economic density facilitates the exchange of ideas and increases markets. This allows better use of economies of scale and economies of scope (through specialisation), and increases competition. Finally, public facilities become more economically viable.

Agglomeration benefits are indirect effects with additional welfare effects, because market inefficiencies (transaction costs and economies of scale) are involved. In principle, there are three ways to determine these agglomeration benefits:

- A spatial general equilibrium model, such as RAEM, can be used. However, the use of these models are often time-consuming and costly and so they are rarely used.
- Estimated elasticities obtained from the literature can be used to measure the gains in labour productivity as the number of employees in an area increases. See, for example, de Groot et al. (2010), Koopmans et al. (2011) and Romijn and Zondag (2012).
- The agglomeration benefits from transport measures are often determined using a generic percentage increment to the travel time gain of between 0% and 30% (but this percentage can also be negative). This is a rough approximation and the CBA compiler should take a critical look at whether and to what degree such an increment is applicable.

Determination of effects and models

Most of the direct effects (effects in the plan area) can be derived from the land development project details. Effects in the surrounding area must also be taken into account, such as vacancies in the existing building stock due to new build. These are comparable to network effects in transport projects. If housing market analyses are available they can be used to determine these effects. In addition, it will be necessary to look for further information about causal relationships in order to determine the effects and side effects in missing markets, such as the effects of an area development project on the perceived quality of the existing building stock.

The interaction between housing, employment and mobility in major development projects can be investigated using the land use transport interaction model TIGRIS XL and spatial general equilibrium models such as RAEM 2.0/3.0 and REMI.

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[78] Economic density is the concentration of activities by people and businesses. Economic density is not only determined by the number of people or businesses in an area, but also by the accessibility of that area. See, for example, de Groot et al. (2010) and Romijn and Renes (2013). Besides agglomeration benefits, there are also agglomeration disadvantages, which include all sorts of nuisance and constraints.

8.4   Health and social care

Measures in the field of health and health care include things such as preventive and curative measures, but also measures for long-term care. Preventive measures are designed to prevent people becoming ill or developing a need for care. Curative measures are for the treatment of ill people. Care includes all nursing and assistance given to people who can no longer care for themselves. Finally, measures in the field of health and health care also have an organisational component: how can the best possible care be provided at the lowest possible cost (collective health insurance premiums) within the parameters of a largely publicly funded system (efficiency, market led), and to what degree should a publicly funded health care system cover individual care needs (basic health insurance).

The direct effects of care measures are often measured as health gains, usually expressed as quality-adjusted life years (QALYs).[79] A QALY is a standardised unit indicating the degree to which patients with different illnesses or care needs benefit from the care they receive. Working with QALYs obviates the need to analyse the different markets for all the various types of care. The various health and health care markets have been combined to form a single market for QALYs, which makes it possible to compare different health and health care measures. They are often expressed as euros per QALY gained, which makes the analysis of these measures more in the nature of a cost-effectiveness analysis (CEA). The result, though, is that the health and health care effects of a measure cannot easily be evaluated against other effects. This problem could be solved by putting a value on a QALY, but valuing QALYs in euros is controversial. Moreover, QALYs are not all equivalent in terms of what they stand for and are not all valued in a uniform way (see Brouwer and van Exel, 2012).

Economic evaluations of health care measures not only measure health gains, but also labour market effects. Sick employees cannot work and this is a cost to their employers, or to the collective health and occupational disability insurance schemes, which in turn is a cost to government. Treatment and preventive measures reduce sickness absence among employees and thus the costs to the employers. Moreover, healthier employees are more productive and there may be an effect on the labour supply.[80]

Health and health care measures can also have consequences for the level of health insurance premiums and government budgets. Finally, health and social care measures may have consequences for the operating balances of hospitals and other care providers. As stated in Chapter 3 (Section 3.2.4), these changes in operating balances are welfare effects.

Preventive measures include vaccination programmes, screening for breast cancer and other periodic checks to prevent minor health problems developing into major ones. Prevention also includes measures that have nothing to do with health or health care, such as policies on

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[79] For a description of how a QALY is compiled, see for example Brouwer (2012). Besides the QALY, there are a number of other standard units available for measuring changes in health, such as the DALY (disability adjusted life year), morbidity and mortality.
[80] Labour supply effects occur if people's health influences their labour market participation decisions. As stated in Chapter 3, the benefits to the employee must be offset against the value of lost free time. Structural effects on the labour supply lead to structural employment effects.

tobacco and alcohol consumption (excise duties, smoking bans, minimum age), public amenities (playgrounds, sports facilities, green space, cycle paths) and health protection (e.g. food safety). The effects of preventive measures (either health and social care-related or not) are generally found in health gains (QALYs) and in avoided future costs of care. The health effects of non-care-related preventive measures are the result of more direct effects, such as the demand for tobacco products or the demand for sports facilities. These direct effects are the main outcomes in the analysis of such measures; health effects are indirect effects derived from these main effects.[81] Care must be taken to avoid double counting of the direct effects and the indirect health gains resulting from them.

Measures to do with the workings of the health care system (e.g. a shift in treatments from hospitals to general practitioners and concentrating certain treatments in a few selected hospitals) affect health care markets that are riddled with imperfections. These are partly due to the regulated nature of the health care system. Measures in one care sector therefore often have an influence in other sectors. But because not much is known about how different sectors are related, some indirect effects may be unexpected and may lead to unintended and counterproductive outcomes.

The definition of markets and other aspects of CBA in the health and social care sectors need to be worked out in more detail in a specific CBA handbook.

Determination of effects

In the health and social care sectors quite a lot is known about treatment–response relationships, because medicines are subject to extensive clinical trials in order to demonstrate their efficacy (see Chapter 6). Moreover, medicines are only eligible for coverage under the collective health insurance scheme once they have satisfied certain efficacy criteria in terms of QALYs gained per euro of treatment cost. In effect, this is a CEA. The procedure for carrying out such studies is set down in the Guidelines for Pharmaco economic Research published by the Health Insurance Board (*College voor Zorgverzekeringen*, CVZ).[82]

In the health field there is a long tradition of good research into the effects of treatments and there are grading systems for assessing the quality of evidence and recommendations (see GRADE. Much information can be found in the Cochrane Library, which maintains systematic reviews of scientific evidence in certain areas (see link). Medical guidelines are also increasingly evidence-based and contain up-to-date reviews of the state of the art in specific fields. As a rule, experimental studies have a limited time horizon and contain disease-specific outcome measures.

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[81] An increase in tobacco duty leads to a reduction in tobacco consumption (on the one hand a welfare loss on the tobacco market, but on the other hand health gains). Sports and games are also valued without their health effects.

[82] The CVZ guidelines deviate from this guidance document on two points. The first is the discount rate to be used. On this point the CVZ guidelines can be accommodated within the framework of this guidance, but this requires a very specific solution regarding the risk premium in the discount rate (Chapter 10). Second, the CVZ guidelines assume that the labour supply effects of care policies are temporary, based on the idea that the extra labour supply displaces the existing labour supply. In times of high involuntary unemployment, this idea is correct, but the extra labour supply due to structural effects create more jobs and there is no displacement on the labour market.

There are a large number of disease-specific models for estimating long-term effects in terms of general outcome measures. These models are often written to evaluate a specific measure. There are also several more general models suitable for a number of purposes. In all cases, though, careful scrutiny is needed to avoid double counting (there can only be one cause of death). Problems arising from competing risks can be avoided by using models that take this into account.

8.5   Flood protection

Flood protection policy usually consists of setting safety standards for dikes, dams and other flood barriers, as for example in the 'Flood Protection for the 21st Century' policy programme.[83] The resulting reinforcement of dikes and methods for managing water levels (washlands, retention basins and other 'room for the river' measures) are important project types. Another important policy tool is damage limitation. Flood probability times damage gives the flood risk.

The main effect of all these forms of flood protection policy is to reduce the risk of flooding. These effects occur in the market for flood risks, a market which can basically be seen as an insurance market. In the Netherlands most residential building insurance policies do not cover flood damage. Instead, the State provides protection against flooding.

Side effects of raising dikes include restriction of views, which can have an impact on landscape and heritage values. The way in which the taller dikes are designed to fit into the landscape can also have ecological impacts, as was revealed in the CEA of the future design of the Afsluitdijk (IJsselmeer Dam).

Willingness to pay and health and social care markets

People have a certain willingness to pay for care services or health care insurance. There is also a supply of care services and health care insurance. We can therefore talk of a market for care services (or health care insurance). Use of CBA requires an approach based on the willingness to pay mentioned above.

A measure lowers or raises the costs of certain care services. What this means for the demand for these care services can be determined on the market for those care services. The benefits can be calculated from the change in consumer surplus on this market.

Defining care markets is a tool in the analysis of the effects of care policies. The regulated nature of the care market, the existence of market failures and the interaction between the market for health care provision and the health care insurance market can mean that policy interventions may have very unexpected consequences. However, it also means that formulating these markets is not easy. A simplified representation can reveal the main mechanisms, and from this the market can be built up step by step. Market segments can be identified and the degree to which changes on one market segment affect other market segments can be investigated. This may involve different types of treatment or treatments by different types of health care providers and the role played by the partially collective health insurance scheme.

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[83] A CBA was made of this policy programme; see Kind (2011).

Two models are available for flood protection policy: OptimaliseRing (Brekelmans et al., 2012; Duits, 2011) and Diqe-Opt (Zwaneveld and Verweij, 2013). Given the flood protection standards, these models can be used to determine investment strategies for dike strengthening (both the required additional height and the timing of the works) and the associated residual risk (flood probability times damage). The models can calculate the economically optimal increase in height of the dike and the year in which the work should be carried out. The models can also be used for 'what if' analyses to determine the effects of given policy alternatives (dike strengthening or other measures to improve flood protection).

OptimaliseRing assumes that the flood probability for a dike ring[84] does not depend on other dikes and/or dike rings. Diqe-Opt considers the interdependence of 17 dike rings in the IJsselmeer region in relation to two major flood barriers: the Afsluitdijk (IJsselmeer Dam) and the Houtribdij (between Enkhuizen and Lelystad).

The models were initially developed for the revision of the statutory flood protection standards (Kind, 2011) and the development of investment strategies for dike strengthening. They are also suitable for use in 'routine' CBAs to compare flood protection options. An example is the use of the Diqe-Opt model to determine the costs and benefits of the water level management options for the IJsselmeer and increasing the freshwater buffer (Bos and Zwaneveld, 2012).

8.6   Energy and environment

Many energy-related CBAs are for renewable energy generation, especially for investments in wind energy. In environmental policy, CBAs are carried out for decisions such as tightening emission standards to improve air quality.

Renewable energy
The main effect of erecting wind turbines, for example, is the generation of electricity and the associated benefits from selling it on the electricity market. A second major source of benefits is the reduction in CO_2 emissions and other air pollution.

Other effects may occur on the electricity market (the production of electricity by conventional power stations and the price of this electricity) if the newly installed generating capacity has an influence on prices and replaces the construction or use of conventional capacity. This is also a direct effect. Another important reason for including the whole electricity market in the analysis is that renewables capacity (sun, wind) is not always available and is not suitable for meeting peak demand. This means that generating options such as wind and solar always have to be backed up by conventional capacity that can be rapidly started up.

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[84] A dike ring consist of one or more sections of dike which can be increased in height independently of each other. There are about 50 dike rings in the whole of the Netherlands.

Other important effects are the nuisance caused by wind turbines to surrounding residents, and landscape and ecological impacts.

Determination of effects: renewable electricity
The amount of electricity to be generated by solar panels or wind turbines can be calculated from the technical specifications of the installations. A business case can be a good source of information on the costs and expected returns from the sale of the electricity. The reduction in CO_2 emissions that can be attributed to renewable energy can be determined by investigating whether the renewable energy will replace any existing capacity, and if so, which capacity. Wind turbines can cause noise disturbance and the effects on surrounding residents can be determined by measuring the sound level just outside the home; in practice this is usually estimated from technical data.

Air quality

The main air pollutants are nitrogen oxides (NOx), sulfur dioxide (SOx) and particulate matter (PM_{10}, $PM_{2.5}$). Local concentrations of particulate matter can have severe health impacts and in some areas, for example near motorways, can lead to reduced life expectancy. Nitrogen and sulfur oxides have less acute effects, but have effects over much larger areas. In general, raising air quality standards leads to higher costs to companies, because their production processes and/or products (e.g. cars) have to meet stricter standards.[85]

Determination of air quality effects
The direct effect of tightening up quality standards for particulate matter is an improvement in air quality and the associated effects on human health (often measured as an increase in expected life years). A model available for determining these health effects is described by Hurley et al. (2005) and has been used for a CBA by Smeets (2012). The health gains are calculated in terms of reduced burden of disease, expressed as the number of deaths, cases of illness and hospital admissions. The model takes account of the location of homes in relation to the main sources of pollution.

Valuation of environmental effects
Environmental effects, such as the effects of particulate matter and noise annoyance, are difficult to monetise. The valuation of these effects has therefore received considerable attention in the field of environmental economics and considerable experience has been gained with measuring consumer willingness to pay. The effects on the environment (and the consequent impacts on health, nature and/or the built environment) are not only important for environmental policy, but extend to other policy fields, such as transport and integrated area development. CBAs in these policy fields, therefore, often make use of insights gained in environmental economics. Much of this type of information is collected in databases of index numbers, such as the SEE database. We have discussed the pros and cons of using these index numbers in Chapter 7.

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[85] Koopmans (2006) discusses CBAs of environmental and other standards.

8.7   Nature conservation

Nature conservation has a quantitative aspect, which is measured, for example, by the amount of land in either protected or unprotected natural habitats and forests. Nature conservation also has a qualitative component, which is measured, for example, by the number of individuals in a population of either protected/endangered or unprotected species. Measures to protect natural values are designed to have effects on things such as biodiversity and ecosystem services.[86]

CBAs of investments in nature conservation are often included in wider studies on area development projects. Investments in nature conservation are often linked to the provision of recreational facilities (and possibly ecosystem services), but there are CBAs of nature reserves and protected areas in which the existence value of nature is the core value, an example being the IJsselmeer Wetlands project. As nature and landscape are inextricably linked, landscape impacts may also play a role in nature conservation assessments.

Determination of effects
Effects on biodiversity can be determined using the *Natuurpuntenindex* ('nature value index'), which has been specially developed for this purpose. The *Natuurpuntenindex* is derived from data on the presence of species collected for environmental impact assessments. These data are used to create a weighted index based on species rarity and other criteria. The *Natuurpuntenindex* is an indicator of the various effects of measures on biodiversity integrated into a single number. See further Sijtma et al. (2009).

In a few cases the effects on ecosystem services are determined by referring to specific ecosystem services, such as water retention, removal of particulate matter and nitrate management. In these cases, effects can be determined using the method for flood protection and environment. Finally, reference is often made to the recreational function of natural areas, including effects on the enjoyment of nature and biodiversity.

Valuation of nature
Much research has been done into the valuation of nature and the landscape, and various methods can be used. When assessing effects on recreational use (and valuation) the number of recreationists is sometimes estimated using the travel cost method. To do this a price elasticity is used to translate a fall in travel costs into a rise in the number of visitors.[87] Hedonic pricing indices are also used in studies of the value of open views. Nature conservation values are sometimes determined using stated preference methods, for example in the IJsselmeer region (Koetse and Brouwer, 2013).

In all cases, though, it is questionable whether the operationalization of nature in ecosystem services (e.g. flood protection, removal of ecosystem services, and recreation) and

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[86] See Wever and Rosenberg (2012, Chapter 9). Things such as city parks and quality of the living environment are aspects of environmental quality. These fall under area development.
[87] The travel cost method leaves the intrinsic value or existence value of nature out of the equation. This is the value of nature in itself, not because of the services it supplies to people (see, for example, van Soest and Blom, 2009).

biodiversity is a measure of all the relevant effects of the changes in nature. In this respect, nature's intrinsic value is often mentioned as an aspect that is omitted. An important consideration here is whether changes in this intrinsic value resulting from the implementation of policy measures can actually be measured. Recreational values, nature value index scores and effects that alter the water retention or nitrate management characteristics of an area may also overlap somewhat, leading to double counting. Where does the willingness to pay for nature conservation measures come from exactly, and what are the relevant markets? In this type of CBA it is hard to come up with an evidence base for the relevant markets and various welfare aspects of nature. For CBAs of projects or measures affecting the built or natural environments, the measurement and valuation of several environmental variables have been standardised (see RIGO, 2013), taking account of the latest scientific knowledge. Further research is needed on what exactly we should consider to be effects on nature and how we should operationalise them in order to evaluate nature policies.

8.8   Education

Cost–benefit analysis is not an established practice in educational policy. Nevertheless, CBAs have been made of early school leaving, community schools and investments in education.[88] The effects are usually measured in terms of an increase in the labour supply or improved labour productivity. The effect on future labour productivity (wages) is often considered to be the most important welfare gain. When individuals improve their prospects on the labour market they will be more inclined to look for work. In practice, analyses often include effects on things such as crime, including youth crime, health, social position and social cohesion.

The direct effects of education policy are measured in the markets where the policies are directly implemented: the numbers of pupils or students and the level of education achieved by them. The effects on labour productivity, labour market participation, crime, health, etc. are indirect effects arising from educational attainment. Conspicuous in the analysis of the effects of education policy is that the market for schooling/education itself is often absent. Although measuring and valuing the effects of educational measures via productivity gains, the reduced probability of ending up in jail and the increased probability of a longer life is in itself a good approach, CBA compilers must also consider whether people value education for other reasons as well.[89] Moreover, care must be taken to ensure that frequently mentioned effects other than the labour market effects do not lead to double counting. A higher income as a result of higher educational attainment may be partly due to the fact that someone with a higher education is less likely to end up in jail and less likely to fall ill, but taking both of these effects into the calculation can lead to double counting. This can be avoided by defining the relevant markets with care and thinking in terms of markets for education (see text box 'Willingness to pay and education markets').

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[88] Krueger and Frederiksson et al. (2003) provide tentative cost–benefit analyses of class size.
[89] Training can also produce disutility, for example in reintegration processes.

Determination of effects

The relationship between level of education and labour productivity is fairly well known (see, for example, Card, 1999). However, much less is known about the effect of educational measures on educational attainment or final scores achieved. This means that when carrying out CBAs special care must be taken when determining the effect of a measure on exam and test scores.

The Perry Preschool Programme (a)

One of the few examples of a high quality study that includes the effect of an educational measure on educational attainment or performance as a whole is the research into the benefits of preschool education in the Perry Preschool Programme, an extensive study in the United States. The research investigates not only the effects of preschool education on income levels much later in life, but also the effects on taxes and benefit payments. The benefits of lower crime rates are also monetised.

(a) See Heckman et al. (2010).

Determination of effects

The relationship between level of education and labour productivity is fairly well known (see, for example, Card, 1999). However, much less is known about the effect of educational measures on educational attainment or final scores achieved. This means that when carrying out CBAs special care must be taken when determining the effect of a measure on exam and test scores.

The need for good impact studies

As in other policy fields, a CBA of education policy stands or falls on the quality of the assessment of effects. If the effects are not estimated using state-of-the-art methods the CBA will be flawed. The quality of impact studies depends largely on the design of the study, and a particular problem in the economics of education is selection bias. Experiments can be helpful in determining effects. For example, the effects of class size have been evaluated by Krueger (1999) and the effects of counselling on early school leaving have been investigated by van der Steeg et al. (2012), but such analyses are rarely carried out.

The ideal experiments involve random sampling. A minimum requirement is a difference-in-differences analysis (before and after measurements of a treatment group and a control group).[90] Qualitative studies are not considered to be adequate.

CBAs of education policy often lack good information about the effects of policy interventions. Many studies are not designed very well, which means the described effects may be highly distorted or inaccurate. There are also often no scientific or other empirical studies that deal with the same measure or phenomenon being investigated in the CBA. CBA compilers therefore sometimes resort to making reasoned estimates,[91] base their assessments on the expectations of the actors involved,[92] or assume that the policy objectives will be met.[93]

Using such non-empirical estimates is a risky business. Research has shown that education policies can have negative effects.[94] If this is the case in a particular situation, but a positive effect is entered into the CBA on the basis of a theoretical argument, there is a risk that the CBA will give an unjustifiably positive outcome to a measure with negative effects.

We must therefore caution against the use of 'reasoned' effects, expectations of relevant actors or policy objectives. If there are no empirical studies available into the direct effects, these studies must be carried out as part of or in advance of the CBA. It may therefore sometimes be impossible to carry out a CBA quickly. As more impact research is done, a body of knowledge can be built up about the effects of policies that can be used for CBA.

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[90] CPB uses this as a selection criterion for studies on education when assessing the financial consequences of election manifestos.
[91] Berenschot et al. (2007, Appendix 9); ministerie van OCW (2013).
[92] For example, Arcadis (2006: 26)
[93] For example, Ecorys (2009: 116)
[94] See Leuven et al. (2007) and van Elk et al. (2013). For evidence of the importance of lock-in effects, see van der Heul (2006).

8.9 Labour market policy

Labour market policy includes policies on labour market participation, income insurance for employees and reducing labour market frictions. Many measures aim to improve the performance of benefits agencies and local authorities in implementing social security schemes.[95]

CBA is not an established analytical instrument in the development of labour market policy. For example, Koning et al. (2002) note that good CBAs of active labour market policies are scarce because no studies have been made of the effectiveness of such policies. However, they also say it is possible to make welfare analyses of these policies and describe the underlying principles for such analyses. But this is not the last word on the identification, determination and valuation of the effects of labour market policies for use in CBA and so in this section we explore several aspects of carrying out CBAs of labour market policies. The discussion is based on Koning et al. (2013), who have made a start with working up the rules and insights contained in this general guidance into more detailed guidance for use in the analysis of labour market policies. Further details will have to be provided in a CBA handbook for this policy field.

Relevant markets

The CBAs of labour market policies that have been done so far have focused on the effects on the labour market itself. Although this is understandable, labour market effects are in many cases the result of a direct intervention in a more specific market.

- In an analysis of measures that reduce childcare benefit (Kok et al., 2011) the market directly affected is the market for childcare. The effects on the labour market (labour market participation choices by the parents) are secondary effects of this intervention.
- If, for example, the measure concerns reintegration policy, the analysis could start from the market for reintegration services. A change in the design of the Unemployment Insurance Act (WW) will initially have effects and welfare consequences on the insurance market (specifically, income insurance). The labour market effects are secondary. The study to determine the optimal level of unemployment benefit by Jongen and van Vuren (2009) pays specific attention to the insurance aspects of the WW.

It is important not to look only at the labour market effects. The first thing to do is establish in which market the policy measure intervenes directly in order to obtain a good understanding of precisely how it works and how the market directly affected by the measure relates to the labour market. This reduces the possibility of overlooking unexpected effects or double counting seemingly distinct effects.

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[95] Labour market policies are part of social policy. Besides labour market policies, social policy consists of measures in the field of community safety and social cohesion, disadvantaged neighbourhoods and segregation. Little is known about the effectiveness of measures in this field. Restructuring is sometimes mentioned as an instrument, but its effects are largely unknown (see Gerritsen and Reininga, 2011).

Impact research

The crux of a CBA is getting the right mix of impact research and welfare analysis. Research into the effects of labour market policies is therefore crucial for making a realistic CBA. Information on these effects can be obtained from labour market impact studies, which will often examine issues such as productivity, reservation wage rates, etc. and distinguish between various target groups of the policy. This implies that a CBA cannot be carried out without the results of a labour market study.

As in other CBAs, a high quality impact study is essential for a good CBA. Even if the step of determining the welfare effects cannot be taken, or at least not yet, because too little is known about monetising the effects, the systematic overview of the effects of a measure is in itself an important step in substantiating policy choices.

However, like many education policies, often little is known about the effectiveness of policy measures for the labour market. Before a CBA can be drawn up, therefore, a serious effort should be made to determine the effects of the measures, because the literature contains few reliable studies of use to the CBA compiler. What works and what does not will have to be found out by trial and error. Well-designed experiments can be particularly helpful.

> ## The MIMIC labour market model
>
> The determination of labour market effects can in principle be done using the CPB model MIMIC. MIMIC is a general equilibrium model of the Dutch economy that concentrates specifically on the Dutch labour market. MIMIC models (among other things) the labour supply behaviour of households. The model is based on Dutch micro data, which allows a detailed analysis of how specific policy measures influences the labour supply of a variety of households. This makes it suitable for long-term analyses of both generic and specific policy reforms in the field of social security and taxation.
>
> MIMIC is frequently used in ex ante evaluations of social security and taxation policies. Key elements in these analyses are labour market effects and effects on the central government budget (see, for example, Inspectie der Rijksfinanciën, 2010). Its use in CBA has so far been limited. Information from MIMIC has been used in a CBA of policy on female labour market participation (Kok et al., 2007).

Nevertheless, there are examples of studies in which effects have been determined for use in a welfare economics evaluation of labour market policies:

- Kok et al. (2007) investigated the economic and social costs and benefits of fiscal measures to increase the labour participation of women. Most of the effects are on the labour market (choosing between paid work and free time/unpaid work by women with a partner). Information from the labour market model MIMIC (see text box 'Labour market model MIMIC') was used to determine the effects.
- A simple simulation model of the Dutch labour market was specially developed for the economic welfare analysis of the introduction of a savings-based unemployment benefit scheme and the optimal level of the benefit (Jongen and van Vuren, 2009).
- For their CBA of childcare benefit, Kok et al. (2011) made much use of price and other elasticities from the literature.

Combination of impact research and welfare analysis

Koning et al. (2013) indicate that a combination of impact research and welfare analysis is crucial if a CBA is to be useful as a decision-support tool. Welfare analyses are usually concerned with supply and demand at a more aggregated level, which must include the welfare effects of existing market imperfections. To transfer the results of an impact study into a form suitable for a CBA it is therefore necessary to further analyse the labour market. The labour market is a very complex market with many distortions. Determining supply and demand according to the rules and guidelines in this general guidance document will reveal the welfare effects of the labour market policies and allow all the distortions in the labour market to be taken into account. An important characteristic of the labour market is that employees are not equally productive and therefore earn different wages.[96] A single demand/supply model may not therefore always be able to properly identify the effects of policy interventions, particularly if they alter the productivities of employees. In such cases, an alternative approach to calculating effects will be required, like the one used by Koning et al. (2002). For simplicity's sake we first describe an example based on a model with a single average wage, which is therefore entirely in line with the fundamentals of the CBA guidance. The example that Koning et al. (2013) use for this is discussed below.

Figure 8.1 is a stylised representation of the labour market for people with a low level of education which includes two existing government interventions: taxes and social security contributions on labour, and the minimum wage (statutory minimum wage and lowest wages in the collective labour agreements). The existence of taxes and social security contributions creates a difference between gross labour costs and net wages, called the 'tax wedge'.

The supply curve indicates how much labour employees are willing to offer. Depending on their own situation, each employee will want to earn a minimum wage before they offer their labour; this is called the reservation wage. The supply curve is the outcome of a variety of different reservation wages. The 'Demand without tax wedge' curve indicates how much employers are prepared to pay their employees. This amount incorporates the differing productivities of employees. The existence of taxes and social security contributions reduces the demand for labour, shifting the demand curve downwards to give a lower wage and therefore a lower labour market participation rate. In addition, the existence of a minimum wage ensures that an equilibrium situation in which the demand is the same as the supply is not achieved. With a minimum wage, the supply is greater than the demand, which results in unemployment.

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[96] For more about the problems of aggregating the labour supply see, for example, Heckman and Sedlacek (1985).

Figure 8.1   Tax wedge and minimum wage on the labour market for the low skilled
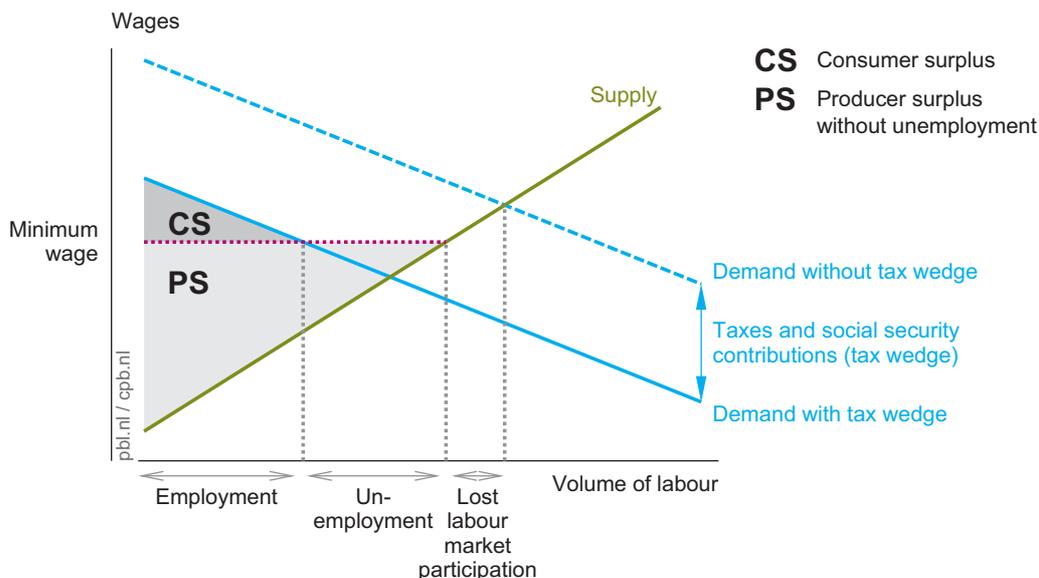
Source: CPB/PBL, 2013

Normally speaking, welfare is defined as the consumer surplus. In this case, it is a producer surplus that defines the net welfare of employees. In addition, there is a consumer surplus that represents the 'profit' to employers.[97] This profit is eventually transferred to consumers and is therefore counts towards the level of welfare.[98] In the figure, total welfare is shown in the form of triangles. The producer surplus shown in the figure is only partially achieved because of the existence of unemployment.

Labour market measures lead to changes in the demand or supply curves or to changes in the tax wedge or the minimum wage. The welfare effects can be derived from the figure as the changes in the size of the triangles. These changes are then the welfare effects in the CBA.

Policy interventions in the labour market and education can often be translated into changes in demand curves, supply curves, the tax wedge, the minimum wage or other aspects of the labour market. A few examples of interventions and translation are:

- Lowering the level of social security benefits may lead to an increase in the supply of labour, because it becomes relatively more attractive to work. The supply curve shifts to the right.
- Lowering the tax wedge moves the demand curve upwards (Demand with tax wedge).
- Penalties increase the costs to the unemployed of not working, therefore increasing the relative benefits of working. This moves part of the supply curve upwards.
- Lowering the minimum wage leads to a downward shift of this restriction, resulting in a higher consumer surplus, a smaller 'producer surplus without unemployment' and lower unemployment.

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[97] Here the employers are the 'consumers' and the employees the 'producers' of labour services.
[98] This is comparable with the operating balance of public transport (see Section 8.2).

- Better education or training leads to higher employee productivity, increasing employers' willingness to pay and thus shifting the demand curves 'Demand without tax wedge' and 'Demand with tax wedge' upwards.

The volume effects of policy measures must be derived from impact studies.

Equally important is knowing the slope (elasticity) of the demand and supply curves, at least those parts of them along which policy interventions cause shifts. In many cases, impact studies can deliver valuable information on the situations before and after the policy intervention.[99] CBAs often assume that the relevant parts of the supply and demand curves are more or less linear. In some cases it may be necessary to make other pragmatic assumptions. An important task for the authors of the individual handbooks is to come to appropriate and justifiable decisions on such aspects for a broad range of possible measures.

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[99] For example, the hypothetical outcome 'a lowering of the minimum wage by 2% leads to 0.1 percentage point less unemployment' links a change in price to a change in amount and therefore says something about the slope of the supply and demand curves.

9   Estimating costs

Costs can be considered to be one of the effects of a policy measure. However, there is a need for a separate method for determining costs for use in a CBA. In this chapter we examine the way costs are defined in a CBA and show how cost estimates can be translated into welfare effects suitable for use in a CBA.

The key **principles** for drawing up an estimate of costs are:

- The costs of a measure are made up of the costs of the resources required to implement and sustain it.
- In a CBA the costs are defined in welfare economic terms. This means that the cost of a measure is expressed in terms of relevant opportunity costs, or the value of the best alternative use the goods or services could be put to.
- Costs are calculated in market prices at the price level of a chosen fixed base year.

In addition to these principles, we provide a **step-by-step procedure** for drawing up the costs of a measure for use in the CBA:

1. Check whether all types of costs have been included.
2. Use realistic inputs, in line with the prevailing market
3. Explicitly state what risk provision has been included in the estimates costs.
4. Costs should be determined at their economic value.
5. Filter the book value from the calculations and state them separately (optional).
6. Eliminate government subsidies and contributions.
7. Calculate indirect taxes.
8. Adjust all prices to real values (compensate for inflation).
9. Use a real discount rate with a risk premium.
10. Categorise risks and determine how they should be dealt with in the CBA.

From the principles and the step-by-step procedure we can distil a few guidelines for how to estimate costs in a CBA:

- Follow the step-by-step procedure and if in doubt fall back on the principles.
- Check whether the estimated costs are plausible or not. Compare the estimated costs with those for similar measures. CBA compilers will not usually be experts on costs, so when in doubt enquire further and if necessary get a second opinion. Never simply accept without question any submitted costs, but examine them critically.
- Take a critical look at cost mark-ups. In many cases, these are the same as risks accounted for elsewhere in the CBA and are only significant from a business economics perspective. This is particularly the case when the mark-ups is to cover a risk which is also accounted for in the risk premium in the discount rate.
- Specify the risks of cost overruns.

9.1   Introduction

The academic CBA literature suggests that costs can be considered to be one of the effects of a policy measure. In foreign CBA guidance documents and the OEI guidelines on the evaluation of infrastructure projects from 2000 they are indeed interpreted this way.[100] However, in Dutch CBAs costs are dealt with as a separate category, although it is not always easy to distinguish between costs and negative benefits. In this chapter we examine the way

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[100] See, for example, Office for the Management of the Budget (2003), OECD (2006), Boadway (2006), Boardman et al. (2006), Zerbe et al. (2010) and Hagen et al. (2012).

costs are defined in a CBA and show how existing cost estimates can be translated into welfare effects suitable for use in a CBA.

The cost estimates CBA compilers get from topic experts present two types of problem. The first is that these cost estimates are often not drawn up with CBA in mind, but for a client or a developer. They may therefore contain elements that are *not* costs from a welfare economics perspective or do not contain elements that *are* economic welfare costs and so should be accounted for in the CBA. When determining the costs for a CBA there is therefore a danger of overlooking the differences between business costs and economic welfare costs. The second problem is that costs are often underestimated and so the resulting ex ante CBA balance is not a good indication of the economic rate of return of a measure to society. How can CBA compilers identify and rectify overoptimistic or inaccurate cost estimates?

When drawing up a CBA the estimation of effects and their associated benefits requires much work, and because determining the scale and value of effects is generally a very problematic business (see Chapters 6 and 7) it can be tempting to use existing cost estimates. The danger is that CBA compilers go to great pains to obtain detailed information about benefits that are hard to determine or value, but at the same time overlook margins of error of 10 or 20 per cent, or even higher, in the cost estimate.

Finally, the costs of a measure are important in themselves, to the extent that they are financed from public funds. If this endangers the financial health of the government authority, the measure may not go ahead in any case, however much it may increase economic welfare.

In Section 9.2 we examine the question of how and why we have to define costs. We look at the 'best alternative use of the goods or services' as the most suitable definition of economic welfare cost and at the grey area between costs and benefits. Section 9.3 is about using the value of the resources used as the basis for determining costs. Section 9.4 discusses the practical aspects of estimating costs. Section 9.5 examines cost overruns.

9.2 Costs in a CBA

The dividing line between costs and (negative) benefits is not clear-cut. For the purposes of this chapter, therefore, we first define what we mean by the costs of a measure and where benefits begin (Section 9.2.1). We then discuss how to measure costs according to the principles of welfare economics (Section 9.2.2).

9.2.1 Costs and negative benefits

What are the costs of a measure? If the government builds a new railway line, the first costs that come to mind are the construction costs. A measure that tightens up workplace safety standards has incurred costs during the policy preparation process and the drafting of the legislation, but the main costs of the measure will be to employers. Are those costs of the

measure, or are they negative benefits? And are noise annoyance and landscape intrusion costs or negative benefits?

There is no watertight definition of the difference between the costs of a measure and the negative benefits. However, it makes no difference in welfare economics how we define costs. As long as all the positive and negative welfare effects have been accounted for (including the costs), the balance will be calculated correctly and it does not matter what part of the effects have been included under the costs.[101]

For the purposes of this chapter we define the costs of a measure as the resources required to implement the measure and sustain it (maintenance costs). This means that investments in transport infrastructure or other development and landscape projects (housing, industrial estates, flood protection measures, habitat creation, etc.) can be seen as costs. The same applies to the costs of training and employing additional teachers or police officers, for example. Costs are also incurred to implement legislation and standards, although these are only the costs of amending legislation and regulations.

Policy measures can also lead to costs to citizens and businesses affected by the policy measures (often intended). These costs are not direct costs of implementing the measure, but costs arising as a consequence of the measure. We therefore view such costs more as effects of the measure with negative economic and social benefits. For the purposes of this chapter we do not treat these as costs.

9.2.2 Costs in welfare economics

In welfare economics, costs are always opportunity costs. In other words, the costs are always equal to the value of the benefits of the best possible alternative foregone. In the same way, we can define the costs of a policy measure as the foregone benefits of the alternative use of the resources required to implement the measure. This is because, implementing a measure requires the use of resources, which may consist of labour, financial capital, intermediate goods or services, such as the services provided by consultants and also

> **Economic and social costs of land acquisition**
>
> One of the costs to the developer (often a local authority) of developing a piece of land (for example for housing) is the cost of purchasing the land. In the land development appraisal (statement of income and expenditure) the developer states the price that has to be paid to the current owners of the land. However, these prices are not the economic and social costs. The alternative use of the land (often an agricultural use) usually generates much less income than the price paid by the developer. The acquisition costs to the developer are the benefits to the current owners of the land. The economic and social costs of the land for house building consist of the value of the land for agricultural use (alternative use).

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[101] What does matter for the total of costs and benefits is whether something is entered as a cost or a negative benefit, because it affects the ratio of benefits to costs. This benefit/cost ratio (BCR) is a much used indicator for the economic return to society or social value for money of a measure. However, the difficulty of clearly distinguishing between costs and negative benefits, as well as the possibility of netting out costs and benefits, means that the BCR of a CBA with a positive balance can be any value between one and infinity and that the BCR of a CBA with a negative balance can be any value between minus infinity and one. Say that a measure costs 100 euros to realise. The measure has two effects. One effect generates positive benefits to the value of 1200 euros; the other effect generates 900 euros worth of damage. The CBA balance is therefore 200 euros. If we enter the damage as a negative benefit the BCR is 3; if we enter the damage as a cost, the BCR is 1.2. This means that the BCR is not unambiguously defined and is therefore unsuitable as a self-contained measure of the rate of return of a project and/or an indicator to put this into perspective. It can be any number.

(foregone) ecosystem services. If the intervention is not realised (baseline alternative) the resources are put to an alternative use and generate benefits. The costs are therefore estimated in comparison with the baseline alternative. An example of the use of these opportunity costs is given in the text box 'Economic and social costs of land acquisition'.

For the purposes of this chapter we have limited the costs of a measure to the costs arising from the implementation of the policy measure (including maintenance costs). These costs are therefore only incurred in the project alternative and not in the baseline alternative. This is because resources that are used in the baseline alternative in the same way as in the policy alternative are not economic and social costs of the measure; they exist in both cases. A brick factory that supplies bricks to a housing development is not itself a cost to the housing project, but the bricks are. If the project does not go ahead, the brick factory will still manufacture bricks, but for another project.[102]

It can be questioned whether preparatory costs should be included in the costs of a measure or project, and if so, to what extent. Examples include the organisational and equipment costs of preparing for the measure and investments that have already been made. If a measure requires an input from a legal assistant in a government department, it is highly likely that were the measure not to be introduced the legal assistant would simply do the same work, but on a different piece of legislation. Like the bricks in the previous example, the resources (legal assistant) in the baseline alternative and the policy alternative are used in the same way. According to the principles of welfare economics, therefore, the costs of the legal assistant are not included in the costs of the policy measure.

However, sometimes the organisational and equipment costs form a substantial part of the policy measure. For example, for the project on alternative mobility payment (*Anders Betalen voor Mobiliteit*), which studied the introduction of a road pricing scheme,[103] a separate project organisation of considerable size was set up within the ministry, for which personnel were specially hired. When the road pricing scheme was finally abandoned, this organisation was dismantled and the personnel fired or reassigned. In such cases we can talk of costs attributable to the project ('introduction of road pricing') because the resources of the project organisation are considerable and would have been used differently had the project not been initiated. Specific organisational and equipment costs can therefore be attributed to the policy alternative. However, this applies only to organisational and equipment costs that are yet to be made. Specific organisational and equipment costs that have already been incurred and cannot be recouped are no longer costs that can be attributed to the further decision-making process.

Investments that have already been made (such as land acquisition) are also valued in the baseline alternative according to their opportunity cost (the value of the most valuable or alternative use). This means that past investments or purchases are sold if the measure does

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[102] The scale of a project can also influence the operationalization of the costs. For example, if a new brick factory is built to produce bricks for the project, the cost of this must be written down to the project.
[103] The idea behind road pricing was that instead of paying for owning a car via the car and motorcycle tax and the motor vehicle tax, car owners would pay according to how much they used their car.

not go ahead (baseline alternative). The proceeds from these sales (not the original investment or acquisition costs) are the costs that can be attributed to the measure. If it is not possible to sell these investments or if the sale yields no return (the value of the alternative use is zero), then these past investments are considered to be 'sunk costs' and valued in the CBA at zero euros.

9.3 From cost estimate to CBA: The basic principles

We have established that the costs of a policy measure can be defined as the foregone benefits of the alternative use of the resources required for a project/intervention. In this section we examine the valuation of these resources and set out the basic principles for making the cost estimate suitable for use in a CBA.

In principle, market prices can be used to value the resources, but the market value is not always equivalent to the social value of a resource. We look at this in Section 9.3.1, and then in Section 9.3.2 we briefly examine how to deal with indirect taxes (which increase prices) or subsidies (which reduce prices). We then describe how to account for inflation and relative price fluctuations on cost estimates for CBA (Section 9.3.3). In Section 9.3.4, we look at the much-used practice of mark-ups on estimated costs to take into account (yet) unknown costs and the risks of cost overruns. We show how, in principle, this can be taken into account in a CBA. And finally, we look at the significance of financing measures with public funds (Section 9.3.5).

9.3.1 Market value and social value

In efficient markets for the resources the foregone benefits are reflected in the prices of the resources in those markets. The premise is that in a market without distortions the market price equals the social value. In this case the costs amount to the spending on resources.

Prices in distorted markets do not reflect the economic and social costs of the goods and services used. The inputs to a production process may be unpriced (externalities) or a producer may have market power (excess profit). The difference between market prices and economic and social costs must be corrected in cost estimate for the CBA. For example, if the brick manufacturing industry has monopolistic tendencies, excess profits may be made. The economic cost of the bricks for the project is the price paid to the supplier. When calculating the economic and social cost of the bricks the excess profit to the supplier must be subtracted from the price, because the economic and social cost consists only of the cost of the bricks based on a 'normal' price for the factors of production labour and capital.

When making cost projections, close attention must be paid to compensation costs. If a measure damages a non-existent market (reduces the supply of services in that market), it has welfare effects. If an expense or loss must be incurred to implement the measure, for the purposes of this chapter we call this a cost (or non-priced cost). The damage is accounted for as a negative welfare effect. For certain missing markets (especially for nature), however, the

compensation principle is enshrined in national or European law. This means that the measure causing the damage should not be carried out unless the damage is repaired or compensated for (see, for example, the Second National Structure Plan for Rural Areas (Structuurschema Groene Ruimte, 1993)). This compensation principle means that in a CBA the costs of restoration or compensation must be added to the measure in addition to the damage itself. In these cases, the benefits of the restoration or compensation should also be included (as a reduction in the damage) in the CBA. This means that if it can be assumed that restoration or compensation themselves have benefits equal to the damage (i.e. cancel it out), only the costs of restoration will have to be taken into account. If compensation is only a possibility, this should be included in a separate policy variant.

Costs that are not strictly necessary for the measure itself but are needed to secure sufficient support should be accounted for as part of the costs of a CBA. An example of this are costs of landscape integration measures that go beyond statutory requirements, the benefits of which should of course also be taken into account in the CBA.

9.3.2   Market prices and indirect taxes

The cost of a measure to government should be valued in market prices including VAT (and other indirect taxes such as excise duties and cost-reducing subsidies). This may seem counterintuitive because the VAT paid by the government on the market price immediately flows back into government coffers. There are two reasons for using market prices including VAT:

1. Benefits are valued in terms of consumer willingness to pay, which is based on market prices. When consumers decide to spend their income on good A or good B they compare the market prices for these goods. Consumers also base their valuation of non-priced services on the priced alternatives they could spend their income on. The value consumers place on non-priced services is therefore a valuation in market prices including VAT.
2. The government pays for measures by raising taxes on disposable household income. This tax has the effect of depressing household expenditure. The resulting loss of VAT income to the government is about equal to the amount of VAT in the total cost of the measure.[104] This means that the amount the government needs to finance the measure is equal to the cost of the measure in market prices including VAT.

These reasons are also addressed if both the costs and the benefits are measured in market prices excluding VAT or in factor costs. The important thing is that the costs and benefits are measured in the same unit price, and the most practical way of doing this is to use market prices including VAT. This is explained further in Zwaneveld et al. (2011).

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[104] Unless the costs of the measure are subject to very different VAT liabilities than the typical consumer basket.

9.3.3　Price developments during the course of the project

Costs and benefits are quoted at the price level of a certain base year (see Chapter 7), as are the values of the resources used for the development and implementation of a measure. As a result, CBAs do not take account of the general rise in the price level, or inflation. If nominal values are used in cost estimates made for business purposes, then these prices must be converted into real or market values by filtering out inflation.

It is important to identify the relative price developments of the relevant cost items. Such price fluctuations can occur throughout the lifetime of the project, if certain resources become scarcer, for example. They include real increases in prices (compared with the general price level) and possibly cost decreases as a result of economies of scale and learning effects.

For instance, the four scenarios of the study on Welfare, Prosperity and Quality of the Living Environment ('WLO scenarios': see CPB, MNP and RPB, 2006, and Section 5.6) contain different trends in real house prices. These real increase in prices are caused by the increasing demand for homes (depending on the growth in the number of households and their income) outstripping the supply of new homes due to an acute shortage of development land in or near the most sought after locations. As a result, in the highest economic growth scenario (Global Economy, GE), house prices rise by 1.4% per year above the general rate of inflation; in the lowest economic growth scenario (Regional Communities, RC) this is still 0.3% per year above inflation.

Likewise, measures in the care and education sectors take into account the fact that trends in the cost of care and education can differ from inflation. People employed in the care and education sectors are probably unable to increase their productivity at the same rate as people working in the market sector, but they have to receive competitive salaries because otherwise insufficient number of people would choose to pursue a career in care or education. Care and education will therefore become relatively more expensive.[105] This also applies to other activities in the (semi-)public sector, including public transport.

Other reasons for deviations from a constant price level are the effects of economies of scale, learning effects and the introduction of new technologies. These factors can result in a decline in the costs and benefits per unit. Economies of scale and learning effects can be estimated using progress ratios (PRs), which describe how much costs decrease as production doubles.[106]

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[105] This is called Baumol's law. However, it is not certain that this law will hold true. It is also possible that improved methods will lead to increasing quality in the education and care sectors so that on balance the productivity of employees in these sectors may even increase at a faster rate than in the private sector. It depends on how much scientific and academic research is conducted in these fields worldwide and how much progress is made.
[106] For example, ECN (2010) calculated the costs of generating energy in a Blue Energy power station in 2020 and 2030. The growth in energy generation by Blue Energy power stations leads to a reduction in generating costs. The ECN study uses a PR of 0.95, which means that a doubling in capacity leads to a 5% reduction in investments costs.

9.3.4   Mark-ups in cost estimation

Cost estimates often include several mark-ups as a matter of course. These are used to build in margins to cover various additional costs, such as costs above and beyond the measure or project itself (for example, as a contribution to access roads serving a wider area; similar financial settlements are also used in social insurance schemes, such as occupational disability and social care) to account for costs yet to be determined, or to cover the risk of unexpected costs (such a construction site risk).

Some of these mark-ups do not belong among the cost items of a CBA, such as risk premiums. Risks are accounted for separately in a CBA, as, for example, are the costs of infrastructure serving a wider area for which the costs are listed separately in a CBA. Although these cost provisions – for that is what they are: provisions for setbacks – are prudentially highly responsible, for reasons of welfare economics they must not be included as costs in CBAs, but must be compensated for. Mark-ups for costs yet to be estimated can be included as a provisional sum for work to be carried out at a later date, for example under contingencies.

9.3.5   Marginal cost of public funds

The marginal cost of public funds (MCF) is the ratio between the marginal value of the utility of income in the private sector and the value of an additional euro in tax revenue. The MCF measures the welfare loss to the economy of increasing tax revenues. Government uses tax revenues to finance its expenditure and these taxes have a disruptive effect on the economy, leading to a loss of welfare. This means that the MCF is larger than one.

The MCF in the CBA

A standard view is that in a CBA the effects on the government budget of a policy measure should be multiplied by the marginal cost of public funds (MCF). However, Jacobs and de Mooij (2009) state that the disruptive effects of taxation are compensated for by a more favourable distribution of income. From this perspective, it is no longer necessary when appraising policy to take into account the disruptive effects of taxation.(a) Kaplow (2004) argues that when analysing the welfare effects of government policy it is not necessary to take into account the disruptive effects of taxes. The argument he uses is that a welfare economic analysis of policy only has to consider distribution-neutral financing. This is because there are many ways to finance policy and each of them has its own set of consequences for the distribution or redistribution of welfare. A distribution-neutral method of financing does not interfere with the welfare effects of the policy; neither does the combination of the measure and the financing have a disruptive effect.(b)

Besides this difference in viewpoint on the relevance of the MCF, it is also not clear what value the MCF should have. Drawing on the international literature, de Nooij and Koopmans (2004) come up with a value of 1.25. However, this estimate is not based on empirical data for the Netherlands, which is significant because the MCF differs according to the type of taxes levied and so the national mix of taxes influences the size of the MCF. MCF values for the Netherlands have been published in the study by Barrios et al. (2013) who estimate the MCF for wages tax to be about 1.5 and the MCF for energy taxes to be about 0.8. There is no empirical information available for other taxes in the Netherlands and so it is not possible to calculate the total MCF for the Netherlands.

(a) In a reaction to Jacobs and de Mooij (2009), Koopmans and de Nooij (2009) state that redistribution effects should not be valued in a CBA and so the disruptive effects of taxation cannot be offset.
(b) Distribution-neutral financing as presented here is theoretical. It can be used irrespective of whether any actual financing is distribution-neutral. If a decision is made to use a specific form of distribution-neutral financing, there is in fact a combination of two measures: the actual measure and a redistribution measure.

In practice, most CBAs do not take account of the MCF. As stated in the text box, there is much uncertainty about the relevance of using the MCF in welfare economics analysis of public policy and the correct value to use. Therefore no definitive answer can be given to the question of whether the MCF should be used or not, and if so, what value it should have. Further research is need. Until this research leads to clear and binding conclusions, we recommend continuing with current practice, namely not to take account of the MCF, in effect using a MCF of one.[107] We also recommend conducting further research into the relevance of using the MCF in CBA and the value it should have.

9.4   Estimating costs in CBA: A step-by-step procedure

The previous sections set out the basic principles that should be met when preparing a cost estimate for a policy or project alternative in a CBA. In this section we look at the practical aspects of estimating costs. The various guidance documents, manuals and cost estimation systems that are available advise structuring the costs to make it clear which costs are included and which are not. In this section we provide instruction on how to set about this in the form of a step-by-step procedure.[108]

The main focus of the procedure is on determining the economic and social costs of policy proposals from a cost estimate available in the form of a quote, a budget or an income and expenditure account for the measure or project. With some minor adjustments, the procedure can be made suitable for other types of policy measures. This step-by-step procedure covers the main points the CBA compiler should think about when drawing up a cost estimate:

1. Check whether all types of costs have been included.
2. Use realistic values obtained from competitive markets.
3. Explicitly state what risk provision has been included in the estimated costs.
4. Calculate costs at economic values.
5. Filter the book value from the calculations and list them separately (optional).
6. Delete government contributions.
7. Calculate indirect taxes.
8. Adjust all prices to real values (compensate for inflation).
9. Use a realistic discount rate with a risk premium.
10. Categorise risks and determine how they should be dealt with in the CBA.

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[107] This does not mean that the tax burden can be increased without any loss of economic efficiency. Increasing the tax burden will lead to this type of efficiency loss, but that is not a relevant consideration in a CBA. CBAs analyse measures in an otherwise unchanging environment, including the future development of the economy, taxes and government finances. These are contained in scenarios. In general these scenarios are based on a sustainable trend in government finances so that the question of whether or not a measure increases the tax burden is not relevant. A scenario with an unsustainable trend in government finances would lead to a catastrophic economic situation, making any analysis of a measure in a CBA meaningless. It is therefore not correct to deduce from this rule of using an MCF of one that the tax burden can be raised without consequence.

[108] This step-by-step procedure is based on the handbook *Van GREX naar MKBA* for area development projects (Fakton, Buck and SEO, 2012) and adapted for more general use across a broader range of policy fields.

The first three steps are about making the costs transparent. The other seven steps are about processing costs stated in a quotation or income and expenses account to make them suitable for use in a cost estimate for a project alternative in a CBA.[109] For more detailed instructions for specific policy fields and types of policy measure we refer the reader to the handbooks.

Step 1: Check whether all types of costs have been included
It is important to perform this check to be absolutely sure that all costs have been included. The cost estimate of a policy alternative contains an overview of all the costs to all parties in the Netherlands during the preparation, realisation and operation or implementation phases. This is a different approach than that taken in a land development project or business case, for example.

This check can be made using various lists of costs and cost estimation systems.[110] These systems provide a systematic overview of the various costs that may be relevant to a project or measure. Other guidelines and manuals contain lists of costs, for example the working guide for CBA of integral area development (*Werkwijzer MKBA van Integrale Gebiedsontwikkeling*) and the guide for cost–benefit analysis of ICT projects (*Handreiking voor kosten-batenanalyse voor ICT-projecten*). If these or similar lists of cost types are not available, it may be possible to check whether all relevant costs have been covered by using lists that are available as a starting point.

Step 2: Use realistic values obtained from competitive markets
The resources used should be included in the cost estimate at market prices and on the basis of realistic assumptions. Although the issue at hand is the price, the volumes involved should not be forgotten and so any (implicit) assumptions should be carefully reviewed. The following questions may be relevant:

- Is the use of resources realistic? This can be checked by comparing the use of resources with similar measures. For policy measures with mainly variable costs, a check can be made by calculating cost movements for different usage levels.
- Are the assumptions about trends and future developments realistic? This can be assessed by comparing these assumptions with the scenarios drawn up by policy assessment agencies.[111]
- Is the price indexation of the costs correct? Forecasts such as those made for the consumer price index (see CBS) and/or private-sector-specific forecasts (such as the BDB index by the Dutch knowledge institute on building costs data (*Stichting Bureau Documentatie Bouwwezen* can be used to check whether the indexation is realistic.[112]
- Have standard estimation methods been used? If so, which ones?

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[109] Step 9 and 10 are developed in more detail in Chapter 10.
[110] For infrastructure projects, standard cost accounting systems are used, such as SSK (the standard cost estimation system) and PRI (project estimation for infrastructure).
[111] CPB/MNP/RPB (2006)
[112] Cost estimates for use in a CBA must be in constant prices. In Section 9.3.3. we state that account should be taken of price movements that deviate from the trend in the general price level. Accordingly, in this step it is necessary to check whether the trend in prices is realistic. In step 8 the nominal prices are converted into constant prices. This may be done in a single step if the required information on the real trend in prices of cost items is directly available.

- How have internal organisational and equipment costs been included in the calculation of economic and social costs? Where these costs are attributable specifically to the project, has the welfare economics principle stated in Section 9.1.2 been observed?

Step 3: Explicitly state what risk provision has been included in the estimated costs
Risks may be implicitly included in the cost estimates, for example by increasing the estimated costs a little (and lowering the estimated proceeds), allocating costs (and proceeds) to a later point in time, including an item for contingencies and including a risk premium in the (nominal) discount rate.

This will lead to the inclusion of implicit risk provisions in the cost estimate (often very many) and these can be seen as economic welfare insurance premiums. However, the social risks may be larger or smaller than covered by the implicit risk premiums. Also, the implicit nature of the risk premiums means that it is not clear which part of the cost estimate is covered by the risk premium. Moreover, there is a danger that further analyses of uncertainties and risks beyond those covered by the risk premium will have to be made (step 10). As the cost estimates must reflect the expected costs as closely as possible, risk provisions must be made explicit and removed from the cost estimate. Making the risks transparent is dealt with in step 10.

It is standard practice in cost estimates to list some of the costs under an item called 'contingencies'. These are estimates of as yet unknown costs which may be specified in more detail at a later date. The 'contingencies' item is therefore not a risk premium or risk reserve and so care should be taken not to put any risks under this item.

Step 4: Calculate costs at economic values
In this step the prices of resources obtained on inefficient markets are determined, or these prices are adjusted. If the resources are traded on an efficient market, the budget expenditure is equal to the welfare effects and the price reflects the true value. This is not the case for inefficient markets, such as situations in which the market is missing and so the price is unknown, or situations in which the price does not reflect the social ('correct') cost. In these situations the economic value of the resources must be inferred or adjusted. For further explanation, see Section 7.2.

Step 5: Filter the book value from the calculations and list them separately (optional)
The book value of past investments is in many cases not the value listed in the CBA. The book value is usually based on the purchase price, whereas the value in the CBA depends on the baseline alternative and is based on the opportunity cost. The value of acquired land and buildings therefore depends on the uses to which they can be put should the project not go ahead. In the CBA these values are usually based on a continuation of their current uses. In some cases past investments are treated as sunk costs – which are investments without any alternative uses – which must be valued at zero in the CBA.

Step 6: Delete government contributions

Financial contributions from the government reduce the costs to the project initiator or developer, but not the costs of a measure in terms of the resources used. Such contributions must therefore be deleted from the cost estimate.[113] Any government contribution will come back into the picture in a balance sheet of the distribution of costs and benefits among the parties involved, where it is shown as a transfer between the government and the initiator/developer.

Step 7: Calculate indirect taxes

In the CBA the costs and benefits must always be valued in the same price unit, the consumer price: the market price including VAT and other indirect taxes, such as excise duties and transfer taxes. See Section 7.2.2 and Zwaneveld et al. (2011).

Step 8: Adjust all prices to real values (compensate for inflation)

The costs and proceeds over time should be recorded in the CBA in real prices (i.e. without inflation) and in the price level of the chosen base year. In this step the nominal values (including price movements) from the business case are converted into real values by compensating for inflation. See also Section 9.2.4.

Step 9: Use a realistic discount rate with a risk premium

A CBA uses a real risk-free discount rate (2.5%) with a measure-specific premium for macroeconomic risks. Measure-specific means that the risk premium may differ per cost or benefit. For example, it may be lower for proceeds from the sale of land for housing than for the proceeds from the sale of land for office development. In practice, measure-specific macroeconomic risk premiums have so far proved almost impossible to determine. It is therefore common practice to use the standard value for macroeconomic risk premiums of 3%. The costs and proceeds are then discounted to the base year using a discount rate of 5.5% (2.5% real risk-free + 3% premium for macroeconomic risk). If it can be demonstrated that the macroeconomic risk of the measure or project (or part of the project) is different from the national average, a project-specific premium may be used. In Chapter 10 we discuss the theory and use of the discount rate in more depth.

Step 10: Categorise risks and determine how they should be dealt with in the CBA

In step 3 all the implicit risk premiums were removed from the cost estimate to ensure that it reflects the expected costs as accurately as possible. However, cost estimates are subject to considerable uncertainty and risk. In this step these risks are made transparent and decisions are made on how to deal with each type of risk.

Risks that involve exceptional events, called pure risks, should be explicitly included (i.e. not as a risk premium, but as a stated pure risk) on the basis of the expected value (probability times impact). Other risks, such as decision uncertainties, diversifiable risk and

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[113] In relation to this it is important to make a distinction between cost-reducing subsidies included in the market prices of the goods and services purchased for the measure and transfers that are not related to products. The government contributions mentioned here belong to the second category. What needs to be identified are the costs involved, valued at market prices.

macroeconomic risk, are revealed and described by comparisons between variants, scenarios, sensitivity analysis and a premium on the discount rate. How that is done is the subject of Chapter 10.

9.5   Cost overruns

Budget overruns on public investment projects are the rule rather than the exception – at least in the popular perception. Well-known examples of cost overruns are the construction of the Betuwe rail freight line, the HSL-Zuid high speed rail connection, the renovation of the Stedelijk Museum in Amsterdam, the town hall in The Hague, the Joint Strike Fighter, the Delta Works and the North–South metro line in Amsterdam. The fact that the construction of the Hanze railway line between Lelystad and Zwolle was promoted as 'on time' and 'within budget' says it all.

Drawing up a realistic cost estimate is difficult to do, as has been shown in research by Bent Flyvbjerg and Cantarelli. Flyvbjerg concluded that 9 out of 10 infrastructure projects worldwide eventually cost more than initially estimated. The Netherlands performs quite well in this respect: the amount of overspend is lower than the global average.[114] Flyvbjerg et al. (2003) give the following reasons why costs can get out of hand during the course of a project:

- Cost estimation errors;
- Failure to consider risks and too little accountability, or lack of it, during the decision-making process;
- Tactical overestimation or underestimation of effects in the initial phases of a measure or project to ensure a positive CBA or environmental impact study so that the initiative will go ahead to the advantage of its proponents and stakeholders;
- Integration, compensation or mitigation measures that are agreed to during the process and which, therefore, are not included in the original cost estimate.

The problem of cost overruns is particularly important for investments. Although the only known research into cost overruns is on transport projects, the insights into the mechanisms underlying this overspending is also relevant to other policy fields. It is important for the decision-making process that the CBA compiler understands these mechanisms and takes account of them as much as possible in the CBA. To limit these risks they must first be acknowledged and made transparent, and greater emphasis should be given to accountability during the decision-making process. Those responsible should also be alert to potential conflicts of interest between private parties (project proponents) and public institutions (guardian of the public interest).

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[114] See also Cantarelli et al. (2012).

Important instruments for keeping expenditure under control are:[115]

- Transparency;
- Result indicators (focus on targets);
- Agreements on adhering to economic rules (early insight into all costs and how to cover them);
- Reveal risks and eliminate them as far as possible;
- Reference estimate/benchmarking (comparison with costs of similar measures).

To be of practical value, CBAs must contain sound cost estimates. Moreover, cost overruns must not become habitual. To achieve this the CBA compiler must investigate the degree to which cost control instruments are being or will be used during the measure or project and whether cost overruns are likely to occur. A second opinion should be obtained if there are any doubts about the cost estimate. If there are uncertainties about the validity of the cost estimate, the CBA compiler can make a sensitivity analysis.

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[115] Besides the instruments listed here there is the possibility of inducing various parties involved in a policy change to keep costs under control. For example, the proponent of the project could take a private stake in the costs and benefits of the project.

10 Uncertainty and risk

The future is uncertain, which means that estimates of the costs and benefits of a measure will also be uncertain. In this chapter we examine how to deal with this uncertainty and the associated risk. This uncertainty means that ex ante estimates of costs and benefits are not exact, but are subject to a margin of uncertainty which increases as the effects in question occur further in the future. There are three forms of uncertainty:

- knowledge uncertainty;
- policy uncertainty;
- uncertainty about the future.

Sensitivity analyses are used to identify the sources and magnitude of the first two types of uncertainty.

Uncertainty about the future is mainly an issue for long-term effects. This uncertainty is revealed by using scenarios of possible future trends and is accounted for in the calculation by including a general risk premium in the discount rate.

- It is important that various scenarios are used to test the effects of a measure because this provides information about the robustness of the outcome of a CBA.
- The scenarios used in the CBA must in any case reveal the order of magnitude of the main uncertainties. These scenarios must cover more than simply economic growth. Useful complementary sets of scenarios are available for various policy fields.
- The general risk premium and the real risk-free discount rate are set by the Government. In the most recent decision by the Government (made in 2011) the real risk-free discount rate was set at 2.5% and the general risk premium (the macro-economic risk premium) was set at 3.0%. For irreversible effects the discount rate is reduced by 1.5%.
- If it is possible to calculate a risk premium that is specific to the measure under investigation, this is preferable to the use of a general risk premium. As a minimum requirement, it must be demonstrated whether or not the effects of each policy measure are related to the macro-economic risk. If not, the real risk-free discount rate can be used; otherwise, the general risk premium should be used.

The influence of uncertainty and risk can be mitigated by including policy alternatives that are flexible in their response to uncertain future developments, for example by estimating the advantages of postponing the measure, considering the consequences of a phased introduction of the measure, or adapting the measure to different future circumstances. Such flexibility has the advantage of not locking in losses and not locking out benefits.

The most important guidelines are:

- Identify the three uncertainties and all the risks using sensitivity analyses, scenarios and the risk premium on the discount rate.
- If necessary, determine whether making the policy alternatives more flexible would mitigate the uncertainties and risks in the decision-making process.
- Do not deviate from the Government-prescribed real risk-free discount rate and the general risk premium.
- If there are no scenarios available for identifying uncertainties about the future, an alternative approach is to use a sensitivity analysis.

10.1 Introduction

A CBA is an ex ante evaluation of a policy measure. This means that before the measure is introduced, the costs, effects and associated benefits resulting from it are assessed in the CBA. Such predictions of costs and benefits, however, are subject to uncertainties, which in turn makes the outcome of the CBA uncertain. It is possible that under certain circumstances (such as high economic growth) a measure will increase total welfare, but under other circumstances it will generate a much smaller welfare gain or even result in a loss of welfare. The outcome of the CBA is therefore not exact, but is subject to a margin of error. The greater the uncertainty, the wider the margin of error in the CBA balance will be. Policy-makers and decision-makers must therefore decide on measures without knowing with certainty how big the costs and effects of the measures are and whether or not they will lead to increased welfare.

It is therefore important that decision-makers know how big these uncertainties are. The magnitude of the risks is a separate decision criterion. Risks and uncertainties have a negative welfare value. Most people do not like risks: they are 'risk averse', which means they put a negative value on risk; risk-averse people are prepared to give up some income to avoid risks. This is the principle underlying insurance. Uncertainties can have a negative welfare value and this must also be reflected in the CBA. These preferences also percolate through to the decision-making. If two variants of a measure are expected to generate the same welfare return, but the degree of uncertainty of their outcomes differs, the less uncertain variant will generally be preferred because the risks are smaller and the chance that the measure will later prove to have been a mistake is also smaller. The decision-maker should therefore have a clear idea of how uncertain the outcome of the CBA is.

In this chapter we examine uncertainty and risk and how these can and should be accounted for in a CBA.[116] Different approaches may be required depending on the policy field, the type of policy instrument, the time between making the investment and the occurrence of the effects, and what is known about the effects of the project. We present an overview of the various types of uncertainty, the various analytical methods and the advantages and disadvantages of those methods. This chapter does not provide new insights, but presents the state of the art.[117]

In Section 10.2 we discuss the types of uncertainty and risk. We distinguish between uncertainties about the future, uncertainties about knowledge and uncertainties about other policies. In Section 10.3 we go into the methods for dealing with the different types of risk and in Section 10.4 we discuss ways of actively responding to risk in the decision-making process (mitigation, adaptive policy).

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[116] There is a difference between risk and uncertainty. 'Risky' situations have unknown outcomes, but from the start the outcome is subject to a known probability distribution. 'Uncertain' situations also have unknown outcomes, but the probability of potential outcomes is unknown. See Knight (1921).
[117] This chapter draws heavily on Ministry of Transport, Public Works and Water Management et al. (2004). Other sources include the findings of the various departmental working groups on discount rates and risk premiums (2003, 2007, 2009, 2011). An important source is De Zeeuw et al. (2008).

10.2 Types of uncertainty

Uncertainty leads to a spread of possible outcomes of a CBA. The appropriate way of dealing with this spread in possible outcomes depends on the nature of the uncertainty. We can distinguish between three types of uncertainty:

- uncertainty about knowledge;
- uncertainty about policy;
- uncertainty about future developments, which can be divided into:
  - o macroeconomic uncertainty;
  - o specific risks.

An important uncertainty is our patchy knowledge of causal relationships governing the effects of measures and the accuracy of valuation indices. In addition, there may be uncertainties about the policy environment in which a measure should be analysed. For example, what is the tax burden, what other measures are in force (or have not been taken) in related policy fields? This is the policy uncertainty.

Uncertainty about future developments arises from the fact that the future may be different from what was expected. Social, political, technological and economic developments can all have an influence on the costs or effects of a measure. These are called macroeconomic risks. However, future risks may also be specific to the market directly affected by the measure or to the implementation of the measure, such as higher or lower than expected costs.

Below we look in more detail at knowledge uncertainty (Section 10.2.1), decision or policy uncertainty (Section 10.2.2) and future uncertainty (Section 10.2.3).

10.2.1 Uncertainty about knowledge

Knowledge uncertainty arises from the limitations of our knowledge about the effects of introducing a measure and how to value them.

Policy effects (and costs) have to be estimated. As we saw in Chapter 6, various techniques are available for doing this. These techniques have different levels of refinement and the level of detail of the input data varies accordingly. How many people will make use of the new regulation? How well will habitats and wildlife recover after the intervention? How many new visitors will the redesigned Museumplein attract? How sure are we about the valuation index of a certain non-priced effect?

The relations between a measure and its effects always involve a certain degree of uncertainty. The same goes for the valuation indices used. These are often based on assumptions about the size of certain parameters that determine the effects and which are more or less derived from empirical research. In itself, this results in a range of possible results, because the values of these parameters may turn out to be different than originally estimated. Important parameters include the discount rate, property values, the degree to

which employees respond to changes in wages or the level of benefits, the degree to which suppliers must pass on subsidies in their prices, the degree to which consumers react to changes in the prices of various (publicly financed) services, the value of time, the degree to which climate measures limit carbon emissions and how carbon emissions affect the global climate.

10.2.2   Uncertainty about policy

The economic return to society of a measure is influenced by other policy measures or projects. For example, introducing a road pricing scheme will have a big effect on the rate of return on transport infrastructure projects. Other examples can be found in the connections between water and flood control policies, nature conservation policies and planning policies. The rate of return of a measure in one of these fields is heavily dependent on policies in the other fields.

The best way to reveal these uncertainties is to define various policy scenarios, each with several concrete options for policies that have a major impact on the issue at hand. For example, transport infrastructure projects can be analysed with and without road pricing. This reveals the range of possible outcomes caused by the policy uncertainty.

10.2.3   Uncertainty about future developments

Uncertainties about the future fall into two categories. One category consists of macroeconomic risks, in which the uncertainties about the outcome of a measure vary according to macroeconomic fluctuations. The uncertainties affect all markets and influence the outcome of all policy measures and government projects. There are also future uncertainties that do not vary according to macroeconomic trends and are specific to a policy measure.

Macroeconomic uncertainty

The level of welfare a consumer can expect to achieve in a certain year in the future is uncertain. As consumers are risk-averse, they are prepared to pay to avoid this uncertainty, which itself is welfare-reducing. This uncertainty about welfare is related to uncertain developments in all existing and missing markets in which consumers make their choices and generate welfare. These uncertainties are not only caused by economic circumstances, but also by social trends, technological developments and such like.[118]

If the return on a measure fluctuates in relation to the level of welfare, this also influences the uncertainty consumers experience about their own welfare. If the relation is a negative one, the measure will generate a greater rate of return during macroeconomic downturns when families' welfare levels are low, and vice versa. Such measures reduce the welfare uncertainty of consumers and therefore act as a sort of insurance. If the economic return to

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[118] This is called the macroeconomic risk, the relation between individual welfare risks (how someone's welfare fluctuates) and the overall social trends to which individuals are exposed, as well as the degree to which they can insulate themselves from them through collective or private insurances or a well-balanced investment portfolio. In practice, this is measured as the degree to which individual consumption (as an indicator of individual welfare) correlates with the overall economic trend (as an indicator of aggregated risk). This is a limited conception of macroeconomic risk, but the only measurable one. It is also the reason why it is called the macroeconomic risk.

society of a measure relates positively to the macroeconomic trend, the welfare uncertainty of consumers is increased. When the economic return to society of a measure fluctuates in relation to macroeconomic movements, we refer to this as the macroeconomic risk of the measure.

The government takes many different measures and carries out many projects (to the benefit of consumers, households, citizens, voters, tax payers, etc.). Incidental gains and losses arising from a measure or project are therefore cancelled out by other incidental gains and losses from other measures and projects, and the average consumer is not troubled by them: the risk is 'diversifiable'. A macroeconomic risk of a measure is not diversifiable. In fact, incidental macroeconomic gains and losses will be structural effects and occur on all markets and systematically influence the outcomes of all government (and private-sector) measures and projects. Because the effects of the measure are connected in some way with the macroeconomic risks, they offer no protection against macroeconomic misfortunes, but actually heighten them. For this reason, macroeconomic risks have to be priced (see Section 10.3). In practice, macroeconomic risk is derived from fluctuations in the national income or national consumption as an approximation of the fluctuation in welfare.

Specific risk

In contrast to macroeconomic risks are risks that are specific to a measure. These have no influence on the welfare uncertainty of consumers because they cancel each other out: some policy measures produce unexpected gains, while others produce unexpected losses; the overall effect on consumer welfare is nil. These types of risks are called diversifiable risks. They are often specific to the markets in which the measures have a direct effect.

However, it makes sense to assess these diversifiable risks as well. First of all, it is important to be clear about which risks are considered diversifiable. Second, while some risks may in theory be diversifiable, in practice they are not diversified for individual consumers, governments or companies:

- Some risks may be 'concentrated', such as flood risks. These may not be correlated with macroeconomic trends, but for many residents the risk is not diversifiable.[119]
- Other risks may be diversifiable, but the associated financial losses to the government make them relevant to the decision-making process, for example if there are politically binding deficit ceilings.

10.3   Risk analysis and valuation

An important element in preparing a CBA is obtaining information about the uncertainty of the outcome and, as far as possible, valuing this uncertainty. Although many methods are available for describing uncertainty, in many cases the degree of uncertainty will be difficult

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[119] Building insurance in the Netherlands does not cover loss or damage from flooding. Instead, the State provides protection against flooding, but does not guarantee compensation should flooding occur.

to determine empirically. Valuing this uncertainty presents even more problems. In this section we discuss several different ways of quantifying risk and uncertainty and how these effects can be valued. The aim is to provide a palette of techniques for estimating uncertainties and determining whether and how they should be valued.

- Knowledge uncertainty can be described by means of sensitivity analyses. This involves making additional CBA calculations using alternative values for a number of crucial parameters. These parameters usually include the intensity of causal relationships (elasticities) or their valuation. Alternative values can also be used for the extrapolation method for prices and volumes between or after time horizons. The CBA compiler must determine the relevant range for each parameter, drawing on information that can be found in international empirical studies.
- Policy uncertainties can also be determined by means of sensitivity analyses, but instead of using different values for crucial parameters (as for knowledge uncertainty), alternative policy scenarios are used. These must not be confused with project variants.
- In general, the rate of return of a measure depends heavily on the size of the discount rate. It is therefore advisable to carry out a sensitivity analysis of the general risk premium of 3% by repeating the calculations with lower and higher risk premiums. CBA compilers must use their professional judgment and choose a suitable range. As an alternative the internal rate of return can also be calculated (see Chapter 11).

In the remainder of this section we concentrate on the analysis and valuation of spread risks associated with uncertainties about future developments. In essence, this revolves around a single question: how well does the CBA compiler know the probability distribution of the future costs and benefits of the measure, the factors influencing this distribution and what this means for the valuation? In Section 10.3.1 we discuss the methods for determining spread risks associated with future risks. In Section 10.3.2 we examine the methods that can be used to value these risks.

10.3.1   Analysis of spread risks associated with future uncertainties

Scenarios can be used to describe trends in the markets relevant to the measure under investigation. Scenarios are often prepared as part of complementary systems of internally consistent but complementary scenarios which can be used to describe fundamental uncertainties about the future. Analysing a measure with such a complementary system of scenarios provides information on the effects of the measure in different contexts, which in turn gives a picture of how uncertain the outcome of the measure is. Because this highlights the strengths and weaknesses of policy measures under various different conditions, it reveals critical factors for the success and failure of the measure and the possible consequences of different strategies for dealing with this uncertainty can be explored.

Scenarios are therefore important in identifying the uncertainties surrounding the outcome of a measure. The question is, how many scenarios should be used to properly identify and estimate these uncertainties? If a scenario is part of a system, an obvious approach is to analyse the measure for all the scenarios in the package, because this will give the policy-

maker the most complete picture. For example, the Four Futures (*Vier Vergezichten*) scenarios (2004) and the Welfare, Prosperity and Quality of the Living Environment (WLO) scenarios (2006) are both systems of four complementary scenarios.

In practice, the possibilities for using several scenarios in the analysis are limited because not all scenarios will be in a form suitable for use with the analytical instruments used to determine the effects of a measure. If only one scenario has been suitable programmed, the only option is to use that scenario.[120] However, this does not relieve the CBA compiler of the duty of identifying spread risks associated with future uncertainties. The future uncertainties should be calculated by carrying out a sensitivity analysis of the trends in a few strategic environment variables.

This will give a rather ad hoc picture of the uncertainty, because it takes no account of the relations between the various environment variables, but it is better than nothing.[121]
On the other hand, using more scenarios means more work, and the amount of research to be done should not be needlessly increased. The important thing is that the analyses that are carried out should provide useful information and not just doing as many analyses as possible. For this reason, often two scenarios are used, one with a high rate of economic growth and one with a low rate of economic growth. This option usually gives the biggest range of outcomes, but not always. It is therefore worth checking whether this is in fact the case. If it is not, an additional scenario will be needed to determine the maximum range.[122] Running an analysis with an additional scenario can also be useful when the outcome of a CBA based on high growth and low growth scenarios does not provide enough information on the effects of a measure, for example because in one scenario the outcome is a welfare gain and in the other a loss of welfare.[123] If a system of scenarios is available, the full range of outcomes under these scenarios must be determined; using just one scenario will not be sufficient because this would result in underestimating the risks and give a distorted picture of the rate of return of the measure under investigation.

An alternative method for identifying future uncertainty is Monte Carlo simulation (see text box). In practice, though, this is seldom used. Exceptions include the CBAs of the eastern high speed rail line and the Maasvlakte 2 Rotterdam port extension.

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[120] This shows that it is necessary to check whether it is possible to compile a complementary package of scenarios for the relevant policy field or type of measure in order to obtain a better understanding of the uncertainties involved.
[121] The MKBA RRAAM report (Ecorys, 2012) attempts to determine the maximum range of uncertainty by 'stacking up' all the sensitivity analyses in a minimum and maximum variant for the economic return to society. However, this again leads to an overestimation of the uncertainty because it is unlikely that all negatives or positives will arise at the same time. Bisschop et al. (2012, Appendix C) propose a pragmatic solution that takes account of the likelihood or improbability of combinations of assumptions. Although this solution is an improvement on the stacking approach, it involves making two assumptions: (i) all the sensitivity analyses have a normal distribution with a known average and known variance; (ii) the sensitivity analyses are not correlated. These are far-reaching assumptions which cannot be met in practice. Further reflection quickly leads to two further options: to develop an alternative scenario or to fully specifying a probability distribution for all future uncertainties. Both involve a well-nigh impossible amount of research.
[122] For road projects an analysis with the highest (WLO-GE) and lowest (WLO-RC) economic growth scenario is sufficient because these two scenarios show the greatest difference in the trend in mobility. However, this is not the case for public transport because the highest growth in public transport occurs in a scenario with moderate economic growth and a very strict (European) environmental policy (WLO-SE).
[123] This was the case for the KBA Zeetoegang IJmond study (see Romijn and Visser, 2012).

Monte Carlo Simulation

A system of scenarios can be seen as a summary of the possible trends relevant to the risks of a measure. Besides this summary it is of course possible to reveal the whole story. This full story consists of the probability distribution of the trends in all relevant exogenous variables, including the relations (such as correlations) between them. This allows the researcher to take a random draw from the probability distribution and calculate the effects of the measure for this draw. Repeating this sampling process thousands of times builds up an overall picture of the statistical uncertainty of the outcome of a measure. This process is called Monte Carlo simulation. A system of scenarios can be considered to be a well-chosen sample from the distribution.

An important advantage is that Monte Carlo simulation gives a picture of the entire probability distribution. In turn, this makes it possible to set measure-specific risk premiums (see Section 10.3.2) and make an explicit valuation of flexibility (see Section 10.4). However, this is an idealised picture and there are at least two practical problems:

1. First, the amount of work involved. Studying all the effects of a measure for more than a few scenarios would in many cases be considered an unreasonable burden. Calculating several thousand samples is certainly prohibitive. A possible way to get round this problem is automated calculation, but this requires very detailed knowledge of the relations between the measure, the effects and environmental variables.
2. The second problem is the availability of empirical data. We do not know how different strategic environmental variables are statistically related in the real world, certainly over the long term, given that economic trends can be thrown off course by political and technological developments.

An integrated Monte Carlo simulation is therefore often not feasible in practice. Instead, Monte Carlo simulation can be used to supplement scenario analysis by determining the probability distribution of one or more variables in a scenario to obtain an indication of the consequences for the valuation of risk and flexibility (see also Section 10.4).

10.3.2 Valuation of spread risks associated with future uncertainties

In this section we discuss the valuation of spread risks associated with future uncertainties. Because it is difficult to value these risks in the costs and benefits accruing from a measure, the usual approach is to use a discount rate that includes a macroeconomic risk premium.[124]

In the Netherlands the real discount rate and risk premium for CBAs is set by the Government and periodically reviewed. The most recent review was in 2011.[125] The risk-free discount rate was set at 2.5%, with, in principle, a risk premium to be set on a project-by-project basis. The review also noted that, in practice, it has so far usually not been possible to determine a project-specific risk premium. In almost all cases the standard 3% risk premium has been used. The minister subsequently adopted the advice of the working group on the long-term discount rate (*Werkgroep Lange Termijn Discontovoet*) to set a risk premium of 1.5% instead of 3% for project effects that satisfy two criteria: (1) they are negative externalities which are redressed by a project or caused by a project; (2) they are

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[124] The principle of discounting is explained in Section 7.4.2.
[125] See the letter from the finance minister to the House of representatives dated 24 August 2011, which is based on the recommendations of the working group on the long-term discount rate (Werkgroep Lange Termijn Discontovoet, 2009) and draws on an earlier letter on this subject from the minister to the House of representatives dated 11 September 2009.

irreversible effects.[126] The decisions and recommendations of the working group that have been adopted by the Government should be followed when preparing CBAs.[127]

In various policy fields (health care, education) there is a debate about whether the discount rate for long-term effects is too high, which would mean these effects are underrated in CBAs. Another question is whether the official discount rates and risk premiums are appropriate for all policy fields. We recommend that both these issues should be looked into further during the next review of the discount rate.

Risk premium on the discount rate

A CBA compiler confronted with future risks should determine the degree to which the uncertainties of a measure are related to macroeconomic fluctuations. This is captured by the beta, which measures the correlation between a (net) benefit stream and macroeconomic developments.

In practice, the relation between the effects and macroeconomic movements is not so clear for measures that have to be taken by the government. In the supplement to the OEI guidelines on risk valuation (2004), statistical analysis and Monte Carlo simulation are stated as possible methods for determining this relation (the beta). At the same time, it is noted that these are difficult to do in practice.

A possible alternative is to examine relevant market information or comparable measures. A beta can only be determined for effects arising in existing markets, for example by examining company profits or returns. However, the markets on which many government measures have an effect, are missing markets, which means that market information will seldom be relevant for determining the beta for the effects of government measures.

Because in practice it is hardly ever possible to determine the beta, often a choice is made between the effects 'without macro risk' with a discount rate of 2.5% (beta is zero) and the effects 'with macro risk' with a discount rate of 5.5% (beta is one). The beta for diversifiable risks is by definition zero.

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[126] This is a pragmatic choice based on as yet partially tested theoretical knowledge. It applies to projects that can be seen as a form of insurance against the risk of undesirable long-term effects, especially negative effects of climate change, such as sea level rise. Albers (2009) shows that an adjustment of the standard discount rate can be considered for such effects. However, the academic discussion on this topic has not come to a satisfactory conclusion yet.
[127] This Government decision is reviewed every four years and reflects the state of the art in a continuing academic debate. A revised Government decision replaces the previous decision with immediate effect.

The effect of discounting

The figure below shows what the discount percentages mean for the present value of 100 euros of welfare the further in the future it is paid out.

Change in the present value of 100 euros in the future at various discount rates
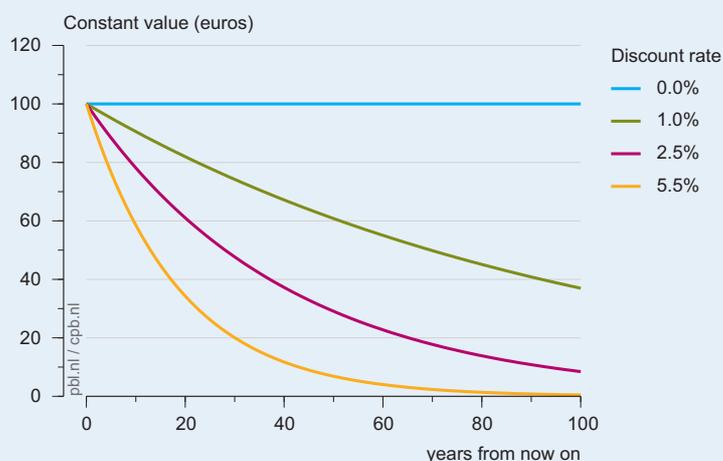
Source: CPB/PBL, 2013

The size of the discount rate makes a considerable difference to the value of a 100 euro welfare gain in 25 years' time. At a discount rate of 2.5%, the present value of the welfare gain will be 54 euros and, at a discount rate of 5.5%, it will be 26 euros. After 100 years, the present value of the welfare gain of 100 euros has shrunk to just 8 euros at a discount rate of 2.5% and is worth just 50 cents at 5.5%. Discounting therefore has major consequences for the value of effects that arise in the distant future, and the size of the discount rate itself makes a considerable difference.

Discounting cost and benefit streams separately

When determining the risk premium based on the beta we recommend setting separate risk premiums for each cost and benefit stream. The reason for this is that benefits and costs can correlate differently with macroeconomic movements. It is often easier to investigate and understand these separate relations than those for the balance of the various costs and benefit streams and as a result there is more justification for the specific risk premiums for individual cost and benefit streams.

However, calculating separate risk premiums (betas) for separate cost and benefit streams is still not easy. A pragmatic choice must be made between no risk premium (beta = 0) and a risk premium of 3% (beta = 1). There is no general rule on the items for which a risk premium should or should not be used. However, it is not uncommon for the fixed costs of a measure to be discounted without a risk premium and variable costs to be discounted with a risk premium. The Government's rules on the discount rate still have to be elaborated in detail for the different policy fields in the handbooks.

10.4   Flexibility

Uncertainty and risk not only have consequences for the research that needs to be done for a CBA and the results of this research, but also for the nature of the decision about the measure and the policy alternatives to be investigated. The question is no longer just about whether a measure should be introduced or not, but also whether it should be introduced now or later, how quickly, in what form and to what degree. Flexibility is therefore important when shaping the policy alternatives for dealing with uncertainty and risk. A flexible design has advantages, because it leaves room to anticipate and respond to new developments and changing circumstances. Keeping certain options open avoids incurring unnecessary costs or missing opportunities.

How well a measure can respond flexibly to changing circumstances is determined in part by the initial choices made. For long-term measures in particular it often makes sense not to work out everything in detail to start with. Consideration should therefore be given to building choices and decision moments into the design of the measure when drawing up policy alternatives. What has to be decided now and what can be left until later? Or, to what extent can a measure be broken down and introduced as a phased programme of sub-measures[128] in which each subsequent phase requires a new decision?[129] Can a measure be designed in such a way as to avoid sunk costs? Another form of flexibility is the use of pilot projects and experiments before introducing a measure in its definitive or final form – or not introducing it at all. These methods are used in the care sector, labour market policies, community safety and education.

Phasing and flexibility are thus a strategy to limit the risks of a measure. Other things being equal, a flexible variant should have a narrower range of outcomes. Flexibility is valuable in a CBA because it reduces uncertainty. This may mean that from a welfare economics point of view it is a good idea to choose flexible variants or look for opportunities for the phased introduction of a measure. A CBA should show whether these are indeed better options than less flexible alternatives.

There are various possibilities for using a CBA to decide whether flexibility will have added value for society.

- On option to help decide whether the introduction of a measure should be postponed or not is to use the first year rate of return (FYRR) in addition to the CBA balance. This criterion indicates whether postponement by a year would be economically

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[128] An example is the investments that need to be made now to ensure protection against the rising sea level. As there is still much uncertainty about the future rise in sea level and because building flood defences now to meet the requirements of the worst case scenario is exceedingly costly, a flexible strategy is needed that makes the investments that will be needed during the coming period dependent on the trend in sea level rise.
[129] When doing this it is important to keep in mind the definitions of policy alternatives (see Chapter 5). Is the programme indeed an indivisible whole that requires an integral study, or are there really separate policy alternatives that should be studied separately?

favourable.[130] For a phased programme of sub-measures, the FYRR can be calculated again for each subsequent phase.

- The effect of flexibility can be demonstrated by defining more and less flexible policy alternatives and calculating the outcomes under different conditions (scenarios). The optimal use of the flexibility built into a variant must be determined for each scenario, which means the flexible policy alternative acquires a different design for each scenario.[131] The resulting CBA outcomes of the more and less flexible variants illustrate the degree to which flexibility can mitigate the uncertainties in the outcomes and how much this costs.

- Both of the above methods do not give a direct valuation of flexibility. In theory, this can be done using the real options valuation method.[132] However, there are serious obstacles to the use of the real options analysis for CBA. For these reasons, in this guidance we do not recommend using this method as standard practice.

The main criterion when choosing a method is that it provides information relevant to the policy under investigation. If the scenario analysis is sufficiently conclusive, no further study should be needed. However, if the scenario analysis does not produce a clear enough picture, consideration can be given to introducing more detail into the policy alternatives, which will mean analysing addition policy alternatives. There is then the possibility of using a real options analysis to investigate the most important remaining uncertainties (see also the text box on Monte Carlo simulation in Section 10.3.1).

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[130] For an explanation of the FYRR see Appendix C of Eijgenraam et al. (2000). The FYRR can also be calculated for longer or shorter periods of postponement than one year. The FYRR may only be used if the CBA balance is positive.
[131] This was done, for example, in Grevers and Zwanenberg (2011).
[132] Flexibility introduces choices or options into a policy variant. In theory, these can be valued using the techniques for valuing financial options and financial call options. This is explained in Chapter 7 of Eijgenraam et al. (2000, Part II). See also Dixit and Pindyck (1994). An illustration of the use of real options valuation in the context of a CBA can be found in van Rhee (2012).

11 The outcome of a CBA: Reporting, presentation and interpretation

It is essential that CBAs are done properly, but it is equally important that they are reported clearly. No matter how good a CBA is, if the report is inadequate, the policy preparation will not fully benefit from the insights gained and the decision-makers may be wrong-footed.

A good CBA report satisfies the following criteria:

- The results are clear and presented in a user-friendly way.
- The CBA report contains the basic information needed to answer the questions most relevant to the decision-making.
- The report must interpret the outcome of the CBA: what can the decision-maker learn from the CBA?

The report must also be written in clear language and make use of illustrative material if this helps to make the results more accessible and easily understood.

To this end a CBA report should preferably cover the following topics:

I   Description of the CBA
    a   The structure of the CBA
        • the problem analysis
        • the baseline alternative
        • the proposed measure or measures and variants/alternatives
        • relevance to the decisions to be made: the questions the CBA answers
        • the costs of the policy measures
        • choice of scenarios (short or long term)
    b.   Effects included in the CBA (definition of the markets)
    c.   Results of the CBA
    d.   Distributional effects

II   Methodology
    a.   Scoping, determination and valuation of effects
    b.   Determination of costs
    c.   Knowledge uncertainties: sensitivity analyses
    d.   The main knowledge gaps and how they have been addressed
    e.   Preparation of the CBA, the people/organisations involved and their input

III Interpretation of the CBA
    a.   How does the outcome of the CBA inform the decision-making?
    b.   What are the key factors that determine the results?
    c.   What options are available for improving the policy measures (including phased introduction, postponement and alternative measures)?

IV   Summary and conclusions
    a.   A self-contained and well-written policy letter stating the main results and conclusions (including a short explanation of the basis for these conclusions) and an interpretation of their significance for the decision process
    b.   A table showing the expected effects of each policy variant, the associated benefits and costs, and the overall balance, as well as important unquantified or non-monetised effects and the important uncertainties

The order of these topics is not fixed. For example, it is usually a good idea to put the summary at the beginning of the report, but it may also be attached to the report as a separate document in the form of a policy letter. The interpretation of the outcome may also be presented along with the description of the effects. The explanation of the methodology may be included in appendices.

In this CBA guidance document, we present general rules for presenting the CBA. Detailed advice for specific policy fields will be given in the handbooks. Deviations from the contents of the report, the summary and summary table are permitted as long as clear reasons are given.

11.1   Introduction

In the previous chapters, we looked into what CBA is, the role it can play in the preparation of policy and the decision-making process, and how a CBA should be carried out. But no matter how good a CBA is, if the report is inadequate, the policy preparation may not fully benefit from the insights gained and the decision-makers may be wrong-footed. The report on the findings of the CBA is therefore just as important as the study itself.

The outcome of the CBA must be presented clearly and unequivocally. To this end, we set out a number of general requirements and points that need to be considered when preparing the report and presentation. Because no two CBAs are the same, the report should also address this specificity.

This chapter explains these requirements and the points to be addressed when reporting on the findings of a CBA. In Section 11.2 we discuss the importance of the report, formulate the requirements and points for consideration, and present a template for a CBA report. In the subsequent paragraphs we describe each of these requirements and points in more detail: how the CBA should be written up (Section 11.3) and reporting the terms of reference and underlying methodological principles (Section 11.4). Section 11.5 is about interpreting the results of the CBA. In Section 11.6 we look at the summary and summary table. All the topics covered in Chapters 5 to 10 have a place in the report.

11.2   The importance of a good report: Requirements and points to consider

To ensure that the CBA can play a full role in the decision-making process the report must be well-written and contain the main conclusions and supporting evidence. If the findings of the CBA are not fully understood because of poor presentation, it will not be possible to make full use of the CBA when examining the measure, discussing its merits and drawbacks and coming to a considered decision. A poor report means that the users will not get the full benefits of the insights provided by the CBA.

The goal of the CBA is to support the decision-making process by providing structured information. The supplement to the OEI guidelines *Heldere Presentatie* [Clear Presentation] notes that if the results of the CBA are not clear to the decision-makers they may get an incorrect picture of the merits of the project or measure. In the final instance, an attempt will be made to find information and measures that can be understood (for example, from a multi-criteria analysis). This may lead to different decisions, with potentially unfavourable consequences for welfare in the Netherlands. In the longer term, ambiguous or poorly written reporting may lead to an erosion of support for the use of CBA, or for research to support decision-making in general. If the results are incomprehensible, one may conclude that the study should not have been done in the first place.

This section deals with the requirements to be met by a CBA report. These requirements are designed to ensure that optimal use is made of the advantages offered by CBA and that this will sustain a sufficient level of support for the use of the CBA. The CBA report should meet three main criteria. For detailed requirements for specific policy fields we refer to the separate handbooks. The three main requirements are listed below:

1. The report on the CBA must present the results objectively, clearly and in a user-friendly form, backed by supporting arguments and evidence.
2. The information contained in the CBA must meet the needs of at least the most important readers. The report must give readers the basic information they need to answer the questions most relevant to the decision-making.
3. The report must interpret the outcome of the CBA: what can the decision-maker learn from the CBA?

In addition, the usual rules for clear writing apply. Use may also be made of alternative forms of presentation, such as visualisations supported by maps, figures and graphics. We discuss the requirements briefly below.

Results and accountability
The report on the CBA must present all the relevant results in an overview table. These results must be presented objectively, clearly and in an easily understandable form. The outcome must be verifiable. The report must contain an explanation of the underlying principles of the CBA and the methods used. It is therefore important to be fully transparent about the structure of the CBA, the assumptions made, the calculation methods used and outcome. The text box at the beginning of the chapter shows how this is reflected in the structure of the report.

The report must be theoretically and empirically sound. Conclusions must not only be backed by evidence and sound reasoning, but the reliability and accuracy of the information should be discussed, as well as how the assumptions, premises and postulates influence the outcome. In addition to the results, the report should present an objective account of the limitations of the CBA.

Information needs of the users
The second requirement is that the report should reflect the needs of the various users of the CBA. To make a good presentation it is necessary to know who will use the report, because the findings must meet their information needs. A judgment has to be made on the type of information the users will need and the key actors in the decision-making process supported by the CBA. A good CBA report is one from which users can quickly obtain the information relevant to them. It must therefore be written in a clear and easily understandable style. This may mean that the author will sometimes have to explain the reasoning behind the findings.

Interpretation
Finally, the report must contain an interpretation of the results of the CBA: what can the decision-maker learn from the CBA? This interpretation must include a discussion on what

questions the CBA answers and what it does not, what the outcome says about the decision to be made, the most important factors underlying the outcome, the uncertainties that have a significant impact on the results, and how the policy alternative could be improved.

11.3 Description of the CBA

The report first describes the CBA itself, the policy measure and alternatives, and explains the structure of the CBA. An analysis of the problem is essential here. The report should state the relation between the measure and the problem identified in the problem analysis – as well as any policy objectives. The effects of the policy measures and the resulting benefits and costs are presented and the distributional effects of the measure are explained.

CBA design
The report should contain a description of the design of the CBA: the policy measures investigated and the corresponding problem analysis. The design of the baseline alternative is described (the choice of either a CBA or a CEA) and reasons are given for the assumptions made in the baseline alternative. It should also be made clear whether the effects of the measure have to be determined for a long period and what scenarios are used. The structure of the CBA consists of the report of the work described in Chapter 5 of this guidance document. Finally, the costs of the measure are presented (according to the guidelines given in Chapter 9).

The description of the design of the CBA should also contain a statement on how the measure interacts with its policy environment and its relation to the decision at hand. This means, first of all, that the description must state what questions the CBA can answer, how well the answers address the problems identified in the problem analysis and the policy objectives, and how the results of the CBA can be of use in supporting the decision-making. In addition, the CBA report should address aspects considered important by other stakeholders. If these aspects are not significant for the outcome of the CBA, the report should explain why this is the case.

Definition of markets
Based on the problem analysis and the proposed policy measures, the CBA compiler must define the markets used to measure the effects of the policy measures. It must be clear which effects will be examined in the CBA and the reasons for including these effects must be explained. The report should also explain the arguments for not including effects which are important to the policy-makers, stating whether:

- the effect does not arise;
- the effect does arise, but:
   o it is so small it can be ignored;
   o it is a redistribution effect;
   o including it would amount to double counting with another effect.

Results of the CBA

The report should then present the results of the CBA in a benefit–cost table, showing the effects (volume changes in the relevant markets) and the benefits and costs of all the variants of the measure that were investigated. The CBA compiler can choose to present the effects per year or for the year of a time horizon. It is usually necessary to give the present values of the benefits and costs because they are spread out over a period of time.

When interpreting the outcome of the CBA the benefit–cost balance is often used as a measure of the rate of return. The advantages and disadvantages of a few other measures of rate of return are discussed in the text box. In principle, when the benefit–cost balance is positive it can be concluded that the policy measure has a positive effect on welfare under the conditions and assumptions used for the calculation. However, if there are many unknown or non-priced effects in the CBA, it is more difficult to interpret the results properly: the monetised balance must be set off against the non-monetised effects. The report must make this clear and if possible contain an assessment of the importance of the non-monetised effects in relation to the monetised effects. In such cases, another option would be to indicate the values the non-monetised effects must have to obtain a positive balance.

Finally, it is important that the uncertainty of the information is expressed in the range of outcomes presented. In the first place, this uncertainty is expressed in the differences between the scenarios and so the report must contain an overview of the outcomes of all the scenarios. There may also be uncertainties within scenarios, such as knowledge uncertainties and policy uncertainty. These can be identified using sensitivity analyses and expressed in the form of ranges in the presentation of the outcomes of individual scenarios.

Rate of return criteria

The simplest way to express the economic rate of return to society of a measure is the balance of benefits and costs: the benefit–cost balance, or CBA balance. If this balance is positive, the measure increases welfare; if it is negative, it does not increase welfare. The main disadvantage of the CBA balance is that it is difficult to compare measures that have benefits and costs of different orders of magnitude. If two variants of a measure A and B each have a benefit–cost balance of 10 million euros, but variant A involves an investment of 100 million euros and variant B involves an investment of 200 million euros, which variant is better value for money in terms of the welfare gain?

In principle, the benefit/cost ratio (BCR) corrects for the scale of a measure. In the example above, the BCR of variant A is 1.1 and the BCR of variant B is 1.05, which suggests that variant A gives a better rate of return and is therefore preferable. The problem with the BCR is that costs and benefits cannot be identified separately (see Chapter 9). If individual costs and benefits are netted out, a measure with a positive balance can have any BCR between 1 and infinity, and a measure with a negative balance can have any BCR between 0 and 1. The balance does not suffer from this problem. To get round this, it is necessary to define unequivocally what are costs and what are benefits. This is not possible for all CBAs and has to be done separately for each policy field, but even then it is fraught with difficulties. Our advice is therefore not to use the BCR on its own.

A less ambiguous measure is the internal rate of return (IRR). The IRR is the discount rate that would give a present value of zero and can therefore be seen as the return generated by the measure. If the IRR is larger than the discount rate used to calculate the balance, the measure raises total welfare. The higher the IRR, the more profitable the measure.

Distributional effects

As indicated in Section 7.5, it is important not only to present the welfare gain or loss (at the national level), but also – where relevant – the distribution of the change in welfare across the various social groups or regions of the country. The CBA report should therefore also include the relevant distributional effects.

11.4   Methodology

The CBA report must not only contain a description of the structure, implementation and outcome of the CBA, but also include a methodological justification of the results. This allows the reader to find the arguments that support the conclusions of the report,[133] presented such that it is possible to propose counter-arguments. The supporting rationale for the study should describe the estimation of effects and the uncertainties in the results of the CBA, for example as given by the sensitivity analyses, as well as indicating how the premises and assumptions used affect the outcome of the CBA.

The estimation of effects is comprehensible and verifiable

If the underlying calculations are not transparent, it will be impossible – particularly for non-experts – to run through and check the calculations and discuss them in any meaningful way. Non-transparency can lead to a loss of confidence in the CBA. Conversely, a CBA report that makes it possible to check the assessment of effects – because the researchers clearly explain how they have arrived at them – will encourage optimal use to be made of the advantages CBA can provide. From Mouter et al. (2012) we can conclude that the main players in CBA in the Netherlands need a chart that clearly shows how effects have been assessed. The assumptions made when assessing the effects should also be clearly stated. In addition, an account of the theoretical and empirical quality of the determination of effects should be given.

The value of the information on the effects should also be clearly stated, for example by explaining the influence of the assumption on the calculation of effects, which can be determined using sensitivity analyses.

Determination of costs

The report should indicate how suitable the costs of the policy measure are for use in the CBA. Are the cost estimates reasonable? Have taxes and subsidies been accounted for correctly? The steps that need to be taken to ensure the costs have been properly arrived at are described in Chapter 9. This substantiation of the costs included in the CBA should be reported in a separate section of the report.

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[133] Page (2000) states that (averagely sceptical) readers lose faith in the objectivity of a report when they cannot find the main findings and rationale on which the conclusions are based. According to Page this applies especially to conclusions that run counter to the reader's intuition.

Knowledge uncertainties: sensitivity analyses

In the previous section we looked at the uncertainties involved in determining the effects of the measures. Other assumptions, for example about the discount rate, can also involve uncertainties that justify the use of sensitivity analyses.

Limitations of the CBA

In addition to describing the CBA itself, its limitations must also be reported. Providing insufficient information about these limitations may result in users not correctly appreciating the value of the results, which can in turn lead to findings being considered sacrosanct or to a loss of confidence in the conclusions. If the limitations of the CBA are not spelled out clearly enough, sceptical readers in particular will become increasingly suspicious of the results. It is therefore important to get across to the reader in no uncertain terms what the advantages and the limitations are of using CBA in practice. This must be a balanced picture to avoid readers mistakenly getting the impression that CBA cannot generate any useful insights.

11.5   Interpretation of the CBA

To make optimal use of the CBA during the policy preparation process it is important not only to present (and substantiate) the outcome of the CBA, but also to get across how to interpret and use the results: what can the decision-maker learn from the CBA? The CBA compiler must therefore discuss which questions can and cannot be answered by the CBA, what the outcome says about the decision to be made, the most important factors underlying the outcome, the uncertainties that have a significant impact on the results, and how the measure could be improved. The user will then be able to understand the results of the CBA much better, which in turn will benefit the decision-making process.

Clarifying which questions can and which cannot be answered by the CBA overlaps to a certain extent with the description of the relation between the CBA and the problem analysis. The latter emphasises the questions which are not answered in the CBA, and also considers other policy measures that would solve the problem, but were not included in the CBA. The degree to which the conclusions depend on the specific structure of the CBA should also be addressed. The user can then reflect on how the design of the baseline alternative, the scenarios and other aspects of the CBA influence the results. This is particularly important if the way in which the CBA was carried out is itself an issue.

The most important outcome of a CBA for the policy preparation process is the CBA balance: does the measure increase total welfare or not? However, it is often the case that a CBA does not provide a clear picture of this, for example because an important effect cannot be assessed or valued. In such cases, an option worth considering is to calculate a break-even point: how big should the effect be or what should its value be in order to obtain a CBA balance of zero? Sometimes a measure generates a positive balance in one scenario and a negative balance in another. In that case it is advisable to look into whether postponing the measure would generate a clearer picture of its welfare effects, or whether it would be

advisable to design more flexible variants. Moreover, the CBA compiler should examine all other outcomes of the CBA (for different variants, distributional effects, etc.) of significance to the decision-making.

In certain cases, the results of the CBA can also provide information about improvements that could be made to the policy measures, such as adding or removing elements, considering alternative measures or variants, and options involving phased introduction or postponement. A negative CBA balance indicates that a policy measure does not increase total welfare. It may mean that the problem is not big enough and that consideration should be given to the phased introduction or postponement of the measure. Interpretation is not just required for CBAs with a negative balance; CBAs with a positive result can also be examined to see whether any improvements are possible. The CBA must clearly state that if any improvements are suggested they must be studied in a supplementary CBA.

11.6   Summary and summary table

The CBA report should include a summary and a summary table. The summary is a self-contained *policy letter* stating the key findings of the CBA, their consequences for the decisions to be taken and the reasoning behind these conclusions. The summary is aimed primarily at decision-makers and must therefore not be too long. It is essential that the summary refers to the section of the CBA report where the various topics are explained in more depth. The report must be so structured that the most important conclusions are stated in the summary, the detailed descriptions and explanations can be found in the main report, and the supporting data are provided in appendices.

Visualising CBA results

The *Handreiking Visualiseren van MKBA-resultaten* [Guide to Visualising CBA Results] contains a number of tips on how to graphically present the results of CBAs in ways that make them readily comprehensible to decision-makers, stakeholders and the public.

Visualisation is making an informative illustration. Before starting, though, various tasks must be performed, such as checking and cleaning up the required data. Care should also be taken to use clear and concise language and to refer to the sources of the information. Although not all the tips in this Guide are about visualisation itself, they do help towards making a clear presentation:

1. Be clear about the significance and nature of the effects.
2. Divide the investigated effects into the main issues and the side issues.
3. Describe alternatives and effects in the language of the relevant target groups.
4. Check (and improve) the quality of the source material.
5. Make visualisations according to the grammar of graphic presentation.
6. Present the results in a stepwise manner.
7. Use a timeline to show the choices made during the study.
8. Communicate uncertainties and limitations.
9. Interpret the underlying information.
10. Tell the reader who is making the presentation.

The Guide contains quotes and actual examples that illustrate why the presentation tips are important. The examples of visualisations and concrete tips and advice provide CBA compilers with a practical resource guide on presenting the results of technical and research reports.

The summary table contains the relevant effects measured in volumes and all the benefits and costs (present values). The most important effects are listed at the top. The balance of benefits and costs (or another measure of the result of the CBA) should also be included in the table. It is important to consider the use of ranges, especially if it is uncertain whether the cost–benefit balance is favourable or unfavourable. All the relevant policy alternatives investigated in the CBA are listed across the top of the table and all the scenarios used in columns beneath. An example of a summary table is illustrated below.

The table summarising the results of the cost–benefit analyses is often too big and therefore difficult to comprehend. Smaller tables are better suited to the needs of many policy-makers. The volume effects could also be reported in a separate table or, if useful, in another form (such as a spider diagram or mind map).

Table 11.1   Example table

Measure	'Minimal Intervention' (MI)			'More of the Same' (MoS)			'Radical Choice' (RC)		
Scenario	'Left'	'High'	'Blue'	'Left'	'High'	'Blue'	'Left'	'High'	'Blue'
present value in million euros (converted base year Y1 in Y2 prices)									
Effect 1	-1340 to -1960	...	...	...	...	...	...	...	...
Effect 2	680 to 750	...	...	...	...	...	...	...	...
Effect 3	++	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
Balance	-30 to -100	...	...	...	...	...	...	...	...
	++								
volume effects in time horizon Y3									
Effect 1	costs (€m)	...	...	...	...	...	...	...	...
Effect 2	z%es)	...	...	...	...	...	...	...	...
Effect 3	+q participants	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...

To keep the table manageable it is important to aggregate information. The effects of a measure can be aggregated for inclusion in the summary and in the table. For example, the summary and summary table may include a group of effects called 'environmental effects', which are itemised and discussed separately in the main report. It is advisable to include only the relatively important effects in the summary table, which will usually be the biggest effects of a measure. There will also be effects that are relatively important to the reader of the CBA report, but whose magnitude or value is virtually zero or non-existent. These should be mentioned in the summary, but not shown in the table. It is important to maintain a balance between comprehensiveness, transparency and succinctness in both the summary and the summary table. This is down to the professionalism of the CBA compiler. The best way to accomplish this in practice depends on the policy field and/or the type of measure under investigation. Further rules and guidelines for compiling the table will be given in the individual handbooks.

A standard format for the summary table has been agreed upon for CBAs in the field of transport (see Koopmans, 2004). It may be convenient to develop a standard CBA table for CBAs in specific fields and/or for comparable goals and/or for comparable policy measures. This would make it easier to compare the results of CBAs. As the requirements in policy fields may differ, the details of any agreed standard tables should be included in the handbooks for the various policy fields. These should also meet the general requirements set out in this section.

Given the large amount of information produced by CBAs and the need for readers to quickly find the information of importance to them, it may be possible in future to make more use of digital reports. One possibility would be digital multi-layered may CBA reports in which the main texts contain the most important conclusions. More detailed descriptions and the information and arguments underlying the conclusions can be accessed by clicking on the links.

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Appendix A: Terms of Reference

The guidance document on the OE(E)I method for the evaluation of infrastructure projects (*Overzicht Effecten Infrastructure*), which was published in 2000, is a widely accepted set of guidelines on preparing cost–benefit analyses (CBAs) of infrastructure projects in the Netherlands. Over the subsequent years the method has been further developed and expanded, with additional handbooks, guidelines and complete CBAs. The number of fields in which the method can be used has also been expanded and continues to grow. In view of this, there is a need to pull together the knowledge and expertise gained in recent years and adapt it for use across a broader field of application in a new general guidance document for cost–benefit analysis.

On 8 December 2011 the Interdepartmental Committee on Infrastructure and the Environment (*Interdepartementale Commissie voor Infrastructuur en Milieu* (ICIM) decided to prepare a general guidance document on cost–benefit analysis ('general CBA guidance'). The ICIM appointed the CBA core team (previously OEI core team) to draw up the document. The CBA core team delegated this to the CPB Netherlands Bureau for Economic Policy Analysis and PBL Netherlands Environmental Assessment Agency.

The authors at the CPB and PBL were assisted by two advisory committees:

1. A Departmental Steering Committee (CBA core team) chaired by Corina den Broeder, with secretarial support given by the Strategic Analysis Department of the Budget Inspectorate, Ministry of Finance, and the Netherlands Institute for Transport Policy Analysis (KiM). In addition to CPB and PBL, the CBA core team consists of civil servants from the Ministry of Finance, the Ministry of Infrastructure and the Environment (including KiM), the Ministry of Economic Affairs, the Ministry of Education, Culture and Science, the Ministry of Social Affairs and Employment, the Ministry of Health, Welfare and Sport, the Ministry of the Interior and Kingdom Relations, and the Ministry of General Affairs.
2. An Academic Advisory Committee chaired by Carl Koopmans. The Academic Advisory Committee gives a second opinion on the general CBA guidance. See Appendix B.
3. In addition, expert meetings were held and external experts wrote down key points to be covered in each chapter (see Appendix C).

Appendix B: Academic Advisory Committee

The preparation of the general CBA guidance by CPB and PBL was supervised by an Academic Advisory Committee. This Committee played an important role in the preparation of the general CBA guidance and the authors express their gratitude and appreciation for the contribution made by the Committee.

This Appendix discusses the remit, composition and duties (including providing a second opinion) of the Academic Advisory Committee.

Text of the terms of reference of the Academic Advisory Committee

The Academic Advisory Committee will provide feedback on the intermediate products and submit a second opinion on the draft general guidance document. This second opinion may give rise to a request by the commissioning body to CPB and PBL to revise the text. The Academic Advisory Committee will hold three meetings with the authors: one meeting in February on the structure and contents of the report, once in April on the first draft and one in June on the final draft. The Committee will base its second opinion on the final draft. In April or May 2013, an expert meeting will be held with the experts who took part in the key point sessions in May and June 2012.

The chair of the Academic Advisory Committee has the following tasks:

- Deciding on the composition of the Committee in consultation with the commissioning body.
- Reacting to previous intermediate results in the role of criticaster (at three points during the process).
- Participating in the expert meeting to be held in April or May 2013 to inform the participants and build support.
- Writing a second opinion, discussing this with the commissioning body and CPB/PBL and finalising the second opinion in September 2013 (according to the planned schedule for preparing the CBA guidance).

Composition of the Academic Advisory Committee

The Academic Advisory Committee consists of the following members:

- Professor Luca Bertolini, Professor of Urban and Regional Planning, University of Amsterdam
- Professor Werner Brouwer, Professor of Health Economics and Chair of the Institute of Health Policy & Management (iBMG), Erasmus University Rotterdam
- Professor Pierre Koning, Chief Science Officer, Ministry of Social Affairs and Employment and Professor of Labour Markets and Social Security and VU University Amsterdam
- Professor Carl Koopmans (chair), Research Director at SEO Economic Research and Professor of Policy Evaluation / Evidence-Based Policy Making , VU University Amsterdam
- Professor Dinand Webbink, Professor of Policy Evaluation, with a specific focus on Education and Strategic Philanthropy, Erasmus University Rotterdam
- Professor Bert van Wee, Professor of Transport Policy, Delft University of Technology
- Professor Aart de Zeeuw, Professor of Environmental Economics, Tilburg University

Activities

The Academic Advisory Committee met three times (26 February 2013, 13 May 2013 and 24 September 2013). A round of written comments was held in July 2013. Several rounds of written consultation were held in the run-up to the second opinion (end of September to the beginning of November).

The meetings of the Academic Advisory Committee made valuable insights available to the authors of the CBA guidance document. Not only was this important in producing a workable, correct and relevant guidance, but also in creating support for use of the document and CBA across the various policy fields. Much of this was due to two memoranda written by members of the Committee, one on the role of CBA in relation to impact studies carried out during the preparation of policies on education and labour markets (Koning, Webbink and Koopmans, 2013) and the other on the importance of embedding CBA into policy processes (Bertolini, 2013).

The findings of the Academic Advisory Committee on the general CBA guidance are described in the second opinion, which is given in the text box below.

Response of the Academic Advisory Committee to the General CBA Guidance

Luca Bertolini (UvA), Werner Brouwer (EUR), Pierre Koning (SZW, VU), Carl Koopmans (SEO, VU; chair), Dinand Webbink (EUR), Bert van Wee (TUD), Aart de Zeeuw (UvT)

11 November 2013

Great achievement, important result

- This guidance is very important for the proper preparation of policy in many fields. CBA is an important part of this process, not only for transport and spatial investments but in other areas as well.
- CPB and PBL have done an excellent job. Writing a guidance document for general use is no easy task. A lot of work has been done and the result is most impressive. The guidance treats the various components of a CBA systematically and explains them clearly.
- Many comments by the Academic Advisory Committee on previous versions have been addressed. Some of the information contained in memoranda written by committee members has also been included.(a)

Further research needed on some points

Within the scope of this guidance document it was not possible to provide definitive advice on three major aspects. The Committee advises the departments to take further action to investigate these issues, as proposed in the guidance document. The three issues are:

- Discounting. In various policy fields (care, education, environment) there is a debate about whether long-term effects are sufficiently taken into account in CBAs. The guidance refers to the official discount rate of 5.5% and the reduced discount rate of 4% for irreversible externalities, but it is debatable whether these discount rates are appropriate for all policy fields. This issue should be considered during the next review of the discount rate.
- Marginal cost of public funds. The guidance document states that it is not known what the marginal cost of public funds is. The conclusion that can be drawn from this is that practice to date (do not include any taxation costs) cannot be considered satisfactory. The Committee endorses the recommendation by CPB and PBL to conduct further studies into the impact of the marginal cost of public funds on CBAs.
- Heterogeneity of markets. The analysis of labour market policies (Section 8.9) does not do justice to the fact that labour is heterogeneous and that this has important implications for the effectiveness of policy and the structure of a CBA. The guidance states that further research is needed on this point, and the Committee endorses this position.

(a) Koning, P., C. Koopmans and D. Webbink, Onderwijs en arbeidsmarkt in MKBA's, September 2013; Bertolini, L., Begrijpelijkheid van MKBA's en de rol van MKBA's in het beleidsproces, September 2013.

CPB/PBL supervisary committee

- Frank Dietz (PBL)
- Free Huizinga (CPB)
- Jan Rouwendal (Free University Amsterdam)
- Arjan Ruis (PBL)
- Barry Zondag (PBL and Significance Quantitative Research)
- Peter Zwaneveld (CPB)

Information sheets

In preparation for the CBA Guidance experts were invited to write information sheets on a number of subjects that should be included in de Guidance. The subjects were "use and necessity", "background and principles", "policy alternatives and the baseline", "determination of effects" and "presentation". These information sheets were drawn up by Carl Koopmans, Freddie Rosenberg and Wim Spit. The information sheets were discussed at expert meetings. Discussant were Kees van Ommeren, Freddie Rosenberg, Elisabeth Ruijgrok, Veroni Larsen and Sytze Rienstra. The authors of the Guidance gratefully used the inputs of the information sheets, discussants and the discussion at the expert meetings.

Participants at expert meetings
- Carl Koopmans (SEO, VU)
- Veroni Larsen (LPBL)
- Kees van Ommeren (Decisio)
- Sytze Rienstra (Syconomy)
- Freddie Rosenberg (Rigo)
- Elisabeth Ruijgrok (Witteveen+Bos)
- Wim Spit (Ecorys)
- Edgar Wever (Rigo)
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Other experts consulted
- Paul Besseling, programme manager, CPB
- Roel van Elk, research officer, CPB
- Egbert Jongen, research officer, CPB
- Sonja Kruitwagen, senior policy researcher, PBL
- Debby Lanser, programme manager, CPB
- Niek Mouter, PhD student, Delft University of Technology
- Johan Polder, Professor of Health Economics, Tilburg University, and Chief Science Officer at the National Institute for Public Health and the Environment (RIVM)
- Marc Pomp, health economics consultant, Marc Pomp Economische Beleidsanalyse
- Casper Schoemaker, senior researcher, Centre for Health and Society

Cost–benefit analysis (CBA) is an information tool for surveying and valuating the advantages and disadvantages of policy measures for society as a whole. CBA supports decision-making on proposed measures so that policy decisions can be as objective as possible. CBA can be applied to all sorts of measures in all policy fields.

This general CBA guidance was prepared by CPB Netherlands Bureau for Economic Policy Analysis and PBL Netherlands Environmental Assessment Agency. It gives a stepwise description of the CBA process and the criteria for its various components, thus providing rules and guidelines. In addition, this new guidance leaves various aspects open for more detailed development, for specific policy fields. This general guidance thus provides a minimum set of CBA requirements.