Department for International Development United Kingdom

Guide to Investment Appraisal for DFID Economists

DCP GIGECON/05/005

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ADDRESS	TELEPHONE	FACSIMILE	EMAIL	WEBSITE
Enterplan Limited 1 Northfield Road Reading RG1 8AH, UK	+44 (0) 118 956 6066	+44 (0) 118 957 6066	enterplan@enterplan.co.uk	www.enterplan.co.uk

DFID Economist Guide

Chapter on Investment Appraisal (IA)

This report has been prepared by James Winpenny, Consultant, through the DFID Economist Resource Centre Framework in collaboration with Enterplan Ltd and the Overseas Development Group (ODG), University of East Anglia.

Contents

1. Purpose and basic approach

1.1 IA is a method of systematically assessing and comparing proposals using objective and rational criteria. It can apply to a single and well-defined act of investment (a *project*), a group or series of projects (an *investment programme*) or even a *policy* or piece of *legislation.* It can also be used to justify specific items of recurrent spending. The pre-condition for the use of IA is that the proposal should be coherent, have clear boundaries, and its effects should be identifiable.

1.2 Most kinds of IA use a *cost-benefit* framework. As the name implies, this identifies and compares the costs and benefits expected from the proposal and provides a decision rule – benefits should exceed costs – and a criterion for comparing and ranking proposals – the size of net benefits.

1.3 Certain concepts underlie all kinds of IA:

- There are always *alternatives*. The analyst should ensure that other solutions have been considered and that the proposal under scrutiny is the best available. The proposal should be the most *effective* in achieving the aims of the project, and/or the most *feasible* (e.g. practical, timely, acceptable), as well as being the most *cost-effective* of options available.

- *Do nothing* is a perfectly respectable option in many cases. The net costs and benefits of the proposal should be carefully compared to the effects of "doing nothing". This may mean what it says, but it is more likely to involve some minimum level of activity, or "carrying on as normal". The *without project scenario* provides the benchmark against which the project is judged. If this scenario is badly drawn the case for the project will be flawed.

- Resources used in the project normally have alternative uses. They should be valued at their *opportunity cost*, *viz*. their value to society in their best alternative use. This applies to

inputs such as idle land or temporarily unemployed workers, the cost of which to the project should not automatically be assumed to be zero.

- IA is a *quantitative* decision tool. Costs and benefits should be quantified as far as possible, and within the limits of credibility. They should be expressed in common units to achieve rigour, objectivity and consistency. Not all costs and benefits can be quantified or valued, and the presentation of results should be very clear about unquantified items and their importance.

- The treatment of *time* is an integral feature. The timing of costs and benefits, and how these streams compare, is crucial information. Hence the use of *discounting*, which reflects both society's time preference and what capital could earn in alternative uses.

1.4 The completion of an IA is very far from being the end of the assessment process. It is part of an *appraisal and evaluation cycle*. As a project starts to be implemented, its performance should be *monitored* and, at an appropriate time after completion, it should be formally *evaluated*. Any lessons from these stages – such as serious unexpected features or deviations from performance – should be used in *feedback*, which can then be used either in modifying the project – if that is not too late – or in the design of future projects of a similar kind.

1.5 In some parts of HMG the above procedure has been formalised as ROAMEF, comprising a continuous cycle of Rationale, Objectives, Appraisal, Monitoring, Evaluation and Feedback, and back to Rationale etc. The practical lesson is that data from projects at all stages of implementation and operation should be collected and reviewed, and fed back wherever it is appropriate. Evaluation results should be available to appraisers as a matter of routine.

2. The use of IA in DFID

2.1 There are broadly six circumstances in which IA could be useful for DFID economists.

- Appraisal of DFID's own projects and programmes. Although the volume of conventional project aid in DFID's programme is less than it used to be, it remains important in some departments (e.g. for Dependencies). Elsewhere, it should be recalled that IA is also useful for assessing pilot exercises and spending programmes with well-defined benefits (e.g. budgetary aid).

- For commissioning external consultants, monitoring their work, and interpreting and presenting their findings to higher authority.

- Interrogating multilateral agencies on their spending proposals and projects. DFID is a major contributor to certain multilateral agencies and is represented at Board level on some (e.g. World Bank, European Development Fund, European Investment Bank, EBRD, etc). Occasionally their projects have to be challenged.

- The same is true where DFID co-finances projects with the other bilateral or multilateral agencies. It is important to understand the appraisal and decision criteria used by partner agencies.

- Expenditure on the aid programme has to be constantly justified – to Treasury, parliamentarians, press, Public Accounts Committee, and the broad spread of public opinion. The results of IA provide quantitative evidence in the case for the defence.

- Developing the methodology for the choice and justification of projects in specific sectors targetted by DFID (e.g. health, education, water).

3. Variants of IA

3.1 The main distinction is between appraisal methods that use social and economic criteria, on the one hand, and those that use purely financial criteria, on the other. Socio-economic criteria are typically used in public sector decisions, while financial criteria are used by private companies.

3.2 The most common socio-economic appraisal method is *cost-benefit analysis(CBA)*, also known as *benefit-cost analysis (BCA).* This entails:

- estimating all the costs and benefits attributable to a project;
- adjusting market values to eliminate various distortions;
- expressing them in common currency units;
- *discounting* the flows over time;
- summing the discounted flows; and
- justifying the project by the excess of discounted benefits over costs – the *net present value*. (these concepts will be explained below).

3.3 *Cost-effectiveness analysis (CEA)* is used where it is difficult or impossible to quantify benefits, or where a number of options are available to achieve the same ends. Appraisal consists of:

- defining the objective,
- estimating the costs of the various options; and
- choosing the one with the least (discounted) total cost.

3.4 The total cost can be divided by the output or physical quantities involved in the project, where this is feasible (e.g. number of hospital beds, or patients treated) to produce a cost per unit, which is sometimes more meaningful.

3.5 Problems arise with CEA where different options produce uneven results and are not strictly comparable, e.g. some will over-achieve on the main target but underachieve on important secondary matters. Some options may produce secondary benefits (e.g. marketable output) as a side effect (in this case, the value of benefits can be netted off costs for the purpose of comparison). Where it is impossible to ensure identical achievement, options may need to be weighted according to their different impacts, which complicates the use of the simple CEA measure.

3.6 CBA and CEA are both used in *option appraisal* to select preferred projects.

3.7 These methods can be complemented by various kinds of *Impact Appraisals*. For instance, the Green Book recommends that a Business Case for a project (based on one of the above methods) should be accompanied by appropriate Impact Assessments, detailing implications for Regulatory Bodies, Health, Safety, Environment, Consumers, particular Social Groups, etc. It may also be possible to include certain of these impacts (e.g. environmental, health) in CBA and CEA , where they can be quantified and valued.

3.8 In recent years *risk assessment* has become much more important in government and public agencies as an element in risk management strategies. Traditional CBA takes a probabilistic approach to outcomes, and assumes the sponsor is risk-neutral. Risk assessment and risk management drop this assumption, and identify the main risks and ways of managing them from the viewpoint of the *risk appetite* of the sponsor. The Treasury's Orange Book provides guidance (see section 9 below).

3.9 *Multicriteria analysis* assesses projects on a number of different criteria, which are not directly comparable and cannot be reduced to a single measure. Typically numbers from CBA and CEA are presented alongside quantitative data on other effects, sometimes using subjective scoring. The analysis can be presented to the decision-maker with the results on each criterion kept separate, or a single measure presented based on summing the scores for the separate criteria, weighted in some way.

3.10 Most forms of *financial analysis* are based on *discounted cash flow* to a person or enterprise. Benefits and costs are strictly in financial terms, include taxes and subsidies, ignore price or market distortions, and discount at a rate reflecting the opportunity cost of the funds employed.

4. Discounting in brief

4.1 Since discounting is an integral part of IA some initial explanation is required. Further guidance on the choice of discount rate is contained in section 10.

4.2 Costs and benefits arising in the future have a lower value than the same nominal amounts arising now. The more distant in time they occur, the less they are valued. *Discounting* is the process of adjusting future sums to arrive at their *present value.*

4.3 There are two main reasons for discounting. The first is *time preference*. A given sum has a lower subjective value to a person or society, the later it arises. A person offered the same sum now or in the future will normally choose to have it now, and will subjectively discount the value of getting the same sum in future. This is true even if there is complete certainty about receiving the sum in future, and results from myopia, an urgent need for gratification (e.g. because of poverty or greed) or the belief that future consumption will be greater (hence the *marginal utility* of a given amount of consumption will be less). Governments, acting on behalf of their citizens, reflect these collective concerns through *social time preference,* for example where they expect future average incomes to be higher than now. However, governments can, and should, take a longer view than individual citizens, since society will continue, whereas individual mortals will not.

4.4 The second reason for discounting is the *opportunity cost of capital*. A sum of money is worth more now than in the future because it can be invested profitably or lent for interest right away. In this case the discount rate is the inverse of the rate of interest. Capital committed to a project earning a return in future could have been earning interest or profits now. The discount rate reminds us of what is being forfeited, and sets a threshold rate of return for the project to achieve.

4.5 Discounting also has the practical value of offering the basis of comparison between cost and revenue streams with different time profiles. Of two projects with the same nominal cost and the same expected annual revenues, the one that can stagger its capital costs and accelerate its revenues will have a higher net present value and should be preferred.

4.6 Table 1 gives a simple example to illustrate the use of discounting to derive a net present value. Imagine an oil company considering sinking a small well costing $10 million, spread over 2 years, with annual operating costs of $0.5 mn. Benefits arise in the form of oil sales, starting in year 3, peaking in year 6, and disappearing after year 7[1/]. The value of costs and benefits in each year is set out in the first three columns, and the difference is shown as net benefits in each year. The discount factor for each year is obtained from published discount tables, here at a rate of 10%, and applied to the net benefit stream for each year to produce discounted net benefits. The final column of discounted net benefits for each year is then summed to produce a *net present value* for the investment, in this case positive.

1/ For simplicity, we assume that all costs and benefits arise at the end of their respective years.

Table 1. Calculation of net present value ($ million, rounded).

Year	Costs	Benefits	Net benefits	Discount factor @10%	Discounted net benefits
1	5.0	0	-5.0	0.9091	-4.55
2	5.0	0	-5.0	0.8264	-4.13
3	0.5	1.0	0.5	0.7513	0.38
4	0.5	3.0	2.5	0.6830	1.71
5	0.5	5.0	4.5	0.6209	2.79
6	0.5	7.0	6.5	0.5645	3.67
7	0.5	3.0	2.5	0.5132	1.28
Net present value					+1.15

4.7 Most textbooks and guides contain basic discount tables, and some pocket calculators have a facility for estimating NPVs, IRRs, etc.

4.8 A difficult issue often raised is whether it is correct to *discount physical units,* as well as monetary values. The problem can arise when estimating the value of future costs or benefits *per unit,* for instance the cost or value per cubic meter of water from different sources. Although one's intuition is not a reliable guide, it can be shown mathematically that both terms in the sum (value and physical unit) should be discounted.

4.9 A similar difficulty is the treatment of future lives saved or health improvements. Imagine comparing alternative road transport improvements, or public health interventions, one of which would save 10 lives annually starting in year 5, the other 20 lives annually starting in year 12. Is discounting the extra lives saved in future ethical? Although many will disagree, it is likely that the notion of social time preference extends to health and life, as well as to money. Imminent benefits have their attractions over more distant ones, especially in poverty-stricken and AIDS-ridden societies[2/].

5. Decision rules

5.1 Following the completion of the CBA various criteria can be used, either singly or in combination, to decide whether to proceed. The main decision rules are as follows:

5.2 *Net present value(NPV)*. A positive NPV, expressed in currency units, indicates that the net return on the project exceeds the discount rate used. A positive NPV is a necessary, but not a sufficient, condition for proceeding – see below.

5.3 *Internal rate of return (IRR,* sometimes referred to as *the Economic Internal Rate of Return*, or its financial equivalent *the FIRR).* This is the % discount rate at which the streams of costs and benefits are equalised. The IRR should be above the discount rate used as a "test" or "cut-off" threshold. In theory, in certain restrictive conditions a project will not have a unique IRR, hence the NPV is more reliable. However, for those accustomed to thinking of rates of return, the IRR is more appealing.

5.4 *Benefit-cost ratio(BCR).* This expresses the total discounted benefits as a ratio of the total discounted costs (e.g. 1.5:1.0). The difference between the two discounted streams is the same as the NPV, but the BCR has the merit of relating the size of NPV to the scale of resources (costs) being employed on the project. For instance, a large project may have a respectable positive NPV, but three smaller projects might have larger total NPVs and would be a better use of available capital.

2/ It can also be argued that, if costs were discounted, but not lives saved, it would be rational to delay action indefinitely, since benefits would be unchanged but costs would always be less.

5.5 Which decision rule to use depends on the circumstances of the decision. There are broadly three situations.

- A yes-no decision on a single project, using a predetermined threshold indicator (e.g. a test discount rate). All three decision rules will converge on the same result. A project with a positive NPV at the test discount rate will have an IRR greater than this discount rate and a CR greater than 1.0.

- Choice between mutually exclusive projects (e.g. different sites for a dam, different routes for a highway). The decision rule should be to maximise NPV at the chosen discount rate[3/].

- Where a number of projects compete for a limited pool of finance and ranking is needed. The best procedure is to rank projects by descending order of their BCRs.

5.6 Other common decision rules are:

- *Least cost option*: where the benefits of all alternative projects are the same, the criterion of choice is the smallest NPV of costs.

- *First Year Rate of Return (FYRR)* Where a project satisfies other criteria, but where the timing of the investment is an important part of the decision, the FYRR can be used to determine optimal timing. The FYRR is the benefits of the project in its first year of operation as a % of total costs, both discounted. If the FYRR is below the discount rate used, the project could advantageously be delayed.

- *Payback period*. This is a common financial rule of thumb: the period over which the initial investment outlay is expected to be fully recovered (answers the question, "how soon before I can expect to get my money back?").

6. Basic values

6.1 This section considers some general issues involved in choosing the values used in CBA. Specific cost and benefit items are dealt with in subsequent sections.

6.2 The choice of basic values for investment appraisal is hardly an issue in financial appraisal, where the decision is taken on the actual market prices confronting the enterprise and the cash flows they give rise to. However, for socio-economic appraisal in the context of public decisions, the unit of value is a key factor.

Domestic vs. border prices

6.3 If the price of a project's output is greatly distorted – in either direction – there is a likelihood of the wrong decision being taken. Much of the early cost-benefit literature favoured foreign exchange as the *numeraire* in which costs and benefits should be expressed. More recently, widespread economic liberalisation in both developed and developing countries has reduced the need for comprehensive price adjustments.

6.4 For the UK, the Treasury's Green Book recommends:

"Costs and benefits should normally be based on market prices as they usually reflect the best alternative uses that the goods or services could be put to (the opportunity cost)…."

6.5 Elsewhere, distortions in the prices of goods and factors of production such as land and labour may persist, particularly where trade barriers are important and/or the national currency

3/ Even if the smaller project has a higher BCR than the larger one- which has a higher NPV. This is somewhat counter-intuitive, but is still a rational use of resources.

is seriously under- or over-valued. Particular products (e.g. food, energy, water) may also be distorted by subsidies or taxes. In these cases, some adjustment to actual prices may be required.

6.6 The broad options are to use either *domestic prices*, with the worst distortions ironed out by *ad hoc* adjustments, or to use a foreign exchange unit of account by converting domestic values into their equivalent *border prices.* Deriving a set of border values can be an elaborate exercise and will not be feasible in every case.

6.7 For countries with convertible currencies and reasonably open markets the use of domestic prices can be justified, with the proviso that specific items should be adjusted if they are important to the project *and* seriously distorted. Countries with heavily distorted foreign exchange and trade regimes will require more comprehensive price adjustments – including the use of *shadow prices* for key inputs and factors, or the use of *Standard Conversion Factors (SCFs)* to the full range of costs and prices. Shadow prices are obtained either by the careful study of the real opportunity cost of the item, or as an output from general linear programming models.

6.8 SCFs are less used now than previously. They are a short-cut method of converting domestic prices to their world price equivalent. They are obtained by dividing the following sums:

$$\frac{\textit{border price value of all imports, without taxes}}{\textit{value of all imports plus all tariffs and taxes on imports, minus subsidies}}$$

6.9 The result is a ratio, e.g. 0.9. SCFs are crude and arbitrary as applied to specific items, and for most countries it is preferable to work in domestic prices, with specific adjustments where justified.

Taxes, subsidies & transfer payments

6.10 Values should exclude taxes, subsidies and other transfer payments on the grounds that, for the nation as a whole, they are merely transfer payments between different groups. These transfers do not represent real scarcity values – on the contrary they may disguise the true opportunity cost of the item. Income and corporate taxes should be excluded from the analysis, as well as major indirect taxes affecting the project (e.g. export taxes, import tariffs, excise taxes) and subsidies and other transfers between citizens and the state.[4/] (Charges and duties that represent payment for actual services, as well as benefits corresponding to services rendered, should, on the other hand, be included as costs and benefits, respectively).

Tradeables, non-tradeables & unquantifiable items

6.11.*Tradeable items*, such as oil and textiles, can be valued at their border prices (import or export values, converted at the prevailing exchange rate). Imports should be valued c.i.f. (cost, insurance & freight, which represent resource costs to the economy), and exports f.o.b. (free on board, excluding transport costs overseas). Where the current exchange rate is substantially different from estimated free market equilibrium levels, the latter should be used where it can be accurately inferred (e.g. from purchasing power parity estimates, or the black market – though the latter should be used with caution since it is likely to be based on narrow and – by definition - illegal markets.

6.12 Some goods and services are not actually traded, though they potentially have an overseas market and a border price. Examples include fruit and vegetables produced for own consumption, bartered items, items where trade is barred, telecoms and electric power (where these services can be traded at the margin). The valuation principles for these items are the same as for actually traded goods.

4/ The Green Book merely recommends adjusting market prices "for tax differences between options".

6.13 *Non-tradeables marketed domestically* include land[5/], water and some other public utilities, etc. Many goods with a low value-to-bulk ratio may be in practice non-tradeable, e.g. bricks, rubble, water, but could be traded in certain circumstances. In principle, they should be valued against the general yardstick of *marginal social benefit to consumers* Certain items, such as land and labour, can be subject to specific valuation principles that are discussed in section 7.

6.14 *Non-tradeable, non-marketed items* include health care, education, administration, road transport, environmental services, etc. A further sub-division is between items that are quantifiable (e.g. lives saved, number of rare birds preserved) and those that are non-quantifiable (e.g. amenity, pain & distress, existence values of biodiverse habitats, etc).

6.15 Significant *time savings*, such as those from transport improvements, are usually valued as some proportion of the average hourly wage, though they can also be inferred by what people are prepared to pay for superior services (e.g. tolls for the use of a faster road).

6.16 *Illness and disease* are commonly valued in relation to the reduced productivity of the sufferers, though this excludes grief caused to "unproductive" members of society and the "psychic" costs of pain and distress.

6.17 Various other techniques exist for measuring and valuing *non-traded, non-marketed items,* including:

- Willingness-to-pay. People affected by the project are asked, through carefully crafted interviews or questionnaires, how much a particular change is worth to them. For a change adversely affecting them, they are asked their willingness-to-accept compensation. This method is also known as contingent valuation.

- Defensive expenditure & avertive behaviour. Values can be inferred by observing what people actually spend in order to shield themselves from the effects of a project (e.g. aircraft noise, contaminated drinking water)

- Hedonic pricing. Used particularly for valuing environmental effects. It infers the values people place on environmental quality by observing what they pay for goods incorporating environmental attributes, usually their houses.

- Travel cost. Peoples' valuation of the natural world or local amenity is inferred from the amounts they spend (time, transport) on travelling to the site in question.

- Replacement cost & shadow projects. Where a project threatens a valuable site or habitat a budget can be included in the CBA to replace or relocate it. This can be regarded either as a real cost to the project, or as a hypothetical device to balance against its claimed benefits. A shadow project is one that would fully offset the negative effects of the project under study.

6.18 In summary, items that are actually or potentially tradeable should be valued at border prices. Non-tradeables are more difficult: in many cases market prices can be used where they are a reasonable reflection of marginal social benefit. Specific valuation methods are applicable to certain common non-tradeables in such areas as health & education[6/], environment and transport. For other non-tradeables, rather than resort to standard conversion factors which can become arbitrary and crude, it is better to use *ad hoc* adjustments of the domestic price where this is judged to be badly distorted.

6.19 One approach in valuing non-tradeables is to break down the cost of the item into the four main components, labour, taxes, traded goods and non-traded items. The first three can be dealt with along relatively straightforward ways, and the residual item can be broken down into

5/ Though in some countries there is an active market in property amongst overseas buyers and sellers.
6/ Though in many developing countries there is a private market for these services

the same four items, and so on, iteratively, until the residual item is very small. This is only worth doing for major items whose domestic prices are judged to be seriously out of line with their marginal social cost/benefit.

Value of life

6.20 There have been many attempts to derive the *value of human life* for the purpose of evaluating different transport safety measures, alternative health interventions , the impact of global warming, etc. Sometimes these are nothing more than attempts to infer the implicit value of life from policymakers' choice of particular safety and health measures (e.g. a programme to spend $100 million on motorway lighting that could save a total of 50 lives , implies a valuation of $2 mn per life.). Exposing these implicit values of life may make the choice between options more rational (or, one might say, *life-effective)*.

6.21 As an example, a study in Guinea for WHO compared the cost per life-year saved of a range of health interventions, as follows:

- child vaccination $25;
- treatment of measles with complications $43;
- treatment of severe diarrhoea $87; and
- construction of pit latrines & provision of safe water $343.

6.22 These choices are not alternatives, but could indicate an order of priority where resources are scarce.

6.23 It is becoming common to approach the valuation of lives saved from public health interventions by one or both of the following techniques:

- willingness-to-pay; how much individuals would be willing to pay (WTP) to reduce the risk of premature mortality;

- using the human capital (HC) approach to measure the benefits in terms of the income an individual would gain from extra productive years of life.

6.24 Recent studies have uncovered major differences in values based on these two approaches, mainly because WTP is typically estimated using benefit transfers from data in high-income countries. It is an inconvenient fact that these methods result in values that are substantially lower in developing than in developed countries.

6.25 Exercises of this kind are concerned with the value of a *statistical life,* whereas if the lives of *particular people* or communities are concerned, society will often expend vastly larger sums to save them.

6.26 Using values of life in public policy decisions is a delicate matter. It is important to stress that the values produced do not value human life as such, but rather the WTP of individuals or society to reduce the risk of premature mortality, or alternatively the income benefits resulting from longer productive lives. It is nevertheless an unenviable diplomatic challenge for economists to justify these values to decision-makers, politicians and the general public, particularly where they indicate large differences between specific groups and countries.

Future generations

6.27 Another problem is how to take into account the welfare of *future generations*, yet unborn. They obviously can't be consulted, yet they are invisible stakeholders in present decisions that will shape the future. This is often used as an argument against discounting, or at least the use of a high discount rate, which has the effect of minimising any effect extending beyond the present generation (see section 10).

6.28 In many of the things they do, people – and governments on their behalf – take a long term view and show concern for unborn generations. In the natural world, many governments accept the Precautionary Principle and the need to avoid irreversible damage to critical natural capital. Sustainable development famously means keeping options open for future generations. However, the pace of change in the modern world is very rapid, and it is impossible to predict how it will be two generations or more hence, or what the preferences of these future generations will be. There is a specific problem in poor societies that can expect their descendants to be better off- is it reasonable or equitable to make sacrifices now for more fortunate future generations?

Human bias?

6.29 Another criticism sometimes made by environmentalists is that CBA is conducted from the viewpoint of human welfare and is biased against non-human species. In short, CBA is *anthropomorphic,* since all its values are derived from human preferences, even those purporting to take the interests of the non-human natural world into account. This "bias" is unavoidable, in the absence of other ways of eliciting non-human preferences, but it is unfair to blame CBA for the shortage of projects of this kind, if indeed there is one. The remedy lies in changes in sensitivity, attitudes and policies, and more, and better-designed, projects to meet these concerns.

Constant prices & inflation

6.30 The analysis should be conducted in *constant prices*, normally those of the year in which the study is carried out. Otherwise, if attempts are made to allow for future inflation, the results of the analysis could be seriously distorted. Using constant prices is equivalent to assuming that future inflation will have a neutral impact on the main cost and benefit items concerned (i.e. relative values will be unchanged). If, on the contrary, there are good reasons to believe that the relative value of an important item will change (e.g. the international price of a key commodity, or oil) this can be factored in (though it would be prudent to include this in the *sensitivity analysis).*

Technical & economic life and appraisal period

6.31 The *technical or physical life* of a project is the number of years over which it can go on producing its expected output, with reasonable maintenance and the occasional essential repair. Many infrastructure assets, buildings, environmental projects, etc. have a physical life measured in decades (even centuries).

6.32 There are two conceptual approaches to maintenance. The first is to include in costs all the maintenance, repairs, minor replacements, etc needed to keep the project generating its designed level of benefits. The project should then have a *residual value* at the end of its economic life, which is credited as a future benefit of the project. The residual value may arise either as future net benefit potential, or as scrap value, or as second hand value. The second approach is to build in obsolescence, with minimum recurrent costs, with a scenario involving zero residual value at the end of the project's life.

6.33 But the *economic life* is the period relevant to employment of the capital in question, which is often much shorter than the physical life of the asset. The economic life is influenced by the level of the discount rate: at 10%, a benefit or cost stream loses half its value after 7 years, and at this rate there is little point in extending the analysis beyond 15 years because future values are so heavily discounted.

6.34 If, at the end of the appraisal period, the project's assets are in reasonable condition and capable of generating further benefits, they can be given a *residual value*. If the appraisal period is 20 years, an assessment should be made of how many more years' of physical life the project would have, given adequate maintenance and periodic repairs. The future stream of net benefits, starting in year 21, should be reduced to an NPV (applying the discount factor for year 21), which represents the residual value of the asset. In most cases, discounting will ensure that residual value is not a critical decision factor.

7. Costs

General points

7.1 The notion of opportunity costs should underlie the treatment of costs in CBA. The cost of a project is the loss to the rest of society from using the resources for this purpose. Costs already incurred at the point of decision (e.g. a partially built project) should be disregarded for the purpose of the decision. *Sunk costs* should be ignored, and only *incremental costs* reckoned in. If a project causes a *loss of benefits*, this too is a cost (e.g building a port which destroys a previous fishing ground).

7.2 Costs can be either *tangible* (e.g. wages) or *intangible* (e.g. loss of amenity, destruction of wildlife habitat). In principle, both should be brought into the analysis: techniques are available for estimating non-market costs (and benefits).

7.3 Further guidance is available in the sector-specific chapters on health, water, environment, rural roads, etc. in the Economists' Guide.

7.4 Costs can be *internal* to the project, or *external* to it (*externalities)* . An externality is a project impact which does not directly affect the project sponsor, and which is not factored into the decision to proceed[7/]. Externalities may be either tangible or intangible.

Specific cost items

7.5 Certain *financial costs* are invalid in a CBA. Apart from taxes and transfer values, which have already been discussed, depreciation *allowances* have no place in economic appraisal Depreciation is an accounting device used to maximise tax advantage by spreading expenditure on a capital asset over its lifetime. It does not correspond to real opportunity cost. C*apital charges* represent the annual financial costs of the investment (interest and capital repayments). Some projects include payments into a *sinking fund*, which is intended to create the funds necessary to replace the project at some future date, or repay the initial debt. In both these cases, a CBA captures the point through discounting. A project that achieves a positive NPV at a discount rate reflecting the cost of capital can by definition recover all its capital costs during its lifetime.

7.6 Projects that use up non-renewable natural resources (e.g. oil, gold) or use renewables in excess of their rate of replenishment (e.g. groundwater) are effectively mining projects. Part of their cost is the *depletion cost* or *user cost* from using up finite resources. Conceptually, this cost arises in the future, when alternative resources have to be developed earlier as a result of the project's consumption now. The depletion or user cost is the value of the extra future spending needed to tap alternative natural sources, or, more precisely, the discounted cost of bringing forward by [say, one] year the use of alternatives, where they are available.

7.7 *Contingencies* are often written into cost budgets*.* There are various kinds. *Physical contingencies* are extra quantities of work, materials, pieces of equipment, etc. included "to be on the safe side", since a shortfall in cost provision for such extra items might have a disproportionate impact on the project. They should, however, be excluded from CBA because the Base Case should be the best possible estimate of the project's contents and costs. *Price contingencies* cover cost increases that may arise over and above the prices used in the Base Case scenario. If they are attempts to provide against general inflation, they should be excluded from the analysis. If, on the other hand, they reveal disquiet about the reliability of price estimates for key items, it would be better to reestimate or renegotiate these so that the Base Case contains the analyst's best estimate of costs.

7/ Unless the government *internalises* the externality by imposing a tax, or requiring polluters to clean up their processes, etc.

7.8 On the other hand, *contingent liabilities* are real costs that should be included. These are the cost of commitments that will fall on the sponsor, or government, if certain events happen (e.g. guarantees and performance bonds that may be called, cancellation penalties, redundancy payments). The (discounted) probability (expected value) of these events should be included in CBA.

7.9 Following the Green Book, the following cost categories should be distinguished:

- Fixed costs, such as office overheads or a senior management team, which remain constant across the range of output;
- Variable costs, which depend on the level of output (e.g. overtime payments, raw materials);
- Semi-variable costs which include both fixed and variable elements (e.g. maintenance, transport, non-core staff); and
- Step costs, which are fixed for a certain level of activity, and which then increase once a threshold is crossed (certain machines, staff categories, storage areas, etc).

7.9 Within the general categories, the following cost items often cause problems in CBA.

- *Land.* The opportunity cost of land is its value in its best alternative use. In a freely functioning and undistorted market this is reflected in its market price. However, land is often treated as though it were free to the project and useless for anything else, whereas in reality it always has an alternative use, which may be more valuable than that proposed.
- *Labour*. In most countries labour markets do not properly "clear" in the sense that wages smoothly adjust to price workers in and out of jobs. Unemployment may persist, either of a chronic nature, or seasonal, or structural (e.g. immediately after the closure of an important local employer). Using a *shadow wage* below the actual wage paid can correct for this distortion, and may be a better reflection of the true opportunity cost of the labour. While theoretically correct in certain cases, this practice has been widely abused and should be used cautiously and sceptically. Even in the midst of widespread rural underemployment, labour shortages arise at certain times. Much apparent unemployment conceals informal activities, and new entrants to the labour market may need to spend "search time" looking for jobs. In any case, although employment creation may be a perfectly legitimate aim of government policy, labour costs should never be entered as a project benefit.
- *Subsidised raw materials & energy*. Projects may be set up to capitalise on the presence of plentiful local resources, such as raw cotton, iron ore, timber, hydropower, oil, water, etc. which are provided at a below-market cost to the project. The CBA should, however, include these items at their opportunity value, which may be their export price (net of transport etc), their value in other uses, or the future benefit of not using them and preserving them for later (oil, stored water, minerals, etc).

8. Benefits

General points

8.1 The principles to be followed in the estimation of benefits are similar to those discussed above for Costs and in the section on Basic Values. In summary:

- the avoidance, or reduction, of a cost also counts as a benefit;
- benefits may be quantifiable, marketable or intangible;
- market prices or market proxies should be used where possible;

- for items where direct markets are absent, various other estimation techniques are available, some of them summarised in sections 6 and 7;

- only incremental benefits, directly attributable to the project, should be counted;

- benefits may be internal to the project or in the form of externalities. For the latter, ways should be sought of "internalising" the benefits through charges, taxes, etc; and

- values should be expressed in constant prices; if a change in relative prices is expected, this should be made explicit.

Consumer surplus

8.2 The welfare gain from a project is the sum of the producer and consumer surpluses that it generates. The latter is the difference between what consumers would be willing to pay (or what they were paying previously), and what they actually have to pay with the project. This category of benefit is likely to be important for goods and services that are not priced, or whose prices fail to reflect their true values. Common examples include: road user cost savings; improvements in household water supply; domestic connections for power and water; time savings from faster services at clinics, etc. The actual amount previously spent (cash, time) is one yardstick against which welfare can be measured. Where this is not available, willingness-to-pay (WTP) surveys can be done, or data from benefit transfers (see below) used.

Benefit transfer

8.3 Growing use is being made of the benefit transfer method of generating values for CBA, where the alternative is to conduct lengthy and complicated original surveys. This applies particularly in environmental and health appraisals. The method is to tap into data bases of existing empirical studies in the sector in question and extract data from those whose features seem most relevant to the characteristics of the project being appraised.

Wider social and economic benefits

8.4 Project sponsors try to strengthen their case by citing a range of positive effects, beyond those quantified in the CBA. These can include job creation, regional multiplier effects, backward and forward linkages into the local and regional economy, social cohesion, amenity gains, learning effect for local entrepreneurs, empowerment of women, etc. These effects will normally be larger for projects of a large size relative to the national or regional economy in which they are located.

8.5 The normal convention is to treat projects as *marginal*, in the sense that they do not have substantial impacts on other sectors or projects, and do not greatly affect the price of their major inputs or outputs. For a relatively large project where this assumption does not hold, it is relevant to examine its effect on capacity utilisation in supplying sectors (e.g. will these become bottlenecks), direct and indirect employment generation (e.g. will it absorb surplus labour, or will it aggravate labour shortages) effects on prices of outputs and inputs, local income generation and its distribution, etc.

8.6 *Forward linkages* are benefits to sectors that use the output of the project, while *backward linkages* are gains accruing to those that supply a project's inputs. In theory, these extra producer surpluses are benefits of the original project , though in practice it is hard to know where to draw the line. Where the linkage effects are achieved from existing capacity, they are akin to multiplier effects (see below). Where they require substantial new investment in the related sectors, this is an argument for redrawing the project boundary to include these other sectors.

8.7 *Multiplier effects* arise when an investment project in an area with surplus capacity generates successive rounds of spending as the original injection of funds works through the local economy. In theory, the total eventual increase in income is a multiple of the original investment.

In practice, few economies display uniform surplus capacity, and spending from an investment "leaks" in various ways, e.g. through higher prices of goods and services where there is no spare capacity, and imports from abroad or from other regions. For multiplier effects to be credited to a project, the two conditions are:

- there should be underemployed capacity, including labour, which cannot be used except by undertaking the project in question; and

- the funds to be used on the project should not be able to generate comparable benefits from other projects. In practice, any public spending *could* have a potential multiplier effect, as Keynes illustrated in the 1930s with his examples of digging holes in the ground and building new Pyramids.

8.8 It may be perfectly legitimate to take these wider effects into account, particularly if the CBA produces a marginal result. However, the analyst should approach such claims critically, otherwise the rational basis of CBA would become easily undermined. Relevant effects are included in the CBA to the greatest possible extent, if necessary using the various estimation methods for non-marketable items (e.g. environmental benefits). For an effect of this kind to weigh in the decision it should be strong, probable and specific. Above all, if any wider effect is a particularly important motive for the project (e.g. job creation, encouragement of female entrepreneurs), it should feature in the design of the project. In this latter case, if the benefits are difficult to quantify, the analysis can compare various options for meeting the aim of the project, using cost-effectiveness analysis.

9. Risk & uncertainty

9.1 Evaluation results show that project outcomes cannot be fully predicted and often turn out wildly different from those anticipated. This may be due to *ignorance* and *uncertainty* about some of their possible results. If, however, probabilities can be attached to possible outcomes, uncertainty is converted to *risk*, which can, in principle, be managed.

9.2 An approach prevalent in some financial circles is to include a *risk premium* in the required rate of return from an investment: the greater the risk, the higher the premium required. In financial markets, for example, "junk" bonds carry a higher interest rate than gilt-edged securities because of the higher risk they entail. In CBA, however, manipulating the discount rate to serve one particular purpose creates other distortions, and is best avoided, since there are other ways of dealing with risks in a project.[8/]

9.3 The traditional CBA approach to risk is to include the *expected value*s (Box 1) of the main costs and benefits and to use a *sensitivity analysis* to test the impact on the Base Case NPV/IRR of changes in key variables. The implicit assumption of this approach is that public policy-makers are *risk-neutral*, and would be indifferent between projects of high and low risk with the same expected values.

Box 1. Calculation of Expected Values

Possible outcome compared to Base Case	Probability of outcome (1.0 = certainty)	Expected value (EV)
+4.0	0.3	+1.2
0.0	0.3	0.0
-2.0	0.4	-0.8
	1.0	+0.4

In this simple example, the possible outcomes are reduced to 3, namely Base case, and Base Case plus 4 and minus 2. Probabilities are attached to each outcome, totalling 1.0 assuming they are mutually exclusive. The EV of each outcome is the probability times the possible outcome. The sum of the EVs in the final column gives the EV of the project

8/ Though it should be noted that the Green Book (section 5.65) advocates the use of a risk premium in the earlier stages of an appraisal as a way of countering "optimism bias" and forcing attention on what needs to be done to counter this.

9.4 Recent appraisal practice, reflected in the guidance in this section, is much more risk-centred. It dwells much more on the types of risk involved and ways of mitigating them, taking into explicit account the attitude to risk of the sponsor and other key stakeholders. The decision rules used, and the way results are presented to sponsors, should be sensitive to their concerns.

9.5 For large, complicated or particularly risky projects the following steps are recommended:

- make a full assessment of the risks involved during the appraisal and include the expected values of key variables in the Base Case;
- show how these risks affect the project, using sensitivity analysis and switching values;
- assess the *risk appetite & risk perception* of major players and what this implies;
- decide how risks can be mitigated or managed and make any necessary revisions to project design; and
- choose appropriate decision rules and present the results of the CBA meaningfully to the sponsor.

Risk assessment

9.6 During appraisal, analysts should identify the main areas of risk to which the project is exposed. Some of these will be common to all projects, others specific to the project in hand. Examples of *generic risks* would include demand for the good or service, output price, construction costs and implementation period, funding problems, failures of counterparties to live up to commitments, untried technology, failure to get timely planning approval, etc. The Green Book has a checklist of 20 General Risks of this kind. For large and complex projects it may be useful to compile a *risk register*.

9.7 The next step is to judge the importance of the risks identified, which requires a view on:

- the possible range of deviation from the values used in the Base Case, and
- the probabilities of these deviations occurring.

9.8 Except for the largest projects, it will not be feasible to carry out this routine for all risks. A more pragmatic approach would be to consult professional opinion and refer to previous experience to identify the most important risks and feasible magnitudes for their possible deviations from Base Case values. The Base Case should incorporate (expected values of) the best available information on the project, while data on the possible deviations should be retained for sensitivity analysis (see below).

Risk mitigation & management

9.9 Armed with an assessment of the principal risks and their importance, the analyst should consult the sponsor to agree on the agenda for risk management and mitigation. The options are summarised in Box 2.

Box 2. Options to manage risk

- active risk management: identify risks well ahead & install mechanisms to minimise their occurrence; create process to monitor risks and feedback information; put controls in place to mitigate adverse consequences; ensure decision-making is backed by risk analysis and evaluation;
- early consultation;

- avoidance of irreversible decisions;
- pilot studies;
- design flexibility;
- precautionary principle;
- transfer risks to other parties better able to bear them or able to minimise them at least cost;
- Less use of leading-edge technology;
- Reinstate, or develop different options; and
- As a last resort, abandon the proposal.

Source: Green Book
Sensitivity analysis, switching values, Monte Carlo analysis & optimism bias

9.10 Once risks and probabilities have been estimated, and mitigated so far as possible, the potential impact of the remaining risks on the Base Case can be demonstrated through *sensitivity analysis*. Potential variations in crucial project variables are tested for their impact on Base Case NPV/IRR. For instance, a 20% shortfall of benefits compared to Base Case could reduce the IRR to 4%, while an increase of operating costs of the same proportion may only reduce IRR to 6%, indicating that the project is more sensitive to lower benefits than to higher than expected operating costs.

9.11 Another way of presenting this same information is through the use of *switching values.* These show, for each important project variable, by how much it would need to change to reduce the NPV to zero. Variables which are not very crucial to the project could vary greatly before they affected the NPV, whereas highly sensitive items would only need to vary by a small proportion to plunge the project into difficulties.

9.12 The outcome of sensitivity and switching value testing is an opinion on how *robust* the project is to changes in its key variables.

9.13 The format for displaying the results of sensitivity and switching analysis is shown in Box 3.

Box 3. Sensitivity analysis and switching values (Base Case NPV = 250)

item	Variation tested	Impact on Base Case NPV	Switching value
Investment cost	+30%	150	+75%
Construction period	+5 years	160	+10 years
Operating costs	+25%	175	+100%
Cost of fuel	+20%	180	+120%
benefits	-30%	150	-70%
Benefit delay	+5 years	160	+10 years

n.b. this is not a properly worked example and figures are not necessarily consistent. It indicates that the project is fairly robust in the face of pessimistic variations in the level of its key variables. The switching values are all large, signifying that relatively large negative changes would be necessary to reduce the project's NPV to zero. However, in this simplified example, the sensitivity and switching values are tested one by one: if combinations of variables are considered, the results would obviously be different, and could be worse. This is discussed in the text.

9.14 Where there are a number of different risks, and many variables to consider, it may not be sufficient to carry out these tests looking only at changes to single variables, in isolation of changes to others. It is more realistic to allow for simultaneous changes to a number of variables,

which can be simulated on a computer programme. For some purposes it may be instructive to construct pessimistic (*Doomsday)* scenarios where all possible outcomes are negative, and see whether the project could survive.

9.15 In most cases, such pessimism may be unwarranted, but it may still be important to test for the impact of random events and correlations between them. This is the realm of Monte Carlo analysis (Box 4)

Box 4. Monte Carlo Analysis

Monte Carlo analysis allows an assessment of the consequences of simultaneous uncertainty about key inputs, and can take account of correlations between these inputs. It involves replacing single entries with probability distributions of possible values for key inputs. Typically, the choice of probabilistic inputs will be based on prior sensitivity testing. The calculation is then repeated a large number of times randomly (using a computer programme) to combine different input values selected from the probability distributions specified. The results consist of a set of probability distributions showing how uncertainties in key inputs might impact on key outcomes.
Source: Green Book

9.16 Finally, *optimism bias* is a widespread form of corruption in project appraisal. Endless evaluation studies confirm the existence of this bias[9/]. There is a "demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters" (Green Book, Annex 4). Appraisers need to be on their guard against this and can take various precautions:

- avoid the blandishments of project sponsors, or those with a strong vested interest in the project,
- seek objective confirmation of data presented by sponsors.
- consult evaluation reports and other ex post studies of similar earlier projects to discover how and where performance departed from expectations.
- put more effort into sensitivity analysis, and use wider and more realistic bands when testing the impact of key variables.
- "Staring into the abyss" at an early stage of appraisal (taking negative outcomes seriously) may induce hard thinking about the design of the project, which pays dividends in its eventual robustness.

Risk perception, appetite and averseness

9.17 The foregoing discussion has been based on the assumption that project sponsors and stakeholders have been *risk-neutral* and that the assessment of risks is objective and widely agreed. This is misleading where there are important subjective perceptions and attitudes to risk.

9.18 Many supposedly "objective" risks have a large judgemental component, especially where new and complicated hazards are concerned. Perceptions of risk by "expert opinion" may differ widely from those of the general public, or groups who believe themselves to be at specific risk.

9.19 People who are risk-neutral are interested only in objectively determined expected values. However, this does not describe most people, who are either gamblers – actively preferring risky propositions – or risk-averse. People may be quite rational to be risk-averse: a farmer may be wiped out if a new crop fails, even if the probability is low; a manager may become redundant or may be prosecuted if a seemingly low-risk venture fails; a politician may lose face or even office

9/ Keynes took a positive view of this "..if the animal spirits are dimmed and the spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die.." (General Theory, Ch 12, p. 162)

from the failure of a public initiative. The *risk appetite* of the sponsor and stakeholders cannot be ignored.

9.20 In theory, differences in risk perception and in risk appetite can be allowed for by attaching *utility* weights (as well as probabilities) to the various possible outcomes to produce an *expected utility*. A more practical solution is to set out the risks in ways comprehensible to the decision-takers and use decision-rules which cater to the sponsor's risk preferences (see below).

Irreversibility & special risks

9.21 Where future uncertainty is particularly important for a project, there is an *option value* in retaining the freedom to proceed or not. Delaying a decision gives time for new data and evidence to be gathered, while implementing the project immediately closes down the option. This is serious if the project has *irreversible* effects, for instance on the natural environment. Postponement may be justified where there is a good chance of relevant data becoming available.

9.22 One of the most difficult judgements to be made is over *zero-infinity* problems, namely, risks with a low probability but a very high severity (e.g. collapse of a dam, accident at a nuclear power plant). Using the normal expected value framework (outcomes x probability) is unlikely to give such events the weight they deserve in the decision. The *Precautionary Principle* is likely to be invoked in such cases, and policymakers may prefer to avoid the risk entirely, or heavily over-insure it.

Some decision rules

9.23 The results of CBA should be presented to sponsors, decision-makers and other stakeholders in ways, which are informative in the light of their respective risk appetites and preferences. Reducing the results of a CBA to a single indicator (IRR, NPV, BCA, etc) and nothing else is a waste of information, and will not satisfy the anxieties and needs of sponsors. Which indicators and decision-rules are presented should be decided following consultation with sponsors and examination of their attitudes to risk.

9.24 Where risks are particularly important, the basic indicators (NPV etc) should be accompanied by full data showing the results of sensitivity analysis and switching values, with worst-possible scenarios highlighted. Other useful indicators and decision rules are the following:

- Maxi-min. Choice of the option which has the least bad worst case (i.e. the maximum minimum outcome).

- Minimax regret. Choice of option which minimises the difference (regret) between the worst outcome and other outcomes.

- Risk-benefit analysis. This form of CBA treats risk mitigation as the option to be analysed. The occurrence of the risky event is the cost, which is compared to the benefit of inaction (avoidance of preventive spending). If it is cheaper to let the risky event happen, no preventive measures are called for, and vice versa where preventive action costs less than the losses from the event.

- Acceptable risk analysis. This is an eclectic method, which avoids exclusive reliance on formal methods of analysis. It involves wide consultation amongst people with legitimate views, and is based on the idea that there are no value-free methods of choosing the most acceptable option.

Investing in information

9.25 Most projects benefit from further study; however, this takes time and resources, and delays the start – which itself has costs. The judgement has to be made whether the long term benefits from a better project, with fewer uncertainties and less risk, justify the higher short term cost of

studies, piloting, and deferment of benefits. How much better could the decision be by waiting? Is it worth the wait?

9.26 Sensitivity analysis can indicate areas of the project where the reduction of uncertainty would pay particular dividends, by reducing a downside variation or improving the prospect of an upside movement. This enables the analyst to focus on the *value of information.* What sum would be worth spending on extra information, in relation to the potential benefit to project returns? The problem can be conceived as the potential value of a *clairvoyant:* what would it worth paying a clairvoyant as a consultant to remove the uncertainty about specific project outcomes.

9.27 The problem may arise as a decision whether to have a pilot project ahead of the substantive investment. The judgement can be made in a cost-benefit framework (Box 5).

Box 5. The case for a pilot programme to test a participatory approach.

The sponsor is considering the pros and cons of a systematic programme for involving the potential beneficiaries of a development programme in decision-making, management and operation of the programme. The costs of the *participatory approach* are identified as:

- building awareness, capacity & support from project partners at all levels,
- training Facilitators at county, township and village levels,
- introducing the approach to villagers,
- facilitating the project cycle stages,
- materials, data collection, & dissemination,
- reflective learning – passing learning on to next phase.

The expected benefits of participation are:

- greater community "ownership" of infrastructure and facilities tends to lead to them being better maintained,
- participation tends to lead to a higher level of access and use of public services, with better outcomes,
- quality of infrastructure construction tends to be better,
- more potential sustainability, more willingness to contribute time and resources, more control over funds,
- leads to greater community awareness and cohesion.
-

In this case, the presumption was that the benefits of participation outweighed the costs.
Source: DFID

10. Choice of discount rate

10.1 The use of discounting in IA has attracted a great deal of discussion and controversy. This is partly an issue of the discount rate chosen. But it is also because the discount rate is asked to perform several different, and often incompatible purposes. It is, for instance, only if certain restrictive theoretical conditions are satisfied that the rate of social time preference would coincide with the opportunity cost of capital.

10.2 The Green Book recommends a rate of 3.5% (in real terms) for UK public sector work, with lower rates for very long-term projects, but recommends that the rate used on international development assistance projects should be the social time preference rate of the recipient country. This effectively throws the choice back onto the individual DFID analyst. It should also be noted that some major agencies (e.g. the Asian Development Bank) recommend the use of the national opportunity cost of capital as the basis for discount rates, which produces higher levels than those based on STP.

Functions of the discount rate

10.3 The root of the problem is that discounting performs several functions, which do not necessarily imply the same rate. These functions are:

- a reflection of the rate of social time preference (STP) expressed by governments for the present over the future.

- Reminder of the opportunity cost (OC) of capital used in the project (for aid projects this is normally taken to be that of the recipient country, but the test discount rate in the donor country is also relevant, and could serve as a minimum threshold).

- A capital rationing device to apportion the available capital investment budget over the most attractive bunch of projects (the discount rate would in theory be set equal to the IRR of the marginal project which just exhausts the budget). This is referred to below as the "market-clearing" rate.

- A practical measure for comparing projects with different time profiles of costs and benefits.

Importance of finding the "right" level

10.4 The dangers of setting the rate too low (or even zero) are:

- encourages capital-intensive projects, in countries which typically have capital shortages and labour surpluses;

- allows a higher volume of less productive schemes to proceed (those that would not pass a higher threshold rate of return). This is likely to put greater pressure on natural resources and the environment;

- ignores the OC of the funds, which leads to sub-optimal allocation of scarce capital; and

- does not reflect the high premium on short term costs and benefits of poor communities with an uncertain future.

10.5 On the other hand, the disadvantages of setting rates too high include:

- at a macroeconomic level, this would induce a lower rate of investment and higher rate of consumption;

- long term impacts, both costs and benefits, are minimised. At 10% any impact arising after 15 years would have little effect on the result. It is difficult to justify projects with long-term benefits (or penalise those with distant costs);

- Hastens the rate of exploitation of renewable natural resources; leads to exploitative rather than conservationist approach; and

- Disregards the interests of future generations.

Empirical considerations

10.6 Where the governments of recipient countries have their own, soundly based, test discount rates for public investments, these are a good basis for DFID use. But not many governments are in this position, and DFID analysts will often have to concoct their own rates. This is a lonely task, without much sound and relevant empirically-based guidance.

10.7 Estimates of STP for the UK are derived from estimates of the pure rate of time preference, the marginal utility of income as incomes change, and the expected growth in per capital incomes, which are the bases of the Treasury's recommended 3.5%. Although inferences can be made about them, two of these components cannot be directly observed, and the third is a forecast. These parameters are unlikely to be appropriate for developing countries where time preference is higher than in UK, life expectancy is less, and where –in some cases -the future trend of per capita incomes is on historical evidence just as likely to be downwards as upwards (see Box 6). It is relevant to note that the current OC of capital in the UK (as measured, for instance, by the historic real rate of return on private equity) is not a great deal higher than the above figure, though this is not a good guide to the OC of funds in developing countries.

Box 6. Estimating social time preference

Social time preference is obtained from the formula:

$S = p + u.g$

Where:

S = social rate of time preference

P = pure rate of time preference, the rate at which utility is discounted

U = rate at which marginal utility declines as consumption increases

G = expected growth in consumption per head.

In developed countries, the following parameters are typical: p = 2%; u = 1.5%; g = 2%, giving a value for s of 5.0%

In a poor developing country with good growth prospects it is plausible to substitute values of p=5% and G= 3% giving s = 6.5%.

For a poor country with poor, or negative growth prospects, the higher value for p would be wholly or partly offset by low or negative values of g.

10.8 A case has been made for setting lower discount rates for very long term projects, based on uncertainty about the distant future. The Treasury recommends the following discounting declension: years 31-75, 3.0%; 76-125, 2.5%; 126-200, 2.0%; 201-300, 1.5%; more than 301, 1.0%. Few, if any, DFID projects have such ample horizons.

10.9 Estimates based on OC can be guided by observations of national capital markets, in particular the real long term rate of return on private capital, adjusted for risk. Although this may be feasible for countries with evolving financial and capital markets, many of the poorer countries will not have sufficient track record, and their capital markets are often distorted, and interest rates suppressed. In repressed capital markets, governments are able to borrow at artificially low rates, hence this is not always a reliable benchmark for the choice of discount rate. The ultimate OC for the use of aid funds is what the recipient government could earn by depositing the funds safely in international financial markets (e.g. the return on US Treasury bonds[10/]).

10.10 "Synthetic" discount rates have also been proposed, taking into account both STP and OC considerations, based on the respective amounts of investment and consumption hypothetically displaced by government spending (see OECD, 1995 for a worked example).

10.11 The Asian Development Bank, a major player in Asian capital markets with some influence over national governments in that region, recommends the use of a minimum Economic Rate of Return of 12%, based on the economic opportunity cost of capital in its countries of operation. EIRRs of 10% are acceptable if it can be demonstrated that substantial net additional non-quantifiable benefits can be expected.

10/ For currencies not tied to the dollar, this entails an exchange risk

10.12 The latest DFID Guide (1997, but based on experience in the late 1980s) favours a discount rate (the "accounting rate of interest") equal to the OC of capital in the public sector, measured by the marginal rate of return on public sector investments which have been appraised following the principles set out in the Guide:

10.13 "Current experience suggests that a discount rate in the range of 8% to 12% applied to costs and benefits in constant prices is a useful operational guide over a wide range of countries".

10.14 The Guide stresses that this rate may vary over time, and between countries. As a minimum, it should not be below the highest rate at which the country could safely lend abroad , taking account of inflation and currency risk.

Conclusions

10.15 There is no consensus on the "correct" discount rate to use in appraising projects in specific developing countries. The rate suggested in the Green Book for use in the UK public sector, based on the STP, is not directly relevant to developing countries. Development agencies tend to favour OC or market-clearing benchmarks, which give higher figures. DFID practitioners need to work out country-specific benchmarks, which will be rough Rules of Thumb, and will need to be adjusted in the light of experience. The following points should be taken into account.

- Discount rates should be in real terms and risk-free.
- Considerations based on STP are likely to give lower rates than those influenced by OC and market-clearing criteria.
- Where countries have their own test discount rates for the public sector, these may be adopted, if they are soundly-based.
- The rate should not be less than the Treasury's recommended 3.5% for UK projects.
- Nor should the rate be less than the (real, risk-free) return available to governments from depositing surplus funds in overseas financial markets, adjusting for foreign exchange risk.
- A sensible starting point would be to focus on the range 8-12%. Lower rates would need to be justified by the expectation of substantial unquantifable net benefits, and 5% should be the absolute minimum acceptable.
- Low Income countries with uncertain prospects may legitimately place a high premium on present consumption and short-term returns. High rates would also be appropriate for rapidly developing and Middle Income economies with ample investment opportunities and a high OC for public capital funds (e.g. India uses a test discount rate of 12%).
- In the relatively rare case of very long term projects, the Treasury guidance is progressively to lower the discount rate.
- Projects of a type, or in a sector, that would be seriously disadvantaged by the use of the chosen discount rate should be considered for special appraisal (e.g., for environmental projects, using the various ways of reckoning non-market costs and benefits[11/].

11/ One possible method is equivalent to lowering the discount rate, where it is judged that environmental values will rise relative to others).

11. Poverty, equity & distribution

Preamble

11.1 Most projects create gainers and losers. A positive result from a CBA (positive NPV, IRR above the threshold rate, etc) merely indicates the presence of an economic surplus which is *potentially* available for the gainers to compensate the losers of a project. Without further fine-tuning of the appraisal, the NPV tells us nothing about the distribution of net benefits between different parts of the affected population.

11.2 However, CBA can display the *distribution* of the costs and benefits of a project, where this is an important feature of the programme. It is also possible in principle to apply *distributional weights* so as to favour projects with the desired pro-poor features.

11.3 A word of caution, however. Appraisal cannot do the job of project design, and cannot compensate for poorly designed projects (though it can provide feedback into re-design). If the main aim of a project is to improve incomes and employment amongst a poor target group, the project should be rigorously designed around this objective – there is a limit to which the appraisal process can "reward" these aims and select pro-poor features, unless they figure strongly in the way the project is set up. Using shadow wages does not create jobs!

11.4 Likewise, distributional weights are a poor substitute for good fiscal and social policies. A well-designed and functional system of taxation and social security is the best way of pursuing distributional goals. However, many systems lack these ideal elements and there is then a case for redistributional features to be built into projects.

11.5 The discussion in this section is concerned only with distribution between contemporary people. Distribution between the present and future generations raises more difficult issues, which are not considered here (see sections 6 & 10).

Disaggregating results by target group

11.6 This is a descriptive procedure, breaking down the impact of the project (costs, benefits, net income gains, employment, etc.) into its incidence on target groups of concern. The target groups may be categorised by geographic location, relative income, main occupation, gender, etc. The result is transparent to decision-makers. Formal quantitative weighting may not be necessary – in fact, this may obscure the results. If the distribution is not acceptable to sponsors the project may be redesigned and readjusted. Box 8 refers to a well-presented pro-poor project.

Box 8. The West India Rainfed Farming Project

The project is an ambitious, complex and innovative programme to enhance the livelihoods of 675,000 poor rural people. It targets the very poorest areas and people, uses a participatory planning process, is implemented through Self Help Groups, requires contributions through labour and compulsory savings, and uses local para-professionals to support activities.

The CBA was at two levels: firstly, it examined the expected economic returns to the project and main programmes from society's perspective; secondly, it analysed financial returns and viability from the perspective of different stakeholders, specifically the Self Help Groups, jankars (para-professionals), borrowers, land and livestock owners.

The CBA estimates benefits under six main categories: on-farm crop and tree productivity, livestock production, forestry products, successful income-generating activities, drudgery reduction (time saved) and employment and higher wages through the migration labour support programme. Based on 20 sample villages, the EIRR is 10%, below the OC of 12% used in India, but considered acceptable for this type of project.

Costs, and the result of the CBA, are broken down for each of the 20 sample villages. A handful of these had EIRRs below the threshold levels. Villages that had taken part in Phase I of the programme had higher average EIRRs than villages newly coming into the project, suggesting a

learning process. The generation of wage employment is also broken down in terms of both additional household income and person-days of work.

It was found that the choice of activities supported under the programme has a major impact on the distribution of benefits. The main benefit was found to be employment generation (as an alternative to seasonal out-migration), asset restoration, entrepreneurial options, and institution building.

Source: DFID
Income & distributional weighting

11.7 The rationale for income weighting is the diminishing marginal utility of income: as one's income rises, the utility of each successive increment of income falls. The argument is extended to inter-personal transfers - $1000 has higher utility (is worth subjectively more) to a poor than a rich person.

11.8 For projects where it is feasible to break down benefits by income group, weights can be assigned to the benefits accruing to each group, reflecting the distributional aims of the sponsors. There are various possible weighting systems, the simplest of which is to assign weights inversely proportional to average incomes in the society concerned. Alternatively, benefits going to the specific target group can be given a weight higher than the rest.

11.9 Such weighting systems face two objections:

- decision-makers may prefer to retain an element of discretion in judging this issue, which is taken away from them by a formal quantitative weighting system
- Any weighting system is arbitrary, subjective and easy to challenge. It has a spurious air of scientific objectivity.

11.10 For these reasons, income weights are not recommended for general use. It is better to aim at full transparency for the distribution of benefits in the CBA, and leave it to sponsors to draw their conclusions.

12. Financial viability

12.1 The use of economic rather than financial values in CBA is necessary to produce the "right" result, but once this has been done it is important to re-integrate the financial dimension before a decision is taken to proceed with the project. Evaluation studies demonstrate beyond doubt that projects that are financially non-viable, for which no proper financial provision has been made, are not sustainable, even if they have high EIRRs. This applies particularly to projects where benefits arise in non-monetary forms or are difficult to recoup from users (e.g. road user time savings, irrigation water for small farmers)

12.2 Financial viability is important for two main reasons:

- to ensure that the project sponsor has enough funds to meet its financial commitments, necessary to keep the project going; and
- to give the key stakeholders in the project enough incentive to make the project succeed.

12.3 The financial authority responsible for the project may be a government department, parastatal, local authority, a specific project authority, a Special Purpose Vehicle as part of a public-private partnership, or some other corporate form. Income must be sufficient to meet its *financial commitments*. These include:

- covering the administrative and managerial overhead costs;
- operating costs;

- maintenance and routine replacement, which can be postponed in the short term but which must be covered eventually;

- financial costs (bank overdraft, debt servicing), without which the enterprise would become insolvent; and

- capital costs of expansion, modernisation and eventual replacement. Although these often fall to government or external donors, a well-run organisation will budget its own funds for these purposes.

12.4 *Sources of income* include:

- revenues from sales and charges to the users;

- proceeds of any earmarked taxes, e.g. pollution tax, environmental charges;

- subsidies from national or local government. It is risky to rely on public subsidies in the long term: they are unreliable and increase the likelihood of political interference. Ideally, subsidies should be targetted, tapering and transparent. Services like education and roads that do not normally have an income from charges need to have adequate and properly funded budgets;

- income from investments, trust funds, etc; and

- funds provided from external agencies, e.g. budgetary support for specified programmes.

12.5 The project should have an appropriate *capital structure*, normally entailing a balance of equity and loan finance. Equity gives the project a start, and provides a "cushion" for fluctuating revenues, though is an expensive source of funds since shareholders eventually expect dividends at the same rates as available elsewhere in the market.. However, most funds usually come from loans, from banks, bond issues, public development corporations, external agencies, etc. The desirable ratio between equity and loan finance (leveraging) depends on the riskiness of the business, the terms of available finance, etc. Generally, a riskier project should have a higher ratio of equity to loan finance, unless the loan finance is available on soft terms (e.g. from development banks), or is convertible into equity.

12.6 Stakeholders also need a financial incentive to fully engage in the project. Many schemes are planned in the public good without fully checking their impact on the key people involved in making it work. In such cases, uptake tends to be poor, benefits are disappointing, and the fabric and infrastructure are neglected. In agricultural projects, it should be asked what the impact will be on farmers' incomes, whether the returns will outweigh any extra risk, what the cash flow will be over the season, whether short term credit will be available, etc. For household water, sanitation and sewerage projects, is there really a willingness to pay, and likelihood of payment, for an improved service, including connection charges? Will this at least cover the operation and maintenance costs of the scheme?

12.7 Box 8 illustrates a good analysis of the financial impact of a rural development project on key parties.

12.8 ODA/DFID (1997) contains a useful account of basic financial planning and analysis.

13. The Policy and Institutional Framework

13.1 A very strong message from evaluation studies is that potentially good projects are thwarted by bad policies. The aid evaluation literature also concludes that aid works best in countries with a conducive policy environment; conversely, it cannot swim against the tide of bad government, poor policies and weak institutions.

13.2 Many projects are used as substitutes for policy changes, especially where the bulk of funding is provided from overseas, and where the brunt of policy changes would fall on politically powerful groups. It is easier for local leaders to commission a new water supply source or build an extra power station than to introduce the demand management measures that would render these investments unnecessary. It is easier to put up more school buildings than to provide proper budgets for teachers' salaries, electric power, textbooks and the other recurrent costs of a good education system.

13.3 It is common to include *conditions* in a project agreement, requiring the local sponsor or host government to undertake certain actions (e.g. policy reforms) in return for receiving the aid or loan. Covenants to raise tariffs are a frequent example. This area of *conditionality* has a very poor record, and in practice is often little more than a fig leaf for donors.

13.4 This is a large topic, and there are many different, project-specific, circumstances to consider. A few general points can be made here.

- analysts need to look beyond the confines of their project to the wider social, economic and political environment and identify features which will have a major impact on their project outcomes. They should consider how these features can be modified to make them more "project friendly". If there is no prospect of change and reform, it may be more realistic not to proceed with project aid, but to consider some kind of policy dialogue.

- Are macroeconomic conditions viable, from the project's viewpoint? High inflation will quickly overtake agreed tariff increases; a depreciating exchange rate will cripple holders of foreign debt and equity; a mounting budget deficit will make it hard for governments to meet their budgetary commitments to the project; illiquid and insolvent banks will make working capital a problem; etc.

- Are the basic general institutions - law and order, a clear legal framework and court system, solvent and efficient banks, a viable bureaucracy, etc. – in place?

- Is the institution within which the project would operate adequate for the task? If not, can it be strengthened? Is there a case for setting up a separate project authority, with its own finances, staffing, etc? (This should be a last resort, since such arrangements are rarely sustainable and cause resentment).

14. Presentation of CBA results

14.1 The Green Book's guidance on this is concise and to the point (Box 9).

Box 9. Presentational points

"The ultimate outcome of any appraisal is a decision whether or not to proceed with a proposal or a particular option. As these decisions will often have far reaching consequences , the presentation of the conclusions and recommendations to decision makers and key stakeholders can be as important as the analysis itself. In all cases, transparency is vital. Presentations and reports should be clear, logical, well founded and geared towards helping the decision at hand. Summary reports in particular should be drafted in non-technical language wherever possible, but, if it is necessary to use technical terms, they should be explained.

Reports should provide sufficient evidence to support their conclusions and recommendations. They should provide an easy audit trail for the reader to check calculations, supporting evidence and assumptions. Major costs and benefits should be described, and the values attached to each clearly shown rather than netted off in the presentation of the analysis. Appraisal reports should contain sufficient information to support the conduct of any later evaluation.

The results of sensitivity and scenario analyses should also generally be included in presentations and summary reports to decision makers, rather than just single point estimates of expected values. Decision makers need to understand that there are ranges of potential outcomes, and hence to judge the capacity of proposals to withstand future uncertainty."

Source: Green Book, p.6

14.2 In the DFID context, the following is a possible framework for presenting the results of an IA, subject to any specific overriding office guidelines.

- Summary of appraisal.
- Objectives of the project, and how this proposal would contribute.
- Development context (MDG targets?), policy background, sector status.
- Alternatives examined; why this proposal was chosen.
- Costs; breakdown; adjustments to obtain opportunity costs.
- Benefits, broken down by category and allocated to major stakeholders; adjustments made to remove major distortions.
- Result of cost-benefit analysis (NPV, IRR, BCR) or cost-effectiveness analysis. Sensitivity analysis and switching values. Impact on target group(s).
- Major risks and uncertainties in project. Worst case scenario. How stakeholders perceive risk. Proposals for mitigating risk.
- Financial analysis; profitability & cash flow for project or sponsoring authority; debt service coverage; coverage of operating & maintenance costs; viability for main stakeholders.
- Implementation: implications of the CBA for project re-design, support for institutional capacity, supply of essential inputs, policy reform, etc. Any further research, piloting necessary; key benchmarks for monitoring progress and subsequent evaluation.

Annex 1. Other Sources

There is an extensive literature on cost-benefit analysis, including contributions from some of the finest academic economists. This annex is not concerned with these texts, important as many of them are, but with further sources of sound, practical guidance for the busy economic practitioner.

The list is very short, and divided into 4 categories: HM Government guidance; previous ODA/DFID guides; currently available general books; and manuals and guides used by or available from other agencies.

i) HM Government guidance

H.M.Treasury: The Green Book: Appraisal and Evaluation in Central Government. An authoritative text, but focussed almost wholly on UK circumstances and case load. Recommends using market prices in principle. Its guidance on discount rates specifically exclude developing countries, for which it recommends the use of locally appropriate social time preference rates. Contains annexes on the case for government intervention, valuing non-market impacts, land & buildings, risk & uncertainty (very much influenced by the UK experience with the PFI[12/]), distributional impacts, and the discount rate.

HM Treasury: *The Orange Book: Management of risk-principles and concepts*. October 2004. A concise manual dealing with all major aspects of dealing with risk in projects, including identification & assessment, risk appetite, addressing risk, reviewing, reporting communicating risk, etc. Much of this is summarised in the Green Book.

Office of the Deputy Prime Minister, Department of Transport, & Department of the Environment, Food and Rural Affairs: A social time preference rate for use in long-term discounting. Written by OXERA, Dec 2002. Commissioned by several government departments, an academic foray into this difficult topic, concluding with specific proposals for lower discount rates for projects with lifetimes between 30 and 300+ years.

ii) Previous ODA/DFID guides

The succession of previous manuals and guides written by or for ODA/DFID economists charts the efforts of earlier professionals to apply the prevailing intellectual paradigms to the practical business of project appraisal in developing countries. These are showing their age, and some of their preoccupations look dated, but their hard-won wisdom still has relevance. Successive versions of the Guide appeared in 1973, 1977, and 1988, with a new Impression in 1997. A comparison of the earliest with the latest versions is instructive of the shifts in aid and development thinking over the period, as well as the evolution of experience in the art of appraisal.

Overseas Development Administration: *Appraisal of projects in developing countries: a guide for economists*. The Stationery Office, 1988, Third Impression 1997 (still available from The Stationery Office, tel. 0870 600 5533). Principal author John MacArthur. Marks the High Point of project appraisal in ODA/DFID. An excellent, sophisticated and comprehensive statement of theory and practice as it was in the late 1980s, with many practical case studies and illustrations of methodology. Somewhat academic, especially in the space devoted to concepts such as the accounting rate of interest, treatment of non-tradeables, conversion factors, *numeraires*, etc. Interesting to compare this with the first version of the guide (see next entry).

The following two works are no longer in print, but still available on the bookshelves of some connoisseurs and worth consulting to show the evolution of current thinking:

Ministry of Overseas Development: *A guide to the economic appraisal of projects in developing countries*. HMSO. First edition 1973, revised 1977. Now a Collectors' Item, at

12/ Private Finance Initiative

the time the first attempt to apply the Little-Mirrlees orthodoxy to the work of the ODA. Its sections on conversion factors, accounting prices and consumption weights reflect leading concerns at the time. Has 25 sector-specific check-lists.

G.A.Bridger & J.T.Winpenny: *Planning development projects: a practical guide to the choice and appraisal of public investments*. HMSO 1983, 2nd edition 1987. An attempt by two ODA staff economists to offer guidance on the use of CBA in a range of sectors typical of the work of a development agency. Contains a wide range of sector-specific checklists of information to be sought during appraisal. Widely distributed at the time.

iii) Currently available books

Michael Snell: *Cost-benefit analysis for engineers and planners.* Thomas Telford 1997. One of the finest books of its kind, written by an author who straddles engineering and economics with remarkable authority. The book is the fruit of many years practising as a consulting engineer and training other consultants, and reveals great experience and insight and is studded with practical cases. It is clear, readable, systematic and practical without losing any of its underlying rigour. It contains substantial annexes on uncertainty & risk, domestic pricing & foreign exchange *numeraires*, estimating economic prices, distribution, choice of discount rate, multicriterion decision analysis, the Effects Method and a lengthy Worked Example. Has a good Bibliography.

iv) Manuals and guides of other agencies

Asian Development Bank: *Guidelines for the economic analysis of projects*. 1997. A comprehensive text covering the full range of issues, expressing the "state of the art" at the time. Readable and mostly non-technical (technical issues are dealt with in 29 appendices). Reflects Asian experience (e.g. the high recommended threshold EIRR) but of general application. Can be downloaded from the ADB website (www.adb.org) or the hard copy is good value for money at $10 from ADB Publications.

OECD/World Bank Economic Development Institute: *The economic appraisal of environmental projects and policies: a practical guide* (written by J.T.Winpenny). OECD 1995 (available from OECD Publications, 2 rue Andre-Pascal, 75775 Paris CEDEX 16). Although slanted towards environmental issues, this concise guide is a good introduction to non-market valuation methods, discounting, and risk and uncertainty/.