Chapter 1

Overview of main issues

This chapter provides a summary of the key themes of the volume. These are the changing character of the developments at the knowledge frontier, the uptake of environmental CBA in actual policy formulation process and the location of possible limits to CBA. An explanation of the structure of the volume is also provided.

Imagine a choice between energy project options which involve investing in a coal-fired power plant or a renewable energy investment, such as in wind turbines. In choosing between these options (or deciding not to invest in either), one analytical tool that decision-makers and practitioners might reach for is cost-benefit analysis (CBA).

This might start by understanding what these options provide in terms of benefits (defined as increases in human well-being or "utility" to use the economic jargon) and costs (defined as reductions in human well-being). For one of these projects to qualify on cost-benefit grounds, its social benefits must exceed its social costs. The geographical boundary for considering the society which is incurring these costs and enjoying these benefits is usually the nation, but this can readily be extended to wider limits. But before getting to this point some way must be found to aggregate benefits and costs across different people (within the geographical boundary) who are affected by the project. This could involve measuring the physical quantities of inputs to the project and its outputs. Crucially, it will also require finding some means to place a monetary value on these quantities, reflecting what winners and losers from this project would be willing to give up or forego in order to obtain (or avoid) these changes. These monetised costs and benefits also occur at different points in time and aggregating these changes over time involves discounting with these discounted future benefits and costs being known as present values. It is the summation of these present values which is the basis of the cost-benefit test and resulting recommendation for choosing between these competing options.

A practitioner undertaking this economic appraisal will benefit from the long-standing character of this policy formulation and investment project selection tool. This is illustrated in the great many authoritative texts on the theory and practice of cost-benefit analysis as well as official guidelines produced by national and supranational jurisdictions or international organisations. For sure these sources indicate that this appraisal will require further considerations that have similarly long standing. This could include concerns about the way in which costs and benefits are distributed across people (within some geographical boundary) or how to address the uncertainty that will characterise the estimated time profile of these net benefit flows.

Importantly, however, a proper consideration of the economic case for each project option would need to draw on developments in environmental CBA. Environmental CBA is defined here as the application of CBA to projects or policies that have the deliberate aim of environmental improvement or actions that affect, in some way, the natural environment as an indirect consequence. In terms of the example above this is relevant for a number of reasons. The implications of each option for global climate change mitigation will be very different and so practitioners may need to find an estimate of the social cost of carbon. Similarly, the contribution of each option to local air quality will differ considerably and assessing this will necessitate tracing the link between emissions (of pollutants such as particulate matter) at, for example, the coal-based power plant and (changes in) ambient air pollution where people live, and ultimately valuing these (relative) environmental risks to

human health. In addition, the impacts of the two options mentioned above on biodiversity could be very different.

This is, of course, just one example. The definition of environmental CBA above indicates that this is relevant to a great many policies and projects (perhaps all such actions, to some degree) as well as a great variety of environmental considerations. As another illustration, a very different project might be one that sought to provide coastal protection against rising sea levels.[1] This might involve options involving traditional built (or produced) defences, such as wave breaks or seawalls or nature-based defences which could involve enhancing and restoring natural ecosystems. An important consideration is that the appraisals should start with interdisciplinary dialogue with natural scientists. For example, the ways in which different configurations of (restored) natural habitats will affect wave attenuation and lead to different levels of the flood protection ecosystem service being provided. Again, valuing this service and the changes in benefits to which it contributes involve considering a variety of impacts on human well-being which have no obvious market price. Moreover, this nature-based flood protection will provide impacts into the relatively distant future, possibly "in perpetuity" if suitably managed. The question of how to value far-off future benefits compared with the same benefits received closer to now is important especially as intergenerational concerns loom large here.

The point here is the need to keep track of developments in environmental CBA as a possibly ubiquitous feature of contemporary economic appraisal. It is the objective of this volume to explore such recent developments (and their context) and evaluate their implications for the practice of CBA. Much of the progress made up to 2006 was the subject of the OECD book *Cost-benefit Analysis and the Environment: Recent Developments* by David Pearce et al. (2006). The starting point for that volume was that there had been a number of generally uncorrelated developments in the theory and practice of CBA that, taken together, altered the way in which many economists would argue CBA should be carried out. Notably, quite a few of those developments came from concerns associated with the use of CBA in the context of policies and projects with significant environmental impacts.

This overarching observation is the starting point for the current volume. However, as might be expected, the character of the developments over the past decade or so – upon which the observation is based – represents both continuity and distinctive difference. The remainder of this introduction provides an overview of some of the main themes explored in detail in subsequent chapters.

One of these themes is the nature of developments at the "knowledge frontier". Continuity here is evident given the prominence that environmental valuation (or non-market valuation) still enjoys. This prominence should not be surprising. Given that a major challenge of environmental CBA is how to evaluate (changes in) unpriced inputs and outputs then it is inevitable that developments in techniques of non-market valuation remain at the front and centre. Nevertheless, such developments have changed in a number of ways. As a result of its long standing (relatively speaking), this sub-field shows welcome maturity through now routine use across a variety of environmental contexts.

One consequence of this maturity, however, is arguably fewer significant contributions which break genuinely new ground. This is a matter of degree, of course. Valuation using subjective well-being approaches (Chapter 7) represents a substantial new development. This is important as it possibly opens up a new frontier within this field. More generally there has been an understandable continuation of ways to demonstrate that these valuation

techniques can yield robust monetary values for environmental impacts of policies and investment projects.

In the case, for example, of revealed preference (RP) methods (Chapter 3), this has resulted in growing statistical sophistication particularly in better establishing causal inference between the transaction for a market good (e.g. buying a house or accepting a job) and the implicit price of an (non-market) environmental good (e.g. air quality in a neighbourhood or the workplace). These techniques make use of the fact that many (non-market) environmental goods and services are implicitly traded in markets, which allows then for RP methods to uncover these values in a variety of ways, depending on the good in question and the market in which it is implicitly traded. For example, demand for nature recreation is estimated by looking at the travel costs associated with this activity, with recent developments linking this to geographical information systems to improve accuracy, such as in mapping natural attributes at recreational sites. Another prominent application is hedonic techniques which value environmental goods and services as attributes or characteristics of related purchases, notably residential property or decisions such as whether to take a job for a given wage.

For stated preference methods (Chapters 4 and 5), the huge increase in popularity of behavioural economics and, in turn, its influence in environmental economics has been useful, recasting what is known about valuation biases and response anomalies in the light of these alternative theories of behaviour. Also the rise of on-line surveys, have been important to enabling more extensive applications and further testing of biases and their resolution.

Chapter 4 examines the contingent valuation (CV) method where respondents are asked directly for their willingness-to-pay or (willingness-to-accept) for a hypothetical change in the level of provision of a non-market good. There is now a wealth of experience that can be gleaned from the literature on CV that can guide current thinking about good survey design and robust valuation. The central debate remains validity and reliability, e.g. in discussions about specific problems and biases. Increasingly this is being understood as highly related to research on behavioural economics.

Many types of environmental impacts are multidimensional in character. What this means is that an environmental resource that is affected by a proposed project or policy often will give rise to changes in component attributes, each of which command distinct valuations. One tool that can elicit respondents' distinct valuations of these multiple dimensions – (discrete) choice experiments (DCEs) – is discussed in Chapter 5. Curiously perhaps, it is CV which has drawn most of the heat of the controversy about stated preference methods. But DCEs are likely to share many of the advantages and disadvantages and so the discussion in Chapter 4 of validity and reliability issues is relevant here too. Again, the links to behavioural research are highly relevant, such as on heuristics and filtering rules guiding choice that are "good enough" rather than utility-maximising.

What is also notable is the extension of valuation into different and new policy domains and the more routine application of these methods as part of policy assessments. The exemplar here is the valuation of ecosystem services (Chapter 13) which has emerged fully as an important sub-field, partly as a result of a number of global and national ecosystem assessments. While the evidence-base is broad and – at least for some ecosystem services – deep, reflections on this progress indicate a need for greater understanding of ecological production, especially as it relates to spatial variability and

complexities in the way that services are produced. This is a truly interdisciplinary activity, given the need for natural science to inform the stages of this analytical process. This situation is fluid and important areas of research remain; particularly in valuing non-use and cultural services from ecosystems, which relatively speaking has been the subject of less attention to date.

Health valuation is a more long-standing application. Even so, increasing evidence of the global burden of disease, and especially the role of environmental pollution as a determinant of this burden, has added a further urgency to this work. Chapter 15 reviews this context and efforts to quantify the physical and economic burden of air pollution in particular. Considerable strides have been made in recent years in terms of clarifying both the meaning and size of the value of statistical life (VSL). One of the main issues has been how to "transfer" VSLs from one country to another, especially where life expectancy of those people who are the object of policy and investment project proposals differs. In terms of practical guidelines, the empirical record has been important in translating findings in base or reference levels. Studies such as OECD (2012) have been important in distilling this empirical record into something highly usable, providing standard values "per unit" of some adverse health outcome, such as VSL in relation to mortalities, for a reference country or groups of countries, which can be adjusted to be applied to countries outside of this reference group.

More generally such developments enable greater use of environmental valuation in policy formulation and appraisal of investment projects. Distilling this empirical record into something more practical for policy use becomes crucial and recognition of this is evident in valuation databases (such as the Environmental Valuation Reference Inventory, EVRI) and "look-up tables" (lists of average values and ranges for various categories of environmental goods and services). These are likely to be important facilitators of uptake so long as lessons from transfer tests are built into applications (so-called "value transfer" – Chapter 6) and similarly distilled into good guidance on use and limitations. A competent application of transfer methods demands informed judgement and expertise and sometimes, according to more demanding commentators, as advanced technical skills as those required for original research. This is something of a paradox as the point of transfer exercises is to make routine valuation more straightforward and widely used.

The contribution of climate economics provides another illustration of this, given the attention devoted to estimates of the social cost of carbon (SCC) emissions (Chapter 14). While this is fraught with difficulties and uncertainties, e.g. in relation to climate sensitivity, future economic growth and emissions paths, and the damages that can be expected as a consequence, this does not obviate the need for practical estimates, since the price of carbon is very unlikely to be zero. However, it does provide a context for advising careful interpretation in policy use. The problem here is the technical complexity of the analytical issues underlying estimation of the SCC. This has led to an emerging desire for transparency and simpler illustrative approaches although it remains early days to decide on how best to provide this clarity in a robust and credible way.

Thinking about CBA in the context of climate economics has had more general import too, especially in terms of the social discount rate (Chapter 8). Intergenerational issues, such as climate change, have provided a formidable challenge to the conventional discounting approach. Not only do the assumptions underpinning conventional discounting become problematic but also the ethical underpinnings of discounting become extremely important.

As a result, there has been considerable interest in how the parameters of the discount rate for social CBA are determined as well as their ethical and practical content. Perhaps the most obvious manifestation of this interest has been the growing consensus around the idea of a declining social discount rate. This still leaves plenty of remaining debate about what the empirical schedule of these declining rates should be. What is clear, however, is that these developments have ramifications beyond the focus on climate economics.

One aspect of a number of these developments is the growing degree of technical sophistication brought to bear on various elements of environmental CBA. This rigour has advantages such as in the statistical rigour which is commonly now a feature of applications of environmental valuation – monetary valuation is more robust as a result. It also places claims, for example, about the social discount rate on a rigorous foundation of theory. A disadvantage is that it makes a lot of these developments the preserve of the economic specialist. At risk then is policy uptake if developments are perceived to make these matters less accessible to a more general audience.

This is not inevitable, although it may need some deliberate and additional effort to translate specialist work into more general terms, as well as to distil possibly complex analytical findings into more readily usable terms. Examples in this respect include statistical modelling in DCE which is increasingly accessible more broadly via a growth in training opportunities and free statistical software, "look-up" tables and valuation databases which summarise an otherwise bewildering large empirical record and practical schedules of declining discount rates.

Of course, it would be surprising along the way if there were not tensions between innovations at the "knowledge frontier" of environmental CBA, on the one hand, and on actual uptake and use of environmental CBA in real policy formulation on the other. Moreover, the reality is also that a number of frontier developments mostly (but not exclusively) emanating from climate economics and sustainability economics appear to circumscribe the use (and usefulness) of CBA. Put another way, one interpretation of this is the discovery of its possible limits to applying environmental CBA.

There is nothing new in this idea of limits, of course. However, the contemporary details are a change and are typically manifested in scientific concerns about thresholds which might characterise ecological systems, combined with the view that breaching such thresholds could be extremely costly indeed in terms of human well-being, or even the sustainability of human development (Chapter 12). This has substantial implications for CBA. For example, in climate economics, a small but significant prospect of catastrophic climate damage will dominate a cost-benefit assessment. If so, then the policy formulation is less about careful deliberation of (marginal) costs and benefits than it is about working out ways of reducing these "fat-tails" of catastrophic risk.

There is also considerable uncertainty (as opposed to known probability distributions) surrounding what is lost when natural capital is degraded or destroyed, and where critical thresholds are actually located. The presumption might be then that precaution is important, rather than assessing costs and benefits. Nor is ethics divorced from reflections about the role of formally weighing up costs and benefits, as these policy questions are fundamentally problems of intergenerational justice.

All this might add up then to a sense in which environmental CBA has a more limited place in terms of informing social decisions about policy formulation and investment projects. This, in turn, might involve imposing (sustainability) constraints on economic

recommendations. Or it might involve conducting CBA on specific options only once the strategic policy decision to act has been made. It even might entail downplaying the role of CBA entirely. For example, in terms of the coastal protection case mentioned towards the outset of this chapter, perhaps the question about sustainability concerns shapes strategic decisions and as a result favours nature-based options. So CBA becomes an issue of choosing between natural flood protection options, rather than comparing these with built infrastructure (such as constructed wave-breaks).

While it is important to recognise these limitations on which such responses might be based, there is a risk of over-reaction too. It is entirely possible to push back the knowledge frontier and to extend the tool where previously it was judged to be problematic or difficult, as numerous past developments in environmental CBA have shown. It is also important to convey whether or not there are substantial (opportunity) costs of those constraints. The role of environmental CBA to act as the instrument to consider the case for (social) efficiency for decisions within the broader policy process remains crucial.

Progress here then is a mixture of pushing back existing frontiers and encountering novel frontiers which may prompt fresh questions about where and how CBA can be applied. It is also important to ask how far the journey has proceeded from developments in environmental CBA to use in the formulation of actual policy and investment projects. For example, proposals for integrating distributional concerns into CBA are long-standing (Chapter 11), although practical applications are less frequent. The suspicion might be that this is not only due to a supply problem (a manifestation of the singular emphasis of cost-benefit practitioners on efficiency), but it is also likely to be an issue about demand: i.e. policy makers have not required this information be provided in the terms of reference for the environmental CBA upon which they rely. It is interesting to ask why this is the case. The problem could lie in traditional responses being seen as controversial or arbitrary (such as distributional weighting of costs and benefits according to the vulnerability or income levels of particular groups of people affected by proposals). However, less ambitious, but nevertheless informative, alternatives exist such as cataloguing how costs and benefits are distributed across people but also how particular environmental goods and bads (such as high or low air quality, unwanted land uses, and so on) are distributed.

More generally, whether (environmental) CBA is used in actual policy formulation and actual investment projects is a question to which a more comprehensive response is needed. Yet this is a question that cost-benefit texts, as good as these are in providing rigorous guidance on how CBA *should* be done in theory and practice, by-and-large, often downplays.[2] There are exceptions and the survey of OECD member country practice in this volume is one example of this sort of systematising of the record on official use of environmental CBA (Chapter 16).

That survey echoes past findings that actual use of environmental CBA is perhaps best summed up by the metaphor of a "glass half-empty or half-full". There are large variations in the extent to which CBA is being carried out, and the extent to which various environmental impacts are being taken into account in these analyses, across economic sectors and across analytical contexts. For example, transport and energy sector investments as well as policy *proposals* are relatively well covered in CBAs, but there is far narrower coverage of non-climate environmental impacts in those assessments. While there is evidence of actual use (sometimes extensive), there are also signs that considerable further progress remains still to be made. Needless to say, the policy process is characterised by a

complicated set of institutions and it is important to place questions about actual use in that context. Put another way, understanding the political economy of CBA is crucial to understanding how it is actually used and what actions might be plausible to affect this in a positive way.

Political economy then seeks to explain why the economics of the textbook is rarely embodied in actual decision-making and related to this, policy-formulation processes. But explaining the gap between actual and theoretical design is not to justify the gap. So while it is important to have a far better understanding of the pressures that affect actual decisions, the role of CBA remains one of explaining how a decision should look if an efficiency approach is adopted.

Interestingly, the sorts of institutional developments that might be proposed as part of this political economy standpoint are actually happening with the broader context here being reform to regulatory frameworks across many national jurisdictions and supranational groupings of countries. Notably this change in the institutional architecture surrounding how environmental CBA is done (and when it is done) has involved the setting up of public (and often independent) bodies that could facilitate a more prominent role for CBA, for example by adding a further tier of scrutiny by, in effect, "policing" or "peer-reviewing" official appraisals. The Regulatory Scrutiny Board of the European Commission is a prominent example of this.

The rest of this book is organised as follows.

Chapter 2 sets the scene in more detail by providing an overview of the basic framework for environmental CBA, as well as showing how subsequent chapters represent developments to, and reflections on the usefulness of, that framework.

Thereafter there is a series of Chapters which deal in more detail with developments to methods that practitioners of environmental CBA utilise.

This starts with Chapters 3 to 7 which deals with techniques of environmental valuation, including established approaches based on revealed and stated behaviour (as well as "value transfer" exercises using existing studies, which comprise the empirical record). Subjective well-being valuation approaches, based on experienced behaviour, represent a novel addition to this array of techniques.

The next four Chapters 8 to 11 present a number of "classical" elements of the core of CBA, including uncertainty, discounting and (intra-generational) distribution.

Chapters 12 to 15 look at a handful of highly significant policy areas where developments have had substantial implications for environmental CBA. This includes the notion of sustainability as it relates to how natural capital is affected by policies and projects. Also relevant to this is the valuation of ecosystems, which has been a highly visible area of applied research for more than a decade. Similarly, climate economics has been a fruitful source of new challenges, given the characteristics of the climate change problem. The last of these applications, health valuation, is the longest standing one but that leads to interesting questions about distilling the empirical record there into usable "reference value" for policy purposes.

That question about policy use is continued in the final three Chapters 16 to 18. This includes the results from a survey of OECD countries as to the use and influence of CBA across a range of environment-related policy sectors, such as transport and energy. Subsequent chapters on the political economy of CBA and alternative policy formulation tools offer some further context for understanding such findings.

Notes

1. See, for example, Nayaran et al. (2016) and Barbier (2012).
2. There are notable exceptions, perhaps most significantly including the work of Robert Hahn for the United States as well as David Pearce for United Kingdom and for Europe.

References

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