

PROJECT EVALUATION WITH DEMOCRATIC DECISION-MAKING: WHAT DOES COST-BENEFIT ANALYSIS REALLY MEASURE?

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It is often argued that projects involving public good changes should be chosen on the basis of monetary valuation and cost-benefit analysis (CBA). However, CBA is not value-free. When used as a welfare measure, it is based on highly controversial value judgements. When used as an efficiency measure, it is based on assumptions of limited relevance to democratic decision-making processes. CBA measures total net willingness to pay, neither more nor less. While interesting in its own right, the normative significance of this indicator is not obvious.

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1. Introduction

Markets function poorly when it comes to provision of public goods, such as a stable global climate, air quality, biodiversity and many other ecosystem services. Securing a reasonable supply of such goods is thus an important task for government.

Economic analysis of potential public sector projects should, to the extent possible, contribute to decision-makers' understanding of what is at stake, regardless of whether consequences have market values. In environmental economics, a common approach to public project evaluation is thus to estimate people's willingness to pay for changed public good provision, use this as a measure of the social benefits of the environmental change at hand, and then compare these benefits to project costs and other social impacts through cost-benefit analysis (CBA). The resulting indicator is usually called the project's 'net benefits' or 'net present value', and is often interpreted as a measure of its social desirability.

Some scholars explicitly consider CBA as a tool for measuring a project's contribution to social welfare; others, while not necessarily accepting the welfare interpretation, speak of it as a means to indicate projects' efficiency.² However, even for the efficiency interpretation, the theoretical rationale can be questioned.

CBA can be interpreted normatively or positively (Hammit 2013). In the present paper, I will discuss what CBA really measures. Turning first to the normative interpretation, I spell out some of the highly controversial ethical and/or political premises one implicitly accepts if using CBA as a normative guide. I next discuss the efficiency interpretation, arguing that it relies on assumptions that are rarely valid in democratic project evaluation processes. Finally, I briefly sketch an alternative approach to economic project analysis, based on the idea that the analyst's job is to convey and summarize relevant facts, pointing out the pros and cons, while final conclusions are determined (whether one likes it or not) through the democratic procedure at hand.³

Basically, what I want to argue is the following. As a tool for choosing between public projects, cost-benefit analysis is far more ethically and politically controversial than most economists (and many environmentalists, physicians, engineers and others) seem to think. This holds even if one sticks – to the extent possible – to traditional theory and concepts from welfare economics, and even if one disregards widely discussed CBA controversies such as issues related to discounting and/or uncertainty, valuation techniques, altruism/agency, and CBA's anthropocentric welfarism.

To pursue this end, I use the language of standard welfare economics. While my discussion is based on a simple formal model, all results are also stated verbally, hopefully making the discussion accessible to a broader audience.

² Arguments for using CBA as a normative guide to decision-making can be found in, e.g., Harberger (1971), Navrud (1992), Hanemann (1994), Hahn and Litan (2005). For different views, see e.g. Kelman (1981), Sagoff (1988). The popularity of non-market valuation and CBA in environmental economics can for example be confirmed by leafing through any volume of *Environmental and Resource Economics*.

³ For a more elaborate discussion, see Nyborg 2012.

Substantial parts of my message are not at all new.⁴ For precisely that reason, I have been reluctant to write this paper. I have done so because, after discussing the topic with policy makers and researchers over more than twenty years, I still find that even highly competent people dealing with CBA in their daily work are totally unfamiliar with the insights summarized below.⁵

Pinpointing exactly what CBA measures, in an intuitively understandable but yet precise way, turns out to be surprisingly hard. A main problem is that the standard explanations start from assumptions with limited relevance in applied policy-making contexts. Economics textbooks often assume, implicitly or explicitly, that the purpose of a CBA is to judge projects' social welfare effects based on the value judgments (or in the language of welfare economics, the social welfare function) of some unique policy-making entity, like "the planner", "the government", or the "ethical observer".⁶ My starting point here is different. I will assume that the aim of the project analysis is to enable *each individual participant* in a democratic project selection process to judge alternative projects' social welfare effects, given his or her own value judgments.

There are two main reasons why distinguishing between these purposes is important. First, democratic procedures involve many participants (sometimes called the *demos*). The ethical and political views of these participants must be expected to differ. A very fundamental requirement of democratic decision-making is that every demo should have an equal opportunity to explore and express reasons for her views (Dahl 2006).⁷ An analysis provided as background information to participants in a democratic process ought to be useful even to participants who do not subscribe to a particular value judgment chosen by the analyst.⁸

Second, democratic decision-making is often, by its very nature, fragmented. Power is shared, it is delegated, it is lost. Ruling parties as well as individual decision-makers can be replaced at frequent intervals, and at unexpected times. Different types of decisions are separated according to constitutional rules, or delegated to different political bodies; for example, project decisions may be made by a regional council, while the tax system is determined by Parliament. Democratic decision-making processes are characterized by conflict, compromise, negotiation and renegotiation. The assumptions made in common textbook explanations of CBA, particularly those ensuring the possible separation between efficiency and distribution concerns, become questionable under such circumstances.

Some scholars take a more pragmatic approach to cost-benefit analysis, not necessarily defending the welfare or efficiency interpretations at all. Sunstein (2013) points out that CBA may, by counting

⁴ See, for example, Dasgupta et al. 1972, Hammond 1979, Kelman 1981, Drèze and Stern 1987, Sagoff 1988, Blackorby and Donaldson 1990, Bromley 1990.

⁵ Here are some of the reactions I tend to get, often at the same occasion: 1. This has to be wrong. 2. This is trivial. 3. This is too uncritical to economics. 4. This is too critical to be taken seriously. 5. This is too technical. 6. There is no real formal model here. 7. This is interesting.

⁶ "The key principle that underpins CBA ideally is very simple. (...) The typical project will involve some winners and some losers. Some kind of social welfare function is then used to aggregate across affected individuals" (Perman et al. 2003, p. 368).

⁷ See also Nyborg and Spangen 2000.

⁸ In the language of welfare economics: Ranking projects according to a unique policy-maker's value judgements begs for *output* from one particular social welfare function. Enabling each demo to arrive at a well-founded policy evaluation requires information that can be used as *input* into different social welfare functions (Brekke et al. 1996, Nyborg 2000, Nyborg 2012).

effects in a systematic, yet simple way, help prevent cognitive limitations and biases from causing policy-makers to neglect vital aspects of proposed policies. This is an important point which should be borne in mind.

Public policy is crucial to secure a reasonable supply of public goods. Since public funds are limited, sound economic analysis of alternative projects is important. In practice, however, the impact of CBA and monetary valuation on actual policy-making appears to be limited.⁹ This lack of influence might, of course, be due to policy-makers not understanding the CBA methodology, or simply not caring about the costs and benefits of proposed policies at all.¹⁰ Nevertheless, another potential explanation, which is often heard from policy-makers but rarely from economists, is that CBA simply answers other questions than those policy-makers need economists' help to answer.¹¹ If so, economic project analysis might become more influential if analysts were concerned less with identifying 'best' projects and more with laying out projects' pros and cons in intuitively understandable ways – even if the normative evaluation itself was left to others.

2. Individual utility

Let me start with a very simple formal framework.¹² While discounting, risk and uncertainty have been among the most hotly debated aspects of CBA, they are not crucial to my concern here; for the purpose of simplification, I will thus use a static, deterministic model and ignore discounting¹³ as well as uncertainty. In the same vein, I assume that individual incomes are exogenously fixed, and that any income not used for contributing to public goods is spent on the individual's own private consumption. I restrict myself to discuss choices between alternative marginal projects.¹⁴ In this context, "marginal" means that the project's impacts on market values, as well as marginal non-market values including individuals' marginal utility of income, are small enough to be disregarded.¹⁵

In neoclassical consumer theory, 'utility' simply represents an individual's choices, or revealed preferences, regardless of her motives for these choices. Below, I will begin by replicating the standard theoretical rationale for the social welfare interpretation of cost-benefit analysis, and for that purpose the usual 'revealed preferences' utility concept is in fact insufficient (see Sen 1979, 1985). In what follows, 'utility' should thus be thought of as a representation of what is good for the individual, i.e. her own well-being (for a more thorough discussion, see Nyborg 2012, Ch.5). To keep the analysis simple, and avoid (otherwise likely) inconsistencies between revealed choice and well-

⁹ Kuik et al. (1992), Fridstrøm and Elvik (1997), Nyborg (1998), Hahn and Tetlock (2008), Hahn (2009), Odeck (2010), Rogers et al. (2013).

¹⁰ "The poor quality of analysis can help explain some of this ineffectiveness. However, regardless of how good the analysis is, politicians sometimes choose not to take basic economic ideas seriously." Hahn and Tetlock (2008), p. 69.

¹¹ Nyborg 1998, 2012, Nyborg and Spangen 2000.

¹² The model is based on the presentation in Nyborg (2012).

¹³ The static set-up is not crucial for the results; values below could easily be interpreted as present (discounted) values.

¹⁴ For major reforms, e.g. changes in the overall tax and transfer system, part of the reasoning below may require modification.

¹⁵ Here, a "project" simply means a combination of changes, compared to a base case, in the population's access to public and private goods.

being, I disregard the (reasonable) possibility that individuals have altruistic, idealistic and/or duty-oriented preferences (see Sen 1985, Sagoff 1988, Nyborg 2000).¹⁶

Assume that there are $n > 1$ individuals in society, who care about their own access to private as well as public goods. For any individual i , the utility level U_i can be specified as

$$(1) \quad U_i = u_i(X_i, E)$$

where X_i is individual i 's consumption of private good (measured in money), and E is the supply of a public good, which I will think of as environmental quality (measured in physical units). The utility function u_i has standard properties.¹⁷

A marginal project is defined by small changes in individual incomes (dX_1, \dots, dX_n) and environmental quality (dE).¹⁸ Although inessential for the results, I will discuss the problem as if the purpose of the project is to increase public good provision, while changes in individual private consumption result from citizens being required to contribute to cover the cost of this.

By differentiation of the utility function, we get a formal expression of a project's impact on an individual's utility:

$$(2) \quad dU_i = u'_{iX} dX_i + u'_{iE} dE$$

Here, u'_{iX} is i 's marginal utility of income, and u'_{iE} is her marginal utility of environmental quality. That is, the change in the individual's utility is determined by the changes in private consumption and the environmental quality, respectively, and how strongly each change influences her utility.

Let WTP_i be the individual's willingness to pay for improved environmental quality (dE). WTP_i can be defined as the amount of money one must take away from her in order to leave her with exactly the same utility level as she would have had without the environmental change. If we combine this definition with equation (2) and rearrange, we find that WTP_i can be expressed as

$$(3) \quad WTP_i = (u'_{iE}/u'_{iX})dE.$$

Using standard economics language, this says that willingness to pay for an environmental change is given by the marginal rate of substitution between environmental quality and private consumption – that is, how relatively important these are to her on the margin – and the size of the environmental change.

¹⁶ While obviously unrealistic, these assumptions still leave my utility concept somewhat vague. A similar vagueness is inherent in most of welfare economics, and for the sake of brevity and simplicity I will leave it at that. Allowing altruistic/duty-oriented utility functions adds to the problems pointed out below, as demonstrated in Nyborg (2000).

¹⁷ That is, it is quasiconcave (indifference curves bend towards origo), and increasing and differentiable in both variables.

¹⁸ More formally: that the project is marginal means that we can disregard the effects of dX_i and dE on marginal values – including the individual's own marginal valuation u'_{iE}/u'_{iX} . Thus, if a project changes u'_{iE}/u'_{iX} , it is not marginal in the sense used here, even if all market prices are unchanged. This implies that the difference between willingness to accept and willingness to pay measures (or compensating and equivalent variation) can be disregarded.

Willingness to pay, as expressed by (3), is a hypothetical payment. *Actual* payment – the individual’s contribution to cover the project’s costs – may be bigger or smaller than this. Assume now that individual i must pay a pecuniary cost $C_i \geq 0$ if the project is implemented (that is, $dX_i = -C_i$). Using (2) and (3) and rearranging, we get

$$(4) \quad dU_i = u'_{iX} (WTP_i - C_i).$$

In words: i 's utility change is proportional to her net willingness to pay.

Assume now that we want to rank projects according to their contribution to the individual’s utility. Net willingness to pay ($WTP_i - C_i$) can, in principle (if not always in practice), be measured. The proportionality factor u'_{iX} , however, which reflects the individual’s marginal utility of income (how important money is to her on the margin), is not known. But since it is strictly positive and constant (by assumption), its level is inconsequential for the ranking. Hence, i 's net willingness to pay ranks alternative projects in the same way as her preferences – which is the standard textbook rationale for using net WTP as a welfare measure.¹⁹

In standard (unweighted) CBA, one adds the net WTP of all members of society (or, equivalently, adds up the WTP for all individuals, then subtracting the sum of costs for all individuals). Since individual net WTP ranks individual utility change, one might expect that the sum of net WTPs ranks aggregate utility change. That, however, is not generally true, as I will return to below.

Note that while i ' net willingness to pay tells us how relatively important one good (environmental quality) is as compared to the other (private consumption), it says nothing about these goods' absolute importance to the person in terms of utility. If a person’s willingness to pay for improved lake visibility is low, it could reflect that she cares little for improved lake visibility, or alternatively, that money is extremely important to her at the margin. Similarly, a moderate WTP could mean either that she cares little about both goods, or that both are extremely important to her. To draw conclusions about how important improved lake visibility is to a person – in *absolute* terms – from her WTP, we would need to know her proportionality factor u'_{iX} .

When using CBA as a tool for welfare measurement, we are essentially comparing the importance of one change for one person to other changes for others. Ranking projects according to each individual’s utility change, as above, is then of little help; we need to compare the utility changes *across persons*. To make such comparisons, we thus need a utility concept that is meaningful in absolute terms, for example in terms of well-being or happiness, and for which interpersonal comparison makes sense, at least in principle.

This is why the ‘revealed preference’ utility concept of neoclassical consumer theory is not sufficient when discussing CBA. The ‘revealed preference’ utility concept is concerned only with rankings (this is called an *ordinal* utility concept); it contains information neither on how important each change is

¹⁹ If preferences are not exogenously given, or if the individual acts according to different preferences when in different roles (e.g. as citizen or consumer), then net WTP is *not* necessarily a measure of ordinal utility (see Kelman 1981, Sen 1979, 1985, Sagoff 1988, Nyborg 2000). I am disregarding these complications here.

for the individual in absolute terms, nor on how utility might be compared between persons (see Boadway and Bruce 1984).^{20 21}

3. Aggregating utility

If we want to aggregate utility over individuals, the proportionality factor u'_{iX} becomes crucial.

The proportionality factor u'_{iX} plays the same role for utility comparisons across individuals as the exchange rate plays for comparison of goods prices expressed in different currencies. To compare the prices of two computers for sale in Norway, where I live, I don't need to know the exchange rate between Norwegian kroner and US dollars. When travelling to the US and comparing the price of a computer offered there to those at home, I certainly do need to know the exchange rate. Similarly, although the level of u'_{iX} is inconsequential when evaluating projects from one single individual's point of view, it is essential when comparing utility changes across individuals.

Formally, this can be seen by adding dU_i for all n individuals in society, using eq. (4):

$$(5) \quad \sum_i dU_i = \sum_i [u'_{iX} (WTP_i - C_i)] \neq \sum_i (WTP_i - C_i)$$

where the sums are over all $i=1, \dots, n$.

In the special case where u'_{iX} is equal for everyone, the sum of utility changes will be proportional to the sum of net WTP. Thus, if money is equally important to everyone on the margin, the sum of net WTP actually measures the sum of individual utility changes – and this would be the interpretation of CBA.

So what do we know about u'_{iX} , the marginal utility of income? Unfortunately, not all that much. Neoclassical economics provides no generally accepted method for its measurement; this should not be surprising, since this concept is not even well-defined within the (ordinal) revealed preferences notion of utility. Nevertheless, many measurement attempts, all of them somehow involving extensions of or alternatives to the purely neoclassical approach, have been made (e.g. van der Praag 1991, Oswald 2008). One promising approach takes its starting point in the recent happiness research, based on the idea that utility and reported happiness, or alternatively life satisfaction, are closely related concepts (as assumed in the present paper). This research does not indicate that money is equally important to everyone on the margin. Layard et al. (2008) used several surveys of self-reported happiness, using data from 50 countries during 1972 to 2005, and found that when

²⁰ An *ordinal* utility concept only defines whether an individual i prefers social state A to B, i.e. whether $U_i(A) > U_i(B)$. A *cardinal* utility can also specify whether one utility *change* is more important to i than another, i.e. whether $U_i(A) - U_i(B) > U_i(C) - U_i(D)$ (where A – D are social states). A *cardinal and interpersonally (level) comparable* utility concept can define whether a utility change for one person is more important than another change for another person, that is, whether $U_i(A) - U_i(B) > U_j(C) - U_j(D)$.

²¹ Adding up purely ordinal information (rankings) to yield apparently well-behaved social welfare functions is not, in fact, even possible, unless one individual is given the role of a dictator (Arrow 1951). Anyone who has organized a soccer tournament knows the difficulties in proclaiming a winner based on binary rankings only.

household income increases by 1 percent, the marginal utility of income decreases by 1.26 percent. That is, the marginal utility of income u'_{ix} is substantially higher for poor than for rich households.²²

If u'_{ix} varies between persons, total net WTP is not proportional to the sum of utility changes. Nor is there another similarly simple relationship between the two. In the absence of knowledge or assumptions on how important money is to people on the margin, total net WTP is uninformative on aggregate utility change.

4. Social welfare change

Above, I was simply summing up individual utilities, without considering whether every utility change is equally important from society's point of view. Let us now introduce what economists call social welfare functions.

A social welfare function is a formal representation of value judgements about what constitutes a good society. It thus represents purely normative - ethical and/or political – views.

In standard textbook explanations of CBA, and in most of welfare economics, one usually assumes that there is only one social welfare function, representing the value judgements of the government, a 'representative consumer' (whatever that may be), an ethical observer or the like. It is also usually assumed that this social welfare function is 'welfaristic', meaning that social welfare depends only on the utility of each individual in society.²³ Many value judgements cannot be expressed in a functional form, and/or do not satisfy welfarism (e.g. by depending on animal welfare or human rights *per se*). To keep as closely to standard welfare economics as possible, however, I will keep to the assumption of welfarism below.

Since I have democratic decision-making in mind, assuming that every demo has the same social welfare function makes little sense; that would amount to assuming full agreement on ethical and political value judgments. Instead, I will take the point of view of the individual demo, and consider the following question: For unweighted CBA to rank projects correctly, according to this demo's ethical/political value judgements, which restrictions must be placed on her value judgments?

Assume that social welfare W can be expressed as follows, where V is a differentiable function which is increasing in all variables ($V'_i > 0$ for all $i = 1, \dots, n$ members of society, where V'_i is the derivative of V with respect to U_i):

$$(6) \quad W = V(U_1, \dots, U_n)$$

One example of V would be the utilitarian social welfare function $W = U_1 + \dots + U_n$, for which $V'_i = 1$ for all i .

Let us now consider a marginal project's contribution to social welfare. Differentiation of (6) and inserting from eq. (4) gives an expression for the change in social welfare due to a project:

²² See also Stevenson and Wolfers (2008).

²³ Thus, welfarism implies but is more narrow than antropocentrism; it encompasses but is broader than utilitarianism. For a critical discussion of welfarism, see Sen (1979).

$$(6) \quad dW = \sum_i (V'_i u'_{iX} \cdot (WTP_i - C_i))$$

where the sum is over all $i = 1, \dots, n$.

That is, the social welfare contribution of a project is given by a weighted sum of individuals' net willingness to pay. The weight placed on net willingness to pay for individual i ($V'_i u'_{iX}$) is often called the *welfare weight* for person i .

The weights are composed by two factors.²⁴ The first (V'_i) says how much emphasis society should place on person i 's interests. This is a purely normative judgment, which must itself be based on ethical and/or political values; it will thus presumably differ between demos, and has no economically "correct" value. An egalitarian demo (egalitarian in terms of utility) would give less weight (V'_i) to the interests of somebody whose utility level is high, and more weight to one whose utility is low. A utilitarian would give the same weight to utility changes for everyone regardless of their current situation. The second factor (u'_{iX}) is the marginal utility of income, discussed above.

Standard CBA implies adding up the unweighted net WTP of all individuals. Thus, for CBA to measure social welfare change, the welfare weights ($V'_i u'_{iX}$) must be identical for all individuals. In other words, only those demos who agree that welfare weights should be equal for all can use CBA to measure projects' welfare effects. So what do equal welfare weights mean in terms of ethical or political judgment?

If $V'_i u'_{iX} = V'_j u'_{jX}$ for all i and j , we must also have $u'_{jX} / u'_{iX} = V'_i / V'_j$. That is, if any two individuals have a different marginal utility of income, equal welfare weights necessarily imply that one of them is considered more socially important than the other with respect to social welfare.

To simplify even further: Assume that I have a social welfare function implying that $V'_i u'_{iX} = 1$ for every member of society i , corresponding exactly to the implicit welfare weights used in standard CBA. Then, by simple logic, I must agree that for every i ,

$$(8) \quad V'_i = 1/u'_{iX}.$$

That is, I – and the CBA – are attaching a social importance (V'_i) to each individual's interests which is *inversely proportional* to this individual's marginal utility of income. The more i values an extra dollar, the less I care about her utility. Or, if we follow Layard et al. (2008) and assume that the marginal utility of income is declining in income: I care less about a person's utility change the poorer she is. This is the ethical/political meaning of equal welfare weights for all.

There seems to be a common misunderstanding that unweighted summation of net WTP, as in CBA, can be justified by utilitarianism. As shown by eq. (8), however, unweighted summation of net WTP is *inconsistent* with utilitarianism. The only exception is if everyone has the same marginal utility of income. In all other cases, CBA gives more weight to the interests of those with a low marginal utility of income (the rich?) than utilitarianism.

²⁴ Each of them is, by assumption, positive and constant (since the project is marginal), hence welfare weights themselves are positive and constant.

Some textbooks suggest that rather than taking an explicit stand on the issue of welfare weights, the analyst can simply assume that the income distribution is optimal. If the government has already redistributed income to the degree it finds best, and money is still more important (on the margin) to person i than to person j , it must be because the government values marginal utility improvements less for i than for j . Hence, with a socially optimal income distribution, welfare weights $V'_i u'_{ix}$ are indeed equal for all.²⁵ This is merely another way to say exactly what I said above: If one finds the income distribution is optimal, while the marginal utility of income is nevertheless decreasing in income, then this means saying that society ought to place more emphasis on utility changes for the rich than for the poor.²⁶

Note that conflicts of interests are central to the above. If we know that a project increases at least one person's utility while reducing nobody else's (i.e. it is a Pareto improvement), neither welfare weights nor net WTP are required to declare this a social welfare improvement (given welfarism). The interesting cases concern decisions involving gains to some people and losses to others. Then one must decide how much weight to give to one person's interests as compared to the other's. Welfare weights are formal representations of this kind of intuitive judgments.

5. Efficiency, not welfare

Above, I explained why CBA is a measure of projects' welfare change only for those demos who accept (in addition to welfarism) the view that society should give utility changes for the rich systematically more weight than utility changes for the poor. The social welfare interpretation of CBA is explicitly normative (see Hammitt 2013). Let us now turn to a more positive interpretation, namely to consider CBA a measure of projects' efficiency.²⁷

It is common to think of *efficiency* as concerned with maximizing the size of the "pie" to be shared, while *distribution* is about how to share this "pie". In the present context, it is not obvious which kind of "pie" we would be trying to maximize. We thus need to define what "efficiency" should be taken to mean.

In textbook models, *efficiency* is sometimes used synonymously with *welfare improvement*. Accordingly, a project might be considered efficient if it increases social welfare. That definition is of no help here, however: it brings us immediately back to the normative interpretation.

The central efficiency concept in economics is that of Pareto efficiency. A Pareto improvement is a change that improves the situation for at least one person, without making things worse for anyone else. Pareto *efficiency* describes a situation in which no further Pareto improvements are possible. Based on this efficiency definition, an alternative A improves efficiency as compared to B if choosing A over B gives higher utility of at least one individual and lower utility for no-one. Again, this definition is not very useful here. If A represents a Pareto improvement compared to B, we need no CBA to rank them: everyone would agree that A should be preferred (given the present

²⁵ See, e.g., Johansson (1993, Ch. 2 and 7).

²⁶ Nyborg (1998) and Nyborg and Spangen (2000) found that skepticism towards CBA was greater among politicians on the political left than among those on the right. If those on the left are more unhappy with the income distribution, their higher degree of skepticism is justified.

²⁷ For a discussion, see Bromley (1990).

assumptions). CBA is designed precisely for cases involving conflicts, that is, cases for which trade-offs between diverging interests are indeed required.

A third possible definition is that of *potential Pareto improvements*. A project is said to represent a potential Pareto improvement if it could hypothetically have been made a Pareto improvement, provided that appropriate redistribution took place. The view that CBA measures efficiency according to this definition exists in at least two versions.

The first version is familiar to every economist: Call those with a positive net WTP 'winners' and those with a negative net WTP 'losers'. If total net willingness to pay is positive, this must mean that the winners' gain is sufficiently large to fully compensate every loser. Hence, by taking money from winners and giving it to losers, the project could potentially become an actual Pareto improvement.

The problem with this argument is that such redistribution is typically not possible even in theory (Hammond 1979). Transfers of income involve administrative costs, and provide incentives for changed behavior. Hence redistributing the "pie" cannot be done without simultaneously changing its size. In addition, a democratic government cannot just take money from one person and give it to another in any way it likes; if the transfer is not mandated by the general tax system, doing so may be in conflict with citizens' constitutional property rights or other laws.

A possibly even bigger problem is to identify losers and winners, as well as the magnitude of their loss or gain: This requires private information on e.g. individuals' preferences. If an individual knows that her reported WTP is being used to make her actually pay (or receive compensation), she has every incentive to misreport her WTP.

However, there is also a second version of the view that CBA measures efficiency in terms of potential Pareto improvements. Hylland and Zeckhauser (1979) demonstrated that under certain conditions, social welfare is maximized by ranking projects according to their unweighted total net benefits (i.e. according to CBA), while taking care of redistribution through the income tax system instead (see also e.g. Christiansen 1981, Johansson-Stenman 2005, Kaplow 2008, Boadway 2010). This argument can hold even if transfers make people change their behavior, and takes into account that income taxes may be distortionary. The idea is not, as above, that each individual project could potentially be turned into a Pareto improvement through appropriate redistribution, but rather that the general tax system is better suited as a tool for redistribution than public projects.²⁸

This argument is based on rather specific assumptions, which cannot always be expected to hold in practice.²⁹ When they do hold, a dictatorial (and benevolent) policy maker should rank projects according to CBA, and handle the income distribution through the income tax system. But we are now concerned with democratic project selection processes, not dictatorial decision-making.

Imagine that you are a rational, benevolent politician participating in a vote in Parliament. The options are to vote for either project A or B. Total net WTP is higher for A. However, in your view, the

²⁸ For a counterargument, see Quiggin (1995).

²⁹ According to Johansson-Stenman (2005), it is optimal to use distributional weights in CBA when different projects will affect tax revenues equally much via changed labor supply, and unless differences in distributional welfare effects are offset by corresponding changes in tax revenue effects. Kaplow (2008) introduces "distribution-neutral income tax adjustments" allowing one to largely ignore concerns about distribution when determining the optimal provision of public goods.

project (viewed in isolation) will reduce social welfare unless compensation measures are implemented.

Your problem is that you are not in control of the available redistribution processes. You have a vote in the project selection process, but the tax system is not currently on the agenda. The next time it is, you may no longer have a seat in Parliament, or if you do, you may not expect to be able to secure enough support for the redistribution measures you propose.

If you vote for project A, and redistribution measures do not take place, you will have contributed to a reduction in social welfare. Unfortunately, the same thing is likely to happen next time: Unless you find the income distribution optimal, CBA will systematically rank projects based on value judgments diverging from yours. Thus, you may be contributing to what you consider a steady decrease in social welfare, or at least a smaller increase than would have been attainable through other project choices.

6. The power line example

By now, the reader might be asking him- or herself what all this has to do with the environment. Can't the problem discussed above safely be disregarded for most environmental projects, since they are rarely motivated by redistribution concerns, and often have small distributional effects anyway? Drawing such a conclusion, however, would be completely missing the point.

In my analysis, I have only considered marginal projects. Thus, all effects, regardless of whom they harm or benefit, are "small". This discussion is important to environmental economists not because they necessarily care about the income distribution per se. It is important for environmental economists because they need to understand that environmental valuation and CBA is only one of several ways to prioritize between environmental and other concerns, one that is hardly more value-free than the alternatives.

The natural environment is counted in CBA only to the extent that someone is willing to pay for it. Whenever people disagree on society's priorities, whose views are counted the most obviously matters for conclusions.³⁰

Let me illustrate by means of an example. Imagine that the government considers two alternative routes for a new electric power line. The project is not motivated by distributional concerns. The income distribution is not on the agenda. The routes pass through two different recreation areas, A and B, of which only one can thus be protected. The alternatives are identical in almost every respect: the pecuniary cost and its distribution, the physical environmental impact, the number of individuals using the area for recreational purposes, and users' preferences (which I will assume take the form $U_i = u(X_i) + z(E_i)$), where u and z are concave and increasing functions and $E_i = A$ for one half of the population and $E_i = B$ for the other half). The only difference is that users of area A have higher incomes than users of area B (the government is unaware of this).

³⁰ See also Brekke (1997).

A valuation study concludes, correctly, that aggregate willingness to pay for protection of area A is higher than for area B.³¹ Committed to make its decisions in accordance with CBA, the government thus protects area A and constructs the power line through area B.

The aggregate utility reduction caused by the power line, however, would have been identical in the two alternatives. The decision to exploit area B is made solely because its users are poorer.

Such a principle might seem more reasonable if losers were in fact compensated through side payments. After all, money is more important on the margin to the users of area B; hence, compensating them is cheaper.

The problem arises when aggregate WTP is used to measure welfare change, while compensation is *not* paid. Their recreation area is exploited because they are poorer and thus *could have been* easily compensated. When *not* compensated, the use of this principle deteriorates even further their less privileged situation.

Of course, it varies from time to time who wins and who loses, but this bias is systematic and will thus be present in every CBA of every project. Say, for example, that the next CBA is concerned with the location of a hazardous waste dump, where the alternatives are the same two areas A and B as above. If costs and environmental impacts are again the same for the two locations, the cost-benefit test will point to B as the most suitable location for the dump. If a third CBA analyzes the choice between air quality improvements in A and water quality improvements in B, and the aggregate utility change is in fact the same for the two alternatives, the CBA will pick the improvements in A.

Three insights can be taken away from this. First, it is not generally true that CBA identifies those environmental improvements that yield the highest welfare improvements (unless one takes the value view that society ought to care less about poorer people's interests).

Second, actual and hypothetical Pareto improvements are fundamentally different things. If people have different marginal utilities of income, then taking money from some and giving it to others will itself *change* the 'pie' of aggregate utility.

Third, as emphasized above, monetary valuation and CBA provide no 'neutral' measurement of the social importance of environmental changes. In particular, ecological concerns play no role at all in the CBA procedure except through their (possible) reflection in individuals' WTP. CBA directs public goods towards those who would have purchased them if they were market goods. But they are not market goods. They are public goods.

7. Explicit welfare weights

In principle, the problem that utility changes for the poor systematically count less in CBA can be amended by introducing explicit welfare weights in the applied analysis (Dasgupta et al. 1972; Boadway 1976, 2006; Drèze and Stern 1987; HM Treasury 2003; Johansson-Stenman 2005). For example, net WTP for each individual might be multiplied by a factor inversely proportional to income.

³¹ Person i 's WTP for protecting the recreation area she is using is $WTP_i = [z'(E)/u'(X_i)]dE$, implying that WTP is increasing in income.

Nevertheless, while this knowledge is not new, explicit welfare weights have rarely been used in applied work. For example, although the World Bank's CBA guidelines did require distributional weights, Little and Mirrlees (1994) found that the use of such weights was almost absent. One reason is probably that applying differentiated weights is harder and requires much more detailed data than the traditional practice (HM Treasury 2003, Boadway 2006).

Second, even if total net WTP is adjusted by differentiated welfare weights, the analysis will still measure projects' contributions to social welfare only for those demos who agree to the value judgements implicit in these weights. For a dictatorial decision-maker, weighted CBA would rank projects 'correctly' as long as the analyst only uses the 'correct' weights (i.e. weights representing the dictator's ethical/political values). Sensitivity analysis – calculating projects' welfare contributions given a broad range of welfare weight sets – would of course help; note, however, that in principle, one might need a separate analysis for every single demo.³²

These are not intended as arguments against using income-differentiated welfare weights; if CBA is to be used as a normative guide, my personal view is that such weights ought to be used. My concern is rather that this is neither a realistic nor a fully satisfactory solution of the problems discussed above.

8. Cost-impact analysis

Alternative evaluation methods do exist. Note, however, that *any* method claiming to rank public projects' social desirability must necessarily be based on specific value judgments – whether values are expressed explicitly or only implicitly. As input into democratic decision-making, any such method will be useful mainly to those demos sharing the method's underlying values.

So what should the analyst do? Sunstein (2013) clearly has a point: Due to cognitive biases, limited time and limited attention, policy makers may easily overlook important consequences of their decisions. It is also conceivable that this happens more easily for those consequences that do not have market values.

How to best conduct an analysis depends on the purpose of that analysis. The question of which project is socially best is a normative one, and cannot be answered without relying on normative premises. In democratic decision-making, however, the purpose of a project analysis is not necessarily to give a final answer to which project is best, but to enable each participant in the decision-making process to arrive at her own well-founded evaluation of this question.

With the latter purpose, the analysis should of course list the pros and cons, but it is not obvious that aggregating all information into one number is always necessary, or even desirable. A good analysis, in this case, is an analysis that succeeds in giving its users a proper understanding of what is at stake. It is, after all, the demos who make the decision, neither the analyst nor the analysis itself.

In the discussion above, I have focused on what one may call full cost-benefit analysis: A method for project evaluation where the analyst values every consequence in monetary terms, to the extent possible, and uses these values to arrive at an explicit ranking. This is frequently contrasted with cost-

³² That is, even if welfare weights are used in the analysis, CBA provides output from one specific social welfare function rather than input into *any* reasonable social welfare function (see Nyborg 2000a).

effectiveness analysis, in which projects are ranked (inversely) according to their costs. Cost-effectiveness requires, however, that benefits can be regarded as identical for all projects to be compared. I would argue that a third version of economic project analysis, *cost-impact analysis*, can often be more useful than the two other varieties.

The name cost-impact analysis was initially suggested by Hervik et al. (1998) in an expert group report to the Norwegian government concerned with CBA guidelines for the public sector.³³ In a cost-impact analysis, most costs are calculated exactly like in standard CBA. However, although all other relevant consequences should be described, there is no requirement that each must necessarily be valued in monetary terms. Project benefits can be expressed in monetary and/or physical units: the number of birds saved; the share of inhabitants protected from traffic noise; changes in the expected number of fatal accidents; sometimes even a non-numerical verbal description. The outcome of a cost-impact analysis is thus a list or overview of consequences, not necessarily measured in similar units, and providing no explicit ranking.

The criterion for how much to value and to aggregate in a cost-impact analysis is indicated by the following question: What way of presenting the relevant information makes it most likely that decision-makers achieve a proper understanding of the trade-offs they will be making? This is, in turn, largely a pedagogical and psychological question.³⁴

Of course, this leaves it up to policy-makers to make the final evaluations and decisions. But that is a power delegated to them by democracy, not by the choice of project analysis methodology. If the analysis tries to force policy-makers to use specific normative assumptions in their evaluations, and they dislike this fact, they are completely free to disregard the analysis altogether.

Although a final summary indicator is hardly *required* for rational decision-making, it might still be *helpful*. Numbers can be highly interesting even when they do not, on their own, provide definite answers. If total net WTP for protecting a local wetland area is highly positive, for example, this may be a rough signal that local concern for wetland protection is substantial compared to its costs. To make up their minds, most decision-makers would need a lot more information than that: ecological reasons for protection of the site, its size and location, alternative uses, budgetary details, information on proponents' and opponents' arguments. But some policies' consequences are so complex, and so hard to summarize, that rough indicators are needed to even begin to understand the picture. Total net willingness to pay is a quite simple and transparent indicator, and in some cases it can be very revealing.³⁵

It is perfectly possible to find a piece of information interesting without accepting it as a normative guide. This requires, however, that one understands intuitively what the information means in positive (descriptive) terms.

The central indicator of standard CBA does have a simple, descriptive interpretation. It measures total net willingness to pay, i.e. how much the population in sum claims to be willing to pay to realize

³³ The report is in Norwegian; the proposed word was «kostnads-virkningsanalyse». See also Nyborg (2012) and Hagen et al. (2012).

³⁴ For an elaboration, see Nyborg (2012).

³⁵ For an excellent example of using WTP for illustrating complex effects in a very illuminating way, see Bateman (2012), Bateman et al. (2014).

the project, less its actual costs. If the analyst chooses to present numbers on total net willingness to pay to demos, the information should in my view be presented as precisely that – total net willingness to pay. Using names such as net benefits, net social value, welfare effects or efficiency effects is unfortunate, and serves to confuse rather than convey the precise meaning of the indicator.

9. Conclusions

Cost-benefit analysis is not value-free. When used as a welfare measure, it is based on highly controversial value judgments. When used as an efficiency measure, it is based on assumptions of limited relevance to democratic decision-making processes.

There is, however, one simple, purely descriptive interpretation of CBA: it measures the population's total net willingness to pay. Presented as positive information, this indicator may contribute to decision-makers' factual understanding of the trade-offs they are about to make.

Interpreted this way, as one piece of factual information among many others, the indicator's normative significance is of course greatly reduced. But if its normative significance was based on a weak foundation in the first place, that is hardly a big problem.

When presented with its proper name – total net willingness to pay – it is my belief that most policy-makers can understand quite well what it means: It does give some rough information about the interest for the project as compared to its costs; it can be heavily influenced by the income distribution among those with conflicting interests; it is not mainly guided by ecological insight or other expert judgments; it does not provide a unique answer to what is best for society.

The question remains: Aren't monetary valuation and CBA required to prevent environmental concerns from being ignored?

Perhaps, but the answer is not evident. Firstly, it is not always clear to which extent monetary values do help. A price tag will not necessarily reduce exploitation of the environment if exploiters do not have to pay the price indicated on the tag. And as mentioned in the introduction, several studies have concluded that CBA does not influence actual policy all that much.

Secondly, if the aim is to make environmental changes salient in decision-makers' minds, this is partly a pedagogical and psychological issue. It is not clear why decision-makers' understanding is best achieved through description in monetary terms. To have an impact at all in a democratic decision-making process, the project analysis must change the views of sufficiently many decision-makers. Using a language they can easily relate to then seems at least as important as presenting every consequence in one particular unit. If demos disagree with the value judgements inherent in the analysis, or doubt the relevance of central assumptions, they are of course free to disregard the analysis in its entirety.

Still, the argument of Sunstein (2013) should not be forgotten: Demos may need to be reminded of consequences they might otherwise inadvertently neglect. A major argument for CBA is that it is comprehensive and systematic. However, the same holds for cost-impact analysis, as this term is explained above. A cost-impact analysis presents factual arguments for and against each alternative, complying with most CBA procedures, but without ranking the alternatives explicitly. Unlike CBA, a cost-impact analysis does not necessarily value non-market benefits in monetary terms to the extent

possible. Rather, its criterion for how much to value is whether such valuation contributes to decision-makers' understanding of the decision ahead of them.

Personally, I find that the strength of economic analysis lies in its positive, not its normative, aspects. Most economists are not trained in ethics and philosophy. We are, however, trained in understanding mechanisms and facts that comprise important elements of the pros and cons of alternative political decisions. Making decision-makers understand these mechanisms and facts can contribute importantly to better public decisions.

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