Statistics Norway
Statistisk sentralbyrå

Statistics Norway
Research Department

Bente Halvorsen

Documents

Philosophical Issues Concerning Applied Cost-Benefit Analysis

Abstract:

The aim of this paper is to present an overview of the literature on the welfare economic foundation for, and the current practice of, applied cost-benefit analysis. First, the paper outlines the different schools of welfare economics and their appurtenant welfare criteria. We then go on to present some critics of welfare economics and the implications of their criticism on applied cost-benefit analysis. Finally, we discuss the current practice of such analysis, as the design of the valuation procedure imposes implicit restrictions on the possible welfare economic interpretations of the results.

Keywords:

Applied cost-benefit analysis, utilitarians, the Pareto-principle, the Hicks-Kaldor compensation principle, Bergsonian social welfare functions, Arrow's general possibility theorem, Rawls' difference principle

1 Introduction

Large public projects tend to have many and complex consequences for the welfare of the public. Cost-benefit analysis (CBA) is a tool for measuring and analysing the economic effects of a project. This is done by weighting its positive effects against its negative effects, applying some sort of social welfare weights. The aim of CBA is to give a complete ranking of all potentially interesting projects according to their social and economic desirability. There are, however, several philosophical and methodological problems related to such procedures. The aim of this paper is to give an outline of the literature on the welfare economic foundation for applied CBA and to discuss some critics of welfare economics and the implications of their criticism on applied CBA.

One large debate concerns the theoretical foundation of CBA, in particular since different 'schools' of welfare economics have different criteria for ranking projects in terms of social desirability (Utilitarians, the Pareto-Principle, the Hicks-Kaldor compensation criterion, and Bergsonian social welfare functions,[1] to mention some). One major controversy has been whether to interpret the welfare economic basis of CBA in a cardinal or an ordinal utility setting (Robinson 1932, Kaldor 1939, Samuelson 1948). In applied CBA, the choice of social welfare criterion may affect the conclusions drawn from the analysis, and it is thus a normative choice (Johansson 1993). The choice of welfare criterion also has implications for the need to measure different aspects of social and individual welfare since some interpretations require an estimate of both the individual utility effect and the social welfare weights, whereas others only require an estimate of the individual Hicksian consumer surplus.

Several researchers have questioned the welfare economic foundation of applied CBA (Arrow 1951, Rawls 1973, Sen 1984, 1986, 1993, 1995). Rawls' critique was initially aimed at the Utilitarian interpretation of welfare economics, but it also applies to others. He found

[1] See, for example, Johansson (1993) or Gravelle and Rees (1981) for a general discussion of different welfare criteria. See also Kaldor (1939), Bergson (1938), and Samuelson (1948).

the maximisation of average welfare in society too non-egalitarian and argues that the Utilitarian welfare criteria would never have been chosen if rational individuals should decide upon a set of distributive rules behind the 'veil of ignorance'. He suggested an alternative distributive rule, called the 'Difference' or the 'Maximin' principle, which seeks to maximise the life expectancy of the least advantaged (Rawls 1973). Amartya Sen is also concerned with the fairness of traditional welfare economics. He argues that utility is a relative concept, depending on the individuals' capabilities to derive utility from consumption and on their expectations about the quality of life. He argues that this makes welfare criteria which are only based on utility comparisons defective as a basis for policy decisions with distributional effects (Sen 1984). Kenneth Arrow is concerned with aggregation problems in welfare economics. In his *general possibility theorem*, he proves that there exists no democratic voting procedure that ensures a complete and transitive preference structure for a group of decision makers (e.g. parliament members) for *all* sets of individual preferences. This implies an existential problem for CBA, as this analysis involves the maximisation of a social welfare function. Arrow has been criticised for being too strict in his demands on a democratic voting procedure. Buchanan, for one, questions whether the researcher should want to check the decision-maker's collective preference structure against some preconceived ideal, since decisions on public projects mostly are made by democratically elected representatives.

It is not obvious that the aim of CBA is to give a prior ranking of all public projects. Alternatively, CBA may be seen as a way to describe how a project affects the public's welfare and how the decision-makers weigh individual gains and losses. However, a descriptive interpretation of CBA does not eliminate all normative choices. For example, the choice of valuation procedure may affect the conclusions because it places *a priori* restrictions on the possible welfare economic interpretations of the results. This is particularly problematic for valuation procedures based on revealed preferences since these approaches identify the Marshallian consumer surplus for changes in 'use-value' only (Johansson 1993). If we apply approaches based on stated preferences, all welfare effects of

a project are, in principle, identifiable. However, the choice of information given to the respondents during a survey, and the framing of questions, may influence the results obtained by procedures based on stated preferences (Hanley and Munro 1992, Cowen 1993).

The remainder of this paper is organized as follows: In the next section, we give a brief presentation of the welfare economic foundation for CBA. In section three, we describe different interpretations of welfare economics and their appurtenant criteria for social desirability. This section ends with a discussion of the critique put forward by Rawls, Sen and Arrow. In section four, we discuss problems with measuring changes in individual and social welfare and how the choice of valuation procedure puts *a priori* restrictions on the possible welfare economic interpretations of the results. Finally, in section five, some concluding remarks are made.

2 The welfare economic foundation of cost-benefit analysis

The objective of CBA is to measure, and weigh, all individual welfare changes due to a governmental decision - for instance, the implementation of a public project. To obtain an estimate of the change in social welfare due to the project, we need a procedure for aggregating individual welfare using some social welfare weights.

We assume that the individuals derive utility from consumption of a vector of private goods (X) (market goods that are available at a price P), conditional on a vector of "public" or non-market goods (Z) (e.g. air quality, biological diversity, the existence of virgin forests etc.), and a vector of individual specific attributes (β) (age, gender, education, income, etc.). Furthermore, we assume that all individuals maximise their utility with respect to the consumption of private goods (X), subject to the price vector (P), their income (Y), and the provision of non-market goods (Z). Individual j's indirect utility, that is, the individual's utility at an optimal consumption of X for different P, Z, and Y, is then given by:

where x_{ji} is j's consumption of private good number $i = 1,..., m$ at the price p_i.

$$V_j = V_j(P, Y_j; Z, \beta) = \max_{X} U_j(X; Z, \beta) \quad s.t\ Y_j = \sum_{i=1}^{m} p_i x_{ji} \tag{1}$$

Assume that the government considers carrying out a project. This project may influence both prices of the private goods (P) and the supply of non-market goods (Z). Whether individual j is better off after the project is initiated depends on whether his indirect utility increases or decreases. We label the situation before the project is initiated with superscript 0 and the situation after with superscript 1. The change in individual j's indirect utility due to the project, is given by:

$$\Delta V_j = V_j(p^0, Y_j; Z^0, \beta) - V_j(p^1, Y_j; Z^1, \beta) \gtrless 0 \tag{2}$$

To compare the individual welfare effects of a project, we apply the compensating variation (CV) criterion.[2] CV is defined as the reduction, or increase, of income necessary to make an individual indifferent between whether the project is initiated or not. CV is defined by:

$$V_j(p^0, Y_j; Z^0, \beta) = V_j(p^1, Y_j - CV_j; Z^1, \beta) \tag{3}$$

CV_j is positive, that is a willingness-to-pay (WTP), if individual j gains net utility from the project. CV_j is negative, that is a willingness-to-accept compensation (WTA), if individual j's utility is reduced by the project. If the individual is indifferent to the project, his CV will be zero. By using the intermediate-value theorem, we can write the change in individual j's utility caused by the project as:[3]

$$\Delta V_j = V_{jY}'(P^1, \bar{Y}_j; Z^1, \beta) \cdot CV_j \tag{4}$$

where V_{jy}' is the marginal utility of income evaluated at some intermediate income

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[2] In this paper, we discuss the compensating variation measure only since this is the welfare measure applied in all surveys in this dissertation. The case of equivalent variation (EV) is symmetric with reversed signs. See Johansson (1993), or Mitchell and Carson (1989) for more information.

[3] See equation (3.5) in Johansson (1993).

$\bar{Y} \in [Y, Y - CV]$ so as to preserve the equality. Thus, the change in utility is proportional to, and has the same sign as, the CV measure, since the marginal utility of income is assumed to be positive.[4]

To measure the change in social welfare due to a project, we need to aggregate changes in individual utilities by introducing the social welfare function ($W(V_1, V_2, .., V_n)$). This function represents the decision-makers' collective preferences[5] with respect to the distribution of welfare between different (groups of) individuals ($j=1,2,..., n$). Whether a project is socially desirable or not depends on whether social welfare increases or decreases, as measured by the social welfare function. The change in social welfare due to the initiation of a project may be written as:

$$\Delta W = W\,[V_1(p^1, Y_1; Z^1, \beta), .. V_n(p^1, Y_n; Z^1, \beta)] - W\,[V_1(p^0, Y_1; Z^0, \beta), ... V_n(p^0, Y_n; Z^0, \beta)] \quad \textbf{(5)}$$

We may apply the intermediate-value theorem, writing the change in aggregate social welfare as a function of the individual compensating variations, that is, the individual's WTP (WTA) for the project.[6]

$$\Delta W = \Sigma\, W_j' \cdot V_{jY}' \cdot CV_j \quad \textbf{(6)}$$

Here, both the individual marginal utilities of income (V_{jy}') and the social welfare weights (W_j') are measured at their intermediate values to preserve the sign of equality. A project is socially desirable if the weighted sum of all WTPs from individuals who benefit from the project exceeds the weighted sum of the compensations required by the individuals who lose. The weights are a product of the individual marginal utilities of income (V_{jy}') and the welfare weight put on a utility change for each (group of) individual(s) (W_j'). The *CV* of low income

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[4] See Johansson (1993), or Mitchell and Carson (1989) for more information.

[5] In this paper, we assume that all decisions are made by political decision-makers. Thus, the social welfare function will represent the collective preferences of representatives of the decision-making authority.

[6] See Johansson (1993), equation (7.8) for more information.

individuals will thus be given a higher welfare weight than the *CV* of high income individuals since both the marginal utilities of income (V_{jy}') and the social welfare weights (W_j') are positive and decreasing with income and utility by assumption (see the discussion in section 3.3).

If the project involves a Pareto-improvement, all CVs are positive, and the project is socially desirable by definition. However, if some individuals' utilities are reduced by the project and no actual compensation is paid to the losers, the different individuals' gains and losses need to be weighted by some social welfare function to determine whether the project is socially desirable. The question of a project's social desirability depends on the utility weights given to different (groups of) individuals. Thus, among economists, there exist several criteria for what is meant by a social desirable project, depending on their interpretation of welfare economics.

3 Different interpretations of welfare economics

As noted, economists disagree on how to interpret welfare economic theory. Major issues of disagreement include whether individual utility is cardinal or ordinal and whether interpersonal comparisons of utility are meaningful. Such disagreement has led to the development of several separate welfare criteria. If CBA is used as information for an actual decision, the choice of welfare criterion may influence which projects are initiated and thus also influence the distribution of income in society. The choice of welfare criterion is thus normative, as it has implications for how large inequalities are viewed as acceptable.

In this section, we describe and discuss some main schools of welfare economics and their respective welfare criterion. We compare the different schools of thought and discuss their consequences with respect to the initiation of a project. The interpretations discussed are: Utilitarianism, the Pareto principle, the Hicks-Kaldor criterion, and Bergsonian welfare functions. We end this section with a discussion of Rawls' difference principle and the Rawlsian welfare economists, and how the different schools of welfare economics are

affected by Arrow's general possibility theorem and Sen's critique of the utility concept in welfare economics.

3.1 Utilitarians

The Utilitarian welfare function is the sum of all individual utilities. The Utilitarian's aim is to maximise aggregate total welfare with respect to the distribution of income.[7]

$$\underset{Y}{Max}\ W = \sum_{j} V_j\ (p,\ Y_j;\ Z) \quad => \quad V_{1Y}' = V_{2Y}' = \ldots = V_{nY}' \tag{7}$$

The Utilitarians have a cardinal interpretation of welfare economics, that is, individual utility levels are measurable and comparable. The theory is individualistic in the sense that the sole factors entering the social welfare function are the individual utility levels, and it has no perception of what the individuals deserve. Nor does the Utilitarian interpretation of the welfare theory pose any ethical judgement on how the individuals obtain their utility. The utility of a sadist, obtained by tormenting other people is just as valuable as the utility of mother Theresa helping suffering children. Furthermore, Utilitarianism is not an egalitarian theory because all individuals are assigned equal welfare weights irrespective of their initial place in the income distribution. It follows from the Utilitarian optimisation rule that an egalitarian income distribution is only optimal if all individuals have identical preferences; that is, when they all have the same desires, needs and dreams. In the more general case where preferences differ, it is optimal, and thus desirable, for income to be unequally distributed among individuals. This is because the Utilitarian optimisation criterion implies that all marginal utilities of income are equal at the social welfare optimum. If individual *i*'s marginal utility of income lies below that of individual *j* for all observed incomes, it is socially optimal for *j* to have a higher income than *i*. This implies that it is optimal for *j* to

[7] We only consider the distribution of income, as this distribution will decide the possibilities for an individual to consume private goods.

have a higher utility than *i* for two reasons. First, *j* will achieve a higher utility out of every unit of income. Second, in optimum *j* receives a higher income than *i*.

If the economy is located at the Utilitarian social welfare optimum where all marginal utilities of income are equal, a sufficient condition to decide whether a project is socially desirable is whether the sum of all individual *CVs* is positive or negative. If the economy is not located at the Utilitarian social welfare optimum, the researcher needs to observe the individuals' marginal utilities of income, in addition to their *CVs*, to decide whether a project should be carried out. It is thus necessary to measure utility, which requires a cardinal interpretation of welfare economics.

3.2 The Pareto principle and the Hicks-Kaldor compensation criterion[8]

Utilitarianism was the dominant school of welfare economics until the 1930s, when most economists were convinced by Lionel Robbins' argument that interpersonal comparisons of utility had no scientific foundation (Robins 1932, 1938). The 'New Welfare Economics' emerged as an attempt to avoid such interpersonal comparisons. These economists searched for a criterion that only required an ordinal interpretation of the welfare economics and that was independent of normative welfare judgements. By basing the criteria on the Pareto principle, it was no longer necessary to make interpersonal comparisons of utility. The problem with the Pareto criterion is that it cannot evaluate projects for which some individuals lose and some gain utility. This makes the Pareto criterion insufficient for real life political decision-making. Hicks (1939) and Kaldor (1939) suggested an extension of the Pareto principle, named 'potential Pareto improvements'. If the sum of all individual *CVs* is positive, that is, if the total WTP from individuals who profit by the project exceeds the total compensation required by the individuals who derive a negative utility from the project, it is possible to achieve a Pareto improvement if the winners overcompensate the losers. By the

[8] Sources: Sen (1995) and Gravelle & Rees (1981).

Hicks-Kaldor criterion, projects are regarded as socially desirable if the sum of individual *CV*s is positive. As for the Pareto principle, this criterion does not require any interpersonal comparisons of utility, and an ordinal interpretation of welfare economic theory is sufficient.[9]

T. Scitovsky soon pointed out logical problems with the Hicks-Kaldor compensation criterion (Scitovsky 1941). The main issue of concern was that the compensation criterion is not time consistent. It may recommend a transition from state A to B, and then back again to state A (ones in B), in cases where two welfare distributions intersect.[10] This is called the Scitovsky's 'Double-switching' theorem. The problem is caused by shifts in the demand functions due to the change from state A to B, as such shifts will change the value of the project. Thus, the Hicks-Kaldor criterion is not time consistent in such cases, as the ex ante value of a project differs from the ex post value.

3.3 Bergsonian social welfare function

In addition to the logical problems associated with the Hicks-Kaldor compensation criterion, attempts to avoid interpersonal comparisons may prove difficult and/or unethical in some real life decisions. Consider the following example: Assume that a landlord is planning to build a safari park. The construction of the park implies that the whole 'next door' village of poor peasants must move. Further more, assume that the landowner, who wants to run the park, can overcompensate the poor peasants by the profit he earns from the park. Thus, this project will involve a potential Pareto improvement and be desirable according to the Hicks-Kaldor compensation criterion. In reality, such compensations are seldom, or never, paid, and the whole village will suffer so that the landlord may have his safari park.[11] In his 1938 article, Bergson introduced a social welfare function to handle such distributional effects (Bergson

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[9] See Johansson (1993) or Gravelle and Rees (1981) for a more detailed discussion.

[10] See Gravelle and Rees (1981), Rawls (1973) or Cowen (1993) for a more detailed discussion.

[11] An alternative argument for applying the Hicks-Kaldor criterion is that it ensures an efficient allocation of resources in cases where the government has alternative policy instruments to redistribute income.

1938). The social welfare function allows a weighting of individual utility changes, for instance by putting a higher weight on individuals in the lower tail of the income distribution. The aim is to maximise a weighted sum of all individual utility changes with respect to income.

$$\underset{Y_j}{Max}\ W = W\ [\ V_1\ (p,\ Y_1;\ Z),\ V_2\ (p,\ Y_2;\ Z),\ \ldots .\ V_n\ (p,\ Y_n;\ Z)\ ]$$
$$W_1' V_{1Y}' = W_2' V_{2Y}' = \ldots . = W_n' V_{nY}' \qquad \textbf{(8)}$$

W_j' is assumed to be positive, which implies that social welfare increases with individual j's utility, ceteris paribus. Furthermore, W_j'' is assumed to be negative, which implies that the increase in social welfare decreases with the magnitude of individual j's utility. Utility is assumed to increase with income ($V_Y'>0$), implying that (W_j') decreases with income. Thus, a change in 'poor' individuals' utilities are assigned a higher social welfare weight than a change in 'rich' individuals' utilities. This make the income distribution more egalitarian at the social welfare optimum than using the Utilitarian approach.

At the social welfare optimum, all social weighted marginal utilities of income (W_j' V_{jY}') are equal, and it is thus sufficient to sum the individual *CVs* to decide whether a project is socially desirable. If the economy is located outside the social welfare optimum, we need to observe both the individual marginal utilities of income and the individual social welfare weights in (6) to decide whether social welfare increases or decreases with a project. Thus, we need to apply a cardinal utility concept unless we are located at the Bergsonian social welfare optimum.[12] The possibility of observing both the individual marginal utilities of income, *CV*s and the social welfare weights is discussed in section 4.

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[12] One might argue that, as long as the distribution of the individual *CV*s are reported as a function of the income distribution, expected duration of life, etc., the political authorities can weigh the individual *CV*s according to these characteristics. This is, however, insufficient to avoid a cardinal interpretation when the economy is not at the social welfare optimum, as the individual utility changes consist of both the individual marginal utilities of income and the *CV*s. There is no reason to believe that the decision-making authorities have any prior knowledge about the magnitude and distribution of the individual marginal utilities of income.

3.4 Critique of welfare economics

In this section, we discuss three critics of welfare economics: First we discuss Rawls's criticism of the utilitarian welfare criterion. Second, we discuss Sen's argument that welfare criteria based on utility comparisons only are not sufficient when applied to the evaluation of projects with distributional impacts. Finally, we discuss how different welfare criteria are affected by Arrow's general possibility theorem.

3.4.1 Rawls' difference principle and the Rawlsian welfare economists

Rawls criticises the Utilitarians for being not egalitarian enough. He claims that if the members of a society were to decide upon what is meant by a *just* distribution, there is no reason to believe that they would choose the Utilitarian welfare criterion and accept a project that would destroy a small minority, even if the society on average would benefit from the project. He bases his argument on the theory of social contracts. Assume that a society is divided into different social classes, with different expectations of life quality. The main idea in the contract doctrine is to let the individuals who are going to live in a society decide upon a set of distributional rules for this society at the beginning of the period. This decision is done behind 'the veil of ignorance', that is, all individuals have full information about the society in which they are going to live, except the social class they themselves will belong to. All individuals are assumed to act rationally according to their own self interest when choosing among different distribution rules. Rawls argues that there is no reason to believe that rational individuals will choose Utilitarianism as a distributive rule and maximise the average utility in society irrespective of the effects this may have on their own life prospects. Rawls' aim is to derive a principle that may be agreed upon, and he argues that two principles emerge from the contract theory: 1) *"..each person engaged in an institution or affected by it has an equal right to the most extensive liberty compatible with a like liberty for all; and"* 2) *"..inequalities as defined by the institutional structure or fostered by it are arbitrary unless it is reasonable to expect that they will work out to everyone's advantage and*

provided that the positions and offices to which they attach or from which they may be gained are open to all".[13] On the second principle, and three additional assumptions, Rawls bases his 'difference principle': *".. differences are just if and only if the greater expectations of the more advantaged, when playing a part in the working of the whole social system, improve the expectations of the least advantaged".*[14] If the difference principle is accepted as a distributional criterion, this implies that a project is only social desirable if it increases the life expectancy of the least advantaged. This is a very restrictive criterion since it implies that the implementation of a project totally depends on its effect on the (group of) individual(s) considered to be the least advantaged.

Rawls was concerned with the distribution of what he calls *primary goods* and not utility, neither ordinal nor cardinal. With primary goods he means: "... *the political condition and principal economic and social institutions which together define a person's liberties and rights and affects his life-prospects, ...* " [15] Thus, the term 'primary goods' includes both personal income and wealth. Several economists, among them Phelps and Atkinson, have developed a welfare economic interpretation of Rawls' difference principle (Sen 1984) and are thus often called Rawlsian welfare economists. The welfare economic interpretation of Rawls' difference principle is that all individuals are given a zero welfare weight ($W_j' = 0$) except the least advantaged one.[16] The only factor of interest when evaluating a project is whether the CV of the least advantaged is positive or negative, that is whether the (group of) respondent(s) considered the least advantaged gains or loses by the project.

Both Rawls' difference principle, and its welfare economic interpretation of it, suffer from the same time-inconsistency problem as the Hicks-Kaldor compensation criterion.

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[13] Rawls (1973), p 323 .

[14] Rawls (1973), p 329.

[15] Quotation from Rawls (1973), p 323.

[16] See Johansson (1993), Phelps (1973), or Atkinson (1983) for more information.

Assume that a project increases ex ante life expectations for the least advantaged individual and that it also improves his internal ranking in the distribution of primary goods (utility). If the individual who becomes the least advantaged after the project is initiated derives a negative utility from the project, it will be socially desirable to reverse the project ex post because the individual(s) who is (are) now considered least advantaged gains from this reversal.

All the interpretations of welfare economics described above accept that the evaluation of a project's social desirability is based on some weighting of its effects on individual utilities.[17] In the following two sections, we turn to the critique of this fundamental idea.

3.4.2 Sen's critique of welfare economics

Amartya Sen has questioned whether it is meaningful to base welfare criterions, evaluation of the social desirability of a project with distributional consequences, on utility changes only. Here, we give a short description of some arguments from his 1984 article 'Rights and capabilities' (Sen 1984) of particular interest to CBA.

First, Sen points out that the Utilitarians (and other welfare economists) neither distinguish between different types of pleasures and pain (utility) nor how this utility is achieved. Second, he is very critical towards interpersonal comparisons of utility.[18] As an example on how erroneous such utility comparisons can be, he discusses the results from a study conducted by the All-India Institute of Hygiene and Public Health one year after the large Bengalian famine in 1943. The respondents were asked whether they were 'ill' or 'in indifferent health'. In particular, Sen discusses the differences in the responses found between widows and widowers. He points out that *"..the condition of women in India outside elite*

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[17] This also applies to the Pareto criterion, potential Pareto criterion, and the Rawlsian welfare economists, as they either put infinite welfare weights on the losers, all weights equal to one, or all welfare weights equal to zero except for the (group of) individual(s) considered as the least advantaged respectively.

[18] A critique shared by the ordinal welfare economists.

groups - and of widows in particular - is generally recognized to be nothing short of scandalous, and the position of women in terms of nutrition tends to be particularly bad".[19] 48.5 percent of the widowers complain, whereas only 2.5 percent of the widows complained. When the question about illness was excluded, 0 percent of the widows complained, whereas 45.6 percent of the widowers did. Sen points out that this does not give a very good description of the reality. As possible explanations for these findings, he argues that *"..people learn to adjust to the existing horrors by the sheer necessity of unevntfull survival, the horrors look less terrible in the metric of utilities."* Most people learn to accept their destiny. They will not use the utility level they would have derived as a queen to compare today's happiness if they have no possibility of living like one. Utility is a relative concept, and we automatically adjust our scale of content to the level of welfare we can expect to achieve.[20] Third, Sen claims that most people will regard the outcome of some utility comparisons as most unjust when the only issue of concern is the achieved level of utility, and not the effort nor the initial possibilities of the individual to achieve this utility level. He gives two examples. In the first, he considers a comparison of utility between a blind and a seeing man. If they achieve the same utility from their consumption of goods, they will be assigned equal weight in the Utilitarian social welfare function. Utilitarians do not consider the fact that the seeing man can do several things that are impossible for the blind man to do. The reason the blind man has achieved the same utility as the seeing one is his 'good spirit and strong will'. Another consequence of the Utilitarian interpretation of welfare economics is that because of the blind man's good spirit, he is not entitled the same help as he would have been if he were more depressed (Sen 1984). Sen's second example is a comparison of utility between an illiterate and someone who can read. It is possible that the literate does not

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[19] Sen 1984, p 309.

[20] Another explanation for this observation may be that the social status of widows does not allow them to complain about their position in life because they are dependent on somebody to provide for them. It would be considered rude and ungrateful to complain, specially after a famine.

read books, and that his utility from reading books thus equals the illiterate's, but the illiterate does not have the possibility of reading books if he wants to.

In Sen's opinion, there are so many aspects which are not captured by the utility concept that it is ethically irresponsible to use this concept as the only criterion in governmental decision-making with distributional consequences. This critique will affect all welfare economists, from the Utilitarians to the Rawlsian welfare economists. It is possible that the person least advantaged, measured in utility terms, is a depressed rich old man without the ability to enjoy his fortune in life, although there exists people who by more 'objective' criteria would be considered as less fortunate. An example of this problem may be the widows and widowers after the Bengalian famine. If the results from this study were to be believed, 45.6 percent of the widowers seem worse off than the least fortunate widow, which is obviously not true if some more objective criteria were to be applied.

3.4.3 Arrow's general possibility theorem[21]

In 1951, Kenneth Arrow presented his famous *general possibility theorem* (Arrow 1951). The problem occurs when the decision-making authority is a group of representatives with individual preferences. Arrow shows that there does not exist any democratic voting procedure in which each individual of the group votes according to his/her own preferences, which ensures the existence of a complete and transitive collective preference structure for *all* sets of individual preferences. In his book *Social Choice and Individual Values,* Arrow discusses four demands that a democratic voting procedure should fulfill: 1) collective rationality, 2) independence of irrelevant alternatives, 3) the Pareto-principle, and 4) non-dictatorship.[22] Arrow applies Condorcet's paradox to exemplify a set of individual preferences for which there exists no voting procedure that results in a collective preference

[21] This discussion is based on Føllesdal et al. (1990).

[22] For a supplementary discussion of Arrow's general possibility theorem, see Gravelle & Rees (1981).

structure which fulfils all four criteria. Here, we give a brief description of the impossibility by applying Condorcet's paradox.

Assume that the group of decision-makers consists of three (groups of) individuals (1, 2, 3), who have the following preferences over three alternatives (A, B, C):

1: $A \succ B \succ C$,

2: $C \succ A \succ B$,

3: $B \succ C \succ A$

Now, assume the following voting procedure: The two first alternatives are put together and voted for. Then, the most preferred of these projects is put together with the third alternative, and so on. For this set of individual preference structures, assuming the individuals always vote according to their own self-interest, the collective preference structure is not transitive, as $A \succ B \succ C \succ A$ etc. This violates the first requirement of collective rationality because the order in which the alternatives are voted for decides the outcome. Furthermore, due to the second demand, concerning independence of irrelevant alternatives, it is not possible to use outside information to ensure transitivity. Arrow proves[23] that there exists no voting procedure that satisfies the four demands in Condorcet's paradox. As we cannot ensure the existence of a rational collective preference structure, we can neither ensure the existence of a social welfare function. Arrow's general possibility theorem affects all interpretations of welfare theory involving some kind of weighting of different individuals by a decision-making authority, which is all interpretations except the Pareto principle and the Hicks-Kaldor compensation criterion.[24]

Several researchers have argued that Arrow is too strict in his demands for a democratic voting procedure, and several modifications have been suggested.[25] Here, we only

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[23] A discussion of the proof is given by Gravelle & Rees (1981) among others.

[24] See Sen (1995) for a discussion of how Arrow's general possibility theorem affects different interpretations of welfare economics.

[25] For a discussion of this literature, see Sen (1970), (1986), (1995), and Føllesdal et al. (1990).

discuss the arguments of two of these critics: Duncan Black and James Buchanan. Black points out that the reason for Arrow's problem is that the collective preferences in cases like Condorcet's paradox are not unimodal. Thus, it is impossible to separate the majority view from preferences regarded as extreme. If there exists an unambiguous majority view, there will also exist some voting procedure that will satisfy Arrow's four criteria. If we abolish the requirement that the collective preferences must be complete and transitive for *all* sets of individual preferences, it is possible to ensure that the remaining Arrow requirements are fulfilled in cases where there exists a majority view.

The criticism raised by Buchanan involves a more fundamental property of welfare economics: *"Why should any restriction whatever be placed a priori on the choice function for the society? Why should not the decision emerging from agreed social mechanisms be acceptable without having to check them against some preconceived idea of how choices made in different situations should relate to each other?"*[26] Since the decisions are made by a universally accepted process, e.g. representatives elected by a popular vote, it is not the duty of a researcher to make normative statements based on some ideal procedure. Sen (1995) discusses whether this argument helps us escape Arrow's general possibility theorem and concludes that a modification of the four criteria based on this critique[27] is not sufficient to escape it. He also points out that this does not, however, undermine the general importance of Buchanan's critique.

To sum up this discussion, we cannot ensure the existence of a collective preference structure for the decision-making authorities which is democratic according to Arrow's four demands. This, however, does not imply that cost-benefit analyses are meaningless. In practice, the parliament will make its decisions independent of whether the voting procedure

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[26] Source: Sen (1995).

[27] Sen removes the requirement of collective rationality, retaining the Pareto-criterion, non-dictatorship, and independence of irrelevant alternatives. The proof that this is not sufficient to avoid Arrow's general possibility theorem is given by Sen (1993).

ensures complete and transitive collective preferences for *all* sets of individual preferences, thus satisfying Arrow's four demands. Tactical voting and compromises involving more than one decision are present for most decisions. This does not necessarily weaken the right of the parliament to make these decisions, but merely implies that Arrow's demands are normative. Buchanan's critique raises some very important issues concerning the aim of CBA. If we accept the right of the parliament to make actual decisions, whether they satisfy Arrow's requirements or not, the main purpose of CBA is a descriptive one, that is, to describe the preferences of the individuals affected by the decision and/or the preferences of the decision-making authority with respect to distributional issues.

4 Applications of cost-benefit analysis

We have so far discussed various philosophical and methodological problems associated with interpreting the welfare economic foundations of CBA. In the following, we assume that there exists a meaningful social welfare function and that we may base decisions with distributional consequences on individual utility comparisons. In this section, we discuss some problems of observing the effects on the individuals' utility and/or the social welfare weights, conditional on the welfare criterion chosen.

4.1 Measuring individual utility effects

The way in which individual utilities enter the social welfare function may be split into two components: the marginal utility of income (V_Y') multiplied by the compensating variation (CV) (see equation (4)). We need to observe the individual *CV*s for all interpretations of the welfare economic foundation of CBA. We also need to measure the marginal utility of income for all cardinal interpretations of welfare economics. When the economy is not at the social welfare optimal solution, this includes all interpretations of welfare economics, except the Pareto principle, the Hicks-Kaldor compensation criterion, and the economic interpretation of Rawls' difference principle. The challenge is to find a valuation procedure

that allows the measuring of such welfare effects. There exists two major valuation approaches: one is to observe the consumer preferences revealed in already existing markets, called revealed preference (RP) methods. The second is to elicit stated preferences (SP) from respondents confronted with hypothetical /constructed markets, applying sample surveys.

4.1.1 Revealed preferences

One way to obtain an estimate of the public's net value of a project is to observe how people reveal their preferences towards its attributes in already existing markets. Examples include observing property prices and travel costs, to investigate how much money people are already allocating to less noise disturbance, air pollution reductions, and improvements of a recreation site. There are, however, several weaknesses common to valuation methods based on RP (Johansson 1993). First, it is only possible to measure the attributes of a project reflected in some form of existing market behaviour. Thus, methods based on RP only measure use-value and/or option-values reflected in existing markets. Second, large projects may change the prices in the affected or related markets. If this is the case, the estimated net value of a project will be biased if it is based on old marked prices and does not consider changes in the consumer surplus due to price changes. Third, by applying actual market behaviour, we only obtain a lower limit of the Marshallian consumer surplus and not the entire Hicksian consumer surplus because we cannot observe the individual reservation prices. Finally, it is very difficult to obtain an estimate of the individual marginal utility of income by applying RP methods. This becomes a problem if the economy is not located at the social welfare optimum, and we need a cardinal interpretation of welfare economics. Valuation approaches based on RP thus implicitly assume that the economy is at its social welfare optimum, or that the Pareto principle or the Hicks-Kaldor compensation criterion is used. We also implicitly assume that only use-value is of interest and exclude existence and option-values not reflected in existing markets. Finally, we assume that the project does not influence other markets than those investigated, that is, that no price changes in related

markets will result from carrying out the project.

4.1.2 Stated preferences

By hypothetical markets, we mean some form of sample survey in which a project and its implications are described to the respondents. The respondents are then asked questions concerning their preferences for the project. There exist several such valuation techniques. In this dissertation we describe and discuss three main valuation approaches: the contingent valuation method (CVM), conjoint analysis (CA) and other methods based on rankings, and multi-attribute utility theory (MAUT). Applied to a random sample of the population, all these valuation approaches are, in principle, able to capture all welfare effects, even the marginal utility of income.[28] It is also possible to obtain an estimate of the entire Hicksian consumer surplus (both concerning use, option and non-use/existence value) since the aim of these valuation procedures is to obtain an estimate of the individual reservation prices. Valuation techniques based on SP are, however, very sensitive to the questionnaire's description of the good and the market.[29] These valuation approaches are thus very controversial. Generally, problems occur because the respondents have imperfect *a priori* information about the good and thus form their preferences during the valuation procedure based on the information given to them in the questionnaire.[30] The fact that people base their decisions on imperfect information is not the only problematic issue here. The choice of information given to the respondent in the questionnaire also may affect the results from the survey (Hanley and Munro 1992). Thus, valuation approaches based on SP make it almost impossible for the researcher to adopt a purely descriptive attitude.

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[28] In all discrete-choice specifications of valuations approaches based on SP, random utility theory may be applied. In this framework, the marginal utility of income is estimated explicitly (Adamowicz et al. 1994).

[29] See Hanley and Munro (1993) for an overview of this literature.

[30] Problems with endogenous preferences are discussed in more detail in Cowen (1993).

4.2 Measuring political welfare weights

If the economy is not at the social welfare optimum, we need information about the social welfare weights to decide *a priori* whether a project is socially desirable or not. If the welfare theory is interpreted normatively, the researcher needs to specify a particular welfare function. For example, if a Utilitarian approach is chosen, the welfare weights are equal for all individuals. By interpreting the welfare theory normatively, the researcher makes judgements about how large distributional differences should be acceptable in the society. Alternatively, the welfare theory may be interpreted descriptively and seek to describe the preferences of the political decision-makers concerning distributional issues. There are several ways to obtain an estimate of these welfare weights. First, the weights may be derived by studying actual decisions made in previous and similar cases (RP). The problem with this approach is that very few projects have the same impacts on public welfare. Thus, these welfare weight estimates are very rough, and the potential for systematic biases is not insignificant. A second way to obtain an estimate of the welfare weights is to survey the decision-making authorities explicitly about their preferences towards a project and its effects on the distribution of welfare in society (SP). There are two main problems with this approach. First, the politicians may have strong incentives to act strategically if they think this behaviour will strengthen their views. Second, such surveys will not reflect the political process in which decisions are normally made, with compromises both within and across decisions. Some may regard this as a main strength of such survey methods, rather than a problem. By eliciting politicians' individual preferences, we may exclude from the CBA compromises due to political considerations. This argument does, however, imply that the researcher moves from a descriptive towards a more normative position.

The problem with both these approaches is that the researcher's judgements may affect the estimated welfare weights, which brings us to an alternate interpretation of CBA, founded on Buchanan's critique of Arrow's general possibility theorem. Political authorities are elected to make decisions on behalf of the public, whereas the researcher is 'self-

appointed' in the sense that his participation is not a result of democratic elections. Thus, the researcher's job is to produce the background information requested by the politicians and to leave all decisions with consequences for the distribution of welfare to them. The practical implication for CBA of this view is that only information about the individual CV and marginal utilities of income is reported to the authorities. Then it is the decision-makers' privilege, and duty, to weight the different individual welfare effects, irrespective of whether this involves tactical voting and/or compromises. CBA is, by this view, seen as a part of the information base on which the political authorities will make their decisions.

5 Concluding remarks

We want to stress that CBA is a very powerful tool which can give the political decision-makers vital information in complex situations. It is, however, important to be aware of implications due to the design of the analysis. First, we need to decide whether to view the welfare economic foundation of CBA as normative or descriptive. If a normative approach is applied, a particular set of welfare weights must be chosen, which implies that a specific social welfare function is used. Many researchers try to avoid making normative statements.[31] They view the role of the researcher as that of providing decision-makers with neutral information. A descriptive interpretation of welfare economics may, however, also imply several philosophical and ethical problems. Traditionally, welfare economists have claimed that the only issue relevant for social welfare is individual utilities, ignoring how they are formed and the possibilities and the capabilities of the individuals deriving utility from the consumption of goods. Thus, when designing a CBA, we must decide whether utility changes are the only relevant aspect of a project or if other 'more objective' information is also of interest for the decision-making (e.g., Sen's suggestion of using individual capabilities. Sen 1984). If the researcher does not want to take a normative role, the choice of what

[31] For a discussion of the normative role of research, see Føllesdal et al. (1990) and Hume (1739).

information is relevant to a decision should be left for the decision-makers. Second, Arrow's general possibility theorem may cause problems since we are not ensured a complete and transitive collective preference structure for the group of decision-makers, emerging from a democratic voting procedure (satisfying Arrow's four demands). Third, the researcher needs to select a valuation procedure for measuring the effects of a project. As discussed in section four, different valuation procedures impose different restrictions on the welfare economic interpretation of the results for CBA.

Current practice of applied CBA has several normative elements. Most valuation studies only estimate the individuals' WTP ($CV > 0$) for a project and are concerned with neither the marginal utilities of income nor the social welfare weights. There are four possible interpretations of CBA by which the estimation of social welfare weights would not be necessary; assuming that the social welfare function is Utilitarian; assuming that the economy is located in social welfare optimum; assuming that we apply the Pareto principle or the Hicks-Kaldor compensation criterion, and; assuming that we view the CBA results as background information for the decision-making authorities. If the researcher's advice to the politicians is to base their decision solely on the information that the sum of the individual CVs are positive (or negative), he implicitly assumes the Hicks-Kaldor compensation criterion is applied or that the economy is located at the social welfare optimum.Another problem is that there are no standards regarding how to obtain an estimate of the individual marginal utilities of income, although some suggestions have been made (Johansson 1993, Adamowicz et al. 1994). If the economy is not located at the social welfare optimum, and we do not apply the Pareto principle, the Hicks-Kaldor compensation criterion or the Rawlsian difference principle, we need to observe the individual marginal utilities of income. Otherwise, if the marginal utilities of income are not considered when a project is evaluated, too many projects will be carried out since the marginal utility of income is assumed to

decline, and the WTP to rise, with income.[32]

The design of a CBA may change with its purpose - whether it is to provide decision-makers with background information about the effects on public welfare of a planned project, to describe an actual decision, or to be used as a normative analysis of what the decision-makers ought to do. Whatever design is chosen, we find that it is important to state all the implications of this design explicitly, in order for the decision-makers, or other potential users, to better evaluate the information derived from a particular study.

[32] For a more thorough discussion of this problem, see Brekke (1993).

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