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Project Evaluations and Decision Processes

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Abstract:
Cost-benefit analysis have been attacked by many critics because of its implicit ethical assumptions. The normative content of the method is at odds with the common attitude that economists should analyze how to reach given goals, while determination of the goals should be left to the politicians. This paper presents a descriptive model of decision makers' behavior, demonstrating that rational, benevolent politicians will only in special cases accept the evaluation of projects resulting from a cost-benefit analysis. An alternative approach to project evaluation, which allows individual decision makers to rank projects in accordance with their own ethical views, is presented. In this framework, estimates of willingness to pay are generally not required. On the other hand, information about groups that are significantly affected by the project, as well as physical unit information on changes in the supply of public goods, is crucial.

Keywords: Cost-benefit analysis, welfare judgements, information constraint.

JEL classification: A11, D61, D78, D83, H43.

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1 Introduction

The role of the economist is frequently regarded as that of giving advice about the most efficient means to reach some given goals. Deciding on what those given goals should be, however, is usually thought of as something which should be left to others.

Quite frequently, however, it is not evident what the goals are. This is in particular true if the information provided by the economist is going to be used as input in a political decision process. A central feature of such processes is precisely that individual participants in the process may disagree about ethical or political issues. How can we provide information about the most efficient policy when we do not know what to aim at?

This paper discusses analysis of public projects when policy makers have differing normative views. I will discuss two alternative approaches, namely traditional cost-benefit analysis and "sufficient welfare indicators" [Brekke et al.(1994)]. A sufficient welfare indicator is defined as "aggregated information which enables any decision maker to rank social states according to his or her own ethical beliefs".

A common way of approaching the problem of varying ethical or political views is to take the Pareto principle as a sufficient normative guide in project evaluation. In a first-best model with side payments, efficiency and distributional concerns can be separated. Disagreements on distributional issues do then not need to be dealt with in the project analysis. But this conclusion is questionable as soon as second-best considerations such as deadweight losses, legal constraints on income redistributions, administration costs and asymmetric information are introduced into the model. In that case, there is no clear distinction between efficiency and distribution, not even in theory. [See, for example, Dreze and Stern (1987) for a discussion.] To claim that the Pareto principle is a sufficient normative basis for cost-benefit analysis, one must really be able to visualize how a potential Pareto improvement may in practice be changed into an actual Pareto improvement.

Another approach is to postulate a goal, frequently in the form of a Samuelson-Bergson social welfare function, and simply assume that the chosen formulation is uncontroversial enough to be accepted by all parties as a basis for the analysis. A traditional cost-benefit analysis may be interpreted as based on a utilitarian social welfare function, accompanied by the assumption that everybody has the same marginal utility of income (or, more generally, everybody's income counts the same at the margin in terms of social welfare).

Introducing a utilitarian welfare function into the analysis raises two questions. The first is whether this moral philosophy is ethically acceptable or not, an issue that has been extensively discussed both in the philosophic and economic literature [see, for example, Sen and Williams (1982)]. That question will, however, not be taken up here. The second question, which will be discussed below, is the following: If the analysis is based upon a specific ethical view, and some politicians are not certain that they accept that view, how

are they going to treat the results of the analysis?

The methods used in economic analysis may, of course, have to vary according to the purpose of the analysis. Regarding the analysis of public projects, I find it particularly useful to distinguish between the following two cases:

A. The purpose of the analysis is to arrive at a ranking of alternatives.

B. The purpose of the analysis is to facilitate *someone else's* (the decision makers') ranking of alternatives.

If there are several decision makers, and if they disagree on ethical issues, these two aims generally require different information.

Much of the literature in welfare theory, including most texts on cost-benefit analysis [such as Drèze and Stern (1987), Ray (1984)], implicitly or explicitly assume that the purpose of the analysis is as pictured in A above. However, in practice, economic analyses are frequently intended as background material for a political decision process, not as final answers to the question of what should be done; and hence, other methods may be required. The essential difference is that while purpose A requires *output* from a welfare judgement, purpose B requires information which can be used as *input* to a welfare judgement.

Cost-benefit analysis is an example of a method which provides estimates of the *output* of a specific welfare judgement. As will be discussed in section 4, it may be difficult or even impossible for a decision maker to use information provided from such analyses and at the same time respect his own ethical or political views. The problem of identifying information which can be used as *input* into an arbitrary social welfare function is analyzed in a general context in Brekke et al. (1994). Here, I will study if such an approach may be useful in the context of project evaluation, and to what extent such data may differ from the traditional cost-benefit approach.

2 A basic model of decision makers' behavior

In the following, I will look at the case where the economist's job is to provide information on alternative projects, while an evaluation of this information, and a subsequent final decision, is made in a political process. I will assume that the decision process is of the following stepwise type:

1. The alternatives are specified and described.

2. Individual participants in the collective decision process (henceforth: decision makers) make their subjective judgement regarding the social desirability of the various alternatives, based on the information from step 1 and their own ethical or political views.

3. Decision makers' judgements, which were determined in step 2, are aggregated in one manner or another to yield a collective choice.

This is, of course, a very simplified picture of an actual decision process. For example, the procedure described here is a kind of one-way communication, while in practice the administrative and political parts of the process may be more intermingled. The important feature of the procedure 1-3 is that there is no assumption of a central planner who has the power to determine social goals; rather, there are several participants in the decision process. This stylized decision process allows us to study the important case where economic analysis is intended to serve as a background for democratic processes, rather than to serve the interests of one central planner in an efficient way.

Many economists have been concerned with the problem of ensuring that the optimal decision is reached in a collective decision process. That is not the problem which will be studied here. When conflicting interests and views are introduced into the model, there is no objective way to define a social optimum. Nor is the problem of choosing a decision mechanism in step 3 which is transitive, or independent of irrelevant alternatives, or fair, or reasonable in other ways, touched upon. The strategy in this paper will be to take the aggregation procedure in step 3 as exogenously given, and ask: How can the individual opinions generated in step 2 be made as well-founded as possible?

2.1 Evaluations of social welfare

In the decision process described by the steps 1-3 above, only step 1 is within what is usually perceived as the domain of the economics profession. The use of the provided information, however, takes place in step 2. Hence, it is important that information is presented in a way which fits into decision makers' needs in this step, since otherwise they may not want to or be able to utilize it at all. In this section I will present a simple model of decision makers' behavior in step 2. The model is largely based on Brekke et al. (1994), though some amendments have been made. Section 3 presents the approach of sufficient welfare indicators, while section 4 considers traditional cost-benefit analysis as a way of presenting information in step 1.

We shall limit ourselves to look at a static, deterministic model, and study the situation where the set of alternative, feasible projects is clearly defined.[1] Let $N = \{1, ..., n\}$ be the set of all members of society, while $I \subseteq N$ is the set of decision makers. Each decision maker $j \in I$ have his or her own ethical views, which I will regard as exogenously given.[2] Assume further that for each j, these ethical views can be expressed as a social welfare function

$$W^j = V^j(\omega_1^j, ..., \omega_n^j, Z) \tag{1}$$

[1]It might be argued that the process of arriving at a set of alternatives to choose from is itself a task where project evaluation should be applied, but to simplify the problem I will disregard this.

[2]This assumption is made to simplify the problem. A more plausible assumption would perhaps be that social preferences are to some extent endogenous to the process of decision making and public debate.

where W^j is social welfare as judged by individual j, ω_i^j is person i's well-being as judged by j, and Z allows for inclusion of non-welfaristic considerations.[3] This may for example be the view that certain rights and duties should be respected, religious concerns, or the view that nature has an intrinsic value.[4] I will refer to preferences defined by the subjective social welfare functions as the decision maker's *social preferences.*

Measurement of individual well-being is certainly not a straightforward matter. Still, in everyday life people repeatedly make their own subjective judgements in an informal way: For example, while one may think that Mary, who is a single mother with low income, is worse off than Linda, who is a married mother with high income, Mary may still be thought to be much better off than Fiona who is a drug addict living on the street. Another observer (with less favorable experiences from married life?) may perhaps judge the well-being of these women in a different way. Nevertheless, in this example the judgements on individual well-being were both cardinal and interpersonally comparable, even if they were informal.

Thus, I will assume that decision makers are able to make up their mind about what they think other people's well-being is. To make such judgements, however, the decision maker needs information about i. I will assume that if given information on i's income, the supply of public goods and i's characteristics, any decision maker is able to make up his mind as to what he thinks i's well-being is.

This can be stated formally:

$$\omega_i^j = \nu^j(x_i, y; \alpha_i) \tag{2}$$

where x_i is i's real income, and y is the supply of public goods (which may be a vector, but for simplicity I will treat it as a single variable). α_i is a vector describing i's characteristics, for instance age, sex, socioeconomic class, or health. Characteristics are regarded as exogenous and given. I will also assume that they are observable.[5]

This assumption does not necessarily mean that decision makers make "correct" judgements in the sense that i would agree to j's judgement. In fact, it is not required that the judgements made by two different persons are comparable at all. j's evaluation of the well-being of any two persons, however, is assumed to be comparable from j's point of view. In addition, the ν^j functions will typically, but not necessarily, be cardinal.[6] The essential

[3]Sen (1979) defines a value system as welfaristic if "social welfare is a function of personal utility levels, so that any two states must be ranked entirely on the basis of personal utility levels in the two states".

[4]It is not obvious that a social welfare function is the most suitable tool for discussing rights, though. See Pattanaik and Suzumura (1994) for a discussion.

[5]An alternative formulation of this may be to include everybody else's income in the well-being evaluation, taking into account such phenomena as for example envy. For the sake of simplification I have not considered this. Such concerns may partly be dealt with in the welfare functions.

[6]Most social welfare functions require cardinal estimates of individual well-being. The exceptions are welfare functions such as the minimax criterium (maximize the well-being of the worst off individual), or a "maximax"-criterium (maximize the well-being of the best off individual).

feature of equation (2) is that decision makers are **able to** and **do** evaluate and compare different people's well-being.

Let $X \in \mathcal{X}$ denote the vector of individual incomes for all $i \in N$, where $\mathcal{X}$ is the set of all feasible combinations of individual incomes. Any project b, including the zero project, doing nothing, leads to a social state (X, y, Z). Hence, we can write

$$X = X(b) \tag{3}$$

$$y = y(b) \tag{4}$$

$$Z = Z(b) \tag{5}$$

Let us denote the status quo $(X(0), y(0), Z(0))$. Note that combining equations (1) - (5) implies that both W^j and ω_i^j will be functions of (α, b), where $\alpha = (\alpha_1, ..., \alpha_n)$.

2.2 The decision maker's problem

Decision makers participate in a collective decision process which finally leads to a collective decision. The goal of each decision maker is to try to make this final decision as far as possible in accordance with his own preferred alternative. He can do this by choosing an action, for instance giving his vote if the aggregation procedure is that of majority voting. The optimal action will depend on the aggregation procedure, other decision makers' actions, and, of course, the actions which are available to him. It may for example be optimal not to reveal his preferred alternative, but rather to strategically vote for something else. However, to choose the strategically best action, he must first know his preferred alternative. This is true whatever the procedure for aggregation of decision makers' opinions is (that is, disregarding the trivial case where the decision maker has no influence at all and the optimal action could be anything). To decide on this, he evaluates the proposals in accordance with his own ethical preferences, in other words, he applies his subjective social welfare function.

To determine which project he prefers, the decision maker must maximize $W^j(b, \alpha)$, subject to $b \in B$ and $\alpha = \overline{\alpha}$. Here, B denotes the set of alternative, feasible projects, and $\overline{\alpha} = (\overline{\alpha}_1, ..., \overline{\alpha}_n)$ is the actual characteristics of individuals $1, ...n$ in the status quo. However, since the strategic best action for the decision maker is not necessarily to go for his preferred alternative, solving such a maximization problem may not be sufficient. He may need a ranking of alternatives, and he might even want a cardinal measure of welfare differences between the alternatives. For a project b, thus, he needs information which enables him to identify $\triangle W^j(b, \alpha) = W^j(b, \alpha) - W^j(0, \alpha)$.

2.3 Restrictions on information

According to the equations I have presented this far, any decision maker can evaluate projects in accordance with his own ethical views if he is supplied with the data $(X(b), y(b), Z(b), \overline{\alpha})$, for every project b (including the zero project). This will usually be a huge amount of data, since both $X(b)$ and $\overline{\alpha}$ consist of n or more elements.[7] Hence, if the problem is not restricted any further, the question of what information decision makers need has a straightforward, but rather uninteresting answer: They should know, more or less, everything. Obviously, in practice people have a limited ability and time to receive and understand information. Providing too vast amounts of information may easily confuse decision makers rather than inform them.

To incorporate this formally into the problem, I will assume that each decision maker is capable of handling a maximum of K pieces of information regarding each project.[8] A piece of information is defined as a single number with an interpretation attached to it. For example, the statement "the income of the Prime Minister will decrease by 20$" is one information item, and "the average increase in the income of single mothers will be 2$" is another. An information item could also be of the type "the increase in the indicator for air pollution in Oslo will not exceed 10 per cent".[9] I will assume that $1 < K < \infty$, meaning that even though the decision maker's capacity to recieve information is limited, he is nevertheless able to understand more than simply one summary indicator (for example an estimate of net social benefits) for each project.

Although the constraint of K items is inspired by the literature on bounded rationality, it is consistent with rational decision makers in the sense of procedural rationality [Simon (1987)]. K may be exogenously given as a natural limit to people's brain capacity or something of the like, or it may be the result of an optimizing process (which for our purposes must be regarded as made "once and for all", not being revised for every new decision problem) if perceiving information is costly.

Thus, I will assume that decision makers apply some kind of procedure which enables them to evaluate projects on the basis of no more that K information items. Changes in social welfare due to project b, judged by j, can then be written as a function of K or less indicators:

[7]Note that $X(b)$ and α are ordered vectors and not simply sets. This is required because the decision maker must know the characteristics of a person receiving a specific amount of income.

[8]For simplicity I assume that the decision makers do not differ regarding the amounts of information they are able to handle.

[9]To make the definition sensible, one must exclude the possibility of using codes, like the following example demonstrates: "The first digit in the number 875 is the income change of civil servants in thousand dollars, the two next digits are the percentage decrease of CO_2 emissions." It seems reasonable that this should count as two numbers, not one. For the purposes in this paper, I think that the somewhat intuitive definition I have provided should otherwise be sufficient.

$$\triangle W^j(b,\alpha) = F^j(P_1^j(b,\alpha),...,P_k^j(b,\alpha)) \tag{6}$$

$$k \leq K \tag{7}$$

where $\triangle W^j(b,\alpha) = W^j(b,\alpha) - W^j(0,\alpha)$. $P_1^j(b,\alpha),...,P_k^j(b,\alpha)$ are indicators that j can accept as sufficient input to her evaluation of project b. The superscripts j are included to allow the possibility that different decision makers have different views of what is important information, and therefore need different indicators. If P^j is defined as the set $\{P_1^j(b,\alpha),...,P_k^j(b,\alpha)\}$, this means that the situation $P^m \neq P^l$ is allowed, where $m,l \in I$, and $m \neq l$.

In the following, I will assume that the same information should be given to every decision maker. I will further assume that if the decision maker is presented with more than K information items on each project, he is not able to pick out the $k < K$ items he needs. In other words, giving information about everything and leaving to the decision maker to pick out what he finds relevant will not work.

In section 3, I will first look at what kind of indicators any one decision maker will need in order to make evaluations according to his subjective social welfare function. In other words, I will look for indicators which can ensure consistency between equations (1) and (6) for a given j. Then, I will discuss under which conditions it is possible to identify a set of indicators which will give sufficient information for *all* decision makers.

2.4 Anonymity assumptions

If decision makers want to put special emphasis on the needs of particular persons (for instance themselves), and every decision maker receives the same information, it is impossible to escape the need of giving information about every single individual. Hence, I will assume that both the well-being evaluations (2) and the social welfare functions (1) are anonymous in the sense that i's identity is not allowed to count in the evaluations, and that α_i does not contain full identification of i. However, decision makers should be allowed to use characteristics as a determinant when deciding what weight to give to someone's well-being. For example, the view that the well-being of small children should count more than the well-being of adults should not be excluded *a priori*. If the welfare functions are anonymous in the sense that interchanging the individual well-beings of any two individuals should give the same social welfare [see Sen (1977)], an assumption which is common in the social choice literature, then this is ruled out.

Hence, I will instead impose the restriction that interchanging the well-beings of any two individuals i and l where $\alpha_i = \alpha_l$, $i,l \in N$, should not affect social welfare.[10]

[10]The assumption of anonymous aggregation found in Sen (1977) can be formulated as follows:

2.5 Social and personal preferences

The two equations (1) and (2) presented above imply that I actually assume that each decision maker has two possibly different sets of preferences: Social preferences, described by the function V^j, and personal well-being preferences, described by $v^j(x_j, y; \alpha_j)$. The former describes the decision makers' preferences when he regards himself as an agent for society, while the latter represents his own personal interests. It is not obvious that it is always relevant to draw such a distinction. In fact, many models in political economics contain the explicit assumption that politicians seek to maximize their own personal interests. However, it seems to me that most people occasionally find themselves in moral dilemmas caused by conflicts between their own personal interests and what they perceive as better for society as a whole. Such moral dilemmas would not arise at all if people didn't have some perception of their own good as opposed to society's interests.

For the purposes in this paper, one only needs to recognize that people who make decisions on behalf of society may not necessarily regard their own personal interests as the only relevant decision criterium. The two sets of preferences may be closely connected, however: For example, the model does not exclude the possibility that some decision makers give their own interests a huge weight in the welfare function.[11] Nor do I exclude the case that the shape of someone's social welfare function is originally motivated by opportunism, selfishness, or other "not-so-benevolent" motives.[12]

Now, which of these functions corresponds to the more familiar **utility function**? Let us define a utility function as *a numerical representation of an individual's revealed binary choices.* Then, the utility function will be some kind of mix between her social and personal preferences: If the individual always only acts to maximize her own well-being, utility coincides with well-being, and if she always acts to achieve what she thinks is best for society, utility coincides with her social preferences. If she acts in accordance with her social welfare function in cases where she feels a responsibility to represent social interests (for example when voting in Parliament), but in accordance with her own well-being otherwise (when going to the shop), her revealed preferences may be intransitive.

$W^j(\omega_1^j, ..., \omega_n^j) = W^j(\omega_1^j, ..., \omega_{i-1}^j, \omega_k^j, \omega_{i+1}^j, ..., \omega_{k-1}^j, \omega_i^j, \omega_{k+1}^j, ..., \omega_n^j)$. for any $i, k \in N, i \neq k$. The assumption of anonymous aggregation within groups which is used here can be formulated in the same way, except that the above equation is only required to hold when $\alpha_i = \alpha_k$.

[11]The anonymity assumptions require that the same treatment must be given to anybody else in excactly the same situation, though.

[12]Much more could be said about this. For a discussion of the concepts of well-being and agency, see Sen (1985). One could argue that if people are able to act as agents for "society as a whole", they may be able to act as agents for any other "prior" they feel a moral responsibility for, for example the firm they work for. In that case, the individual actually has several sets of preferences, and which one she applies in a given situation depends on who she regards herself as an agent for in that specific setting. This could provide a rationale for the commonly used political tool of "moral campaigns", even in the case that preferences are given: The campaign could persuade some individuals to change the agency role they take on, thus inducing them to apply another set of preferences. However, for the purposes here, it suffices to assume that decision makers distinguish between their own personal interests and what they think is morally right.

The focus on motivation and agent roles may seem odd, since in most economic analysis one focuses on ordinal revealed choices without considering motives at all. Since we are concerned with welfare judgements, however, and not only descriptive analysis, knowledge of binary choices is insufficient [Arrow (1951)]; it is hard to get around statements on what is "good" and "bad" for someone. And in such considerations, motives may be important.

2.6 A summary of the model

Before proceeding, let us just sum up the main idea of the model, which is quite simple. The central point is the following: Decision makers, that is, politicians, are assumed to make intuitive judgements regarding how well off different people are. I also assume that they have ethical beliefs of their own, concerning what is good and bad for society as a whole, which may differ between decision makers. Furthermore, when they decide which project to support in the political decision process, they choose in accordance with these subjective evaluations. But when regarding any specific project, they are only capable of taking a limited amount of data into account.

Our problem, now, is to present background information to the decision makers in a way which fits into this decision process, so that they can make use of the provided information in a relevant manner. If we succeed in this, decision makers have at least had *the opportunity* to ensure that their individual rankings of projects are well-founded.

3 Sufficient welfare indicators

In Brekke et al. (1994), The concept of a *sufficient welfare indicator* was introduced. There, a sufficient welfare indicator was defined as *information which enables any decision maker to rank social states according to his own ethical beliefs.* Here, I will define a sufficient welfare indicator *for a project* in the following way:

A sufficient welfare indicator for project b is information which enables any decision maker j to determine $\triangle W^j(b, \overline{\alpha})$, for all $b \in B$.

To begin with, let us assume that b is a marginal project in several senses: First, its general equilibrium effects are small enough to be disregarded, and secondly, its impact on any one individual is small enough to use a first order Taylor approximation of changes in both the social welfare function and the individual well-being evaluations for each i and j. Further, the effects on Z are also assumed to be marginal.

In the previous section it was assumed that $\triangle W^j(b, \overline{\alpha})$ can be expressed using no more than K information items. A first order approximation of $\triangle W^j(b, \overline{\alpha})$ can be found by differentiating $W^j(b, \overline{\alpha})$, using (1) - (5). However, this may yield an expression which includes

more than K items. The next step will thus be to look for reasonable assumptions which enable us to reduce the required number of information items to determine $\triangle W^j(b, \overline{\alpha})$.

Define $\triangle X(b)$ as the vector of income differences between the status quo and the situation after the project is implemented, that is, $\triangle X(b) = X(b) - X(0)$. Accordingly, define $\triangle y(b)$ and $\triangle Z(b)$ as the differences $y(b) - y(0)$ and $Z(b) - Z(0)$, respectively. $(\triangle X(b), \triangle y(b), \triangle Z(b))$ can then be viewed as a description of project b.

We then have the following condition for each decision maker j:

$$b \succeq \tilde{b} \text{ iff } \triangle W^j(b, \overline{\alpha}) \geq \triangle W^j(\tilde{b}, \overline{\alpha}).$$

where, due to (1) - (5),

$$(8) \qquad \triangle W^j(b, \alpha) = \sum_{i \in N} [\frac{\partial V^j}{\partial \omega_i^j} (\frac{\partial \nu^j}{\partial x_i} \triangle x_i(b) + \frac{\partial \nu^j}{\partial y} \triangle y(b))] + \frac{\partial V^j}{\partial Z} \triangle Z(b)$$

for all α and all $b \in B$.

In words: Project b is considered by the decision maker to be better than project $\tilde{b}$ if and only if b contributes more to social welfare than $\tilde{b}$, judged in accordance with the decision maker's own ethical views and his beliefs about other people's well-being.

Note that the partial derivatives of the welfare and well-being evaluations are subjective and vary from decision maker to decision maker. These are generally not constant, and hence information on the status quo, that is, $X(0), y(0), Z(0)$ and α, is required to enable the decision maker to establish these weights. In addition, the decision maker needs a description of the project, $(\triangle X(b), \triangle y(b), \triangle Z(b))$. Even if one assumes that α_i can be counted as only one number for each i, this amounts to $3n + 4$ variables. In a society of some size, it seems reasonable to believe that this will exceed K.

3.1 Aggregating information

First, note that the status quo information $(X(0), y(0), Z(0), \overline{\alpha})$, is the same for all projects. In the following, I will assume that when the projects are evaluated, *the status quo is known to the decision maker.* This may be justified simply by assuming that decision makers know the society they are administering from earlier experience. Alternatively, one can define the description of the zero project as a description of the status quo, implying that for this particular "project" one does not give information on changes in the variables (which would anyway be equal to zero for all variables), but on their actual levels.[13]

[13]If so, it might perhaps be reasonable to allow for some more information items to be received about this special case. Note that the required status quo information includes $\overline{\alpha}$, in addition to the "project description" $(X(0), y(0), Z(0))$. I have not specified whether the decision maker has *perfect* knowledge of the status quo (which does not seem reasonable to me) or not. The important issue here is that the prior knowledge is sufficient to determine welfare weights.

Let us assume that some individuals are equal, meaning here that $\alpha_i = \alpha_l$ and $x_i(0) = x_l(0)$ for two equal individuals i and l. Let us divide individuals into groups such that each group consists of equal individuals. (8) can then be written as

$$(9) \qquad \triangle W^j(b,\alpha) = \sum_{g=1}^{G} n^g [\frac{\partial V^j}{\partial \omega_g^j}(\frac{\partial \nu^j}{\partial x_g}\triangle x_g(b) + \frac{\partial \nu^j}{\partial y}\triangle y(b))] + \frac{\partial V^j}{\partial Z}\triangle Z(b)$$

for all $b \in B$, where n^g is the number of members in group g, $G \leq n$ is the number of homogeneous groups, and $x_g(b) = \frac{1}{n^g}\sum_{i\in g} x_i(b)$.[14]

The assumption that the status quo is known, and the aggregation of homogeneous individuals into groups, reduce the number of information items required for the determination of $\triangle W^j(b,\overline{\alpha})$ to $2G+2$. That is, the decision maker needs information on the number of members in each group and their income change under the project, as well as information which is not group specific, namely the change in public goods provision and Z. Still, this may well exceed K information items, since most people are actually not equal. Is it possible for j to aggregate individuals into heterogeneous groups, and base her evaluations of projects on information about those groups?

Let us first note that not all individual differences can reasonably be regarded as relevant for welfare judgements. For example, if two individuals differ only in that one has blue and the other has brown eyes, it does not seem reasonable to treat them differently. Formally, if

$$(10) \qquad \frac{\partial V^j}{\partial \omega_g^j}\frac{\partial \nu^j(x_g(b),y;\alpha_g)}{\partial x_g} = \frac{\partial V^j}{\partial \omega_{\hat{g}}^j}\frac{\partial \nu^j(x_{\hat{g}}(b),y;\alpha_{\hat{g}})}{\partial x_{\hat{g}}}$$

and

$$(11) \qquad \frac{\partial V^j}{\partial \omega_g^j}\frac{\partial \nu^j(x_g(b),y;\alpha_g)}{\partial y} = \frac{\partial V^j}{\partial \omega_{\hat{g}}^j}\frac{\partial \nu^j(x_{\hat{g}}(b),y;\alpha_{\hat{g}})}{\partial y}$$

for all $b \in B$ and for all $j \in I$, then all individuals in the groups g and $\hat{g}$ can be regarded as homogeneous. Here, α_g denotes the characteristics of the individuals in group g.

This argument can be extended if one assumes that the decision maker is willing to treat individuals she regards as *approximately* equal as homogeneous. Since she knows she is not capable of knowing everything, it may seem reasonable to give an equal treatment to individuals who are so similar that she is hardly capable of distinguishing between the project's effect on them.[15] Then, one of the individuals can be chosen as a representative for the group, and (9) applies, except that x_g must be replaced by the income of the representative.

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[14] $\frac{\partial V^j}{\partial \omega_g^j}$ is the partial derivative of j's subjective social welfare function with respect to the well-being of any one individual in group g. Anonymous aggregation within groups (see section 2.4) ensures that it does not matter which of the individuals in the group we choose, since in the status quo, they are homogeneous. Similarly, $\frac{\partial \nu^j}{\partial x_g}$ is the partial derivative of the well-being of any individual in group g with respect to income.

[15] Tversky (1977) and Rubinstein (1988) provide formal discussions of the concept of similarity.

3.2 Approximately sufficient welfare indicators

Several of the factors defining whether or not two individuals can be regarded as homogeneous are subjective and vary between decision makers. I have required that the same information should be given to all decision makers. It may be the case that each decision maker ideally wants to know as much as possible about each project, within the limit of K items.[16] To be able to identify a set of information which contains *exactly* that information *every* decision maker would ideally like to have, decision makers must in that case agree on which K items should be reported. That is, we must have $P^l = P^m$ for all $l, m \in I$ (see section 2.3). If they have both different ethical views and different judgements of individual well-being, this seems unrealistic.

Let us try to see if we can allow for some more disagreement. Assume that each decision maker $j \in I$ can accept to make an approximate welfare judgment, if she just knows that she has been provided with the $H < K$ items which she regards as *most important*:

$$\triangle W^j(b,\alpha) \approx f^j(P_1^j(b,\alpha), ..., P_H^j(b,\alpha))$$

Then, we get the following result: If the set $\mathcal{P}(b,\alpha) = \{P_h^j(b,\alpha)\}$ for all $j \in I$ and $h = [1, H]$ contains K elements or less, then $\mathcal{P}(b,\alpha)$ is an *approximately sufficient welfare indicator* for project b.

In words: If decision makers agree, more or less, to *what is important information*, then it may be possible to identify approximately sufficient welfare indicators. Then, the indicator set $\mathcal{P}(b,\alpha)$ will enable all decision makers to arrive at their own approximate evaluation of project b. They do not have to reach a perfect agreement on which information is important, since $H < K$; however, if there is little agreement, the set $\mathcal{P}(b,\alpha)$ will contain more than K elements, and the decision makers will not be able to relate to the information contained in it. Note, however, that even if one requires some agreement as to which information is the most important, no agreement is required regarding how this information should be evaluated. For example, if all families with two children will get an income increase of 100 \$/year in project b, most decision makers may agree that this is important information; still, they may disagree in the sense that some of them may think this is bad, some may think it is good, and some may find it very good.

3.3 What is the most important information?

We can now start to approach some general conclusions about what information the analyst should include when the project is presented to the decision makers. Let us take another

[16] This is not necessarily so, though: For example, if the information item ΔW^j were actually available for some j, one information item would be sufficient for those decision makers.

look at equation (9):

$$\triangle W^j(b,\alpha) = \sum_{g=1}^{G} n^g [\frac{\partial V^j}{\partial \omega_g^j}(\frac{\partial v^j}{\partial x_g}\triangle x_g(b) + \frac{\partial v^j}{\partial y}\triangle y(b))] + \frac{\partial V^j}{\partial Z}\triangle Z(b)$$

To begin with, let us imagine that we have identified a few groups that are homogeneous according to every decision maker's judgement. In that case, the above formula tells us the following. First, the number of members in each group is important information. Secondly, the average income change of the members in each group must be reported. Finally, the information which is not group specific, namely changes in the provision of public goods and in any variable with intrinsic value should be included in the indicator set. The latter requires a judgement on the analyst's part: Is it reasonable to believe that some decision makers attach an intrinsic value to variables affected by the project?

In practice, however, most people differ both with respect to characteristics and status quo income. The requirements in equations (10) and (11), which characterize groups which can be regarded as homogeneous, are to a large extent based on subjective judgements. Ideally, two individuals that some decision makers cannot accept to treat as homogeneous should not be put into the same group. One cannot know exactly how to avoid this without providing exceedingly disaggregated data. What, then, is the most relevant way of dividing people into groups?

Let us imagine that the analyst has defined the groups in some specific way. Assume that a decision maker j does not agree that the individuals in one of these groups are homogeneous. It will not be possible for her to distinguish between the project's effects on the individuals within the group, though, since the analyst has aggregated them all together. She is thus forced to treat them as if they were equal. Under what conditions will this lead to important errors in her evaluation of the project?

Looking again at the equation above, one can see the following. If n_g is large, any mistake in the welfare evaluation of this group will be important. If the subjective judgements $\frac{\partial V^j}{\partial \omega_g^j}$, $\frac{\partial v^j}{\partial x_g}$ and/or $\frac{\partial v^j}{\partial y}$ is very different for two groups $g = l$ and $g = m$, aggregating l and m into one group would cause a more serious mistake than otherwise. Further, the larger $\triangle x_g(b)$ is, the more important it is that the welfare weights j attaches this group are correct.

Hence, when considering what information to give in practice, I think that the following list may be useful for the analyst:

1. *Look for groups whose well-being may be regarded as particularly important by some decision makers.* That is, it seems reasonable to believe that $\frac{\partial V^j}{\partial \omega_g^j}$ is large for some j. This might for example be children, the elderly, or perhaps the poor. Decision makers may also sometimes want to know to what extent someone's situation is self-induced, which could in some cases be regarded as a characteristic (smoking or non-smoking asthma patients, for example).

2. *Look for groups whose well-being might be regarded as particularly vulnerable to changes in income or in the public good under consideration.* This means that is seems reasonable to think that $\frac{\partial v^j(x_g,y;\alpha_g)}{\partial x_g}$ and/or $\frac{\partial v^j(x_g,y;\alpha_g)}{\partial y}$ is large for some j. Examples of this: People with asthma if the project implies changes in air quality; low income groups when considering changes in income.

3. *Look for groups with particularly large individual income changes due to the project.*

4. *Look for large groups.*

5. *Report the change in supply of public goods due to the project.*

6. *If the project touches upon issues which may have intrinsic value, report those effects.* This may for example be concerns about equal rights to medical treatment or education. Further, information on certain environmental changes may be just as relevant for this item as for item 5.

This list can not give any firm answer to the question of whether approximately sufficient welfare indicators exist. If there is profound disagreement on what is most important information, the list may not be of much help. However, most projects, if they are marginal in the sense that general equilibrium effects can be ignored, have a limited set of consequences for a limited amount of people. In a given society there will probably also be some kind of limit to the degree of ethical and political disagreement. My unqualified guess is therefore that in important cases, the task of identifying approximately sufficient welfare indicators should be possible to overcome.

I have left the issue of exactly how to organize the information open. However, when working out more specific guidelines, my belief is that some further important lessons may be drawn from the theory of bounded rationality. [Dow (1991), Rubinstein (1993).] For example, it may be shown that the optimal organization of information is a partition, and the optimal partition is of the type high/low. This would imply, for instance, that it is better to give information on income changes for "high income elderly" and "low income elderly" rather than "elderly with about average income" and "elderly with extreme incomes". Also, when one has been giving information about income effects for several special groups, one should also give some indication of income effects for the group "everybody else".

3.4 The analyst's role and personal judgements

As noted above, the possibility of designing sufficient welfare indicators in practice depends on the degree of disagreement regarding *what is and is not important information*, not on disagreement on how this information should be evaluated. To find out if there is some

consensus on the former is an empirical question. One could simply ask people what they need to know to be able to evaluate social states or projects, or perform experiments designed to find out how welfare and well-being evaluations change as the provided information changes.

However, it is clear that when deciding which information to give to the decision makers, and what part of it to disregard, the economist must to some extent use his own personal judgements. Empirical research may over time reduce the need for this somewhat, but they can never be completely avoided. Hence, the theory presented here is not based on the idea that the scientist could or should be perfectly objective, in the sense that personal judgements should be avoided. However, the conclusions in the section above suggest that the economist should try to use his best judgements regarding *which information the decision makers may demand*, while it is not his job to judge what is the best project.

4 Cost-benefit analysis and disagreements

A common way of approaching project evaluation is cost-benefit analysis. Let us therefore take a brief look at that method in the light of the framework presented in this paper. Assume that the decision makers behave in accordance with the model proposed in section 2. Let us now consider the situation where decision makers receive information about projects in the form of a cost-benefit analysis. In doing this, I will look at what may be called a "traditional" cost-benefit analysis, where the purpose is to identify potential Pareto improvements.

A cost-benefit analysis of project b is here defined as follows:

a. Identify $(\triangle X(b), \triangle y(b))$

b. Rank projects $b \in B$ according to the following criterium:

$$b \succeq \tilde{b} \text{ iff } \sum_{i \in N} CV_i(b) \geq \sum_{i \in N} CV_i(\tilde{b}) \tag{12}$$

where $CV_i(b)$ is the compensating variation of individual i for the entire project b[17].

For simplicity, I disregard public budget constraints. If such constraints were introduced, projects ought to be ranked using a cost-benefit ratio rather than just a sum. Note that information on Z is not included in the project description. This would be redundant, since it is anyway not included in the cost-benefit welfare function (see (13) below).

[17]The compensating variation of individual i for project b is defined such that

$$\tilde{V}_i(p(b), x_i(b) - CV_i, y(b)) = \tilde{V}_i(p(0), x_i(0), y(0))$$

where $\tilde{V}_i$ is the indirect utility function of individual i, and $p(b)$ denotes prices after the project has been implemented. Some authors use the term "compensating variation" only in the case when prices change but all quantities are endogenous to the consumer, and use the term "compensating surplus" whenever there are quantitative constraints. For elaborations, see Mitchell and Carson (1989) or Kolstad and Braden (1991).

The criterium (12) may be interpreted as derived from a purely utilitarian social welfare function

$$W^{CB}(b) = \sum_{i \in N} \omega_i^{CB}(b) \tag{13}$$

where

$$\omega_i(b) = u_i(x_i(b), y(b)) \tag{14}$$

Here, the u_i functions should be interpreted as utility functions, as this concept is defined in section 2.5. This implies

$$\Delta W^{CB} = \sum_{i \in N} \left(\frac{\partial u_i}{\partial x_i} \Delta x_i + \frac{\partial u_i}{\partial y} \Delta y\right) \tag{15}$$

ΔW^{CB} is the welfare change resulting from project b, according to the utilitarian welfare function, measured in utility units. Assuming that the marginal utility of income $\frac{\partial u_i}{\partial x_i}$ is the same for everyone, say λ, allows the translation of this into money units:

$$\frac{\Delta W^{CB}}{\lambda} = \sum_{i \in N} \left(\Delta x_i + \frac{\frac{\partial u_i}{\partial y}}{\lambda} \Delta y\right) \tag{16}$$

Here, $\frac{\frac{\partial u_i}{\partial y}}{\lambda}$ are the individual marginal rates of substitution between income and public goods. $\frac{\frac{\partial u_i}{\partial y}}{\lambda} \Delta y$ is the partial compensating variation of individual i for the change in the supply of public goods[18]. The choice of λ does not matter for the results. Then, adding up everybody's income change and everybody's partial compensating variation for the changed provision of public goods (alternatively, adding up everybody's compensating variation for the entire project) yields a monetary measure of changes in social welfare.

This measure will correspond to decision maker j's individual judgements if $\Delta W^j(b) = \mu^j \Delta W^{CB}(b)$ for all $b \in B$, where μ^j is a positive constant[19]. This will be the case if the following sufficient conditions are fulfilled:

$$\frac{\partial V^j}{\partial \omega_i^j} \frac{\partial \nu^j}{\partial x_i} = \frac{\partial V^j}{\partial \omega_k^j} \frac{\partial \nu^j}{\partial x_k} \text{ for all } i, k \in N \tag{17}$$

and

$$\nu^j(x_i, y; \alpha_i) = C^j u_i(x_i(b), y(b)) \tag{18}$$

[18]If the project improves the supply of a public good, this is i's willingness to pay for $\Delta y(b)$, assuming that $\Delta x_i(b) = 0$. If the project leads to less public goods, i's partial compensating variation amounts to her willingness to accept $\Delta y(b)$, assuming that $\Delta x_i(b) = 0$.

[19]In section 2 it was maintained that j might actually need a cardinal measure of ΔW^j. If one only requires a *ranking* of projects, however, then it is sufficient that $\Delta W^j = \phi^j(\Delta W^{CB})$, where ϕ^j is a monotonously increasing function.

where C^j is a positive constant[20], and

$$\frac{\partial V^j}{\partial Z}\triangle Z(b) = 0 \tag{19}$$

For example, putting larger emphasis on income effects for groups with lower incomes in the status quo is inconsistent with (17) - (19). The same is true for the view that the well-being derived by consuming the loot from a bank robbery should count less that the well-being derived from honestly earned income; or the view that animals have rights. One could think of many other examples of ethical views which are at odds with these conditions.

4.1 Using cost-benefit analysis within the model

Thus, according to the model proposed in section 2, a traditional cost-benefit analysis does only fit well into the needs of decision makers in special cases; namely, if $\triangle W^j(b) = \mu^j \triangle W^{CB}(b)$ for all b[21]. But what if the background information provided to the decision makers is actually in the form of a cost-benefit analysis?

Assume that the result of the analysis is reported as only one summary indicator for each project, namely $\sum_{i\in N} CV_i(b)$, which is the net benefits according to the cost-benefit analysis. If the decision maker believes that the conditions (17) - (19) are fulfilled, she will accept the evaluation of projects implied by this indicator. If she does not trust that the normative assumptions of the analysis are in accordance with her own, however, she cannot rely on the ranking defined by the cost-benefit ratio.

She may then look for additional information, and use that data to form her own evaluation of the various projects. This requires, first of all, that more information than the estimate of net benefits is actually available.

Secondly, if additional data *is* reported, it must be presented in a way which enables her to utilize it. One possibility is that the only information available in addition to the net benefit estimate is the disaggregated raw data. In that case, the constraint of K information items may easily become binding, and the decision maker cannot understand the data. Hence, the additional information provided must usually be aggregated in one way or another. It must further be organized in a way which the decision maker can accept as sufficient input to a welfare judgement. If not, there is a considerable risk that she will simply trust her own *a priori* opinion about the projects.

Thus, decision makers will only in special cases use the cost-benefit ratios. In the worst case, the decision maker will not be able to use the factual information contained in the

[20]If only a ranking is required, condition (18) can be rewritten as

$$\nu^j(x_i, y; \alpha_i) = \Psi^j(u_i(x_i(b), y(b)))$$

where Ψ^j is a monotonously increasing function.

[21]Or, if only a ranking is required, $\Delta W^j = \phi^j(\Delta W^{CB})$.

cost-benefit analysis at all.

Note that this result was obtained under the assumption of procedurally rational decision makers. In a strict sense, decision makers are boundedly rational in this model, since they have a limited capacity to perceive information. Apart from the disability to perceive an unbounded amount of information about each project, however, they act in a rational manner to maximize social welfare. *Strictly* rational decision makers would really not need project analysis at all, since they would have perfect knowledge of all possible social states and be able to calculate $\triangle W^j$ themselves, without any need to be informed.

Further, I have assumed that decision makers are benevolent in the sense that they try to maximize social welfare. This is not intended as a claim that politicians never misuse their positions to increase their own well-being at the cost of other people's interests. In actual political decision processes, there will be many more complicating aspects that the ones I have mentioned here. It may still be interesting to note that even in the naive case where all politicians act rationally to maximize well-defined concepts of social welfare, cost-benefit ratios may not be used.

5 Is there something in between?

5.1 Some contrasts

According to the model presented in this paper, the information requirement for decision makers evaluating projects is, at least at first glance, quite different from the information offered by traditional cost-benefit analysis.

First of all, while cost-benefit analysis provides a ranking of projects, sufficient welfare indicators do not. Accordingly, while the cost-benefit ratio is the central indicator in CB-analysis, there is no corresponding summary indicator in the sufficient welfare indicator framework.

Secondly, there is a difference between the two methods in that a CB-analysis does not specifically give information about variables with intrinsic value, whereas in the alternative approach, such information may be included.

The perhaps most striking result in the framework presented here, though, is that ordinal utility information, such as willingness to pay, is not necessarily more useful to decision makers than several other types of data. The need in cost-benefit analysis to valuate everything in monetary terms arise from the analyst's ambition to provide a ranking, and thus a mechanism to weigh different concerns against each other is essential. In the sufficient welfare indicator approach, the usefulness of a given data set is determined by the extent to which the data provides relevant input to a subjective welfare judgement. Such input data should be easy to interpret, in order to avoid misunderstandings, but all information does

not have to be given in the same units.

A claim that monetary valuation of public goods facilitates decisions problems, compared to the case where only physical unit information is provided, is therefore not necessarily supported by the model. In Brekke et al. (1994, prop. 4) it is shown that willingness to pay by groups of the population may serve as a sufficient welfare indicator, but only under very strict assumptions about the welfare and well-being evaluations.

But is it not of interest to know what people think themselves? Yes, but there are at least two reasons that make the use of willingness to pay-data difficult to use as individuals' judgements of their own well-being. The first is that sometimes it is hard to know whether willingness to pay measures ordinal properties of W^i or ω_i^i, as was explained briefly in section 2.5[22]. This problem is perhaps particularly relevant in the case of valuing public goods by contingent valuation studies, since the respondent may easily give an answer to what she thinks is "right" rather than considering the good's contribution to her own well-being. If this is not clear, and the responses are used in a CB analysis, one may actually be applying a social welfare function of the type $W = V(T^1, ..., T^N)$, where $T^i = W^i$ for some i and $T^i = \omega_i^i$ for some other i.

However, the limited importance of willingness to pay-estimates holds even if one imposes the restriction that decision makers should always respect i's ordinal revealed preferences when judging i's well-being. The reason is that data on willingness to pay provides only *ordinal* utility information, whereas cardinal, interpersonally comparable information is needed for welfare judgements. Thus, to be used in a welfare function, willingness to pay-data must be supplemented with a judgement of different individuals' marginal utility of income. In my view, such a judgement is very much of the same type as the well-being evaluations described in equation (2), and it is not obvious that it is any easier, or that it can be made in a more objective way.

To avoid misunderstandings, however, let me add that my intention is not to say that ordinal utility information is entirely worthless. If it can reveal something of relevance for the decision makers' estimates of individual (or group) well-being, then it is useful. For example, if there are unobservable characteristics which some decision makers want to know, and these characteristics can be revealed through people's responses to a contingent valuation study, this may be helpful. It is also possible that decision makers actually do find the task of judging individual or groups' marginal utility of income easier than to judge changes in well-being.

Since the decision makers' ability to receive information is limited, the information contents must nevertheless be weighed against other types of data. Another issue, which I have not touched upon here, is that there will usually be a limited budget available for gathering

[22]For a more general treatment of this, see Sen (1985, 1987).

data. Since reliable data on willingness to pay for public goods are expensive to collect, the results in this paper should perhaps serve as a question mark to the fairly large effort on conducting such studies which take place in some countries, and which have been advocated by many economists.

5.2 Is there room for a synthesis?

Any cost-benefit analysis is based on large amounts of factual background information. Presumably, this is much of the same information which is needed to yield sufficient welfare indicators. It it therefore interesting to find out if some revisions of the way cost-benefit analyses are presented may enable decision makers to identify sufficient welfare indicators from the cost-benefit analysis.

As discussed in section 3, sufficient welfare indicators typically consist of indicators on a medium aggregation level. In section 4, it was noted that if the cost-benefit analysis is supplemented with some indicators in addition to the estimate of net benefits, the decision maker may be able to utilize the analysis, even if she does not trust that the normative assumptions in the analysis support her own judgements. Hence, if the net benefit estimate is supplemented with the type of indicators sketched in section 3, the analysis may provide a set of approximately sufficient welfare indicators, even if the net benefit estimate itself will only be of interest to some decision makers.

In applied cost-benefit analysis it is not always easy to decide which effects should be evaluated in monetary terms and included in the analysis. The concept of net benefits may be defined in a narrow or broad sense. While a broad definition aims for a higher degree of completeness, a narrow definition may actually be more interesting if the purpose is to provide *input* to welfare judgements rather than *output.*

In some cases, the project's income effects on groups that are given special attention in the analysis may be relatively small. A net benefit measure defined as $\sum_{i \in N}(\triangle x_i)$ may then provide a rough indicator of the income effects on that group of people whose situation is such that it is not necessary to give them any kind of special treatment. If a large part of income changes are associated with groups that have to be treated separately, however, the income changes of those groups should ideally be netted out of the indicator for the "rest of society".

If the net benefit indicator is defined in a narrow way, for example as the sum of changes in individual incomes, this could be emphasized by terming it, for example, "net economic benefits" or "net income effects". Other concerns than aggregate income effects, such as for example environmental issues, would have to be dealt with through other indicators. Note, however, that even if a very broad net benefit concept is applied, decision makers will only in special cases put any emphasis on this indicator as a final evaluation of projects.

In applied cost-benefit analysis it is not always made clear how the net benefit concept is defined. If the analysis is to be used as input into subjective welfare judgements, it is clearly essential to provide an intuitive explanation of what the indicator is intended to measure. Explaining that it measures "the impact on social welfare" is not satisfactory, since one cannot expect there to be any agreement about what this phrase means. One may of course say that it measures the sum of individual income effects, where income is defined in a broad sense: Hicksian income (Hicks 1946) is defined as "the maximum value which one can consume during a period of time, and still expect to be as well off at the end of the week as one was in the beginning". If "well off" is interpreted in terms of well-being or welfare, however, we have in my view not come much further in explaining the concept of net benefits, since this seems to be just another way of presenting the output of one particular social welfare judgement.

On the other hand, even in the sufficient welfare indicators framework, *some* decision makers can use net benefit estimates to evaluate projects; namely those who believe that the normative assumptions used in the analysis are in accordance with their own views. Thus, if one could confirm that one particular view on welfare and well-being evaluations has especially many supporters, this might be an argument for defining net benefits in accordance with this view. Still, in a democracy one would ideally want every participant in the decision making process to be well-informed, not only those who belong to a majority. In my view, providing a full indicator set, not only an estimate of net benefits, should therefore be part of any project analysis which is to be used in a public decision process.

6 Summary and conclusions

Several Scandinavian empirical studies have recently found little or no correspondence between *a priori* estimated cost-benefit ratios and decision makers' actual choices of which projects to go through with [Nilsson (1991), Fridstrøm (1994), among others]. The model presented in this paper may provide one explanation for this.[23] According to the model, procedurally rational and benevolent decision makers will only in special cases evaluate projects in accordance with the reported net benefits. In the worst case, they will be unable to utilize the results from the cost-benefit analysis at all.

Quite frequently, public project analysis is intended as background information to a political decision process, where individual decision makers may disagree on normative issues. In such cases, I have argued that project information ought to be provided in a way which can be used as *input* into an arbitrary welfare function. An estimate of net benefits or a

[23]Note, however, that this paper has been concerned with decision makers' *individual* evaluations of projects. Final decisions are usually reached through collective choice procedures, and such processes have not been studied here.

cost-benefit ratio can be interpreted as *output* from one specific welfare function, but cannot in general be used as input into another.

A *sufficient welfare indicator* for a project is information which enables any decision maker to arrive at a well-founded evaluation of the project, *in accordance with his own ethical views.* In this paper I have outlined what kind of information will be required to meet such a requirement.

One main conclusion is that it is important to report the project's effects on several subgroups of the population, not only aggregate effects. Changes in the supply of public goods should also be reported. In the framework presented here, however, ordinal utility information, such as willingness to pay for public goods, does not necessarily facilitate project evaluations much. Possibly, information in the form of physical unit indicators may be just as useful, or even more useful.

Finally, some projects may involve variables that some decision makers attach an intrinsic value to. By that I mean issues which are regarded as important not only because they affect individual well-being, but for their own sake; such as moral concerns about what human beings have the right to do at all. If it is reasonable to assume that such issues are at stake, this will be important information.

The approach of sufficient welfare indicators thus identifies information requirements that are very different from the single summary indicator of net benefits resulting from a cost-benefit analysis. However, most CB analyses are reported not only as a single number, but with some additional data as well. Hence, if the net benefit estimate is supplemented with an indicator set satisfying the requirements outlined in section 3, the analysis may provide sufficient data for any decision maker to make a well-founded ranking of alternatives, according to his own ethical or political views. In that case, those decision makers who accept the normative premises of the CB analysis can rely on the estimated net benefits, while other decision makers can disregard this indicator and use the additional information provided to draw their own conclusions.

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