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On the possibility of a bridge between CBA and CEA: Comments on a paper by Dolan and Edlin

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Abstract

In a recent work by Dolan and Edlin, it is concluded that no link can be established between cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA). However, the conclusion seems to depend rather heavily on what is understood by a link between CBA and CEA as well as on the exact meaning of the latter two terms. We argue that there is at least one approach to CBA and CEA in which the two are very intimately linked. On the other hand, the limitations in the access to preference information has consequences for the kind of questions that can be meaningfully addressed in both CBA and CEA.

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1. Introduction

In the health economic literature of the last years, a recurrent theme has been the relationships between classical cost-benefit analysis (CBA) and the variant practiced in health economics, cost-effectiveness analysis (CEA) (cf. e.g. Johannesson, 1995; Johannesson and Meltzer, 1998; Garber and Phelps, 1997; Bleichrodt and Quiggin, 1999; Brouwer and Koopmanschap, 2000; Dolan and Edlin, 2002). The recent contribution to this literature by Dolan and Edlin (2002) (in the following denoted DE) is therefore one among many, and what will be stated below as comments to DE applies to other contributions as well.

A common feature of the contributions to this discussion is the search for a theoretical justification for using cost-effectiveness ratios in decisions on whether or not to adopt a given medical technology or treatment. Constructing a cost-effectiveness ratio

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clearly presupposes that there is some well-defined outcome measure to be put into the denominator of the cost-effectiveness ratio; if effects cannot be meaningfully aggregated into a single variable, then cost-effectiveness ratios are meaningless and a closer scrutiny of how they may be derived from classical cost-benefit is unnecessary.

In this paper it is argued that this trivial condition for the theoretical meaningfulness of cost-effectiveness ratios – a condition which is related to the possibility of aggregating outcome measures into a single variable in a meaningful way, not only for a single individual but for society as a whole – is all one needs to worry about. *If* the aggregation problem is solved, then CEA is indeed very closely related to CBA. Thus, what is behind the discussion is essentially an aggregation problem.

The paper is structured as follows: In the following Section 2, we give a short introduction to the discussion of possible links between CBA and CEA, formulated as a comment on the recent contribution to the discussion in DE. This is followed by a presentation of classical cost-benefit theory and its version related to problems involving health and other non-marketable goods; we show how CEA can be seen as the proper method for comparing projects under lack of information about the valuation of health outcome in terms of money, provided of course that the non-marketable goods can be aggregated into a single variable. In Section 4, we consider a possible alternative, the “decision maker’s approach”, and we show that this approach faces the same basic aggregation problem. We conclude in Section 5 that the aggregation problem is indeed the central problem for the theoretical meaningfulness of cost-effectiveness analysis.

2. What is a ‘link’ between CEA and CBA?

In what seems to be the main results of Dolan and Edlin, the establishment of a link between CBA and CEA is made contingent on specific properties of a utility function. The authors assume – as do indeed most of the contributors to this field – that all agents have the same utility function¹. The utility function has the form

$$U(c, N, h)$$

where c is consumption (of a single commodity), h is health status (measured in QALY), and N is (a vector of) other factors affecting utility. We shall keep the one-period framework since multiperiod models may be reduced to this one using separability assumptions.

The first question arising is what is to be understood by a ‘link’ between CBA and CEA. DE are not very explicit about this; actually the closest one gets to a precise explanation of the nature of such a link is a paragraph in the proof of Theorem 1 (in Appendix B of the paper). Here the authors introduce a compensation function expressing the amount of the consumption good that an agent is willing to give up in order to move

¹ This is actually a rather strange assumption in a discussion of social decision making – if all agents have the same preferences then the basic problem of cost-benefit analysis, that of getting to know the preferences of agents in society, can be solved by the decision maker by introspection.

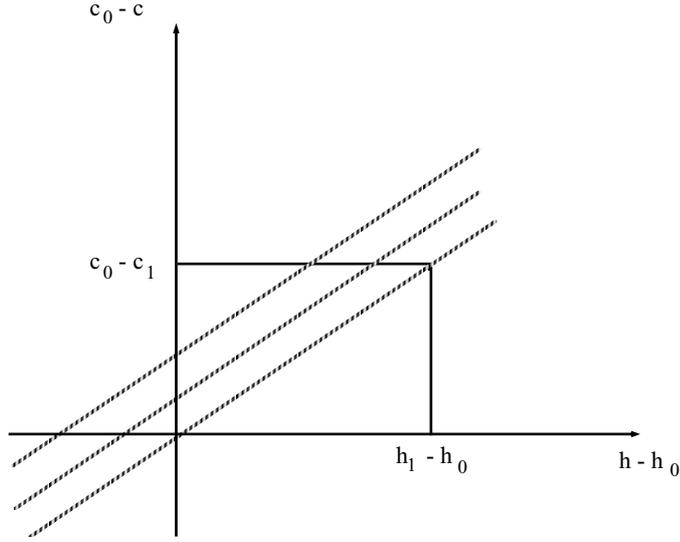


Figure 1

from (c_0, N_0, h_0) to a situation described by health status h_1 and other factors N_1 ; this situation is illustrated in our Figure 1. The ‘link’ now seems to imply that the size of the marginal compensation per unit of health (seen from the initial situation) should not depend on the initial consumption, at least for small changes²; the marginal compensation can be written

$$\frac{\partial}{\partial h_0}(c_0 - C(U(c_0, N_0, h_0), N_1, h_1)),$$

where $C(u, N_1, h_1)$ is the consumption at N_1, h_1 which gives rise to the initial utility $U(c_0, N_0, h_0)$. The partial derivative can be written as

$$-\frac{\partial C}{\partial u} \frac{\partial U}{\partial h} = \frac{\partial U}{\partial h} / \frac{\partial U}{\partial c}, \quad (1)$$

where we have used that $C(u, N, h)$ is defined as solving the equation $U(c, N, h) - u = 0$ for fixed N, h , so that its derivative w.r.t. u can be found as

$$\frac{\partial C}{\partial u} = \left(\frac{\partial U}{\partial c} \right)^{-1}.$$

Now (1) is the marginal rate of substitution between health and consumption. If our interpretation of DE is correct, then a link between CBA and CEA means that this MRS should be constant for small changes in c_0 , and then, since c_0 varies over all possible nonnegative values, it should not depend on c_0 at all. In our Figure 1, this means that if we fix $N_0 = N_1$ at some given level, then we get indifference curves in the (c, h) -plane which are straight lines. Clearly, the mixed partial derivatives of U must then all be zero, which seems to be the point of Theorem 1.

² The authors state that the compensation function “must satisfy $g(c_0, N_0, h_0, N_1, h_1) = \lambda(h_1 - h_0)$ for some common $\lambda \in \mathbb{R}$ ” (p.840), which may amount to the same as what we have stated in the text, or may be stronger, depending on the meaning of the term ‘common’.

If a link between CBA and CEA is to be understood as a fixed and constant marginal rate of substitution between health measured in QALY and consumption measured in monetary terms, then it is clear that the other factors entering the utility function are irrelevant for this trade-off, so that utility must be separable in other factors and the consumption-health parts. However, taking the stronger formulation by DE of the ‘link’, namely that compensation does not depend on N_0 and N_1 at all, it is obvious that N cannot enter the utility function, as is indeed the conclusion of the authors’ Theorem 2.

It may be worthwhile pondering for a moment over what the ‘other factors’ can be, since their presence in the utility function seems to preclude any linkage between CBA and CEA; in particular, they must include all those aspects of health which are not captured by QALY measurements: DE mention autonomy and self-respect as examples of such other factors. However, if QALYs are assumed to be determined by standard methods of preference elicitation, such as the standard gamble or the time-trade off method, then if ‘other factors’ are important they can also be captured by the quality adjustment of life years following the different medical interventions. For example, if two medical interventions are compared using CEA and one intervention results in a greater loss of self-respect than the other, then the greater loss of self-respect affects the number of QALYs obtained by the intervention. In this sense it actually becomes meaningless to include N as arguments of the utility function and consequently ‘other factors’ pose no problem with respect to a possible link between CEA and CBA. As we shall see below there is no need to operate with separate factors N and h since changes in N may be conceived as effects of a given medical intervention. The problem is therefore caused by the use of QALYs in the utility function as QALYs by themselves are a sort of utility function.

3. What is CBA and CEA, then?

Even if we rightly interpret the link in DE between CBA and CEA, it still leaves some questions open. In particular, it might not be obvious *why* the existence of a constant trade-off between consumption and health should be a condition for either CBA or CEA, not to speak of a link between the two: We have learned that in a world where the evaluation of changes in consumption, health and other things is described by a fixed and constant MRS, the other things must be irrelevant, and the indifference curves in (c, h) -space must be linear. But what has this to do with CBA and CEA?

What DE seem to be aiming at in establishing a link between CBA and CEA is to give conditions for the existence of a well-defined marginal rate of substitution (for society as a whole) between the monetary variable (consumption) and health, that is a societal willingness-to-pay for health. Indeed, the availability of such a WTP per QALY would make it possible to decide for every medical project whether or not it is desirable for society, namely by simple comparison of cost per QALY of the project, that is its cost-effectiveness ratio, with society’s willingness to pay per QALY. What the authors show is that such a well-defined WTP for society as a whole will usually not come about, if the agents in society differ at least in some aspects (in DE they are (implicitly) assumed to

differ in the consumption variable, in Pratt and Zeckhauser (1996) agents may be equal in consumption but differ in risk). But this is basically an *aggregation* problem, and it has nothing to do with the foundation of CBA and CEA.

For a closer view of the relation between CEA and CBA it might be useful to start at the basic level, introducing CBA in its general equilibrium framework such as it is done e.g. in Lesourne (1975), with the necessary extension to allow for application in the context of health economics. We consider a society with m individuals, each with a utility function $u_i(x_i, h_i)$ depending on consumption bundles x_i consisting of l different commodities and on vectors of r additional variables $h_i = (h_{i1}, \dots, h_{ir})$.³ For simplicity we refer to these variables as health characteristics, but some of them may of course describe other factors than health, corresponding to the vectors N_i above. Contrary to DE and others, we do not assume that agents have identical utility functions, and we do not assume that different health characteristics have already been aggregated into a one-dimensional index (such as the QALY) which would then figure as an argument in the utility function. The latter is important since if a QALY index is assumed to capture all relevant aspects of health, parts of the aggregation problem have been assumed away, and fundamental underlying assumptions are thereby left unaccounted for.

We assume that society's preferences may be described by a social welfare function

$$S(u_1(x_1, h_1), \dots, u_m(x_m, h_m)).$$

A project is described by its consequences on individual consumption, dx_1, \dots, dx_m , as well as by the changes dh_1, \dots, dh_m in the health characteristics of each individual which it gives rise to. The change in social welfare is

$$dS = \sum_{i=1}^m \frac{\partial S}{\partial u_i} \sum_{h=1}^l \frac{\partial u_i}{\partial x_{ih}} dx_{ih} + \sum_{i=1}^m \frac{\partial S}{\partial u_i} \sum_{k=1}^r \frac{\partial u_i}{\partial h_{ik}} dh_{ik}. \quad (2)$$

Most of the quantities in this expression are however unobservable. To proceed, we need some assumptions connecting unobservable marginal utilities with other economic variables which may be observed. The first of our assumptions relates marginal utility to market prices:

Assumption 1. *In the initial allocation, consumers obtain their commodity bundles by trading in the market.*

The assumption says that there is some price vector $p \in \mathbb{R}_+^l$ such that for each individual i , the consumption bundle x_i maximizes u_i on all x'_i satisfying the budget constraint

$$p \cdot x'_i \leq p \cdot x_i = w_i,$$

³ The model and assumptions are formulated for continuous variables, but may easily be modified in case health characteristics are discrete. Moreover, health characteristics seem naturally to be continuous and it is only due to measurement problems that they may be discrete in practice.

where w_i is the income of individual i , $i = 1, \dots, m$. From standard textbook results (see e.g. Mas-Colell, Whinston and Green, 1995), we then have

$$\frac{\partial u_i}{\partial x_{ih}} = \lambda_i p_h$$

for each commodity h , where $\lambda_i > 0$ is individual i 's marginal utility of income. Inserting into (1) we obtain

$$dS = \sum_{i=1}^m \frac{\partial S}{\partial u_i} \lambda_i \sum_{h=1}^l p_h dx_{ih} + \sum_{i=1}^m \frac{\partial S}{\partial u_i} \sum_{k=1}^r \frac{\partial u_i}{\partial h_{ik}} dh_{ik}. \quad (3)$$

The (unknown) quantities $(\partial S / \partial u_i) \lambda_i$ may be interpreted as society's marginal utility of assigning income to individual i ; we may eliminate them by assuming that $S'_i \lambda_i = K$, where K does not depend on i :

Assumption 2. *The distribution of incomes sustaining the consumptions at the initial allocation is optimal measured by the social welfare function.*

By now, the expression (2) has become

$$dS = K \sum_{h=1}^l p_h \sum_{i=1}^m dx_{ih} + \sum_{i=1}^m \frac{\partial S}{\partial u_i} \sum_{k=1}^r \frac{\partial u_i}{\partial h_{ik}} dh_{ik}. \quad (4)$$

Proceeding in analogous way with the second member on the right, we assume that the distribution of health is optimal from the point of view of society:

Assumption 3. *For each health characteristic k , health is optimally distributed among individuals in the sense that*

$$\frac{\partial S}{\partial u_1} \frac{\partial u_1}{\partial h_{1k}} = \dots = \frac{\partial S}{\partial u_m} \frac{\partial u_m}{\partial h_{mk}} = H_k > 0.$$

Using Assumption 3, we get that welfare gains for society can be expressed as

$$dS = K \sum_{h=1}^l p_h \sum_{i=1}^m dx_{ih} + \sum_{k=1}^r H_k \sum_{i=1}^m dh_{ik}. \quad (5)$$

Thus, welfare gains of society may be assessed as a weighted sum of the health gains and the changes in value of net consumption.

While Assumption 2 on the optimality of income distribution in society (w.r.t. the social welfare criterion S) is standard in the cost-benefit literature, its counterpart (Assumption 3) related to health variables is of course specific for applications to health. Both assumptions are quite powerful and in other contexts one would perhaps not subscribe to the view that distribution in society is optimal. However, such assumptions are needed in order to assign a change in society's welfare to any single project: If welfare could

be increased just by redistributing consumption or health, how can we then know how much of the welfare gain of any project is due to the project itself and how much to the side-effects of doing something more efficiently with the existing methods of treatment?

The expression in (5) still contains the unknown constants H_1, \dots, H_r and K , so that although the change in value of total consumption $\sum_{h=1}^l p_h \sum_{i=1}^m dx_{ih}$ may be observed, as well as the aggregate change in each health characteristic $\sum_{i=1}^m dh_{ik}$, the sign of dS cannot be unambiguously determined. However, though evaluation of any single project is beyond reach, comparison of projects may still be feasible. In the simple case of a single health characteristic ($r = 1$), we have the following result which may well be considered as the welfare theoretic foundation of cost-effectiveness analysis:

Proposition 1. *Assume that there is only one health characteristic. Let P^1 and P^2 be two projects, and let $dh^j = \sum_{i=1}^m dh_i^j$, $dc^j = -\sum_{h=1}^l p_h \sum_{i=1}^m dx_{ih}^j$, $j = 1, 2$ be their associated changes in health and in consumption. Then the project P^1 carried through at some scale is preferred by society to P^2 if and only if its cost-effectiveness ratio is smaller than that of P^2 , that is*

$$\frac{dc^1}{dh^1} < \frac{dc^2}{dh^2}.$$

Proof: Let dS^j be the increase in S caused by P^j , $j = 1, 2$. In the case where there is only one health characteristic, the expression (5) reduces to

$$dS = Hdh - Kdc, \quad (6)$$

so $dS^1 > dS^2$ if and only if

$$Hdh^1 - Kdc^1 > Hdh^2 - Kdc^2,$$

which, assuming $dc^2 > 0$, is equivalent to

$$\frac{H}{K} \frac{dh^1}{dc^2} - \frac{dc^1}{dc^2} > \frac{H}{K} \frac{dh^2}{dc^2} - 1.$$

Consider now the project \hat{P}^1 carried through at such a scale that its total cost equals that of P^2 , that is the project \hat{P}^1 with $d\hat{c}^1 = dc^2$, $d\hat{h}^1 = dh^1(dc^2/dc^1)$. For this project we get

$$\frac{H}{K} \frac{d\hat{h}^1}{d\hat{c}^1} - 1 > \frac{H}{K} \frac{dh^2}{dc^2} - 1 \quad \text{or} \quad \frac{d\hat{c}^1}{d\hat{h}^1} < \frac{dc^2}{dh^2},$$

which proves the proposition. □

If CEA is to mean an analysis of projects where cost-effectiveness ratios play a crucial role, then Proposition 1 furnishes a link between CBA and CEA: Indeed, CEA is the restricted version of CBA which can be performed with the information available; it does not allow for deciding upon the social desirability of any single project, but it can be used for comparison of projects.

The above justification of CEA seems *not* to be what DE have in mind when they speak about a link between CBA and CEA. Rather, they want CEA to be a method for deciding on the social desirability of any single project, so they look for a possible way of aggregating the two sides of the analysis, concerning marketable and non-marketable commodities, respectively, into a single one. This of course presupposes that one of the coefficients H or K in (6) can be expressed as a given multiple of the other one – or to make things even worse, that all the coefficients H_k in (5) can be expressed in terms of K . This is indeed a recurrent topic of the literature (treated e.g. in Garber and Phelps, 1997).

4. The basic aggregation problem – is it solved by the DMA?

The search for a “cut-off-ratio”, i.e. a benchmark CE-ratio with the property that projects having CE-ratios greater than the benchmark are undesirable whereas projects with smaller CE-ratios are desirable, has been connected in the literature with an alternative theoretical foundation for CEA, the so-called *Decision Maker’s Approach* (DMA). According to the advocates of this approach (e.g. Culyer 1991; Williams, 1993; Hurley, 1998; Brouwer and Koopmanschap, 2000), the point of departure should be a decision maker who is maximizing “health” subject to a given budget. Clearly, there is no social welfare function and no considerations of the changes in consumption and utility of the individuals in society; instead, there is a decision maker, endowed with a criterion for judging about the amount of health achieved when individuals have attained health status $(h_1, \dots, h_m) = ((h_{11}, \dots, h_{1r}), \dots, (h_{m1}, \dots, h_{mr}))$, which may be represented as a utility function

$$U(h_1, \dots, h_m)$$

of the decision maker. The decision maker has a given budget, denoted B ; a project is specified by the changes in the health characteristics of the individuals to which it gives rise, $dh = (dh_1, \dots, dh_m)$ and its costs as far as they are relevant to the decision maker. While the project can be documented as having the effects $dx = (dx_1, \dots, dx_l)$ on society’s consumption, some of these may be outside the scope of the decision maker. At the outset, we shall however consider the case where the decision maker takes all effects into consideration. In this case, the project gives rise to a change in cost which is $dc = -\sum_{h=1}^l p_h dx_h$, so that the project as a whole is fully specified by (dc, dh) . However, the second term dh is a vector with r times m components; there is still an aggregation problem to overcome.

In the DMA, the crucial step is the assumption that in the initial situation, the problem of choosing from available projects (not including the one under consideration) has already been solved in a rational way, that is the utility function U has been maximized on the set of all available projects. Let $H \subset \mathbb{R}^{l+rm}$ be the set of all vectors

$$(x, (h_{11}, \dots, h_{1r}), \dots, (h_{m1}, \dots, h_{mr}))$$

available in the medical technology as used currently, describing the amount of the different commodities which is given up and the level of health of each type and for each individual

achieved; we assume for ease of exposition that H can be described by a differentiable function $F : \mathbb{R}^{l+rm} \rightarrow \mathbb{R}$ in the sense that $F(x, h) \leq 0$ if and only if $(x, h) \in H$. Then we may formulate the decision maker's problem as

$$\begin{aligned} & \text{maximize } U(h_1, \dots, h_m) \\ & \text{subject to the constraints} \\ & F(x_1, \dots, x_l, (h_{11}, \dots, h_{1r}), \dots, (h_{m1}, \dots, h_{mr})) = 0 \\ & B = - \sum_{h=1}^l p_h x_h. \end{aligned}$$

We pause for a moment to notice that this formulation of the decision maker's problem rests on the implicit assumption that commodities can be bought at market prices. To compare with what was done in the foregoing section we state it explicitly:

Assumption 1*. *The decision maker has access to the market for buying and selling (ordinary) commodities.*

In order to obtain useful marginal conditions we shall use the necessary conditions for an optimum for the decision maker. For this to make sense, we must of course assume that the maximization problem stated above has already been solved:

Assumption 2*. *In the initial situation, the decision maker has maximized her utility function under the constraints given by technology and budget (i.e. she has solved the decision maker's problem).*

Under this assumption we have the following first order conditions for constrained maximum:

$$\begin{aligned} \mu \frac{\partial F}{\partial x_h} &= -\nu p_h, \quad h = 1, \dots, l, \\ \frac{\partial U}{\partial h_{ik}} &= \mu \frac{\partial F}{\partial h_{ik}}, \quad i = 1, \dots, m, \quad k = 1, \dots, r, \end{aligned} \tag{7}$$

together with the constraint $F(x, h) = 0$ where μ and ν are the Lagrangean multipliers of the constrained maximization problem. To evaluate a new project specified (as before) by changes in aggregate consumption dc and in the health characteristics of each individual (dh_1, \dots, dh_m) , the decision maker will check whether the change in utility

$$dU = \sum_{i=1}^m \sum_{k=1}^r \frac{\partial U}{\partial h_{ik}} dh_{ik}$$

arising from the creation of health due to the project is greater than the loss in utility resulting from reducing other existing activities so that the budget can contain the cost of the project, and this utility loss is $-\nu \sum_{h=1}^l p_h dx_h$ (using the interpretation of the Lagrangian multiplier as the marginal utility of changing the relevant constraint); inserting from (7), we may write the condition for improvement of the decision maker's utility as

$$\sum_{i=1}^m \sum_{k=1}^r \mu \frac{\partial F}{\partial h_{ik}} dh_{ik} > -\nu \sum_{h=1}^l p_h dx_h. \tag{8}$$

This expression may alternatively be written as

$$\frac{-\sum_{h=1}^l p_h dx_h}{\sum_{i=1}^m \sum_{k=1}^r \mu \frac{\partial F}{\partial h_{ik}} dh_{ik}} < \frac{1}{\nu}, \quad (9)$$

so that the criterion for whether or not a given project is desirable takes the form of a cost-effectiveness ratio; the right-hand side of the expression (the marginal utility of the budget) is the benchmark cost-effectiveness ratio, expressing the best possible arrangement with the known technology and budget.

Thus, on the face of it, DMA does provide us with a simple theoretical background for marginal analysis using cost-effectiveness ratios: For any new project, it should be checked whether its (incremental) cost-effectiveness ratio is greater or smaller than the cost-effectiveness ratio inherent in maximum. However, there is still a problem left over: the denominator in (9) contains quantities which are observable only to the decision maker; more specifically, the coefficients $\mu \partial F / \partial h_{ik}$ expressing the weights in the decision maker's utility function of different health effects on different individuals, cannot be observed by outsiders. In order for a CEA (performed by the staff of the decision makers or by independent researchers, that is by outsiders) to be of any relevance, the decision maker's weights must be available to others. Some simplification is obtained under the following assumption.

Assumption 3*. *The decision maker considers the health (of a given type) of each individual as equally important, that is*

$$\frac{\partial U}{\partial h_{ik}} = H_k, \text{ all } i$$

for each health characteristic k .

Under Assumption 3*, the expression in (9) simplifies to

$$\frac{-\sum_{h=1}^l p_h dx_h}{\sum_{k=1}^r H_k \sum_{i=1}^m dh_{ik}} < \frac{1}{\nu},$$

which is more tractable than (9) but still not quite good enough, in the sense that the quantities H_k remain unobservable (for everyone except the decision maker), much like the case considered in the previous section.

Proposition 1*. *Assume that A1*-A3* are fulfilled and that there is only one health characteristic. Let P^1 and P^2 be projects, and let $dh^j = \sum_{i=1}^m dh_i^j$, $dc^j = -\sum_{h=1}^l p_h dx_h$, $j = 1, 2$. Then the project P^1 carried out at some scale is preferred by the decision maker to P^2 if and only if*

$$\frac{dc^1}{dh^1} < \frac{dc^2}{dh^2};$$

moreover there exists a benchmark cost-effectiveness ratio σ such that a project $P = (dh, dc)$ is desirable for the decision maker if and only if

$$\frac{dc}{dh} \leq \sigma.$$

PROOF: Under our assumptions, the second statement follows directly from (9). The first statement is proved in the same way as Proposition 1. \square

Several authors consider the decision maker's approach a sufficient foundation for CEA (see e.g. Brouwer and Koopmanschap, 2000), and we shall not argue this point. Instead, we want to emphasize that it can hardly be considered as furnishing any 'link' whatsoever between CBA and CEA. The assumptions tell their own story in this respect: The decision maker is *not* society, and her perception of individuals' health can hardly be considered as a theoretically correct way of aggregating individual welfare. But even if this coincidentally should be the case, the very rationality of the decision maker works against the approach; decisions, however rational, taken under an assumption of a fixed budget, will invariably miss an essential point of social rationality, connected with the determination of the size of this budget. There are many examples of cases where rational behavior under less than full information about society's needs lead to gross inefficiencies. Whatever can be said in favor of the local health budget manager, she does not represent society, and a method which helps her in being a success in her job is not automatically good for the rest of society.

5. Conclusion: The problem lies elsewhere

In the foregoing sections we have argued that cost-effectiveness analysis – as long as it makes sense – may indeed be based on cost-benefit analysis. It seems that so much attention has been put on the process of forming a cost-effectiveness ratio as a main part of the analysis that the role played by *aggregation* – across individuals and across health characteristics, has been downplayed or ignored.

In this comment we have made an attempt to turn this around (or to set it right, depending on viewpoint): We have argued that CBA *and* CEA are both exercises in aggregation, using whatever aggregating weights that may be obtained from observation, and in their absence, from reasonable assumptions. It matters little whether one takes the welfaristic or the decision maker's approach – the need for aggregation and the process by which such aggregation is obtained is more or less the same in the two cases.

The real problem facing cost-effectiveness analysis is not, therefore, whether or not it is founded on or linked to or derived from cost-benefit, but whether the aggregations performed are acceptable. CEA branched off from standard CBA once it was realized that health variables cannot readily be aggregated together with commodity variables into one number (in money terms). In view of this, it should cause particular worry that existing methods of CEA accepted the equally problematic aggregation of different aspects of health into one variable rather than inventing methods for treating them as different variables, as one does with health and money in traditional CEA. The profession needs such methods and are waiting for them. They will not furnish any missing 'link' but they will improve the quality of cost-effectiveness analysis.

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