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## **Antisocial welfare functions:**

### **A reply to Hansen et al.\***

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#### **Abstract**

We could reasonably expect society to give at least the same weight to the marginal utility of the poor as to the rich, and to the marginal utility of the ill as compared to the healthy. Whilst Hansen et al (\*) may be said to link CEA and CBA within a welfarist framework, the assumptions they require are inconsistent with these types of ethical preferences. Thus, the degree to which they employ a reasonable social welfare function is doubtful.

This paper argues that any link between CEA and CBA will occur not within a welfarist framework but instead within a non-welfarist one in which it is unlikely that CBA results could be easily transformed into cost-effectiveness ratios.

*JEL Classification:* I10

*Keywords:* economic evaluation, cost-benefit analysis, cost-effectiveness analysis, willingness-to-pay, quality-adjusted life-years, non-welfarism

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## 1. Introduction

For CEA to have a welfarist interpretation, health must appear in the utility function. Dolan and Edlin (2002, “DE”) CEA is not currently justifiable on strictly welfarist grounds as the conditions necessary to “link” cost effectiveness analysis (“CEA”) and cost-benefit analysis (“CBA”) are implausibly strong. As we used favourable conditions for such a link, we assumed that a single health measure allowing the formation of quality-adjusted life-years (QALYs) is unproblematic.

In contrast, Hansen et al (\*) do not assume a single measure exists (in a welfarist sense) but instead let health appear in the utility function as a vector of  $r$  health variables,  $\mathbf{h}_i = (h_{i1}, \dots, h_{ir})$ . Using general equilibrium theory, they establish conditions under which CEA can be said to “exist” as part of a general equilibrium model. In this reply, I question several aspects of their methods and suggest that they do not significantly improve the prospects of a link between CEA and CBA. However, I first present an erratum of Theorem 1 within DE, which contained an algebraic error.<sup>1</sup> Section 3 then comments directly on Hansen et al, before I conclude with a short discussion on the prospects for linking CEA and CBA in Section 4.

## 2. An erratum

Within Theorem 1 of DE, Conditions (1)-(3) underlie the QALY model (within a welfarist view) by representing well being as the sum of identical per-period utility functions in health ( $h_t$ ), consumption ( $c_t$ ) and other non-health factors ( $N_t$ ),  $U(c_t, N_t, h_t)$ . Condition (4) requires weak concavity in consumption ( $\partial U / \partial c_t > 0$ ,  $\partial^2 U / \partial c_t^2 \leq 0$ ), whilst Condition (5) requires better health to improve the ability to enjoy consumption ( $\partial^2 U / \partial c_t \partial h_t > 0$ ). The theorem is established by proving a contradiction between Conditions (1)-(4) and (5).

Conditions (1)-(4) allow a per-period utility function  $U(c, N, h)$  to be defined that is one-to-one in consumption (holding  $h$  and  $N$  constant). Let  $C(u, N, h)$  be a function returning the consumption required to achieve a specific level of utility where non-consumption variables are given. Within a specific period, consider a treatment that increases health from  $h$  to  $h'$ , and

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<sup>1</sup> The text of the theorem is unchanged however, barring the addition of “consumption” in (5) for clarity.

may change non-health factors from  $N$  to  $N'$ . Where initial consumption is  $c$ , the willingness to pay ( $g$ ) to implement such a change satisfies:

$$g(c, N, h, N', h') = c - C(U(c, N, h), N', h')$$

So that:

$$\frac{\partial g(c, N, h, N', h')}{\partial c} = 1 - \frac{\partial C(U(c, N, h), N', h')}{\partial u} \frac{\partial U(c, N, h)}{\partial c} \quad (\text{i})$$

and 
$$\frac{\partial g(c, N, h, N', h')}{\partial h} = - \frac{\partial C(U(c, N, h), N', h')}{\partial u} \frac{\partial U(c, N, h)}{\partial h}. \quad (\text{ii})$$

This  $g$  function must satisfy  $g(c, N, h, N', h') = \lambda(h' - h)$  for some common  $\lambda \in \Re$  if each individual's willingness to pay (WTP) is to be consistent with a single implementation of CEA.

Hence, also:

$$\frac{\partial g(c, N, h, N', h')}{\partial c} = 0 \quad (\text{iii})$$

and 
$$\frac{\partial g(c, N, h, N', h')}{\partial h} = -\lambda \quad (\text{iv})$$

By (i)-(iv):

$$\begin{aligned} \frac{\partial C(U(c, N, h), N', h')}{\partial u} &= 1 / \frac{\partial U(c, N, h)}{\partial c} \\ -\lambda &= - \frac{\partial C(U(c, N, h), N', h')}{\partial u} \frac{\partial U(c, N, h)}{\partial h} \\ -\lambda &= - \frac{\partial U(c, N, h)}{\partial h} / \frac{\partial U(c, N, h)}{\partial c} \end{aligned}$$

The marginal rate of substitution between health and consumption is thus constant at all levels of both variables. Consumption and health are perfect substitutes and  $U$  has the functional form:

$$U(c, N, h) = (c + \lambda h)Y(N) + Z(N)$$

Since  $\frac{\partial^2 U(c, N, h)}{\partial h \partial c} = 0$ , the impossibility is established as Condition (5) assumes otherwise.

As this function is entirely similar to that in Case I of the earlier version for  $\partial U / \partial c > 0$ , the earlier proof applies for Theorem 2. I return to discussing Hansen et al.

### **3. Addressing Hansen et al**

This reply to Hansen et al is structured in four parts, relating to their interpretation of health (Section 3.1), the relationship between CEA and the decision maker approach (Section 3.2), the meaning of a “link” (Section 3.3), and the relevance of their results (Section 3.4).

#### *3.1 The existence and limits of health related quality of life measures*

CEA uses an outcome measure defined in terms of either natural units (such as lives saved) or as a function of aggregate health related quality of life (HRQoL), such as QALYs. This latter form of CEA can be defined in either welfarist or non-welfarist terms. Hansen et al consider the “existence” of CEA from a welfarist viewpoint only. Even if health domains cannot be combined together in a theoretically tidy fashion under welfare economics, an approximate pragmatic measure may still be acceptable within a non-welfarist view where this provides our best estimate of health. Here, rather than consistency with individual utilities, the aim is to ask what aspects of health we require to live full and fruitful lives, and how these domains interact with one another.

Note also that health measures used in CEA consider a limited number of variables, so that a class of non-health, non-consumption variables exist. This class includes both unmeasured variables within the health domain of a wider quality of life measure, and factors falling within other domains of quality of life. These variables remain a potential confounder of a welfare economic version of CEA and should not be dismissed as trivial.

#### *3.2 What is CEA?*

Hansen et al define CEA as any analysis “where cost-effectiveness ratios play a crucial role”, rather than the more standard definition including a budget constraint. Within Hansen et al, CEA is thus limited to ordering projects rather than determining whether or not they should be undertaken given a limited budget. As a threshold is the acknowledgement of scarcity within standard CEA, it is unclear what purpose a no-threshold CEA could have in promoting improved resource allocation and indeed what role it has within health economics.

Hansen et al argue that the decision-maker approach (which does include a budget constraint) does not provide a link between CEA and CBA. However, this is unsurprising given that this approach is typically viewed as a *non-welfarist* basis (Brouwer and Koopmanschap, 2000). Further, the insight that a decision maker will not necessarily share society's values is hardly new, and may be part of the reason why some health economists choose to investigate both the ethical questions faced by decision makers (e.g. Williams (1997), Nord et al (1999)) and the concerns of individuals about who should be treated (e.g. Cookson and Dolan (1999)).

### 3.3 *What constitutes a link?*

In DE, a link between CEA and CBA was intended to represent conditions under which CEA (with an appropriate budget constraint) and CBA would produce the same conclusions. The CEA threshold defines a single trade-off between health and the cost of treatment across society. For this to be consistent with individual judgements (and hence provide a welfarist basis for CEA), we showed that utility functions must be linear to accommodate a single trade-off between health (as a source of utility) and wealth (as a source of funding) – the “common” WTP-per-QALY across individuals. As such, the link in DE requires that:

$$c - C(U(c, N, h), N', h') = \lambda(h' - h)$$

For a common value of  $\lambda$  across individuals and over time. Even were a weaker sense of “common” intended, the curves produced appear as straight lines through the origin when using axes  $c - C$  and  $h' - h$ . Figure 1 in Hansen et al (\*) is thus incorrect, as it displays situations in which individuals have positive WTP for no apparent health gain.

In contrast to DE, Hansen et al define CBA and CEA using a general equilibrium framework where health changes are valued by a perfectly operating market in health care. As this allows direct comparisons between the costs and benefits of health interventions this would, if valid, furnish a link between the analyses. (Let us lay the problems of market failure in health care to one side.) This validity should not be judged according to whether a special case can be found for the existence of a link but the relevance of the assumptions used to obtain this special case.

### 3.4 *Testing the strength of Hansen et al's framework*

Hansen et al state that their assumptions are those required by welfare economic theory when considering marginal health improvements, and acknowledge that these may be unpalatable.

Their Assumption 2 governs the relationship between societal priorities (the marginal social welfare of each individual's utility,  $\partial S/\partial u_i$ ) and consumption goods,  $x_i$ . This requires that society arrive at a distribution of consumption corresponding to society's view of the marginal importance of each of our utilities. These priorities satisfy  $\partial S/\partial u_i \lambda_i = K$  for each person's marginal utility of income  $\lambda_i$  and for some common  $K$  across individuals. Unfortunately, this implies that social policy gives our utility less weight as our marginal utility of income increases (as we grow poorer). Within this world, social policy aims to *increase* inequalities.

Assumption 3 – that health is distributed optimally – is far more worrying. Whilst it may be possible to assume that health is currently “approximately optimal”, it is worth asking what optimality requires. For any two individuals  $i, j$  and any health characteristic  $k$ :

$$\text{Since } \frac{\partial S}{\partial u_i} \lambda_i = \frac{\partial S}{\partial u_j} \lambda_j = K \quad \text{and} \quad \frac{\partial S}{\partial u_i} \frac{\partial u_i}{\partial h_{ik}} = \frac{\partial S}{\partial u_j} \frac{\partial u_j}{\partial h_{jk}} = H_k > 0,$$

$$\left( \frac{\partial u_i}{\partial h_{ik}} \right) / \lambda_i = \left( \frac{\partial u_j}{\partial h_{jk}} \right) / \lambda_j$$

It seems reasonable to assume that for each health characteristic,  $\partial u_i/\partial h_{ik} > 0$  and

$\partial^2 u_i/\partial h_{ik}^2 \leq 0$  for all  $i$ . Here, “optimality” requires that those in poorer health (who are likely to have high  $\partial u_i/\partial h_{ik}$  values) *should* also be those with less money, so as to also guarantee equally high  $\lambda_i$  values. Those who are poor in one health characteristic should also be poor in all others. Further, because the aim of any distributive policy over consumption is to increase inequalities, we must also expect it to also *promote* inequalities in achieved health.<sup>2</sup>

There is certainly issue as to how we should react to these policy aims. A link between CEA and CBA based on Hansen's general equilibrium framework seems untenable, as this requires individuals to desire highly unequal outcomes across society in order to promote the necessary type of (anti-social) social welfare function. Hansen et al claim that abandoning these assumptions would largely put an end to the current development of health measurements. However, this is only true if we accept that these health indices must be based solely within

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<sup>2</sup> Other, more minor, problems exist if we are to maintain these assumptions. Those falling ill should have their consumption cut in line with their decreased importance to society. Further, if some groups have shortfalls in one health characteristic out of proportion with the  $H_k$  values, they may need to have their health reduced in other areas in order to remove distortions to the market. Here, you can never have “just a headache”.

positive welfare economics. Nothing in Hansen et al's findings prevent these assumptions being discarded and developments continuing elsewhere.

Hansen et al's suggestion that practitioners of CEA are largely untroubled by these unappealing assumptions regarding interpersonal comparisons of utility is broadly true. However, this is due less to an implicit acceptance of distasteful assumptions than a rejection of the pure welfarist viewpoint that necessitates looking at the benefits in strict welfare terms.

#### 4. Non-welfarist CBA

If a social welfare function (SWF) is to provide a link between CEA and CBA, then the simplest form of SWF will be linearly indistinguishable from the maximand of CEA analysis to allow for identical recommendations. A standard (welfarist) SWF takes only individual utilities as its arguments. Health-maximising CEA, when viewed as part of a broader reflection of society's preferences, may be consistent with a non-welfarist SWF that may take other arguments. A non-welfarist SWF can even include arguments that do not directly affect an individual's utility but are still deemed important when they consider aims for a health provider (for example, procedural preferences over the decision making process). Such a function underlying health-maximising CEA could be given by  $\hat{S}$ :

$$\hat{S}(c_1 \dots c_n, N_1 \dots N_n, h_1 \dots h_n; \mathbf{X}) = F(c_1 \dots c_n, N_1 \dots N_n; \mathbf{X}) + \sum_i h_i$$

Where the  $h_i$  values represent individual health values, and  $F(\bullet)$  represents society's objectives over non-health variables (individual consumption ( $c_i$ ), other non-health utility variables ( $N_i$ ) and non-utility arguments ( $\mathbf{X}$ )).

In order for a welfarist SWF to be linearly indistinguishable from the non-welfarist SWF above, we require it to separate health from other aspects of an individual's utility, and identify how that contributes towards (non-welfarist) social welfare in non-health areas. A welfarist SWF must therefore be able to distinguish between different sources of utility, and it is unable to do this without having a great deal more information than that provided by a vector of individual utilities. For example, a welfarist SWF cannot distinguish between being rich and in poor health and a poor and in good health where these states provide the same utility. It therefore appears unrealistic to expect a welfarist SWF to furnish any basis for CEA.

In contrast, a non-welfarist SWF allows a basis for CEA and may also allow a form of non-welfarist CBA to exist. However, given that the welfare economic basis to CBA is one of its major strengths, any such link would seem to require a major sacrifice from CBA advocates. A tenable non-welfarist link between CEA and CBA would also appear to be more complex than the equivalent welfarist link, where the results of CEA could be transformed by multiplying the effectiveness measure by the appropriate shadow price. Moving from CBA to CEA requires that we potentially know the levels of all non-health variables (and the identities of each individual in the case that utility functions differ), as well as society's objectives over all non-health variables. The only way that this movement could be simplified is under special and unrealistic cases of a shared utility function – such as those identified in the DE theorem – where the relationship of each individual's health to their consumption and the level of other factors is particularly simplistic. The process of moving from CBA to CEA is likely to be sufficiently complex to make any link of little practical value.

## **5. Concluding remarks**

A welfarist link between CEA and CBA providing comparability between findings in health care and other fields would allow governments to provide an “optimal” mix of health, education, road safety, crime prevention and so on. However, this would be potentially costly for health economics, as it would require that we abandon those philosophies suggesting that utility is not the only factor that should be considered for inclusion in a SWF.

Hansen et al claim that a general equilibrium framework presents a potential basis for CEA consistent with a welfarist SWF. This “link” requires unpalatable (and probably implausible) assumptions about the priorities that individuals, as members of society, will give to those who are poor and ill against those who are both wealthy and healthy. The alternative non-welfarist SWF may be more consistent with the aims that individuals hold in regard to social policy, but it seems doubtful that any such link would offer much to CBA. In particular, it requires an acknowledgement that CBA is somehow contaminated with information that is normatively irrelevant when viewed from the normative stance of the (joint) non-welfarist basis. Rather than attempting to amalgamate two radically different approaches, it once again seems prudent to suggest that we turn our attention to considering the relative merits of welfarist and non-welfarist philosophies in the context of health care resource allocation decisions.

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