Deriving welfare measures in discrete choice experiments: a comment to Lancsar and Savage (I)

Mandy Ryan*
Health Economics Research Unit, University of Aberdeen, Polwarth Building, Foresterhill, UK

Summary

Lancsar and Savage argue that current methods of deriving welfare estimates, using discrete choice experiments, are inconsistent with random utility and welfare theory. In this paper I show that this not the case. The general formula proposed by Small and Rosen for estimating welfare, which Lancsar and Savage claim should be used, reduces to the method used by health economists for state of the world models. The important question then becomes when are state of the world models, as opposed to multiple alternative models, appropriate? Copyright © 2004 John Wiley & Sons, Ltd.

Keywords discrete choice experiments; welfare estimation; state-of-the-world models; multiple alternative models

Introduction

Discrete Choice experiments (DCEs) are being increasingly used in health economics to estimate willingness to pay (WTP) for changes in the attributes of health care interventions and services. I read with interest the paper by Lancsar and Savage (Lancsar E, Savage E. Deriving welfare estimates from discrete choice experiments: inconsistency between current methods and random utility and welfare theory. Health Econ Lett, this issue) concerned with estimating welfare measures within the framework of a DCE. Whilst this paper makes an important contribution to the literature, it is important to note that the paper is misleading. Current methods of estimating monetary valuations within health economics are not inconsistent with random utility and welfare theory. Two points are worth noting here. Firstly, current methods of estimating welfare are appropriate at the individual level. Secondly, when moving to the aggregate level, the general formula proposed by Small and Rosen [1,2] reduces to the method used by health economists [3] for ‘state-of-the-world’ models.a The question then arises as to when such ‘state-of-the-world’ models are appropriate. These points are illustrated and discussed using the example from Lancsar and Savage (this issue).b

Distinguishing ‘state-of-the-world’ model from ‘multiple alternative’ models: an empirical exposition

A crucial distinction that Lancsar and Savage fail to make is between ‘state-of-the-world models’ and ‘multiple alternative models’. State-of-the-world models assume that there is only one alternative on offer at any one time and individuals therefore take up the service/drug with certainty. Crucially, the Small and Rosen formula reduces to the

*aCorrespondence to: Health Economics Research Unit, University of Aberdeen, Polwarth Building, Foresterhill, Aberdeen AB25 2ZD, UK. E-mail: m.ryan@abdn.ac.uk

Copyright © 2004 John Wiley & Sons, Ltd.

Received 3 October 2003
Accepted 4 November 2003
approach adopted by Health Economists for ‘state of the world’ models. However, if there are multiple options, estimation of aggregate welfare must involve the expected value arising from each option.\(^c\) Intuitively the expected value takes account of the change in utility, weighted by the probability of choosing that option.

The importance of the distinction between state of the world models and multiple alternative models is demonstrated in Tables 1 and 2 above, drawing on the Indirect Utility Function estimated by Lancsar and Savage (this issue). In Table 1 we assume a state of the world model. That is, there is only one drug on offer at any point in time and individuals consume it with certainty. Let us assume that in the initial state of the world the drug has the worst level of all attributes and in the state of the world following the policy change the drug has the best levels of each attribute.\(^d\) The utility for these states of the world is given by Lancsar and

<table>
<thead>
<tr>
<th>Table 1. Welfare estimation in a ‘state-of-the-world’ model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Drug at worst levels only ((V^0))</td>
</tr>
<tr>
<td>1/(\lambda) = (-1/\beta p)*</td>
</tr>
<tr>
<td>Individual WTP for change</td>
</tr>
<tr>
<td>(P_i = \exp(V_i)/\sum \exp(V_j))</td>
</tr>
<tr>
<td>Welfare change from policy change</td>
</tr>
</tbody>
</table>

\(*\lambda\) is the marginal utility of income. Since this usually cannot be estimated, it is replaced by the negative of the price coefficient \((\text{Santos Silva J. On deriving welfare measures in discrete choice problems. Health Econ, this issue})\).

<table>
<thead>
<tr>
<th>Table 2. Welfare estimation in a ‘multiple alternatives’ model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Current drug</td>
</tr>
<tr>
<td>1/(\lambda) = (-1/\beta p)*</td>
</tr>
<tr>
<td>Individual WTP for change</td>
</tr>
<tr>
<td>(P_i = \exp(V_i)/\sum \exp(V_j))</td>
</tr>
<tr>
<td>Welfare change from policy change</td>
</tr>
</tbody>
</table>

\(*\lambda\) is the marginal utility of income. Since this usually cannot be estimated, it is replaced by the negative of the price coefficient \(\beta p\) (Santos Silva, this issue).
Savage as –6.996 (worst levels) and –0.417 (best levels). These negative utilities imply that both drugs are worse than the patient’s current medication.

The first point worth noting is that at the individual level, for any individual who makes the change from the drug with the worse levels to the drug with the best levels, there is a change in utility equal to a value of $438. That is, there is a utility loss of $466 in the initial state of the world and $28 in the changed state of the world. The utility loss has therefore reduced by $438, from $466 to $28. However, the crucial point here, given we are in a state-of-the-world model, is that individuals have only one option in both states of the world. They therefore have a probability of one of taking up the drug in each state of the world. It can be seen from Table 1 that the Small and Rosen formula reduces to the method adopted by Health Economists for state of the world models. This is a result simply of the fact that, in a state-of-the-world model, the expression \( \ln \frac{e^{V_j}}{\sum e^{V_i}} \) reduces to \( V_j \).

However, when there are two or more options that the individual can choose from, the utility \( V_i \) from any defined option must be multiplied by the probability of choosing that option. Table 2 indicates the case where there are two options in each state of the world – the current and a hypothetical defined alternative. In the Lancsar and Savage article this hypothetical drug was defined as the worst level of all attributes of the drug in state 0 and the best levels in state 1. WTP for this change is estimated in the same way as in a state-of-the-world model.

A number of points are worth noting here. Firstly, for any given individual that moves from the current to the worst drug in the initial state of the world, there will be a reduction in welfare of $466, and post policy change, for any individual who moves from current to best level of drug attributes a welfare loss of $28. This is the same as in Table 1. However, what changes now is the probability of taking any given option. This is no longer equal to one since individuals are no longer forced to change. In each state of the world, individuals have a choice between their current medication and a new drug. In the initial situation the high negative utility for the worst level drug results in very few individuals taking the hypothetical drug, reflected by the low probability of 0.001.

When the worst level for all attributes are now change between the current drug and alternative (though the majority stay with current medication, 0.603 compared to 0.397). This difference in take-up of the hypothetical drug compared to current medication explains the different welfare estimates in Tables 1 and 2. That is, once a second alternative option is introduced into the real choice set the estimate of welfare must allow for the proportion of individuals who consume the different options. The welfare loss is now reduced to $34 since the majority stay with their current medication.

### State of the world models or multiple alternatives in health care?

Thus, the crucial question then becomes when is it appropriate to apply ‘state-of-the-world’ models, i.e. when do subjects have one option that we know with certainty they will consume? Within health care, given that choices are often limited, this may be a more appropriate assumption than in applications of DCEs to transport and environmental policy questions where individuals often have more choice. For example, when valuing a new bus service that reduces travel time, consumers may have choice over a number of bus companies, as well as alternative means of travel. When estimating the impact of changing moose populations on recreational hunting, and allowing for the fact that hunters are faced with a number of wildlife management units, then the welfare impact of a change in moose levels at one site will be determined by the utility at all N sites, multiplied by the probability of that take-up at that site [4]. Similarly, when valuing recreational sites, individuals face many alternatives [5]. However, within health care, choices are often limited.

At most the choice may be between the treatment/care on offer and choosing not to consume (Ryan M, Skåtun D. Modelling non-demanders in discrete choice experiments. *Health Econ Lett*, forthcoming). The importance of allowing for non-demanders in health care has been recognised (Ryan and Skatun, forthcoming), and this will clearly have implications for welfare estimates.

### Conclusions

In summary, contrary to the claims by Lancsar and Savage (this issue), current methods for
estimating WTP are consistent with random utility theory and welfare theory. At the individual level, current methods of estimating WTP are useful for defined policy changes. That is, they show the value of a given policy change, assuming the individual makes that change. The important question then becomes how the probabilities of take-up change following a policy change. For state of the world models, the probability is always one and the Small and Rosen Formula reduces to the method used by health economists to estimate welfare. Aggregate WTP can then be estimated as individual WTP multiplied by the relevant population. However, for multiple alternative models consideration should be given to the probability of take-up across the different options. The paper by Lancsar and Savage should encourage practitioners of DCEs to do this. However, Lancsar and Savage are wrong in stating that current methods of estimation are inconsistent with random utility and welfare theory. Put simply

\[
\frac{1}{\lambda} \left[ \ln \sum_{j=1}^{J} e^{v_j^0} - \ln \sum_{j=1}^{J} e^{v_j^1} \right]
\]

reduces to \( 1/\lambda (V^0 - V^1) \), or \(-1/\beta p(V^0 - V^1)\), for state of the world models.

Notes

a. This was acknowledged by Lancsar and Savage. However, by developing the argument it can be shown that current methods of welfare estimation in health economics are not inconsistent with random utility and welfare theory.


c. A distinction should be made between multiple options offered in an experimental context, and multiple choices offered in the real world. Whilst a DCE may offer individuals a number of options, this does not mean that such choice is translated to the real world. Indeed, this is the advantage of a DCE – preferences can be estimated for a number of options that are not available in the real setting.

d. This is the example that Lancsar and Savage use to demonstrate the traditional approach to welfare estimation in Health Economics. This movement could equally have been demonstrated with moving from the current medication to either worst levels (welfare loss of \(-S466\)) or best levels (welfare loss of \(-528\)).

e. Using this methodology it would be a simple matter to show that if the three drugs were all available – current, worst and best – the probabilities would need to be estimated for all three drugs and this would again change the welfare estimates.

f. Particularly in publicly provided health care systems where DCEs have traditionally been applied.

g. To the authors knowledge current studies in health economics have applied DCE at the individual level, not going on to estimate an aggregate WTP.

h. Though given the sensitivity of probability estimates to both the specification of the IUF (Santos Silva, this issue) and the estimation of the scale parameter (Ryan and Skatun, forthcoming), one should proceed with caution.

References


