Estimating intergenerational utility distribution preferences*

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Abstract

Resource management decisions influence not only the output of the economy but also the distribution of utility between groups within the community. The theory of Benefit Cost Analysis provides a means of incorporating this distributional change through the application of distributional or welfare weights. This paper reports the results of research designed to estimate distributional weights suitable for inclusion in a Benefit Cost Analysis framework. The findings of a choice modelling experiment estimating community preferences with respect to intergenerational utility distribution are presented to illustrate this innovative application of a stated preference technique.

Keywords: ***Distributional weights, Choice Modelling, Intergenerational distribution, Benefit Cost Analysis.***

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1.0 Introduction

One of the limitations of Benefit Cost Analysis (BCA) is the ability to incorporate distributional considerations along with efficiency in a comprehensive policy analysis. Although the theory of applying distributional weights is well established, [See for example: (Johansson 1993), (Mäler 1985)] there are few examples where explicit distributional weights have been applied in a benefit cost setting (Markandya 1998). In part this has been due to a difficulty in estimating community preferences for the distribution of utility. This research illustrates one way of addressing this limitation through the application of the stated choice method of choice modelling (CM) to the question of estimating distributional preferences. Importantly, rather than the conventional CM focus on utility estimation, the model seeks to estimate how social welfare changes as distribution parameters vary.

A case study of intergenerational distribution preferences of the general community has been undertaken to illustrate this innovative application of CM. The paper is structured as follows. The following section provides a background to distributional weights while section 3 provides an introduction to the question of intergenerational distribution. Section 4 describes the intergenerational utility distribution CM experiment and section 5 presents some early results of the survey. The paper finishes with a brief conclusion in section 6.

2.0 Distributional weights

The theoretical distributional weighting term that can be applied in a BCA setting is known as either the marginal social utility of income (Johansson 1993), the welfare weight (Dreze and Stern 1987), or the marginal social utility (Boadway and Bruce 1984). This distributional weight is a product of two components: the change in social welfare if the utility or well-being of individual *i* increases marginally (W_i or $\partial W/\partial V_i$), and the marginal utility of income of individual *i,* (V_i or $\partial V_i/\partial y_i$)[1]. Put

[1] Although the second component of the weight is generally referred to in terms of income, this does not necessarily need to be the case. For example, it could also be the marginal utility of an additional

simply, the weight indicates firstly, how person *j* ranks the utility of individual *i* in their distributional preferences. For example, does it matter more to person *j* that the utility of a low income person is improved relative to a high income person? The second component of the weight reflects how much person *j* assesses the well-being of individual *i* changes as a result of the benefit or cost. For example, does a dollar of benefit increase the utility of a low income person more than it would increase the utility of a high income person?

The distributional weights may be different for each individual in society reflecting their perception of the utility of various groups within society and their personal ethical and distributional preferences. Assumptions regarding the first component of the distributional weight reflect varying theories of social justice. For example, in a Benthamite or utilitarian society $W_i = 1$ for all individuals, so that changes in individual utility are added indicating everybody's utility is treated equally. (This is not the same as an egalitarian society where weights are applied with the aim of an equal outcome.) Alternatively, in a Rawlsian society, $W_i = 0$ for all individuals except the worst-off, reflecting Rawl's view that welfare is maximised by seeking to maximise the least well-off group.[2]

Hence, the distributional weight is dependent on the impact of money, (assuming this is the chosen numéraire) on the well-being of the individual and the utility of the individual on society's total welfare. The greater the distributional weight (α), the greater is the social gain from an increase in *i*'s real income, and redistributing $1 from individual *k* to individual *i* raises social welfare if $\alpha_i > \alpha_k$.

3.0 Intergenerational distribution

In order to illustrate the capacity of the stated preference method of choice modelling to elicit community welfare preferences, a case study of intergenerational utility distribution preferences of the community has been conducted. Most environmental policies affect the distribution of resources, both financial and environmental,

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unit of an environmental good for individual *i.* Medin et.al (2001) illustrate the sensitivity of distributional weights to the choice of numéraire.

[2] For more details see Johansson (1993) or Maler (1985).

between generations. Benefit cost studies analysing changes to environmental policies often include benefits and costs which are incurred by different generations. Hence, designing projects and programs to allow for distributional fairness within a generation may be an ineffective way of serving the goal of fairness (Pearce 1993). Sustainable development implies some general rule about not impairing the capability of future generations to achieve the same level of well-being as the current generation. For example, the Brundtland Commission (1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" and Pearce and Barbier (2000) stress the "fair treatment of future generations". These definitions highlight an anthropocentric focus placing emphasis on achieving a quality of life that can be maintained for future generations.

A Rawlsian approach to intergenerational distribution is also useful in deriving general principles of justice, and to decide on the potential resource use patterns to be followed in order to achieve intergenerational equity (Tacconi 2000). However as Tacconi points out it cannot provide definitive answers to questions of intergenerational resource distribution. It is impossible to know the exact conditions that will allow the certain existence of future generations. Consequently, intergenerational utility distribution also depends on the extent of altruism of current generations towards future generations. However, our knowledge and understanding of intergenerational distribution preferences is limited (Tacconi 2000). The environmental justice movement both in principle and in terms of practical political action emphasises the distributional implications of environmental change (Agyeman, Bullard et al. 2003) highlighting the strong link between sustainability and social justice.

Yet notions of social justice, both generally and with respect to sustainability and intergenerational equity, vary between individuals reflecting personal judgements regarding fairness. Broome (1995) suggests we look for a class of reasons, referred to as claims, why one person should be given priority over another. He argues that fairness is about mediating the claims of different people and requires that claims should be satisfied in proportion to their strength. The important aspect of this view of equity is the need to mediate claims as one of the paramount considerations for

fairness as an aspect of justice is not just how an individual fares in relation to his/her own claims but how he/she fares in relation to the rest of the claimants (Rescher 2002). In the context of sustainability, the claimants reflect varying generations and the question becomes one of weighing the gains and losses to different generations.

The literature on distributive justice also suggests that fairness is likely to vary depending on the contextual setting (Bojer 2003). Hence for the purposes of this research the context has been limited to environmental policy. Another key feature of the literature on fairness is that it is dependent on the actor and beliefs about what is fair are personal (Elster 1992). Elster suggests four groups of actors that can be useful for analysing distributive justice; individuals in the institution that is charged with the allocative task, political actors, claimants and public opinion. While policy makers generally have the opportunity to express their justice principles, the public has limited forms of social choice in which to express their preferences. This is one of the strengths of using a stated preference technique to estimate community utility distribution preferences.

4. Intergenerational utility distribution choice modelling survey

This paper reports the findings of research aimed at eliciting the intergenerational distribution preferences of the general community. A CM experiment has been undertaken where rather than estimating utility, as in conventional applications, social welfare is the dependent variable and the utility levels of different groups, in this case generations, are the attributes that are varied. This broader application of CM addresses the question of the distributional effects of policies and the consequent social welfare outcomes of policy alternatives. Rather than applying the model to the estimation of individual well being and value in a dollar measure, the emphasis is on the estimation of the distributional preferences of respondents. It is the respondent's conception of social welfare rather than utility which is being maximised. The choice between the current distribution associated with the status quo and a change in policy resulting in distributional change was presented to respondents. The attributes of the policy options that were varied were the levels of utility or well-being of particular groups within society and the measure of interest is the willingness of respondents to

trade-off a change in the utility of one group for a change in the utility of another group.

Arrow (1963) suggests that people have two distinct personalities: their self-interested selves essentially disjoint from their ethical selves. Self-interested preferences guide day-to-day participation in the market economy while their ethical ones apply to participation in collective decision making. Nyborg (2000) formalises this distinction between "Homo economicus", the individual maximising personal well-being, and "Homo politicus", the individual expressing their social justice preferences. Focus on the behaviour of "homo politicus" allows for a sense of social justice which Musgrave and Musgrave (1989) argue is essential for the definition of a good society and the functioning of a democratic society. Broome (1995) describes this as a notion of communal good that is separate from the good of individuals.

Hence, a key assumption in developing a CM experiment aimed at eliciting distributional preferences is that respondents are able to express their social justice preferences[3]. Consequently, a degree of "interpersonally comparable cardinal utility" has been assumed meaning that respondents are able to make judgements about the well-being of other groups and individuals in society. It is also assumed that respondents have some knowledge of the well-being of groups within society under the status quo policy. Therefore, decision-making is seen in a broader context of social structure rather than individuals engaged in maximising their self-interest in the market. Hence, each individual has a personal view of social justice based on their notion of what they consider to be a fair distribution.

4.1 Survey design

Hypothetical policies with generic labels (A, B, C etc) were used as the sources of distributional change for the CM choice sets in an attempt to ensure that values other than distribution preferences are not reflected in the respondent's choices. This also

[3] The ability of respondents to view policy in this manner is supported by a study of the equity considerations of the burden of meeting the costs of environmental policy by Atkinson et.al.(2000) where they did not find strong support for the proposition that respondent significantly allowed their own position to influence their ranking of different options.

encouraged the respondent to remove their own well-being from the decision making process and centre on their social justice preferences. This does not mean that respondents do not bring preconceived beliefs to the decision making process, rather that these beliefs are part of ethical preferences regarding social welfare.

The attributes in this experiment are described in terms of the impact on individuals from different generations resulting from the three hypothetical policy options. Individuals with specific characteristics are used as proxies for the group described. In order to investigate the distributional preferences of respondents with respect to the gains and losses that accrue to different generations, the specific characteristic of individuals that is varied is the generation. The attributes and levels are described in Table 1.

Table 1

Attributes and levels in intergenerational distribution choice model

Attribute	Levels				
Utility change Person Aged 50	**-$1,000**	**-$500**	**+$500**	**+$1,000**	**+$1,500**
Utility change Person Aged 25	**-$1,000**	**-$500**	**+$500**	**+$1,000**	**+$1,500**
Utility change Newborn	**-$1,000**	**-$500**	**+$500**	**+$1,000**	**+$1,500**

The chosen design has limited the choices to generations currently living to avoid time and discounting complications acknowledging the trade-offs required when considering the cognitive demands placed on respondents. The total time period of the analysis could be increased by increasing the number of attributes, however, this also would increase the cognitive burden for respondents and there is likely to be a trade-off between the number of attributes and valid responses.

The levels of the attributes are described in dollar terms. The dollar terms reflect the change in well-being to the individual with the specific characteristic described by the attribute. Dollars have been adopted as a metric with which respondents can associate. The main advantage with this numéraire is that dollars are a common metric to respondents and it is with dollars that governments and organisations operate in

choosing between alternatives. However, at the same time respondents were reminded that the dollar values represent the general well-being of the individual, and should not be interpreted as financial wealth alone. It is recognised that a disadvantage associated with this choice of numéraire is the difficulty for respondents to think in terms of general well-being or welfare and not just income. The equity preferences may be sensitive to the choice of numéraire and it is possible that if a different factor contributing to welfare was applied, the distributional preferences may be different.

Theoretically, another possible solution to this difficulty would be to describe the attributes in terms of an *"index of well-being"*. This has been used in making a theoretical case in an example by Broome (1995) but not in an empirical exercise. While an index of well-being would encourage respondents to think in terms of welfare being broader than income and therefore more in line with the notion of welfare in the literature (Sen 1982; Sen 2000), the difficulty and subjectivity in developing an index, determining the values for components of the index and descriptors of the index make it impractical. Even if these issues were resolved, the cognitive difficulty for respondents of making complex decisions in an unfamiliar metric would remain a concern. For these reasons money is likely to be the more appropriate numéraire.

The levels of the attributes involve the manipulation of attribute differences, not absolute values of the attributes. The hypothetical dollar values represent a one-off loss or gain to the individual representing the group described by the specific characteristic determining the attribute. In this example, there are five levels for each attribute with each level varying well-being to the value of $500[4].

A *fractional factorial* design taken from Lazari and Henderson (1994) was used to create 25 choice sets, an example of which is presented in Figure 1. The 25 sets were blocked into groups of 5 so that each respondent was presented with five choice sets in a survey. Respondents were provided with a reference key such as that in Figure 2 when asked to complete the choice sets.

[4] Feedback from focus groups suggested this degree of variation was large enough to be significant to respondents in determining a choice, and not unrealistic in representing a once-off gain or loss.

Figure 1

Example of an intergenerational utility distribution choice set

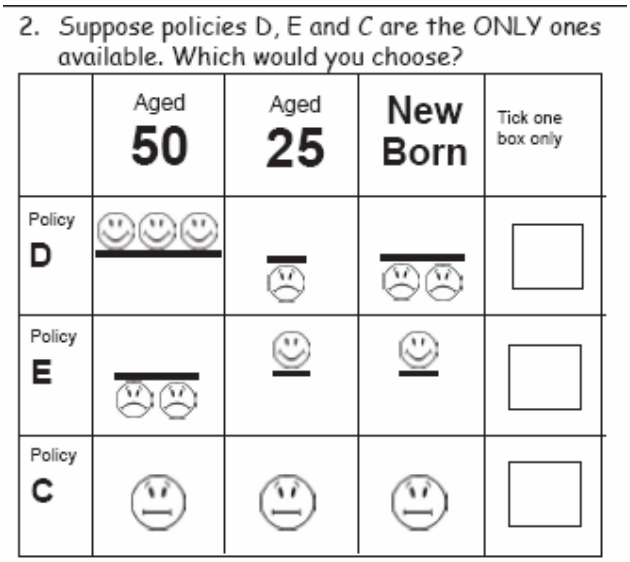
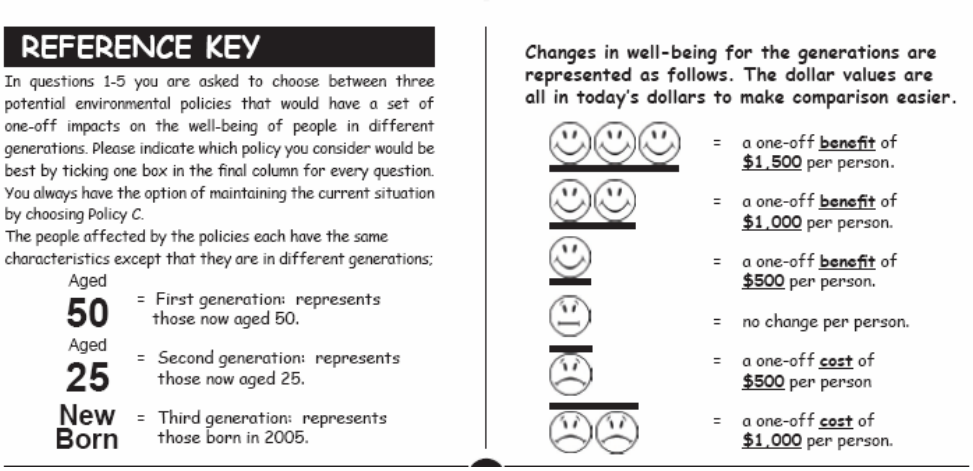


Figure 2

Reference key for choice set in Figure 3



4.2 Model equations

The equations for the model are:

$$W_A^j = \beta_{1A} + \beta_{aged\ 50\ A} v^j_{aged\ 50\ A} + \beta_{aged\ 25\ A} v^j_{aged\ 25\ A} + \beta_{newbornA}\, v^j_{newbornA} + \beta_{5A} S^j_{age} + \beta_{6A} S^j_{gender} + \beta_{7A} S^j_{parent} + \beta_{8A} S^j_{noschild} + \beta_{9A} S^j_{gparent} + \beta_{10A} S^j_{income}$$

$$W_B^j = \beta_{1B} + \beta_{aged\ 50\ B} v^j_{aged\ 50\ B} + \beta_{aged\ 25\ B} v^j_{aged\ 25\ B} + \beta_{newbornA}\, v^j_{newbornB} + \beta_{5B} S^j_{age} + \beta_{6B} S^j_{gender} + \beta_{7B} S^j_{parent} + \beta_{8B} S^j_{noschild} + \beta_{9B} S^j_{gparent} + \beta_{10B} S^j_{income}$$

$$W_C^j = \beta_{1C} + \beta_{aged\ 50\ C} v^j_{aged\ 50\ C} + \beta_{aged\ 25\ C} v^j_{aged\ 25\ C} + \beta_{newbornC}\, v^j_{newbornC} + \beta_{5C} S^j_{age} + \beta_{6C} S^j_{gender} + \beta_{7C} S^j_{parent} + \beta_{8C} S^j_{noschild} + \beta_{9C} S^j_{gparent} + \beta_{10C} S^j_{income}$$

where W_A^j refers to the welfare function of respondent *j* with respect to Policy A, and $v^j_{aged\,50\,A}$ respondent j's opinion of the utility derived by a person aged50 from Policy A etc.. The socio-demographic characteristics (SDC) of the respondents including age, gender, income, parental status, number of children, grandparental status and income are represented by S^j_{SDC}.

The key output of the welfare based choice model is the marginal rate of welfare substitution (MRWS) which is the ratio of the welfare parameters and indicates the distributional weights applicable to a BCA setting[5]. In effect, the MRWS reflects a willingness to accept distributional change, which can be represented graphically by the slope of the SWF. This distribution reflects the respondent's notion of social justice.

The hypotheses drawn from the model are that the distributional weightings for each age group are not equal to one. For example, if there is altruism towards the younger generations then:

[5] For further elaboration of this point see Scarborough and Bennett (2004)

$$\beta_{aged\,25} \Big/ \beta_{aged\,50} \geq 1 \quad \text{and} \quad \beta_{newborn} \Big/ \beta_{aged\,50} \geq 1$$

4.3 Data collection

A random household survey was conducted in July 2005 in Warrnambool, a regional city in South West Victoria. A personal drop off and pick up form of distribution and collection was used and respondents were also provided with the opportunity to participate in the draw for a $150 shopping voucher at any Coles Myer related outlet if they completed the questionnaire. A total of 431 questionnaires were distributed. Of the 337 which were collected or returned by mail, 295 were usable giving a response rate of 68.5%. Each of the 295 usable responses included 5 completed choice sets giving a total of 1475 completed choice sets.

Each respondent also completed socio-demographic questions and two qualitative questions; one regarding specific strategies they had employed in answering the choice set questions and one regarding general comments they wished to make about the survey. Comparison of the socio-demographics with the 2001 ABS census data indicates a slightly higher representation of females and younger people completing the survey than in the general population. Table 2 provides a comparison of the age profile of the sample with that of the 2001 census as this variable is particularly relevant to the analysis.

Table 2: Age profile of Respondents

Age group	Number	% of sample	% of Census 2001*
18-24	34	11.5	13.8
25-34	49	16.6	18.0
35-44	56	19.0	20.1
45-54	70	23.7	17.7
55-64	46	15.6	11.6
Over 65	36	12.2	18.8
No response	4	1.4	
Total	295	100	100

* Taken as % of census population aged 18 and over (includes domestic visitors but excludes overseas visitors): 20,886

5. 0 Results

A basic Multinomial Logit Model (MNL) was run using the Stata software program. Each of the variables used in the model is specified in Table 3.

Table 3: Variables used in the CM application

Aged50	Change in the well-being of person representing those aged 50
Aged25	Change in the well-being of person representing those aged 25
Newborn	Change in the well-being of person representing those newborn
Age	Age of respondent (in years)
Income	Income of respondent in last year in dollar terms
Parent	Parental status of respondent
Gparent	Grandparental status of respondent
Noschild	number of children of respondent
Gender	Gender of respondent

Model results are summarised in Table 4. The model appears robust, with each attribute significant and signed as expected indicating that the utility of each age group contributes positively to the social welfare function.

Table 4: Intergenerational utility distribution MNL model.

Variable	Coefficient	Standard error	P>/z/
asc	-.9568934	.2421870	0.000
aged50	.0002839	.0000518	0.000
aged25	.0004490	.0000496	0.000
newborn	.0006079	.0000597	0.000
age	.0150489	.0062328	0.016
income	5.62e-06	2.54e-06	0.027
parent	-.5151895	.2354562	0.029
noschild	-.0254056	.0639200	0.691
gparent	-.1799172	.198123	0.364
gender	-.1676084	.1345082	0.213
Model Statistics			
Log L	**-1135.19**		
Adj Rho-square	**0.0896**		

Of the social characteristics, the age, income and parental status variables are significant at the five percent level. Interpretation of the signs for the social

characteristics is difficult as changes were both positive and negative in the design of the choice experiment.

Table 5 summarises the 95% confidence intervals for the mean marginal rates of welfare substitution. These results suggest welfare parameters indicating a distributional preference towards the younger generations with the ratio of the welfare parameters being greater than 1 for both the aged 25 and newborns relative to the aged 50.

Table 5: Estimated mean marginal rates of welfare substitution*

	Aged25/Aged50	**Newborn/Aged 50**	**Newborn/Aged25**
Model excluding SDC	1.50 (0.97, 2.37)	2.28 (1.47, 3.74)	1.54 (1.12, 2.10)
Model including SDC	1.70 (1.03, 2.88)	2.35 (1.43, 4.28)	1.39 (1.00, 1.98)

*95% confidence intervals estimated with the Krinsky-Robb (1986) method using 1000 replications

The altruism towards younger generations evident in the quantitative analysis is supported by comments made by respondents to the qualitative questions regarding the strategy they had used in making choices. (One hundred and fourteen of the 295 respondents chose to briefly explain the strategy they had used in answering the choice questions.) Examples of these comments include:

> *"Help younger generation and early workforce people."*
> *"Picked ones that were most likely beneficial to the younger generation."*
> *"Thinking about effect on future generations."*

6.0 Conclusion

The early findings of this research suggest that choice modelling is a useful method for eliciting the distributional preferences of the community. This has important implications for analysing the distributional impacts of environmental policies, particularly in a BCA setting.

With respect to the intergenerational utility distribution preferences of the community, the initial results suggest distributional weights which are not equal to one and positively favour the younger generations. Comprehensive data analysis including cross-product analysis to determine relationships between particular socio-demographic characteristics and attributes, and testing for 11A violations is still to be undertaken.

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