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Decision-Making in a Social Welfare Context

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ABSTRACT

This paper presents analysis of the decision-making strategies adopted by respondents when confronted with potential policy options that include changes in both aggregate levels of welfare and equity in distribution. The analysis is based on the results of a choice experiment designed to estimate intergenerational distributional preferences. Non-linear welfare functions are employed within a conventional conditional logit framework. The heuristics employed by respondents in the stated preference context provide valuable insights into the application of welfare principles by respondents in determining trade-offs between the potential changes in the well-being of different generations.

KEYWORDS: Intergenerational Equity, Distribution, Choice modelling

1.0 Introduction

Although environmental economists have tended to focus on efficiency issues, the importance of equity in shaping environmental policy is increasingly being appreciated (Kristöm 2006). Distributional consequences are inextricably bound in many environmental policies as evidenced, for example, in the range of case studies discussed in Serrett and Johnstone (2006). However, the complexity of the notion of social justice confounds research into the equity principles applied by the community in determining their distributional preferences.

The environmental justice movement, both in principle and in terms of practical political action, emphasises the distributional implications of environmental change (Agyeman *et al.* 2003). Tientenberg (2006, p.503) argues that paying attention to environmental justice is desirable for two reasons:

> *"The ethical dimension concerns whether the distribution of risks, benefits and costs is in accordance with the norms of social justice. The desire for just policies is a conventional complement to the desire for efficient policies. The pragmatic dimension emphasizes the relationship between the distributional burden and both the likelihood that environmental legislation will pass and its ultimate form."*

Assessment of the distributional impacts of environmental policy alternatives can be based on criteria such as the economic status, ethnicity, age, geographical and temporal distribution of those who gain and those who lose. Social justice principles generally either formulate more specific interpretations of utilitarianism or apply alternative or complementary ethical frameworks such as rewards according to contribution, equality of opportunity or equality of outcome (Banuri *et al.* 1996). This research uses a choice modelling (CM) case study of intergenerational distributional preferences to explore the application of justice principles by respondents in determining welfare maximising policy alternatives.

Environmental policies affect the distribution of resources, both financial and environmental, between generations yet empirical understanding of the willingness of members of the current generation to sacrifice some of their own consumption opportunities to increase the consumption opportunities of future generations is very limited (Kopp and Portney 1999). The results of this research increase our understanding of intergenerational distributional preferences; in particular revealing positive preferences by the community toward the utility of future generations.

The paper is structured as follows. Section two provides background on the application of social justice principles in determining intergenerational distributional preferences. This highlights the welfare economic theoretical underpinnings of the analysis of equity preferences. Section three outlines the choice experiment designed to elicit intergenerational distribution preferences. Section four provides the results of the estimation of non-linear social welfare functions within a conditional logit framework. This analysis provides valuable

insight into the social justice principles applied by respondents when confronted with the challenge of expressing welfare maximising preferences. The paper concludes in section five with a brief discussion of the implications of the findings.

2.0 Background

Welfare economic theory is based on the assumption that social justice preferences can be expressed in a social welfare function (*SWF*). Randall (1987) describes a social welfare function as a mathematical relationship precisely expressing the societal preferences as to how economic well-being should be distributed among the individual members of society. Therefore the *SWF*, *W*, is a function of utility U_i, for individuals, $i=1...n$ in society.

$$W = w(U_1, U_2, ...U_n) \tag{1}$$

Each *SWF* represents one person's view of the allocation of utility across individuals in society. Assessment of policy options involves analysis of comparisons of changes in welfare. Myles (1995) asserts that the maximisation of a *SWF* is invariably adopted as the objective of policy in public economics.

Consequently it is the estimation of shape of the SWF that is of relevance. This involves estimating the utility of each individual in each state and aggregating the utilities to the *SWF*. Hence, the functional form of the *SWF* involves ethical judgements regarding the aggregation of individual utilities. The most common form of the *SWF* is the classical utilitarian, where the utilities of individuals, $i...n$, are summed and the aim is to maximise the sum of the utilities, that is:

$$W(U_1...U_n) = \sum_{i=1}^{n} U_i \tag{2}$$

This classical utilitarian or Benthamite welfare function, developed by Bentham (1789) and championed by economists such as Mill (1861), Edgeworth (1881), Marshall (1890) and Pigou (1920) has been, in many ways, the "official" theory of traditional welfare economics (Sen 2000). The classical utilitarian *SWF* assumes a linear relationship where the utility of each individual or group of individuals is treated equally when aggregating social welfare. Although the classical utilitarian *SWF* is the most generally applied *SWF*, other forms of the *SWF* have also been adopted in the welfare literature. They are reflected in assumptions regarding the willingness to trade off the utility or wellbeing of one individual for another and illustrated in the slope of the *SWF* or social marginal rate of substitution (*SMRS*)[1]. For example, a convex function assumes that the *SMRS* is diminishing with movement down the

[1] The slope of the SWF reflects inequality in terms of units of utility. It does not indicate indifference to inequality of income or consumption, because the marginal utility derived from an additional unit of consumption may vary between individuals (Johansson 1987).

SWF. In some instances the further restriction of *constant elasticity* is imposed (Cowell and Gardiner 1999; Pearce 2006).

In this paper the evidence of non-linear social welfare preferences, including the constant elasticity assumption, is explored within the context of the specific question of intergenerational distributional preferences.

2.1 Intergenerational equity

The question of intergenerational distribution involves decisions regarding the balance between consumption by the current generation and consumption in the future. The resources available for future production and consumption are inherently dependent on the capital/consumption balance of the current generation. Hence, the intergenerational social justice preferences of the community are an integral distributional aspect of environmental policy.

For example, the well-known Ramsey (1928) model, which is concerned with optimal growth and capital accumulation, takes the sum over time of instantaneous utilities from consumption as its measure of social performance. This *utilitarian* ethic assumes that equity between generations is adequately taken care of by adding one generation's utility level to another's and treating each generation equally. Each generation's utility is assumed to depend only on its own consumption. As a consequence, the utilitarian ethic suggests that any generation should only sacrifice a unit of utility when this leads to an increase of more than one unit of utility for any other generation.

In more recent times, intergenerational distributional issues are often raised under the banner of *sustainability* as 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 (Pezzey 1989). The strong link between sustainability and social justice between generations has resulted in policy debates increasingly considering intergenerational distributional issues. Hanley *et al*. (2007, p.14) suggest that "economists would say sustainable development is indeed principally an equity rather than an efficiency issue."

However, while sustainability and intergenerational equity are interrelated, sustainability on its own does not provide an irrefutable notion of intergenerational justice. As Krysiak and Krysiak (2006, p.257) comment, sustainability is "a minimal requirement for intergenerational justice and not a complete concept of justice in itself". The literature suggests acknowledgement of the desire to consider the well-being of future generations in environmental policy decision-making. However, knowledge of how this desire translates more specifically into intergenerational distribution preferences is limited.

3.0 Questionnaire design

In the CM experiment which has been undertaken rather than estimating utility as a function of the attributes of goods consumed, 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. It is the respondent's conception of social welfare rather than their individual utility that is being maximised in the choices being made. Choices between the distribution associated with the status quo and changes in policy resulting in distributional changes were presented to respondents. The attributes of the policy options that were varied were the levels of utility or well-being of different generations within society.

A degree of interpersonally comparable cardinal utility must be assumed so that respondents are able to make judgements about the well-being of other groups in society. In this application it is assumed that respondents use their knowledge of the well-being of groups within society under the status quo policy. Arrow *et al.* (1996) argue that, although SWFs have been criticised for assuming interpersonal comparability of utility, there seems to be no way of addressing the ethical issues involved in making decisions affecting different generations without making some comparisons implicitly or explicitly about interpersonal comparability. Therefore, decision-making is seen in a broader context of welfare maximization within a social structure rather than individuals maximising their utilities. Hence, each individual has distributional preferences based on their personal social justice preferences.

Respondents were encouraged to adopt a social welfare perspective by the following introduction to the survey instrument:

> *Many environmental policies result in a transfer of both income and resources between generations. For example, some environmental policies are paid for by current taxpayers with the aim of improving the environment for future generations. We are interested in finding out what you think about the way these policies lead to gains for some generations and costs for other generations.*

Hypothetical policies with generic labels (A, B, and C) were used as the sources of distributional change for the choice sets in an attempt to ensure that values other than distribution preferences were not reflected in the respondent's choices. The attributes in this experiment were described in terms of the impact on the utilities of individuals from different generations resulting from the three hypothetical and generic policy options. Individuals with specific generational characteristics were used as proxies for the group described[2]. The attributes and levels are described in Table 1.

[Insert Table 1 about here]

[2] Following Mackay (1997), a time span of 25 years was taken as a generation.

The chosen design limited the choices to generations currently living acknowledging the trade-offs required when considering the cognitive demands placed on respondents. The levels of the attributes were described in dollar terms. The dollar terms reflected the change in utility to the individual with the specific characteristic described by the attribute. Dollars were adopted as a metric with which respondents could associate. The main advantage with this numéraire is that dollars are a common and well understood metric to respondents. However, respondents were advised in the following way that the dollar values represented the general utility of the individuals, and should not be interpreted as financial wealth alone:

> *In this survey, dollars have been used to measure the gains and losses to different generations. The dollar amounts represent gains and losses from changes to access to environmental resources such as air, water, forests and beaches as well as monetary wealth.*

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 monetary income. The distribution of preferences may be sensitive to the choice of numéraire and it is possible that if a different numéraire was applied, the distributional preferences may vary.

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 case, there are five levels for each attribute with each level varying well-being to the value of A$500.

A fractional factorial design taken from Lazari and Anderson (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 five 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.

[Insert Figures 1 and 2 about here]

The survey was conducted in July 2005 across a random sample of households in Warrnambool, a regional city in South West Victoria, Australia. A personal drop off and pick up form of distribution and collection was used. A total of 431 questionnaires were distributed. Of the 337 that were collected or returned by mail, 295 were usable giving a response rate of 68.5%. Each of the 295 usable responses included five 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 survey sample's socio-demographics with the Australian Bureau of Statistics (2001) census data indicates a slightly

higher representation of females and younger people completing the survey than in the general population.

4.0 Analysis

The results of the linear estimation of the CM application are presented in Scarborough and Bennett (2008). In order to further explore the decision-making strategies of respondents in applying social justice principles to distributional change this paper focuses on the estimation of non-linear social welfare functions within a conventional conditional logit framework. This approach extends the analysis of social welfare maximisation beyond the classical utilitarian framework.

The linear models of Scarborough and Bennett (2008) reveal a preference for a form of inequality with respondents placing differential weights on the different groups and positive preferences toward the youngest of the three generations. From this it could be inferred that they would prefer to allocate any given transfer entirely to the most favoured group; that is newborns. However, this result could be a consequence of the linear welfare functions employed. The estimation of non-linear functions allows for the possibility that the social marginal rate of substitution changes as the allocation between age groups varies. If this is present, then it implies inequality aversion that may, at some point, offset the preferences implied by the unequal weighting of marginal allocations to different groups. The non-linear models have been estimated using Biogeme[3] and following a brief description of each model the results are compared in section 4.4.

4.1 Mean variance model

In order to determine whether respondents displayed an aversion to inequality in the distribution of utility between the three generations a mean variance model has been estimated. This assumes that social welfare, as defined in equation (3), depends on both the aggregate utility to the three generations, and the variation in return between them.

$$W = \beta_1 * U_{aged50} + \beta_2 * U_{aged25} + \beta_3 * U_{newborn} + \propto * sd \tag{3}$$

Where

$$sd = \sum_{i=1}^{3} (\beta_i * T_i - avT)^2; avT = \sum_{i=1}^{3} (\beta * T)/_3 \tag{4}$$

and β and T are the different weights and transfers.

[3] For ease of estimation the following models have been estimated with the socio-demographic variables excluded.

Thus, in estimating the variance the weighted transfers between generations have been used rather than the actual utilities. Table 2 summarises the results of the model. The standard deviation variable (α) is negative and significant suggesting an aversion by the respondent sample to inequality in distribution between the different generations.

[Insert Table 2 about here]

4.2 Standard exponential model

A standard exponential model has also been estimated. In this case, alpha (α) is a measure of the absolute inequality aversion. The advantage of this model is that the negative utility transfers included in the experimental design can be incorporated. In this case the social welfare function is expressed as:

$$W = \beta_1 * \exp\left(-\alpha * U_{aged50}\right) - \beta_2 * \exp\left(-\alpha * U_{aged25}\right) - \beta_3 * \exp\left(-\alpha * U_{newborn}\right) \quad (5)$$

Table 3 summarises the results of the exponential model. In this model the measure of inequality aversion (α) is not significant at the five percent level indicating that it is the direction of inequality in terms of gains and losses that is significant in respondents' decision-making.

[Insert Table 3 about here]

4.3 Constant Elasticity Social Welfare Function (CES)

As the results of the mean variance model suggest curvature in the *SWF* representing intergenerational distributional preferences, a constant elasticity function was estimated to further explore the shape of the *SWF*. Elaboration of the constant elasticity of substitution function is provided in Burton (2002). The results of the estimation of the welfare function expressed in equation (6) are summarised in Table 4.

$$W = \mu(\beta_1(U + U_{aged50})^{-\alpha} + \beta_2(U + U_{aged25})^{-\alpha} + (1 - \beta_1 - \beta_2) * (U + U_{newborn})^{-\alpha})^{1/(-\alpha)} \quad (6)$$

An assumption regarding the base level of utility is required for this model (as otherwise one enters infeasible regions in the estimation due to negative transfers) and a grid search with varying base levels of utility was undertaken. In the choice experiment the transfers between generations are measured in changes in utility to the value of A$500 and hence this gives some guidance on what might be reasonable values. However, whether the base level was five or fifty had little affect on the results so a base level of five has been reported. The critical thing to note is that as the value of the baseline utility is changed estimates of alpha are altered, but the log likelihoods do not change at all: essentially there is indeterminacy

between the two values, although the betas do not change. Results for the scale parameter are also reported. As with the standard exponential and mean variance models, alpha is significant thereby indicating a degree of inequality aversion by respondents and curvature in the estimated *SWF*.

[Insert Table 4 about here]

4.4 Comparison of the models

The above models have been compared in order to further understand the heuristics employed by respondents in this social welfare context. The analysis has identified two competing social justice principles being applied by respondents; a desire to positively favour the younger generations and an aversion to inequality in the distribution between the three generations. Of particular interest is how respondents balanced these competing equity principles when faced with choice sets indicating possible distributional change. "Equity equivalents", analogous to certainty equivalents, have been calculated to explore the trade-off employed by respondents between social justice principles.

Results from all models indicate that, for marginal changes, respondents place a higher weight on newborns. This suggests that if respondents had utility to the equivalent of one thousand dollars to allocate, they would prefer that it all should be allocated to newborns. However, allocating all transfers to this group would maximise the inequality of the distribution. The "equity equivalent" is the minimum total allocation that will generate the same welfare as an unequal allocation solely to the newborn. One can consider two forms of this: allowing only positive (or zero) allocations to groups, or permitting reallocations of existing utility between groups also. The results of these estimations are reported in Table 5.

[Insert Table 5 about here]

The results of the three models are consistent in showing that because of the differential weights placed on the three groups respondents prefer to take utility away from the older age group and re-allocate utility gains to the newborn and aged 25 groups. In cases where one allows negative transfers, there are significant reductions in total transfers, largely achieved by reallocating away from the older age group. For example, the "equity equivalent" transfers with the mean variance model suggest that the same level of welfare as that achieved by allocating utility to the value of A$1000 to the newborn group could be achieved by a total allocation of A$850; with -A$360 to the aged 50 group, A$500 to the aged 25 group and A$710 to the newborn group. Although the variance of the distribution falls (as compared with giving everything to the newborn), this is hardly an 'equal' allocation.

In a policy sense it may be more appropriate to only consider the possibility of positive transfers (Table 5b). In this case, where one allows only positive allocations, the CES and standard exponential welfare functions show relatively little reduction in the total transfer can be achieved by allowing for the social welfare improving reduction in inequality. The effect

is greater with the mean variance model but not substantial. This suggests that, although statistically significant, the curvature in the social welfare function is not that great.

5.0 Discussion and conclusion

Economists have long been aware of the conflicting equity principles influencing social justice preferences. The egalitarian principle of each group or person being treated equally, which is the foundation of the classical utilitarian *SWF*, is often assumed to be the overarching principle to be applied in the consideration of equity objectives. This research finds that in terms of one area of distribution, the distribution of utility between generations, the classical utilitarian *SWF* may not accurately reflect the social justice preferences of the community.

Driving these findings is the positive preferences toward the younger generations evident in the data set. This suggests that the heuristics employed by respondents in the stated preference context, when choosing between distributional changes resulting from potential natural resource policy changes, are more complex that implied by a classical utilitarian *SWF*. In this case when confronted with alternate intergenerational distributional outcomes, the social justice principle of positively favouring one group, that is the youngest of the generations, has a more dominant influence on social decision-making than a preference for equality of outcome.

There are a number of limitations with this research which require further exploration. For example; the reference point of the status quo utility distributions is unknown, the magnitude of the variance of utility distribution in the experimental design may not have been large enough to pick-up the curvature in the *SWF*[4], and the extent to which respondents were able to cognitively move to a welfare maximising context is difficult to assess. It may be that the positive preferences toward younger generations also represent utility maximisation and interdependent utility functions. Nevertheless, the work also illustrates the potential of stated choice methods to enhance understanding of distributional preferences and the decision-making strategies employed by respondents in a social welfare context.

The challenge of incorporating equity considerations in the development of environmental policy is considerable. Increasing our understanding of the distributional preferences of the community and the social justice principles applied in determining these preferences is an integral aspect of addressing this challenge.

[4] Appreciation to Geoff Kerr for raising this point is acknowledged.

Table 1: Attributes and levels in intergenerational distribution choice experiment

Attribute	Levels ($A)				
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

Table 2: Results of Mean Variance Model

Variable	Value	Std Error	t-test	P-value	Rob. Std error	Rob. T-test	Rob. P-value
α	-0.709	0.201	-3.52	0.00	0.212	-3.35	0.00
asc	0.322	0.104	3.08	0.00	0.109	2.97	0.00
β_1	0.282	0.0453	6.22	0.00	0.0452	6.23	0.00
β_2	0.408	0.0491	8.31	0.00	0.0529	7.72	0.00
β_3	0.646	0.0646	10.12	0.00	0.0648	10.08	0.00

Table 3: Results of Standard Exponential Model

Variable	Value	Std Error	t-test	P-value	Rob. Std error	Rob. T-test	Rob. P-value
alpha	0.372	0.199	1.87	0.06	0.212	1.76	0.08
asc	-3.45	1.93	-1.79	0.07	2.05	-1.69	0.09
β_1	0.806	0.452	1.78	0.07	0.480	1.68	0.09
β_2	1.26	0.693	1.82	0.07	0.754	1.68	0.09
β_3	1.79	0.927	1.93	0.05	0.963	1.86	0.06

Table 4: Results of Constant Elasticity Social Welfare Function

Variable	Value	Std Error	t-test	P-value	Rob. Std error	Rob. T-test	Rob. P-value
α	2.01	0.880	2.28	0.02	0.882	2.27	0.02
asc	5.28	0.0687	76.95	0.00	0.0686	77.04	0.00
β_1	0.217	0.0269	8.05	0.00	0.0261	8.30	0.00
β_2	0.320	0.0282	11.33	0.00	0.0297	10.76	0.00
Utility	5.00 fixed						
Homogeneity parameter (μ): 1.34 0.103 13.02							

Table 5: Equivalent transfers for $1000 allocated to newborns only

a): Negative transfers allowed

	Constant elasticity	Standard exponential	Mean variance
Aged50	-350	-830	-360
Aged25	290	360	500
Newborn	980	1,310	710
Total	930	840	850

b) Only positive transfers allowed

	Constant elasticity	Standard exponential	Mean variance
Aged50	0	0	0
Aged25	160	30	280
Newborn	830	970	610
Total	990	1000	890

Figure 1: Example of an intergenerational utility distribution choice set

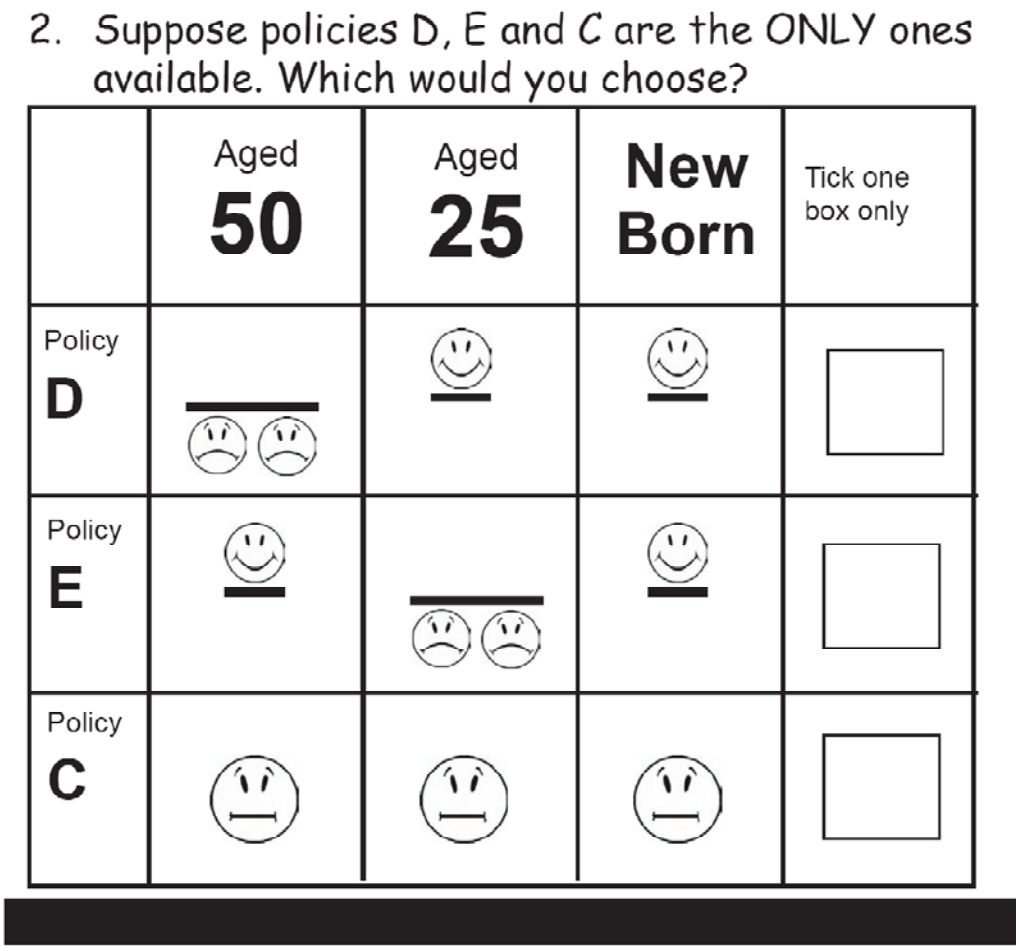
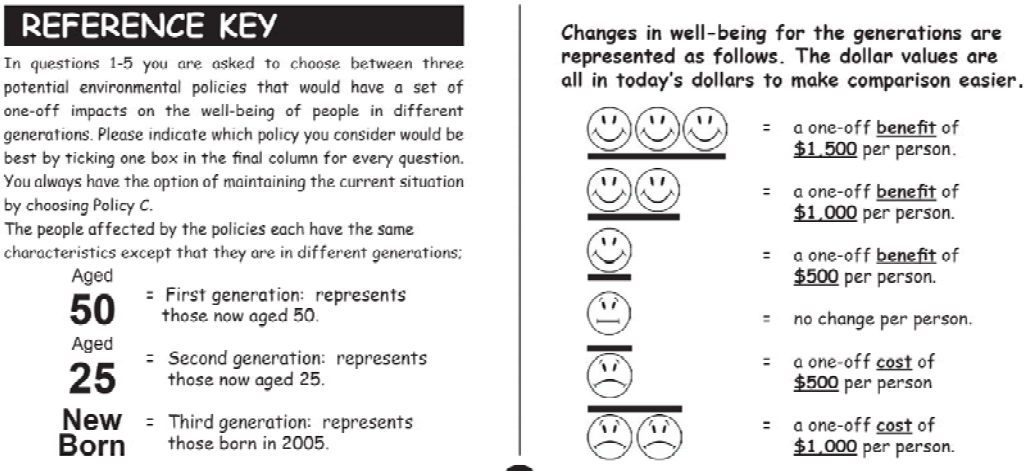


Figure 2: Reference key for choice set in Figure 1



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