CONTRIBUTI DI RICERCA CRENOS

CRENOS
CENTRO RICERCHE
ECONOMICHE NORD SUD
Università di Cagliari
Università di Sassari

EFFECTS OF DISTANCE ON NON-USE VALUES

Giovanni B. Concu

WORKING PAPERS

CUEC

2004/11

Giovanni B. Concu
SARE, University of Western Australia,
DEIS, Università di Sassari and CRENoS
tel +61 8 6488 3491; fax +61 8 6488 1098
concug01@fnas.uwa.edu.au

EFFECTS OF DISTANCE ON NON-USE VALUES

Abstract
A Choice Modelling (CM) experiment is designed to analyze the relation between Non-Use Values (NUVs) and distance. This issue is relevant in environmental valuation as it can help to identify the relevant market for a given environmental asset and improve individual benefit estimates. The CM experiment extends the literature by designing the environmental attributes so that NUV changes can be disentangled from Use Value (UV) changes. The experiment also allows for a flexible specification of the distance covariates. Data are obtained from a geographically representative sample. We find that NUVs do not depend on distance. Aggregation of NUVs is based on income and individuals' environmental attitudes.

Keyword: Non-use values, Choice modelling, Experimental design, Distance, Substitution, Information.

September 2004

1. Introduction

Estimation of Non-Use Values (NUVs) of natural resource is a controversial aspect of environmental valuation. Some economists regard NUVs as theoretically conceivable but operationally meaningless [12]. Others argue that disregarding NUVs in Cost-Benefit Analysis may lead to resource misallocations and defend the use of Stated Preference (SP) techniques to estimate NUVs [9]. Among non-economists, a benevolent scepticism over environmental valuation is common [31, 32]. Indeed, the use of environmental valuation and NUVs estimates in resource decision-making appears quite limited [1]. Little agreement among advocates over terminology, definitions, motives and how to measure NUVs does not help to convince sceptics.

The prevailing approach to estimating NUVs is to sample individuals that are assumed to be non-users and utilize a SP method to elicit their Willingness To Pay (WTP). Garrod and Willis [14], for instance, use the contingent ranking method and claim their figures are non-use benefit estimates of enhancing forest biodiversity since "*(…) most respondents would probably never visit these remote forests*". On the basis of the same assumption, Morrison *et al.* [29] sample respondents living far from the resource under valuation and estimate their WTP via the Choice Modelling (CM) technique.

Sampling distant respondents has several drawbacks. It does not exclude past and future users from the survey. Stated WTP may hence encompass some Use Values (UVs) and option values. Even if we assume that distant respondents are non-users, the estimated benefits are a measure of non-users' NUVs which disregards the fact that users may also hold NUVs. Further, benefit transfer and extrapolation from the sample to the population is possible only if the estimated values are "distance independent" or the estimated distance-values relationship is stable across populations and/or areas. However, sampling only distant respondents reduces the variability of the distance covariate, and distance effects may be not revealed.

This paper circumvents the problem of sampling distant respondents, tests if NUVs are distance-independent and if the NUVs are stable over the sampled area, in three steps. First, it adopts a different approach to isolate NUVs from UVs drawing from Kotchen and Reiling [21]. In their contingent valuation study on endangered species, Kotchen and Reiling assume respondents hold just NUVs since "*the species' endangered status prohibits consumptive uses and opportunities to view the species are limited by its habit*". In other words, changes in the environmental attribute only determine a variation of NUVs. This paper designs a Choice Modelling experiment so that changes in the level of a selected attribute of the environmental resource only entail a change in NUVs. This is possible because the attribute change results in variations of ecological characteristics whose net effect on use is nil. Second, the Choice Modelling experiment uses a sampling procedure based on the geographical distribution of the population. Third, unlike previous studies [24, 31], the distance-value relationship is specified to allow greater flexibility than a linear or a log-linear specification in order to identify geographical discontinuities.

The CM design is applied to the valuation of Kings Park's bushland, in Perth, the largest urban park in Western Australia.

The experiment shows that NUVs are distance-independent. Income and respondent's attitude toward the environment appear to be the only factors affecting NUVs. Aggregation of NU benefits can be carried out disregarding the geographical distribution of the population.

2. The Choice Modelling technique.

Distance effects on willingness to pay for an environmental good are expected because of people's preferences over closer, rather than distant, goods (the 'pure effect of distance') [28, 5], because distance increases the number of substitution opportunities [34], and information is distance dependent [5]. In this paper, the importance of these factors in determining NUVs is investigated exploiting the features the Choice Modelling technique. The Choice Modelling (CM) technique has been increasingly applied in environmental valuation [1]. It is a technique belonging to Conjoint Analysis, a set of experimental tools designed in the early 1960s by mathematical psychologists [27, 25]. CM combines Lancaster's approach to consumer theory [22], with Random Utility Theory. Individuals are assumed to choose the alternative that yields the highest utility on the basis of the characteristics of the alternatives. Each alternative i is represented by a utility function U_i that contains an observable (deterministic) element V_i and a stochastic element ε_i:

$$U_i = V_i + \varepsilon_i \quad (1)$$

in which the alternative's characteristics or attributes enter the deterministic element of the utility function. An individual will choose alternative i if $U_i > U_j$ for all $i \neq j$. Since the stochastic elements are not observed, the analyst can only describe the probability of choosing i as:

$$\Pr[i \quad is \quad chosen] = \Pr[(V_i + \varepsilon_i) > (V_j + \varepsilon_j)] \qquad \forall j \in C \quad (2)$$

where C is the set of all possible alternatives. Assuming, as in the McFadden's Conditional Logit Model [26], that the errors are assumed to be independent and identically distributed with a type I extreme distribution (or Weibull distribution), it can be shown that the probability of i being chosen is

$$Pr_i[i|C] = \frac{e^{\mu V_i}}{\sum_{j \in C} e^{\mu V_j}} \quad (3)$$

Here, μ is a scale parameter determined by the variance of the statistical error inherent in the modelling.

CM requires the attributes that enter the utility function to be defined in a way that is consistent with the requirements of the decision making process. To be useful in a benefit-cost analysis framework, where the focus is on the net benefits of making a change, environmental valuation should provide measures of marginal benefits and costs resulting from the implementation of alternative policies relative to some pre-defined status quo alternative. In CM applications, this base alternative has to be careful identified, for the respondents to compare it against the proposed changes. Also the benefit impacts of each alternative, in terms of its effects on use, non-use or total economic values, need to be clarified. Focus group and pilot studies are usually set up with these purposes.

CM involves a sequence of six to eight comparisons between the base alternative – the *status quo* - and number of different proposed changes. A vector of meaningful attributes describes the proposed and the base alternatives. Alternatives differ in terms of the levels of the attributes. The set of alternatives with different attribute levels is known as the choice set. The size of the choice set depends on the number of attributes and levels. Even for a small number of attributes and levels, the size of the choice set (i.e. number of possible combinations making up the alternatives) may be too large for each respondent to be able (and willing) to make the required comparisons. It is necessary to devise a mechanism that, even reducing the size of the choice, allows the researcher to estimate the effect on choice of individual attributes. Such mechanism is known as the design of the experiment [11]. Once the attributes and levels have been identified, the researchers have to decide how many choice alternatives each respondent has to compare. This decision is made taking into account two conflicting needs: the need to separate the effects on choice of individual attributes and the need to avoid respondents face an unbearable burden of choices. Two strategies are possible: a full factorial design – i.e. all possible combinations – is segmented into blocks ('blocking"), and the sample of respondents is divided in sub-sample each comparing a different block – or subset – of choices. Otherwise, it is possible to select a sub-set of attribute levels combinations via a 'fractional factorial". The process of selecting a fractional factorial requires orthogonality between attribute levels to be preserved. A fractional factorial disregards some interaction effects of the attributes on choice to make the task of choosing a bit easier. Variables that do not vary across alternatives, such as socio-economic characteristics and distance, have to be interacted with choice specific attributes. This paper exploits the possibility of combining in a single attribute different environmental features so that its changes result in NUVs changes. It then estimates the effects of distance as the interaction term with the NUV attribute, as shown in the next section.

3. The Choice Modelling experiment.

The asset under valuation is Kings Park & Botanic Garden in Perth (hereafter referred as Kings Park). It was established in 1871 and sits above the city of Perth in Western Australia. It is the largest urban park in the southern hemisphere, located on the fringe of the Central Business District. Kings Park has strong spiritual meaning for the aboriginal culture, and is regarded as a place of commemoration, education and recreation. Kings Park consists of two basic landscapes: the "*Bushland*" and the "*Developed Areas*". The bushland is approximately four fifths of the park (320 hectares), and is mainly covered by original native vegetation representative of the Western Australian environment. It contains more than 450 species of plants, 70 types of birds and one of the richest assemblies of small reptiles in Western Australia. The developed areas contain facilities for recreation and memorials. A botanic garden was opened in 1965 to provide a year-round display of West Australian flora and a selection of species from eastern Australia and other places with Mediterranean climate. Several surveys conducted by the Park's Management Authority show people see Kings Park as a West Australian icon. [20, 6, 7]. Kings Park is funded by the West Australian government. The management authority receives around Au$8 million a year, the equivalent of about Au$8 per West Australian taxpayer. The care of the bushland requires around Au$300.000 per year (3,75% of the annual budget).

In order to design a CM experiment that allows direct estimation of the effect of distance on NUVs, we need to isolate NUVs from UVs. Disentangling NUVs and UVs is not simple to achieve because in most of the contexts for environmental quality or quantity changes, UVs and NUVs vary simultaneously. For instance, improving birds' habitats in Kings Park may help conserve the ecosystem of an endangered species that has a high non-use value. At the same time it would increase the use of Kings Park by bird lovers. The Total Economic Value (UVs + NUVs) is supposed to increase, but one cannot say what the increase due to NUVs and UVs is. The most common strategy is to sample distant respondents, whose UVs are assumed to be nil [14, 30]. We follow the approach by Kotchen and Reiling [21] by identifying an attribute that represent ecological characteristics of Kings Park whose variations do not lead to UV changes.

Take the case of two competing species that are indistinguishable to the lay person. Substituting one with the other would not change the benefits he or she gains from their use. Although, if they have different intrinsic characteristics, it is possible that he or she attaches also different NUVs to the two species. Hence, replacing one with the other may change the net NUVs. For this to happen, three conditions are necessary. First, replacing a species with another must be ecologically feasible and sound so that it is plausible and realistic. Second, people should not be able to distinguish the two species. Third, one must possess intrinsic characteristics that make the species preferred to the other. Consultations with the management authority and focus groups helped to assess if these conditions were somehow met in the case of Kings Park. The park authority indicated three major problems in the conservation of the park's bushland: weeds that replace native species, degradation caused by human treading, and fires. Focus groups suggested that one of the important features of park's bushland is the native – endemic – species it contains. At the same time participants in the focus groups could not distinguish between native and non native species and were unaware that 60% of Kings Park has serious weed encroachment problems. The benefits from the use of Kings Park come from native and non native species alike. However participants stated they would pay to preserve indigenous flora and fauna. Native species possess both NUVs and UVs, while non-native species have just UVs.

A set of attributes were constructed and tested in order to convey the idea of NUVs and UVs changes. The Weed attribute (*Weed*) describes the percentage of bushland free from weeds. Changing the composition of the species in Kings Park in favour of natives does not change the use of the bushland, but would increase its NUVs if people attach NUVs to the native species (for cultural, bequests, or existence reasons). If NUVs are distance-independent, we also expect that the coefficient of the *Weed* attribute is not affected by distance.

A second attribute represents the percentage of bushland that is accessible to the public (*Acc*). Human treading is reputed to damage native flora and increase weed encroachment. Restricting people's access would change the bushland NUVs – preventing weeds and damages to native species - and also UVs of the bushland – less bushland would be available for use. The effect of distance on this attribute cannot be foreseen a-priori since a change in the attribute affects both UVs and NUVs.

On average 6 hectares of Kings Park bushland are damaged each year by fires. We constructed a third attribute that illustrates the percentage of hectares of bushland annually destroyed by fire (*Fire*). Bushland destroyed by fire is not usable for recreation for years. Any effort to prevent fires would, on average, make more bushland available every year to the public and reduce damages to native flora and fauna. Some people would gain some NUVs and UVs. Distance effects are again hard to predict, given the simultaneous change in UVs and NUVs determined by the attribute changes.

Respondents are asked to select between management alternatives made up by different levels of the three attributes and a tax increase as the cost of the alternative. This payment vehicle is likely to create some protest, but it appears the most plausible given that the park is actually funded with taxpayers' money. Entrance fees were rejected by participants in the focus groups, and they are not allowed by Kings Park' charter. Donations were also considered, but again the focus groups indicated a degree of scepticism in the use of the funds. Attributes and levels are shown in table 1.

Management alternatives are created by combining attributes and levels via a fractional factorial Graeco-Latin square procedure [11]. It designs the choice set containing the status-quo alternative (describing the actual state of the bushland) and 16 alternative management strategies. All these alternatives are combined in 8 sets of three management strategies. Figure 1 contains an illustrative CM question.

4. Questionnaire design, model specification, and sampling procedure.

Management alternatives that the respondents have to choose from are presented in the second section of a questionnaire. The first and third parts of the questionnaire contain a set of questions that aim to gather information on respondents' characteristics. The first part is designed to introduce the respondent to the subject and remind them about the budget constraints of the local government for the management of the environment and other policies. It also aims to obtain information on respondents' environmental attitudes, knowledge of Kings Park, use of natural resources and an indication of the recreational activities performed in parks, reserves or natural areas. This information is synthesized by the following variables (see table 2).

Information on respondents' knowledge of Kings Park is used to create a "knowledge index". It records the percentage of correct answers given to a series of True/False questions on the features of Kings Park. This index is used to study the relation between information and distance and to understand if the distance effects are related to the availability of information on Kings Park.

Respondents are also asked to list their substitutes for Kings Park, if any, and the activities they perform there. The question anticipates cases where it is not applicable because the respondent does not consider Kings Park has a substitute, or it is not used. The categorical variable *Subst* takes value from -1 (Kings Park does not belong to the respondent's choice set) to 3 (the respondent indicating he/she has 3 or more substitutes to Kings Park), taking value of 0 when Kings Park has no substitutes. Information on recreation activities and substitutes is combined to construct a *Substitution Index* (*SI*) to assess the degree of substitutability of Kings Park. By comparing the type and number of activities performed in Kings Park and in the indicated substitutes, we are able to compute the percentage of matches between the activities performed in the substitute sites and Kings Park as a proportion of the total number of activities performed in Kings Park. This index reflects the idea that substitutability depends not only on the site characteristics but also on preferences over activities that can be performed at alternative sites [23]. The *Substitution Index* (*SI*) can take a value of 100 when respondents indicate Kings Park has perfect substitutes, and a value of zero when they state Kings Park has no substitutes. Correlation between distance and substitution availability is expected.

The distance variable is calculated for each respondent as the geographical distance from Kings Park [19]. In the literature on stated preferences distance effects are usually assumed to be linear [35, 24], or log-linear [33, 30], or a second order polynomial [8, 16]. However, in the field of transportation, regional science and economic geography, distance effects are shown to take several different forms [5]. Further, economic theory tells us that the relationships between distance, spatial distribution of substitutes and preferences could be either positive or negative, depending on the role of information and on the type of natural resource under scrutiny [17]. Given that no restrictions on the specification of the utility function are anticipated, a search for the best transformation is necessary. As for the Box-Cox transformation to test for non-linearity in income [15], so we have to start with a specification that allows different functional forms according to the sign and magnitude of the parameters. A complementary criterion is the computational burden imposed on the search procedure by the number of parameters. Our choice falls on the Gamma or Transcendental Transformation. We define a distance variable *DIST2* according to:

$$DIST2 = a_0 (DIST1)^{a_1} e^{(a_2 DIST1)} \tag{4}$$

where *DIST1* is the distance of a sampled individual from the asset under valuation and a_0, a_1, a_2 are parameters to be estimated. A grid search involves choosing a vector of potential values for a_1 and a_2 and estimating the model for each pair of values of a_1 and a_2. a_0 is estimated, along with other parameters, in the maximum-likelihood estimation of the model. The values of a_1 and a_2 that maximize the log-likelihood function value are the maximum likelihood estimates of a_1 and a_2. The advantage of this specification is that it can mimic the behaviour of linear, quadratic (or any higher-degree polynomial), power, exponential and logarithmic functions. As can be seen in figure 2, it can also provide a representation of more complex relationships[1]. However, the grid search procedure does not provide the standard errors of the *a*'s parameters. A series of tests makes possible to check if they are statistically different from zero. Indeed, simpler functional forms are nested in the Gamma Transformation specification. For instance, the Gamma model collapses in an exponential model if a_1 is zero. Hence, a Likelihood Ratio test comparing the Gamma Transformation and the exponential specification indicates if one has to be preferred to the other (for the results of these comparisons see [10]).

Sampling was organized 'in waves'. The sampled population was divided in 11 distance zone from Kings Park (see table 3). The first five distance zones are identified according to the increase of fares of the public transport system. The others are defined to provide an equal number of residents in each zone. From each distance zone residents were randomly selected from the telephone directory in proportions equal to the population share in the zone. The sample was firstly contacted to seek agreement in taking part into the survey. 750 questionnaires were posted in 'waves'. After the first wave we were able to adjust the mailing out according to the response rates of each distance zone by seeking more contacts in zones with low response rates. The sampling procedure provided a geographically balanced sample in which the difference between the sample share and the population share of each zone is not greater than 1% in 7 out of the 11 zones.

Data were collected between mid June and mid-September in Western Australia (WA). 348 questionnaires were returned. 141 questionnaires

[1] Espey and Owusu-Edusei [13] but see also [5, 18] found that the impact of proximity to an environmental amenity on house prices may be negative in the short distance, with a closer house selling at a lower price. As distance increase, prices tend to increase at a decreasing rate until the effect of distance turns negative. This behaviour is represented in picture 1 by the curve with parameters $a_0>0$, $a_1=1.4$, $a_2=-1$.

were dropped because respondents protested (24), complained about the difficulty of the choice task (88) or did not provide all the necessary information (29). The remaining 207 questionnaires were used in the estimation. For each respondent, the questionnaire provided 24 observations given that respondents chose the best alternative from a group of three in 8 choice sets. The final number of observations is equal to 4968.
Attributes and variables collected and constructed from the questionnaire enter the deterministic element of the utility function in the conditional logit model of equation (1) to (3):

$$
\begin{aligned}
V_A = {} & \alpha_{ASC} ASC_A \\
& + (\beta_{Weed} + \beta_{WAVE2} + \beta_{WAVE3} + \beta_m \textstyle\sum_m CHAR_m)\, Weed \\
& + (\gamma_{Fire} + \gamma_{WAVE2} + \gamma_{WAVE3} + \gamma_m \textstyle\sum_m CHAR_m)\, Fire \\
& + (\omega_{Acc} + \omega_{WAVE2} + \omega_{WAVE3} + \omega_m \textstyle\sum_m CHAR_m)\, Acc \\
& + (\eta_{COST} + \eta_1\, INC)\, COST
\end{aligned} \qquad (5)
$$

where V_A is the utility associated with alternative A (A=*status quo, alternative 1, alternative 2)*, ASC_A is a dummy that takes value 1 if A=(*alternative 1, alternative 2*) and the α_{ASC} indicates if there is a bias toward the status quo. β_{WAVE}'s, γ_{WAVE}'s and ω_{WAVE}'s record the stage of data collection. $CHAR_m$ is a vector of individual-specific characteristics, including the distance variable calculated according to the Gamma transformation[2], income of the respondent, environmental attitude dummies, gender, substitution indexes, country of origin and so on. The model shows if and how these variables affect the parameters for each attribute program (β_{Weed}, γ_{Fire}, ω_{Acc}) and if the marginal effect of the cost attribute changes with income levels.

4. Results.

Distance effects on the three attributes are summarized in table 4, while table 5 shows the results of the conditional logit model.
Table 4 shows the results of the grid search procedure and the parameter

[2] Other functional form specifications were used. Tests for nested and non nested models indicated that the Gamma transformation is the model to be preferred [10].

of the “gamma transformed” distance variable estimated by the conditional logit model. NUVs embedded in the *Weed* attribute are not affected by distance. The a_0 parameter (that corresponds to the β_{Dist} in equation (5)) is not statistically significant. Distance affects the other two attributes in different ways. Indeed, the *Accessibility* attribute implies a trade-off between UVs and NUVs, the *Fire* attribute implies that the two classes of values change in the same direction (see [10] for a full discussion of these results).

The set of variables to enter the final specification of the model, as reported in table 5, is chosen on the basis of Likelihood Ratio tests. The alternative specific constant has a negative and significant parameter. As in Adamowicz *et al.* [2], this is evidence that respondents have a preference for the status quo, because the utility associated with any other alternative, *ceteri paribus*, is negative. This is known as a status quo bias or endowment effect.

The coefficient β_{Weed} for the *Weed* attribute is estimated for the base category of *EnvAtt=0* (for respondents that stated public expenditure on environmental issues should not be increased) and for the *Subst=0* (respondents that declared Kings Park has no substitutes). Even if the Likelihood Ratio test suggests retaining the Substitution categorical variable, the parameters for the other classes are not significant from zero. Hence, other things being equal, respondents belonging to the class *EnvAtt=0* assign a value to the *Weed* attribute lower than the class *EnvAtt=1*, whose interaction coefficient $\beta_{EnvAtt=1}$ is positive and significant. So is the coefficient for the income interaction β_{Inc} (income is expressed in logarithmic terms). Higher levels of income are associated with increasing willingness to pay for the *Weed* attribute.

The base category for the *Fire* attribute is made by the same classes of respondents as in the *Weed* attribute. The parameter estimate for this base category (γ_{FCP}) is not significant. It does not mean that people do not assign any value to the attribute. Indeed, the value is dependent on people environmental attitude, income and, as we have seen, distance.

The coefficient for the *Accessibility* attribute is estimated with reference to respondents who:

- Stated that government spending on the environment should not increase (*EnvAtt=0*);
- Indicated that Kings Park has no substitutes (*Subst=0*);

- Ranked environmental policies as the less important (*Rank=1)*;
- Have an education level equal to or lower than Y10 (*Educ=Y10*);
- Do no belong to any environmental organization (*Org=no*);
- Are born in Australia.

These are the individual characteristics of the base category. ***Rank*** and ***Org*** are measures of individuals' attitude toward the environment. They have significant negative signs, in accordance with expectations. Indeed, the *Accessibility* attribute describes the increases in the percentage of Kings Park's bushland closed to the public for restoration/conservation purposes. Being more environmentally aware translates into favouring less bushland to be left accessible. Respondents' education level (***Educ***), individuals' Knowledge of Kings Park (***Info***) and the number of children in the family all show positive signs indicating that more educated and informed respondents, as well as respondents with more children, prefer having the bushland accessible. The ***Subst*** variable is significant except for respondents that stated that Kings Park does not belong to their choice set. Respondents with substitution opportunities are less willing to pay to keep the park accessible to the public.

The variable *Wave* is not significant for any attribute and is discarded from the model. We find no evidence for the expectation that the evaluation context has changed during the sampling procedure.

A degree of correlation is expected between individual characteristics. In particular, distance, number of substitutes and knowledge of Kings Park are supposed to be correlated. However, it is also expected that the knowledge index (*Info*) does not affect values, because the questionnaire provides information on Kings Park prior to the valuation questions, levelling out possible informational differences among respondents. This appears to be the case for the *Weed* and *Fire* attributes, hence the correlation between distance and knowledge does not cause parameter instability. For the *Accessibility* attribute, however, both distance and knowledge have significant parameters and the distance coefficient is not significant if we drop the knowledge index. The parameter of the distance variable, then, cannot be interpreted as the "pure effect of distance", but we have to acknowledge that it is also capturing some distance-dependent information factors.

We tried to circumvent the likely correlation between distance and substitution by creating a substitution index *SI* and using it in the model.

It is never significant for any attribute, while the categorical variable *Subst* (that divides respondents according to the number of substitutes they named for Kings Park) is retained in the model on the basis of Likelihood Ratio tests. In the case of the *Weed* attribute, the presence of *Subst* makes distance not significant, suggesting that distance effects on NUVs are possibly due to substitution opportunities. For the *Fire* attribute, neither the magnitude nor the significant level of the distance parameter is affected by the *Subst* variable. This last is again kept in the model on the basis of the Likelihood Ratio test. Distance effects on the *Fire* attribute seem to be due to the "pure effect of distance". *Subst* does not affect the parameter of the distance variable for the *Accessibility* attribute.

5. Conclusion.

It is critical to fully understand the spatial behaviour of Non-Use Values (NUVs), given that in most applications benefit aggregation and transfer over populations and areas assume they are spatially independent. The issue so far has been explored via the contingent valuation method. In addition, NUVs are commonly identified as non-users' values. The criterion for sampling non-users is based on the concept that distance limits the use of a resource.

The contribution of this study is to analyse the relationship between NUVs and distance making use of an alternative environmental valuation technique and an alternative way of isolating NUVs. The study develops a Choice Modelling experiment and exploits its properties to describe an environmental change by attributes. One of the attribute in the experiment captures environmental features that imply changes in only NUVs. Focus groups and consultations with experts were used to develop and test the experimental design. The study also uses a sampling strategy that provides a geographically balanced sample and a specification of the distance-values relationships that allows greater flexibility than the linear of logarithmic forms usually adopted in the literature.

The findings from the CM experiment regarding NUVs are similar to those obtained by Pate and Loomis [30] and Bateman and Langford [4] respectively for iconic species and pure non-users. NUVs in the *Weed* attribute are found to be distance-independent. It is also affected by income level and influenced by individuals' environmental attitude. For aggregation purposes, individual estimates of NUVs should be aggregated only on the basis of income distribution among the population, information that is usually readily available. For NUVs, substitutability among environmental goods is dictated by economic substitution (the budget constraint) rather than by locational substitution that is, the availability in space of substitutes [28].

The study also highlights the complexity of the spatial behaviour of environmental preferences. The experiment shows that whenever an environmental attribute implies both NUVs and UVs change, distance effects may take very complex forms that cannot be captured by simple model specifications such as the linear of the logarithmic distance function. It shows the importance of taking into account spatial factors in environmental valuation and the risk of biased parameter estimates and under-over estimation of benefits and losses [10]. Yet more investigations on the relationship between substitution and NUVs seem necessary.

These findings are strongly contingent on the attribute design, the asset under valuation and the sampling procedure. The definition of the environmental attributes, and the implied values changes, is indeed peculiar to the environmental problem at hand. The experiment should also be replicated for environmental assets that are less known and less environmentally important as the one used in these study. This may indeed affect familiarity and knowledge of respondents that are reputed important factors affecting values. Further research is also necessary to take into considerations an important source of spatial discontinuity such as the crossing of a political boundary.

REFERENCES

[1] W.L. Adamowicz, Advances in environmental valuation: what's it worth? Presentation to the Australian Agricultural and Resource Economics Society, 48th AARES Conference, 11-13 Feb 2004, Melbourne, Australia.

[2] W. L. Adamowicz, P. Boxall, M. Williams, J. Louviere, Stated preference approach for measuring passive use values: choice experiment and contingent valuation, Amer. J. Agr. Econ. 80 (1998) 64-75.

[3] W.L. Adamowicz, J. Louviere, M. Williams, Combining revealed and stated preference methods for valuing environmental amenities, J. Environ. Econ. Manage. 26 (1994) 271-292.

[4] I.J. Bateman, I.H. Langford, Non-users' willingness to pay for a national park: an application and critique of the contingent valuation method, Reg. Stud. 31 (6) (1997) 571-582.

[5] M.J. Beckmann, Lectures on Location Theory, Springer-Verlag, Berlin, 1999.

[6] Botanic Garden and Park Authority, Annual report, BG & PA, Perth, 2001.

[7] Botanic Garden and Park Authority, Annual report, BG & PA, Perth, 2000.

[8] W.S. Breffle, E.R. Morey, T.S. Lodder, Using contingent valuation to estimate a neighborhood's willingness to pay to preserve undeveloped urban land, Urban Stud. 35 (4) (1998).

[9] R.T. Carson, N.E. Flores, N.F. Meade, Contingent Valuation: controversies and evidence, Environ. Resource Econ. 19 (2001) 173-210.

[10] G.B. Concu, A choice modelling approach to investigate biases in individual and aggregated benefit estimates due to omission of distance, Crenos Working Paper 04/12, www.crenos.it.

[11] D.R. Cox, N. Reid, The theory of the design of experiments, Chapman and Hall, London, 2000.

[12] R.G. Cumming, G.W. Harrison, The measurement and decomposition

of non use values: a critical review, Environ. Resource Econ. 5 (1995) 225-247.

[13] M. Espey, K. Owusu-Edusei, Neighborhood parks and residential property values in Greenville, South Carolina, J. Agr. Appl. Econ. 33 (3) (2001) 487-492.

[14] G.D. Garrod, K.G. Willis, The non-use benefits of enhancing forest biodiversity: a contingent ranking study, Ecolog. Econ. 21 (1997) 45-61.

[15] W.H. Greene, Econometric analysis, 5th edition, Prentice Hall, New Jersey, 2003.

[16] D.M. Hanink, K. White, Distance effects in the demand for wildland recreational services: the case of national parks in the United States, Environ. Planning A 31 (1999) 477-492.

[17] D.M. Hanink, The economic geography in environmental issues: a spatial analytic approach, Progress in Human Geography 19 (3) (1995) 372-387.

[18] D. Imber, G. Stevenson, L. Wilks, A contingent valuation survey of the Kakadu Conservation Zone, Resource Assessment Commission, research paper no.3, February 1991.

[19] Intergovernmental Committee on Survey and Mapping, Geocentric datum of Australia, technical manual, version 2.2). http://www.icsm.gov.au/icsm/gda/gdatm/gdav2.2.pdf

[20] Kings Park and Botanic Garden, Kings Park bushland management plan 1995-2005, KP & BG, Perth, 1995.

[21] M.J. Kotchen, S.D. Reiling, Environmental attitudes, motivation, and contingent valuation of non use values: a case study involving endangered species, Ecolog. Econ. 32 (2000) 93-107.

[22] K.J. Lancaster, A new approach to consumer theory, J. Polit. Econ. 74 (2) (1966) 132-157.

[23] L. Lo, A translog approach to consumer spatial behavior, J. Reg. Sci. 30 (3) (1990) 393-413.

[24] J.B. Loomis, How large is the extent of the market for public goods? Evidence from a nationwide contingent valuation survey, Appl. Econ. 28 (1996) 779-782.

[25] J. Mackenzie, A comparison of contingent preference models, Amer. J. Agr. Econ. 75 (1993) 593-603.

[26] G.S. Maddala, Limited dependent and qualitative variables in econometrics, Cambridge University Press, Cambridge, 1983.

[27] D. McFadden, The choice theory approach to market research, Marketing Sci. 5 (4) (1986) 275-297.

[28] R.C. Mitchell, R.T. Carson, Property rights, protest, and the siting of hazardous waste facilities, Amer. Econ. Rev. 76 (2) (1986), 285-290.

[29] M. Morrison, J. Bennet, R. Blamey, J. Louviere, Choice Modelling and tests of benefit transfer, Amer. J. Agr. Econ., 84 (1) (2002), 161-170.

[30] J. Pate, J. Loomis, The effect of distance on willingness to pay values: a case study of wetlands and salmon in California, Ecolog. Econ. 20 (1997) 199-207.

[31] W.E. Rees, M. Wackernagel, Monetary analysis: turning a blind eye on sustainability, Ecolog. Econ. 29 (1999) 47-52.

[32] W.E. Rees, Consuming the earth: the biophysics of sustainability, Ecolog. Econ. 29 (1999) 23-27.

[33] J. Silberman, D.A. Gerlowski, N.A. Williams, Estimating existence value for users and nonusers of New Jersey beaches, Land Econ. 68 (2) (1992) 225-36.

[34] S.A. Stouffer, Intervening opportunities: a theory relating mobility and distance, American Sociological Review 5 (6) (1940) 845-867.

[35] R.J. Sutherland, R.G. Walsh, Effect of distance on the preservation value of water quality, Land Econ. 61 (3) (1985) 281-291.

Table 1. Attribute, levels and corresponding variables.

Attributes	Levels	Variable in Model
Weed-free Bushland (in %)	30, 40 (sq)*, 50, 60	***Weed***
Bushland annually destroyed by Fire (in %)	1, 3, 6 (sq)*, 9	***Fire***
Bushland accessible to the Public (in %)	25, 50, 75, 100 (sq)*	***Acc***
Cost (in $)	0.30 (sq)*, 1, 3, 6	***Cost***

*(sq) = status quo levels

Table 2. Definitions of variables.

Variable	Type	Values/Meaning
EnvAtt	Categorical	*Respondents answered the question: "Should the government spend more on the protection of the environment?"* Values: 0 = No/Don't know 1= Yes
Rank	Categorical	*Respondents ranked environmental issues in relation to other policies (education, health, security, etc.):* Values: 1 (less important) to 5 (most important)
Info	Continuous	*Respondents' knowledge of KP computed as % of correct answers to a set of questions on KP location, extension, facilities on site :* Value: 0 to 100
Subst	Categorical	*Respondents indicated if they would consider to use KP and in case of a positive answer where they would go in case KP was not available:* Values: -1= KP is not considered as a choice / No answer 0= Nowhere (KP has not substitutes) 1 to 3 = Number of stated substitutes for KP
Substitution Index (SI)	Continuous	*# of matches between activities performed in KP and in its substitute / # of Substitutes (if Subst>0)*: Values 0 = no substitution 100 = perfect substitution
Distance	Continuous	*Respondents' geographical distance from Kings Park*
Gender	Categorical	Values: 0= female 1= male
Age	Continuous	*Age of the respondent*
Child	Continuous	*Number of children in the household*

Table 2 – Continuous			
Country	Categorical	*Country of origin:* Values:	0 = born in Australia 1 = born overseas/other
Educ	Categorical	*Attained level of education:* Values:	Y10= up to year 10 Y12= up to year 12 Cert= Certificate Uni=University Oth= Other
Empl	Categorical	*Employment status :* Values:	Emp=employed by someone else Self= self employed Unemp=unemployed Stu=student Ret=retired Oth= other
Income	Continuous	*Weekly household income*	
Prop	Categorical	*Ownership of the house/apartment actually occupied:* Values:	0=own 1 =rent/other
Org	Categorical	*Membership in environmental organizations:* Values:	0 = No/no answer 1 = Yes

Table 3. Definition of distance zones, population and sample share.

	Distance	Populatio	Sample	Difference
ZONE 1	0-5 Km	9.4	10.1	-0.7
ZONE 2	5-10Km	18.2	17.4	0.8
ZONE 3	10-15 Km	17.4	17.9	-0.5
ZONE 4	15-20 Km	12.3	14.0	-1.7
ZONE 5	20-30 Km	8.6	9.7	-1.1
ZONE 6	30-50 Km	6.9	6.8	0.1
ZONE 7	50-100 Km	4.3	2.9	1.4
ZONE 8	100-150 Km	4.8	4.8	0.0
ZONE 9	150-300 Km	3.9	3.9	0.0
ZONE 10	300-700 Km	5.3	6.3	-1.0
ZONE 11	Over 700 Km	8.9	6.3	2.6
		100.0	100.0	

Table 4. Results from the grid search procedure.

Attribute	**Gamma function:** $DIST2 = a_0(DIST1)^{a_1} e^{(a_2 DIST1)}$		
	a_0 [(a)]	a_1	a_2
Weed	-0.0040	-0.3	-2.4
Fire	32.08**	3	-6
Accessibility	7.10E-19*	-6	-6

*** Statistically significant at 5%.*

** Statistically significant at 10%.*

[(a)] *The values reported here are* a_0 *times the parameter estimates for the interaction terms* β_{DIST}, γ_{DIST},, ω_{DIST}.

Table 5. Results of the CM estimation.

Variable		Coef.	Std. Err.	P>z
ASC	α_{ASC}	-0.21817**	0.091038	0.017
	β_{Weed} (base parameter)	-0.08227**	0.040655	0.043
	$\beta_{\text{Log (Inc)}}$	0.01267**	0.005851	0.030
	$\beta_{\text{EnvAtt =1}}$	0.03518**	0.008905	0.000
Weed	$\beta_{\text{Subst (=1)}}$	-0.01658	0.012885	0.198
	$\beta_{\text{Subst (=2)}}$	0.01146	0.012293	0.351
	$\beta_{\text{Subst (=3)}}$	0.01379	0.011718	0.239
	$\beta_{\text{Subst (not applicable) (a)}}$	-0.01113	0.017049	0.514
	γ_{Fire} (base parameter)	0.15409	0.142067	0.278
	γ_{Dist}	32.1751**	8.494688	0.000
	$\gamma_{\text{Log (Inc)}}$	-0.03459*	0.020385	0.090
	$\gamma_{\text{EnvAtt =1}}$	-0.07162**	0.031887	0.025
Fire	$\gamma_{\text{Subst (=1)}}$	0.00707	0.046992	0.880
	$\gamma_{\text{Subst (=2)}}$	-0.07056	0.04473	0.115
	$\gamma_{\text{Subst (=3)}}$	0.05697	0.043547	0.191
	$\gamma_{\text{Subst (not applicable) (a)}}$	-0.00013	0.061792	0.998
	ω_{Acc} (base parameter)	-0.01211	0.015298	0.429
	ω_{Dist}	6.68E-19*	3.92E-19	0.088
	$\omega_{\text{Log(Inc)}}$	-0.00204	0.001789	0.255
	$\omega_{\text{EnvAtt =1}}$	-0.00415	0.002844	0.145
	$\omega_{\text{Rank (=2) (b)}}$	0.02206**	0.007031	0.002
	$\omega_{\text{Rank (=3)}}$	0.01431**	0.006575	0.030
	$\omega_{\text{Rank (=4)}}$	0.00919	0.007002	0.189
	$\omega_{\text{Rank (=5)}}$	0.01508**	0.007466	0.043
	$\omega_{\text{Subst (=1)}}$	-0.00778**	0.003945	0.049
Acc	$\omega_{\text{Subst (=2)}}$	-0.0082**	0.003817	0.032
	$\omega_{\text{Subst (=3)}}$	-0.00784**	0.003695	0.034
	$\omega_{\text{Subst (not applicable) (a)}}$	0.00076	0.00531	0.887
	$\omega_{\text{Country (o/seas)}}$	-0.01289**	0.00244	0.000
	$\omega_{\text{Education (=Y12)}}$	0.00669**	0.003201	0.037
	$\omega_{\text{Education(=Cert)}}$	0.00828**	0.003451	0.016
	$\omega_{\text{Education (=Uni)}}$	0.00814**	0.002908	0.005
	$\omega_{\text{Org (=Yes)}}$	-0.00847**	0.003091	0.006
	ω_{Info}	0.00029**	8.51E-05	0.001
	ω_{Child}	0.00222**	0.001007	0.028
Cost	η_{COST} (base parameter)	-0.08647**	0.041888	0.039
	η_{Inc}	-0.00015**	3.85E-05	0.000
Observations	4868			
Log Likelihhod	-1556.4585			
Pseudo R^2	0.1445			

***significant 5%* **significant at 10%*

(a) ***Subst(not applicable)****= this class groups Non-users and respondents that did not provide answer to the number of substitutes.*

	Parameter Values		
	a_0	**a_1**	**a_2**
	<0	*1*	*0*
	>0	*<0*	*0*
	>0	*0*	*<0*
	<0	*2*	*0*
	>0	*1.4*	*-1*

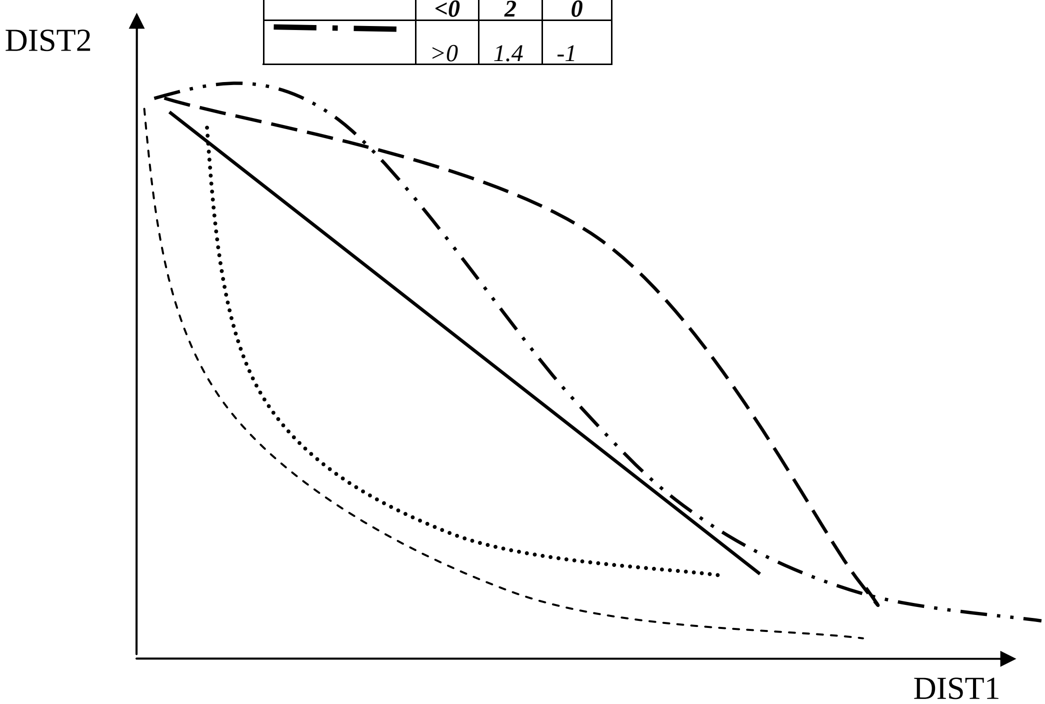
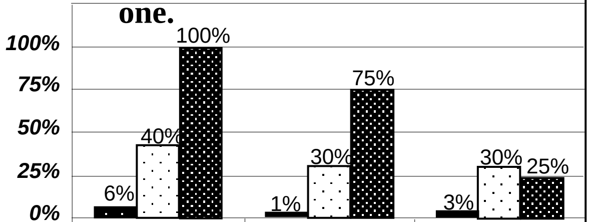


Figure 1. Gamma Transformations of the Distance variable

Figure 2. An example of choice set.

9) Suppose for now that these programs are the ONLY options to choose from. Please TICK below your preferred one.



	Current Status	Alternative 1	Alternative 2
% of Bushland annually destroyed by Fire	6%	1%	3%
% of Bushland freed from Weeds	40%	30%	30%
%of Bushland accessible to the Public	100%	75%	25%
Cost to you ($)	**$ 0.30**	**$ 0.30**	**$ 6**
Please tick your preferred option	☐	☐	☐