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Giovanni B. Concu

Schools of Economics and Political Science
University of Queensland
Brisbane, 4072
rsmg@uq.edu.au

ARE NON-USE VALUES DISTANCE-INDEPENDENT? IDENTIFYING THE MARKET AREA USING A CHOICE MODELLING EXPERIMENT

Giovanni B. Concu

Risk and Sustainable Management Group

School of Economics, University of Queensland,

and

DEIS, Università di Sassari

tel +61 7 3365 6093

fax +61 7 3365 7299

e-mail: g.concu@uq.edu.au

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Abstract

This article tests for the effect of distance on non-use values using a Choice Modelling (CM) experiment. Estimating a distance decay relationship for non-use values (NUVs) is important because it would define the market area for an environmental good, i.e. identify the limits for aggregating individual benefit estimates. In contrast to the common definition of NUVs as non-users' values, the CM experiment designs the environmental attributes so that NUV changes can be disentangled from Use Value (UV) changes. The experiment also allows for testing different specification of the distance covariates. Data are obtained from a geographically representative sample. Results show that NUVs do not depend on distance. Aggregation of NUVs is based on income and individuals' environmental attitudes.

Keyword: Choice modelling, Non-use values, Aggregation, Distance, Geographical Sampling.

Estimation and aggregation of non-use values (NUVs) are controversial aspects of environmental valuation. Some economists regard NUVs as theoretically conceivable but operationally meaningless (see Cumming and Harrison 1995). 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 (see, for instance, Carson, Flores and Meade 2001). Among non-economists, scepticism over environmental valuation is common (Rees and Wackernagel 1999, Rees 1999). Little progress is also recorded in identifying the relevant population – or market area - of an environmental asset and aggregation of estimated values is generally based on some political or administrative criteria. However underestimation of aggregate benefits is likely when estimation is restricted to the political jurisdiction in which a natural asset is located (Loomis 1996, Pate and Loomis 1997).

In principle, it is possible to empirically determine the market area by defining a population large enough so as to be sure it contains all agents that hold non-zero values (Carson, Flores and Meade 2001). In practice, this means sampling across a wide geographical area (Bennett and Blamey 2001). This approach is unsatisfactory. For it to provide unbiased aggregated benefit estimates, distance should drive benefits to zero within the chosen geographical boundary. If this is the case in a particular application can be determined only through an empirical investigation on the relationship between distance and values. The result of such an investigation depends on the how large is the sampled population. This is clearly a circular argument. To complicate the matter, some benefits may be distance-independent (and NUVs are prime candidates) and the aggregation procedure would leave out some beneficiaries no matter how large is the sampled population. Again the sampling frame strongly affects the possibility of testing if NUVs are distance-independent. Indeed NUVs estimation is generally based on sampling individuals that are assumed to be non-users. Non-users are defined according to their distance from the environmental asset under valuation. For instance, Garrod and Willis (1997) use the contingent ranking method and claim their figures are non-use benefit estimates since most respondents would probably never visit the remote forests under valuation. On the basis of the same assumption, Morrison et al. (2002) sample respondents living far from the resource under valuation and provide estimates of NUVs using the Choice Modelling (CM) technique. Sampling distant respondents does not exclude past and future users from the survey. Stated Willingness To Pay (WTP) may hence encompass some Use Values (UVs) and option values that can be affected by distance. Even if distant respondents are non-users, the estimated benefits are a measure of non-users' NUVs which disregards the fact that users may also hold distance-dependent NUVs. More importantly, sampling only distant respondents reduces the variability of the distance covariate, and distance effects may be not revealed.

The objective of this article is to determine if NUVs are distance-dependent. Aggregation based on a geographical criterion can then be accepted – and further investigation would be necessary - or rejected. Unlike previous studies, the method adopted to investigate this issue is the Choice Modelling technique (CM). The CM experiment is designed in such a fashion so as to avoid sampling distant respondent and instead it isolate NUVs from UVs by proposing environmental changes that entail only a variation of NUVs. The sampling procedure provides a geographically balanced sample. Several functional forms are also compared in order to identify geographical discontinuities in the distance-NUVs relationship.

Non-Use Values and distance.

Several theoretical reasons justify the use of distance to determine the market area for an environmental asset. If a public good is located in space, congestion may appear as direct competition - too many people recreating at the same site - and in the form of competition for the limited land close to the public good. In addition, the use of the public good requires incurring travel costs; hence, as the number of users increases, the social cost of the public good increases as well. Distance makes environmental public goods similar to private goods (Scotchmer and Thisse 1999). In other words, distance works as a substitute of the price mechanism because it regulates the demand for environmental goods through the purchase of a private good, travel. It is a weak exclusion mechanism because of the several types of demands for environmental services, some may not be correlated with distance, as the demand for private goods may not be simply price-driven. Define the use of an environmental good q_1 in terms of the purchase quantity of a travel x_1 whose price p_1 is a function of the distance of individual j from site q_1, $p_1=p_1(d_{j1})$. Also denote the Marshallian and compensated demand function for the private good x_1 as $x_1=x_1(P,q_1,M)$ and $h_1=h_1(P,q_1,u_0)$ respectively, where P is the price vector for private goods, M the individual's income and u_0 indicates the utility level at 0. The conditions for distance to be a perfect exclusion mechanism are:

a) For some individuals j's living at a distance $d_{ij} \geq d^*$ there is a "choke price" $p_1^*=p_1(d^*)$ for which $x_1=0$;
b) If $x_1=0$, $\partial U/\partial q_1=0$ if $x_1=0$. At or above the choke price p_1^* the marginal utility or marginal willingness to pay for q_1 is zero.

These conditions correspond to the weak complementarity criterion identify by Mäler (1974) to derive welfare measures for changes in the provision of public goods. Given the relationship $p_1=p_1(d_{j1})$, the value of q_1 is itself dependent on distance through the purchase of x_1. If the second of the above restriction does not hold, the marginal utility of q_1 when x_1=0 would be different from zero, i.e. $\partial U/\partial q_1 \neq 0$, and independent from distance. Distance-dependent values can be called use values (UVs) as they are related to the complementary use of a private good, and distance-independent values can be termed non-use values (NUVs). Indeed, the classical definition of NUVs does not entail the consumption of private goods. The distance effects on UVs is comparable to the effect of the own price on the demand for a commodity and can be termed "the pure effect of distance". As price-elasticities vary for commodity classes, so the pure effect of distance varies according to the type of environmental goods and services (Clawson and Knetsch 1966).

Distance effects are also expected because, as distance increases, the number of substitution opportunities increases as well. The use of x_1 (and the value of q_1) depends on the availability of its substitutes q_k, where *k,* the number of substitutes, may depend on d_{j1}. This effect can be termed "the substitution effect of distance". Substitution effects do not impinge on NUVs. Recall the definition of NUVs: $\partial U/\partial q_1 \neq 0$ when x_1=0. Suppose that q_2 becomes available and that its use implies the purchase of x_2 (travel to site q_2). If x_1=0 and $p_2<p_1$, the availability of x_2 cannot further reduce the purchase of x_1 or change the marginal utility of q_1. Consider the case in which $x_1>0$ and q_2 becomes available. If q_2 relative distance from the user is such that $p_2<p_1$, the user would find it convenient to switch to x_2. This is termed *locational substitution* (Lo 1999) and depends on the spatial distribution of natural resources. Locational substitution arises

when x_k>0 and hence does no affect NUVs when x_k=0. Disregarding eventual free-riding problems, if an individual is not willing to pay for q_1 when x_1=0 and $\partial U/\partial q \neq 0$ can be explained with *economic substitution*. However, one cannot rule out the possibility that values not related to use of x_1 are distance-independent. It may be argued that NUVs are related to the availability of information, and that information is, to a certain degree, distance-dependent. NUVs may also arise from a sense of "ownership" and past experience, both of which may be related to distance. Hence, even if the theory suggests effects of distance on NUVs are not expected, there are reasons why distance may negatively affect NUVs. It is then a matter of empirical investigation to provide an answer to this issue.

Empirical evidence on the effects of distance on UVs is vast. On the contrary, on an empirical ground the relationship between distance and NUVs is not clear. Sutherland and Walsh (1985) conducted the first systematic study of the effect of distance on non-use values. Using the open-ended Contingent Valuation (CV) approach and sampling residents of the state of Montana (USA), they estimate three types of NUVs (option, existence and bequest values) for water quality improvements. They find that WTP declines with distance and approaches zero at about 640 miles from the study area. Aggregating individual WTP over this distance gives a total WTP of around US$97 million. On the other hand, aggregating over the population of the state of Montana gives a total WTP of around US$15 million or one-sixth of the aggregation over the wider area. The fundamental assumption in this approach is that the estimated WTP-distance relationship is stable beyond the limit of the sample area. Loomis (1996) uses a Dichotomous Choice CV to estimate the benefit of river restoration in the state of Washington (US) and computes the point at which Willingness To Pay (WTP) equals zero. He finds that each mile reduces WTP by 0.01%. WTP is equal to $78 in Seattle (Washington State) and to $60 in the east cost of USA, nearly 3000 miles away. Since the probability of visits from individuals living thousand of miles away from the site is very small, the $60 can be interpreted as a measure of non-use benefits. Distance effects are hence negative but very small and may have been created by the sampling frame and the linear specification of the distance variable. Loomis's sample consists of residents of Washington State (52%) and the rest of the U.S. (42%). Residents of Washington State are over-represented. As a result, one should expect WTP to be biased upward, because shorter distance means more use and higher benefits, and the relationship between distance and WTP to be stronger. Loomis concludes that limiting the sampling to the local area will result in as little as 3% of the public good benefits being measured. Pate and Loomis (1997) estimate the Total Economic Value (TEV) for three programs to protect and expand wetlands and reduce loss of wildlife in California (USA). These programs are expected to increase both UVs and NUVs. They surveyed residents of California and three other states. The authors aim to determine if distance negatively affects WTP. The response rate shows that the sample over-represents residents living close to the environmental assets. For two of the three programs, the impact of distance on WTP is negative and small and decreases as distance increases. Pate and Loomis also show that this impact is affected by the presence of substitution opportunities. For the third program, neither distance nor substitute availability affects WTP. The authors provide two interpretations. First, the valuation of the program is "species-driven", in the sense that the species under study has high NUVs (iconic, cultural values). Second, WTP for the species may be "use driven" and respondents expressed a measure of their UVs for the species not for the program. Bateman and

Langford (1996) use an open-ended format CV method to estimate respondents' WTP for prevention of saline flooding in the United Kingdom and study the distance-values relationship. The study targets non-users but stresses the difficulty in identifying such a class of respondents and in equating values held by non-users to NUVs. It designs a sampling procedure to take into account distance decay effects on response rates by sampling according to distance zones. Results show a negative effect of the logarithmic measure of distance on response rates, use of the resources and mean WTP. Respondents in the closest distance zone have a mean WTP 2.7 times higher than respondents in the furthest zone. For respondents classified as "pure" non-users, estimated WTP is not affected by distance. Hanley et al. (2003) estimate distance-decay functions in order to identify the beneficiaries of environmental improvements of a river system in the United Kingdom. They distinguish respondents in users and non-users, and claim that both UVs and NUVs are decreasing as distance from the environmental asset increases.

The disparity of methods and results of these studies is an indication of the complexity of the task of analyzing the spatial behaviour of NUVs. They also show both the importance of accurate sampling, design of the questionnaire and screening of the respondents according to the use of the resources. This article expands on this body of work in a number of ways. First, unlike previous studies, it uses the Choice Modelling (CM) technique to investigate the relationship between distance and NUVs. Second, the possibility of strategically manipulate the explanatory variables in the CM setting is here exploited to design a new approach to distinguish between NUVs and UVs. Third, the study uses a staggered sampling procedure to correct for different response rates and obtain a geographically balanced sample. Finally, the relationship between values and distance is specified according to several functional forms, and statistical tests indicate the one to be preferred.

The methodological approach.

The Choice Modelling (CM) technique has been increasingly applied in environmental valuation (Adamowicz 2004). It is a technique belonging to Conjoint Analysis, a set of experimental tools designed in the early 1960s by mathematical psychologists McFadden 1986, Mackenzie 1993). CM combines Lancaster's approach to consumer theory (Lancaster 1966) with Random Utility Theory. Individuals choose the alternative that yields the highest utility on the basis of the characteristics of the options in the choice set. 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. Probabilities of choice can be computed from (2) once the distribution of the error terms is specified. In a CM experiment, subjects are presented with several alternatives partitioned usually in choice sets of two or three. Each alternative *i* is defined by a set of attributes that are the explanatory variables of the observable element V_i. The alternatives presented to the subjects are selected from the universe of possible alternatives by a mechanism called design of experiment (Cox and Reid 2000). Variables that are expected to affects the utility of any alternative but that do not vary across alternatives, such as socio-economic characteristics and distance, have to be interacted with choice specific attributes. The great advantage of the CM technique is the possibility of breaking down the observable element of utility function into explanatory variables that can be strategically varied by the researcher. It allows estimating marginal values for each single attribute that enter V_i, testing its significance and evaluating the welfare impacts of policies as different bundles of attributes. Consultation with experts, focus group and pilot studies are usually set up with the purposes of identifying the attributes and their levels.

In order to design a CM experiment that allows direct estimation of the effect of distance on NUVs, it is necessary 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. The most common strategy is to sample distant respondents, whose UVs are assumed to be nil (Morrison et al. 2002). An exception is the study by Kotchen and Reiling (2000). In their contingent valuation study on endangered species, Kotchen and Reiling claim respondents hold just NUVs since the species' habits prevent consumptive uses. In other words, any improvement on the species' status determines only a NUVs change. This suggests that it would be possible to isolate NUVs by defining an environmental attribute whose changes have no effect on use and either a positive or negative effect on NUVs. The definition of such an attribute should conform to other criteria as well, such as policy-relevance and measurability. Consultations with experts and focus groups were organised with the purpose of exploring the possibility of identifying an environmental attribute with these properties. First, the Management Authority of Kings Park in Perth

(Western Australia) was contacted. The park authority indicated three major problems in the conservation of the park's bushland: weeds, i.e. exotic species that replace native ones, degradation caused by human treading, and fires. These three problems are clearly correlated. Fires favour the spread of weeds; human presence is a major cause of fires; damages to the native flora and fauna favour weed encroachment. The park authority, however, has different management programs that target separately each problem. It is policy-relevant then to understand how the authority's resources that is, public money, should be allocated among the programs. Second, a series of focus groups were organised to understand if these issues are also demand-relevant, and investigate how each problem affects the participants' use of the park and the benefits they obtain from it. In the first focus group participants were presented with a short questionnaire asking their opinion about problems in the park, and their perception of the weed, fire and human damages in the bushland. Participants were also asked to identify plausible payment vehicles and levels of contributions to park management. A group discussion followed. Participants were informed about how the park Authority is actually managing the bushland area and then expressed their opinion about if, how and why management should change. It emerged that Kings Park's bushland is important to them because it protects iconic species and it is the last example of remnant vegetation in the urban area. Weeds and fires were perceived as serious threats to these features and more effort should go to prevent them. Another questionnaire was presented to the participants in the second focus group. They had to report their use of Kings Park's bushland. Five classes of users were identified, from frequent users (three or more visits per week) to sporadic users (at least one visit every two months). No participant reported to be a non-user. Before a group discussion, participants were shown pictures of plants living in the park and asked to assign them to the group of native and non-native species. It clearly emerged that the group was not able to make such a distinction. The presence of weeds does not seem to affect participants' use of the park because they are generally unable to distinguish between native and exotic species. It was then concluded that changing the composition of species in Kings Park by eradicating weeds would not change people's use while enhancing its iconic value. Replacing weeds with natives species change the park's NUVs. A third focus group was later presented with a structured CM questionnaire and provided useful information about how to present information, attributes, levels and wording of the questions.

The final set of attributes in the CM exercise includes a Weed attribute (*Weed*) that describes the percentage of bushland free from weeds. Increasing this attribute is expected to have no effect on the use of the bushland while enhancing its NUVs. If NUVs are distance-independent, we 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 damages native flora and increase weed encroachment. The effect of distance on this attribute cannot be foreseen a-priori since a change in the attribute affects both UVs and NUVs. A third attribute illustrates the percentage of hectares of bushland annually destroyed by fire (*Fire*). 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 an orthogonal fractional factorial Graeco-Latin square procedure. It designs the choice task containing the status-quo alternative (describing the actual state of the bushland) and 16 alternative management strategies. These alternatives are combined in 8 blocks of three management strategies. Figure 1 contains an illustrative CM question. The questionnaire also provided information on a number of attitudinal, socio-economic and knowledge characteristics of the respondents. Table 2 gives an explanation of the main variables collected.

Model specification and sampling procedure.

The distance variable is calculated for each respondent as the geographical distance from Kings Park. In the stated preference literature distance effects are usually assumed to be linear (Sutherland and Walsh 1985, Loomis 1996), or log-linear (Silberman, Gerlowski and Williams 1992, Pate and Loomis 1997) or a second order polynomial (Breffle, Morey and Lodder 1998, Hanink and White 1999). However, in the field of transportation, regional science and economic geography, distance effects are shown to take several different forms (Beckmann 1999). 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 (Hanink 1995). Given that no restrictions on the specification of the utility function are anticipated, a search for the best transformation is necessary. In this study several specification are compared (table 2). A series of test for nested and non-nested models determined which specification is to be preferred (for a full treatment of the issue and illustration of the test results see Concu 2005).

Sampling was organized 'in waves'. The sampled population was divided in 11 distance zone from Kings Park (see table 4). 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 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 V_i of the utility function in equation (1):

$$\boldsymbol{V_A} = \alpha_{\boldsymbol{ASC}} \boldsymbol{ASC_A}$$

$$+(\beta_{Weed}+\beta_{\boldsymbol{WAVE2}}+\beta_{\boldsymbol{WAVE3}}+\beta_m \Sigma_m \boldsymbol{CHAR_m})\,\boldsymbol{Weed}$$

$$+(\gamma_{Fire}+\gamma_{\boldsymbol{WAVE2}}+\gamma_{\boldsymbol{WAVE3}}+\gamma_m \Sigma_m \boldsymbol{CHAR_m})\ \boldsymbol{Fire}$$

$$+(\omega_{Acc}+\omega_{\boldsymbol{WAVE2}}+\omega_{\boldsymbol{WAVE3}}+\omega_m\textstyle\sum_m \boldsymbol{CHAR_m})\ \boldsymbol{Acc}$$

$$+(\eta_{COST}+\eta_1\ \boldsymbol{INC})\boldsymbol{COST} \qquad (3)$$

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. $\boldsymbol{\beta_{WAVE}}$'s, $\gamma_{\boldsymbol{WAVE}}$'s and $\omega_{\boldsymbol{WAVE}}$'s record the stage of data collection. $CHAR_m$ is a vector of individual-specific characteristics, including the distance variable specifies according to the results of the testes for nested and non-nested models, income of the respondent, environmental attitude dummies, gender, substitution indexes, country of origin and so on (see table 4). 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.

Results.

The model specified in (3) is estimated assuming that the error terms in (2) have a (Gumbel) Type I Extreme Distribution. This assumption generates the well-known McFadden's Condition Logit model. The results of the Conditional Logit model are summarized in table 5. The NUVs embedded in the *Weed* attribute are not affected by distance. No matter how the distance variable is specified, the $\boldsymbol{\beta_{Dist}}$ parameter (that corresponds to the parameter a_0 in table 3) is never statistically significant. Distance affects the other two attributes in different ways. Distance effects on the *Accessibility* attribute are best captured by a Beckmann specification and are depicted in figure 3. For the *Fire* attribute the Gamma transformation is the preferred functional form (the parameters a_1 and a_2 in table 3 are estimated via a grid search procedure. See Concu

2005 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. (1998), 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 weed-free bushland. 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 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.

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 categorical variable ***Org*** indicates if a respondent belong to an environmental organisation. It has a significant negative signs, in accordance with expectations. Being more environmentally aware translates into favouring less bushland to be left accessible, so as to improve its conditions. 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. The sing and magnitude of the ***Rank*** variable are puzzling. They seem to indicate that assigning comparative greater importance to environmental policies is related to preferring more accessible bushland. This partly contradicts the interpretation of other coefficients.

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, eventually causing parameter instability. For the *Weed* and *Fire* attributes, the variable *Info* is not significant and dropping it from the estimation does not change the parameters of the distance variable. 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. For this attribute, the parameter of the distance variable cannot be interpreted as the "pure effect of distance", but it has to be acknowledges that it is also capturing some distance-dependent information factors. To circumvent the likely correlation between distance and substitution, a substitution index *SI* was introduced in the model (see table 4). It is never significant for any attribute, while the categorical variable *Subst* is retained in the model on the basis of Likelihood Ratio tests for all attributes. In the case of the *Weed* attribute, the presence of *Subst* makes distance not significant, suggesting that if any distance effect is identified, it would be caused by 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.

It is useful to calculate the point estimates of willingness to pay for a 1% change in the attribute of interest. This point estimates are called implicit prices and are calculated using the sample means of the socio-economic variables. A 1% increase in weed-free bushland is valued the representative respondent as high as AU$0.17. That is, the individual NUVs of an additional hectare of native bushland is around AU$0.17. Increasing by 1% the bushland that annually is destroyed by fires determines an individual loss of Au$1.16. The implicit price for the *Accessibility* attribute is AU$0.19. This information reflects the concerns of the respondents and could be usefully employed by park managers when deciding which environmental attribute to increase.

Discussion

The main finding of the estimation exercise is that NUVs are distance-independent. It may be argued that this is a fundamental problem for the inclusion of such estimates in a Cost-Benefit Analysis. Aggregating even such a small estimates to a large number of individuals would give a very large estimate of the benefits of environmental conservation. NUVs do not appear to behave as neoclassical economic values. However it should be noted that the estimated NUVs conform to economic expectation in other respect. NUVs are found to be positively dependent on income and environmental attitude. Although these results add further evidence to the findings of Bateman and Langford (1997) and Pate and Loomis (1997), there are other caveats that should be kept in mind interpreting the results. The results are obtained for a very specific environmental good and are strongly contingent on the attribute design 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. There is also some evidence that NUVs are somehow affected by the availability of substitutes, even if this impact is not clearly defined.

Further research is necessary to take into considerations an important source of spatial discontinuity such as the crossing of a political boundary. The sampling frame adopted in the study allowed sampling a population that resides within clear political and administrative boundaries. No one of the estimated distance-value relationships brings the benefits of the respective attribute to zero within this boundary. The market area for Kings Park's bushland is at least as large as the sampled area, but it cannot be stated that the two areas coincide. The market area could be larger. However, it is not possible to conclude it is the case in this application. Indeed, it would not be appropriate to extrapolate the estimated distance-value relationships over the sampled geographical area because one should expect some discontinuities as political boundaries are crossed. Further investigation is hence required. The study also highlights the complexity of the spatial behaviour of environmental preferences. 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.

Conclusion.

It is critical to fully understand the spatial behaviour of NUVs to provide unbiased aggregate benefits. The issue so far has been explored via the contingent valuation method, where 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 describes environmental changes via a set of measurable, policy and demand relevant 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 specifications of the distance-values relationships that allow greater flexibility than the linear or logarithmic forms usually adopted in the literature.

The findings from the CM experiment regarding NUVs are similar to those obtained by Pate and Loomis (1997) and Bateman and Langford (1997) respectively for iconic species and pure non-users. NUVs are found to be distance-independent. They are also positively affected by income level individuals' environmental attitude. No knowledge effects on NUVs are found. For aggregation purposes, individual estimates of NUVs should be aggregated only on the basis of income and environmental attitude, information that is usually readily available.

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Table 1. Attributes, 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***
Annual increase on income tax (in $)	0.30 (sq)*, 1, 3, 6	***Cost***

*(sq) = status quo levels

Table 2. Functional form specifications of the distance variable.

Function	Formula
Linear	$DIST2 = a_0(DIST1)$
Log-linear	$DIST2 = a_0[ln(DIST1)]$
Gamma	$DIST2 = a_0(DIST1)^{a_1} e^{(a_2 DIST1)}$
3rd Polynomial	$DIST2 = a_0 DIST1 + a_1 DIST1^2 + a_2$
Exponential Law	$DIST2 = a_0 \exp(-DIST1)$
Beckmann Law	$DIST2 = \frac{a_0}{1 + DIST1^2}$

DIST1=geographical distance

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

	Distance from Kings Park	% of Residents		
		Population	Sample	Differences (in
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(a). Definitions of variables (*continued*).

Variable	Type	Explanation	Values
EnvAtt	Categorical	*Respondents answered the question: "Should the government spend more on the protection of the environment?"*	0 = No/Don't know 1= Yes
Rank	Categorical	*Respondents ranked environmental issues in relation to other policies (education, health, security, etc.):*	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*	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:*	-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)*:	0 = no substitution 100 = perfect substitution
Distance	Continuous	*Respondents' geographical distance from Kings Park*	
Gender	Categorical		0= female 1= male
Age	Continuous	*Age of the respondent*	
Child	Continuous	*Number of children in the household*	

Table 4(b). Definitions of variables (*continued*).

Variable	Type	Explanation	Values
Country	Categorical	*Country of origin:*	0 = born in Australia 1 = born overseas/other
Educ	Categorical	*Attained level of education:*	Y10= up to year 10 Y12= up to year 12 Cert= Certificate Uni=University Oth= Other
Empl	Categorical	*Employment status :*	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:*	0=own 1=rent/other
Org	Categorical	*Membership in environmental organizations:*	0 = No/no answer 1 = Yes

Table 5(a). Results of the CM estimation (*continued*).

Variable	Parameter	Coef.	Std. Err.	P>z
ASC	α_{ASC}	-0.22138**	0.0910	0.015
Weed	β_{Weed} (base parameter)	-0.08171**	0.0406	0.044
	$\beta_{\text{Log (Inc)}}$	0.012544**	0.0058	0.032
	$\beta_{\text{EnvAtt =1}}$	0.034958***	0.0089	0.000
	$\beta_{\text{Subst (=1)}}$	-0.01611	0.0129	0.210
	$\beta_{\text{Subst (=2)}}$	0.01194	0.0123	0.331
	$\beta_{\text{Subst (=3)}}$	0.014246	0.0117	0.223
	$\beta_{\text{Subst (not applicable) (a)}}$	-0.01081	0.0170	0.524
Fire	γ_{Fire} (base parameter)	0.151834	0.1422	0.286
	γ_{Dist}	34.20221***	8.5390	0.000
	$\gamma_{\text{Log (Inc)}}$	-0.03443*	0.0204	0.091
	$\gamma_{\text{EnvAtt =1}}$	-0.07078**	0.0319	0.027
	$\gamma_{\text{Subst (=1)}}$	0.006276	0.0469	0.893
	$\gamma_{\text{Subst (=2)}}$	-0.07205	0.0447	0.107
	$\gamma_{\text{Subst (=3)}}$	0.056517	0.0435	0.193
	$\gamma_{\text{Subst (not applicable) (a)}}$	-0.0059	0.0616	0.924

Table 5(b). Results of the CM estimation.

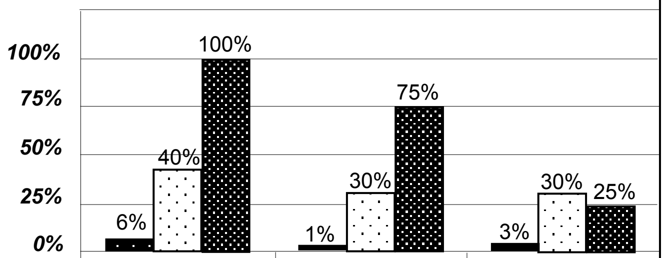
Variable	Parameter	Coef.	Std. Err.	P>z
	ω_{Acc} (base parameter)	-0.03015	0.0192	0.115
	ω_{Dist}	0.02428**	0.0113	0.032
	$\omega_{Log(Inc)}$	-0.00146	0.0018	0.419
	$\omega_{EnvAtt=1}$	-0.0037	0.0028	0.192
	$\omega_{Rank\ (=2)\ (b)}$	0.022492***	0.0070	0.001
	$\omega_{Rank\ (=3)}$	0.013889**	0.0066	0.035
	$\omega_{Rank\ (=4)}$	0.008184	0.0070	0.242
	$\omega_{Rank\ (=5)}$	0.013403*	0.0074	0.072
	$\omega_{Subst\ (=1)}$	-0.00979**	0.0040	0.014
Acc	$\omega_{Subst\ (=2)}$	-0.01112***	0.0039	0.004
	$\omega_{Subst\ (=3)}$	-0.01032***	0.0038	0.007
	$\omega_{Subst\ (not\ applicable)\ (a)}$	-0.00199	0.0053	0.705
	$\omega_{Country\ (o/seas)}$	-0.01233***	0.0024	0.000
	$\omega_{Education\ (=Y12)}$	0.008681**	0.0035	0.013
	$\omega_{Education(=Cert)}$	0.008193**	0.0029	0.005
	$\omega_{Education\ (=Uni)}$	0.006169*	0.0032	0.053
	$\omega_{Org\ (=Yes)}$	-0.00595*	0.0030	0.051
	ω_{Info}	0.000207**	0.0001	0.013
	ω_{Child}	0.002032**	0.0010	0.043
Cost	η_{COST} (base parameter)	-0.08649**	0.0419	0.039
	η_{Inc}	-0.00015***	0.0000	0.000
Observations	4868			
Log Likelihood	-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.*

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	☐	☐	☐

Figure 1. An example of choice set.

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