The Effect of Response Time on Conjoint Analysis Estimates of Rainforest Protection Values

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Abstract

This paper reports the first estimates of willingness to pay (WTP) for rain forest protection in the threatened Atlantic Coastal Forest ecosystem in north-eastern Brazil. Conjoint analysis data were collected from Brazilian tourists for recreation bundles with complex prices. An ordered probit model with time-varying parameters and heteroskedastic errors was estimated. The main empirical results showed that: (1) utility parameters vary systematically with response time, (2) respondents use different anchors and scales in rating attribute differences, (3) mean WTP estimates for nature park attributes converge to stable values as response time increases, and (4) private forests provide public benefits to Brazilians.

Keywords: anchoring, compensatory decision rules, conjoint analysis, non-market valuation, resampling, willingness to pay, yea-saying.

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Introduction

Biodiversity protection and conservation of tropical rain forests are global issues of increasing importance. One of the most pressing problems in designing mechanisms for rain forest protection programs in less developed countries is the lack of financial resources (Dourojeanni, 1993). Nature tourism is one approach for generating financial resources while providing economic alternatives to deforestation and resource degradation (Whelan, 1991). Determining the marketability of potential nature tourism sites and marketing plans are essential steps in determining the economic feasibility of potential nature tourism investments.

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Conjoint analysis (CJ) is a hedonic technique that is conceptually linked to Lancaster's (1966) view of economic goods as bundles of attributes. It supposes that consumer preferences for products can be decomposed into separable utilites or "part-worths" for the constituent parts. Initially developed for conducting marketing research for new products (Green & Wind, 1975), the CJ method asks people to evaluate products as bundles of attributes, known as "product profiles". For example, when people consider recreational trips they may think about the natural setting, the availability of recreational activities, and the types of lodging available. The natural setting may include forests, lakes, mountains or beaches and recreational activities may include hiking or swimming. By eliciting preference information for a sequence of products whose attributes are varied by the analyst, the sensitivity of stated preferences to changes in attribute bundles can be evaluated.

Conjoint analysis methods have recently been adopted by environmental economists for valuing the non-market goods and services provided by natural ecosystems. By including product price as a product attribute, the marginal utility of money can be estimated and used to compute marginal values and willingness to pay (WTP). Mackenzie (1990) used CJ to estimate willingness to pay for attributes of deer hunting trips and showed how rating data could be converted and used in models of ranking and choice (1993). Gan & Luzar (1993) used the method to estimate the value of waterfowl hunting attributes. Roe, Boyle & Teisl (1996) showed how modeling decisions can influence estimates of compensating variation for attributes of salmon fishing trips. Adamowicz, Louviere & Williams (1994) combined a choice-based conjoint model with a revealed preference model for recreational site choice and welfare measures were computed using driving distance to estimate the marginal utility of income.

We use conjoint analysis to estimate the value of potential nature tourism attributes in the Atlantic Coastal Forest in northeastern Brazil. Information on tourists' willingness to pay for nature tourism attributes can help economic development planners evaluate the feasibility of a variety of development options. Intercept interviews were conducted with Brazilian tourists at a variety of tourist locations. Because interviews needed to be conducted in a relatively short period of time, and because the CJ task presented a relatively complex set of tourism decision problems, we were interested in the effect of self-imposed response time on utility parameter estimates. As reported below, we found that response time had systematic effects on utility parameters and the utility theoretic interpretation of results.

Survey Respondent Involvement

Conjoint analysis asks respondents to evaluate an iterative series of trade-offs that are cognitively challenging. Although the analyst may assume that respondents carefully scrutinize and process CJ attribute information, it is not evident *a priori* that everyone invests the time and effort to fully evaluate all trade-offs. Because time and mental energy are scarce resources, consumers may weigh the costs and benefits of information processing. A procedurally rational approach to problem solving is to distribute time and mental effort in such a way to equate the marginal effort of decision-making with the marginal importance of the choice situation (Simon, 1986; Woo, 1992).

People who are highly motivated to provide well-considered responses to survey questions may face significant internal costs (in terms of regret) if they err in their responses. Therefore, they are likely to allocate significant time and effort to decision-making. Respondents who perceive small returns to decision-making effort face high self-imposed opportunity costs. This constraint may lead people to use simplifying "rules-of-thumb"or decision heuristics (Payne, Bettman & Johnson, 1992). Decisions characterized by "impulse buying" and low involvement may be distinguished from decisions based on deeper levels of information processing (Petty & Cacioppo, 1986; van Raaij, 1988).

Recent research shows that decision costs can reduce decision quality. In a computerized economic experiment, Pringle & Day (1996) asked people to trade-off a consumption good for leisure to maximize a given set of preferences. They found that deviations from utility maximizing solutions (defined as "misuse costs") increased dramatically when decision time was costly as opposed to when decision time was free.

The primary hypothesis of this paper is that decision time influences utility parameters and estimates of WTP. Economic values are based on compensatory decision rules where "poor" attributes may be compensated by "strong" ones and leave the individual indifferent. Because compensatory decision rules require time and opportunity for cognitive elaboration and information processing, time pressure, competing activities or other distractions can lead to use of non-compensatory strategies (van Raaij, 1988). Because CJ questions pose complex trade-offs among attributes, respondents may use decision-making strategies that conserve mental energy but deviate from full neoclassical optimization. The use of mixed decision strategies for complex decisions can influence economic welfare estimates (Mazotta & Opaluch, 1995). We introduce decision time as a proxy for underlying, unobserved phenomena characterizing the degree of processing used by respondents in formulating responses. We find that low response time is associated with some violations of utility theoretic properties and that estimates of mean WTP converge to stable values as respondents invest more time in the exercise.

Atlantic Coastal Forest in Northeastern Brazil

The Atlantic Coastal Forest of Brazil (*Mata Atlântica*) is one of the most diverse and threatened tropical rain forest ecosystems in the world. The region around the Una Biological Reserve in southern Bahia (northeastern Brazil) is under a particularly severe threat of deforestation due to the collapse in world cocoa prices that has forced many farmers to cut their forests to pay expenses. The forests in this region encompass about 14,000 km^2 and contain high levels of endemism and biological diversity. For example, these forests are the only remaining native habitat of endangered primates such as the golden-headed lion tamarin and the yellow-breasted capuchin monkey. A recent forest inventory found a world record number of tree species in a single hectare in this region (Thomas & Carvalho, 1993).

Currently, most visitors to southern Bahia come to visit the beaches, and international visits to the coastal areas in this region of Brazil are increasing. The Inter-American Development Bank views tourism as an important economic development sector for this region and is investing significant resources to improve the tourist infrastructure. Forest protection may play an important but poorly recognized role in enhancing the tourism value of this region by providing esthetically pleasing landscapes and opportunities for forest-based recreation.

To assist conservation planning efforts in this region, we developed a conjoint analysis instrument to provide information about forest protection values and potential nature attractions. We tested the hypothesis that the remaining forest cover in this region (14,000 km^2) has value as a public good although it is not directly used or consumed by tourists and forests are mostly privately owned. We also tested the hypothesis that privately owned forests around the Una Biological Reserve would have value as a public nature preserve and low-intensity-use buffer around the core reserve.

In the next section, we introduce a paired-comparison conjoint model that is modified to include response time as a factor influencing utility parameters. We then provide a description of our survey instrument. This is followed by empirical results, conclusions, and implications for future research.

Conjoint Analysis and Respondent Involvment

Three major types of conjoint analysis paradigms have appeared in the literature; rank-order methods, rating methods, and choice-based methods (e.g. see Louviere, 1988). Rank-ordering experiments ask people to rank products, which are composed of sets of specific attribute levels, in order from their most preferred product to their least preferred product. Rating methods ask people to indicate their preferences for individual products on a rating scale. Choice-based methods ask people to choose between two or more different products according to which product they most prefer.

The ACA Method for Eliciting Preferences

The ACA (Adaptive Conjoint Analysis) method combines elements of rating and choice-based methods for eliciting preference information. It is a computerized method in which people are shown two different product profiles, one on the left and the other on the right of the computer screen. Each product profile is composed of attributes, and the attributes vary by level. For example, backpacking and fishing could be two levels of the attribute "recreational activity". Below the product profiles is a rating scale. Respondents are asked to indicate which product profile they prefer and to indicate the strength of their preference by supplying a number between 1 and 9 shown on the scale, where 1 indicates strong preference for the left-hand side product, 9 indicates strong preference for the right-hand side product, and 5 indicates indifference between the two products.

The information obtained from observing trade-offs is expected to be greater for product pairs with similar utility than for product pairs with very disimilar utility. ACA customizes the iterative presentation of profile pairs for each respondent based on prior responses and predicted utility. The estimated difference in the utilities of the pairs is minimized subject to the constraint that the array of levels is balanced in an "almost orthogonal" fashion (Green, Kreiger & Agarwal, 1991). This procedure attempts to move to points of indifference in an efficient manner.

ACA is one of the most frequently used conjoint analysis methods for commercial marketing research and was the most frequently used method in Europe between 1986-1991 (Huber *et al*., 1993). Recently, the ACA method has been used for estimating willingness to pay for environmental preferences (Johnson & Desvouges, 1997) and for measuring multiple benefits of forests (Zinkhan, Holmes & Mercer, 1997). Because of its proven reliability for marketing research and its potential for environmental valuation, the ACA method was selected for this research.

Deriving Willingness to Pay Estimates from ACA

A utility-theoretic interpretation of a conjoint model views individual preferences as the sum of systematic and random components:

$$V_{ij} = v_i\left(X_j, Z_i, p_j; \beta\right) + \varepsilon_{ij}, \qquad (1)$$

where V_{ij} is the true but unobservable indirect utility of commodity bundle j to individual i, v_i is the systematic component of indirect utility, X_j is a vector of attribute levels, Z_i is a vector of individual characteristics, p_j is the cost of the commodity bundle, β is a vector of attribute parameters, and ε_{ij} is a random error term with zero mean[1]. A linear preference function can be specified as:

$$V_{ij} = r_{ij} = \sum_j b_j X_j + \lambda p_j + \varepsilon_{ij} \tag{2}$$

where r_{ij} is individual *"i's"* rating of the bundle containing attributes *j*, the b_j 's are preference parameters, and $-\lambda$ is the marginal utility of money. Economic theory states that an increase in price decreases utility holding all other attributes constant, so we expect *a priori* that $\lambda < 0$.

In the ACA method, respondents evaluate the difference between two product profiles simultaneously. We can rewrite equation (2) in terms of differences:

$$dV_{ij} = \Delta r_{ij} = \sum_j b_j \left(X_{jm} - X_{jn} \right) + \lambda \left(p_m - p_n \right) + e_{ij} \tag{3}$$

where dV_{ij} is the utility difference, Δr_{ij} is the ratings difference between X_{jm} and X_{jn}, X_{jm} is attribute level *m* for attribute *j*, X_{jn} is attribute level *n* for attribute *j*, p_m is price level *m*, p_n is price level *n*, and e_{ij} is the associated disturbance term. If X_j is a continuous variable, the difference $X_{jm}-X_{jn}$ is also a continuous variable. If attribute levels are categorical, X_j is a dummy variable indicating whether or not that attribute level appears in the commodity bundle.

From equation (3), marginal utility values can be directly derived from the parameter vector *b*: $b_j = dV_{ij} / dX_j$ and the marginal rate of substitution between attributes $j = 1$ and $j = 2$ is b_2/b_1. By including cost as an attribute in the product profiles, the marginal utility of other attributes can be rescaled in dollar terms. Willingness to pay for any particular attribute *j* is estimated as b_j / λ.

We introduced a complex pricing problem in the experimental design. Daily trip expenditures were used to compute WTP values for general trip attributes such as lodging, traffic congestion and the degree to which the landscape was covered by forests. Site access fees were used to

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[1] The indirect utility function *V* is assumed to be: (i) continuous, (ii) strictly quasi-convex, (iii) homogeneous of degree zero in prices and income, (iv) decreasing in prices, (v) increasing in income, and (vi) thrice continuously differentiable in all arguments (Johansson, 1987). Below, we identify violations of the property that *V* is decreasing in prices.

compute WTP values for the nature park attribute. We anticipated *a priori* that the marginal rate of substitution between these expenditure categories would be unitary if respondents did not answer strategically or associate higher expenditures with omitted attributes. As discussed below, we found that this expectation did not hold.[2]

A Varying Parameter Utility Model

The model specified in equations (1) through (3) assumes that the utility function parameters are the same for all respondents. This supposes that all people use the same decision rules or, if people use different decision rules, that cognitive differences are captured in the model error term. We propose that people who invest a greater amount of time responding to CJ questions are likely to use a compensatory (i.e. trade-off) decision-rule and people using less time use non-compensatory strategies such as conjunctive decision rules (eg., satisficing, impulse-buying), and that the effect of different decision rules will be observed in utility parameter estimates as well as disturbance terms.

To test the hypothesis that utility parameters vary systematically with the amount of time respondents invest in information processing, we modify the above model by interacting response time for individuals (τ_i) with the commodity attributes. Parameters are modeled as a linear function of τ_i:

$$\begin{aligned} b_{ij} &= c_{ij} + d_{ij}\tau_i \\ \lambda_i &= e_i + f_i\tau_i \end{aligned} \tag{4}$$

where c_{ij} and e_i are location parameters that aren't influenced by τ_i and d_{ij} and f_i measure the effect of response time on marginal utility. Substituting equation (4) into equation (3) we obtain:

$$\begin{aligned} dV_{ij} \equiv \Delta r_{ij} = \textstyle\sum_j \left(c_{ij} + d_{ij}\tau_i\right)\left(X_{jm} - X_{jn}\right) + \\ \left(e_i + f_i\tau_i\right)\left(p_m - p_n\right) + e_j. \end{aligned} \tag{5}$$

[2] In a study of deer hunting attributes, Mackenzie (1990) found that the marginal rate of substitution between per-trip expenditure and the cost of a hunting license was about 0.25. He suggests that this may be due to either protests against higher license fees or other omitted attributes such as fancier meals associated with higher trip expenses.

If response time does not have a significant influence on utility, the varying parameter model collapses to the model in equation (3). As discussed below, a likelihood-ratio test that all time-interaction parameters equal zero, as well as t-statistics on individual parameters, provide strong evidence that response time systematically influences utility parameter estimates.

Estimation

In equations (3) and (5) r_{ij} is the absolute value of the ratings difference on a 1 to 9 scale minus 5 (the mid-point of the scale). The ratings difference variable r_{ij} takes on discrete integer values (0, 1, 2, 3 or 4). If responses reflect ordinal (not cardinal) utility, then ordinary least squares is not an appropriate estimator. For example, a response of "4" on the rating scale represents a higher intensity of preference than a "3", but does not necessarily represent the same cardinal difference as a score of "2" relative to a score of "1". With an ordinal scale, it is more appropriate to use an ordered probit model (eg., see Greene, 1993).

For this model, real differences in utility, dV_{ij} , are unobserved. What we do observe are ordinally ranked categorical variables. The relations between the utility differences and the ratings are given by:

$$\begin{aligned} r_{ij} &= 0 \quad \text{if} \quad dV_{ij} = 0 \\ &= 1 \quad \text{if} \quad 0 < dV_{ij} \le \mu_1 \\ &= 2 \quad \text{if} \quad \mu_1 < dV_{ij} \le \mu_2 \\ &= 3 \quad \text{if} \quad \mu_2 < dV_{ij} \le \mu_3 \\ &= 4 \quad \text{if} \quad \mu_3 < dV_{ij}. \end{aligned} \tag{6}$$

Equation (6) represents a form of censoring. The μ's are unknown parameters that are estimated along with the marginal utility parameters. The hypothesis that the μ's are equally spaced, and therefore the ratings are cardinal measures, is tested using a set of restrictions on the estimated μ's.

All respondents may not use the rating scale in the same way. Previous research has shown that people may anchor at different centering points (Mackenzie, 1993; Roe, Boyle

& Teisl, 1996) and the scale (inverse of the standard deviation, σ_i) of individual specific rating distributions may vary as well (Johnson & Desvouges, 1997). We test for these effects in two ways. First, we include τ_i as an explanatory variable in the model to account for potential anchoring associated with response time.[3] Second, we estimate a heteroskedastic model where the variance of the disturbance term e_i is a function of individual characteristics. In particular, we specify a multiplicative form: var $[e_i]$ = $[\exp(\gamma' Z_i)]^2$. The probability of a rating equaling value k is then:

$$\Pr\left(r_{ij} = k\right) = \Phi\left[\left(\mu_k - dV_{ij}\right)/\sigma_i\right] - \Phi\left[\left(\mu_{k-1} - dV_{ij}\right)/\sigma_i\right] \quad (7)$$

where Φ is the normal cumulative distribution function and individual specific standard errors are functions of characteristics and response time, $\sigma_i\,(Z_i, \tau_i)$.

Study Area and Survey Sample

To develop the survey, we conducted a focus group with people in the United States who had recently taken a nature tourism trip to a foreign country. Focus group participants were asked to consider a list of nature tourism attributes and elucidate attributes that are important in choosing potential nature tourism destinations. A preliminary conjoint analysis survey was developed based on the list of attributes elicited from the group. The preliminary survey was pre-tested and revised in the study area in Brazil.

Survey sampling was conducted in the region around Ilhéus in southern Bahia, Brazil. Ilhéus is near the Una Biological Reserve, a small reserve (50 square kilometers) designed to protect the golden headed lion tamarin (*Leontopithecus rosalia chrysomelas*). Less than 5 percent of the original primary forest in this ecosystem remains. Conservation efforts in the region are trying to find viable means of protecting the remaining habitat for the lion tamarin and other species that depend on old-growth rain forests. Most primary forests are privately owned by cocoa farmers in the

[3] This is similar to the inclusion of individual specific mean ratings in the model by Mackenzie (1993).

region. The decline of world cocoa prices and cocoa production problems arising from the introduction of witches broom fungus have caused cocoa farmers to seek other economic opportunities. Nature tourism is one of the opportunities being considered.

According to state projections, tourism in Bahia will grow to become one of the most important economic sectors in the region by the end of the century. Current plans by the Inter-American Development Bank call for investments of hundreds of millions of dollars to develop the tourism industry and related infrastructure (roads, waste water treatment facilities) along the coast of Bahia. Planners in the study area think that southern Bahia can capitalize on this trend by marketing its unique primary forests and wildlife species.

Intercept survey procedures were used to conduct the computerized interviews for two reasons. First, Brazilian tourists who have chosen the region to visit have already revealed a preference for tourism attributes provided in the study area and are better able to evaluate new tourism options than people unfamiliar with the study area. Second, we are interested in understanding the Brazilian demand for rain forest protection as a sustainable component of tourism demand.

On-site interviews were conducted at local nature attractions, in local lodgings, and at the beach. Computer interactive interviews were conducted and consisted of two parts. First, respondents were asked about their current itinerary and to provide socio-economic information about themselves. Second, respondents were presented with an iterative set of pairwise comparisons regarding the tourism attributes they would prefer if they were to re-visit southern Bahia. Of the 215 interviews completed, 200 respondents were Brazilian and interviews were conducted in Portuguese by local Brazilian interviewers. The remainder of the interviews were conducted in English.

EMPIRICAL RESULTS

Attributes and attribute levels used in the paired comparison rating model are shown in Table 1 and summary statistics for the sample of tourists are shown in Table 2. Respondents were relatively young (mean = 36.5 years), well-

TABLE 1. ATTRIBUTE LEVELS.

Description of the attributes and attribute levels used in the paired-comparison rating model.

ATTRIBUTE	DEFINITION	LEVELS
Forest_cover	Amount of forest remaining (%)	50, 100
Entrance_fee	Cost for site access per person ($)	5, 10, 20, 25
Daily_expend	Food and lodging cost per person ($)	25, 50, 100, 150, 200
$Congest_1$	Rare traffic congestion (dummy variable)	0, 1
$Congest_2$	Occasional traffic congestion (dummy variable)	0, 1
$Congest_3$	Frequent traffic congestion (dummy variable)	0, 1
Lodging	Nice lodging with air conditioning	0, 1
$Nature\_park_1$	Forest reserve with many large trees; view birds and lion tamarins; biologist leads short nature walks; guides lead longer walks (dummy variable)	0, 1
$Nature\_park_2$	$Nature\_park_1$ plus a walkway constructed in the forest canopy (dummy variable)	0, 1
$Nature\_park_3$	$Nature\_park_2$ plus a botanical garden; tour a working cocoa plantation; learn about management systems, history and lore (dummy variable)	0, 1

TABLE 2. SUMMARY STATISTICS.

Summary statistics for a sample of tourists in Southern Bahia, Brazil.

VARIABLE	DEFINITION	MEAN	STD. DEV.
Rating	Conjoint rating	2.10	1.43
Time	Time spent in exercise (min.)	9.21	8.73
Income	Monthly income ($)	2294.44	1034.48
Age	Respondent age (years)	36.45	10.93
Education	Dummy variable, 1 = has some college, 0 = otherwise	0.64	0.48
Nature	Dummy variable, 1 = nature tourism, 0 = otherwise	0.30	0.46
Beach	Dummy variable, 1 = beach tourism, 0 = otherwise	0.37	0.48
Culture	Dummy variable, 1 = cultural tourism, 0 = otherwise	0.02	0.13
Friends	Dummy variable, 1 = visit friends, 0 = otherwise	0.04	0.19
Shopping	Dummy variable, 1 = shopping, 0 = otherwise	0.01	0.10

Table 3. Frequency Distribution of Ratings as a Function of Response Time.

Ratings are adjusted for the paired comparison design by subtracting the midpoint of the 1–9 rating scale and taking the absolute value; row percentages are in parentheses and sum to 1.

	Adjusted Rating				
Response Time (Minutes)	0	1	2	3	4
time < 5	151 (.247)	189 (.308)	100 (.163)	57 (.093)	116 (.189)
5 ≤ *time* < 10	15 (.185)	11 (.136)	24 (.296)	12 (.148)	19 (.235)
10 ≤ *time* < 15	12 (.037)	85 (.258)	73 (.222)	68 (.207)	91 (.277)
15 ≤ *time* < 20	5 (.048)	16 (.152)	30 (.286)	9 (.086)	45 (.429)
20 ≤ *time*	13 (.087)	23 (.154)	24 (.161)	28 (.188)	61 (.409)
Total	196 (.153)	324 (.254)	251 (.197)	174 (.136)	332 (.260)

χ^2 statistic: 173.806*** *** Significant at the 0.01 level

educated (64% had some college education), and had above average incomes ($2294 per month). Most respondents were visiting the study area primarily for beach recreation (37%), followed by nature tourism (30%), visiting friends (4%), cultural tourism (2%) and shopping (1%). Business and other reasons accounted for the remainder of visits.

Frequency distributions of paired comparison ratings for selected time categories are shown in Table 3. Although the proportions of ratings falling in the different categories are roughly similar in total, differences appear when responses are arrayed across time. As the amount of time invested in the conjoint task increased, the proportion of indifferent (adjusted rating = 0) and weak preference (adjusted rating = 1 or 2) responses decreased and the proportion of strong preference responses (adjusted rating = 3 or 4) increased. A chi-square test of independence rejected the null hypothesis that the rows (response time) and columns (intensity of preference) were statistically independent. As involvement increased (as measured by response time) intensity of preference increased as well. This result supports previous analyses concluding that respondents anchor at different points on the rating scale. However, our new results show that different anchors reflect the degree of respondent involvement.[4] These results also indicate that the ACA method was less successful in moving respondents towards points of indifference as response time increased.

The effect of response time on utility parameters can be seen by comparing the results of the standard and varying parameter ordered probit models shown in Table 4. As can be seen, τ is associated both with anchoring points that locate utility functions in parameter space and with marginal utilities or slopes of the response surface. The fit of the varying parameter model is better than the standard model using the percentage of correct predictions, the log-likelihood function and the χ^2 statistic as criteria. A likelihood ratio test, conducted by restricting the time interaction parameters to equal zero, rejects the restricted model at the 0.001 level. The t-statistics indicate statistical significance for most, but not all, of the time varying parameters. These results provide strong evidence that utility parameter estimates were influenced by the degree of respondent involvement and suggest that respondents used more than one decision making strategy.

The heteroskedasticity correction shows a number of independent variables are statistically significant in explaining the variance of the model error term and shows how different individuals interpreted and used the range of values on the rating scale. A likelihood ratio test rejected the hypothesis that the threshold parameters (μ's) were cardinal variables, supporting the conclusion that respondents viewed the response amounts as ordinal numbers.

Marginal Utility of Money

Estimates of the marginal utility of money are provided by the parameter estimates on daily expenditures and site access fees. These parameters represent the change in respondent utility with respect to dollar changes. As can be

[4] Anchoring in the contingent valuation literature refers to bias towards the starting point bid which is the experimental stimulus in dichotomous choice questions. In contrast, here anchoring refers to the propensity to distribute iterative responses around a subjectively determined central point on the conjoint rating scale.

TABLE 4. ORDERED PROBIT ESTIMATES.
Maximum likelihood estimates of standard and varying parameter models.

VARIABLE	STANDARD MODEL		VARYING PARAMETER MODEL	
	Coef.	Std Dev.	Coef.	Std Dev.
Constant	1.125	0.076***	0.714	0.099***
ΔForest_cover	0.005	0.001***	0.007	0.002***
ΔForest_cover × τ			−0.0003	0.0002***
ΔEntrance_fee	0.006	0.004	0.015	0.004***
ΔEntrance_fee × τ			−0.001	0.0004***
ΔDaily_expend	−0.002	0.0005***	−0.003	0.0006***
ΔDaily_expend × τ			0.0001	0.00005**
$Congest_1$	0.004	0.083	0.125	0.094
$Congest_1 \times \tau$			−0.013	0.009
$Congest_2$	−0.251	0.079***	−0.300	0.099***
$Congest_2 \times \tau$			0.011	0.008
$Congest_3$	0.549	0.227**	−1.050	0.897
$Congest_3 \times \tau$			0.088	0.059
Lodging	0.239	0.098**	0.359	0.106***
Lodging × τ			−0.024	0.009***
$Nature\_park_1$	−0.314	0.114***	−0.756	0.188***
$Nature\_park_1 \times \tau$			0.039	0.014***
$Nature\_park_2$	0.117	0.145	0.275	0.165*
$Nature\_park_2 \times \tau$			−0.020	0.016
$Nature\_park_3$	−0.221	0.177	−0.494	0.208**
$Nature\_park_3 \times \tau$			0.046	0.020**
Time (τ)			0.022	0.007***
μ_1	0.864	0.047***	0.727	0.070***
μ_2	1.401	0.053***	1.167	0.104***
μ_3	1.831	0.058***	1.517	0.132***
VARIANCE FUNCTION				
Time (τ)			−0.001	0.004
Income			−0.00008	0.00004**
Education			0.060	0.082
Age			0.003	0.003
Nature			−0.300	0.111***
Beach			−0.270	0.109**
Shopping			−0.221	0.254
Culture			0.356	0.321
Friends			−0.412	0.171
Business			−0.281	0.170*
N	1189		1189	
% correct predictions	0.278		0.327	
log–likelihood	−1834.901		−1763.567	
χ^2	99.658***		233.623***	

*** Significant at the 0.01 level. ** Significant at the 0.05 level.
* Significant at the 0.10 level.

seen in Table 4, the marginal utility of money is very different as derived from the two expenditure categories. The parameter estimate on daily expenditure in the standard model has the expected negative sign. In contrast, the parameter estimate on entrance fee expense is positive (and statistically insignificant). This result does not conform with utility theory because it implies that an increase in the cost of site access increases utility, *ceteris paribus*.

For the varying parameter model, the time interaction parameter on site access cost is negative showing that increasing response time is associated with the theoretically correct (negative) sign. Two explanations are suggested for this result. First, respondents who invested more time may have been more careful in scrutinizing trade-offs and more likely to decouple attribute associations. Because high price can convey positive information about high quality, we conjecture that people making "impulsive" decisions coupled price with an assumed quality of nature parks. Other people were more careful in evaluating trade-offs and decoupled price from quality in a manner posited by neoclassical optimization. Second, because site access fees were described as supporting management and conservation in the potential parks, some people may have been registering support for the idea of park creation rather than an actual commitment to pay. This type of response would reflect the phenomena known as "yea-saying" in the contingent valuation literature.[5] More careful processing of trade-offs as evidenced by increasing response time helped to mitigate these "neoclassical errors".

WTP for Nature Parks and Forest Protection

Parameters from the varying parameter model were used to compute WTP for nature parks and forest protection as the ratio of two linear, time-dependent functions:

$$WTP_j = \left(c_j + d_j \times \tau\right) \Big/ \left((-1) \times \left(e + f \times \tau\right)\right). \tag{8}$$

[5] Mitchell & Carson (1989) suggested that yea-saying, or "the tendency of some respondents to agree with an interviewer's request regardless of their true views" may influence contingent values elicited by dichotomous choice (pp. 240–241). In our conjoint experiment, people who are using non-compensatory decision rules may accept the interviewer's "request" of higher site access fees and reject lower fees if they hold value for nature sites and think that survey responses can influence the social agenda for park creation.

Because the parameters on the right hand side of equation (8) are random variables, WTP is also a random variable. Estimates of mean WTP and its standard error were obtained using a simulation method proposed by Krinsky & Robb (1986). The model parameters and associated variance-covariance matrix were used to resample 1200 times from the joint parameter distribution. For each replication, WTP was computed using equation (8). The 1200 WTP values were used to compute the mean and standard deviation of the simulated distribution.[6] Economically insensible observations were excluded from the WTP estimates. Following the modification proposed by Kling & Sexton (1990), we required that WTP could not be negative. We also required WTP to be less than monthly income and that marginal utility of money be positive.

Mean WTP for the described nature parks and for protection of the remaining 14,000km^2 of rainforest are shown as a function of response time in Figure 1. As can be seen, WTP for nature parks are complex, non-linear function of response time. This is likely due to the complexity of the dual pricing structure and the use of multiple decision rules. In general, estimates of mean nature park WTP converge to stable values as response time increases. Nature park WTP estimates for response times less than about 13 minutes were uninformative, either because they did not meet the requirements of economic sensibility and were omitted or they had not converged to stable values. Estimates of the coefficient of variation (mean divided by the standard error of the mean) were generally large (ranging between 0.31 and 7.05) for the values shown in Figure 1, and reflect the complex form of our WTP estimates as shown in equation (8).

Trimmed means of informative nature park WTP values were computed by taking the weighted average of mean WTP values for response times exceeding a threshold value of 13 minutes. Trimmed mean WTP values for Brazilian tourists for access to new nature parks range from \$22.08 for $Nature\_park_1$ to \$58.52 for $Nature\_park_2$ to \$86.21 for $Nature\_park_3$. These values bound the estimates reported by Tobias & Mendelsohn (1991) regarding the value of a tropi-

[6] Because the simulated values are for mean WTP, the standard deviation of this distribution is the standard error of the mean.

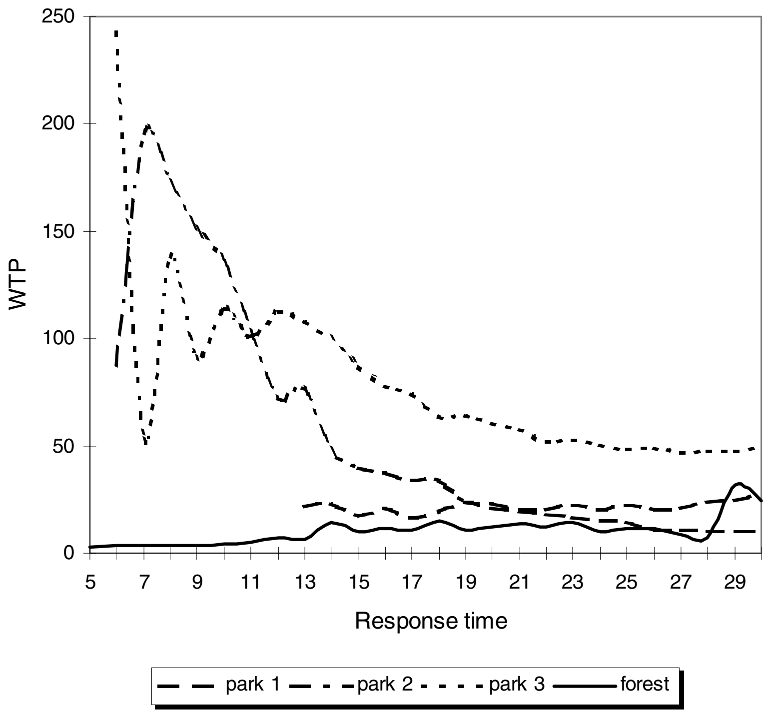

FIGURE 1. WTP AS A FUNCTION OF RESPONSE TIME

Mean WTP estimated using 1200 random draws from the joint distribution of parameter estimates for the varying parameter heteroskedastic model; estimated WTP remains relatively stable for values greater than 30 minutes.

cal rain forest reserve to domestic tourists in Costa Rica ($35/person/visit).[7]

As can be seen in Figure 1, WTP estimates for forest protection were more stable than WTP nature park estimates. Although forest protection WTP estimates showed an upward trend as response time increased, all estimated mean WTP values met our requirements for economic sensibility and were thus included. Our weighted estimates showed that Brazilian tourists to the area would be willing to pay $9.08 per person to protect (one-half of) the remaining 14,000 km^2 of Atlantic Coastal Forest in the region.[8] Al-

[7] The travel cost method was used to estimate economic welfare in the study by Tobias and Mendelsohn.

[8] All respondents rejected a scenario of 100 percent reduction of the remaining forest as unacceptable. Consequently, our estimate reflects the value of protecting one-half of the remaining forest.

though our survey is not a random sample of Brazilian tourists in the study area and our sample did not include non-visitors to the area that may have positive WTP for forest protection in this region, this result suggests that private forests in the region produce public goods in the form of positive externalities. This estimate can provide a starting point in understanding non-use values associated with forest protection to Brazilians.

CONCLUSIONS AND IMPLICATIONS

Our results extend previous conjoint analyses of environmental values by showing that: (1) response time was associated with the tendency to anchor at different points on a rating scale, (2) response time directly influenced utility parameter estimates used to compute WTP, and (3) increasing response time was associated with economically sensible results in the sense that utility parameters were consistent with compensatory decision strategies. Conversely, observations with shorter response times were not consistent with compensatory decision strategies and could not be used to estimate meaningful WTP values for nature parks with complex prices.

Implicit values for respondents who invested little time in the interview likely reflect the use of heuristic decision rules. Time-constrained choices are probably quite common for many consumer decisions. Consumer choices may proceed by first evaluating the relative importance of the choice situation itself and the degree of effort the consumer is willing to invest. Potential consumers who are not motivated to carefully scrutinize trade-offs may conserve mental effort by using non-compensatory decision rules and provide observations that violate the theoretical validity of economic value estimates. Obtaining meaningful WTP estimates for this segment of the population remains problematic.

Conjoint analysis is a relatively new method for valuing changes in environmental quality. It provides the environmental analyst the opportunity to value multiple dimensions of environmental quality simultaneously. This design is similar to but potentially more efficient than earlier approaches such as contingent valuation. However, conjoint analysis is not a panacea for stated preference approaches to non-market valuation and may be subject to some of the same problems concerning bias. In addition, the complexity of the multi-dimensional trade-off problem presented to CJ respondents may introduce new concerns over the utility theoretic interpretation of the data. However, the relative richness of CJ data provides the opportunity to conduct tests of theoretical validity and to trim observations that do not conform to theoretical standards.

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