Chapter Ten

Valuing Tropical Rainforest Protection Using the Contingent Valuation Method

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Introduction

In the last several decades, the intensity and scale of forest exploitation have increased significantly. A large number of developing countries experiencing increasing deforestation trends are also facing acute shortages of fuelwood, fodder, industrial timber, and other forest products for domestic use. Besides potential environmental degradation, depletion of forests and trees may exacerbate poverty, displace indigenous populations, and impede agricultural productivity. Deforestation, especially in the humid tropics, has serious regional and global implications (potential climate change, loss of biodiversity, and degradation of large watersheds).

To address these problems, a cooperative effort on a global scale is needed to assist countries in implementing effective, long-term forest conservation and management programmes. An essential element of this effort is the establishment of an international fund to provide financial support for initiatives to stabilize forests in developing countries. Given that many countries with urgent forest resource problems have limited financial resources and many of the benefits of improved forest management and conservation are global in nature, a strong argument can be made for international cost-sharing (see for example Sharma *et al.*, 1992).

Governments that provide financing for development and conservation programmes are interested in knowing the extent of public support for such activities. To assess the economic value of benefits to US residents from rainforest protection activities in the tropics, a national mail survey was employed. These benefits were estimated with the contingent valuation method (CVM), a non-market valuation technique widely used to value environmental amenities (Smith, 1993). Most applications of CVM have been directed toward assigning economic values to local, regional, or national environmental goods. This study represents one of the first applications of CVM for a global environmental good. This chapter describes the design and implementation of the survey and presents analysis of the results.

Rationale for the Study

The protection of tropical forests generates a wide variety of market and non-market benefits. The benefits include consumptive uses such as timber, medicinal plants, and forage (if a protection scheme allows extraction) as well as non-consumptive uses such as tourism and watershed protection.[1] Identifying the beneficiaries and measuring benefits for these goods and services is relatively straightforward. However, tropical forest protection may also produce another flow of benefits that are global in nature. The increasing concerns in developed countries about the role that tropical forests play in carbon cycles, climate regulation and genetic resource conservation produce another class of beneficiaries who live thousands of miles from the locales where protection activities take place.

As a result, many of the benefits of rainforest protection efforts accrue outside the country where the protection costs are incurred. While some of these benefits can be derived from future pharmaceutical and other consumption products developed from protected species, other benefits are more intrinsic in nature (Van Schaik *et al.*, 1992). Many people value tropical forests and the biodiversity they contain, even if they have no planned direct use of the forests or their products. Economists refer to this as existence value and point to contributions to organizations such as the World Wildlife Fund as evidence of the importance of these economic values. Contributions to environmental organizations may, of course, also reflect use motivations to the extent that the organizations provide information and other private goods (e.g. T-shirts, bumper stickers, and magazines) to members.

Identifying these distant beneficiaries and measuring their willingness-to-pay for rainforest protection is a challenging task for economic analysts. We are aware of only one previous study which examined this issue. Epp and Gripp (1992) surveyed Pennsylvania residents and applied the CV method to estimate mean household willingness-to-pay to protect all remaining tropical forests. They resurveyed many of the same households 10 months later to examine the stability of preferences and reliability of CV estimates. They did not report mean bids, but did conclude that respondents gave similar answers to each round of the survey.

The purpose of our survey was: (i) to measure the willingness-to-pay of US residents for preserving a portion of the world's tropical forests, (ii) to determine the attitudes toward issues concerning tropical rainforest preservation and management (such as compensation). Of course, many of the benefits of biodiversity protection occur in places other than the United States, especially Europe, so this survey provides a pilot study to explore whether or not the CVM is workable for valuing a global good of this nature.

Conceptual Framework

Our empirical effort to value rainforest protection is based on welfare concepts of environmental economics. A fundamental assumption of environmental economics is that the neoclassical concept of economic value based on utility maximization behaviour can be extended to non-market goods. In particular, an individual or household should demand greater or lesser quantities of an environmental amenity if a variable price for the amenity exists. Hence, if one can estimate shadow prices for the amenity and trace out a demand curve, the familiar concept of consumer surplus can be used to assign economic value. Some non-economists prefer to base economic values of rainforests and other ecosystems on something other than changing human preferences. They argue that given the ecological richness and uniqueness of tropical ecosystems, attempts to assign economic values may divert attention from ethical imperatives to preserve as much of the remaining forests as possible (Ehrenfeld, 1988). The environmental economics literature holds that environmental valuation calculus can only be defensible if all market and non-market goods are valued from the trade-offs humans make based on their individual preferences (Braden and Kolstad, 1991).

While few environmental economists would argue that decisions about levels of environmental protection should be based on economic efficiency criteria alone, the monetization of environmental benefits can provide useful information for the mostly political allocations of environmental protection funds. Given the debate surrounding the Convention on Biodiversity at the Rio Conference (Hass *et al.*, 1992), it is clear that policy makers are concerned about the level and distribution of benefits and costs associated with rainforest protection and development.

We assume that households maximize utility subject to an income constraint by choosing a bundle of market and non-market goods. If one of the non-market goods is a public good called rainforest protection, then willingness-to-pay will be a function of the price of rainforest protection, prices of other goods, income, and household tastes. We hypothesize that these tastes will be conditioned by a variety of socio-economic characteristics including household size, political party affiliation, and environmental attitudes.

Contingent Valuation Model

The empirical CVM model used in this study is based on two different approaches. Given the lack of consensus in the literature about the question format for CV questions (Mitchell and Carson, 1989), a split-sample experiment was conducted. Half of the sample was presented with a referendum style question, and half received a payment card style question. The application of referendum CVM questions requires a discrete number of sub-samples. Each sub-sample is asked whether or not they

would be willing to pay a specified amount for the particular non-market good and they respond either "yes" or "no". The probability that an individual's willingness-to-pay (WTP) is greater or less than the offered bid amount is estimated with a logit regression model. The logit model creates a function that depicts the probability that WTP values will exceed offered bid amounts. The total WTP is then estimated as the area under the probability function[2]. By including other explanatory variables in addition to the offered bid in the logit model, we explore how income and other explanatory variables influence the demand for rainforest protection.

The other half of the sample was presented with a payment card question format (Mitchell and Carson, 1989). With this approach, each respondent is presented an array of different dollar amounts starting with zero and asked to circle the amount closest to their WTP. One way to calculate mean WTP from payment card responses is to take a simple average of the circled amounts. Cameron and Huppert (1989) have argued that circled amounts may not reflect the maximum amount that people are willing to pay, but simply reflect the interval within which the maximum WTP lies. We follow their approach and use a censored regression model from which a mean predicted WTP can be calculated. As with the logit analysis of the referendum responses, explanatory variables can be included to identify demand shifters. Willingness-to-pay estimates based on each approach will be presented below.

Survey Design and Implementation

The survey was developed and refined through the use of focus groups, review by experts[3], and a mail pre-test. The survey conveyed information on reasons why rainforest conservation is advocated by some, and why forest conversion to other land uses is advocated by others. It contained questions on ranking social problems and environmental problems, questions about familiarity with and causes of deforestation, contingent valuation questions, and socioeconomic questions.

Focus groups are often used to refine and test survey instruments. This is particularly important when the topic is novel, such as asking people to assign economic values to goods they are not accustomed to purchasing. For this study, three focus groups were conducted. One group was recruited from non-faculty, university staff. The other two groups were recruited from members of church groups. The focus groups were used in part to refine the amount and type of information about tropical rainforests presented in the survey. This enabled us to balance the information on why some people may want to save rainforests and others might what to cut rainforests. Exercises were also conducted to define the good to be valued. Initially, we asked focus group members to allocate their preferences and WTP across different regions (Africa, Asia, Latin America). We found that most people were comfortable valuing tropical rainforest in general but not for specific regional or country subcomponents. Thus, our final good was the creation of parks and reserves to protect 110 million

acres (or 5%) of the remaining rainforests (in addition to the 5% already preserved). The World Wildlife Fund estimates that at least 10% of all rainforests should be preserved in national parks or nature reserves to ensure survival of representative samples of the tropical rainforest ecosystem. The final major use of the focus groups was the testing of alternative payment vehicles. We experimented with higher taxes, higher prices, and donations to non-profit organizations. After extensive discussions with the focus groups participants and contingent valuation experts, we settled on the following payment vehicle: a hypothetical United Nations Save the Rain Forests Fund. A pre-test was employed with a national mail sample of 100 households.

The final version of the survey was mailed to a random sample of 1200 US residents between April and June 1992. A mailing list was purchased from a commercial marketing firm. The sampling frame was all households with listed telephone numbers. In total 542 surveys were returned. Correcting for bad addresses (approximately 15%), the response rate was 56%. The design and implementation of the survey followed the Total Design Method developed by sociologist Dillman (1978), including the use of three follow-up mailings.

Socioeconomic Characteristics and Environmental Attitudes of Survey Respondents

This section reports on the socioeconomic characteristics of respondent households as compared to summary statistics for the overall US population reported in the Statistical Abstract of the United States, 1992 (US Bureau of the Census).

The respondents exhibited characteristics quite similar to the overall US population (see Table 10.1). The median income of the respondents was $31,500, whereas the 1990 median money income of all US households was $29,943. The median of school years completed by survey participants, 13.6, was slightly above that of the US population, 12.4 years in 1991. Average household size was 1.95 persons, somewhat smaller than the 1991 national average of 2.63. The respondents were overwhelmingly male (67%), which reflects the bias of drawing the mail sample from names in telephone directories. Most American households list their phone numbers in the name of male heads of households. The reported political affiliation of the surveyed sample was 32% Democrat, 31% Republican, and 33% Independent. Comparable percentages for the US in 1988 were 36%, 28%, and 36%. Therefore, the sample appears to be well representative of the US population except for the high proportion of males.

Tropical deforestation appears to be a well known issue among the general public. Ninety-one per cent of the respondents responded affirmatively to the question "Before today, have you ever read, heard, or seen TV shows about tropical rainforests?" and 81% claimed to be familiar with reasons for deforestation (see Table 10.2). This is not

Table 10.1: Socioeconomic Characteristics of Surveyed National Sample.

Number of Respondents: 542
Response Rate: 56%

Variable	Range	Median
Income	$7500-127,500	$31,500
Education	8-24 years	13.6 years
Age	18-95 years	47.9

Variable	Percentage of Respondents
Sex	
male	33%
female	67%
Conservation organization membership	25%
Political affiliation	
Democrat	32%
Republican	31%
Independent	33%
Other	4%

surprising since the timing of the survey was just before the Rio Conference when there was considerable media coverage of tropical deforestation and other international environmental issues. Two-thirds of the sample answered yes to the question: "Should industrialized countries help developing countries pay for preserving their rainforests". This has important ramifications for the ongoing political debate about the role of

industrialized countries in bearing some of the costs of environmental protection in less developed countries. A follow-up question asked what percentage of the costs should be borne by the industrialized world. The median response was 41%. Only 11% had visited a tropical rainforest and 8% planned to visit one in the future (another 31% were uncertain). This low percentage of visitors suggests that much of the willingness-to-pay discussed below must reflect non-use values. Of course, to the extent that individuals expect to consume pharmaceutical and other products derived from rainforests, non-visitors may hold use values as well.

Table 10.2: Percentage of Respondents Answering "Yes" and "No" to Questions about Knowledge of, Visits to, and Obligations to Pay for Rainforests.

	Yes	No
Any knowledge of rainforests	91%	9%
Knowledge of causes of deforestation	81%	19%
Previously visited a rainforest	11%	89%
Plan to visit a rainforest	8%	61%[1]
Should industrialized countries help developing countries pay for preserving their rainforests	67%[2]	33%

[1] 31% were uncertain if they would visit a rainforest in the future.
[2] For those responding "Yes", the percentage amount industrialized countries should pay ranged from 1-100% with an median of 41%.

To encourage the respondents to think about tropical deforestation relative to other social issues, we asked them to rank "general problems" on a 1 to 6 scale with 1 being most important. As shown in Table 10.3, the environment received the highest average ranking (2.85), followed by education (3.07), world hunger and poverty (3.13), the economy (3.34), crime (3.97), and drug abuse (4.15). It is of interest to compare these results with those of the Gallup Organization's 1992 Health of the Planet survey in which 11% said "Environmental problems were most important in the nation" (Dunlap *et al.*, 1992). In the Gallup survey, 53% rated environmental problems as "very serious".

Table 10.3: Relative Rankings of the Importance of 6 General Problems (1=most important . . . 6=least important).

Problem	Avg. Rank 1=most important 6=least important	Percentage For Each Rank					
		1	2	3	4	5	6
The environment	2.85	31	19	17	12	10	11
Education	3.07	16	22	24	19	13	7
World hunger and poverty	3.13	27	20	13	13	10	18
The economy	3.34	25	12	18	16	11	19
Crime	3.97	10	12	11	21	32	14
Drug abuse	4.15	9	13	14	15	21	30

In a similar fashion, respondents were encouraged to weigh tropical deforestation against other environmental problems by asking them to rank a variety of environmental problems. Highest rankings (indicating greatest importance) were given to air (2.63) and water pollution (2.73) (see Table 10.4). This is not surprising since the local effects of these problems are more pronounced than other problems in the list, and there may be a perceived greater link with the health of respondents and their families. Next in average order of importance were two international environmental problems that have received extensive media attention: atmospheric ozone depletion (3.47) and global warming (3.65). Considerably lower rankings were given to the other problems on the survey list: tropical deforestation (4.52), acid rain (4.60), and harvesting old-growth forests in the northwestern US (5.37). The above mentioned Gallup Survey reported the following percentages of US respondents saying the following world environmental problems were "very serious": air pollution (60%), water pollution (71%), contaminated soil (54%), loss of species (50%), loss of rainforests (63%), global warming (47%), loss of ozone (56%).

Table 10.4: Relative Rankings of Seven Major Environmental Problems. (1=most important . . . 7=least important)

Environmental Problem	Average Rank 1=most important 7=least important	Percentage For Each Rank						
		1	2	3	4	5	6	7
Air pollution	2.63	29	26	17	15	9	4	2
Water pollution	2.73	29	24	17	13	12	4	2
The hole in the ozone layer	3.47	29	12	13	12	12	11	12
The Greenhouse effect (global warming)	3.65	17	18	13	18	13	17	8
Tropical deforestation	4.52	8	7	12	15	24	24	12
Acid rain	4.60	6	8	18	12	18	15	23
Cutting ancient forests in the NW US	5.37	0	6	5	12	7	22	42

Factors Affecting Willingness-to-Pay

To examine factors affecting willingness-to-pay for rainforest protection, the CV responses were regressed against a number of socioeconomic and attitudinal variables. Results are given in Table 10.5 for both sub-samples. The first column indicates the effects of the variables on the dollar amount selected by the payment card respondents.[4] The second column shows the effects of the independent variables on the probability of saying yes to the offered bid by the referendum format respondents. Although the coefficients have different interpretations for the two different question formats, the results will be discussed jointly in terms of the direction of influence of the independent variables on WTP.[5]

Because of the inherent nature of the question formats, only the referendum model has a variable for the offered bid. The log of the offered bid has a negative and significant effect on the likelihood of bid acceptance. Hence, there is confirmation of the expected negative relation between price and quantity of rain forest protection.

Table 10.5: Maximum Likelihood Estimations of Responses to Willingness-to-Pay Questions.

	Payment Card Responses[1]	Referendum Responses[2]
Constant	-3.522 (-1.747)[4]	-15.914 (-2.641)[3]
Log of bid	---	-1.165 (0.229)[3]
Log of income	0.379 (1.904)[3]	1.426 (2.516)[3]
Political affiliation dummy	0.231 (0.769)	-1.190 (-1.857)[4]
Charitable contributions dummy	1.04 (3.045)[3]	2.194 (2.059)[3]
Rainforest visitor dummy	0.711 (1.943)[3]	-0.942 (-1.182)
Tropical deforestation dummy	-0.151 (-1.817)[4]	-0.230 (-1.015)
Old-growth forests dummy	-0.047 (-0.613)	0.377 (1.954)[3]
Cost-sharing dummy	1.921 (5.883)[3]	1.947 (2.464)[3]
Family size	0.190 (2.088)[3]	-0.018 (-0.083)
Number of observations	173	163
Goodness of fit	---	McFadden R^2 = 0.48 Correct Pred. = 89%

[1] Dependent variable is the log of the amount (ranging from 0 to $1500 which was circled.
[2] Dependent variable is the yes/no response to the offered bid level.
[3] significant at 5% level.
[4] Significant at 10% level.

Income has the expected positive effect on the WTP in both models. As incomes rise, there is a shift in the demand for this environmental good. Political affiliation has no significant effect in the payment card model, but in the referendum model Republican affiliation has a negative association with accepting offered bids. A dummy variable for whether or not respondents reported making charitable contributions during the

previous year has a significant and positive coefficient in both models. A dummy variable which reflects past or planned visits to rainforests increases the WTP in the referendum model. The ranking given tropical deforestation compared with other environmental problems (see Table 10.4) was also included as an independent variable. As expected, the more important the ranking (1 = most important), the higher the WTP in the payment card model (at the 10% significance level). Surprisingly, the importance given to the cutting of old-growth forests in the Northwest US had the opposite effect in the referendum model. One possible explanation is that people who are concerned about old-growth forests in the US may have more of a national focus and be less concerned about tropical forests, and hence have a lower propensity to pay for protection in the tropics. Respondents who said that industrialized countries should help pay for rainforest protection, had higher WTP in the payment card model and were more likely to accept offered bids in the other model. Finally, family size had a positive relationship with WTP in the payment card model perhaps indicating a bequest or intergenerational equity motive.

Willingness-to-Pay

Estimated willingness-to-pay is shown in Table 10.6. In contrast to a split-sample survey on the Southern Appalachian spruce-fir forest (Holmes and Kramer, 1995), the two different question formats gave similar WTP estimates for rainforest protection. The referendum format yields a mean WTP per household of $24, while the payment card format gives a mean WTP of $31 per household. Aggregating over 91 million households in the US gives a total WTP of $2.2 billion and $2.8 billion for the two methods. While this total figure appears quite large, it should be viewed in context. Recall that the CV question asked for a one-time contribution. Hence the $2.2-$2.8 billion dollars can be thought of as a revolving fund that would be used over a number of years to finance tropical forest programmes. If one makes a more conservative assumption that only households with at least $35,000 in annual income would actually donate to the fund, then the aggregate WTP would be $0.8-$1.0 billion.

Conclusions

This study represents an application of non-market valuation methods to a global environmental good. Most previous applications of contingent valuation have focused on local or regional environmental goods. The results suggest that US residents are able to respond to valuation questions about the value of tropical rainforest protection and to give consistent responses across two different CV formats.

Table 10.6: Willingness-to-Pay Estimates for Tropical Rainforest Preservation.

Type of Question Format	Mean WTP ($/household)	Total WTP (all households)[1]	Total WTP (income > $35,000)[2] (income > $25,000)[2]
Referendum	$24	$2,184,000	$ 780,000,000 $1,131,000,000
Payment Card	$31	$2,821,000	$1,007,000,000 $1,461,000,000

[1] Assuming 91,000,000 million households in US in 1989 (US Bureau of Census).
[2] Based on income distribution in 1989 (US Bureau of Census).

Perhaps the most interesting policy finding is that two-thirds of the households said industrialized countries should share the costs of protecting remaining rainforests. The Biodiversity Convention signed by most countries attending the Rio Conference was based in part on a principle of shared costs between beneficiaries in industrialized and less developed countries. Our results suggest that the US public supports this international financing approach.

For our sample, tropical deforestation ranked below most other environmental problems, perhaps reflecting a higher priority for domestic environmental issues. Despite this low relative ranking, households are willing to contribute between $24-$31 on average. This could create a substantial global fund if households in other industrialized countries are willing to make similar sized donations. For both methodological and policy information purposes, it would be of interest to replicate this study in other countries to determine if the willingness-to-pay for global environmental goods varies across countries with similar income levels for cultural or other reasons.

Endnotes

1. See Kramer, Healy and Mendelsohn (1992) for a review of forest valuation.

2. There are a number of different approaches in the literature for empirically estimating WTP for referendum CV questions (Cameron, 1988; Cooper and Loomis, 1992; Hanemann, 1984, 1989; Johansson *et al.*, 1989). In our estimation procedures, we take the approach of assuming that WTP is a non-negative random variable. See Cooper and Loomis (1992) for a defence of this approach.

3. Without implicating them for any errors in our design, the authors appreciate the review of the survey instrument provided by Mimi Becker, Richard Dunford, Paul Ferraro, Bob Healy, Tom Holmes, Jan Laarman, Peter Principe, Dixie Reaves, Priya Shyamsundar, Kerry Smith, Stephen Swallow, and John Terborgh.

4. Respondents to the payment card version who circled $1000 (three people) or $1500 (one person) were considered outliers and dropped from the sample. Of these four individuals, three reported no contributions to environmental organizations in the previous year and one reported a $300 contribution. Furthermore, no bid amount above $400 was accepted by the respondents who received the referendum version of the survey.

5. The estimated regression coefficients for the payment card responses are marginal impacts on the dollar amount that respondents are willing to pay. The estimated coefficients for the referendum responses cannot be interpreted as marginal influences on the probability of accepting offered bids, but the sign of the estimated coefficients indicates the direction of influence.

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