

## **Tropical Forest Conservation: Attitudes and Preferences**

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### Abstract:

This paper applies contingent valuation to assess public awareness of tropical deforestation, to investigate the willingness to pay (WTP) to conserve tropical forests, and to determine the impact of the payment vehicle on the stated WTP of a sample of about 500 individuals in Geneva, Switzerland. About  $\frac{3}{4}$  of respondents state that they have already heard about tropical deforestation and biodiversity. People rank carbon storage as the most important contribution of tropical forests, followed by biodiversity and support to local communities. The mean stated WTP is about CHF 110.- per year. All other things being equal, the stated WTP is about 24% higher for a tax payment vehicle compared to a voluntary payment. Education and income have a positive impact on WTP. WTP is also higher when the respondent judge that the main contribution of tropical forest is towards biodiversity.

Keywords: Tropical forest; Contingent valuation; Willingness-to-pay; Biodiversity

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## **1. Introduction**

Environmental issues are currently at the forefront of global media and political debates. Around the world, people are increasingly aware that economic activity can generate significant environmental damages, with potentially serious repercussions for human welfare. Global climate change, especially, has been receiving increasing attention, but – as highlighted in the Millennium Ecosystem Assessment – many other ecological problems are also getting worse (MA, 2005). While many natural resources (e.g. food, timber, medicine, etc.) are valued through markets, other natural processes and ecosystem services (e.g. erosion control, carbon sequestration, plant pollination, etc.) are typically neglected in economic decision-making. When taking these ecosystem services into account, tropical forests can be seen as a global public good whose values largely extend beyond the reach of existing market transactions. The values of public goods can be grouped into two broad categories: use and non-use. Use values can be either direct (e.g. value derived through hunting and fishing), indirect (e.g. water filtration by upstream forest ecosystems), or optional (i.e. value derived from preserving the option of using an ecosystem service in the future) (for a detailed discussion, see Heal, 1999). Non-use values refer to the worth that people associate with ecosystems simply by knowing of their existence, even though they might never use the resource directly themselves. It is mainly these non-use values that have a truly global reach, as they are often enjoyed by people who are far removed from the area where the value is being produced (Albers and Ferraro, 2003).

Recent efforts have been made to capture the value of forest ecosystems through the development of payments for ecosystem services (PES) and related initiatives. With the growing concern surrounding climate change, interest is likewise growing for one particular ecosystem service, namely the sequestration of carbon in biomass. Carbon sequestration through the restoration and conservation of tropical forests is increasingly seen as a cost-

effective option for mitigating climate change and regulating the global climate. The potential benefits for biodiversity and rural development that could result from increased funding for tropical forests make this particular mitigation strategy appealing to a wide range of stakeholders.

In this paper, we analyze responses from a public survey of attitudes and preferences on the issue of tropical deforestation conducted in Geneva, Switzerland. The aim of the study is to (i) assess public awareness of tropical deforestation, (ii) investigate the willingness to pay (WTP) to conserve tropical forests and (iii) determine the impact of the payment vehicle on the stated WTP. In the following section, we outline the methodology and empirical approach that was used to design and implement the survey. The data collected through the survey is presented in section 3. In section 4, a bid curve analysis is conducted and the results are discussed in reference to the stated WTP. Finally, section 5 presents the main conclusions and policy implications.

## **2. Methodology and empirical approach**

The purpose of the study consists in gauging public attitudes and preferences towards tropical forests. Acknowledging the increasing attention being directed toward the role of deforestation in climate change, it was initially expected that respondents would demonstrate a significant willingness to ensure the conservation of these ecosystems, and probably more than in previous related studies.

There are several techniques that can be used for surveying attitudes and preferences for global public goods such as tropical forests. However, only stated preference techniques can estimate existence values in monetary terms. These survey mechanisms allow researchers to ask individuals about their WTP to continue receiving the services provided thus far, their WTP to enjoy an increase in these services, or their willingness to accept (WTA) compensation to forego these services or to accept a decrease in their provision. In this paper,

the analysis is based on a contingent valuation (CV) survey. CV is perhaps the most well-known and often used method for surveying stated preferences. There are several varieties to the CV method (CVM), which serve the purpose of deriving WTP from hypothetical situations concerning non-marketed goods and services (Bateman et al., 2002). Although this economic valuation technique is not without controversy, it is still applied in many studies to elicit the demand for non marketed goods. In particular, Carson (1998) shows that CV can be used to determine the WTP for global environmental goods such as tropical rainforests.

In the literature, there are some studies analyzing the WTP for avoiding tropical deforestation. Over ten years ago, a survey of citizens' opinions on tropical rainforest policy was implemented in the United States (Kramer and Mercer, 1997). This study was specifically designed to assess how people in the United States value the rainforests of the world, recognizing that they were distant beneficiaries of their conservation. In order to test for the influence of the question format, Kramer and Mercer (1997) used a payment card and a referendum question. Both instruments yielded similar estimates of the WTP for rainforests conservation: \$24 and \$31 per household as a one-off contribution to a hypothetical United Nations 'Save the Rainforests' Fund. The results of the Kramer and Mercer (1997) study suggest that people are effectively able to respond to valuation questions about tropical forests and that their answers are consistent across varying survey techniques. In 2003, Horton et al. performed a similar study in Europe (Italy and the United Kingdom) but considering a specific biome, the Amazon, as opposed to a general focus on the tropical forests of the world. The results show that the average household's WTP for preserving 5% of the Amazon was \$45 per year, and of \$60 for 20% protection.

As highlighted by Carson (1998), when using CVM it is particularly important to precisely define the non-marketed good and to communicate a plausible means of providing the stated environmental good. In our survey, respondents are given information about which tropical

forests are concerned (the survey contains a picture of the world showing where tropical forests are located), the pace at which they are disappearing, the services they provide to humans, and the main consequences of deforestation. The mechanism for protecting the forests is described as an international forest preservation programme that aims at protecting 100 million hectares of tropical forests, thereby reducing tropical deforestation by 50% during the next 20 years. The programme would be financed by contributions to an international fund from all developed countries and/or countries where deforestation is taking place. Respondents were asked to indicate in which proportion developed countries should contribute to the fund and which type of organisation should manage it (e.g. the United Nations, the World Bank, the Worldwide Fund for Nature (WWF) or the Swiss government). The money would be used to help local governments implement measures to reduce deforestation, for example by creating national parks or by providing incentives to local stakeholders to choose to preserve their forests instead of converting them into fields or pastures. An independent organization would control that the payments are used correctly. The costs of the programme are also described to the respondents.

Another important issue to be addressed relates to the specification of the payment vehicle, as it might strongly influence the respondents' stated WTP. CV studies typically use either a voluntary or a mandatory payment vehicle, both of which can cause a payment vehicle bias, particularly when used to value a public good. A voluntary payment vehicle, such as a donation to a fund, can provoke two major problems having opposite effects. The first problem is free-riding, which can result in low or even null contributions, as the respondents would like to benefit from the protection of tropical forests conservation without having to pay. The second problem is strategic behaviour, causing overbidding (Carson 1997 and Carson et al. 1999). Respondents state a high WTP in order to encourage the development of a tropical forest protection programme, but plan to revise their contribution once the

programme is actually implemented, eventually giving less than the amount they initially stated. The NOAA panel (Arrow et al., 1993) recommends the use of a mandatory tax instead of a voluntary payment to a fund when soliciting stated preferences. In particular, it is expected that the tax is more realistic, reduces the free-rider problem and deters strategic behaviour, while minimizing the variability of the responses. However, the tax has a non neutral effect on WTP. Also, people's generally negative attitude towards the introduction of any new tax can lead to an increase in the protest rate, whereby respondents refuse to indicate the sum that they might be willing to contribute to preserve tropical forests. Moreover, respondents may find donations to be a more credible payment vehicle than taxes, since the latter are not commonly used to finance the provision of global public goods. In their study on tropical forest valuation, Kramer and Mercer (1997) opted for voluntary donations to a fund, while Horton et al. (2003) used taxation as the mean of collecting funding. In the Bienabé and Hearne (2005) study on WTP for biodiversity conservation and scenic beauty in Costa Rica, foreign respondents expressed a stronger preference for voluntary payments (e.g. at hotels) for conservation as opposed to taxation (e.g. at the airport). Tests of the impact of the payment vehicle on the stated WTP are rare and come to divergent conclusions. Wisler (2007) compares the stated WTP for renewable energy under tax and voluntary payment vehicles. He finds that the stated WTP is higher with the tax payment vehicle. This result is confirmed by Champ et al. (2002), Bateman et al. (1995) and Jakobsson and Dragun (1996). It should however be noted that other studies, such as Ajzen et al. (1996), do not find the payment vehicle to have a statistically significant impact on WTP.

In order to test for the influence of the payment vehicle on WTP, we created two questionnaires, differing only in the choice of the payment vehicle. In both questionnaires, the money is to be managed by an international forest conservation programme. To finance the programme, one questionnaire proposes a yearly voluntary payment to an international fund,

while the other proposes the establishment of a yearly mandatory tax. In the case of the tax, it is clearly stated in the questionnaire that it would be implemented to cover the Swiss contribution to an international effort supported by all developed countries.

For both the voluntary and tax vehicles, we have to choose the format for the payment question. We opted for the payment card technique initially developed by Mitchell and Carson (1981). In this technique, respondents are given a range of values and asked to circle the maximum amount they are sure to be willing to donate or to pay as a tax to the tropical forest conservation programme. We chose the payment card rather than the dichotomous choice approach recommended by the NOAA panel (Arrow et al., 1993), because the first results in a more conservative WTP measure compared to the latter. Indeed, Ready et al. (1996), Ryan et al. (2004) and Blaine et al. (2005) among others have shown that the dichotomous choice method produces statistically higher WTP estimates compared to payment card approaches, as “yea-saying” tends to introduce an upward bias.

In order to estimate the WTP for the tropical forest preservation programme and to analyze its determinants, we estimated a functional relationship between stated WTP and a vector of socio-economic, knowledge, and attitudinal explanatory variables  $X_i$ . The empirical approach must, however, acknowledge that the payment card values represent interval data. Indeed, the respondent’s “true” WTP is included between the circled amount (the highest they are sure to be willing to pay) and the next highest option. Cameron and Huppert (1989) note that simple ordinary least-square (OLS) midpoint estimation would lead to biased results and propose interval regression methods. Here we follow the approach proposed by Cameron and Huppert (1989) and suppose that the conditional distribution of valuation for the tropical forest preservation programme is lognormal, as tropical forest preservation should have a non negative impact on people’s welfare and the distribution of WTP is right-skewed. There is

thus a linear in parameters expression that defines the logarithm of the “true” WTP of the  $i^{\text{th}}$  respondent as:

$$\log wtp_i = X'_i \beta + u_i, \quad (1)$$

where  $i = 1, \dots, n$  and  $u_i$  is the residual, assumed to be distributed normally with mean 0 and standard deviation  $\sigma$ . If the respondent’s “true” willingness to pay  $wtp_i$  lies within an interval defined by a lower threshold  $t_l$  and an upper threshold  $t_u$ , then the probability that the “true” WTP is located within the interval defined by the circled value and the next highest amount can be written as:

$$Pr(wtp_i \in (t_{li}, t_{ui})) = Pr\left(\frac{(\log t_{li} - X'_i \beta)}{\sigma} < z_i < \frac{(\log t_{ui} - X'_i \beta)}{\sigma}\right) \quad (2)$$

where  $z_i$  is the standard normal random variable. The probability in (2) can be rewritten as the difference between two standard normal cumulative densities. The joint probability density function can then be interpreted as a likelihood function:

$$\log L = \sum_{i=1}^n \log[\Phi(z_{ui}) - \Phi(z_{li})] \quad (3)$$

where  $z_{li}$  and  $z_{ui}$  represent the lower and upper limits in (2) and  $\Phi$  is the cumulative standard normal density function<sup>2</sup>. After estimating  $\beta$  and  $\sigma$ , the individual conditional fitted means of the WTP can be computed as  $\exp(X'_i \beta) \exp(\sigma^2/2)$ .

### 3. The data

We collected the data via a questionnaire divided into four main parts<sup>3</sup>. The first part contains questions testing the individuals’ knowledge and awareness of tropical deforestation. In part two, personal attitudes and motivations concerning environmental issues are investigated. Part three is the core of the questionnaire, as it aims to highlight the WTP to avoid deforestation. The final part of the questionnaire collects the individual’s socio-demographic characteristics. After the usual validation process and in order to test for the pertinence and understanding of

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<sup>2</sup> See Cameron and Huppert (1989) for further details.

<sup>3</sup> The full questionnaire (in French) is available upon request.

the questions by the respondents, the Geneva School of Business Administration students conducted face-to-face interviews with individuals in the streets of Geneva, Switzerland. The survey started on November 1<sup>st</sup> and ended on December 10<sup>th</sup> 2007. Initially, the voluntary payment vehicle sub-sample contained 312 observations and the mandatory sub-sample had 327, for a total of 639 observations. We eliminated 40 incomplete questionnaires, 19 observations of respondents who claimed they would pay a random amount and 13 outliers who stated a very high WTP (CHF 1'000 or more) also compared to their revenue (lower than CHF 20'000). Further we have excluded 59 protest zero bids (see discussion below), so we performed our analysis on 508 valid observations.

### *3.1 Sample socio-economic characteristics*

Table 1 summarizes the socio-economic and demographic characteristics of the sample and the sub-samples. We note that the composition of both sub-samples is very similar, except for a relatively lower proportion of Swiss individuals in the tax sub-sample. We will thus only discuss the results for the whole sample.

[Table 1]

With respect to the overall population of Geneva, the sample is representative with respect to gender (in the Geneva Canton the proportion of males is 48% and 52% are female), while they over-represent younger people (the survey target population is limited to residents aged 18 and older, who in Geneva are on average 47 years old)<sup>4</sup>. The share of Swiss residents (about 62% for the overall Geneva population) and the household size (in Geneva the average household is composed of 2.11 persons) are also a little larger in our sample. Concerning the

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<sup>4</sup> The data referring to Geneva are taken from the Geneva Cantonal Statistical Office (Ocstat) and refer to the available data in 2006, most data from <http://www.geneve.ch/statistique/>.

professional status, our sample slightly under-represents lower education levels (mandatory school and apprenticeship). The median value of the annual gross revenue is about category 4, which corresponds to revenue in the range between CHF 75'001 and CHF 100'000<sup>5</sup>. This figure compares with a median yearly salary for the private sector in Geneva of about CHF 76'000 and with an average yearly gross labour income of about CHF 82'000 in the Lemman region (cf. <http://www.bfs.admin.ch/>). Revenue in our sample is thus relatively similar to the one for the whole Geneva population. Rows 7 and 8 in Table 1 also report useful information concerning people's attitudes and motivations towards the environment and/or more general social issues. Table 1 reports that about 14% of the individuals in our sample are members of an environmental organisation and that about 70% of them have already donated money to a non-profit organisation. Those factors are of course expected to influence WTP for avoiding tropical deforestation.

### *3.2 Knowledge and attitudes*

Table 2 reports people's knowledge of the tropical deforestation problem and the importance that respondents attribute to this issue, relative to other problems. Individuals in our sample are well aware of tropical deforestation and biodiversity. Indeed, about  $\frac{3}{4}$  of the interviewed individuals state that they have already heard about both of those issues. We could be quite surprised by this high level of awareness. However, the survey was conducted just before the international climate change convention meeting of the parties (UNFCCC COP13) in Bali, and some media were reporting on the link between deforestation and climate change. Table 2 also shows that almost  $\frac{1}{4}$  of the sample has already visited a tropical forest, while about  $\frac{1}{3}$  is planning to visit one in the near future. This indicates that the sample is composed by people who are relatively well informed about tropical forests and thus the stated WTP should not be particularly biased by information problems. The data on people who have already

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<sup>5</sup> Currently, 1 CHF = 0.66 Euro and 0.92 US Dollars.

visited a tropical forest, as well as those who are planning to visit one, are important in order to test what determines WTP and to distinguish among different tropical forest values. Indeed, the WTP of the respondents who have visited a tropical forest and those who are planning to visit one could possibly be related to use and option values respectively, while the WTP reflects existence value only if the respondent has never visited a tropical forest and does not plan to do so in the future.

Concerning the importance of environmental issues relative to other problems, we explicitly asked the respondents to judge it relative to issues such as poverty, health, social security, international migrations, education and unemployment. About 40% of the sample judge that environmental problems are “very important” and about 50% state that they are “rather important”. Overall, a large majority of the individuals thus perceive the environment as an important issue. Looking at the relative importance attributed to various environmental issues, climate change is most often perceived as the most important issue, followed by water pollution, air pollution and deforestation. Those results confirm recent surveys on public perceptions towards environmental issues, which show a strong prominence of climate change as the most important problem to be addressed (Curry, 2004; Reiner et al., 2006; Curry et al. 2007; Asahi Glass Foundation, 2007). Accompanying the rise of climate change in the public consciousness, environmental issues as a whole are gaining in importance relative to other issues such as health care, crime, and education (see Curry et al., 2007).

One specific question asks respondents to rank the relative importance of the various main services offered by tropical forests. Given the prominence of climate change, it is not surprising that people rank carbon storage as the most important contribution of tropical forests. The other main perceived contribution is the preservation of biodiversity, while support to local communities is ranked third. It is interesting to note that tourism – which

represents the most direct and individual use value of tropical forests for developed countries' households – is ranked last.

[Table 2]

### *3.3 Financing of avoided deforestation and stated WTP*

Concerning the financial aspects of avoided deforestation, we firstly ask respondents who should finance the preservation of tropical forests. Nearly 25% of respondents express that developed countries should be the sole financiers, while only 4.5% state that developing countries alone should finance the preservation of tropical forests. The great majority (over 70% of the answers) indicates that both developed and developing countries should contribute to its financing. When an individual states that both countries should contribute to the total cost of preservation, they were asked to indicate what should be the countries' respective shares. Table 2 reports that the median contribution of developed nations proposed by respondents is 80%.

Another question in both the fund and tax questionnaires explicitly asks individuals their WTP to preserve tropical forests. Theoretically, the maximum WTP to avoid tropical deforestation is the change in income that would leave the respondent's utility unchanged if she either pays the amount and the conservation programme is implemented or keeps the money and the programme is not implemented. We elicit this information with a payment card that goes from CHF 0.- to CHF 1'000.- and over, in terms of a yearly contribution (see Table 3). The amounts indicated under the tax or the voluntary payment are thus perfectly comparable. Of course, one of the main problems with this kind of question is that people might not think too seriously about the amount that they indicate, since it does not correspond to a real financial payment, i.e. there is a hypothetical bias. In order to minimise such a bias,

we ask people to indicate the maximum amount they are sure to pay; the maximum amount they could eventually pay; and the amount that for sure they are not willing to pay. That way we are giving respondents an incentive to spend more time on considering their WTP and to hopefully put more thought into their answer.

As expected from the literature, we have a relatively high proportion of zero answers in both sub-samples. Indeed, from Table 3 we note that about 20% of respondents in the fund sub-sample and about 15% in the tax sub-sample refuse to pay anything at all. However, an answer indicating a WTP of CHF 0.- could have different motivations and interpretations. On the one hand, it might reflect the respondent's true preferences and thus her WTP would be situated somewhere between zero and the first positive amount proposed on the payment card (CHF 1.-). But on the other hand, respondents may state a zero WTP because they disagree with some part of the survey design, thus giving a protest zero bid, although the tropical forest might have a positive value for them. Protest zero bids do not give information on the respondent's preferences, and we have eliminated them from the sample<sup>6</sup>. To be able to isolate protest answers, we explicitly asked respondents to indicate their motivations for refusing to pay to preserve tropical forests. The answers "I do not think that it is important to preserve tropical forests", "I cannot afford to pay for the preservation of tropical forests", "There are more important causes to support first" or "I do already give enough money for good causes" are considered to indicate true zero responses, while people who state "Tropical forest preservation has a value for me, but it is not for me to finance the programme", "I think it is impossible to preserve tropical forests", "I would like to contribute to the preservation of tropical forests, but I am against new taxes", "I do not trust international organisations/the government" are considered protest answers. Respondents were asked to indicate their two

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<sup>6</sup> Please note that it is important to define zero bids which correspond to protest bids, and then eliminate them, because we are interested in investigating the true value that respondents attribute to tropical forests. As mentioned by a referee the strategy would have been different if our aim was to predict the outcome of a vote on the specific forest conservation programme described in the survey.

principal motivations for refusing to pay. Only the people who gave no non protest motivation are considered protest bids and eliminated from the sample, meaning that we use a conservative criterion to define protest bids and have eliminated a minimum amount of zero values. Table 3 shows that about 10% of respondents have given protest answers both in the individual (voluntary fund) and the collective (tax) payment sample. In the collective payment vehicle sub-sample, about 6% of respondents are not willing to pay anything because they are against the introduction of any new tax (not reported in Table 3). Looking at only those individuals who have stated a zero WTP, being against new taxes is indicated as the reason for refusing to pay by 40% of the respondents, second only to the justification that the respondent does not trust international organisations, indicated by 43% of them. In the voluntary payment sub-sample, the answer with the highest score of 44% (“not for me to pay”) could again reinforce the free-rider issue related to this particular voluntary payment vehicle.

The highest values stated are CHF 600.-, implying a WTP of CHF 600.- to 1000.- per year. The most frequently circled maximum WTP are CHF 50.- and 100.-, meaning that these respondents have a WTP that is either situated between CHF 50.- and 75.- or in the CHF 100.- to 150.- per year interval, respectively. The mean stated WTP based on the interval midpoints is about CHF 110.- per year, the value being slightly higher in the collective tax than in the voluntary payment sub-sample. However, a t test does not find the difference between the two means to be statistically significant at the 10% level.

[Table 3]

We also explicitly asked respondents to justify the main reasons for a positive WTP. We observe firstly that the answer “random choice” is fortunately very rare, which seems to

indicate that people do not just mention an amount without any rationale because of the hypothetical scenario. In the same vein, only about 12% of respondents indicate that the amount they chose is simply the amount that they would normally give to similar issues. We can therefore be relatively confident that the indicated WTP is related to the value of tropical forests. It is also interesting to note that about half of the respondents – 47% of the voluntary and 53% of the collective payment sub-samples – indicate an amount that “would be enough if everyone would pay the same”. In the voluntary payment subsample, this answer illustrates quite nicely the respondents’ sensitivity to the free-rider issue. It is however more difficult to interpret it in the tax subsample. Indeed, as the tax is mandatory, the individual should not worry about the amount that others will pay. However, since the instrument is an international tax, respondents may consider the possibility that other countries will not implement it.

The final question specifically concerning the voluntary payment asks who should manage it. It is interesting to note that non-governmental organizations and the United Nations receive the highest score (33% and 34% respectively). Of course, this result could be related to the big UN presence and the numerous NGOs in Geneva. Surprisingly, only about 13% of the respondents support the World Bank, even though this organization is also known to be managing different funds in the environment and development domain.

Focusing now on the international tax, the final question relates to the tax base. Individuals state they would prefer a tax on vehicles, on tropical woods or an income tax (about 20% each). Since individuals probably associate tropical deforestation with one of the possible activities leading to it, i.e. to produce tropical woods to be sold in international markets, an increase of its price would be paid only by consumers of tropical woods, who would probably reduce their consumption. However, the majority of the respondents selected a large tax base, where the financial burden is carried by almost everyone, e.g. an income tax or a tax on vehicles. This could indicate that, in addition to equity reasons, individuals seem to consider

tropical deforestation as a global problem, whose solution requires the financial contribution of everyone.

#### **4. Estimation results**

In order to define our bid function we refer to studies such as Kramer and Mercer (1997) and Horton et al. (2003) which show that family size, gender, education and income have an influence on tropical forest conservation WTP. They further find that people who have already visited a tropical forest or plan to do so value tropical forests more. The same goes for attitudinal variables like the importance attributed to environmental problems compared to other issues, the relative importance of deforestation relative to other environmental problems and the percentage of forest protection to be financed by industrialized countries. People who make charitable contributions tend to have a higher WTP too. All these variables are included in our estimated bid function. As there is a growing interest in policy instruments that would combine the mitigation of climate change and the conservation of biodiversity, our function also contains variables that measure the importance that respondents attribute to the contribution of forests to biodiversity, pharmaceutical research, carbon storage, tourism and support to local communities. This gives insight into how respondents value the distinct tropical forest services. The model further integrates age, as younger respondents may be more sensitive to future climate change and biodiversity loss because they are going to have to deal with the consequences during their lifetimes, as well as dummies to account for environmental organization membership and knowledge of deforestation and biodiversity. The occupation variable is included to measure educational and income effects not yet captured by the other variables and finally a dummy controls for the influence of the payment vehicle. A bid curve analysis is conducted to determine the influence of all these factors on WTP. Maximum likelihood interval estimates of the parameters of the log-linear tropical forest valuation function (1) are presented in Table 4. The interval estimates are very close to

those obtained from a simple OLS midpoint estimation of the model, indicating that the values proposed on the payment card were well-chosen (see Cameron & Huppert, 1989)<sup>7</sup>. The analysis with the Variance Inflation Factor (VIF) estimated after the OLS regression showed no sign of multicollinearity among the regressors. We note that most of the variables possess the expected sign. The coefficient associated with the continuous variables corresponds to a semi-elasticity, that is the percentage change in the WTP for a unit variation in the variable, all other things being equal. For instance, an increase by 1 percent in the proportion of financing by developed countries increases the WTP by 1 percent. The estimated coefficients of the discrete variables cannot be interpreted directly as the variations are not marginal and thus have to be transformed by  $(\exp(\beta) - 1)$ , as shown by Halvorsen and Palmquist (1980). The coefficient attached to the dummy variable associated with the payment vehicle is significant at the 10% level and it implies that the stated WTP is about 24% higher for the tax than it is for the voluntary payment, all other things being equal. As already mentioned, this difference could be related to free-rider behaviour. A potential difference in the structure of the two sub-samples is however rejected by a test for structural change on the coefficients from the OLS midpoint estimation. The null hypothesis that the behaviour of the voluntary and coercive payment vehicle sub-samples is the same cannot be rejected, implying that the two sub-samples should be pooled together.

[Table 4]

As could be expected, education increases WTP: higher educated people are willing to contribute about 35% more than those with low education levels. In addition, the WTP of people who have finished their education but do not have a remunerated job is approximately

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<sup>7</sup> Results are available upon request

37% lower than the one of students and respondents who are working. Surprisingly, having children significantly lowers WTP. One might think that these respondents would worry about intergenerational equity and thus be inclined to attribute higher values to forest preservation. The negative impact of children on WTP in our study might reflect an income effect, as might the education level and occupation. The impact of income on WTP is positive and significant at the 10% level. Note that it cannot be inferred that in our case tropical forests are a normal good (see Flores and Carson 1997). An individual who is not planning to visit a tropical forest in the future possesses a lower WTP by about 27%, indicating that part of the value attributed to tropical forests is a direct use or option value. It is also interesting to note that attitudinal variables have a significant and relatively high impact on stated WTP, notably the importance attributed to the environment in general compared to other issues such as employment and education. Respondents were also asked to rank several environmental problems, among which was deforestation. The relative importance attributed to deforestation does not significantly influence stated WTP. It is very interesting to see that the more important respondents think the contribution of tropical forests to biodiversity to be, the higher their WTP. The same is not true for carbon storage, pharmaceutical research, tourism or support of the local population: the importance attributed to these services does not have a significant impact on WTP.

Further, the more respondents think developed countries should participate to the financing of tropical forest preservation, the higher their WTP. The estimated mean WTP is 174 CHF/year at the mean of the distribution, while the median is 151 CHF/year<sup>8</sup>.

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<sup>8</sup> WTP values have been estimated at the conditional mean of the distribution, but it is interesting to look at the conditional median as well, as it is a good measure of the central tendency (Cameron and Huppert, 1989). The conditional median can be computed as  $\exp(X_i' \beta)$ . The mean and median computed on the individual conditional median WTPs are 65 and 56 CHF/year.

## **5. Conclusion**

In this paper, we obtain several interesting results. Firstly, we observe that the payment vehicle has an influence on the WTP: *ceteris paribus*, the WTP is 24% higher with the tax, compared to the fund. This hints to free-riding with the voluntary payment vehicle, a potential problem that should be kept in mind when performing CV. Also, the overall awareness of the sample population on the issue of tropical deforestation is quite high. As was initially expected, the stated WTP to conserve tropical forests is relatively higher than what has been observed in other similar studies. The results indicate that high levels of concern about environmental issues have a positive effect on WTP.

Of particular interest is the strong link between biodiversity conservation and WTP. Indeed, the results show that those respondents who have a higher sensitivity to biodiversity relative to other forest-based ecosystem services have a higher WTP for avoiding tropical deforestation. These findings mirror the keen interest that the biodiversity conservation community is taking in the international environmental policy arena related to the role of forests in mitigating climate change. The findings also suggest that support for climate change mitigation activities through ‘avoided deforestation’ could be largely driven by biodiversity-related concerns.

Further research would be needed in order to validate the results of the WTP estimates. It would be interesting to test the significance of the study location, Geneva, by carrying out the survey in other areas with similar socio-economic characteristics. Also, it would be useful to solicit preferences for tropical forest conservation by using alternate CV methodologies, such as choice models, to gauge the potential effects of the treatment bias.

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**Table 1: Socio-economic characteristics**

Variable	Pooled		Voluntary		Tax	
	Mean	Median	Mean	Median	Mean	Median
Age	37.20 (15.61)	32	36.66 (15.23)	31	37.69 (15.97)	32
Gender (1 = female; 0 = male)	0.51	1	0.50	1	0.52	1
Occupation (1 = retired, unemployed or housewife; 0 otherwise)	0.17	0	0.18	0	0.16	0
Education level (1 = high; 0 = low)	0.75	1	0.78	1	0.73	1
Children (1 = has children; 0 otherwise)	0.30	0	0.31	0	0.29	0
Revenue (categories, from 1 to 7)	3.85	4	3.94	4	3.76	4
Member of an environmental organisation (1 = yes; 0 = no)	0.14	0	0.14	0	0.15	0
Has already donated money (1 = yes; 0 = no)	0.70	1	0.71	1	0.70	1
Nationality (1 = Swiss; 0 = Other)	0.76	1	0.83	1	0.70	1
Household size	2.69 (1.44)	2	2.74 (1.54)	2	2.65 (1.35)	2
Number of observations	508		244		264	

Note: Standard deviation in brackets.

**Table 2: Attitude towards and knowledge of tropical forests**

Variable	Pooled		Voluntary		Tax	
	Mean	Median	Mean	Median	Mean	Median
Knowledge of tropical forests (1 = knows both deforestation and biodiversity; 0 otherwise)	0.75	1	0.73	1	0.77	1
Has visited a tropical forest (1 = yes; 0 = no)	0.24	0	0.23	0	0.25	0
Does not plan to visit a tropical forest (1 = does not plan to; 0 = plans to or does not know)	0.21	0	0.2	0	0.22	0
Importance attributed to environmental issues on a 1 to 5 scale (5 = very important)	4.21	4	4.18	4	4.24	4
Importance attributed to deforestation (5 issues ranked) (1 = deforestation is the most important issue; 0 otherwise)	0.1	0	0.08	0	0.13	0
Contribution of tropical forests to biodiversity on a 1 to 5 scale (5 = very important)	4.55	5	4.52	5	4.58	5
Contribution of tropical forests to pharmaceutical research on a 1 to 5 scale (5 = very important)	3.64	4	3.57	4	3.71	4
Contribution of tropical forests to carbon storage on a 1 to 5 scale (5 = very important)	4.61	5	4.57	5	4.64	5
Contribution of tropical forests to tourism on a 1 to 5 scale (5 = very important)	2.89	3	2.82	3	2.95	3
Contribution of tropical forests to support the local population on a 1 to 5 scale (5 = very important)	4.09	4	4.09	4	4.1	4
Percentage of tropical forest conservation that should be financed: by developed countries	72.72 (25.92)	80	69.23 (28.3)	75	75.95 (23.1)	80
Number of observations	508		244		264	

Note: Standard deviation in brackets.

**Table 3: Stated WTP**

WTP	Pooled			Voluntary payment			Collective tax		
	Freq.	%	Cum.	Freq.	%	Cum.	Freq.	%	Cum.
<i>Answers excluding protest bids</i>									
0	38	7.5	7.5	27	11.1	11.1	11	4.2	4.2
1	6	1.2	8.7	2	0.8	11.9	4	1.5	5.7
5	11	2.2	10.8	3	1.2	13.1	8	3.0	8.7
10	37	7.3	18.1	18	7.4	20.5	19	7.2	15.9
20	59	11.6	29.7	28	11.5	32.0	31	11.7	27.7
35	24	4.7	34.5	8	3.3	35.3	16	6.1	33.7
50	103	20.3	54.7	60	24.6	59.8	43	16.3	50.0
75	30	5.9	60.6	10	4.1	63.9	20	7.6	57.6
100	102	20.1	80.7	48	19.7	83.6	54	20.5	78.0
150	30	5.9	86.6	12	4.9	88.5	18	6.8	84.9
200	51	10.0	96.7	18	7.4	95.9	33	12.5	97.4
400	11	2.2	98.8	6	2.5	98.4	5	1.9	99.2
600	6	1.2	100	4	1.6	100	2	0.8	100
<b>Total</b>	<b>508</b>	<b>100</b>		<b>244</b>	<b>100</b>		<b>264</b>	<b>100</b>	
<i>Protest zero bids</i>									
	59	10.4		28	10.3		31	10.5	
<b>Total</b>	<b>567</b>			<b>272</b>			<b>295</b>		
<b>Mean WTP</b>	<b>110.2</b>			<b>105.52</b>			<b>114.51</b>		
	(127.58)			(135.04)			(120.38)		

Note: Standard deviation in brackets.

**Table 4 : Results of the interval regression estimation of the tropical forest valuation function**

<b>Variable</b>		
Payment vehicle	0.214	*
Member of environmental organisation	0.050	
Donation	0.079	
Occupation	-0.460	**
Education	0.301	*
Age	-0.003	
Gender	0.189	
Children	-0.310	**
Income	0.069	*
Knowledge	0.197	
Has visited a tropical forest	0.035	
Does not plan to visit	-0.318	*
Financing by developed countries	0.011	***
Importance of environment	0.232	***
Importance of deforestation	0.299	
Contribution to biodiversity	0.280	***
Contribution to pharmaceutical research	0.085	
Contribution to carbon storage	0.112	
Contribution to tourism	-0.045	
Contribution to local population	0.086	
Constant	-0.765	
Sigma	1.390	
Log likelihood	-1244.2	
N	508	

Note: \*\*\*, \*\*, \*: statistically significant at 1%, 5%, and 10%, respectively.