Valuing Global Public Goods

A European Delphi Stated Preference Survey of Population Willingness to Pay for Amazon Rainforest Preservation

*Ståle Navrud
Jon Strand*

The World Bank
Development Research Group
Environment and Energy Team
October 2013

Abstract

The Amazon Rainforest is a global public good. As such, and given that 15 percent of the original Amazon forest area has already been lost, households worldwide might be willing to pay to reduce or avoid additional losses. A full elicitation of global preferences for valuing preservation of the current forest, using stated-preference population surveys, would be costly and time consuming. Alternatively, this paper uses a Delphi stated-preference technique in which 48 European environmental valuation experts were asked to provide “best guesses” on the possible outcomes of population surveys in their own

countries and Europe as a whole. The expert judgments indicate willingness to pay in Europe for preserving the current Amazon Rainforest of about 28 € per household per year on average; a slightly lower value is inferred for a plan that allows a 10 percent future reduction from the current rainforest area. The income elasticity of experts’ stated willingness to pay with respect to per-capita income in their own countries is in the range 0.5–0.8. These findings indicate that Delphi studies might be used more widely as a tool for global benefit transfer.

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Ståle Navrud and Jon Strand¹

Key words: Delphi expert survey; stated preferences; contingent valuation; global public goods; Amazon rainforest.

JEL classification: Q23; Q51; Q57.

Sector board: Environment

¹ Navrud: School of Economics and Business, Norwegian University of Life Sciences, 1432 Ås, Norway; E-mail: stale.navrud@umb.no. Strand: Development Research Group, Environment and Energy Team, the World Bank, Washington D.C. 20433, USA; E-mail: jstrand1@worldbank.org. We thank Ariel Ortiz-Bobea, Michael Toman and Jeff Vincent, and participants at a World Bank seminar, for helpful comments. This research has been supported by a grant from the Bank's Knowledge for Change Program. The conclusions and viewpoints in this paper are those of the authors and not necessarily the World Bank, including its management, directors and staff.

1. Introduction

In addition to the 15 % already lost, the effects of further significant forest losses in the Amazon could be dramatic. A significant fraction of trees in the Amazon basin could dry out and die; and large swaths of land could be converted from forest to savannah. The entire ecosystem of the Amazon basin, which today supplies the Earth with more than 20 percent of both its oxygen and fresh water, might change dramatically. The climate in the entire South American region, and beyond, will likely be affected. Numerous species might disappear, probably including many yet unknown.

More reliable and robust measures of the economic loss to the global community associated with forest loss in the Amazon region, for populations outside of South America, are called for, due to several reasons.² One is the significance and uniqueness of the Amazon as a global natural resource – perhaps *the* canonical global public good. Secondly, while substantial efforts have been put into the mapping of more direct impacts of the Amazon forest losses for the local population and region³, little is known about the non-use value of protecting rainforests, in general and for the Amazon in particular.⁴

Most of the benefits to individuals outside the Amazon region are likely to be non-use (“passive use”; “existence”; “bequest”) values as most would never have visited, nor plan to visit, the Amazon rainforest. Even if non-use values could be smaller per household than (the combined use and non-use) values among the population in the Amazon region, the global population is both much larger, and also to a large extent wealthier, so that the globally aggregate non-use value could easily constitute a substantial or even decisive fraction of the Total Economic Value (TEV) of conserving or avoiding further losses to Amazon rainforest. Obtaining analytically sound estimates of the global non-use values, even if imprecise, thus could be important for mobilizing expenditure of additional economic resources to reduce or avoid future Amazon forest losses. Economic resources must likely be mobilized both locally and regionally (throughout South America), and by the international donor community, given the public-good nature of the resource. For a diverse set of policy makers to agree to such actions, a scientifically based and objective assessment of how the global economic benefits of protection compare to the protection cost could be quite useful.

² Direct local and regional impacts of Amazon forest losses within South America are being addressed in separate parts of the overall research program for economic valuation of Amazon forest losses, of which this study is part.

³See May, Soares-Filho and Strand (2013).

⁴ Among existing studies to be mentioned, see in particular Kramer and Mercer (1997), Horton et al (2002), and Carson et al (2011).

A central challenge in assessing the non-use value among populations outside of the region itself, for conserving or avoiding further forest loss in the Amazon, is the lack of relevant willingness-to-pay (WTP) data. While the value of e.g. reduced agricultural yield from degradation of soil fertility, or reduced illness-related expenditures associated with lower air pollution levels, can be estimated using market data, the nature of non-use values precludes this. The only viable way of eliciting such preferences is via survey-based Stated Preference (SP) methods.

Traditionally SP elicitation has involved random population surveys using contingent valuation (CV).⁵ Choice experiments (CE) also have become widely applied for environmental valuation over the last 10 years.⁶ The CE approach has however already a long history in other fields including transportation analysis, marketing, and psychological research.⁷

Our ultimate aim is to apply both CV and CE for elicitation of preferences for Amazon rainforest preservation, in all countries outside of the Amazon region. Ideally, (at least) the entire OECD area plus all higher- and middle-income countries in Asia, the Middle East, Eastern Europe, and Latin America apart from the Amazon region, would then need to be surveyed. Our realistic aim, given our available resources, is to conduct random sample surveys among national populations in only a few selected European countries, North America, and Japan. If possible, we also aim to do such surveys in some key Amazon region countries (Brazil, Peru and Colombia).

⁵See Mitchell and Carson (1989), Carson, Flores and Meade (2001), and Carson (2011), for presentations of the CV method. The latter reference contains a comprehensive bibliography. See Carson (1998) for a more specific discussion of CV in the context of rainforest valuation.

⁶ For representative CE studies see Adamowicz et al (1998), Hanley, Wright and Adamowicz (1998), and Louviere, Hensher and Swait (2000). Among prominent, more specific and recent, applications to environmental and resource economics, are Bennett and Blamey (2001), Bateman et al (2002), Holmes and Adamowicz (2004), Rolfe and Bennett (2006), and Bennett and Birol (2010).

⁷ The CE and CV approaches have both relative strengths and weaknesses when used to value environmental goods predominantly non-use values. A main strength of CV is its directness. WTP is typically elicited from respondents through direct valuation questions (either showing a payment card with a range of amounts and asking respondents for their maximum WTP; or through dichotomous choice whereby respondents are asked once or with follow-ups about their maximum WTP, or whether or not they are willing to pay a given stated amount). CE is less direct as maximum WTP is typically found from repeated pairwise choices between alternative programs with different characteristics to respondents including different costs (which usually include a “status quo” program involving zero additional cost). The choices involve trade-offs between the additional cost, the principal good to be valued (in our case the area of rain forest lost); and one or more attributes of the public good in question (or the management of the good) deemed relevant for or related to the choice situation in question. A fundamental tradeoff facing respondents will then involve a monetary payment traded off against the set of other attributes. Each respondent would, during a CE session, face several (4-8) different choice sets where the values for each attribute of the program vary; and from respondents’ choices, their trade-off and implicit WTP for levels of change in each attribute can be derived.

Given that we do not have the resources to conduct population surveys in all countries necessary to provide a reasonably complete global picture of WTP for preserving the Amazon rainforest, in order to supplement our planned population survey work, we also are conducting regional “Delphi surveys.” In this approach, experts in environmental valuation and in SP in particular are surveyed concerning their beliefs about how random population samples, in their respective countries, would respond to CV surveys were they to be undertaken. These Delphi surveys can provide not only an order of magnitude estimate of global non-use values for a wider set of countries than those covered by our planned population surveys, but also preliminary estimates of WTP in the countries selected for the combined CV/CE surveys. For countries where both types of surveys are carried out, our results will permit comparisons, and calibrations, of the Delphi results in relation to the population surveys.

This paper reports the results of the first Delphi expert survey under this project umbrella, conducted in the spring and summer of 2012.⁸ Average WTP among European households for particular programs to protect Amazon rainforest were assessed by asking experts on environmental valuation, from 20 different European countries, to provide their best subjective assessments of such values, for their own countries and for Europe as a whole.

In section 2 we first present, and offer a justification for, the Delphi CV method. Section 3 describes our European Delphi expert survey. Section 4 reports the WTP results from two rounds in the European survey, income elasticities of these WTP estimates, and the factors that were found to most significantly affect experts’ WTP estimates. Section 5 presents and discusses aggregated WTP results for Europe, and offers concluding. The Round 1 and 2 Delphi CV instruments are reproduced in Appendices 1 and 2, respectively; and a theoretical note on the income elasticity of WTP can be found in Appendix 3.

2. The Delphi Method

The background, history, and justification for the Delphi method are different from those for the SP method. The Delphi method was developed largely as a management decision-making tool, to ensure mutual consistency of preferences among a set of participants (managers), and to elicit experts’ preferences rather than individual preferences that the SP methods seeks to elicit.⁹ Underlying the method is a belief that these experts have considerable useful knowledge about such population values that is not embodied in already available valuation studies. In our case, a sample of European environmental economists acquainted with SP survey methods, were asked to predict

⁸ Delphi expert surveys also are being done for North America, Australia and New Zealand, and for a range of Asian countries.

⁹ See e.g. Sackman (1975).

the outcome of a CV survey in terms of mean and median WTP per household among households in their own country and among all European households for avoiding a specified future forest loss in the Amazon. Delphi studies tend to differ according to whether they ask for the experts' recommended course of action, or to predict an outcome if some action was taken. Our study falls into this latter category, consistent with the "Oracle of Delphi" as we ask our experts for their best guess about average individual (national, and European) preferences for a public good, were a CV survey to be carried out.

Our Delphi expert survey serves at least three purposes. The first is as an independent check of level and plausibility of numbers obtained in the respective population surveys. Secondly, the Delphi surveys will allow us to make valuation assessments for a much larger set of countries than the individual surveys; and thus hopefully provide a basis for calibrating relative population values across countries (including many which will not be surveyed directly). Thirdly, the Delphi surveys include questions the answers to which can be useful for guiding the future random population sample SP surveys.

Even though the wider project, involving SP surveys of random population samples, will use both CV and CE, only the CV format is used in our Delphi surveys, including the current one. This is because Delphi surveys by their nature need to be "direct" (seeking a direct WTP estimate) as is the nature of CV and not of CE. The overall project will then provide two separate types of calibration: between CV estimates for population samples and SP experts; and between CV and CE for the population samples.

We are aware of only one previous similar Delphi CV survey, Carson et al (2012), published recently but conducted in 1997. European SP experts were in that survey asked to provide their best guess for the mean and median WTP for households in their country and in Europe overall, given that a CV survey, asking households about their WTP for restoring the World Cultural Heritage Site of Fes Medina in Morocco, would then have been conducted. This Delphi CV survey was part of a larger effort (including CV surveys of Moroccan households as well as foreign tourists) to estimate the global economic benefits of a World Bank financed restoration program for this World Heritage site. The results from this survey showed that SP experts were willing and comfortable in providing their best guesses of the outcome of a national and a European CV survey of this global public good. The Delphi survey found a positive median and mean WTP for European households. No actual SP survey of the non-use values outside of Morocco was however conducted, to make it possible to validate and calibrate of the Fes Medina Delphi CV survey.

Turning now to this survey, the categories of global welfare gains, accruing to the global population outside of South America, that may result from reduced Amazon rainforest losses, include the following ecosystem services:

1. Carbon storage value of the preserved Amazon rainforest
2. Recreational value (of “eco-tourism”) for international tourists
3. Non-use value in the international context, including the biodiversity value of the forest.¹⁰

The carbon storage (item 1) is to be assessed separately from our preference elicitation studies, based on estimates of the Social Costs of Carbon (SCC) in terms of global carbon emissions costs. SP experts were told that they should not consider the carbon storage value when stating their WTP. Thus, the Delphi CV survey and the planned SP studies values items 2 and 3 (but mostly 3 since very few households in a random population sample would actually have visited the Amazon Rainforest).

3. The European Delphi Contingent Valuation (CV) Survey

The Delphi CV survey comprised 48 European environmental valuation experts from 20 different countries in Europe. The survey, further detailed in Appendix 1 and Appendix 2 below, proceeded in two steps. In step 1, each expert answered to a set of questions so as to provide his or her “best guess” about the mean and median WTP, among the population of their own country and among the entire European population, in terms of annual per-household **WTP to avoid further forest losses** up to 2050 in the Amazon rainforest region.

We define a “business-as-usual” (**BAU**) **alternative of 25% further loss** of forest area by 2050, on top of the 15 loss that already has occurred since the 1970s: There are **two avoidance alternatives**:

- i) **Plan A - No further forest losses by 2050, beyond what has already been lost (15% relative to the pristine state).**
- ii) **Plan B - Some further forest losses, so that, by 2050, 25% will have been lost relative to the pristine state.** Alternative i) is clearly the better and more valuable, and more challenging, outcome to be achieved.

58 experts were contacted during May and June 2012, and 48 of them (83 %) replied in Round 1. Two reminders were issues. 10 did not reply; out of which 2 refused to answer, 1 was on

¹⁰ In addition to these international components of the Total Economic Value (TEV) of avoiding further loss of the Amazon rainforest; global quasi option context; there is also the quasi-option value (QOV); which can be viewed as a correction factor to TEV. The QOV is the economic value of increased information about the biodiversity value of the Amazon rainforest for medicinal purposes, food security etc that can be gained from *not* undertaking projects with irreversible effects like extinction of species.

paternity leave, and the remaining 7 decided not to answer; mainly due to lack of time. In Round 2 in June and July 2012 all of the original 48 experts replied, after two reminders.¹¹

4. Results

4.1. Willingness-to-Pay (WTP) Results from Rounds 1 and 2

The distribution of the 49 experts (where one expert answered in Round 2 only) from European countries is shown in Table 1, and reflects to some extent the countries that have the largest numbers of environmental valuation practitioners. We see that 29 of 49 experts come from Northern and Central Europe, 12 from Southern Europe and 8 for Eastern Europe. The table indicates the level and differences in WTP by country (for one of our questions, on mean WTP for Plan A in the first questioning round; see below). The table also indicates average income levels in the four indicated regions, both regular (non-adjusted) incomes and purchasing power parity (PPP)-adjusted incomes; where the latter are less dispersed than the former.

Table 1: Geographical distribution of the environmental valuation experts (N = 49) that participated in the European Delphi survey (and the countries they assessed specific WTP estimates for).

Country group	Country (number of experts)	Stated Mean WTP for Plan A, Round 1; euro/household/year	Mean Group GDP (PPP-adjusted GDP), euro/capita/year
Nordic countries (total number of experts = 11)	Denmark (2)	36.0	51,100 (32,500)
	Finland (3)	28.7	
	Norway (3)	65.0	
	Sweden (3)	31.7	
Northern and Central Europe (total number of experts = 14)	Austria (2)	57.5	36,200 (29,500)
	Belgium (1)	45.0*	
	Germany (3)	88.3	
	Ireland (2)	34.0	
	Netherlands (3)	38.3	

¹¹ One additional expert, who answered only Round 2 of the survey, is also included in Table 1.

experts = 18)	Switzerland (2)	25.0	
	United Kingdom (5)	27.4	
Southern Europe (total number of experts = 12)	France (3)	44.3	26,800 (23,400)
	Greece (2)	10.5	
	Italy (4)	15.0	
	Portugal (1)	20.0	
	Spain (2)	26.0	
Eastern Europe (total number of experts = 8)	Croatia (2)	3.2	11,600 (15,800)
	Czech Republic (2)	42.5	
	Hungary (1)	4.0	
	Poland (2)	25.0	
	Romania (1)	30.0	

*"Round 2" figure: no figure was given for Round 1

All participating experts except five had the nationality of the country in which they lived and worked. Some of the latter group were asked to state their estimate for the WTP for the country of origin and in which they had conducted studies (if there were few valuation practitioners in their country), or state the WTP for the country they now lived in if that country had few valuation studies. All respondents were also asked to assess the mean and median WTP for all European households; the measure we are aiming for. The Delphi CV survey instruments for Round 1 and 2, including the CV scenario description, are reproduced in appendices 1 and 2, respectively.

As there were only a handful of participating experts from any one country (1-5 ; see table 1), we only reproduce the experts' guesstimate of mean and median WTP /household/year, related to a hypothetical survey of a random sample of European households, in their own country, and in all of Europe. Tables 2-3 report the main results from Round 1 of this expert survey for Plan A, and Plan B; respectively. The tables report mean, median, standard deviation and lowest and highest amount stated as experts' "best guesses" for mean and median household WTP per year; in their own country, and in Europe as a whole.

We see that experts' mean expressed WTP in terms of their assessed mean WTP of preserving the current Amazon Rainforest among their own national population (Scenario A: 85 of original forest % protected) is about 34 euros, higher than the about 29 euros for Scenario B (75 % of

original forest protected). The stated “no-policy” alternative with no measures (i.e. the BAU alternative) is assumed to retain only 60 % of original forest protected by 2050. The mean estimates of median WTP are lower than for mean WTP for Scenarios A and B, 19 and 14 euros, respectively.¹² Thus, the distribution is skewed to the right. All experts reported equal or higher WTP for the most comprehensive preservation Plan A than for the less comprehensive Plan B. Guesstimates for both mean and median WTP vary from zero to 180 euros.

Another aspect of the answers is that experts’ averages for mean WTP in Europe as a whole are somewhat lower than their average answers for own country mean WTP (with an average differences of 2-3 euros). Experts thus on the whole appear to be slightly more pessimistic regarding WTP for Europe as a whole, compared to their own-country assessments.¹³

In Round 2, each of the experts was shown the overall distribution of experts’ Round 1 estimates for mean and median WTP for Europe (see appendix 2), and asked to reconsider their own estimate in the light of this new information. They were also asked to reconsider their estimates for mean and median WTP for their own country. Tables 4-5 show the main results of experts’ answers in Round 2. We see that overall mean values are lowered somewhat in Round 2; by almost 3 euros on the average for mean WTP in their own country for Plan A, and closer to 5 euros for Plan B; with smaller differences for median WTP assessments. For Europe overall mean WTP is reduced by about 4 and 5 euros for Plan A and B, respectively. This constitutes a reduction in mean WTP of about 13 and 18 % for Plan A and B, respectively.

¹² None of these differences are statistically different from zero, due mainly to the low number of data points.

¹³ These differences should not be over-emphasized; they might in part follow from differences in methods of (implicit and explicit) aggregation across European countries, in our data and as done by experts themselves, and the fact that countries with high overall WTP levels may be overrepresented among the sample of experts.

Tables 2-3: Mean and median WTP figures expressed by experts, Round 1.

All figures in euros/hh/y

Table 2: WTP Plan A

Value concept	Mean value	Median	St dev	Min	Max
Mean WTP in own country	34.5	25	34.4	0	180
Median WTP in own country	18.9	15	20.4	0	120
Mean WTP in Europe	32.2	20	25.2	0	110
Median WTP in Europe	19.1	11	22.3	0	100

Table 3: WTP Plan B

Value concept	Mean value	Median	St dev	Min	Max
Mean WTP in own country	28.9	20	39.1	0	250
Median WTP in own country	14.4	10	15.7	0	80
Mean WTP in Europe	26.2	18	20.6	0.5	90
Median WTP in Europe	15.1	10	16.8	1	80

Tables 4-5: Mean and median WTP figures expressed by experts, Round 2.

All figures in euros/hh/y

Table 4: WTP Plan A

Value concept	Mean value	St dev	Min	Max
Mean WTP in own country	31.7	33.2	1	180
Median WTP in own country	16.0	14.5	0	70
Mean WTP in Europe	28.1	14.7	2	80
Median WTP in Europe	16.1	9.3	1	40

Table 5: WTP Plan B

Value concept	Mean value	St dev	Min	Max
Mean WTP in own country	24.0	23.5	1	130
Median WTP in own country	12.2	11.0	0	45
Mean WTP in Europe	21.4	11.2	2	60
Median WTP in Europe	12.3	8.2	0	40

Figures 1 and 2 show the frequency distributions of mean and median WTP for Europe, respectively; for Plan A and B and after Round 1 and 2. For the country estimates; see figures 3 and 4. Both for Europe and experts' own country WTP estimates the WTP distributions narrow from Round 1 to 2, as we would expect.

Figure 1. Distribution of *Mean WTP* /hh/y for *Europe* for Plan A and B for Round 1 and 2.

Figure 2. Distribution of *Median WTP* /hh/y for *Europe* Plan A and B for Round 1 and 2.

Figure 3. Distribution of *Mean* WTP/hh/y for experts' own *country* for Plan A and B for Round 1 and 2.

Figure 4. Distribution of *Median* WTP/hh/y for experts' own *country* for Plan A and B for Round 1 and 2.

Table 6 reports the percentage shares of experts that changed their WTP estimates for Europe for Plan A and B, from Round 1 to Round 2. We see that more experts retained their original mean estimate for Plan B than for (the more extensive) Plan A; 59 and 33 % respectively. On the other hand, changes were greater on average for Plan B than for Plan A. More experts lowered than increased their mean WTP estimates for both plans. For Plan A, 27 % increased their mean WTP while only 8 % did so for Plan B. Those one-third and one-half of experts who did *not* change their estimates from Round 1 to 2 have likely felt little pressure toward a consensus. Those that did change their stated values seemed overall to be affected by the information given about Round 1 results. A hypothesis, that experts more experienced in conducting SP surveys had a higher probability of changing their WTP estimate, was rejected. Other background variables for the experts could also not explain why some changed their WTP estimate while others did not.

Table 6 also shows the average adjustments (up or down) for those that changed their estimates, which were around 8 euros for Plan A answers, and much higher (15 euros) for Plan B answers.

Table 6: Percent of experts who lowered, increased or stated the same WTP estimates for Europe in Round 2.

Plan	WTP estimate sought	Lower	Same	Higher	Average change, all (euros/hh/y)	Average change, changers (euros/hh/y)
Plan A	Mean	40	33	27	5.7	8.5
	Median	27	42	31	4.8	8.3
Plan B	Mean	33	59	8	6.2	15.1
	Median	35	53	12	2.7	5.7

4.2 Income Elasticities of WTP

Tables 7 and 8 present elasticities of expert-assessed average own-country WTP, with respect to own-country income, from Rounds 1 and 2 for the European WTP estimates for Plan A and B; for two measures of income: regular GDP per capita, and Purchasing Power (PPP) corrected

GDP per capita. Income levels are there the average per-capita incomes in the home countries of the experts asked to provide their “best guesses” for average WTP per household/year for plans A and B for their own country and for Europe overall.¹⁴ These relations are then estimated on log-linear form; see Appendix 3 for a more formal presentation. This elasticity is of some interest, as it should (under various additional assumptions) make it possible to perform a “calibration”, or “benefit transfer”, of overall value estimates from countries where population studies are made, to countries in Europe where such studies are not carried out. The idea pursued is that experts may, collectively, have an idea about the relative values across these countries, even when they do not know the actual values. Income elasticity estimates are then particularly useful as they will permit us to infer approximate average population values for countries where full population surveys are not carried out, using unit value transfer with income adjustments as the benefit transfer method (see e.g. Navrud 2004; Navrud and Ready 2007).

In Appendix 3 we also discuss some prior expected hypotheses about the relations between these elasticities. We argue that the elasticity estimates with respect to PPP-adjusted per-capita income are likely to exceed those for un-adjusted income; this is a result we recover in strong form from our data. We there also argue that it is more appropriate to base our assessment of cross-country WTP on the income elasticities which are calculated from the non-corrected GDP/capita as the income measure. The reason is that such valuation is for international payments that require (non-corrected) foreign exchange. We there also discuss the expected relations between elasticities from Rounds 1 and 2, and argue that (under certain assumptions) Round 2 figures could be more “compressed” thus yielding lower elasticities. But this may not hold if Round 2 figures are lower on the average. This is reflected in our data: elasticities are generally higher in Round 2 than in Round 1.

¹⁴ As country GDP per-capita is a more clearcut predictor of own country WTP rather than overall Europe WTP we focus on results for the experts’ own country WTP estimates, but presents both; see tables 7-8 and 9-10.

Table 7: Elasticities of WTP for own country with respect to average GDP per-capita level in expert's country, with income as the only variable (raw) and with background variables included , see table 12 (corrected)

	Round 1		Round 2	
	Coefficient	t statistic	Coefficient	t statistic
WTP plan A (raw variable)	0.587	2.00	0.760	2.82
WTP plan A (corrected)	0.453	1.57	0.679	2.65
WTP plan B (raw)	0.688	2.35	0.781	2.98
WTP plan B (corrected)	0.627	2.08	0.794	3.12

Table 8: Elasticities of WTP for own country with respect to average Purchasing Power Parity (PPP) corrected GDP per-capita level in expert's country; with income as the only variable (raw) and with background variables included , see Table 13 (corrected)

	Round 1		Round 2	
	Coefficient	t statistic	Coefficient	t statistic
WTP plan A (raw variable)	1.30	2.50	1.54	3.20
WTP plan A (corrected)	0.98	1.96	1.28	2.82
WTP plan B (raw)	1.44	2.76	1.57	3.37
WTP plan B (corrected)	1.28	2.43	1.50	3.35

The number of data points in our survey (48 experts were included) is too small to yield precisely estimated coefficients for the effects of average national income on average national WTP for Amazon forest preservation. We see, however, that for estimations with respect to non-corrected GDP, in Table 8, virtually all estimated elasticities are in the range 0.5 -0.8.¹⁵ It thus appears as relatively safe to assume this as our main conclusion. Elasticities with respect to PPP-

¹⁵ Note that we are presenting both “raw” (with only per-capita national income included) and “corrected” calculations (which include a number of relevant background variables some of which are significant; see here also Table 12 below).

adjusted income, in Table 9, are (as expected) larger, all in excess of unity (although these estimates will play less of a role overall).

Which elasticities are “more correct” to use; those with respect to regular GDP or those with respect to PPP-adjusted GDP? As a measure of “true” WTP, both are “equally correct”: the regular GDP measure captures the “relative price” effects between low- and high-price level countries; while the adjusted GDP measure captures “real income” effects and their impact on WTP. But in our context, since everything, in the end, is measured in international purchasing power of the actual WTP, the non-corrected measure may appear as the more relevant one. This measure is roughly in the range 0.5 – 0.8 with our data.

Table 9: Income elasticities of mean WTP/hh/y for Europe as functions of own-country average income; with income as the only variable (raw) and with background variables included, see table 12 (corrected)

	Round 1		Round 2	
	Coefficient	t statistic	Coefficient	t statistic
WTP plan A (raw variable)	-0.571	-2.11	-0.128	-0.72
WTP plan A (corrected)	-0.643	-2.22	-0.185	-0.95
WTP plan B (raw)	-0.500	-1.78	-0.165	-0.94
WTP plan B (corrected)	-0.534	-1.74	-0.181	-0.95

Tables 9 and 10 represent estimates of experts’ assessments of mean European WTP overall, as function of per-capita average GDP levels. We find, in Table 9, all elasticities for these relations to be negative (so that experts in countries with relatively high incomes provided relatively low estimates of the average European WTP). This tendency is however far less pronounced for round 2 answers than for round 1. This issue is difficult to fully account for. It could, however, be that answers in round 2 are more qualified and rational than those in round 1 (although they could be biased by the information given between the two rounds). Overall these numbers, however, indicate a certain amount of “pessimism” with respect to average WTP among experts in high-income countries; or “optimism” among experts in low-income countries. We have little basis for assessing which of these two hypotheses is more precise.

Table 10 gives us numbers regarding absolute effects equivalents to the numbers in Table 10. We there see that, for round 1 answers, an decrease in WTP per household of about 1 – 2.5 euros per 10,000 increase in own-country per-capita GDP for round 1, and lower numbers (0.5 – 1 euros) for round 2.

Table 10: Estimate of average WTP in Europe, relationship to own-country average income. US\$ increase in WTP per US\$10,000 average own-country per-capita income; with income as the only variable (raw) and with background variables included , see table 12 (corrected)

	Round 1		Round 2	
	WTP change (per 10,000 euros, own country income)	t statistic	WTP change (per 10,000 euros, own country income)	t statistic
WTP plan A (raw variable)	-1.99	-1.21	-0.66	-0.65
WTP plan A (corrected)	-2.97	-1.59	-1.21	-1.11
WTP plan B (raw)	-1.55	-1.10	-0.58	-0.74
WTP plan B (corrected)	-2.47	-1.61	-0.85	-1.06

4.3_ Which Factors Affect Experts' WTP Estimates, and How?

Data on experts' experience in conducting SP studies (both CV and CE) , multi-country studies, benefit transfer exercises and their assessment of how close the Delphi estimate would be an actual CV study were collected in Round 1 (see appendix 1 for the questionnaire), and regressed on their stated WTP amounts in Round 1 and Round 2. The variables are described in table 11, and the results presented in tables 12 and 13.

Table 11. Description of variables used to explain variation in WTP/hh/y

Variable (Question number; according to appendix 1); Description, and measurement unit	Mean	Std. dev
(J 1) How close is Delphi estimate to true value (Likert scale 1-10, where 10 is very close)	6.3	1.6
(J 2) How difficult to implement CV study on Amazon (Likert scale 1-10, where 10 is very difficult)	5.6	2.5
(J 3) How difficult to implement CV study on domestic biodiversity (Likert scale 1-10, where 10 is very difficult)	5.4	2.4
(B1) Familiarity with CV literature. (Likert scale 1-10, where 10 is very familiar)	8.4	1.5
(B2) Familiarity with CE literature (Likert scale 1-10, where 10 is very familiar)	7.4	2.0
(B5) Number of CV and CE surveys on biodiversity done	5.6	5.8
(B10) Number of papers on CV and CE published, last 5 years	6.6	6.4
(B11) Number of papers on CV and CE reviewed, last 5 years	12.1	18.5
(B 8) Fraction of research time spent on CV and CE, (%)	47.9	25.0

(B9, alt 5) Read JEEM regularly (dummy, 1 if read and 0 if not)	0.73	0.45
(B9, alt. 1) Read AJAE regularly (dummy, 1 if read and 0 if not)	0.20	0.41
(B7) Number of benefit transfer exercises conducted	3.7	5.5
(B 12) Number of multi-country (i.e. 2 or more countries) CV or CE studies conducted in Europe	1.9	2.2

Table 12: Potentially important background variables and their partial effects on mean WTP in the expert's own country for implementing plan A in rounds 1 and 2.

(* = significant at level 15%, ** at level 10%, *** at level 5%)

Variable	Round 1		Round 2	
	Log-linear	Linear	Log-linear	Linear
How close is Delphi estimate to true value (1-10)	0.040	-2.24	0.063	-0.76
How difficult to implement CV study on Amazon (1-10)	-0.111 (*)	-1.42	-0.088	-0.63
How difficult to implement CV study on domestic biodiversity (1-10)	-0.030	-4.29 (*)	-0.038	-4.13 (*)
Familiarity with CV literature. (1-10)	-0.137	-1.96	-0.197 (**)	-1.76
Familiarity with CE literature (1-10)	0.064	-1.68	0.066	-2.99
Number of CV and CE surveys on biodiversity done	-0.037	-0.78	-0.017	-0.53
Number of papers on CV and CE published, last 5 years	0.007	1.26	-0.015	1.40
Number of papers on CV and CE reviewed, last 5 years	-0.006	-0.26	-0.020	-0.27
Fraction of research time spent on CV and CE, %	0.013(**)	0.20	0.016 (***)	0.15
Read JEEM regularly (dummy)	1.00 (***)	34.5 (***)	0.903 (***)	30.8 (***)
Read AJAE regularly (dummy)	-1.14 (***)	-31.2 (***)	-1.03 (***)	-24.0 (***)

Table 13: Potentially important background variables and their partial effects on mean WTP in the expert's own country for implementing plan A in rounds 1 and 2.

(* = significant at level 15%, ** at level 10%, *** at level 5%)

Variable	Round 1		Round 2	
	Log-linear	Linear	Log-linear	Linear
How close is Delphi estimate to true value (1-10)	0.040	-2.24	0.063	-0.76
How difficult to implement CV study on Amazon (1-10)	-0.111 (*)	-1.42	-0.088	-0.63
How difficult to implement CV study on domestic biodiversity (1-10)	-0.030	-4.29 (*)	-0.038	-4.13 (*)
Familiarity with CV literature. (1-10)	-0.137	-1.96	-0.197 (**)	-1.76
Familiarity with CE literature (1-10)	0.064	-1.68	0.066	-2.99
Number of CV and CE surveys on biodiversity done	-0.037	-0.78	-0.017	-0.53
Number of papers on CV and CE published, last 5 years	0.007	1.26	-0.015	1.40
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Fraction of research time spent on CV and CE, %	0.013(**)	0.20	0.016 (***)	0.15
Read JEEM regularly (dummy)	1.00 (***)	34.5 (***)	0.903 (***)	30.8 (***)
Read AJAE regularly (dummy)	-1.14 (***)	-31.2 (***)	-1.03 (***)	-24.0 (***)

Table 13 provides some partial results with respect to “background variables” that might have affected experts’ expected WTP answers. Few of these effects turn up as significant; not surprising considering that only 49 experts are involved in the survey. The most striking effect is related to the regular reading of and familiarity with two central journals, the Journal of Environmental Economics and Management (JEEM), and the American Journal of Agricultural Economics (AJAE). Readership of JEEM strongly and significantly increases average WTP, while readership of AJAE has the opposite effect. It is unclear how this should be interpreted. We know that JEEM is the primary publication outlet for environmental CV/CE studies, while AJAE readers typically are more conservative and more skeptical toward SP methods (and may tend to place lower values on the environment). High stated WTP guesses among the JEEM readership could represent a combination of being better informed, and bias in the direction of preferring SP methods over other methods (and, perhaps, believing that the true environmental values among the respective populations are high).

Higher fractions of experts’ research time spent working on CV and CE methods also affect stated WTP assessments positively, and significantly given a log-linear specification. Experts who perceive a greater difficulty in implementing a CV study on biodiversity in their own country were found to provide significantly lower WTP assessments under a linear specification. The experts’ familiarity with the CV literature was found to be more important for expressed average WTP values, than having done many SP studies. On the other hand, more time spent on CE and CV research significantly increases stated WTP. These results could be interpreted “positively” (those who know SP methods well understand better how environmental goods are to be valued), or “negatively” (the sample of experts who are particularly familiar with SP methods is self-selected and contains individuals with a propensity to value the environment highly; or tend to think that the population values it highly).

There are few differences between the WTP results from Rounds 1 and 2. Familiarity with CV studies has however a significantly negative effect on WTP in Round 2 (in the log-linear specification), but not Round 1. This could indicate that after experts were presented with the WTP answers from other experts, and allowed to adjust their responses, the pattern that those that were more familiar with CV studies stated lower mean WTP for their own country became clearer. Note also that if these experts thought that the Amazon CV survey would be difficult to implement in their own country, they stated significantly lower than otherwise WTP (in the log-linear specification) in Round 1, whereas this effect disappeared in Round 2 when they saw that other experts had also managed to provide their estimates.

5. Aggregate WTP for Europe, and Concluding Remarks

This study reports on average assessments among European environmental valuation experts, of mean population WTP for protecting the Amazon rainforest in their own countries and in Europe as a whole. The answers were provided through two rounds of a Delphi expert survey. In the first round, experts gave independent WTP estimates, which could be changed by experts in the second round after having observed the overall Round 1 results from the entire survey. Mean WTP estimates across all the European experts was approximately 34 €hh/y, and 29 €hh/y, respectively, in Round 1 for preserving by 2050, respectively 85 % (Plan A), and 75 % (Plan B), of the original Amazon by 2050; and where the “no-policy” (or business-as-usual) alternative was presumed to imply that only 60% of the original forest will be preserved by 2050. Plan A corresponds to *no further forest loss*, whereas Plan B implies an additional *10% loss* of the original forest. In Round 2, in which experts could adjust their initial value answers after having seen the summary statistics from Round 1, mean answers were approximately 32 €hh/y, and 24 €hh/y, for Plans A and B respectively.

Experts were also asked to provide similar valuation assessments for an equivalent Europe-wide CV survey. Average answers were then slightly lower than the averages given for their individual countries.

We have also analyzed the relationships between WTP and average national income, in the form of both regular GDP per capita, and PPP-adjusted GDP per capita. Income elasticities were found to lie in the range 0.5–0.8 with respect to regular GDP per capita (from Table 7). This implies that mean WTP increase with regular per-capita GDP of the respective experts’ countries, but at a rate somewhat less than proportional to income. When considering PPP-adjusted per-capita GDP, by contrast, income elasticities are overall slightly above unity (mostly in the range 1-1.5, as seen from Table 8). While these results are interesting and plausible, they can however only be considered as suggestive due to the limited number of participants in our survey (with 48 participating experts).

Assuming that our study permits us to add up such values across all European households, and assuming that experts represent their respective populations correctly, our results indicate that the annual WTP among European households for execution of Plan A (after both rounds) could be close to 28 €hh/y x 300 mill hh, or approximately 8.4 billion €/y, given that experts are correct in their assessments of this population value.¹⁶ This indicates that benefits to distant

¹⁶ This result is provided under the reservation that experts’ answers need to be weighted with their respective population sizes, which they are generally not. Weighting might bring overall population WTP numbers down somewhat as experts in high income, and high WTP, regions (such as Scandinavia) seem to be over-represented in our sample of experts.

beneficiaries (primarily non-users) could be substantial for the change in provision of this global public good. We however stress that this Delphi CV estimate is highly preliminary; it will need to be validated and calibrated by planned actual CV surveys in Europe.

We note also that the mean WTP estimate derived from this Delphi CV survey is close that found by Horton et al (2002, 2003), who asked random samples of households in the UK and Italy about their WTP to preserve rainforest areas in the Amazon. However, both of the preservation scenarios used in that study were different from those in our Delphi CV survey; the population covered was different; and that study was carried out more than 10 years prior to our Delphi Survey.

Our European Delphi CV survey indicates a European willingness to spend at least 8.4 million € annually to avoid any further forest loss in the Amazon rainforest. Drawing such a strong conclusion from a survey of 48 European environmental valuation experts may however be premature. The results need to be controlled, and corroborated, through population surveys in at least some of these European countries, which we intend to do later as part of the overall research program of which this study is part. Hopefully, our study may at least provide some useful information about the relative values across countries on the European continent, and how these co-vary with average national incomes.

The present European Delphi survey is also just a part of more comprehensive set of such surveys related to the global economic value of these preservation plans for the Amazon Rainforest. Delphi surveys (CV-based) are also being executed for experts from North America, Australia/New Zealand, and several countries in Asia; while random population surveys are planned for at least three European countries, Japan, and at least two countries in South America. We view the present study as a promising start of this research program.

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Appendix 1

European Delphi Contingent Valuation Survey Instrument Round 1

CONTINGENT VALUATION OF THE AMAZON RAINFOREST

DELPHI EXERCISE **SURVEY INSTRUMENT EUROPE**

Round 1

I. INTRODUCTION TO DELPHI EXERCISE

In this "Delphi exercise" the objective is to use expert judgment (YOURS) to predict what the estimate from a contingent valuation (CV) study on a particular topic under a particular payment mechanism would be if it were conducted in: (a) your country and (b) throughout Europe. The good to be valued is a project to help reduce further forest loss and preserve the Amazon rainforest as a global public good. A description of the basic good to be valued and the scenario plan are described below. The payment mechanism is an annual (non-voluntary) re-occurring tax payment per household for all future years. We are interested in having you estimate for four quantities: (1) mean annual household WTP in your country, (2) median annual household WTP in your country, (3) mean annual household WTP in Europe, and (4) median annual household WTP in Europe.

This Delphi exercise is part of a World Bank project to document the local, national, regional and global values involved in avoiding a predicted loss of parts of the Amazon rainforest. Our hypothesis is that "expert assessments" from environmental and natural resource economists, based on their previous experience and their knowledge about public preferences, could be one way of obtaining information about the potential value to the public of such a project. Such information may be useful in the initial stages of developing a primary valuation study, or when a decision has to be made quickly on the basis of limited information, and when time and/or money does not allow a new primary study to be conducted in all relevant countries. In this regard, the more actual CV studies which are conducted the greater the pool of knowledge of the expert community. Our case, of the Amazon rainforest, is at the outer range of goods which have been valued using contingent valuation in two primary ways. First, the number of CV studies valuing such global public good is small compared to CV studies of local natural areas and outdoor recreation. Second, and perhaps more important, the CV survey proposed here would involve asking households in one country about their willingness to pay to help preserve a natural resource in another country.

After we have collected the information from the participants in this Delphi exercise (Round 1), we intend, in a very short follow-up (Round 2), to provide participants with summary statistics for the European mean and median WTP estimates, and then allow everyone an opportunity to revise their estimates if desired.

We hope this will be an interesting experience for you all. As a token of our appreciation for your time and expert advice, each participant will receive 100 euro upon returning this completed questionnaire (Round 1) and the short follow-up (Round 2) sheet. We estimate that it

would take each participant about 30-40 minutes to complete this questionnaire, and about 10 minutes to complete the follow-up.

Thank you very much for participating in this Delphi exercise!

Best Regards

Ståle Navrud

Norwegian University of Life Sciences

Jon Strand

The World Bank

II. BRIEF DESCRIPTION AND VISUAL PRESENTATION OF GOOD TO BE VALUED

The map below (FIGURE 1) shows the location of the world's tropical rainforests. Rainforests cover only a small part of the earth's land surface; about 6%. Yet they are home to over half the species of plants and animals in the world. The **Amazon rainforest** is the world's largest rainforest, representing 40 percent of the global total, and is also the biologically most diverse ecosystem on earth.

The Amazon is home to the greatest variety of plants and animals on Earth. About 1/5 of all the world's plants and birds and about 1/10 of all mammal species are found there. The rainforest also serves as carbon storage, but **the carbon sequestration value is computed separately and should not be considered in this exercise.**

FIGURE 1 THE WORLD'S RAINFORESTS

(Source: <http://www.srl.caltech.edu/personnel/krubal/rainforest/Edit560s6/www/where.html>)

For you to get an impression of the size of the Amazon rainforest, FIGURE 2 shows its size relative to some European countries. The total area of the Amazon rainforest is 5, 500,000 square kilometers. FIGURE 3 shows an aerial photo of a small part of the Amazon rainforest.

FIGURE 2. LOCATION AND RELATIVE SIZE OF THE AMAZON RAINFOREST

FIGURE 3. A SMALL PART OF THE AMAZON RAINFOREST AS SEEN FROM THE AIR

A recent World Bank study (Vergara, W. & S.M. Scholtz (2011): *Assessment of the Risk of Amazon Dieback*) describes a development where a substantial fraction of the biomass in the standing Amazon rainforest would disappear over time if the current development continues. There are several, man-made, drivers of such a development. One central such driver is man-

made deforestation in the region due to cattle ranching/grazing , other agricultural activities, and timber extraction.

The disappearing rainforest would be transformed into less dense forest, or savannah. A significant fraction of the trees in the Amazon rainforest would dry out and die. Less oxygen would be produced, the standing biomass would shrink dramatically, and the ecosystem of the rainforests would change markedly, and numerous species would disappear.

III. BASIC SCENARIO ELEMENTS

There is concern that unless a major preservation effort is undertaken, only 60 % of the original Amazon rainforest area will remain in 2050. Currently, 85 % remains of the original rainforest area found in the 1970s. FIGURE 4 shows where the Amazon rainforest will disappear in 2050 **with no new preservation measures**. If only 60 % of the Amazon rainforests remains in 2050, the ecologists' best guess is that 88 % of the species will remain.

The Brazilian Government, in collaboration with experts from international agencies, has developed two different rainforest preservation plans. These preservation plans will be expensive to carry out, since a large number of farmers and other property holders must be compensated for preserving their part of the forest. It cannot be implemented by the Brazilian government without additional sources of support. If the funds raised by the Brazilian government and internationally exceed the costs of the preservation, the plans will be implemented and national taxes will be collected from households in all countries.

With no new preservation measures, only 60 % of the rainforest will remain in 2050 (FIGURE 4) . We would like you to consider the two proposed Amazon rainforest preservation plans.

With **PLAN A** (FIGURE 5) *no* further deforestation would occur. The current area of the Amazon rainforest will then remain in 2050, so that 85 % of the original rainforest, and all (100 %) currently existing species, will be preserved. This is the *more ambitious and expensive plan*.

With **PLAN B** (FIGURE 6) there will be some further loss in the rainforest area *but less* than if *no* measure is taken (FIGURE 4). 75 % of the rainforest area will be preserved in 2050, and 93 % of the species. This is a *less ambitious, and also less costly, plan than plan A*.

Note that the **access** to the Amazon rainforest with Preservation plans A and B will be the same as today for national and international tourism, and the indigenous people.

FIGURE 4. NO NEW PRESERVATION MEASURES (REFERENCE SCENARIO)

85 % OF THE AMAZON RAINFOREST AREA REMAINS TODAY (2012) AND WILL BE REDUCED TO 60% IN 2050

FIGURE 5 PRESEVATION PLAN A: PRESERVE CURRENT RAINFOREST AREA.

85 % OF THE AMAZON RAINFOREST AREA REMAINS TODAY (2012) AND WILL REMAIN 85 % 2050

FIGURE 6 PRESEVATION PLAN B: 75 % OF THE RAIN FOREST PRESERVED IN 2050

85 % OF THE AMAZON RAINFOREST AREA REMAINS TODAY (2012) AND WILL BE REDUCED TO 75 % IN 2050

IV. PAYMENT MECHANISM

Households will be asked for an *annual payment per household* in terms of a national tax that would be collected in each country in Europe, and submitted to an international Amazon Rainforest Fund. The Fund will be controlled by the European Commission, and the money will be used exclusively and fully for this Amazon Rainforest Preservation Plan (PLAN A or B). The exact form of the payment vehicle would undoubtedly vary from country to country in order to find payment mechanisms that are plausible. The key factors are: (1) *per household* rather than individual, (2) *annual* for all future years rather than a one-time payment (since the Amazon will provide these ecosystem service every year for infinity if the preservation plan is implemented), and (3) payment is *coercive* (e.g., tax) rather than a voluntary contribution.

V. FOUR WTP ESTIMATES NEEDED FOR EACH PLAN (PLAN A and PLAN B)

All of your estimates should be provided in euro. If your national currency is different from euro; convert to euro using the market exchange rates. Assume that the survey design and the statistical analysis of the data would be done according to what you perceive as the current state-of-the-art. Please assume that the payment card below will be used (in euro), but you are free to state *any* amount (also a number not on the payment card.)

0 1 3 5 10 15 20 25 30 40 50 60 70 80 100 120 150 200 250 300 500 800 1000
euro/household/year

We will first ask you to state WTP numbers for PLAN A (FIGURE 5) , which preserves the current Amazon rainforest area of 85 % of the original area, and then for the less ambitious PLAN B (FIGURE 6) which preserves 75 % of the original area. Both plans should be compared to the 60% preserved if no preservation plan is implanted (FIGURE 4)

PLAN A (FIGURE 5; the most ambitious and expensive plan, to fully protect today's rainforest)

V1. Mean per household WTP (annual payment) in your country

_____ euro/household/ year

V2. Median per household WTP (annual payment) in your country

_____ euro/household/ year

V3. Mean per household WTP (annual payment) in Europe¹⁷

_____ euro/household/ year

¹⁷ For your European WTP estimate each European household should be given equal weight. Thus, it might be useful to know the approximate percentage of the European population in the different European countries: Germany 15 % , France 12 % , UK 12 % , Italy 11 % , Spain 9 % , Poland 7 % , Romania 4 % , Netherlands 3 % ; 2 % each for Austria , Belgium, Czech Republic, Greece, Hungary, Portugal and Sweden; 1 % each for Bosnia, Croatia, Denmark, Finland, Ireland, Norway, Serbia, Slovakia, Switzerland, and the Baltic states taken together (Estonia, Latvia and Lithuania). Albania, Cyprus, Iceland, Kosovo, Luxemburg, Macedonia, Malta, Montenegro, Slovenia and other countries make up the remaining 3 % of the European population.

V4. Median per household WTP (annual payment) in Europe¹

_____ euro/household/ year

PLAN B (FIGURE 6; a less ambitious and less expensive plan than plan A, to only partially protect the rainforest)

W1. Mean per household WTP (annual payment) in your country

_____ euro/household/ year

W2. Median per household WTP (annual payment) in your country

_____ euro/household/ year

W3. Mean per household WTP (annual payment) in Europe¹

_____ euro/household/ year

W4. Median per household WTP (annual payment) in Europe¹

_____ euro/household/ year

VI. YOUR JUDGEMENT ABOUT DIFFICULTY OF IMPLEMENTING THIS CV SURVEY

J1. How close do you think the average estimate for this Delphi exercise would be to the number which would be obtained from undertaking an actual CV survey? [Answer on 10 point scale and record your score]

Not Very Close 1 2 3 4 5 6 7 8 9 10 Very Close
Score:_____

J2. How difficult do you think that it would be to successfully implement a CV survey on this topic (Amazon Rainforest)?

Not At All Difficult 1 2 3 4 5 6 7 8 9 10 Very Difficult
Score:_____

J3. How difficult do you think it would be to successfully implement a CV survey in your own country to value non-use values of biodiversity *in your own country*?

Not At All Difficult 1 2 3 4 5 6 7 8 9 10 Very Difficult
Score:_____

J4. How difficult do you think that it would be to successfully implement a CV study in your own country to value a recreational activity in your own country?

Not At All Difficult 1 2 3 4 5 6 7 8 9 10 Very Difficult
Score:_____

VII. BACKGROUND QUESTIONS

B1. How familiar are you with the literature on Contingent Valuation (CV) surveys?

Not At All Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar
Score:_____

B2. How familiar are you with the literature on Choice Experiment (CE) surveys?

Not At All Familiar 1 2 3 4 5 6 7 8 9 10 Very Familiar
Score:_____

B3. Approximately how many CV surveys, if any, have you worked on (alone or in cooperation with others)?

_____ (write zero if you have not done any CV surveys)

B4. Approximately how many CE surveys, if any, have you worked on (alone or in cooperation with others)?

_____ (write zero if you have not done any CE surveys)

B5. Approximately how many CV and CE surveys of biodiversity and ecosystem services, if any, have you worked on (alone or in co-operation with others)?

_____ (write zero if you have not done any CV or CE surveys of biodiversity and ecosystem services)

B6. Approximately how many empirical studies using valuation methods other than CV and CE

(e.g., hedonic pricing, travel cost analysis) have you worked on (alone or in cooperation with others)?

_____ studies (write zero if you have not done any empirical studies using other methods than CV and CE))

B7. Approximately how many benefit transfer exercise have you conducted (i.e. transferring estimates from primary environmental valuation studies to a new geographical site to perform e.g. cost-benefit analysis (CBA)).

_____ studies (write zero if you have not done any benefit transfer exercises for use in e.g. CBA))

B8. Approximately, what fraction of your research would you say was on contingent valuation, choice experiments, other valuation methods and what fraction on other topics? (Sum to 100%)

_____ % Contingent valuation

_____ % Choice Experiments

_____ % Other valuation methods

_____ % Benefit transfer (not involving doing new primary valuation studies)

_____ % Topics other than valuation

Sum: 100 %

B9. Which of the following environmental economics journals do you read or look through regularly?

(Put "X" next to all that are relevant)

__1. American Journal of Agricultural Economics

__2. Ecological Economics

__3. Environment and Development Economics

__4. Environmental and Resource Economics

__5. Journal of Environmental Economics and Management (JEEM)

__6. Land Economics

__7. Australian Journal of Agricultural and Resource Economics

__8. Review of Environmental Economics and Policy

__9. Other journals; which _____

B10. Approximately how many papers on contingent valuation and choice experiments (both theoretical and empirical

studies) have you published in national and international journals the last five years?

_____papers

B11. Approximately how many papers on contingent valuation and choice experiments (both theoretical and empirical

studies) have you reviewed for national and international journals the last five years?

(Write zero if you have not reviewed any paper on CV or CE the last 5 years())

_____papers

B12. Approximately how many *multi-country* (i.e. 2 or more countries) CV or CE studies in Europe, if any, have you been part of?

_____multi- country CV or CE studies in Europe (write zero if you have not done any)

B13. What is your highest academic degree?

1. ____ Ph.D or equivalent

2. ____ M.Sc. or equivalent

3. ____ B.Sc. or equivalent

B14. Your gender

1 ____ Female

2 ____ Male

B.14 Your country (that you stated WTP for in Plan A and B) : _____

VIII. LAST THOUGHTS

L1. What other information, if any, you would like to see included in the CV scenario Plan A and B descriptions if this CV survey was conducted of a random sample of European households?

L2. What empirical CV studies do you think would be the most useful to look at to determine a reasonable initial WTP estimates for this Amazon Rainforest project?

L3. What empirical CV studies other than those named in L2 above do you think would be the most useful in helping to design an Amazon preservation project CV survey to be administered in Europe?

L4. What do you think the major problems are in designing an Amazon Rain Forest CV survey to be administered in Europe?

L5. Below you will find our suggestion for attributes of a CE scenario valuing the same Plan A and B as in the CV scenarios of this Delphi study.

Proposed Attributes for CE:

A. % forest preserved (avoided deforestation compared to 2050 with no measures; i.e. MAP A and B versus C)

B % of the preserved area with access secured for indigenous people

C % of the preserved area with restriction on access **for** to preserve species diversity hot spots

D Costs in terms of national tax earmarked to an international fund to preserve the Amazon rainforest

a) Is the attribute relevant:

A __No __Yes

B __No __Yes

C __No __Yes

D __No __Yes

b) Should some of these attributes be measured/presented in a different unit/way?

- A** __No __Yes; which unit: _____
B __No __Yes; which unit: _____
C __No __Yes; which unit: _____
D __No __Yes; which unit: _____

c) Are there other attributes that should be included: and in what unit should they be measured?
% biodiversity preserved (or maybe species)

d) Do you have other comments to this proposed CE?

-
L6 Any other comments you might have to this Delphi exercise or the planned CV and CE surveys are most welcome.

THANK YOU FOR YOUR COOPERATION!

Appendix 2

Results from the European Delphi Contingent Valuation Survey, Round 2

PLAN A - RESULTS

Figures 1 and 2 below summarize the responses of 48 European environmental economists from Europe taking with respect to their best estimates of the mean and median willingness-to-pay (WTP) /household/year if a Contingent valuation (CV) of the Amazon rainforest preservation Plan A had been conducted in Europe. Please note that the scale of figures 1 and 2 are different.

FIGURE 1. MEAN WTP /HOUSEHOLD/YEAR IN A EUROPEAN CV-STUDY OF PLAN A (N = 48)

Mean: 32.18 € Median: 20 € Std. Dev.:25.19 € Min: 0 € Max: 110 €

FIGURE 2. MEDIAN WTP /HOUSEHOLD/YEAR IN A EUROPEAN CV-STUDY OF PLAN A (N = 48)

Mean: 18.98 € Median: 11 € Std. Dev.:22.34 € Min: 0 € Max: 100 €

PLAN B – RESULTS

Plan B is less ambitious and less expensive than plan A, to only partially protect the rainforest). Figures 3 and 4 below summarize the responses from the 48 European environmental economists for Plan B in terms of mean and median WTP/household/year. Please note that the scale of figures 3 and 4 are different.

FIGURE 3. MEAN WTP /HOUSEHOLD/YEAR IN A EUROPEAN CV-STUDY OF PLAN B (N=48)

Mean: 25.86 € Median: 18 € Std. Dev.:20.75 € Min: 0 € Max:90€

FIGURE 4. MEDIAN WTP /HOUSEHOLD/YEAR IN A EUROPEAN CV-STUDY OF PLAN B (N=48)

Mean: 15.02 € Median: 10 € Std. Dev.:17.03 € Min: 0 € Max :80€

After studying this information, we would like to ask you to reconsider your original responses for Plan A and B; both with respect to your country and with respect to Europe. It may be the case that you believe that your original estimates are still the best estimates, or it may be the case that you want to revise one or more of your original estimates up or down.

PLAN A :

Please repeat your original Amazon Rainforest Delphi exercise response for Plan A:

Your country:

Mean _____ Median _____ **euro** /household/ year

Europe:

Mean: _____ Median _____ **euro** /household/ year.

Your Round 2 estimates for Plan A

Your country:

Mean _____ Median _____ **euro** /household/ year

Europe:

Mean: _____ Median _____ **euro** /household/ year.

PLAN B :

Please repeat your original Amazon Rainforest Delphi exercise response for Plan B:

Your country:

Mean_____Median _____**euro** /household/ year

Europe:

Mean: _____Median_____**euro** /household/ year.

Your Round 2 estimates for Plan B

Your country:

Mean_____Median_____**euro** /household/ year

Europe:

Mean: _____Median _____**euro** /household/ year

Appendix 3

Interpretation of income elasticities with respect to national income across countries in the European Delphi expert survey

From this study, the result regarding elasticity of expert WTP evaluation with respect to national income is particularly important and interesting. This is perhaps the most important type of data obtained from the study that makes results transferable across the individual countries for which we have any data.

To provide useful interpretations of our data, consider a simple regression model where, in the first step, we regress first-round WTP (W_1) on PPP-adjusted per-capita national income (X_P), and in the second step regress second-round WTP (W_2) on the same variable. We may then adjust any calculation by instead considering the relationship with actual per-capita national income (X).

Define the following log-linear relations:

$$\begin{aligned} (1) \quad & ELW_1 = \alpha_{01} + \alpha_1 EL(X_P) + \varepsilon_1 \\ (2) \quad & ELW_2 = \alpha_{02} + \alpha_2 EL(W_1) + \varepsilon_2 \\ (3) \quad & ELX_P = \beta_0 + \beta EL(X) + \eta, \end{aligned}$$

where the α_i and β are regression coefficients, the α_{0i} and β_0 are constants in the respective regression relations, and the ε_i and η are random (uncorrelated) error terms. Note that we here have an initial estimate of α_1 , which is the regression coefficient (expressed in logs) for first-round WTP with respect to PPP-adjusted per-capita income, which exceeds unity. (2) here expresses the relationship between first- and second-round WTP (still in logs). The presumption here should probably be that the respective coefficient, α_2 , takes a value between 0 and 1 (since second-round results are generally drawn toward the mean). Inserting from (2) into (1) yields:

$$(4) \quad ELW_2 = \alpha_{02} + \alpha_2 [\alpha_{01} + \alpha_1 EL(X_P) + \varepsilon_1] + \varepsilon_2 = \alpha_{03} + \alpha_3 EL(X_P) + \varepsilon_3,$$

where $\alpha_3 (= \alpha_1 \alpha_2 < \alpha_1)$ is the regression coefficient for W_2 with respect to PPP-adjusted income, X_P .

It here seems clear that one should expect $\alpha_3 < \alpha_1$, which would imply the following result:

Proposition 1: Assume a “reversion toward the mean” in the second round of a Delphi survey of experts assessing average WTP in their individual countries, in the sense that $0 < \alpha_2 < 1$ in the relationship (2). Then the measured income elasticity of country-specific average WTP, while positive, will tend to be smaller in the second round than in the first round.

Note that this result is derived under the assumption that the (log of the) average WTP stays invariable from round 1 to round 2. It may fail to hold if average expressed WTP falls in round 2 relative to round 1, and at the same time the correlation coefficient α_2 is sufficiently close to unity. Then a reverse case may easily hold, whereby the measured income elasticity is greater in the second round than in the first. This is what is found in our data.

A next question is the nature of the relationship (3), between nominal and PPP-adjusted national income per capita. One can here typically expect a less steep relationship for PPP-adjusted than for non-adjusted GDP/capita. The reason for this is that, in countries where average incomes are high, price levels are also high (in particular for non-traded goods). This should imply $\beta < 1$.

We find, when inserting for X_P from (3), in (1) and (3):

$$(5) \quad ElW_1 = \alpha_{01} + \alpha_1[\beta_0 + \beta EL(X) + \eta] + \varepsilon_1 = \alpha_{04} + \alpha_4 EL(X) + \varepsilon_4$$

$$(6) \quad ElW_2 = \alpha_{03} + \alpha_3[\beta_0 + \beta EL(X) + \eta] + \varepsilon_3 = \alpha_{05} + \alpha_5 EL(X) + \varepsilon_5,$$

where $\alpha_4 = \alpha_1\beta$, $\alpha_5 = \alpha_1\alpha_2\beta$. Given that $\beta < 1$, we clearly have $\alpha_4 < \alpha_1$, and $\alpha_5 < \alpha_3$. This implies our next main conclusions:

Proposition 2: Assume that PPP-adjusted country-wide average GDP levels are less dispersed than the non-adjusted levels, in the sense that $0 < \beta < 1$ in the relationship (3). Then measured income elasticities of country-wide average WTP, are smaller when taken with respect to non-adjusted national income levels, than when taken with respect to PPP-adjusted national income levels. This result holds for each of the two rounds of a Delphi survey.

It is here of course by no means clear that we will find $\alpha_4 > 1$ (even in the case where $\alpha_1 = 2$ or higher).

The conclusion from Proposition 2 is found in our data, and in a quite strong form as elasticities with respect to PPP-adjusted country average GDP levels are in all cases on the order twice those calculated on non-adjusted GDP levels, for both rounds 1 and 2; see Tables 7 and 8.

Two important issues, in interpreting results from such Delphi surveys, are a) whether relationships involving PPP-adjusted, or non-adjusted, average GDP numbers; and b) whether the first- or second-round results form the best basis for assessing the relevant income elasticities. We will address each of these issues in turn.

- a) This may perhaps seem like an unnecessary question: predictions on country-specific WTP figures as derived from the study will in any case need to be made using the respective average national income (PPP-adjusted, or non adjusted) figure. It is however not a trivial issue if our purpose is to make the best predictions possible from the study, and the variables are not perfectly correlated (which they obviously are likely not to be). In our view, the non-adjusted numbers are more “correct” or appropriate as a basis for an economically interesting interpretation of the results. This is because the adjustments are made mostly due to differences in prices of *non-traded* goods. But here any international payment represents (implicit) payments for *traded* goods (as any actual WTP to support the Amazon would imply giving up foreign currency that can only, in principle, be used for purchasing such goods).
- b) One might, superficially, get the idea that second-round figures are “more correct” than first-round figures, as respondents in the second round have the hindsight of the overall view of all the participating experts. In our view, such a line of reasoning is problematic. The problem is that participants from high-income countries, who tend to give high first-round answers, tend to be drawn down in the second round not mainly by other participants from countries of equal income, but rather by the overall average value which is lower and based on a lower average GDP number. The opposite adjustment tends to be made by participants from countries with particularly low incomes (who tend to provide low average WTP figures). One might then plausibly argue that the numbers in the second round as a result become biased by being drawn too much toward the mean. This leads, on the whole, to too little dispersion in WTP figures as function of average per-capita GDP levels, which in turn biases the income elasticity estimate downward.