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Using the Delphi method to value protection of the Amazon rainforest

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ABSTRACT

Valuing global environmental public goods can serve to mobilize international resources for their protection. While stated-preference valuation methods have been applied extensively to public goods valuation in individual countries, applications to global public goods with surveys in multiple countries are scarce due to complex and costly implementation. Benefit transfer is effectively infeasible when there are few existing studies valuing similar goods. The Delphi method, which relies on expert opinion, offers a third alternative. We explore this method for estimating the value of protecting the Amazon rainforest, by asking more than 200 environmental valuation experts from 37 countries on four continents to predict the outcome of a contingent valuation survey to elicit willingness-to-pay (WTP) for Amazon forest protection by their own countries' populations. The average annual per-household values of avoiding a 30% forest loss in the Amazon by 2050, assessed by experts, vary from a few dollars in low-income Asian countries, to a high near $100 in Canada, Germany and Norway. The elasticity with respect to average (PPP-adjusted) per-household incomes is close to unity. Results from the Delphi study match remarkably well those from a recent population stated-preference survey in Canada and the United States, using a similar valuation scenario.

1. Introduction

The Amazon rainforest is the world's largest, and is widely recognized as a crucial natural resource for all of mankind. Most of its area (about 60%) is located in Brazil, with the remainder spread across eight other South American countries (collectively, the Amazon region). The average annual area deforested in the Amazon region during 2005–10 was nearly five times as large as the annual area deforested in Indonesia, which had the highest deforestation rate of any tropical country outside of the Amazon (Table 3 in FAO, 2010). Deforestation remains a serious concern in the Amazon region, despite an 80% reduction in the annual area deforested in the Brazilian portion between 1995 and 2005 and 2014 (Nepstad et al., 2014).

Surprisingly little is known about the global value of the Amazon rainforest, most reasonably measured by the willingness-to-pay (WTP) to protect the remaining forest, in spite of the conceptual framework for examining this issue laid out in Carson (1998). Two early contingent valuation (CV) studies, however, do shed some light on the issue. Kramer and Mercer (1997) conducted a random population survey of the U.S. population in 1995, to elicit WTP for protecting 5% of *global* rainforests, not specifically the Amazon rainforest. They found that the average U.S. household was willing to make a *one-time* payment of $21–$31 (1995 dollars) for this purpose. Horton et al. (2003) surveyed outdoor recreationists at a small number of recreation sites in Italy and the U.K. in 1999. They found evidence of much higher WTP, around $45 per household *per year* for a program to protect 5% of the Amazonian rainforest, and $60 for a 20%-protection program. Apart from differences in the populations sampled, these differences could reflect preference differences between Europe and the U.S.; a relatively higher value placed on protecting the Amazon than other tropical rainforests; or increasing public attention to, and support for, rainforest protection over the period in question.

A more reliable comparison is achieved from a recent national population WTP survey, Siikamäki et al. (2015), in Canada and the U.S. using essentially the same survey instrument as in this Delphi study. As discussed at more length in the final section of this paper, that survey gives higher per-household valuations than the two earlier surveys noted above; and values reasonably close to estimates obtained from these countries in the Delphi study presented here.

Conceivably, one could estimate global WTP to protect the Amazon rainforest by conducting a CV survey of a globally representative population sample or by sampling the populations of a large number of countries that collectively account for much of the world's population.

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However, such a survey would be very costly. Benefit transfer (BT), to extrapolate from existing studies (Brookshire and Neill, 1992; Ready and Navrud, 2006; Wilson and Hoehn, 2006, can be an alternative to original valuation work; but is often unreliable when the base of studies upon which to draw is small, the correspondence between the good of interest and those valued in earlier studies is poor, the time separating the present and the early studies is long, and there are substantive differences between the population of interest and the populations sampled in earlier studies; all these are relevant issues here. We consider a third option: a Delphi study that relies on expert judgment to estimate WTP to protect the Amazon. We asked 216 environmental valuation experts from 37 countries outside South America to predict the outcome, expressed in mean and median WTP per household per year, of a hypothetical CV study on Amazon protection administered to their respective national populations. Experts participating in the study came from Europe (49 experts from 21 countries), the U.S. and Canada (82 experts), Australia and New Zealand (16 experts), and Asia (69 experts from 12 countries). The combined populations of these 37 countries account for more than 60% of the world's population, and about 70% of the global population outside of Latin America. Our experts also comprise a reasonably large subsample of researchers actively conducting nonmarket valuation studies.

The Delphi method was developed by the RAND Corporation during the 1950s and 60s, with key contributions by Dalkey (1967, 1969) and Dalkey and Helmer (1963). It has a long background and tradition as a management decision tool (Linstone and Turoff, 1975). The key elements are: (a) anonymous responses by experts to multiple rounds of formal questionnaires; (b) an exercise incorporating iterative, controlled feedback with respect to the information provided at each round; and (c) statistical summary of the group's responses. The approach was designed to minimize the influence of dominant individuals, group pressure, and irrelevant communication and to reduce (statistical) noise. By the early 1970s, hundreds of studies had appeared from around the world. After the mid-1970s, methodological development stalled, as the method was criticized as unscientific and its results speculative (Sackman, 1975). Rebuttals of the critique in the 1990s (e.g., Ziglio, 1996; Landeta, 2006) led to various new applications including Holtsapple and Joshi (2002) and Scholl et al. (2004) for knowledge management; Evans (1997) for pharma-economics; and Okoli and Pawlowski (2004) for e-commerce diffusion in Africa. The method is especially useful when it can produce information not readily obtainable in other ways.

There are few applications of the Delphi method to environmental valuation. Hufschmidt et al. (1983) seem to be the first to mention the method as suitable for such valuation, albeit with no reference to particular applications. Some examples of expert-based work on environmental or related topics still exist. Weitzman (2001) asked more than 2000 Ph.D.-level economists to state the appropriate discount rate for future climate-related damages. León et al. (2003) considered whether environmental values elicited through expert opinion could be used as the basis for benefit transfer. Their study dealt with outdoor recreation at national parks in Spain, and it compared experts' predictions to the results of actual CV studies at the sites. Interestingly, they found a high degree of consistency between experts' average valuations, and the outcome of a subsequent CV study, for valuing these parks among visitors; despite the fact that individual experts' valuations varied substantially. Roman et al. (2012) conducted an intensive study that involved only three experts concerning their assessments of the appropriate value of statistical life to use in the United States for valuing health damages due to air pollution. Two papers (Curtis, 2004; Scolozi et al., 2012) have used the approach for valuing biodiversity. Most similar to our study is a 1998 Delphi study applied to a cultural resource, the Fez Medina in Morocco (Carson et al., 2013). In both that study and ours, experts were asked to predict the outcome of a hypothetical CV survey of national populations of countries outside the one where the resource is found.

This study has two main objectives. The first is to learn about the application of the Delphi method to a global public good. Applying the method to a global public good requires a large group of experts drawn from multiple countries, but levels of expertise in environmental valuation vary across countries. Environmental valuation expertise is concentrated in higher income countries, but lower income countries account for more of the world's population. This leads us to examine the effects of different levels of expertise on experts' WTP predictions. We ask the question: what constitutes an “expert?” investigating this using various indicators of expertise. Note that Delphi studies for other global public goods would face similar issues of heterogeneity of expertise across countries.

The second objective is to use experts' WTP predictions for a preliminary assessment of global WTP to protect the Amazon rainforest and how it varies around the world. We also assess the relationship between the WTP predictions and per-capita national income. This relationship could be useful for BT purposes to predict WTP in countries not included in the study.

2. Design and Implementation of the Delphi Study

2.1. Overview

We implemented the Delphi study by email, in two rounds. In Round 1, we sent each expert a cover letter, which described the purpose and organization of the study, and a study booklet. The booklet provided background information on the Amazon rainforest, described the hypothetical CV study, and asked the expert questions related to the study (in particular, their WTP predictions) and the expert's experience with environmental valuation studies. The booklets were in English in all regions, and are available upon request. An effort was exerted to make them as similar as possible across the regions. Some changes to the order of information and the words used to describe it were made in the Asian booklet, on the basis of cognitive interviews with a small number of Asian economists. English language skills were weaker on average among the Asian experts than among the experts from the other regions.

The CV study was described as a survey of a representative sample of the population of the expert's home country. The CV scenario was described as a plan to protect the Amazon rainforest from further deforestation. Two variations on the scenario (i.e., two protection plans) were presented, differing in the extent of protection. The experts were asked to predict mean and median WTP for both plans: i.e., to predict the outcome of the CV study if it were actually implemented in their respective countries. We emphasized in the cover letter and booklet that all experts were asked to assess WTP for a representative sample of their countries' populations, not their own personal WTP.

In Round 2, mean and median predictions across the respective experts in a given country or region were reported back to those experts, who were then given an opportunity to adjust their predictions. National values were reported to the experts in the U.S., Canada, Australia, and New Zealand. In Europe and Asia, values were reported for country groups, shown in Table 1, with the low- and lower-middle-income groups combined for Asia due to the small number of experts from low-income Asian countries. For increased clarity in the Asian survey, we also provided the distribution of responses by broad WTP ranges in addition to mean and median values. We expected the national or regional summary information provided to the experts to draw their Round 2 responses toward the Round 1 summary statistics. An objective of a Delphi study, often implicit, is to achieve an outcome close to a group consensus if one appears to exists, while at the same time not unduly influencing participants to change their predictions if there are strongly held differences in beliefs.