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Analysis

Waiting or acting now? The effect on willingness-to-pay of delivering inherent uncertainty information in choice experiments

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ABSTRACT

This paper analyzes the effect of inherent uncertainty on the willingness-to-pay (WTP) for a policy aimed at reducing expected climate change impacts. To do this, it relates outcome uncertainty to the probability of occurrence of one of these impacts within a given time horizon. Unlike the existing studies, this paper links outcome uncertainty to the uncontrollable component of environmental uncertainty derived from the stochastic nature of an ecosystem's behavior. Results show that the WTP for the policy in the presence of uncertainty does not decrease compared to the scenario where climate change impacts are assumed to occur with certainty. This suggests individuals are adopting a precautionary attitude when stating their WTP. Thus, the paper provides economic justification for preventive measures in highly uncertain contexts. However, findings are not conclusive with respect to the influence of the degree of uncertainty on the support for such measures.

1. Introduction

There is growing concern about how to handle risk and uncertainty within environmental cost benefit analysis. In a risky world, the analyst has an incomplete understanding of the complex environmental, social, institutional and economic processes that interact jointly to produce policy results (Glenk and Colombo, 2011). Therefore assuming *outcome certainty* rather than *uncertainty* could lead to incorrect conclusions about the true benefits of a policy. For example, an environmental policy chosen based on outcome certainty may be less effective in terms of results compared to one which was chosen based on outcome uncertainty (Pindyck, 2007). Outcome uncertainty depends on a variety of factors including a policy's technical performance, social, political and economic contexts, and environmental uncertainty (Wielgus et al., 2009; Bartczak and Meyerhoff, 2013; Lundhede et al., 2015; Rolfe and Windle, 2015). Many of the factors influencing outcome uncertainty are controllable to some extent; for example increasing scientific knowledge about ecosystem functioning can reduce outcome uncertainty (Langsdale, 2008). However, outcome uncertainty also depends on an *inherent uncertainty*. Inherent uncertainty is the component of environmental uncertainty which derives from the stochastic nature of an ecosystem's behavior as a result of interactions between physical, chemical, ecological and human factors (Thom et al., 2004; Ascough et al., 2008). It is associated with non-linear behavior in ecosystems and means it is difficult to predict the occurrence of many natural environmental phenomena (Berkes, 2007). As a result inherent uncertainty cannot be controlled by any action and it is difficult to reduce.

There is increasing interest within stated preference research about the public's willingness to pay (WTP) to reduce outcome uncertainty in environmental policies. This WTP can be viewed as a signal for policy makers to invest in scientific research which reduces these uncertainties (Glenk and Colombo, 2011; Koundouri et al., 2014). WTP studies to date have presented outcome uncertainty as a range of factors (for example Roberts et al., 2008) or have only focused on the controllable component of environmental uncertainty thus assuming that this uncertainty can be reduced through further scientific research (Cameron, 2005; Viscusi and Zeckhauser, 2006; Akter and Bennett, 2012). However, no amount of research can generate absolute predictions about the probability of occurrence of many environmental phenomena (Langsdale, 2008). This helps explain the focus of valuation researchers on the

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controllable nature of outcome uncertainty. To date no study has examined the effects on WTP of outcome uncertainty when inherent uncertainty is the only factor explaining the uncertainty over the policy outcomes. According to Viscusi and Zeckhauser (2006), in settings characterized by many inherent uncertainties, "those who wish to "go slow" point to the level of scientific uncertainty; they propose that we wait to learn more, and possibly learn that the risk was greatly overstated". The reverse might also be true, if individuals perceive uncertainty as a stimulus to act: would individuals be willing to pay for policy measures in a framework in which impacts might not occur? Gaining understanding of the voting public in this context could have interesting policy implications in our environmentally uncertain times where scientific certainty is usually considered as a prerequisite for environmental decision-making (Mitchell, 2002; Sethi et al., 2005). It could stimulate rather than discourage environmental action aimed at addressing (inherently) uncertain expected impacts, thus providing economic justification for adopting precautionary measures. Indeed, a precautionary approach suggests that whenever there is a risk of environmental quality loss, action rather than inaction should be prioritized. Preference analysis when outcome uncertainty is only driven by inherent uncertainty could offer an insight into the social demand for preventive policies in highly uncertain environmental settings.

This paper seeks to contribute to the preference analysis literature by examining the effects of delivering information about inherent uncertainty associated with climate change impacts on the WTP for a wetlands preservation policy. Informing individuals that outcome uncertainty can emerge due to the difficulty of knowing if an environmental phenomenon will occur or not may affect their WTP for measures aimed at reducing the expected impacts of climate change. Climate change impacts provide an ideal scenario in which to examine inherent uncertainty due to the difficulties in predicting climate system alterations as a result of unforeseen variations and associated system responses (Heal and Millner, 2014). Unlike existing valuation studies, this paper links outcome uncertainty to the uncontrollable component of environmental uncertainty derived from the stochastic nature of ecosystems behavior. We do this by relating outcome uncertainty to the *inherently uncertain* probability of occurrence of an expected climate change impact within a given time horizon. The structure of the paper is as follows: the next section reviews the stated preference (SP) literature dealing with risk and uncertainty; Section 3 describes the methodology used for the analysis, including the data source, the choice experiment (CE) design and the modelling approach; results are reported in Section 4, followed by a discussion and conclusions section.

2. Risk and Uncertainty in the Stated Preference Literature: A Review

The growing concern among researchers about how to handle risk and uncertainty in economic valuation has resulted in an extensive SP literature on the topic. Three broad approaches can be distinguished: i) papers which estimate the WTP for policies aimed at reducing health or environmental risks to examine the public's preferences for changes in risk exposure; ii) studies which examine the effects of delivering information about uncertain environmental outcomes on a policy's benefits and iii) papers which focus on preference uncertainty.

Research papers which estimate the WTP for policies aimed at reducing health risks tend to focus on the valuation of mortality risks induced by air pollution problems and predominately employ the contingent valuation (CV) approach (see Krupnick et al., 1999; Alberini et al., 2006; Hammitt and Zhou, 2006; Wang and Mullahy, 2006; Alberini and Chiabai, 2007 for examples). CV has also been used to value reduced cancer risk (see Fu et al., 1999; Bateman et al., 2005). For environmental risk reduction choice experiments have been used to value the health risks associated with flooding episodes (see Zhai, 2006; Reynaud and Nguyen, 2013; Veronesi et al., 2014) whilst various researchers have valued flood risk reductions (Birol et al., 2009; Dekker and Brouwer, 2010; Brouwer and Schaafsma, 2013). Other risks that have been valued are those related to endangered species (Mitani et al., 2008; Lew et al., 2010; Bartczak and Meyerhoff, 2013), algae bloom episodes (Roberts et al., 2008) and wildfires (Fried et al., 1999). All of these papers considered that individuals can exert some control over risks by applying specific measures. For example Cameron (2005) and Viscusi and Zeckhauser (2006) assume that a policy can eliminate climate change risks and their main findings show a positive WTP for risk reduction, which has been often interpreted as a sign of risk aversion.

Studies which examine the effects of delivering information about uncertain environmental outcomes on a policy's benefits state that outcome uncertainty depends on different factors such as management changes, social, political and economic contexts, and environmental uncertainty. The first papers considering this issue used CV and delivered information about outcome uncertainty through the scenario description. Examples are Johansson (1989), which was the first study to estimate monetary measures in an uncertain setting, and Macmillan et al. (1996). Both papers focused on the analysis of respondent's attitudes towards risk. They presented outcome uncertainty through two possible policy results each associated with a given probability.

Delivering information about outcome uncertainty through an attribute representing different degrees of policy effectiveness has become common practice among researchers due to the increasing use of CEs. The majority assume that the evaluation of the stated uncertainty measures is not affected by subjective perceptions. Examples are Ivanova et al. (2010), Glenk and Colombo (2011), Wibbenmeyer et al. (2013) and Koundouri et al. (2014). Some authors choose to analyze the effect on WTP of different ways of delivering information about uncertainty and its impact on a policy's effectiveness (Wielgus et al., 2009). Others focus on analyzing the impact of alternative ways to model choice behavior (Rigby et al., 2010; Glenk and Colombo, 2013; Rolfe and Windle, 2015). In recent years the analysis of the effect on WTP of subjective perceptions about the uncertainty of policy results have also captured the attention of researchers applying CEs (see Akter et al., 2012; Cerroni et al., 2013; Lundhede et al., 2015). All the papers which examine the effects of delivering information about uncertain environmental outcomes put emphasis on the fact that outcome uncertainty can be reduced by improving training and education as well as increasing scientific knowledge. Indeed, they consider that many of the factors influencing outcome uncertainty can be controllable to some extent. This is especially true in the papers applying a CE which explicitly value, through an attribute, the degree of a policy effectiveness. The interest in knowing preferences for policy effectiveness is motivated by the assumption that some control can be exerted over the final policy results. The main findings of these studies are consistent with predictions of the economic theory which state that individuals are risk-averse.

The final approach considers papers focusing on preference uncertainty. Preference uncertainty is normally assessed using a follow up question to identify how confident individuals felt while stating their preferences (Akter et al., 2008; Martínez and Lyssenko, 2012). Preference uncertainty is usually high either when the utility difference between the chosen option and the best alternative to it is small (Balcombe and Fraser, 2011; Olsen et al., 2011) or when an offered referendum bid is not clearly different from the mean value of one's valuation distribution (Wang, 1997). The effect of stated preference uncertainty on WTP has received considerable attention by CV practitioners, as well as those applying CEs. Mixed results have emerged: some studies find that WTP tends to increase when respondent's uncertainty is accounted for (Ready et al., 1995; Alberini et al., 2003), while others show the opposite (Li and Mattson, 1995). In addition, some evidence exists that WTP may increase or decrease with preference uncertainty depending on the approach employed to classify respondents as certain or uncertain basing on their stated degree of uncertainty (Loomis and Ekstrand, 1998; Shaikh et al., 2007; Lundhede et al., 2009; Ready et al., 2010).