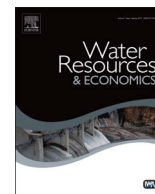




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The effect of risk communication on choice behavior, welfare estimates and choice certainty[☆]

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ABSTRACT

In stated preference research focusing on the elicitation of willingness to pay for reducing environmental or health risks, it is of crucial importance how risk is communicated to survey respondents. This study applies a split-sample approach to examine the effect of using a risk ladder on choice behavior, welfare estimates and choice certainty in a stated discrete choice experiment. It values the improvement of water quality in Switzerland in terms of the reduction in environmental and public health risks that would result from implementing new wastewater treatment technologies that substantially reduce micropollutant discharges into water bodies. Results show that the risk ladder significantly influences respondents' choice behavior and welfare estimates, but not choice certainty. We find evidence of preference learning.

1. Introduction

Much of the stated preference (SP) literature focuses on the valuation of relatively small risks and risk reductions. Most applications estimate the economic values of mortality risks based on the public's willingness to pay (WTP) for a reduction in health risks using the contingent valuation (CV) method (e.g. [5,7,33]). An increasing number of studies address environmental risks, including water-related risks (e.g. [6,14,18,19]). Despite the richness of the risk communication literature, visual aids for communicating risks and their effect on welfare measures have received limited attention in the existing SP literature, particularly in the context of discrete choice experiments (DCE).

The validity and reliability of SP results depend on the way in which risk is conveyed to the survey respondents. Adequately communicating changes in the risk levels to survey respondents is also highly relevant to the SP studies that focus on the economic valuation of changes in water quality, where the main benefits are associated with reductions in the risk to human health and recreational activities [55]. The main pathways through which water quality can affect human health are drinking water, bathing in contaminated surface water and the consumption of fish and shellfish [56]. Despite the fact that numerous SP studies have investigated and valued these aspects of health risks (e.g. [8,52,68,102]), the use of risk communication devices to help respondents to evaluate changes in health risks is the exception rather than the rule. A fine example is [2], who use a visual aid to elicit respondents' WTP for reducing cancer and microbial disease risk from municipal drinking water.

The literature on risk communication and perception is scattered across various disciplines, dominated by psychology

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[39,53,54,92], and shows that decisions involving risk often place a substantial cognitive burden on individuals. A number of CV studies compare different risk communication devices and test their impact on welfare estimates [15,30,65].

The risk ladder is a visual aid used to explain the risk magnitudes; it displays a range of risks vertically, with low levels at the bottom and high levels at the top [88]. In SP studies, the risk ladder typically shows the extent of (a change in) the probability of a risky event relative to probabilities of other risky events faced by the respondents. Risk ladders have proved to be an effective visual tool for risk communication because they convey both absolute and relative risk levels [63]. They consequently help respondents to better understand risks and risk changes and are often used in SP surveys that elicit WTP for a particular risk reduction. However, risk ladders seem to systematically increase welfare estimates in one-shot discrete choice CV procedures [33]. Their effect on the outcomes of repeated DCEs, which became the dominant SP method for eliciting public preferences and valuing (environmental and health) risk reduction programs in recent years, has not yet been thoroughly investigated.

This study values the reduction of environmental and health risks in Switzerland resulting from improved water quality. More specifically, it estimates public demand for a reduction in micropollutants (MPs) in water bodies that would be achieved through implementation of new wastewater treatment technologies. The main objective of this paper is to examine and test the effect of the use of a risk ladder in a repeated DCE on (1) choice behavior, (2) welfare estimates, and (3) choice certainty. For this purpose, the same DCE is applied in a split sample: one sample received the DCE containing the risk ladder while the other sample answered the same DCE without the risk ladder. The split samples are randomly and independently drawn from the same representative household panel. This paper contributes to the existing literature in three major ways. To our knowledge, this is the first study to analyze the effect of a risk ladder on choice certainty. Secondly, we examine the impact of the risk ladder both inter- and intra-samples. In the latter case we distinguish between respondents who report a change in their risk perception due to the risk ladder and respondents who report no change. The third novelty of this study is that it investigates the extent to which the effect of the risk ladder prevails in a repeated DCE where preference learning could possibly eliminate this effect during the choice sequence.

The remainder of this paper is organized as follows. Section 2 presents the literature review on risk communication with a focus on SP research. Section 3 explains the choice modeling framework and specifies the hypotheses tested in this paper. A description of the survey design is provided in Section 4. Section 5 analyzes the results and Section 6 presents conclusions.

2. Theoretical background

Although there exists an impressive body of empirical evidence on the influence of information provided to respondents in SP surveys in general (e.g. [3,9,10,77]), the issue of risk communication, preference construction and decision-making under uncertainty remains a somewhat underdeveloped area in the environmental valuation domain [21]. It is generally acknowledged in the psychology literature that choices and values are highly context-dependent, implying that an ongoing process of preference construction always take place (to some degree) where people make choices depending on the options at hand [101]. Equally, the more ambiguity in someone's preferences, for example due to a lack of familiarity with the particular topic or choice task, the more SP will be subject to procedural and descriptive influences [90]. An assumption underlying SP methods is that individuals are rational economic agents and know their preferences [84]. Empirical insights, however, do not support this hypothesis, as they reveal that respondents are often uncertain about their SPs [4,27,85]. Studies have shown that the more uncertain a respondent is about the stated WTP value, the lower is the probability that (s)he would actually pay the stated WTP amount in a real situation [27,50,83]. Preference uncertainty can therefore substantially influence the WTP results and is an important driver of hypothetical bias [27,78,109]. However, experience gained in repeating choices has been shown to stabilize preferences and increase choice consistency (e.g. [35]). Moreover, self-reported choice certainty increases along the choice task sequence, suggesting that a learning process takes place [20].

Risk is generally defined as the probability and extent of hazard exposure leading to negative consequences for a person or ecosystem [11]. Risk communication refers to the way in which a potential hazard is presented to the public. This is relevant for SP surveys, as risk communication can influence the elicited WTP values, and ultimately the policy decisions they aim to inform. It is therefore important to investigate the effect of various risk communication techniques on the outcome of such surveys. A number of theories have been developed about how risk information is processed, how risk perceptions are formed, and how risk decisions are made (e.g. [32]). Economic expected utility theory [108] inspired the development of various models that explain behavior and decision-making under risk and uncertainty (e.g. [25,73,87,105]).

Viscusi's [105] prospective reference theory provides the theoretical basis for this study. The theory combines elements of the expected utility and prospect theory models, and is consistent with the Bayesian learning process. It postulates that an individual's attitude towards uncertain prospects is influenced by a reference risk level which serves as his/her prior probability. When presented with new risk information, the individual's risk perception is updated in a Bayesian fashion, as demonstrated in [104]. Since the risk perception might affect preferences for risk reduction, presenting the respondents in SP surveys with new (actual) risk information may lead to systematic changes in their preferences and welfare estimates. Empirical evidence from the SP literature suggests that individuals indeed update their risk perceptions and WTP when presented with actual exposure levels [25,34,80,82]. As a result, fully informed risk valuation based on actual risk levels is expected to differ from uninformed (subjective) risk valuation. This implies that studies valuing risk reductions without adequately communicating actual risk levels may well generate biased results, thus emphasizing the importance of studying risk communication in surveys designed to elicit preferences.

Communicating risk information to the public is not an easy task. The risk communication literature shows that people experience cognitive difficulties in trying to understand probability concepts, in particular when the risk is new and the probabilities are low (e.g. [31,106]). Researchers from various disciplines have explored a diversity of risk communication devices, i.e. the formats

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