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Analysis

Exploring heterogeneity in the value of a statistical life: Cause of death v. risk perceptions

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ABSTRACT

Most current environmental policy analyses use Value of a Statistical Life (VSL) figures inferred from workplace safety and traffic accident contexts to compute the benefits of environmental programs that avoid premature deaths. There is considerable debate about the appropriateness of this practice, in part because the effect of cause of death may be partly confounded with latency, initial risks, and competing risks. Preference for reducing risks can be also affected by individual-assessed risk attributes that are rarely controlled in valuation studies. This paper explores reasons for differences in preferences for mortality risk reductions (if any), and establishes the magnitude of the effects of such risk attributes as compared to other sources of VSL heterogeneity. In our conjoint choice experiments, cause of death, the size of the risk reduction, and latency, the "price" of the risk reduction and the mode of delivery of the risk reduction are explicit attributes of the alternatives to be examined by the respondent. Our statistical models also control for actual and perceived exposure to risks, initial risks, risk attributes such as dread, and sensitivity to and controllability of specific risks. We find that there is significant heterogeneity in the valuation of mortality risks and thus in the VSL. The VSL increases with dread, exposure to risk, and the respondents' assessments of the baseline risks. It is higher when the risk reduction is delivered by a public program, and increases with the effectiveness rating assigned by the respondent to the mode of the risk reduction. Even when we control explicitly for all of these factors, the cause of death per se accounts for a large portion of the VSL. All else the same, the fact that the cause of the death is "cancer" results in a VSL that is about one million euro *above* the amount predicted by dread, exposure and other risk perception variables. The VSL in the road safety context is about one million euro *less* than what is predicted by dread, exposure, or beliefs compared to VSL for the respiratory risk context. The effect of cause of death is thus as large as the effect of other sources of VSL heterogeneity. Our respondents do not seem to discount future risks.

1. Introduction

There is a reasonable degree of consensus in academic and policy circles that the Value of a Statistical Life (VSL) is the appropriate metric to estimate the mortality benefits of policies that reduce premature mortality, such an environmental and safety programs (e.g., Máca et al., 2012; Smith et al., 2006). There is much less agreement as to whether a single VSL figure should be used for all beneficiaries and for all causes of death covered by the policy.

In US environmental policy assessments, for example, analysts typically rely on estimates of the VSL based on labor market studies (Aldy and Viscusi, 2007; US EPA, 2000; Viscusi, 1993; Viscusi and Aldy, 2003). Questions have been raised whether such practice is appropriate, since the beneficiaries of environmental regulations are usually the very old (Krupnick, 2007) or the very young, and the causes and timing of death are very different from workplace accidents.

Consider for example air pollution. Epidemiologic research (Hurley et al., 2005; National Academy of Science, 2008; US EPA, 1999a,b) indicates that the most important mortality effects of air pollution are those associated with cardiovascular disease, followed by cancer. Air pollution is also thought to trigger asthma attacks in asthmatic subjects, exacerbate the severity of asthma attacks, and increase asthma- and chronic obstructive pulmonary disease-related mortality.

Should a single VSL be used for such diverse mortality effects? Economic theory suggests a number of reasons why individuals might place a different value on them. Previous psychometric research further indicates that individual perceive risks along many dimensions, including voluntariness, controllability, and dread (Fischhoff et al., 1978; Slovic, 1987; Starr, 1969), and such perceptions may influence their willingness to pay (WTP) to reduce risks (McDaniels et al., 1992). Evidence from previous empirical work is mixed, and in policy practice,

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the US Environmental Protection Agency uses a single VSL in its policy analyses.[1] The European Commission also uses a single VSL figure, even though the Directorate-General Environment of the European Commission recommends a "cancer premium" equal to 50% of the standard reference VSL.[2] In a similar vein, the UK Health and Safety Executive (HSE) has recommended a VSL for cancer that is double that used for other causes (UK Health and Safety Executive, 2001).

In this paper, we report on the results of a choice experiment study that was specifically designed to investigate differences in the VSL by the cause of death and reasons for such differences (if any). In our choice experiments, we created hypothetical alternatives defined by five attributes: i) the cause of death (respiratory illness, cancer, or road-traffic risks), ii) the size of the risk reduction, iii) whether the risk reduction was private or delivered by a public program, the latter case implying that there are other beneficiaries, iv) latency, expressed as the number of years until the risk reduction occurs, v) the one-time cost to the respondent, which must be paid now. Respondents were to indicate their most preferred alternative out of a choice set that included two hypothetical alternatives and the status quo. We use the responses to the choice questions to estimate the VSL. The conjoint choice experiment survey was administered to a sample of residents of the city of Milan, Italy, in late November to mid-December 2008.

Regarding i), we chose respiratory illness and cancer because these are risks associated with air pollution (and, in the case of cancer, other environmental exposures, including contaminated water and soil). We also focus on road traffic risks because virtually everyone is familiar with them, they can be addressed through both private behaviors and public programs, and people may hold various degrees of confidence about the controllability of such risks. Since i) and iv) are varied independently of one another, our study design allows us to investigate whether the cause of death has an effect on the willingness to pay to reduce risk that is above and beyond the mere timing of the risk reduction.

We use attribute iii)—the private or public program nature of the risk reduction—combined with the respondent's assessment of the effectiveness of private behaviors and public program in reducing each of the three types of risk here studied, to examine whether the controllability of a risk influences the WTP to reduce such a risk. In this sense, our work is in sharp contrast with Bosworth et al. (2009) and Adamowicz et al. (2011), who examine mortality and morbidity risk reductions strictly within a public program context, and with earlier work (e.g., Krupnick et al., 2002) where attention is restricted to private risk reductions.

To better understand the sources of heterogeneity in respondents' valuations of mortality risks, we elicit the dread associated with different causes of death directly from the respondents, and control for baseline risk as stated to the respondent in the survey, respondent assessment of baseline risks, personal exposure (McDaniels et al., 1992), and experience with the risk.

Briefly, we find that the VSL does increase with dread, and with our own and the respondent's constructs of the respondent's exposure to the three types of risk. The VSL is higher when the risk reduction is delivered by a public program, and increases with the effectiveness rating assigned by the respondent to public programs in addressing that cause of death. The effectiveness of private risk-reducing behaviors is likewise positively associated with the VSL.

Even controlling for all of these characteristics of the mortality risk reductions, the cause of death per se—namely, whether it's cancer, a road-traffic accident or a respiratory illness—remains strongly statistically significant. All else the same, the fact that the cause of the death is "cancer" results in a VSL that is about one million euro *above* what is predicted by dread, exposure, beliefs, etc. in the respiratory illness context. The VSL in the road safety context is over one million euro *less* than what is predicted by dread, exposure, beliefs, etc. for respiratory illness and over two million euro *less* than a comparable cancer risk.

The remainder of this paper is organized as follows. Section 2 presents background information and reviews the literature. Section 3 describes the research questions and study design. Section 4 presents the questionnaire and survey administration. Section 5 presents the theoretical and econometric model. Section 5 discusses the data. Section 7 presents the estimation results, and Section 8 concludes.

2. Background and Previous Literature

2.1. Risk of Dying and the VSL

The Value of a Statistical Life is defined as the marginal WTP for a small change in the risk of dying:

$$\mathrm{VSL} = \frac{\partial \mathrm{WTP}}{\partial R}\Big|_{U=const.} \quad (1)$$

As a summary measure of the WTP for mortality risk reductions, the VSL is used to compute the monetized benefits of policies that reduce premature deaths. Implicit in Eq. (1) and in most standard expected utility models is the notion that R represents the total risk of dying for any cause.

Economic theory suggests several reasons why the VSL for one cause of death might be different from that for another. For starters, the VSL should increase with baseline risks (Pratt and Zeckhauser, 1996). All else the same, the VSL for a specific cause of death might be larger simply because the baseline risk of dying for that cause is higher.

The existence of competing risks might be another reason for different VSLs. Eeckhoudt and Hammitt (2001) consider competing risks and show that if the utility of a bequest at death is positive, then the marginal WTP for reducing one type of risk (i.e., the VSL for that cause of death) depends on the magnitude of the other risks of dying. Based on their model, a person in poor health with a high risk of dying from a chronic illness would have a very low WTP for a small reduction in the risk of dying for another cause (e.g., pollution exposures) that accounts for a very small share of that person's total risk of dying (the "why bother" effect). Evans and Smith (2006) show that the effect of a competing risk is potentially ambiguous, because it depends on how the competing risks enter in the expected utility.

Another reason why people might be willing to pay different amounts of money to reduce the risk of dying from different causes may simply lie in the timing of the risk reduction. Economic theory shows that the VSL at time t for a risk reduction to be incurred L periods later is equal to the VSL for an immediate risk reduction in period (t + L), discounted back to the present (Cropper and Sussman, 1990).

2.2. Risk Perceptions

The psychometrics literature shows that risk perceptions are influenced by the attributes of the risk beyond its sheer magnitude (e.g., its controllability, familiarity, dread, and whether it is voluntarily faced or not) (Chauvin et al., 2007; Fischhoff et al., 1978; Slovic, 1987; Urban and Ščasný, 2007). It is possible that such differences in perceived risk attributes influence the WTP to reduce the various types of mortality risks, even holding the magnitude of the risks and latency the same (Revesz, 1999; Rowlatt et al., 1998).

For example, evidence from surveys suggests that people consider it very important to reduce cancer deaths (e.g., Jones-Lee et al., 1985), and might be willing to commit more resources to reduce risks with which they are not familiar and/or they consider outside of their own control (McDaniels et al., 1992; Rowlatt et al., 1998; Savage, 1993). McDaniels

[1] In 2000, the Science Advisory Board — Environmental Economics Advisory Committee to the US EPA advised the agency not to adjust the VSL (Dockins et al., 2004). Adjustments are made, however, for future growth in income. See Robinson and Hammit (2011) for a review of the different VSLs used by different US agencies.

[2] See http://ec.europa.eu/environment/enveco/others/pdf/recommended_interim_values.pdf.