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Demand for health risk reductions ☆

Trudy Ann Cameron [a,]*, J.R. DeShazo [b]

[a] Department of Economics, University of Oregon, Eugene, OR 97403-1285, USA
[b] Department of Public Policy, School of Public Affairs, 3250 Public Policy Building, UCLA, Los Angeles, CA 90095-1656, USA

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ABSTRACT

A choice model based on utility in a sequence of prospective future health states permits us to generalize the concept of the value of statistical life (*VSL*). Our representative national survey asks individuals to choose between costly risk-reducing programs and the status quo in randomized stated choice scenarios. Our model allows for separate marginal utilities for discounted net income and avoided illness years, post-illness years, and lost life-years. Our estimates permit calculation of overall willingness to pay to reduce risks for a wide variety of different prospective illness profiles. These can be benchmarked against the standard *VSL* as a special case.

1. Introduction

Policies to reduce health, environmental, and safety risks are often intended to reduce the incidence of major illnesses or injuries that develop in future years. We present a new approach to the measurement of individual-specific benefits that result from reductions in future patterns of morbidity and mortality risks. Measures of such benefits are important to researchers and policy-makers in many fields. For example, this information helps us understand the benefits of expenditures on medical research or the benefits from costly environmental regulations. It can also help us decide upon appropriate levels of regulations for road, workplace, and household safety, or how much we should spend on publicly supported health care (e.g., OECD [55]).

The conventional approach to measuring the benefits of health risk reductions relies upon estimates of the marginal rate of substitution between mortality risk and income in the current period. This approach has arisen as a matter of empirical necessity. Benefit measures based on observable choices have tended to come from estimates of current-period wage-risk tradeoffs (Jones-Lee [38], Viscusi [67], Tolley et al. [63]). These measures of people's willingness to pay (*WTP*) for a small reduction in risk are typically used to construct what is known as "the value of a statistical life" (*VSL*). The *VSL* scales, proportionally, the dollar-risk tradeoffs for small individual marginal risk changes into an aggregate *WTP*, across individuals, for an *aggregate* risk change of 1.00.

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* Corresponding author. Fax: +1 541 346 1243.
E-mail addresses: cameron@uoregon.edu (T.A. Cameron), deshazo@ucla.edu (J.R. DeShazo).

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Policy applications of the *VSL* typically involve one of two cases. In the first case, a one-size-fits-all *VSL* is multiplied by an expected overall number of "deaths avoided" to produce an estimate of overall expected benefits.[1] In the second case, researchers require an estimate of the value of avoiding just a single year of premature mortality, for example when valuing advances in medical research that may extend life. To answer this particular need, it has been standard to calculate the "value of a statistical life-year" (*VSLY*) by dividing a standard one-size-fits-all *VSL* by the population average number of (discounted) expected remaining life-years (Cutler and Richardson [23], Cutler and Richardson [24]; Murphy and Topel [52]).[2]

Our new approach to measuring the values people assign to health risk reductions represents an improvement over conventional empirical strategies. We begin with a structural model of utility in future periods of an individual's life as a function of the health status they will experience in those future periods. We differentiate these future health states as "current health," "sickness," "recovered/remission years," and "lost life-years." In our stated choice survey (also known as a conjoint analysis or a discrete-choice experiment), each subject is presented with several opportunities either to purchase one of two illness-specific health-risk reduction programs or to stick with their status-quo health risks.[3] These risk reduction "programs" involve diagnostic screening and, when risks are high, medical therapies that would reduce, but not eliminate, the subject's chance of experiencing that particular future illness with its associated pattern of health states. We use the tradeoffs embodied in people's stated choices to infer their *WTP* for a given-*sized* reduction in their baseline risk of experiencing a specified future illness profile. However, these given-sized risk reductions are heterogeneous. The implicit value of an *incremental* sick year or lost life-year can then be inferred, as in a hedonic model, by taking the derivatives of this overall *WTP* with respect to the number of sick-years or lost life-years involved.[4]

Our strategy overcomes several limitations of the conventional *VSL* approach. These limitations have long been recognized by researchers, but have been unavoidable due to the constraints of existing empirical data and methods. We introduce two main innovations. First, we generalize the conventional strategy by more comprehensively defining the good to be valued. Instead of valuing a single mortality risk reduction in the current period, we value risk reductions for a time profile of possible adverse future health states. Individuals express their *WTP* to reduce their risks of entire time profiles of adverse health states over their remaining lifespans. We do not have to extrapolate these future estimates from only current-period data. Importantly, we can identify inter-temporal substitutability or complementarity among future health states. This is possible because we estimate demands for a much wider range of health risks than usual. Our model subsumes myriad patterns of illness, recovery, and lost life-years across the individual's remaining lifespan. This generalization is needed because the majority of benefits from many health, environmental and safety policies accrue in future years of the individual's life, as opposed to solely in the current period.[5]

Second, our structural random utility model for our subjects' discrete choices makes it very clear how *WTP* estimates for reductions in the risks of sick-years and lost life-years depend upon the individual's age, income, marginal utility of other consumption, and discount rate. Informed by the lifecycle model of Ehrlich [27], our structural model also recognizes and builds upon a growing empirical literature which has explored various sources of heterogeneity within traditional *VSL* estimates.[6] While we make advances in structural modeling in terms of the most important variables in this paper, we cannot comprehensively explore all alternative assumptions or all possible sources of *VSL* heterogeneity in one paper. For example, we leave to related and future papers a more-detailed exploration of the roles played by, for example, age, current health status, specific-illness effects, subjective risk beliefs, choice set complexity and alternative discounting assumptions.

Conceptually, we focus on the individual's *WTP* for a "microrisk" reduction (where "micro-" means "one-millionth," as in Howard [36]). We prefer the microrisk metric to the more-typical *VSL* terminology for aggregated risks. Our model is based fundamentally on discounted expected per-year utility in distinct future health states. No arbitrary conversion of a standard *VSL* to a per-year *VSLY* is necessary. For example, our model makes it straightforward to assess *WTP* for a reduction in the risk of an illness profile that involves dying just one or two years prematurely. Normalization on a small risk change also helps avoid the all-too-common episodes of public outrage when people misinterpret the *VSL* as an arbitrary government dictum about the intrinsic worth of a specific human life (see Cameron [14]).

[1] A one-size-fits-all *VSL* has been politically expedient since policy-makers have difficulty explaining the logic for differentiated values to their constituents. Baker et al. [8] outline the restrictions on the underlying social welfare function that would be necessary to justify a one-size-fits-all *VSL*.

[2] For an alternative and more sophisticated approach to calculating the *VSLY* see Moore and Viscusi [50].

[3] In the past, stated preference methods generated controversy because of concerns that respondents would overstate their willingness to pay for a public risk reduction. However, over the last two decades, important strides have been made in understanding and minimizing concerns about the incentive compatibility of these choice situations (e.g., List [47]). Indeed, a recent meta-analysis shows that stated preference estimates of the *VSL* are systematically lower than those produced by revealed preference data from wage-risk studies (Kochi et al. [44]).

[4] Strand [62] also considers both mortality and morbidity, but his is a theoretical treatment which emphasizes continuous time.

[5] Van Houtven et al. [66] use a survey that asks respondents to consider a forced relocation, for one year, to one of two other cities, where the two locations differ only in their relative and absolute frequencies of fatal stomach, liver, or brain cancer versus car accident deaths. They randomly describe the illness profiles for the cancer as having 5, 15, or 25 years of latency and either two or five years of morbidity. Dow et al. [26] discuss the importance of competing health risks when one considers the demand for a risk-reducing intervention. Other researchers have valued risk reductions at selected times in the future (e.g., Krupnick et al. [46], Alberini et al. [1], Hammitt and Liu [35], and Van Houtven et al. [66]) but not the reduction of risks involving time patterns of several different adverse health states.

[6] Various other researchers have explored the influence of each of these factors on *VSL*s but not in a comprehensive structural model of intertemporal demand. For age, see Krupnick [45] and Viscusi and Aldy [68]. For income, see Mrozek and Taylor [51], Viscusi and Aldy [69], and Costa and Kahn [22]. For future health states, see (Krupnick et al. [46] and Alberini et al. [1]).