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Consistent estimation of the value of statistical life ☆

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Abstract

Conventional estimators of the value of statistical life are biased. People differ in risk from each of many health threats, ability to reduce these risks, willingness to pay to reduce risk, and other utility parameters—creating a problem of multi-dimensional heterogeneity existing single-equation methods cannot handle. Herein we propose a general method of moments (GMM) approach that uses functional relationships between underlying parameters and observed data to estimate a person's willingness to pay for mortality risk reduction. This approach yields a consistent estimate of the value of statistical life. We use simulations to show that the GMM estimate of the value of statistical life performs well even when combining data from different sources that are sampled at different, low frequencies.

JEL classification: C5; H0; J3

Keywords: Valuation; Risk; Self-protection; General method of moments (GMM); Health

1. Introduction

In our previous work, we argued the estimation of the value of statistical life (VSL) has several problems given the presence of multi-dimensional heterogeneity between people (see Shogren and Stamland, 2002, 2005a,b). Single-equation estimations yield biased estimates of the VSL. And worse, the direction and size of the bias depend upon the distribution of the unobservable

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characteristics in the population. Obtaining accurate VSL estimates requires one to control for individual heterogeneity in multiple dimensions: preferences for risk bearing, skill to cope with risk, and personal VSL.[1]

Herein we propose a general method of moments (GMM) framework to obtain improved VSL estimates in the face of multi-dimensional individual heterogeneity. We allow people to be heterogeneous with respect to every parameter of their utility function. Each person has an idiosyncratic mortality risk from each risk source, of which many exist, an idiosyncratic ability to reduce each of these risks through risk averting behavior, and his or her own value of statistical life. In GMM terms, the goal is to obtain a model in which all parameters are identified. This model then yields, under the usual assumptions underlying GMM, an asymptotically unbiased estimate of the key parameter—the value of statistical life. Our approach has therefore the potential of restoring greater accuracy to the estimates of the value of statistical life by avoiding the bias inherent in single-equation approaches. This advance, however, may come at considerable cost. Keeping the model tractable and its data requirements reasonable requires some strong assumptions. But we believe these assumptions do not invalidate the main strength of the model, which is to strip away the presumption – implicit in previous estimation approaches – that all people are identical.

We use foodborne disease as our motivating example. Well-publicized outbreaks of *Salmonella*, *Listeria monocytogenes*, and *Escherichia coli* 0157:H7 have made people more aware that foodborne disease is a serious public health issue. By one estimate, one in every three consumers in industrialized countries suffer from foodborne diseases each year (WHO, 2000); in the USA, the estimate is about one in four consumers (Mead et al., 1999).[2] The risks posed by foodborne disease have prompted people to demand additional investment, both in the private and public sector, in processes and technologies that can reduce the risks of foodborne illness (e.g. HACCP; see e.g. Buzby and Roberts, 1996; Lutter, 1999; Unnevehr and Jensen, 1999).

Prioritizing such risk reduction strategies that maximize net benefits requires information on the monetary value people assign to safer food (see Hayes et al., 1995). Assessing how people value safer food implies the assessment of the benefits of reduced odds of death and illness, or the value of statistical life (see Schelling, 1968; Thaler and Rosen, 1976). But individual behavior reflects more than just unobserved preferences for risk reduction. Behavior also reflects each person's unobserved and potentially unique food risk and ability to reduce this risk privately (Ehrlich and Becker, 1972; Shogren and Crocker, 1991, 1999). One may protect against foodborne risks through consumption patterns, food preparation, cleaning efforts, and so on. People with a low valuation of collective risk reduction may seem to tolerate greater risk, but of course they may instead have already used their unobservable skill to reduce the risk themselves. They select food consumption with different inherent risks based on both risk reduction

[1] Given the weight put on VSL estimates by United States federal agencies in their cost-benefit analysis of new and existing laws and regulations, improving the VSL estimates would be significant. The VSL accounts for the majority of estimated benefits in many proposed US federal rules and regulations. An illustrative case is the US Environmental Protection Agency benefit estimates for its 2000 diesel sulfur rule. The EPA used VSL of \$6 million per life saved from improved air quality, which accounted for \$62.6 billion of \$70.4 billion estimated annual total benefits—about 90% (USEPA, 2000).

[2] Mead et al. (1999) estimated that 76 million illnesses occur annually, with nearly 300,000 hospitalizations and 5000 deaths. For six bacterial pathogens, Buzby et al. (1996) argue the medical costs are between \$9 and \$13 billion annually, where \$3–\$7 billion should be attributed to foodborne bacteria (also see Crutchfield et al., 1997).