An Empirical Bayes Approach to Combining and Comparing Estimates of the Value of a Statistical Life for Environmental Policy Analysis

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Abstract. An empirical Bayes pooling method is used to combine and compare estimates of the value of a statistical life (VSL). The data come from 40 selected studies published between 1974 and 2002, containing 197 VSL estimates. The estimated composite distribution of empirical Bayes adjusted VSL has a mean of $5.4 million and a standard deviation of $2.4 million. The empirical Bayes method greatly reduces the variability around the pooled VSL estimate. The pooled VSL estimate is influenced by the choice of valuation method, study location, and union status of sample but not to the source of data on occupational risk or the consideration of non-fatal risk injury.

Key words: value of a statistical life (VSL), empirical Bayes estimate, environmental policy, health policy, contingent valuation method, hedonic wage method

JEL Classification: J17, C11, Q28

The value of a statistical life is one of the most controversial and important components of any analysis of the benefits of reducing environmental health risks. Health benefits of air pollution regulations are dominated by the value of premature mortality benefits. In recent analyses of air pollution regulations (United States Environmental Protection Agency (USEPA) 1999; 2005), benefits of reduced mortality risks accounted for well over 90 percent of total monetized benefits. The absolute size of mortality benefits is driven by two factors, the relatively strong concentration-response function, which

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leads to a large number of premature deaths predicted to be avoided per microgram of ambient air pollution reduced, and the value of a statistical life (VSL), estimated to be about $6.3 million. In addition to the contribution of VSL to the magnitude of benefits, the uncertainty surrounding the mean VSL estimate accounts for much of the measured uncertainty around total benefits. Thus, it is important to obtain reliable estimates of both the mean and variance of VSL.

The VSL is the measurement of the sum of society’s willingness to pay (WTP) for one unit of fatal risk reduction, which is what society is willing to pay for reducing each member’s risk by a small amount (Fisher et al. 1989). For example, if each of 100,000 persons is willing to pay $10 for the reduction in risk from 2 deaths per 100,000 people to 1 death per 100,000 people, the VSL is $1 million ($10 \times 100,000). Since fatal risk is not directly traded in markets, non-market valuation methods are applied to determine WTP for fatal risk reduction. The two most common methods for obtaining estimates of VSL are the revealed preference approach including hedonic wage and hedonic price analyses, and the stated preference approach including contingent valuation, contingent ranking, and conjoint methods. EPA does not conduct original studies, but relies on existing VSL studies to determine the appropriate VSL to use in its cost-benefit analyses. The primary source for VSL estimates used by EPA in recent analyses has been a study by Viscusi (1992). Based on the VSL estimates recommended in this study, EPA used a mean VSL estimate of $6.3 million, with a standard deviation of $4.2 million (U.S. EPA 1999).

We extend Viscusi’s study by surveying recent literature to account for new VSL studies published between 1992 and 2002. This is potentially important because the more recent studies show a much wider variation in VSL than the studies recommended by Viscusi (1992). The estimates of VSL reported by Viscusi range from $0.8 to 17.7 million. More recent estimates of VSL reported in the literature range from as low as $0.2 million (Loomis and du Vair 1993), to as high as $87.6 million (Arabsheibani and Marin 2000). Careful assessment is needed to determine the plausible range of VSL, taking into account these new findings.

There are several potential methods that can be used to obtain estimates of the mean and distribution of VSL. In a study prepared under section 812 of the Clean Air Act Amendments of 1990 (henceforth called the EPA 812 report), it was assumed that each study should receive equal weight, although the reported mean VSL in each study differs in its precision. For example, Leigh and Folsom (1984) estimated a VSL of $10.4 million with standard error of $5.2 million, while Miller et al. (1997) reported almost the same VSL ($10.5 million), but with a much smaller standard error ($1.5 million). As