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Publication selection and the income elasticity of the value of a statistical life

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ABSTRACT

Estimates of the value of a statistical life (VSL) establish the price government agencies use to value fatality risks. Transferring these valuations to other populations often utilizes the income elasticity of the VSL, which typically draw on estimates from meta-analyses. Using a data set consisting of 101 estimates of the income elasticity of VSL from 14 previously reported meta-analyses, we find that after accounting for potential publication bias the income elasticity of value of a statistical life is clearly and robustly inelastic, with a value of approximately 0.25–0.63. There is also clear evidence of the importance of controlling for levels of risk, differential publication selection bias, and the greater income sensitivity of VSL from stated preference surveys.

1. Introduction

The value of a statistical life (VSL) is the most important parameter used in monetizing the value of health, safety, and environmental risks. For example, the largest benefit component of regulations under the Clean Air Act consists of the reduction of mortality risks valued by VSL (EPA, 1997). Regulatory policies to reduce mortality risks from medical devices and transportation safety improvements can have large benefits when evaluated at large VSLs. Thus, it is essential to get the value of a statistical life right in order to allocate public resources efficiently (Viscusi and Aldy, 2003). Ideally, these values should reflect the willingness to pay of the population that will benefit from a mortality risk reduction.

Although estimates of the VSL vary greatly, most research surveys report the VSL to be somewhere between $6 million and $10 million U.S. dollars. This range in the literature has been reflected in similar clustering of the VSL estimates used by government agencies since the mid-1990s.[1] Meta-analyses of the VSL literature have played a prominent role in agencies' selection of the VSL.

Policy analysts generally face a benefits transfer problem in that the population in any VSL study may not be representative of the population affected by the policy. While adjusting for population characteristics remains a controversial issue (U.S. EPA, 2010; Viscusi, 2011), agencies have incorporated income elasticity adjustments into their analyses.[2] The U.S. EPA (2010) adjusts its VSL estimates over time to account for the effect of rising income levels on the pertinent VSL. The U.S. Department of Transportation (2011) policy guidance document adopted an income elasticity of

[1] Viscusi (2009) provides the VSL amounts used to assess 40 major government regulations, all of which include estimates of the VSL in the $6–10 million range after 1996.

[2] Adjustments for age are less common and generated controversy in the U.S. (Viscusi, 2009), but Canada and the World Bank have adopted age adjustments to the VSL (Hammitt and Robinson, 2011).

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VSL of 0.55 based on the meta-analysis results in Viscusi and Aldy (2003). More recently, the U.S. Department of Transport guidelines (2013) now use an elasticity of 1.0, splitting the difference between the meta-analysis results in Viscusi and Aldy (2003) and the quantile estimates in Kniesner et al. (2010). Because most VSL estimates are for the U.S. and other developed countries, assessing the pertinent income elasticity is essential to estimating the pertinent VSL in other countries based on the existing literature (Hammitt and Robinson, 2011). Such modifications are especially sensitive to the magnitude of the income elasticity when applied to low-income countries or populations.

This paper integrates, explains, and corrects 101 meta-analytic estimates of the income elasticity of the VSL. Consistent with the VSL meta-analysis in Doucouliagos et al. (2012), we find that once the estimated VSL's income elasticities are corrected for observed publication selection bias, the average reported estimate is greatly reduced. We find that the VSL is a normal good, but not a luxury good. Correcting for potential publication bias yields an overall income elasticity of approximately 0.6 or as low as 0.25 when further adjusted for common misspecification biases.

2. Calculating the value of a statistical life and its income elasticity

The VSL can be estimated in a variety of ways from the choices that workers and citizens make regarding an actual or hypothetical increased risk of death. Most estimates are produced by wage-risk studies based on the tradeoffs implied by the estimated regression coefficient of the risk of fatal injury from a hedonic wage model. In this primary research literature, the dependent variable is usually the worker's log wage, and one of many independent variables is the fatality risk. Because wages comprise much of worker income, these hedonic regressions usually cannot be further employed to estimate how VSL varies with income.

Evans and Smith (2010) note that the income elasticity of VSL can be measured in one of four ways: meta-analyses of hedonic wage studies, stated preference studies, single country comparisons of VSL at different points in time, or cross-country comparisons of VSL estimates. An additional approach involves the use of quantile regressions (Evans and Schaur, 2010; Kniesner et al., 2010). Nevertheless, the most common way to estimate the sensitivity of VSL to income is to ascertain how the VSL varies across studies. Because researchers use different samples of workers, their average income will naturally vary from study to study. Thus, a meta-analysis, which collects all comparable estimates of VSL, can provide that broader perspective needed to estimate the income elasticity of the VSL (Viscusi, 2012).

We conducted a comprehensive search for prior meta-analyses that report the income elasticity of VSL or which report regression results that could be converted into an income elasticity. The search was conducted using various search engines, including Econlit, JSTOR, Proquest, ScienceDirect, Scopus, and Google Scholar. We also pursued references in prior meta-analyses. Our search strategy and subsequent meta-analysis follows the MAER-NET guidelines for meta-analysis of observational data (see Stanley et al., 2013). This search strategy revealed 14 meta-studies from which it was possible to derive or calculate the income elasticity of VSL.[3] These 14 meta-studies jointly report a total of 101 estimates of the income elasticity, and its standard error, of the value of a statistical life (see Meta-Analysis References and Appendix 1). In some cases, the estimates are derived from the same meta-study using the same data but a different specification. In other cases, different original studies are used to generate estimates of the income elasticity.

While these meta-analyses all incorporate a broad set of VSL studies, there is still great variation among these meta-regression estimates of the income elasticity of VSL, which range from −0.26 to 4. For theoretical and practical reasons, researchers should expect there to be some heterogeneity in the income elasticity. But, as we will demonstrate, much of the variation across studies arises from differences in methodology and publication selection. It is important for policymakers to have a clearer, more narrow, estimate of the average income elasticity of VSL and how it might vary with the choices that researchers make.

Generally, VSL estimates can be calculated by a two-step process (Hammitt and Robinson, 2011). In the first step, an overall VSL is estimated from a hedonic wage model or a contingent valuation survey of what people are willing to pay (WTP) for a hypothetical risk reduction. After an overall VSL value is estimated, it can be adjusted for the particular circumstances to which the policy will apply. This adjustment can primarily be made for differences in income from the sample used to estimate overall VSL value and the incomes of those likely affected by the new policy. These adjustments are therefore very sensitive to the income elasticity of VSL, and this sensitivity is especially compounded when applied to low-income countries (Hammitt and Robinson, 2011).[4] Because most VSL estimates come from developed nations with relatively high incomes, it is essential to have an accurate income elasticity estimate to extrapolate to low incomes.[5] Among the 14 existing meta-analyses of VSL that we include on our study, 94% of the VSL estimates come from developed nations.

There are basic economic reasons to believe that the income elasticity will be greater than 1.0 and higher for low income workers (Kaplow, 2005; Viscusi, 2010; Hammitt and Robinson, 2011). When VSL is income inelastic and extrapolated from a high-income sample to a low-income country (or population sub-group), the analyst gets values of VSL that seem to be too high given the expected lifetime income and consumption choices of very low-income workers. In these cases, it is possible for the ratio of the VSL to a worker's discounted expected stream of future income to be much greater than in developed countries. For this reason, some analysts arbitrarily use a value of one for VSL's income elasticity, which gives more modest estimates of VSL for low-income groups.

The primary way to estimate the income elasticity of VSL, η, has been to use meta-regression analysis. As already noted, we have found 14 such meta-analyses containing 101 estimates of the income elasticity of the value of a statistical life. Because primary studies that report estimates of VSL also typically report the average incomes of the sample of workers surveyed, it is rather easy to estimate η from a meta-regression of VSL estimates on average income. Generally, these meta-regression estimates are inelastic. For example, Viscusi and Aldy (2003) report income elasticities ranging between 0.50 and 0.60, while Doucouliagos et al. (2012) estimate VSL's income elasticity to be only 0.2. Likewise, contingent valuation surveys also tend to give inelastic estimates of the income elasticity of VSL (Hammitt and Robinson, 2011).

An exception to these low estimates of the inelastic income elasticity for VSL is the value based on quantile regressions (Viscusi, 2010; Kniesner et al., 2010). Quantile regression analyses of large

[3] Several VSL meta-studies could not be included as they did not include income in their meta-regressions.

[4] An argument can be made that income elasticity might vary between groups or countries, e.g., some groups or countries can have greater taste for safety, regardless of income.

[5] How one should undertake such an extrapolation to less developed countries will also depend on the extent to which the income elasticity varies for much lower income populations, which is beyond the scope of our study.