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The fatality and morbidity components of the value of statistical life☆

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ABSTRACT

The fatality risk–money tradeoff that is the value of a statistical life (VSL) may vary with the nature of the fatality event. While all fatalities involve loss of future life expectancy, the morbidity effects and their duration may differ. This article analyzes fatality risks accompanied by morbidity effects of different duration to disentangle the mortality and morbidity components of VSL using data from the Census of Fatal Occupational Injuries (CFOI). The VSL is comprised of the sum of the value of the fatality risk and the value of the morbidity risk. Labor market valuations of morbidity risks are positive, even for fatalities that are caused by traumatic injuries. The value of the fatality risk is the dominant component of VSL, rather than the value of the morbidity risk.

1. Introduction

The value of a statistical life (VSL) has traditionally been the key measure in computing the benefits of mortality risk reductions generated by government policies. The fatality risk-money tradeoff embodied in the VSL serves to quantify individuals' willingness to accept exposures to fatality risks. Unlike stated preference studies, which potentially can be tailored to specify the exact nature of a potential fatality risk being valued, hedonic labor market studies yield VSL estimates for the average fatality risk actually faced by workers. A fatality is, however, a multi-dimensional event. Focusing on average valuations suppresses the role of differences in the nature of the risk. Some fatality risks are associated with severe and/or prolonged morbidity effects. This paper estimates heterogeneous values of statistical life for job accidents with different morbidity periods, distinguishing the morbidity and mortality components of VSL.

Most of the research to date on the heterogeneity of the VSL has focused on differences in estimated VSL levels based on individual characteristics such as worker age rather than on differences in the VSL based on characteristics of the fatal injury. Our focus here is on hedonic labor market studies used to derive estimates of the VSL, as these are the main studies used by U.S. government agencies to estimate the VSL.[1] Studies have found different VSLs based on worker age (Evans and Smith, 2006; Kniesner et al., 2006; Aldy and Viscusi, 2007, 2008), which pertains to the life expectancy dimension of fatality risks. There have also been estimates of variations in VSL based on race and immigrant status (Leeth and Ruser, 2003; Hersch and Viscusi, 2010), gender (Leeth and Ruser, 2003), income (Evans and Schaur, 2010; Kniesner et al., 2010; Doucouliagos et al., 2014), and other personal characteristics.

While basing regulatory policy on VSLs that vary with worker characteristics, such as age, has generated policy controversy

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[1] See, for example, U.S. Department of Transportation (2013), Table 1. In the U.K., there is greater reliance on stated preference valuations as discussed in Viscusi (2014) and Viscusi and Gentry (2015).

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(Adler and Posner, 2000), heterogeneous VSLs based on injury type and associated morbidity effects do not invoke the same types of equity issues, so there is a greater chance that such estimates would play a policy evaluation role. Recently, studies have started to examine heterogeneous VSLs based on the nature of the injury. Viscusi and Gentry (2015) compute transport-specific VSLs using Census of Fatal Occupational Injuries (CFOI) data from 2003 to 2008. They find that the transport-specific VSL is similar to the non-transport VSL, a result that is robust to both event-based and source-based definitions of transport and to an hours-based and employment-based risk measure. Scotton and Taylor (2011) use 1992–1997 CFOI data and compute separate VSLs for "traditional" sources of death and for assaults, finding that risks of violent deaths generate different valuations than do traditional risks. Similarly, Kochi and Taylor (2011) compute accident-related and violent-death-related VSLs for occupational drivers and find a statistically significantly different VSL for violent deaths.

This paper focuses on a different aspect of fatalities; instead of differentiating VSL based on the circumstances surrounding the death, it examines the effect of morbidity on evaluation of VSL. Some deaths involve more dread or longer illness periods preceding deaths. Morbidity effects have been examined in numerous stated preference studies, particularly in the context of cancer. Indeed, government agencies in the U.S. and the U.K. assume that there is a "cancer premium" in the valuation of reduced fatality risks. There is also some empirical evidence in support of some premium, though the magnitude of the premium is not well-established and is likely to differ based on the type of cancer and the associated morbidity effects. The risk-risk analysis approach established in Viscusi et al. (1991) is used widely in stated preference studies of cancer risk valuations. Magat et al. (1996) use the risk-risk study structure to compare the values of automobile deaths and lymph cancer/nerve disease to explore the morbidity effects of cancer. Van Houtven et al. (2008) expand this technique to include latency effects. They find that the value of cancer, with a latency period of 5 years, is 3 times greater than the value of an immediate automobile death. With a latency period of 25 years, this premium declines to 50% greater than the value of an automobile death. Viscusi et al. (2014) estimate the cancer risk premium for a large, nationally representative U.S. sample. They find a cancer VSL of 21% more than the VSL associated with traffic accidents if there is no latency period. This cancer premium is smaller than the premium used in policy evaluations in the U.K. for asbestos (100%) (U.K. HM Treasury, 2011) and proposed in the U.S. (50%) (U.S. Environmental Protection Agency, 2010). McDonald et al. (2016) use a risk-risk structure to disentangle latency and morbidity effects when comparing the risk of fatality from cancer or a road accident. They find that morbidity accounts for most of the cancer premium. Stated preference studies also can provide a methodological approach to valuing a diverse set of health outcomes (Cameron and DeShazo, 2013).

There has been one revealed preference study of the valuation of cancer risks on housing prices, but it does not distinguish fatal and nonfatal cases of cancer. Gayer et al. (2002) examine the effect of cancer risks from chemical exposures from hazardous waste sites and estimate the value of a statistical cancer case to be $4.3–$8.3 million. If the public believes that there is a 10-year latency period and has a 3% discount rate, the value of an immediate cancer cure would be $5.1 million–$9.7 million.

The valuation of morbidity and dread has not been limited to cancer contexts. There has been a substantial literature on the valuation of nonfatal job injuries, which is surveyed in Viscusi and Aldy (2003). Fatalities may also be associated with morbidity effects. Sunstein (1997) suggests that deaths involving unusual pain deserve special attention and should require special precautions. Dread risks have also been the focus of work by Chilton et al. (2006). More recently, Cameron and DeShazo (2013, Table 2) estimate the willingness to pay to reduce risks of different illness profiles. With a discount rate of 3%, willingness to reduce the risk of sudden death corresponds to a VSL of $8.33 million (i.e., $8.33 per microrisk in their terminology) (in 2003 U.S. dollars). Years of illness preceding death add a morbidity premium, as willingness to pay to prevent one year of sickness before death is valued at $9.22 per microrisk, and five years of morbidity before death is valued at $9.75 per microrisk. In contrast, one year of sickness is valued at $2.58 per microrisk and five years of sickness is valued at $3.39 per microrisk.[2]

This article extends the literature by examining morbidity and fatality effects using a revealed preference approach instead of a stated preference framework. This study provides, to our knowledge, the first methodological framework to distinguish the fatality and morbidity components of VSL. More specifically, we show that the VSL can be separated into two additive components. We introduce the terminology "value of the fatality risk" (VFR) and "value of the morbidity risk" (VMR) and show that the VSL is the sum of the VFR and VMR. The study also provides the first revealed preference estimates that distinguish the morbidity valuation associated with fatal injuries from the fatality valuations. Using CFOI data on worker fatalities, this article characterizes fatality risks in terms of their mortality and morbidity components, making it possible to estimate the compensating differentials that workers receive for fatality risks and morbidity risks. The overall VSL estimates are similar to previous estimates in the literature. Despite the fact that the fatalities used in the study are the result of "traumatic" events rather than systematic diseases or infectious diseases, our study finds a statistically significant VMR based on the average length of time that the person remains injured before death. This study is subject to the standard limitations of hedonic wage studies. It does not capture preferences of people outside the labor force, including children, seniors, and the disabled. Similarly, this study cannot explicitly incorporate latency into the analysis because the focus is on traumatic injuries.

The article proceeds as follows: Section 2 outlines the theoretical model underlying the VSL and extends the model to incorporate both morbidity and fatality risks, outlining the relationship between the VSL, VFR, and VMR. Section 3 provides an overview of the construction of the fatality, morbidity, and nonfatal injury rates, which are used to estimate the hedonic wage model described in Section 4. The estimation results are reported in Section 5. All specifications generated a positive VMR value, which constituted between 6% and 25% of the VSL valuation. Section 6 concludes.

2. Disentangling morbidity and fatality

In order to isolate the morbidity and fatality components of the VSL, we use a model that differentiates between a worker's utility of income when the worker is dead and when the worker has suffered a fatal injury but is not yet dead immediately. The standard theoretical model for risk-money tradeoffs considers utility of income when a worker is healthy, $u(w(p))$, and a bequest function when the worker is dead, $v(w(p))$. To incorporate morbidity into this analysis, we include the utility of income while the worker has suffered a fatal injury but is not yet dead, $z(w(p), t)$. Let z be a function of wage

[2] Our study does not explicitly assume a discount rate, since any discounting is not reported by workers but implicit in their wage preferences. Similarly, while Cameron and Deshazo (2013, Table 4) explore the impact of latency on WTP valuations, our study does not examine latency, as it focuses on traumatic injuries with shorter durations.