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W. Kip Viscusi

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Pricing Lives: International Guideposts for Safety*

W. KIP VISCUSI

Vanderbilt Law School, Nashville, TN, USA

Government agencies throughout the world use the value of a statistical life (VSL) to monetise the mortality risk reduction benefits of government policies. The most reliable empirical estimates of the VSL using US labour market data are about US$10 million (year 2015 US dollars). Based on international estimates of the income elasticity of the VSL, one can transfer these values to other countries, leading to my VSL estimate for Australia of US$7.9 million, or A$10.0 million, which is over double the current Australia best-practices value. Transferring US VSL estimates to other nations after accounting for income differences will boost global VSL estimates. Potential refinements of the VSL based on age and income are also feasible. The VSL could serve a pivotal role in promoting safety by valuing lives in litigation contexts, regulatory sanctions, and corporate risk analyses.

I The Necessity of Pricing Lives

Social institutions place a price on lives in several contexts. Court awards in wrongful death cases and insurance payouts after accidents place an economic value on the lives of the deceased. Regulatory sanctions for violations involving fatalities set a price on lives lost that should serve an appropriate deterrence function and enhance safety. Government agencies value prospective mortality risks that are influenced by policies using economic estimates of the value of a statistical life (VSL; Sunstein, 2014). Here I explore why and how we value lives in these different contexts, focusing on some of the themes articulated in my book, *Pricing Lives: Guideposts for a Safer Society* (Viscusi, 2018).

I begin by considering the value of risks to life in policy contexts. It is infeasible to reduce risks to zero, so that ultimately there must be some trade-off between cost and risk reduction. For example, devoting the entire US GDP to eliminating the 128,000 accidental deaths that occur annually could only permit expenditures up to $115 million per expected death, leaving no funds available for any other purpose such as subsistence. Given financial constraints, government agencies must select some particular finite value for mortality risks.

The standard economic benefit measure in policy contexts generally is society's willingness to pay (WTP) for the benefit.[1] Equating the value of an expected life saved by a policy with human capital measures based on the present value of individual earnings and medical costs bears some relationship to available economic resources. However, this accounting measure does not correspond to the amount per unit risk that people are willing to pay for the modest changes in mortality risks generated by most policies. The appropriate

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Correspondence: W. Kip Viscusi, Vanderbilt Law School, 131 21st Ave. South, Nashville, TN 37203, USA. Email: kip.viscusi@vanderbilt.edu

[1] This established economic principle, which is a foundational component of benefit–cost analysis, is articulated in more recent reviews of appropriate valuation practices in Australia by Abelson (2003, 2007) and Tooth (2010) and is incorporated in US government practices (US Office of Management and Budget, 2003).

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benefit value is the money–risk trade-off rate, or the VSL. The VSL represents the value per unit risk so that a WTP of $900 for a risk reduction of 1/10,000 implies a VSL of $900/(1/10,000), or $9 million.

This paper examines the empirical estimates of these values and their application both across countries and in different societal contexts. Section II focuses on the best revealed preference evidence in the USA based on labour market studies. As indicated in Section III, these values can be applied globally in conjunction with adjustments for differences in income levels and estimates of the income elasticity of the VSL. More generally, it is possible to modify the VSL based on differences in age and income as outlined in Section IV. Accounting for other disparities in the VSL by demographic characteristics may be more problematic, as discussed in Section V. There is a major opportunity to promote efficient levels of safety more generally by using the VSL for judicial decisions, to set regulatory sanctions, and to guide corporate risk analyses, as outlined in Section VI. Section VII highlights some principal outstanding research issues.

II Implementing the Value of a Statistical Life Approach

It is possible to derive estimates of the VSL based on revealed preference evidence from market decisions or from stated preference studies that ask respondents their WTP for risk reductions. The principal studies relied upon in the US policy context are revealed preference labour market studies, but there have been similar labour market studies in many other nations. Viscusi and Masterman (2017a,b) review 68 VSL studies using wage–risk trade-off evidence from 14 countries, including Australia. Because countries' employment data and worker fatality data are often not as reliable as US data, international policy analysts have placed relatively greater emphasis on the results of stated preference studies than have US government agencies.

Median US labour market VSL estimates are in the $9 million to $11 million range. The most reliable US estimates are those based on the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) data. This data series is based on a comprehensive tally of all occupational deaths that is verified using multiple sources. The data provide information on the nature of each fatality and detailed information on the job and demographic characteristics of each individual, making it possible to construct refined risk measures by industry, occupation, and other factors. The VSL estimates based on these data are the only estimates used by the US Department of Transportation (2016) in selecting its VSL and are the findings least subject to publication selection bias (Viscusi, 2015). After adjusting for publication selection effects, the bias-adjusted VSL using the CFOI data is $9.6 million. For the purposes of my discussion, I will use $10 million as the reference US figure for the VSL. This amount is in line with the values used by US government agencies: $9.4 million by the US Department of Transportation (2016), $9.6 million by the US Department of Health and Human Services (2016), and $9.7 million (2013 dollars) by the US Environmental Protection Agency (2016).

This convergence to a similar, fairly large VSL level is a relatively recent development. US agencies did not always use the VSL as the benefits measure to value mortality risks. They formerly used values that were about an order of magnitude less based on a human capital measure that consisted of the present value of lost earnings and medical costs, or what some agencies called the 'cost of death'. The watershed event that led to the adoption of the VSL was the 1982 conflict between the US Department of Labor and the Office of Management and Budget (OMB) over the proposed hazard communication regulation (see Earley, 1985; Viscusi, 2018). The agency had valued the reduced mortality risks by the 'cost of death', leading to relatively modest benefit values. In its review of the regulatory proposal, the OMB concluded that the proposed regulation failed the required test that benefits must exceed costs. The Department of Labor appealed the decision to then Vice President George H.W. Bush, and I was asked to resolve the dispute. The only change I made to the OMB's critique is that I introduced my VSL estimates into the agency's analysis. Use of my VSL figure of US$7.4 million (in 2015 dollars) increased the estimated benefits of the regulation by a factor of 10, so that now the benefits exceeded the costs. The regulation was approved shortly after my economic analysis demonstrated that the overall economic merits of the regulation were positive. Subsequently, other agencies shifted to this approach, though the changes sometimes were gradual, as there was a tendency to remain anchored to the earlier cost of death numbers.

III International Applications of the VSL

Governments seeking to adopt a VSL can either use VSL estimates based on data specific to that country or they can use a benefit transfer approach and adapt the VSL from other countries to make them pertinent to their situation. The international labour market evidence is subject to severe publication selection biases, as studies often report excessively high VSL estimates that appear to have been anchored on the previous high US VSL estimates, which were the first VSL figures in the literature (Viscusi & Masterman, 2017a). These biases combine with international data limitations for wage-risk studies to suggest that in many instances countries either must rely on stated preference evidence or else transfer US labour market estimates for their own purposes.

The current best practices guidelines in Australia (Australian Government, Department of the Prime Minister and Cabinet, Office of Best Practice Regulation, 2014) draw on the VSL literature to recommend a WTP figure (in 2014 Australian dollars) of A$4.2 million for VSL, which is US$3.5 million based on exchange rates, or US$2.8 million based on purchasing power parity adjustments. The value of a statistical life year (VSLY) is A$182,000, or US$142,000 based on exchange rates and US$125,000 based on purchasing power parity adjustments.[2] These figures represent an update of the statistics presented in the review by Abelson (2007), who prepared a survey of international VSL studies and meta-analyses, focusing primarily on wage-risk studies. While most of the studies used US data, two wage-risk studies in his review used Australian data. Abelson's report indicated a VSL range from A$3 million to A$15 million, for which he viewed the most plausible range as A $3.0 million to A$4.0 million. Abelson's mid-point estimate from this range was a value of A $3.5 million for the VSL and A$151,000 for the VSLY, leading to the 2014 dollar figures cited by the Office of Best Practice Regulation after adjusting for inflation. It is likely that the VSL and VSLY magnitudes that were selected were low, relative to the overall range in the literature that he identified, so as to avoid too abrupt a shift from Australia's previous reliance on human capital estimates for the value of expected deaths.

The VSL estimates used in Australian policy contexts have displayed some heterogeneity as well as increased recognition that higher values for mortality risk reduction are warranted. Abelson (2007) notes that the NSW Roads and Traffic Authority recommended a VSL of A$1.57 million, the Commonwealth Bureau of Transport Economics used a A$1.36 million value, the Australian Department of Health and Ageing adopted a VSL of A$2.5 million drawing on Abelson (2003), and reports by Access Economics used a VSL with a mid-range value of A $6.5 million. The report by Austroads (2015) notes there had been previous emphasis on the human capital measures. However, now there was increased acceptance by some agencies of the higher WTP values: the Bureau of Infrastructure, Transport and Regional Economics used a value of A$1.8 million (2010 prices); the Roads and Traffic Authority in Transport for NSW used a VSL of A$6.4 million; and the New Zealand Ministry of Transport used of value of A$3.2 million (2010 prices). The report by Tooth (2010) for the Australasian Railway Association Inc. adopted a VSL of A$6 million (2006 dollars) based on international revealed preference and stated preference evidence.

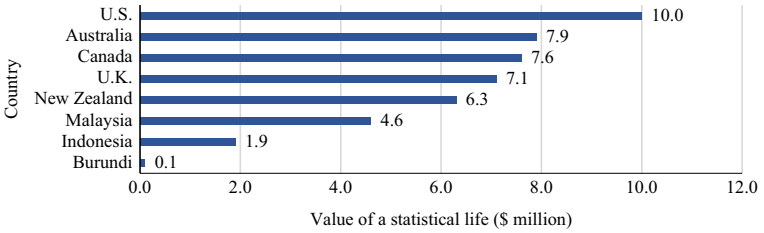
The evolution of estimates of the value of mortality risk reductions in Australia follows a familiar pattern. There has been increased international recognition that the proper measure of the benefits of mortality risk reduction is the WTP numbers embodied in the VSL, not the human capital cost of death values. However, since agencies previously used relatively low amounts to value mortality risks, there has been a tendency to increase these values gradually. This was also the case for the US Department of Transportation, which had long valued lives based on human capital measures.

This slow adjustment process is evident in other counties as well. When selecting the appropriate VSL based on stated preference study results, UK officials likewise opted for lower estimates than the mean values suggested by research efforts in order to have not too abrupt a departure from the previous human capital values (Jones-Lee & Spackman, 2013).

In addition to the relatively gradual movement of VSL values away from the cost of death measures, international estimates of the VSL tend to be lower because of the greater reliance on

[2] International price conversions for Figure 1 will be based on purchasing power parity adjustments using World Bank statistics to be consistent with Viscusi and Masterman (2017b), but otherwise I use exchange rate values.

FIGURE 1
International VSL Estimates Based on US Values [Colour figure can be viewed at wileyonlinelibrary.com]



stated preference studies, which often yield smaller VSL estimates than the labour market studies. Drawing on a sample of stated preference studies, the OECD, for example, recommends a baseline VSL of $3.6 million, with a VSL range of $1.8 million to $5.5 million.

Table 1 summarises representative VSL values used throughout the world for policy purposes.[3] These values range from very low values for countries such as Malaysia and the UK to high values for Canada and the USA. There should, of course, be differences in the VSL across countries, but are these differences reasonable? Are these differences consistent with the discrepancy one would expect relative to US figures based on income adjustments?

The benefit transfer approach that I recommend is to use the US VSL figures as the baseline and to adjust these differences downward based on the income elasticity of the VSL. The baseline VSL figure I will use is $10 million. Income elasticity estimates for the USA are usually in the range 0.5–0.6, but international income elasticity estimates are just above 1.0, which I will use as the income elasticity estimate for my calculations (Viscusi & Masterman, 2017b). The income level used for these calculations is the World Bank's gross national income per capita. Because almost all other countries have lower income levels than the USA, the result of such an adjustment is to reduce the US value when applied internationally. Nevertheless, reducing the VSL based on income-level differences leads to higher VSL estimates than those currently used internationally. Figure 1 presents the income-adjusted VSL for a representative group of countries.[4] The appropriate estimate for Australia of US$7.9 million is more than double the value in Table 1 of US$3.5 million, and the UK value of US$7.3 million is more than triple the Table 1 values of US$2.1 million and US$2.4 million. Estimates for Malaysia increase by a factor of more than 4 after extrapolating based on US evidence.

There may, of course, be other considerations that one wishes to take into account. Cultural differences, differences in life expectancy, and attitudes towards risk taking may vary in ways not fully captured by income differences. One might wish to use a different baseline VSL, though any downward adjustment of the US value is unlikely to be substantial. The income elasticity adjustment may also be greater than the estimated average international income elasticity figure of 1.0, as the income elasticity of the VSL may be higher for very low-income countries, leading to a further reduction in the VSL. Thus, while the overall methodological approach of extrapolating US estimates based on income differences across countries is sound, there remains the potential to refine these estimates after modifying the different components of the calculation.

IV Variations of the VSL by Age, Income, and Differences in Risk Taking

(i) Age and VSL

For most applications, using an average VSL across a broad affected population is a reasonable

[3] Viscusi (2018) details the sources of these various VSL figures. Narain and Sall (2016) provide additional international examples.

[4] These estimates are based on a VSL of $10 million and an income elasticity of 1.0, World Bank gross national income per capita statistics, and World Bank purchasing power parity measures. Viscusi and Masterman (2017b) present VSL estimates for 189 countries using a VSL of US$ 9.631 million and an income elasticity of 1.0.

TABLE 1
International VSL Estimates for Policy Analysis

Country	VSL ($ millions)
Australia	3.5
Canada	5.6
Malaysia	1.0
United Kingdom	
Transport	2.4
Floods	2.1
United States	
Transportation	9.4
Health and Human Services	9.6
Environmental	9.7
OECD	
Range	1.8–5.5
Base	3.6

Note: All figures are in 2015 US dollars.

approach as this value is likely to be a pertinent measure of the WTP benefit value for mortality risk reduction. Some policies may, however, have targeted impacts that affect segments of the population that are particularly vulnerable to risks as, for example, those affected may include people at the tails of the population distribution. In such instances, one might wish to explore whether it is possible to refine the estimates to reflect the heterogeneity of the VSL in the affected population.

Because risk policies do not confer immortality but rather lead to finite increases in life expectancy, the length of life affected is potentially of policy relevance. Older individuals have shorter expected remaining lifetimes and often are in worse health, so their WTP for risk reduction may decline with age. The US Environmental Protection Agency made such an age adjustment by adopting a senior discount in the VSL of 37 per cent in its analysis of a regulatory proposal called the Clear Skies initiative. This devaluation of life of those over 65 in the regulatory impact analysis generated a political firestorm. The substantial resistance to the decline in the VSL is consistent with evidence from psychology and behavioural economics regarding the influence of loss aversion. From the standpoint of those affected, a lowering of the VSL has taken something away from them.

The role of loss aversion in creating resistance to the diminished VSL for senior citizens was also manifested in another context in 2008 when the US Environmental Protection Agency Air Office lowered its VSL from US$8 million to US$7 million. This reduction posed an economic puzzle since income levels have risen over time. Coupled with the positive income elasticity of the VSL, one would expect the VSL to be increasing over time, not decreasing. The rationale for the change was never fully articulated, but was based on the agency's assessment of the results of two meta-analyses of the VSL, Mrozek and Taylor (2002) and Viscusi and Aldy (2003). As in the case of the senior discount, there was a public relations backlash. The outcry was noteworthy since even the reduced VSL exceeded the estimates used by other agencies. The fact that the VSL had changed in a downward direction was the source of the controversy, not the level of the VSL. The senior discount and the Air Office incidents provide cautionary tales for policy-makers in that any reductions in the VSL should be undertaken with considerable care and coupled with efforts to provide a compelling rationale for the change.

The political controversy over age adjustments does not resolve the fundamental issue of whether there should be such a reduction in the VSL. One might pose the question in terms of whether it is fair for those who are older to be accorded the same VSL as the young. Framing the age issue from the standpoint of fairness in this manner raises different concerns but does not resolve the problem of choosing an appropriate benefit measure. One might view using the same VSL across the population as equitable, or alternatively one might suggest that assigning the same VSLY to all people is equitable, where the VSLY is the VSL divided by the discounted number of remaining years of life expectancy. A uniform VSL for all will lead to higher overall VSL estimates for older citizens than will a constant VSLY. Similarly, a constant VSLY will generate increasingly greater values for mortality risk reduction, the more years of remaining life expectancy one has. The alternatives of either using a uniform VSL or a constant VSLY per year of life expectancy give diametrically opposed estimates of how differences in life expectancy should be treated, even though both are purportedly equitable.

A more promising approach is to return to the fundamental WTP principles and estimates based on workers' valuations of risk based on their remaining life expectancy. While there have been a series of wage-risk studies of the VSL–age relationship over several decades, only recently

has the availability of refined data made it feasible to construct age-specific fatality risk measures to pinpoint the age variation in VSL. The result is that there is an inverted U-shaped pattern to the VSL. This trajectory tracks the overall pattern of income and consumption over time, with a peak for workers in their late forties. Because of their greater affluence, the VSL for those in their sixties is higher than for workers in the youngest age group, so that there is not a precipitous drop in the VSL. Since the age-related decline in the VSL is not steep, and downward adjustments in the VSL generate substantial resistance, the political feasibility of age-related refinements in the overall VSL is not great.

However, there may be situations in which the policy has a very modest effect on life extension, such as an experimental cancer treatment that leads to a life expectancy gain of 1 year or less. Should the lives affected by this policy be valued using the full VSL or should some other metric be used? A reasonable approach that incorporates both the length of life at risk and the VSL in a WTP measure is the VSLY. This approach is frequently adopted in contexts where the life expectancy gains are very short, as is the case with some US Food and Drug Administration regulations.

The age-related trajectory of VLSY estimates follows an inverted U-shaped pattern as does the VSL, so that it is not appropriate to assume a constant VSLY. The VSLY peaks at a later age than does the VSL, as it is at its highest value for workers in their fifties and remains higher for workers in the older age groups than for most younger age groups. The VSLY estimates vary depending on the data set and the risk measure, generating results such as a US estimate that the VSLY is US$411,000. The US Food and Drug Administration formerly used what appeared to be a placeholder VSLY value just above US $100,000, but more recently adopted a figure of US$369,000 based on Aldy and Viscusi (2008). This figure is about an order of magnitude greater than the value per quality-adjusted life year guidance values for UK health care expenditures, which has a £20,000 cut-off for cost-effective expenditures, and an expenditure range for treatments that may be worthwhile of £20,000 to £30,000, which is equivalent to US$25,800 to $38,700. The Australia best-practices VSLY guidance figure of A$182,000 (in 2014 dollars) is consequently far above the UK value but below current US policy values.

(ii) Income and VSL

A second personal characteristic that has played a policy-relevant role is income adjustments to reflect income-related differences in WTP. Adjustments for income differences in mortality-related contexts have a long history. Court awards in wrongful death cases generally try to replace the income loss associated with the death, and this loss will be steadily increasing with income levels. Making income distinctions when providing compensation after a fatality is quite different than applying a different VSL linked to income. The VSL relates to the value of preventing the death through reductions in the fatality risk rather than addressing the financial loss experienced by the survivors. As noted above, the WTP for risk reduction increases with income, as is reflected in the positive income elasticity of the VSL throughout the world. The US Department of Transportation (2016), for example, formerly used an income elasticity of 0.55 drawing on the estimates in Viscusi and Aldy (2003), but raised it more recently based on other estimates by me and others. From the standpoint of economic efficiency, making income distinctions has a strong rationale since individuals' WTP for fatality risk reductions rises with income.

How and whether policy-makers will choose to incorporate the role of income adjustments depends on the context and, in particular, on whether the adjustments reflect income differences across the population at a point in time or adjustments that capture income changes over time. Intertemporal income adjustments are less controversial and a fairly common practice. Thus, if the agency was using VSL estimates based on data from an earlier era, it would be desirable to recognise the impact on the appropriate VSL of income changes since the time of the study, which will generally lead to a higher VSL, raising the assessed benefits of the agency's policies. A less frequent intertemporal adjustment is with respect to future effects, ranging from cancer risks that are being reduced after a latency period or impacts on future generations. Discounting of temporally remote effects will diminish the present value of deferred risk reductions. However, the appropriate VSL to be applied for future impacts should also be increased to reflect the rise in income levels over time. This adjustment diminishes the effect of discounting, as the pertinent net discount rate is the rate of interest minus the rate of growth in the VSL. Note, however, that intertemporal adjustments do

involve an intertemporal equity issue. The result of the income adjustment in the VSL is to increase the degree to which resources are being transferred from the current population to more affluent future populations.

Equity controversies are particularly acute for income adjustments at a point in time within a particular population. Should the lives of the rich receive preferential treatment relative to the lives of the poor? Most would regard it to be unacceptable for ships to provide lifeboats only for first-class passengers based on the rationale that they have a higher VSL. The lifeboat scenario also takes us out of the realm of statistical lives in that *ex post* after the ship has begun to sink, death without the lifeboat is a certainty, not a low-probability risk. There may, however, be some instances in which income distinctions are more palatable. In a report that I prepared for the Federal Aviation Administration, I advocated that the agency be permitted to use a higher VSL than the rest of the Department of Transportation to reflect the greater relative affluence of airline passengers. The cost of the regulations would be borne by the airlines which, in turn, would raise ticket prices so that the customers in effect would be paying for the greater safety in line with their preferences. If the beneficiaries of the policy are paying for the benefits, recognition of the role of income differences seems compelling.

In situations in which the policies are being funded through general revenues, however, the practice of incorporating income differences in the VSL is more complicated. Failing to make such adjustments may lead to imposing societal costs for programs that the poor do not greatly value. Substituting alternative policies that better meet their preferences would be welfare-enhancing, but may not be forthcoming. Given the sensitive nature of VSL calculations generally, agencies have been understandably reluctant to fine-tune the VSL for cross-sectional income differences across the population.

The reluctance to make such distinctions can be traced to the equity concerns raised by using general public funding to provide targeted benefits. If, however, the income adjustments are made across populations in different countries, there is not the problem of creating a mismatch between the funding and the benefits. As a result, different countries can adopt different VSL levels for policy analysis that correspond to the preferences of their citizenry. One would not, for example, expect Indonesia to use the same VSL as the USA. As a consequence, one would expect the degree of stringency of health, safety, and environmental regulations to be greater for more affluent nations and to be increasing over time as countries develop economically, as has been the case. Similarly, both the World Bank (Narain & Sall, 2016) and the OECD (2012) recognise the importance of making income-related distinctions across countries rather than suggesting that there be a single VSL applied throughout the world.

V Making Sense of VSL Disparities

In addition to there being legitimate differences in the VSL based on age and income, there may also be evidence of differences in wage–risk trade-offs by smoking status, race, and immigrant status. Consider the situation of the VSL of immigrants, whose situation parallels that of other disadvantaged groups. Should Mexican immigrants, who have a very low estimated VSL compared to that of native US citizens, be accorded a lower VSL for policy purposes based on the market evidence?

Whether there should be such distinctions depends on whether the standard assumptions of the hedonic wage model are satisfied. The standard assumption is that the workers are facing the same labour market offer curve. However, Joni Hersch and I hypothesised that different groups face different labour market opportunities, whereby the labour market may be segmented by factors such as race and immigrant status (Hersch & Viscusi, 2010). Figure 2 illustrates such a situation. The more advantaged labour market group faces a higher and steeper wage offer curve, $w(p)$, whereas disadvantaged workers face the lower and flatter curve, $v(p)$. As a result, the wage compensation that the affluent group receives for an additional risk is greater than that received by the workers confined to the lower wage offer curve. That Mexican immigrant workers are in fact selecting jobs from different market opportunities consistent with Figure 2 is borne out by the statistics in Table 2. Based on estimates using employment data from the Current Population Survey, Mexican immigrants receive no statistically significant compensation for fatality risks despite facing risks that are 37 per cent greater than those incurred by native US workers. Similarly, results from the New Immigrant Survey indicate that the gaps are particularly pronounced for Mexican immigrants who do not speak English as they receive no evident compensation for fatality risks.

These gaps in market performance serve to highlight situations in which there are evident

FIGURE 2
VSL with Segmented Markets

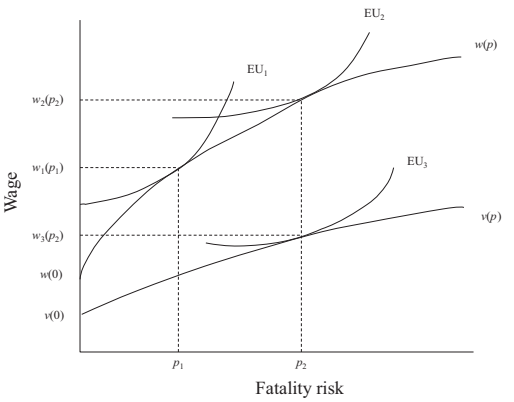


TABLE 2
VSL and Immigrant Status

	Fatality risk*	VSL
Estimates based on the CPS		
Native US	4.35	7.95
Mexican immigrants	5.97	Not significant
Estimates based on the NIS		
All immigrants	4.50	9.35
Mexican immigrants	5.70	Not significant
Mexican immigrants who speak English	5.70	3.44

Note: *Fatality risk is the annual fatality rate per 100,000 workers for the individual's industry, immigrant status, and age group.

market failures. Labour market evidence regarding the VSL is not only instructive in establishing an overall benefit value for safety, but also can be used to identify particular market contexts in which the standard economic mechanisms fall short, thus creating a rationale for government intervention. While the occupational challenges faced by immigrants who do not speak English have been recognised by occupational safety officials, evident gaps remain.

VI Applications to the Courts, Regulatory Enforcement, and Business Decisions

While the VSL has become the most prevalent policy approach to valuing mortality risks, particularly for regulatory policies, considerable opportunities remain for extending this technique to the operation of other societal institutions. Here I will highlight three promising opportunities: using the VSL to assess liability; using the VSL to set regulatory sanctions; and using the VSL in business contexts to mirror the kinds of risk analyses undertaken by government agencies.

The role that the VSL could play in the judicial system is twofold: determining liability and setting damages. With respect to determining liability, a producer has provided an efficient level of safety if the costs of additional safety exceed the benefits under standard economic models of negligence. The VSL could serve as the appropriate reference point for ascertaining whether the firm has struck an efficient balance between risk and cost. The second potential judicial role is with respect to setting damages in situations where establishing appropriate deterrence is of paramount concern, which in the USA is situations that merit punitive damages awards. Compensatory damages have a purpose that is more closely linked to providing insurance for the survivors of accidents and consequently should continue to be addressed by the standard compensatory damages components in routine accident situations related principally to the financial loss that is experienced. Other scholars, such as Polinsky and Shavell (1998) and Tooth (2015), have recognised the potentially important role of the VSL in providing safety incentives. They advocate a broader use of the VSL to establish deterrence through wrongful death awards and insurance payments based on the VSL. Unfortunately, there is an inevitable trade-off between optimal insurance and optimal deterrence levels as it is not feasible to achieve both the deterrence and insurance objectives with a single policy instrument. My targeted approach reduces the problem of over-insurance, compared to a broader application of the VSL, while ideally using the VSL in situations where the benefits of additional deterrence are greatest.

A second institutional context in which the VSL could play an additional constructive role is with respect to setting sanctions for violations of government regulations. While government agencies routinely use the VSL to assess the merits of prospective regulatory policies, the sanctions that are levied after there are regulatory violations are not linked to the VSL. To create efficient levels of deterrence, the VSL establishes the price that firms should pay for failing to adequately reduce risks. Not only is there no such formal linkage,

but the levels of regulatory sanctions are often several orders of magnitude smaller than the VSL. In the USA, occupational safety violations leading to fatalities lead to penalties that have a median value of only US$7,000. After the General Motors defective ignition switch incident that led to 124 deaths, the penalties for the defect were capped by statute at US$35 million. While there may of course be additional sanctions, such as for failure to report defects to the government, the penalties directly related to the fatality risks fall short of the VSL levels required for optimal deterrence.

A third institutional context where the VSL could play a greater role is with respect to corporate risk decisions. Companies often undertake risk analyses for dangerous products. The US auto companies, for example, formerly undertook risk analyses similar to benefit–cost analyses for regulatory policies. In valuing the reduced risks to life, companies used information on the average level of wrongful death awards in the courtroom, which is consistent with former government practices linked to the monetary cost of death. These values, which were more than an order of magnitude lower than the VSL, led companies to be exposed to critiques that their products displayed a reckless and conscious disregard for safety. The result was that companies were hit with punitive damages awards, including awards of US$100 million or more in several cases (*Grimshaw* v. *Ford Motor Co.*, *Jimenez* v. *Chrysler Corp.*, and *Moseley* v. *General Motors*). In retreat, companies appear to have abandoned the explicit benefit–cost approach. General Motors, for example, has a list of forbidden words that employees should not use in describing vehicles, including 'bad', 'critical', 'dangerous', 'defect', 'failure', 'problem', 'safety', 'serious', and 'terrifying' (Valukas, 2014).

Adoption of the VSL would align corporate risk decisions with the public's WTP for safety and be consistent with government practices. However, my experimental findings with mock jurors suggest that use of the VSL also could expose companies to higher damages awards to the extent that the VSL serves as a reference point for the value that court awards must exceed in order to provide adequate safety incentives. To avoid such adverse effects and to encourage corporate risk analyses I propose that companies be given a safe harbour whereby corporate risk analyses would be given additional legal protections so that evidence regarding such analyses could not be introduced in court.

VII An Agenda for the International Valuation of Life

The increasingly broad acceptance of the VSL has not resolved all pertinent economic issues but has made considerable progress in implementing a sound economic approach to valuing risks to life. There has been a pronounced shift internationally from the human capital or cost of death approach, to a WTP measure embodied in the VSL. The previous use of comparatively low values for valuing mortality risks established a reference point for the valuation of mortality risks. Countries are moving in the correct direction, with values that are converging on the level of VSL estimates in the economics literature.

However, due to data limitations, there are not sound revealed preference estimates of the VSL for all countries. The most refined labour market data and fatality risk data are from the USA. A potential strategy for a benefit transfer process to other countries would be to use the US estimates as the baseline figure, and adjust these values for other nations using the income elasticity of the VSL coupled with information on the income levels in the countries. This procedure would generally lead to higher VSL estimates throughout the world.

Despite the substantial progress in using the VSL, particularly in regulatory impact analyses, the potential role of the VSL has not been fully exploited. The VSL not only serves as the policy value for mortality risks, but can play a central role in corporate risk decisions, in regulatory sanctions, and in personal injury litigation. In each of these venues, the principal result from broader application of the VSL will be a greater valuation of safety and a more protective society.

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