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Pricing Lives for Corporate and Governmental Risk Decisions

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Abstract: The value of a statistical life (VSL) is the most influential single parameter used in calculating the benefits of governmental regulations. While there are some interagency differences, there is a commonality in the conceptual approach, the central role of mortality risk valuation in benefit assessment, and the general range of valuations used. Corporate risk decisions are based on a less rigorous risk analysis procedure. As typified by the General Motors ignition switch recall problems and the company's lax corporate safety culture, there is often little systematic corporate balancing of cost and risk. This suppression of safety concerns may be attributable to the adverse experiences automobile companies had after conducting risk analyses that valued fatalities based on damages awards for wrongful death, and in response juries levied blockbuster punitive damages awards. Instead, companies should adopt the VSL in its product risk decisions. Companies should also be provided with a safe harbor reference point for responsible risk decisions. Regulatory agencies should use the VSL in setting regulatory sanctions.

Keywords: GM ignition switch; health; risk; safety; value of a statistical life; VSL.

JEL classifications: I10; I18; K32; J28; J17.

1 Expanding the role of benefit-cost analysis and the value of a statistical life

The value of a statistical life (VSL) is the most influential economic parameter used in the evaluation of governmental regulations. The necessity for valuing mortality risks in benefit-cost analyses arises from the limitations in societal resources,

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coupled with substantial opportunities to promote health and safety both through private decisions and government policy. Recently, mortality risk benefits have comprised the preponderance of the benefits of all new major governmental regulations, particularly due to the efforts of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation (DOT).[2] In this article, I review the pivotal role that the VSL plays in government policies and examine how the VSL could also serve a constructive function in corporate risk decisions adopting a benefit-cost approach.

There is no conceptual barrier that limits the application of the VSL concept to valuing outcomes resulting from government policy decisions. Most of the estimates of the VSL in the economics literature are based on revealed preference studies of the risk–money trade-offs reflected in private decisions.[3] In lieu of revealed preference estimates, economists may attempt to create simulated market trade-offs using stated preference methods, but the focus remains on individual preferences for personal risks. Estimates of compensating differentials for workplace fatality risks are the most common revealed preference studies, but researchers have also estimated money–risk trade-offs implied by consumer choices such as seatbelt use, the price–safety gradient for used cars, and the relationship of housing prices to environmental hazards. These valuations consequently reflect the value that consumers place on safety.

In this article, I begin with an overview of government practices with respect to the use of VSL estimates. When did government agencies adopt this methodology, and how has it evolved during the course of its application to evaluating government policies? My primary interest here is not to provide a comprehensive assessment of government practices but to establish the basic dimensions of the use of VSL estimates and to explore how corporate risk decisions might also profit by incorporating the VSL methodology.

The principal case study that I use to explore the safety–cost trade-off made by corporations is the 2014 General Motors (GM) ignition switch recall. The recall, the subsequent penalties for failing to disclose the defect, and the examination of the internal GM practices that gave rise to the defect raise fundamental issues with respect to how corporations should undertake risk analyses for safety measures.

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2 The U.S. Office of Management and Budget (2014), p. 14, made the following observation: "The largest benefits are associated with regulations that reduce the risks to life . . . ." Table 1-1 of that report documents the dominant role of EPA and DOT regulations in terms of both the benefits and costs of regulatory policies.

3 See Viscusi (1992) for a review of both stated preference and revealed preference VSL studies and Viscusi and Aldy (2003) for a review of the revealed preference VSL literature. Viscusi (2014) reviews government practices and provides a list of the VSL amounts used in about 100 regulatory impact analyses.

Previous discussions of this behavior by GM CEO Mary Barra, the internal review commissioned by GM, and subsequent media coverage have not offered any explanation for this conduct, apparently treating the GM safety culture as an inexplicable random event. I suggest that GM's lax safety culture is a consequence of the company's response to being punished with extremely high punitive damages awards in instances in which the company undertook a detailed safety study. Companies should return to doing systematic risk analyses, and the valuation of the safety-related fatalities in these analyses should be based on the VSL rather than on the level of court awards from wrongful death cases. Even adopting a sound economic methodology may, however, lead companies to continue to be vulnerable to punitive damages awards so that greater legal protection for economic analyses would be worthwhile.

Similarly, there are additional opportunities for government agencies to utilize the VSL as the guiding parameter for health and safety policies. There is no need to restrict the use of the VSL to prospective regulatory impact analyses. Government agencies should also utilize VSL estimates to set appropriate sanctions for regulatory violations in situations where it is desirable to create efficient incentives to reduce mortality risks.

2 Calculating and estimating the value of a statistical life

The VSL terminology indicates that the value we are seeking is the value per unit risk for small changes in risk levels. The meaning of the VSL can be illustrated using a simple example. Suppose that there is a 1/10,000 fatality risk to 10,000 people. Consequently, there is one expected death that will occur to this group. Assume that each person in the group would be willing to pay $900 to eliminate the risk. Then collectively, it would be possible to raise $900 from each of the 10,000 exposed individuals to avert the random death, leading to a total amount of $9 million to avert the one expected death. Viewed in value per unit risk terms gives a valuation: $900/(1/10,000) = $9 million. This trade-off rate per expected death serves as the VSL. For small changes in the risk level, the VSL should be the same whether people are paying for small decreases in the risk or being compensated for a small increase in the risk. This theoretical prediction is borne out in labor market data.[4]

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4 Kniesner, Viscusi and Ziliak (2014) estimated levels of VSL for workers who changed jobs in an analysis that compared the VSL of workers whose new jobs led to an increase in job risk with the VSL levels of workers who moved to safer jobs. There was no statistically significant difference in the estimated VSL levels for these groups.

The dominant approach to estimating the VSL utilizes evidence on wage–risk trade-offs in the labor market. The underlying theory is not new, but dates back to 1776 with Adam Smith's theory of compensating differentials: Workers demand a premium for jobs that are unpleasant or pose additional risk. Testing the theory successfully based on econometric evidence took two centuries. But there is now a substantial economics literature that estimates the VSL from labor market decisions. Controlling for other aspects of the job, how much pay do workers get for incurring extra risk?

In some instances, the risks workers face are substantial. Fictional characters such as Jack Bauer in the television antiterrorism series *24* represent extreme examples of risk. Coal miners and deep sea fisherman are nonfictional examples of workers who incur relatively large risks. Although such dramatic risks are not the norm, few workers' jobs are risk-free. In my early studies of VSL using data from the 1970s, the average annual worker fatality rate from job-related risks was 1/10,000. At present, the annual worker fatality risk averages about 1/25,000.

The trade-offs for facing risk are sometimes explicit. For example, elephant handlers in the Philadelphia Zoo received an annual wage premium of $1,000 because elephants pose the greatest risk to zookeepers.[5] Firefighters who battled the fires in Kuwait received $500,000 per year.[6] More typically, workers receive a modest premium for the relatively low risks that they face on the job. The econometric task is to estimate this premium and to ascertain the wage–risk trade-off. Analogously, one can also estimate the cost–risk trade-off from product choices. The switch to smaller, more fuel efficient vehicles has killed thousands of motorists, but in return for these greater risks consumers have reduced their gas bills.[7]

The average VSL based on the revealed preferences in the labor market yields a U.S. value of about $9 million. Thus, a worker facing a risk of death of 1/10,000, as in our example above, requires $900 in extra pay per year to face this risk. For the current average annual death risk of 1/25,000, the additional wage compensation is $360. This figure is just an average amount across the labor market. The VSL is not, however, a universal constant. There is substantial heterogeneity in the VSL with workers in high risk jobs having a VSL far below $9 million and workers in lower risk jobs having a VSL of $20 million or more.

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[5] Viscusi (1992), p. 8.

[6] Ibid.

[7] The DOT produced such an estimate of 1,300 deaths per year that was cited in *Product Safety and Liability Reporter*, Vol. 18, No. 38, September 21, 1990, pp. 1054–1055. Crandall and Graham (1989) provide an economic exploration of the relationship between mortality risks and fuel economy standards for which they estimated that the fuel economy standards for the 1989 model year cars would lead to an extra 2,200 to 3,900 fatalities over the next decade.

A principal characteristic that drives differences in estimates of VSL is the level of individual income. Safety is a normal good, and more affluent consumers place a greater value on safety. Across the U.S. working population, the estimates of the income elasticity range from 0.5 to over 1.0. Similarly, there are also income-related differences in the VSL that appear in international evidence. Countries with lower per capita income than the United States, such as India, have lower estimated levels of VSL.[8]

The landmark event that led to the widespread adoption of the use of VSL by government agencies can be traced to the debate over the hazard communication regulation proposed by the Occupational Safety and Health Administration (OSHA) in 1982.[9] In its regulatory impact analysis, OSHA viewed the expected lives saved as being too sacred to value. Instead, OSHA calculated the "cost of death" associated with these prevented fatalities. The present value of lost earnings and medical expenses served as the benefit value. Based on this analysis, the benefits did not exceed the costs, and the Office of Information and Regulatory Affairs of the Office of Management and Budget (OMB) rejected the proposed regulation.

OSHA then appealed the decision to then Vice President Bush, leading to my involvement in the policy debate. I was asked to prepare an analysis to resolve the dispute between the two agencies, after being approved by OMB and the Secretary of Labor. OMB's critique of many of the components of the OSHA analysis was compelling. However, even if one accepted all of the OMB assumptions, the estimated benefits would exceed the costs if instead of valuing lives saved by the cost of death one used the VSL. My VSL estimate at that time was $3 million (or $7.4 million in current dollars), which exceeded OSHA's cost of death value by an order of magnitude. An analysis making this change generated benefits exceeding the costs, and the Reagan administration approved the regulation, which was the most ambitious regulatory proposal to date in that administration.

Subsequently, OSHA and other agencies began to adopt the VSL approach. This methodology had a persuasive economic rationale in that agencies were now able to value lives correctly. Although I would like to think that agencies were swayed by economic reasoning, it is also likely that boosting the benefit estimates by a factor of 10 enhanced the attractiveness of agency regulations, which no doubt had substantial political appeal as well.

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8 The estimated income elasticity of the VSL reported in Viscusi and Aldy (2003) ranged from 0.5 to 0.6. The median U.S. VSL based in their meta-analysis was $7 million in year 2000 dollars, while the estimated VSL levels for studies utilizing data from India had a VSL range from $1.0 million to $4.1 million, with a median value of about $1.4 million.

9 Viscusi (1992) provides more detailed discussion of the OMB–OSHA controversy and my economic analysis.

3 Policy-related methodological issues

The use of the VSL for benefit assessment raises a host of methodological issues, but for the most part agencies have either resolved them or have made a policy decision regarding the agency approach. The reliance on revealed preference values or stated preference values differs by country. In the United States, where many labor market estimates have generated reliable estimates of the VSL, the primary, and in some cases, the exclusive, emphasis of agency policies has been on revealed preference data. In contrast, labor market estimates of the VSL have been more unstable in the United Kingdom. As a result, the policy focus in the United Kingdom is on stated preference values of the VSL, particularly on transportation-related values elicited using various survey techniques.[10]

Which studies the agency relies upon in setting its VSL varies across agencies. At one extreme, the agency may rely on a single best estimate from a reliable labor market study, as in the case of the U.S. Department of Homeland Security. An intermediate case is the U.S. Department of Transportation (2014), which derives its current VSL of \$9.2 million relying on an average of the estimates from labor market studies using the Census of Fatal Occupational Injuries (CFOI) data, which is the current gold standard in occupational fatality data.[11] The EPA has a long history of interest in VSL issues governed primarily by a series of meta-analyses, which comprise primarily the revealed preference estimates but also may include stated preference estimates.

The role of publication selection bias has been of increasing concern in the literature and is a topic I examine in Viscusi (2015b). Fortunately, the VSL estimates currently used for policy assessment purposes are in the appropriate range even after adjusting for publication selection effects, which are statistically significant. Selection effects may influence the VSL estimates that researchers submit to journals and the VSL estimates that journals are willing to publish. An additional potential selection bias can arise with respect to agencies' choice of estimates of the VSL to be used in assessing the appropriate levels of the VSL for policy purposes. While there is evidence of significant publication selection biases in the literature, my selection-corrected estimates of the VSL are similar to the values currently used by regulatory agencies.

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10 The survey studies by Jones-Lee (1989) and his various collaborators examine money–risk trade-off rates for transportation safety risks.

11 In Viscusi (2013), I review the properties of the CFOI data and the capabilities that these data provide for economic analysis. The CFOI data are based on a comprehensive census of all work-related injuries rather than a sample of fatalities, where all deaths and their job relatedness must be verified using multiple sources such as death certificates and workers' compensation records.

To what extent can labor market estimates of the VSL be used to capture the appropriate VSL for risks outside the labor market? This issue, which is known as benefits transfer, is often acknowledged but seldom examined. Both the U.S. Office of Management and Budget (2003) guidance and the U.K. H. M. Treasury *Green Book* (2011) highlight the potential importance of benefits transfer issues with respect to VSL. The role of benefits transfer has arisen with particular prominence with respect to cancer, for which the mortality risks may be accompanied by a substantial morbidity component. The EPA and the United Kingdom both have adopted a cancer premium, though the extent of the premium and its justification based on economic studies remain matters of continuing concern.[12] Less dramatic benefits transfer issues arise with respect to the application of the VSL estimates from labor market risks to mortality risks outside the labor market from transportation activities, products, and environmental exposures. Many agencies, such as DOT, use the labor market estimates of VSL to assess the benefits of mortality risk reductions from causes other than job accidents. Viscusi and Gentry (2015) provide evidence in support of the appropriateness of using labor market estimates of the VSL for transportation-related deaths that occur outside of workplace settings. Job-related deaths and transportation-related deaths both involve traumatic injuries. Motor-vehicle-related deaths comprise a large component of job-related fatalities. The estimated VSL levels for motor-vehicle deaths are similar to the estimated VSL levels for fatalities unrelated to motor vehicles, as well as to overall labor market VSL estimates.

Much of the focus of the recent economics literature has been on estimates of the heterogeneity of VSL with different personal characteristics, such as age. Efforts to incorporate this heterogeneity in policy evaluations have not been successful. The EPA performed a sensitivity analysis of its Clear Skies initiative using an age-adjusted VSL that reduced the VSL for fatalities to those over age 65 by 37% using results from stated preference research in the United Kingdom. The public outcry over the use of a "senior discount" led to the abandonment of this exploratory effort.

My interest in age-related variations has continued for several decades and has been enhanced by the availability of more refined fatality statistics.[13] From an economic standpoint, the VSL is the risk–money trade-off, and this amount may remain

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12 The U.S. EPA has adopted a provisional cancer premium of 50%, whereas in the United Kingdom the cancer premium entails using a VSL that is double that for accidental deaths. The U.K. guidance provides no supporting evidence for this premium. Viscusi, Huber and Bell (2014) review these approaches and present new evidence of a more modest cancer premium of about 21%.

13 Viscusi (2013) reviews the capabilities of the new fatality risk data, and Viscusi (2014) examines the empirical evidence regarding these and other aspects of the heterogeneity of VSL. Aldy and Viscusi (2007) provide a detailed assessment of labor market evidence with respect to age variations in VSL.

quite high over the life cycle. I noticed that my son drove a topless Jeep Wrangler while I drove a car with a full roster of safety devices. It did not seem reasonable that my VSL should be substantially lower than his. Also I had not noticed senior citizens engaging in the risky behaviors one would expect if they had a low VSL. As it turns out, the VSL does follow the life-cycle income trajectory and has an inverted U shape. However, the VSL does not plummet as one ages, but tapers off so that the VSL of a 65 year old is higher than that of an 18 year old. It is also note-worthy that because of the pattern of VSL over the life cycle, using labor market estimates of the age variations in VSL for the Clear Skies initiative yields benefit estimates similar to those obtained without any age adjustment.

Government agencies currently use the VSL approach based on similar eco-nomic rationales and have abandoned the human capital, or cost of death, approach. Both in government as well as in economics research circles, the controversy over the use of VSL is substantially muted. Agencies also have converged to using fairly similar monetary values. Whether the estimates are derived from labor market stud-ies or stated preference studies, agencies generally use an average VSL for the pop-ulation rather than incorporating the heterogeneity of VSL.

While valuing mortality risks is a standard operating procedure for govern-ment agencies, the use of VSL in business decisions is less well established. On a conceptual basis, there is no reason that the VSL should not generalize to corporate risk decisions. Indeed, the VSL figures derived from revealed preferences in market decisions would seem to be ideally suited to safety policies of business.

4 GM ignition switch recall overview[14]

In 2014, the National Highway Traffic Safety Administration (NHTSA) fined GM $35 million for failing to report a defect in the ignition switch for several vehicle lines. GM had done a recall analysis in 2007, but there is no evidence that they did a full blown benefit-cost analysis. Here I will explore various aspects of the GM ignition switch controversy. How should GM have handled the defect? Why did GM ignore the problem? How can regulatory policy and liability rules be restruc-tured to foster more responsible corporate behavior? Finally, does the VSL have a constructive role to play in corporate risk decisions?

The nature of the ignition switch failure is that while the vehicle is moving, the switch might accidentally turn off the vehicle. Although there was some initial speculation on the part of GM that the failure might be due to the driver putting

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14 Viscusi (2015*a*) provides documentation with respect to the factual issues in much of the discussion below.

items on the chain connected to the key fob, the defect ultimately was not traced to the role of such extra weight. At the time of the 2014 NHTSA penalties of GM, the company's estimate of the number of fatalities attributable to the defect was 13 deaths. By the March, 2015 date of the Society for Benefit-Cost Analysis conference, the official death toll announced by GM had risen to 64 deaths. The estimates of the number of deaths attributable to the defect have continued to rise and now stand at 124 fatalities. In addition, hundreds of people were injured by the defect, and there was substantial property damage as well.

Regulatory action by NHTSA brought the ignition switch problem into prominence. Although the ignition switch problem was not new, GM never disclosed the defect to NHTSA. Last year, NHTSA fined GM $35 million for not reporting the ignition switch defect. Although GM had not reported the defect to NHTSA, the defect problem was the subject of internal analyses. My main theme is that GM and other companies should undertake benefit-cost analyses of safety-related decisions in much the same manner as do government agencies.

When GM CEO Mary Barra testified at the congressional hearing, she displayed an example of the problematic ignition switch. Although she was informative about the nature of the mechanical problems, her discussion of the defect did not illuminate much about the process that led GM to continue to market cars with a defective switch or GM's failure to do a proper recall. She indicated that GM had done a recall assessment for which they assumed the cost was about $100 million back in 2007. She did not indicate the estimate of any adverse effects that would have been prevented. Suppose that for purposes of illustration we use the 124 fatality estimate that GM now attributes to the defective switch, and set aside the nonfatal injuries and property damage for purposes of this calculation. What would the estimated benefits have been? If you take the current VSL estimate used by DOT of a $9.2 million VSL and multiply it by 124 deaths, the estimated benefits equal $1.141 billion. Alternatively, if you take my meta-analysis VSL number with Joseph Aldy of $7 million (year 2000 dollars), which understates the inflation-corrected VSL level at the time of the recall decision, then the mortality risk benefit of doing the recall is $868 million. In each case, the mortality risk reduction benefit exceeds the $100 million cost estimate, so it easily passes the benefit-cost test. Moreover, as I indicate below, the use of the VSL to value mortality risks associated with defects may be greater than that for vehicle design changes for additional safety features. On benefit-cost grounds wholly apart from their legal obligations, GM should have done the recall. What is particularly striking is that GM did not do any such analysis. While there apparently was at least an attempt to develop a rough estimate of the cost of a recall, there is no evidence that any employees sought to assess the safety benefits of a recall.

The inattention to safety-related matters at GM was a consistent theme of an analysis of the decisions that led to the GM ignition switch problems. General Motors commissioned an investigative study in 2014 known as the Valukas Report (Valukas, 2014) to examine the corporate decisions that led to the ignition switch problem and the failure to institute a prompt recall of the defective product. This striking report provided an in-depth examination of the corporate safety culture at GM, which is actually fairly bizarre.

In an effort to head off legal and regulatory controversies, GM had established a list of forbidden words that GM employees are supposed to not ever use. These included, among others: bad, critical, dangerous, defect, failure, problem, safety, serious, and unstable. General Motors memos and reports are never to include such language. Less surprising is that more inflammatory words are also prohibited. These words struck me as being potentially more controversial: apocalyptic, catastrophic, death trap, decapitating, evil, ghastly, inferno, terrifying, and "You're toast!" Along the same lines, GM memos instructed company drivers of GM vehicles to never make comments about the vehicles such as the following: "This is a safety and security issue," "Dangerous; almost caused an accident," "This is a very dangerous thing to happen," and "This is a lawsuit waiting to happen."

The GM safety culture extended beyond the prohibition of specific language. It also included behaviors designed to deflect proper attention away from responsible safety practices. One such behavior is known as the GM nod. This practice was so pervasive that GM CEO Mary Barra highlighted the role of the GM nod in discussions summarized in the Valukas Report. The GM nod involved people at a meeting nodding in agreement that yes, safety is a good thing and that it would be appropriate to undertake the safety measure. However, with that nod there is also an implicit agreement that nobody is really going to do anything to implement this initiative.

A companion behavior is known as the GM salute. Consider a meeting environment in which the participants reached an agreement about an appropriate safety-related measure. At the time of this agreement, the participants cross their hands and point to the people on each side of them. The responsibility lies with them; it is not your responsibility to do anything. The result is that the participants reached a consensus on the desirability of the safety effort, but they also shared a lack of commitment to taking any concrete action.

The Valukas Report did not offer any speculations as to how the corporate safety culture developed at GM. There was a combination of suppression of frank safety-related discussion coupled with a concerted effort to avoid responsibility for safety-related measures. Is the lack of any responsible safety culture a historical accident? What influences led GM to develop these practices? Is it likely that this

behavior is only a characteristic of GM or is it probable that other companies display a similar inattention to safety?

The reluctance to undertake benefit-cost analyses and the suppression of frank discussion of safety matters may be attributable to the unfavorable history that automobile companies have had with respect to risk analyses. Many auto companies have undertaken systematic assessments of costs and risk not unlike a rudimentary form of benefit-cost analysis. The result is that the companies became exposed to substantial legal penalties in terms of punitive damages awards for defective products. The emphasis on avoiding language and other written documents that could contribute to the firm's liability exposure is consistent with the likely impact of past legal sanctions.

A prominent starting point for considering the potentially costly ramifications of risk analysis is the tort liability case involving the Ford Pinto, *Grimshaw v. Ford Motor Co*. This entry level vehicle had a shortcoming in that if you are driving a Ford Pinto and somebody hits your car from the rear, there is a good chance the car will have a fire, leading to potential burn injuries and possibly death. Ford was aware of the fire-related risk from the gas tank placement and had done a benefit-cost analysis of the desirability of moving the gas tank so that there would not be a fire upon rear impact. The Ford analysis used $200,000, the average court award for wrongful death cases at that time, as the benefit value for preventing each expected death. The Ford analysis concluded that the cost of $137.5 million exceeded the benefits, so the company did not move the gas tank. Thus, the company was aware of a potential safety-related issue and the cost to address it, but chose not to move the tank since the benefits did not exceed the costs, in their view. One plaintiff's attorney called it the most remarkable document ever produced in an American lawsuit.

While the *ex ante* perspective of a risk analysis showed that costs exceeded benefits, in the *ex post* perspective of litigation the comparison is quite different. From the standpoint of the jury, the case is a no-brainer: the jury sees that somebody died (and actually in this case somebody else was also catastrophically injured), and on the other hand there is the $11 cost for Ford to change the design of the car by moving the gas tank. So with a comparison of an identified death with $11, the *ex post* litigation calculus is clear-cut. The company is going to lose. The jury not only found Ford liable for the death, but also levied a $125 million punitive damages award to punish Ford for its behavior.

Such punitive awards in excess of $100 million are rare, and in a series of articles I have termed them "blockbuster punitive damages awards." I have been able to identify over 100 of these blockbuster awards to date. Ten of these awards are related to automobiles. Particularly striking is that most of these auto-related blockbuster awards have been triggered by the company doing a risk analysis.

Ford encountered similar legal controversies with respect to a risk analysis that did not deal with gas tank fire risks in *Miles v. Ford Motor Co*. Ford suffered legal penalties related to injuries associated with a tension eliminator for the shoulder harness on the seatbelt. What was Ford's transgression? Ford would first run what was characterized as "a cost-benefit analysis" to see what the cost would be to fix or repair the defect. This type of procedure starts to sound like some of the things a lot of economist members of the Society for Benefit-Cost Analysis generally do, though the specifics of the analysis would be different. As part of its analysis, Ford's apparent transgression is that it would assign arbitrary values to each death or serious injury and would predict the number of occurrences that would involve either death or serious injury. At an abstract level, this effort seems remarkably similar to standard benefit assessment practices. In the final step of this calculation, Ford would determine the cost to litigate such deaths and serious injuries and use this value to monetize the benefits. This approach is a departure from current economic norms, but was not uncommon in the era before agencies adopted the VSL methodology. If the cost to repair the defect exceeded the other costs, then Ford would not correct the design problem.

The adverse experiences with risk analyses were not limited to Ford. Chrysler undertook similar risk assessments and in one case, *Jimenez v. Chrysler Corp*., was hit with a $250 million punitive damages award. What did Chrysler do that was so reprehensible? According to the quotes from jurors, "Chrysler officials at the highest level cold-bloodedly calculated that acknowledging the problem and fixing it would be more expensive in term of bad publicity and lost sales than concealing the defect and litigating the wrongful death suits that inevitably would result." However, such calculations would be a routine part of any benefit-cost analysis that would be a responsible approach provided that the company also valued the mortality risk reductions properly.

As one might expect from the ingrained lax safety culture at GM, General Motors has not been restricted to the role of spectator viewing other companies being penalized for risk assessments. General Motors has had a particularly prominent role in terms of these lawsuits and blockbuster punitive damages awards. As with Ford and its experience with the Pinto, GM has also had fuel-fed fire impact cases. General Motors engineer, Edward Ivey, applied his engineering training to undertake a benefit-cost analysis of moving the fuel tank.[15] Similar to the Ford analysis approach, he did a benefit-cost analysis using $200,000 per fatality based on the wrongful death awards and concluded the costs exceeded the benefits. As a result, the company did not alter the placement of the tank.

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15 See the Memorandum from E. C. Ivey, Value Analysis of Auto Fuel Fed Fire Related Fatalities, General Motors, June 29, 1973.

The juror comments in a prominent case involving this analysis and gas tank risks, *Moseley v. General Motors*, indicate how such analyses will be interpreted in the *ex post* venue of judicial proceedings. In the post-trial discussions, the jurors indicated that because GM officials had done the analysis, the company knew there was a risk. That they knew of the risk was the constant refrain among the jurors who were interviewed. The jury awarded $101 million in punitive damages. When asked why the jury picked a number such as $101 million, the jurors indicated that they included $1 million as an exclamation point. From my vantage point, I think $100 million would have gotten their attention regardless of the exclamation point bonus.

Similar rear impact risks were the focus of a GM Chevrolet Malibu case, *Anderson v. General Motors*. The burn injuries arose after a Chevrolet Malibu was rear-ended on Christmas Eve – timing that may have boosted the jury award. The jury awarded $107.8 million in compensatory damages and $4.8 billion in punitive damages. These awards were for nonfatal burn injuries, not deaths. General Motors's risk analysis once again played a pivotal role. Jurors told reporters that they thought the company valued life too lightly. However, it is not clear that the jurors would have been happy with any benefit-cost trade-off. The jurors seemed to express a zero-risk mentality. One juror said that there was no evidence that the car they put out there was as safe as the car they could have put out there. This final quote epitomizes the juror's views: "We're just like numbers, I feel, to them. Statistics. That's something that is wrong." Interestingly, one could make that same comment about most regulatory impact analyses for governmental regulations involving mortality risk.

In addition to being the target of criticism for its rear impact fire analyses, GM also came under attack for its door latch analysis. In this case, *Hardy v. General Motors*, the jury levied another $100 million punitive damages award. The legal risk the companies face is that if the company performs a benefit-cost analysis or a risk analysis of any sort, that exercise shows awareness of the risk. Such awareness of the risk is one of the standard triggers in jury instructions for awarding punitive damages. In effect, doing the analysis demonstrates that the company was aware of the risk and proceeded to put the hazardous product in the market anyway.

5 Experimental evidence on responsible risk analyses

Is it possible to undertake sound risk management efforts and avoid the pitfalls exemplified in these cases? For all of these past efforts in which there have been

attempts to monetize the safety benefits, the unit benefit value has been a human capital measure linked to compensation measures in wrongful death cases rather than the VSL. It would be useful to explore how companies would fare if they undertook a more meaningful benefit-cost analysis. Instead of using as the benefit measure the present value of lost earnings for whoever is being killed, what if the company used the $9 million figure adopted by DOT or some other VSL number widely used by government agencies? Adopting a benefit-cost analysis approach utilizing the VSL has a sound economic rationale, will include a much larger fatality rate benefit measure than the human capital, or cost of death approach, and would be consistent with standard government practices.

To explore the reactions of prospective jurors to this approach, I developed a series of hypothetical case scenarios that I presented to a sample of almost 700 adult jury-eligible citizens.[16] Interestingly, even if the company uses the VSL number in its analysis, there is still substantial support for a punitive damages award. What is particularly disturbing is that when the mock jurors are setting the value of the award, they seek to "send the company a message" by picking a punitive damages amount greater than the VSL figure used by the company. As a result, the higher the number used by the company, the higher will be the punitive damages award the juries wanted to levy. So if the company values life at $1 million, a juror can send the company a message with an award of $2 million. But if the company values life at $7 million, in order to send the company a message, the juror would have to levy a larger punitive damages award such as $10 million.

This counterproductive effect of valuing lives more highly, and in effect placing a greater weight on safety, poses inherent difficulties for any company seeking to undertake a sound risk analysis. The difficulty arises because unlike regulatory agencies, courts act *ex post*, after people are injured. And the comparison is consequently between an identified life and the per-product safety cost. Because of the substantial influence of hindsight bias in such situations, there are practical impediments to framing the decision as a prospective corporate risk decision, which is what is essential for jurors to have a proper vantage point.

Fostering responsible corporate risk management through the use of benefit-cost analysis is highly desirable, but faces considerable practical obstacles. The task of getting companies to adopt the benefit-cost analysis approach is much more challenging than the task facing government agencies because of the pending liability risks and the retrospective nature of jury deliberations. Current jury instructions

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16 The principal wave of these mock juror evaluations was the sample of 489 reported in Viscusi (2000), with the remainder of 197 mock jurors being included in responses to different scenarios in Viscusi (2002).

that include awareness of the safety hazards as a standard component of criteria for punitive damages do not foster efforts by companies to grapple with risk issues in a meaningful way.

6 Policy remedies to promote corporate benefit-cost analyses

Suggesting that corporations base their safety policies on benefit-cost analyses using VSL statistics is not akin to asking them to abandon their corporate function and to behave as a government agency. The VSL estimates reflect the risk–money trade-offs of their customers, play a central role in consumer choices, and should have a pivotal role in design decisions with respect to auto safety (Blomquist, 1988).

The implicit VSL embodied in private choices with respect to transportation risks was first established in the VSL literature with respect to consumers' use of safety equipment. Studies of the use of seatbelts beginning with Blomquist (1979) imputed the VSL based on the monetary value of the time and effort cost of buckling that consumers incur in return for the reduced risk levels. Other protective equipment often involves an explicit monetary cost, but the time cost continues to loom particularly large, given the frequency with which the consumer must undertake the precaution. Based on an extension of the general approach in the seatbelt analyses, Blomquist, Miller and Levy (1996) estimated the VSL associated with motorcycle helmets as well as the risks based on the use of child safety seats for children, for whom they find comparatively higher values. Given the expected safety benefits of protective equipment, are people irrational if they fail to take advantage of these protective measures? Whether that is the case depends on whether the safety measure passes a private benefit-cost test. Just as the benefits of safer vehicle design features for motor vehicles may not pass a benefit-cost test, Blomquist (1991) found that those consumers who forego some precautionary opportunities may do so for quite rational reasons, such as a higher value of time. Similarly, respondents who indicate a higher VSL in stated preference surveys are more likely to use seatbelts (Hakes & Viscusi, 2007) so that decisions to engage in safety-related behaviors are consistent with their levels of VSL.

The wage premium required to get workers to accept risky jobs has a product market counterpart, as consumers will be willing to pay more for safer cars. Several studies have examined how the product price varies with safety. For example, Dreyfus and Viscusi (1995) find that used cars with a better safety record command a higher price, controlling for other automobile characteristics. More recently, Rohlfs, Sullivan and Kniesner (2015) have shown that the price premium for cars equipped with air bags yields a VSL estimate very similar to the estimates used for

government policy. In effect, basing corporate decisions on a benefit-cost analysis using a VSL will replicate the decisions that would emerge if consumers were fully informed of the vehicle safety levels and had the opportunity to pay a higher price for safer cars.

Despite the fundamental linkage to consumer preferences, jurors may nevertheless be unsympathetic to such analyses, given the retrospective nature of jury proceedings. To overcome these challenges, I suggest the following solution. First, companies should undertake systematic benefit-cost assessments of safety measures just as do government agencies. Second, in doing these analyses companies should value the lives saved using VSL estimates rather than the values based on wrongful death cases. Third, we should establish government practices for benefit-cost analyses as a safe harbor reference point. If a safety feature fails a benefit-cost test, so that not adopting it is efficient, then the company also is not negligent. In such situations I would prohibit introduction of the analysis by the plaintiff. The plaintiffs would not be able to introduce as evidence information indicating that the company had done a benefit-cost analysis or the results of this analysis. If, however, the safety measure passes a benefit-cost test and the company decides to not implement the safety measure anyway, then there would be no legal protection for the analysis.

Policy reform also includes a meaningful role for the VSL in terms of the regulatory sanctions. NHTSA penalties are currently capped at $7,000 per violation, with a limit of $35 million total penalties for a related series of violations. These are trivial amounts. The appropriate deterrence value for known risks is the VSL. So at $9.2 million a life and 124 people killed, the amount of money you would need to generate the appropriate incentives is $1.141 billion. Rather than using $7,000 per violation, NHTSA should use the VSL to set the penalty level in the case of fatalities, boosting the scale of penalties by three orders of magnitude. Changing the penalty structure in this way would require a change in the agency's legislation.

Creating efficient levels of deterrence becomes more complicated and requires larger sanctions if the probability of detecting the wrongful conduct is below 1.0. If there is only a 50% chance that the company's transgressions will be identified, then it is possible to create optimal levels of deterrence for the risk of a fatality by setting the award equal to twice the VSL. More generally, it is possible to create efficient deterrence by setting the total damages equal to the VSL divided by the probability of detection.

While this approach is sound economics and can be traced back to Jeremy Bentham, assessing the probability of detection is often difficult. In the case of GM's ignition switch problem, the probability of detection is less than 1, because the company withheld the information from NHTSA for seven years and had confidential settlements with the parties who sued them. GM clearly tried to reduce

the likelihood of being discovered. Unfortunately, *ex post*, the probability of detection after learning about the risk is always 1.0. Fine-tuning optimal deterrence by incorporating the probability of detection is likely to remain beyond jurors' inclinations or capabilities. But at the very least, the VSL can assume a central role in setting punitive awards and regulatory sanctions.

A final caveat is that the use of average VSL figures may understate the VSL associated with safety defects as opposed to safety improvements. The application of benefit-cost analysis to design changes for components of a vehicle that is voluntarily purchased may entail a different valuation of the risks than when benefit-cost analysis is applied to a design defect that purchasers had no reason to anticipate. While on a theoretical basis, small changes in risk in either direction should be valued equally, when asked in a stated preference survey most people would require a substantial price discount if they were told that 124 people who buy this car model will die because of some safety defect. If you are told about this risk, you might wonder what else is wrong with this car. That there is a substantial market response to such product defects is well established. Several articles have documented the adverse effect of product recalls on the wealth of sellers, where this measure captures both consumer demand effects as well as liability costs.[17] Moreover, there is also a demonstrable impact of product recalls on the consumer demand component of the impact of recalls. Crafton, Hoffer and Reilly (1981) found that recalls of the Ford Pinto and other models depressed sales of the defective models and boosted the sales of substitutes. Subsequent studies by Reilly and Hoffer (1983) and Hoffer, Pruitt and Reilly (1992) have found that consumers use the recall information as an input to their purchase decisions. The effect of a recall on the perceived risk of the product may have a general effect in undermining consumer confidence in the product. So the substantial amount that consumers must be compensated to be indifferent to an identified product defect is not just a question of a discrepancy between willingness-to-pay and willingness-to-accept values. The prospect of buying a defective car may be influenced by how the defect affects one's product risk assessment more generally.

There is also the complication that while the VSL is an average population figure, there is substantial heterogeneity in the VSL level across the population. Market choices enable people to match product riskiness to their preferences. Some consumers may be particularly averse to incurring product risks because of their high VSL. Risks associated with defects are unanticipated. If the consumer learns about the risk after buying the product, then there is no opportunity to align the level of safety with the consumer's preferences other than by not using the product.

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17 Examples of such analyses include Jarrell and Peltzman (1985), Hoffer, Pruitt and Reilly (1988), and Gokhale, Brooks and Tremblay (2014).

7 Conclusion

Much of the controversy over the past three decades with respect to the use of the VSL to value mortality benefits has stemmed from a misunderstanding of what the economic value of mortality benefits actually is. When I first generated VSL estimates in the 1970s, there were critics at each end of the valuation spectrum. On the one hand, people would argue that the VSL number should be infinite so that the government should place an infinite value on risks to lives. At the other extreme, some people argue that the multimillion dollar numbers are way too high because they exceed the present value of lost earnings. Following this logic, how could lives be worth more than what people earned? I believe the current economic approach strikes a reasonable middle ground between infinity and lifetime earnings, with current VSL estimates based on consumer preferences being in the vicinity of $9 million.

A recurring lesson for public and private decisions is that monetizing benefits makes them matter. So if we start leaving these numbers out of the analysis because lives are too sacred to value, we will be back in the pre-VSL era and lives will be less highly valued than they are now. The use of VSL in benefit-cost practices is well established for government agencies. The remaining challenge is to promote the use of benefit-cost analysis in corporate risk management decisions. While government agencies had to deal with philosophical debates about the valuations of mortality risks, the challenges facing companies are much greater. Companies are operating in a different legal environment in which their decisions are assessed retrospectively. Companies will be penalized for a flawed analysis to a much greater degree than regulatory agencies. Ideally, we should give companies greater legal protection for risk analyses and encourage them to undertake responsible corporate risk analysis.

The pivotal number for fostering responsible risk management decisions is the VSL. The VSL is already the most influential single parameter driving governmental risk and environmental policies. It should also be the key parameter for companies' risk decisions and for setting legal and regulatory sanctions for contexts involving fatality risks.

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