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The Value of Life in Legal Contexts:
Survey and Critique

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Abstract

Value of life issues traditionally pertain to insurance of the losses of accident victims, for which replacement of the economic loss is often an appropriate concept. Deterrence measures of the value of life focus on risk-money tradeoffs involving small changes in risk. Using market data for risky jobs and product risk contexts often yields substantial estimates of the value of life in the range of $3 million to $9 million. These estimates are useful in providing guidance for regulatory policy and assessments of liability. However, use of these values to determine compensation, known as hedonic damages, leads to excessive insurance.

I. Introduction

Society routinely places a value on life in a variety of ways. Government regulators must make decisions regarding the level of regulatory costs that should be incurred to reduce risks to life and health. The courts provide compensation after fatalities, both to compensate families for their loss and, in some cases, to provide deterrence as well. In our daily lives we routinely make decisions that either reduce risks of death, such as the purchase of a crashworthy car, or increase risks to our lives, such as the purchase of a small fuel efficient car that exposes us to the risk of injury. These choices all reflect an implicit value of life. The value attached to life and health in these various contexts has different economic content and different dollar magnitudes.

The natural question that arises is which measure of the value of life is the appropriate way for society to approach such decisions. The key issue in selecting the pertinent value of life is to establish the purpose for which the number is intended. It is noteworthy that in no case are we asking for the amount of money a person would be willing to pay to avoid certain death or the amount that a person must be paid to accept certain death. Rather, the focus is usually either on the value of a statistical life in which the matter of concern is the risk-money tradeoff involving small mortality risks or the appropriate level of compensation after a fatality for which there is the desire to provide insurance for the survivors.

One can potentially distinguish four potential conceptualizations of the value of life. First, what is the appropriate value of life to establish efficient incentives for safety for deterrence and accident prevention? Second, what is the appropriate value of life from the standpoint of the principles of optimal insurance and appropriate compensation of accident victims? Third, if our objective is to make the victim whole, as in tort liability contexts involving nonmonetary damages, what should be the appropriate level of compensation? Unlike the property damage case in which making the victim whole is an appropriate framework for determining efficient levels of deterrence and compensation, this approach to valuing life will neither be the appropriate deterrence measure nor the appropriate insurance measure, and it has no role to play in an efficiency based value of life framework. Finally, if regulatory expenditures to save lives are very unproductive, is there any level at which their effect on risk leads to the loss of a statistical life rather than a health benefit?

II. Overview of Valuation Approaches

The Value of Statistical Lives

Economic discussions of the value of life almost invariably focus on the value of a statistical life, considering an individual facing a very small probability of death.[1] What is that person's willingness to pay to eliminate some small risk of death? For very small changes in risk, these willingness to pay measures should equal the values for people's willingness to accept increases in risk. The underlying impetus for this approach is the broader maxim in the public finance literature that the value of the benefits for any public policy consists of the willingness to pay of the citizenry for these benefits.[2] Within the context of policies that reduce risk, this value becomes the willingness to pay of those affected by the risk reduction, hence the value of the statistical life. This measure should be appropriately cast as the value from the standpoint of deterrence rather than compensation. The thought experiment embodied in the methodology is a tradeoff between money and a very small risk of death. This approach considers how much individuals need to be compensated to face certain death or how much their heirs would need to be compensated after their death to provide appropriate insurance. These events involve discrete fatality outcomes, where the compensation decision is an *ex post* judgment. In contrast, the value of a statistical life is a prospective measure that in effect establishes the appropriate price society is willing to pay for small risk reductions.

Insurance and Human Capital Measures

Non-economists speculating on what must be meant by the economic value of life typically think of accounting measures, such as the present value of lost earnings.[3] These human capital measures are not an appropriate guide to the value of life from the standpoint of preventing accidental deaths. As will be indicated below, statistical evidence on the value of a statistical life suggests that these values are roughly an order of magnitude greater than the present value of the earnings of the individual exposed to the risk.

In general, one's financial resources do not necessarily provide a bound on the value of a statistical life because the level of expenditure is low. It would not be entirely inconsistent for an individual to be willing to spend more than one-one thousandth of one's income to reduce the risk of death by 1/1,000. Most prospective risk reductions, whether from safer consumer products or increases in regulatory costs, involve sufficiently small probabilities of death that the budget constraints implied by one's earnings are typically not binding. Those who are more affluent will, of course, generally be willing to pay more to prevent risks to their life and health, but this is quite different from saying that one should value risks based on the proportional share of one's income that corresponds to the pertinent probability of death.

Calculation of the present value of the economic loss, including lost earnings, services, and medical expenses, is totally appropriate from the standpoint of providing insurance and compensation to the accident victim. From a theoretical standpoint, the efficient level of insurance when faced with actuarially fair insurance opportunities is to equate the marginal utility of income in the no accident state with the marginal utility of income after an accident.[4] In situations involving financial loss, the utility function is unchanged by the accident. The prescription that marginal utility levels before the accident and after the accident be the same consequently leads to the full replacement of the economic loss. Doing so keeps both the utility and the marginal utility of income at the level it would have had if the accident had not occurred. From the standpoint of the accident survivors, addressing their economic loss so as to provide efficient insurance requires that they receive full compensation of the economic losses that have been incurred. The impetus for the insurance justification is to insure the accident survivors rather than provide for the welfare of the deceased.

The Make Whole Principle

In many accident contexts, the principle for setting damages is to make the victim "whole" after an economic loss by compensating for the value of the loss that has been incurred.[5] This approach not only provides for full compensation of the loss, but also establishes appropriate incentives for accident avoidance in situations in which all accident losses are monetary. The underlying rationale for making individuals whole from an insurance standpoint stems from the principles for optimal insurance when actuarially fair insurance is available. Optimal insurance will provide for sufficient compensation to equate the marginal utility of income in both the accident and the no accident state of the world. Since the utility function is unchanged by an accident, as the only losses are purely financial, equating marginal utilities is tantamount to equating the overall utility level had the accident not occurred.

Making the victim whole is seldom sensible in the case of permanent health impairments or in extreme cases such as death. Money is not as valuable in promoting individual welfare after such catastrophic outcomes. This underlying assumption that health impairments diminish the marginal utility of money lies at the heart of law and economics debate over setting the appropriate level of pain and suffering compensation. If there is no such diminution in marginal utility, then the total value of the compensation an accident victim receives for the financial loss plus any pain and suffering compensation should be sufficient to make the victim whole. For nonfatal injuries, once the financial needs are met by the compensatory award, the task of pain and suffering payments would be to make the victim indifferent to the health consequences. In the case of fatalities, it is clearly implausible to make the victim whole except in rare instances in which one’s bequest motive is overwhelming. Indeed, empirical evidence in Viscusi and Moore (1989) indicates that the value placed on these bequests is in fact less than the value of consumption when one is alive, as one would expect. Purchases of life insurance are also consistent with this result as few people provide their heirs with enough coverage to prevent any income loss.

In most of the law and economics literature, analysts have analogized to the fatality case and have asserted that other accidents, such as brain damage and paraplegia, for example, also reduce the marginal utility of income. As a consequence, full compensation restoring the accident victim to the pre-accident level of welfare is not efficient from an insurance standpoint. Whether an accident that adversely affects health increases or decreases one's marginal utility is, however, an empirical question. All adverse health effects are not simply equivalent to a certain fraction of being dead. However, all available evidence suggests that such health reducing accidents diminish the marginal utility of income. The findings for work-related accidents reported in Viscusi and Evans (1990) generate estimates of the shape of individual utility functions in the pre-accident and post-accident states. Job accidents do reduce the welfare enhancing properties of income to a sufficient extent that the optimal replacement rate for the typical work injury is not 100%, but is rather 85%. Similar findings for multiple sclerosis in Sloan et al. (1998) also imply that this severe illness reduces the marginal utility of income as well. No empirical evidence has been published in the literature to suggest that accidents causing heath impairments raise the marginal utility of income. There is consequently no economic justification for levels of post-accident insurance compensation that will restore the fatally injured or seriously impaired accident victims to their pre-accident welfare level.

<u>Risk-Risk Analysis</u>

The final concept pertaining to the value of life emerged as a salient concern in the 1990s, but can be traced back to previous economic contributions.[6] Regulations may create risks as well as reduce them. In some cases, there may be direct risk effects of the regulation. Earlier consumer product safety regulations protected children's sleepwear from fire hazards with the flame retardant chemical Tris. Unfortunately, this chemical was found to be carcinogenic, producing an unintended risk increase from the regulation. A second class of risk-risk effects is that all economic activity has associated injuries and fatalities, including that resulting from regulatory requirements. For example, regulations that stimulate manufacturing activities, such as the production of pollution control equipment, will generate injuries and deaths that occur in the normal course of all production efforts.[7]

By far the most prominent risk-risk concept, also known as health-health analysis, pertains to the health opportunity costs associated with regulatory expenditures. Allocating society's resources to regulation or other efforts diverts these expenditures from the usual market basket of consumer goods, which includes health care, housing, and other health-related consumption items. Economists have developed a value of life type concept with respect to such expenditures, where this value pertains not to how much it is worth to save a life. Rather, the question is what level of expenditures in terms of the cost per life saved is so high that these expenditures become counterproductive in terms of affecting personal health risk levels. This approach represents an opportunity cost measure of the value of life that will set an upper limit on the level of expenditures that could possibly be sensible even if one's sole concern were with health risks, irrespective of the cost.

III. The Value of Statistical Lives

The underlying principle for establishing the value of a statistical life is that the focus is on the risk-money tradeoff for small risks, not the value of an identified life. Consider the following thought experiment. Suppose that you are faced with a 1/10,000 risk of death. This risk is comparable to estimates of the long run fatality risk that has faced the typical American worker. Suppose that this is a one time only risk that will not be repeated and that you can draw on your future resources to buy out of the risk. Also assume that the death is immediate and painless. How much would you be willing to pay to eliminate this risk?

Very few respondents indicate that they would be willing to sacrifice all of their economic resources in return for this risk reduction. As a result, life clearly has a finite value, and the only question is determining its magnitude. Similarly, few respondents indicate that they are willing to pay nothing to reduce the risk. If the risk scenario can be conveyed in a credible manner, respondents typically indicate a figure such as $500 to eliminate the risk.

How might one use such estimates to calculate the value of life? Suppose that we had 10,000 respondents, each of whom faced a 1/10,000 risk of death. Overall, there would be one statistical death expected in this group. If each person is willing to pay $500 to eliminate the risk, a total of $5 million could be raised to eliminate the one statistical death to the entire group. Thus, $5 million would be the value of a statistical life in this situation. If the respondents had indicated $200 in terms of the willingness to pay, the corresponding value of life would have been $2 million. Similarly, one can view the value of life as simply the value per unit risk, or the willingness to pay for the risk reduction divided by the probability of death, which gives the same answer as the procedure above.

Utilizing survey questions to elicit the value of life is a frequent procedure, particularly for health outcomes such as cancer deaths for which reliable market data often do not exist. A preferable approach is to analyze tradeoffs implied by actual decisions involving real risks rather than creating hypothetical survey scenarios. While there are no explicit market trades involving the certainty of death, there are a variety of contexts in which there are transactions in which a probability of death is one component of the transaction. Purchases of cars with differing safety characteristics reflect the value that consumers place on their lives as well as fuel economy, comfort, and other attributes. Housing market decisions that expose one to various forms of pollution will reflect these valuations, as will job risk decisions of workers and purchases of safety devises, such as smoke alarms.

The principle underlying all such assessments can be traced back to Adam Smith's (1776) analysis of compensating differentials, which was developed more than two centuries ago. Smith suggested that workers would need to be compensated for jobs that posed additional risk; otherwise, these positions would not be as attractive as safer job alternatives. In much the same way, houses in hazardous neighborhoods will command a lower price, and safer cars will command a higher price. The practical task for economists has been to identify market situations in which there is sufficient data to disentangle the risk-money tradeoff from tradeoffs involving other product attributes, whether it be fuel efficiency of automobiles or the promotion prospects of employment. The overall literature dealing with these multiple attribute concerns has been called hedonic wage analysis or hedonic price studies, as the focus is on obtaining quality-adjusted measures of prices or wages, where one of the quality components is the health and safety risk.[8]

By far the most extensive literature on money-risk tradeoffs has focused on labor market estimates. The availability of job risk data as well as detailed information on workers and the characteristics of their employment has enabled analysts to estimate the wage-risk tradeoffs for the United States as well as in numerous other countries. Before considering these estimates, it should be noted at the outset that there is no reason why these studies should yield the same value of life estimates. The value of life is not a natural constant, such as e or π. Rather, it simply reflects the risk-money tradeoff of the sample of the individuals being examined. People will differ in their implicit values of life depending on their willingness to bear risk, their affluence, and other factors.

Figure 1 indicates the manner in which the labor market generates wage-risk tradeoffs. The curve FF represents a market offer curve for a particular firm. For higher levels of risk, the firm is willing to offer a greater wage because the costs of workplace safety to the firm are less at higher risk levels. The additional wage premium for greater risk diminishes because the cost reductions made possible by the increase in risk decrease in size as the risk rises. The curve GG represents a different firm and its associated wage offer curve. In practice, all that is relevant to any particular worker is the highest wage for any given risk level from among the various wage offer curves available in the market place.

The preferences of workers may differ as well. The curve EU_1 represents the set of points for worker 1 that yield the same level of expected utility. As the risk level increases, the wage that the worker must receive to maintain the same level of welfare, or expected utility, is higher. In addition, this compensation must rise by an increasing amount as the risk level becomes greater. The comparable constant expected utility locus for worker 2 is EU_2. Each worker has a whole set of such constant expected utility loci, where the direction of preferences is in the northwesterly direction. What is shown in Figure 1 is the constant expected utility locus for worker 1 and for worker 2 at which they are able to select the job risk-wage combination that gives them the highest level of welfare. Thus, EU_1 is tangent to the offer curve FF at the job risk level p_1, and EU_2 is tangent to GG at the risk level p_2. The slope of the constant expected utility curves and the market offer curves are identical at these points of tangency, as the wage-risk tradeoff simultaneously reflects the wage workers require to accept small increases in risk as well as the costs to the company of altering the risk level. Statistical estimates do not isolate the tradeoff for any particular worker but instead estimate the locus of such tangencies using a curve such as XX in Figure 1. The result economists generally report is an average wage-risk tradeoff or slope of XX for the range of empirical estimates.

More specifically, economists usually estimate an equation, which in its linear form, is

$$\text{Wage} = \alpha + \beta_1 \text{ Death Risk} + \sum_{i=2}^{n} \beta_i \text{ Job and Worker Characteristics}_i + \varepsilon.$$

The coefficient of β_1 represents the wage-risk tradeoff, controlling for the personal characteristics of the worker and the job. If the wage and death risk variables are each in annual terms, β_1 is the implicit value of a statistical life for that sample.

These empirical estimates clearly pertain only to local rates of tradeoff for small changes in risk. Suppose, for example, that one were to ask worker 1 to move from a risk

p_1 to p_2. Would it be appropriate to use the estimated market rate of tradeoff XX to determine how much wage-risk compensation worker 1 would require for such an increase in risk? Using the value of XX, one finds that instead of requiring $w_1(p_1)$ as the wage rate, the wage $w_2(p_2)$ that is sufficient to induce worker 2 to take the riskier job perhaps might suffice. However, examining EU_1, which is the locus of points that gives the worker the same level of expected utility as at the initial risk-wage position of p_1, $w_1(p_1)$, we find that a higher wage at $w_1(p_2)$ is required. Whereas market wage-risk tradeoffs are pertinent to analyzing small changes in risk, large risk increases would command a larger wage premium than the market estimates suggest. To estimate the amount of compensation required for non-incremental risk changes, one would need to know the shape of workers' utility functions, which can in fact be estimated, as was done in Viscusi and Evans (1990). For the logarithmic case, the result was that utility was equal to log Income in the injured state and 1.007 log Income in the healthy state.

Table 1 summarizes selected studies from the value of life literature, which now consists of dozens of estimates. An early influential study is that by Thaler and Rosen (1976), which found an implicit value of life of just under $1 million. However, their sample focused on workers in particularly high risk jobs, with an annual fatality risk on the order of 1/1,000. Workers who are most willing to bear risk will sort themselves into these very risky jobs and, as a result, one will find a lower value of life than in more representative samples. The estimates in Viscusi (1979) for workers facing an annual death risk of 1/10,000 indicated an implicit value of life on the order of $4.9 million. These estimates also appear to be sensitive to the risk measure used, as shown in Moore and Viscusi (1988a), for which the value of life obtained using the Bureau of Labor

Statistics death risk measure is $3 million, whereas the value of life using the National Traumatic Occupational Fatality Survey measure is $8.7 million. Estimates for foreign countries found by Kniesner and Leeth (1991) indicate a value of $3.9 million for Australia and $13.8 million for Japan. Overall, most value of life estimates cluster in a range of $3-$9 million for most studies in the literature.

A wide variety of studies have also examined tradeoffs outside the labor market. In much the same way as there is a wage-risk tradeoff, one can also estimate a price-risk tradeoff. Estimates in Table 2 for seatbelt use, cigarette smoking cessation, automobile safety, and housing price responses to hazardous waste risks all indicate value of life estimates that are broadly in the same range as those in labor market studies. Some of the estimate in these tables differ because in some cases very strong assumptions are needed to generate value of life estimates, and in other instances there are very strong elements of self selection that affect the value of life figures that are generated. For example, cigarette smokers would be expected to exhibit relatively low values of life, and in fact they are at the bottom end of the range of the estimates in Table 2. These findings for cigarette smokers are consistent with those in Hersch and Viscusi (1990) for nonfatal job risks, for which they found that the greatest implicit value of an injury was for individuals who wore seatbelts and did not smoke, the lowest implicit value was for people who both smoked and did not wear seatbelts, with people who engaged in only one of these risky behaviors being in the intermediate range. In short, there is substantial heterogeneity in individuals' value of life, and this heterogeneity gets reflected in people's safety decisions and in subsequent market estimates of the value of a statistical life.

Analysts have also utilized survey techniques to estimate the value of life. These approaches, which sometimes come under the heading of contingent valuation, elicit people's willingness to pay for various kinds of risk reduction. Estimates for automobile accident death risks and for cancer indicate value of life figures of the same order of magnitude as those found in labor market studies.[9] Interview studies of this kind are most useful in indicating how the value of life may vary depending on the kind of death, such as cancer versus an accidental death. They also may be instructive in indicating how the value of life differs for populations of a different age or demographic profile than the typical worker or consumer in the market-based studies.

IV. Regulatory Applications of the Value of Life

A Profile of Regulatory Costs per Life

Historically, the federal government valued statistical lives saved by government policies using human capital measures. In some instances, this approach was characterized as the "cost of death," where it included both the present value of medical expenditures as well as income loss associated with death and injury. This approach shifted in the early 1980s after the Reagan administration at least nominally imposed a requirement that the agency show that the benefits of its regulatory efforts exceed the costs. In 1982 the Occupational Health and Safety Administration (OSHA) proposed a hazard communication regulation. This proposal was the most expensive regulation proposed to date in the Reagan administration. It was rejected by the Office of Management and Budget because in its view the associated costs exceeded the benefits. OSHA then appealed the dispute to then Vice President Bush. My reanalysis of the standard which was prepared at the request of these agencies found that the benefits exceeded the costs if one valued the lives saved using the value of life methodology rather than the cost of death. In particular, this shift alone increased projected benefits by roughly a factor of 10.[10]

The U.S. Office of Management and Budget now recommends the use of the value of life methodology for benefit assessment for all proposed federal regulations. While agencies now routinely assess benefits using these value of life figures, the results of the analysis do not always bind government policy. In most instances, the restrictive legislative mandates of the regulatory agencies require that they issue protective regulations irrespective of benefit-cost balancing. As a result, with the notable exception of the U.S. Department of Transportation, which undervalues life somewhat by using a figure of just under $3 million per life, the risk regulation agencies often issue regulations that have inordinately large costs.

Table 3 summarizes the cost effectiveness of a wide variety of regulations. The columns of the table indicate the name of the regulation, the year the regulation was issued, the pertinent agency, the cost per expected life saved, and the cost per normalized life saved. This normalization transforms all lives into accident equivalents. Thus, prevention of cancer cases generally has less of a life saving effect on a quantity-adjusted basis, where the normalization has been done based on the discounted expected number of life years saved relative to accidental deaths using a 3% rate of discount. The effect of this normalization is to make the health oriented regulatory policies, which already are at the bottom of the table in terms of cost effectiveness, even less efficient than they would seem to be based on the unadjusted cost per life saved.

Suppose that one establishes a cutoff for desirability of a policy in terms of the cost per life saved. Let all efforts with a cost exceeding $6 million per life fail a benefit-cost test and all policies with a lower cost pass such a test. A range such as this is consistent both with the results of the labor market and other value of life studies as well as with the values currently used by most federal agencies. Many regulations in Table 3, particularly those issued by the National Highway Traffic Safety Administration (NHTSA) and Federal Aviation Administration (FAA), pass a benefit-cost test. These agencies tend to be outliers because their legislative mandates do not exempt them from a benefit-cost test. Moreover, the Department of Transportation selects its regulatory interventions based on the value of life performance. Indeed, this agency consistently has used a value of life below the midpoint estimates of the value of life in labor market studies so that there may be additional transportation regulations that would be warranted but which are not now being adopted.

In contrast, the Environmental Protection Agency (EPA) and OSHA routinely issue regulations with considerable costs per life saved. For the last five regulations appearing in Table 3, the costs per life saved were on the order of $5 billion or more. Put somewhat differently, the U.S. Department of Transportation refrains from issuing regulations that are 1,000 times as cost effective as these efforts. These high levels of regulatory costs are even greater once one considers the cost per normalized life saved column in Table 3, which adjust for latency periods and the length of life saved. All regulations with higher costs than the rear lap/shoulder belts for autos regulation issued by NHTSA have costs per normalized life saved that are excessive given this measure.

Salient Policy Issues

While the value of life estimates are useful measures of the risk-money tradeoff for accidental deaths to the populations exposed to these risks, because of individual heterogeneity in the value of life the appropriate measure may differ depending on the regulatory context. The first potential adjustment is with respect to individual age. Risk reducing policies do not confer immortality, but merely extend one's life. Although there have been some estimates of the quantity-adjusted value of life in the literature,[11] as well as estimates indicating how value of life estimates in surveys vary with age,[12] such quantity adjustments are still being refined. The most extreme instances of quantity adjustments arise when the regulation affects the lives of children or people with very short life expectancies, such as those with advanced respiratory ailments. Air pollution regulations promulgated by EPA are particularly affected by such concerns since it is largely the elderly and young children who are protected by these efforts. Some regulatory analyses at least attempt to indicate the distribution of the populations affected and, in some cases, adjust for the amount of life expectancy lost (or more correctly, the discounted number of life years lost), but such adjustments remain controversial.

A second salient aspect of heterogeneity is with respect to income. Human capital measures for the present value of lost earnings as compensatory damages are directly proportional to one's income level. Estimates of the implicit value of job injuries also suggest that there is a strong income elasticity, which also may be close to 1.0.[13] Presumably there is similar variation in people's willingness to pay for risk reduction so that based on the usual benefit measures the value of life for more affluent populations should be greater. The government currently makes no such distinctions, a practice that in effect represents an implicit form on income redistribution.

Although income-based differences in the value of life are particularly controversial when government expenditures are involved, if the regulatory structures will impose costs that ultimately will be largely borne by the consumers themselves, they would presumably be less controversial since they will be fostering the safety levels that an efficient market would generate, and there would be no governmental subsidy to the more affluent consumers. A case in point is that of airline safety, since airline passengers have above average levels of income. The U.S. Department of Transportation does not, however, permit the FAA to use a higher value of life for airline safety than for other agency policies in which it is government funds being expended, such as for improved guard rails on highways. In this case, however, safety regulations are not at the public's expense. They are requirements that must by paid for by the airlines and will be reflected in the ticket price.

Failure to recognize potential heterogeneity in the value of life may also lead to policies that are less protective of the environment for future generations. Society's willingness to pay for safety has been rising over time with increased affluence. Recognizing the greater value that future generations will place on environmental quality and safety will lead to more protective environmental policies than assuming these valuations would remain constant. Because future generations cannot carry out bargains with those now alive and compensate us for our protective actions, the result may be that the level environmental quality may be lower and at a less efficient level than if such transactions could be executed.

Other refinements of the value of life that are often salient include recognition of the quality of life years at risk as well as whether the risks are voluntary and have received some form of compensation. If people have voluntarily chosen to incur risks through a market transaction, then it is often the case that this self selection process will make those exposed to the risk a non-random sample of the population and hence will have a lower average value of life among their group. In addition, the fact that these individuals have received compensation for the risk may affect the perceived equity of the outcome as compared to a situation in which the risk tradeoff is similarly at the efficient level but no compensation has in fact been paid.

V. Value of Life in the Courts

Torts Cases

A routine part of wrongful death, discrimination, and wrongful discharge cases is to calculate the economic loss suffered because of the wrongful behavior. This loss amount typically is the human capital measure based on the present value of lost earnings. In the case of a person who is deceased, there is also often a subtraction for person consumption expenditures and taxes, though these practices vary by state. These calculations are now standard practice and have become a relatively uncontroversial exercise except for differences between the experts in their projections of likely earnings trajectories and in their selection of the discount rate for bringing these projections back to their present value.

Whereas regulatory agencies have adopted the value of life methodology almost universally, the courts continue to rely on the human capital measure. The principal rationale for this continued emphasis is that the human capital approach is more pertinent to the insurance function of damages, which is to meet the economic loss of the survivors. The value of life concept can be viewed more appropriately as a deterrence concept, and awarding damages based on this amount would lead to excessive insurance as compared to what the individual would have chosen if insurance had been available before the accident on an actuarially fair basis.

Use of the value of life methodology as a substitute for the human capital measure as a compensation approach has come under the heading "hedonic damages." Numerous economists have attempted to introduce this concept in a variety of jurisdictions, but this approach has generally been rejected because of the mismatch between the value of life concept and the compensatory objectives of damages.[14] Hedonic damages are more pertinent from the standpoint of deterrence, which most courts recognize as a punitive damages concept, but even then there is the danger that there will be excessive insurance provided to accident victims.[15]

Value of life statistics nevertheless are useful in determining liability. In particular, a company's expenditures on safety should reflect an appropriate risk-money tradeoff. Consider the analysis prepared by Ford with respect to the gas tank design for the Ford Pinto. Although Mother Jones magazine received a Pulitzer Prize for an article suggesting that this analysis was prepared with reference to rear impacts that were the object of tort litigation, the assessment by Schwartz (1991) suggests that it pertained to rollover risks and regulatory matters. However, General Motors did prepare a similar analysis with respect to fires resulting from side impacts on the gas tank so that consideration of the highly publicized Ford analysis is instructive of the general approach that seems to be prevalent within the auto industry.

The cost of relocating the gas tank was $11 per unit for a total cost across the car population of $137.5 million. Relocation of the gas tank would eliminate 180 burn deaths and a similar number of burn injuries, the values for which Ford chose amounts comparable to the court awards at that time -- $200,000 for a burn death and $67,000 for a serious burn injury. The result, as is shown in Table 4, is that Ford's estimate of the total benefits of relocation were just under $50 million, which is far less that the costs. If, however, Ford had used the value of life measure of $5 million for fatalities, this safety improvement alone would exceed the cost of the gas tank relocation. If, for sake of concreteness, we assume that burn injuries are half as valuable as saving lives, then the total benefits of relocating the gas tank are almost 10 times greater than the cost. Focusing on court awards rather than the public's willingness to pay for greater safety will lead companies to greatly undervalue safety improvements. Liability in these contexts should be judged using value of life reference points reflecting appropriate risk-money tradeoffs rather than the much smaller human capital values that fail to reflect the full value of greater safety to those exposed to potential injury.

Risk-Risk Analysis

The very high costs per life saved of government regulations reflected in Table 3 have not gone unnoticed by the courts. In an influential opinion, U.S. Federal Court Judge Steven F. Williams indicated that such regulations may in fact be counterproductive since the health costs of wasteful regulatory expenditures exceed the direct risks reduced.[16] This decision in turn stimulated a letter from the Office of Management and Budget to OSHA, suggesting that OSHA consider this approach in its regulatory analyses.[17] To date this methodology has not yet been adopted as official agency policy. The available evidence at that time was based on the work by Keeney (1990), who used direct estimates of the link between the mortality rate and income level leading to an estimate in the range of $7 million, or $12.5 million in 1992 prices.[18] A variety of other estimates similarly based on the correlation between income and mortality indicate that expenditures ranging from $2 million to $12 million on efforts that do not reduce heath risks directly will have an opportunity cost of one statistical life.[19]

These estimates imply that expenditure levels of this amount will lead to the loss of a statistical life, whereas the value of life estimates cited above indicate that the value of life from the standpoint of saving a statistical life is $3 million to $7 million dollars. Surely these value of life estimates cannot be correct if these expenditures are only a breakeven proposition in which as many statistical lives are lost as are being saved by expenditures of this level.[20] To resolve these difficulties, Viscusi (1994) developed a methodology whereby there would be a linkage between the level of expenditure that would lead to the loss of a statistical life and the value of a statistical life from the standpoint of society’s willingness to pay to reduce risk. In particular, the risk-risk analysis measure of the opportunity cost of saving a life equals the estimated value of life divided by the marginal propensity to consume health-related expenditures, which he estimated to be 0.1. The result was that the level of expenditures leading to the loss of a statistical life would be $50 million.[21]

Thus far, there is general agreement on the concept,[22] but it has not yet been adopted for widespread policy use because there is not yet any consensus regarding the appropriate magnitude of the empirical value that should be used. As a practical matter, if agencies actually adopted policies based on benefit-cost analysis, the use of the risk-risk tradeoff value would become largely superfluous. This technique emerged as an alternative when the restrictive aspects of legislative provisions prevented the U.S. Office of Management and Budget from rejecting policies based on their inordinately high cost per life saved values. Even if agencies are not permitted to perform benefit-cost analysis, the reasoning was that at least on balance they should reduce death risks rather than increase them. So long as the opportunity cost in lives lost exceeds the risk gains from a policy, these efforts will not only be wasteful of financial resources but on balance will have an adverse health effect.

VI. Conclusion

Non-economists might view attaching a value to human life as the most problematic of all undertakings. Such an effort is presumably not only immoral but also unlikely to yield any estimates of practical import.

The opposite has in fact proven to be the case. The courts and regulatory agencies long used human capital measures as determinants of the appropriate value of compensation for fatalities and incorrectly used these measures to value the prevention of fatalities. The more recent literature has focused on these prevention values under the heading of the value of life, which in effect has inquired not about the value of life but rather society's willingness to pay for small risk reductions. This focus on the risk-money tradeoff for small changes in risk is convenient analytically, and can be linked to market evidence for prices and wages that are in exchange for shifts in the individual risk level. Focusing on the small risk changes also leads to an appropriate match to government policies as well as most preventive risk decisions, since typically what is at stake is not the certainty of life or death but rather small incremental shifts in the probability of this adverse outcome. Estimates of the value of life in the labor market are similar to those that have been obtained for product market contexts and in interview studies. Because these values are in the millions per statistical life, there has been considerably less controversy concerning the inappropriateness of these measures than would have been the case if they had a more modest value comparable to the human capital measure for lost earnings.

The result is that value of life estimates are now used routinely in benefit analyses of risk reduction policies throughout the U.S. federal government. However, because of restrictive legislative mandates, they often do not provide the guide to policy. Attempts to use these values in court contexts for hedonic damages have largely been unsuccessful because the value of life measure is not a compensation concept but is rather a measure of the appropriate value of eliminating small risks. Adoption of this approach for determining liability would be an appropriate role for these estimates, but there is no evidence that this use of the value of the life estimates has made its way into the courts.

Another value of life concept that has been at the forefront of the recent economic literature pertains to risk-risk analysis. Very wasteful expenditures may in fact have an opportunity cost in terms of lives saved, which one might view as an expenditure level that will lead to the loss of a statistical life. This concept has been the object of preliminary discussions both in the courts and the regulatory arena, but the methodology has yet to be adopted on a widespread basis.

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Footnotes

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[1] For an early discussion of this principle, see Schelling (1968).

[2] For a review of these public finance principles, see Stokey and Zeckhauser (1978).

[3] Indeed, this approach was in fact widely used throughout the federal government. See Rice and Cooper (1967).

[4] Arrow (1971) articulates this general principle for optimal insurance for financial risks, and a large number of authors have generalized this result for state-dependent utility functions in which there is a utility function in good health and a utility function in ill health.

[5] The idea of making the victim whole is a routine result in the case of financial losses and a desire to provide both efficient insurance and efficient deterrence. For background on these fundamental law and economic principles, see Polinsky (1989), Posner (1998), and Shavell (1987).

[6] The underlying rationale is that as society has become richer, preferences for safety have increased. For empirical evidence on this result see Viscusi (1978), and for further discussion of its policy implications see Wildavsky (1988).

[7] Estimates of the injury cost by industry based on this approach appear in Viscusi and Zeckhauser (1994).

[8] An early contribution to the hedonic price and wage literature Griliches (1971). See Rosen (1986) for an extensive discussion.

[9] Results for the United Kingdom appear in Jones-Lee (1989) and for the United States appear in Viscusi, Magat, and Huber (1991). Estimates of the value of cancer appear in Magat, Viscusi, and Huber (1996).

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[10] The key results from my report prepared for Secretary of Labor Donovan, "Analysis of OMB and OSHA Evaluations of the Hazard Communication Proposal," March 15, 1982, are reported in Viscusi (1992), Chapter 14. The regulation was approved the day after the report reached the White House.

[11] See Moore and Viscusi (1988a and 1988b) and Viscusi and Moore (1989).

[12] See, for example, the results in Jones-Lee (1989).

[13] See the estimates in Viscusi and Evans (1990). For different formulations of the model, the income elasticities are 0.67 and 1.10. Also, in Viscusi (1978) I show that there are also wealth effects in the risk levels people select, as workers with greater economic resources are more likely to select safer jobs.

[14] Most but not all court cases have not permitted hedonic damages to be presented. For a review of the case law in this area, see Ward and Ireland (1992, p. 413-430).

[15] Ideally, one would want to couple compensatory damages with a fine paid to the state to establish efficient incentives. Such a fine can, in effect, be levied through regulatory sanctions in many instances.

[16] See UAW v. OSHA, United States Court of Appeals for the District of Columbia Circuit, 89-1559.

[17] See letter to Nancy Risque Rohrbach, Assistant Secretary for Policy, U.S. Department of Labor, from James B. MacRae, Jr., Acting Administrator, Office of Information and Regulatory Affairs, U.S. Office of Management and Budget, March 10, 1992.

[18] More specifically, Keeney (1990) fitted an exponential curve relating mortality risk to income using 1959 data on mortality of whites, age 25-64.

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[19] For a review of the range of these studies as well as direct evidence, see Lutter and Morrall (1994) and Viscusi (1994).

[20] There are other controversies as well. For example, improved individual health affects income level so there are problems of simultaneity in estimating the relationship between income and mortality rates.

[21] This methodology has since been refined to recognize income related expenditures that harm individual health, such as smoking and drinking. Such refinements indicate that the risk-risk analysis measure for the expenditure level that leads to the loss of a statistical life may be as low as $12 million, which is still substantially above the value of life figure for saving a statistical life. See Lutter, Morrall, and Viscusi (1999).

[22] For example, several articles in the University of Chicago Law Review (Fall 1996) address this approach in a favorable manner.

Table 1
Summary of Selected Value of Life Studies

Based on Labor Market Data

Author (Year)	Sample	Risk Variable	Mean Risk	Implicit Value of Life ($ millions)[a]
Smith (1974)	Industry data	Bureau of Labor Statistics (BLS)	n/a	8.6
Smith (1976)	Current Population Survey (CPS)	BLS	0.0001	5.5
Thaler and Rosen (1976)	Survey of Economic Opportunity	Society of Actuaries	0.001	1.0
Viscusi (1978, 1979)	Survey of Working Conditions	BLS	0.0001	4.9
Brown (1980)	National Longitudinal Survey of Young Men	Society of Actuaries	0.002	1.8
Viscusi (1981)	Panel Study of Income Dynamics (PSID)	BLS	0.0001	7.7
Olson (1981)	CPS	BLS	0.0001	6.2
Arnould and Nichols (1983)	U.S. Census	Society of Actuaries	0.001	1.1
Moore and Viscusi (1988a)	PSID	BLS	0.00005	3.0
Moore and Viscusi (1988a)	PSID	National Traumatic Occupational Fatality Survey	0.00008	8.7
Kniesner and Leeth (1991)	Industry data for Japan		0.00003	13.8
Kniesner and Leeth (1991)	Industry data for Australia		0.0001	3.9
Kniesner and Leeth (1991)	CPS data for U.S.		0.0004	0.7

[a] Expressed in 1998:III prices using the GDP deflator for personal consumption expenditures, as reported in the *Economic Report of the President*, 1999.

Table 2
Summary of Selected Price-Risk Studies Based on

Product and Housing Market Data

Author (Year)	Nature of Risk, Year	**Monetary Tradeoff**	Implicit Value of Life ($ millions)[a]
Blomquist (1979)	Automobile death risks, 1972	Estimated desirability of seatbelts	1.4
Portney (1981)	Mortality effects of air pollution, 1978	Property values	1.0
Ippolito and Ippolito (1984)	Cigarette smoking risks, 1980	Monetary equivalent of risk information	0.8
Atkinson and Halvorsen (1990)	Automobile accident risks, 1986	Price of new automobiles	4.8
Dreyfus and Viscusi (1998)	Used car purchases, 1988	Price of used cars	3.4-4.8
Gayer, Hamilton, and Viscusi (1999)	Cancer risks from hazardous waste sites, 1988-93	Housing price effects	4.2

[a] All estimates are in 1998:III dollars using the GDP deflator for personal consumption expenditures.

Table 3

Regulatory Costs and Cost-Effectiveness in Saving Lives

Regulation	Year	Agency	Cost per life saved, millions of 1995 dollars	Cost per normalized life saved, 1995 dollars
Unvented space heater ban	1980	CPSC	0.1	0.1
Aircraft cabin fire protection standard	1985	FAA	0.1	0.1
Seatbelt/air bag	1984	NHTSA	0.1	0.1
Steering column protection standards	1967	NHTSA	0.1	0.1
Underground construction standards	1989	OSHA	0.1	0.1
Trihalomethane in drinking water	1979	EPA	0.2	0.6
Aircraft seat cushion flammability	1984	FAA	0.5	0.6
Alcohol and drug controls	1985	FRA	0.5	0.6
Auto fuel-system integrity	1975	NHTSA	0.5	0.5
Auto wheel rim servicing	1984	OSHA	0.5	0.6
Aircraft floor emergency lighting	1984	FAA	0.7	0.9
Concrete and masonry construction	1988	OSHA	0.7	0.9
Crane suspended personnel platform	1988	OSHA	0.8	1.0
Passive restraints for trucks and buses	1989	NHTSA	0.8	0.8
Auto side-impact standards	1990	NHTSA	1.0	1.0
Children's sleepwear flammability ban	1973	CPSC	1.0	1.2
Auto side door supports	1970	NHTSA	1.0	1.0
Low-altitude windshear equipment and training	1988	FAA	1.6	1.9
Metal mine electrical equipment standards	1970	MSHA	1.7	2.0
Trenching and excavation standards	1989	OSHA	1.8	2.2
Traffic alert and collision avoidance systems	1988	FAA	1.8	2.2
Hazard communication standard	1983	OSHA	1.9	4.8
Trucks, buses and MPV side-impact	1989	NHTSA	2.6	2.6
Grain dust explosion prevention standards	1987	OSHA	3.3	4.0
Rear lap/shoulder belts for autos	1989	NHTSA	3.8	3.8
Stds for radionuclides in uranium mines	1984	EPA	4.1	10.1
Benzene NESHAP (original: fugitive emissions)	1984	EPA	4.1	10.1
Ethylene dibromide in drinking water	1991	EPA	6.8	17.0
Benzene NESHAP (revised: coke by-products)	1988	EPA	7.3	18.1
Asbestos occupational exposure limit	1972	OSHA	9.9	24.7
Asbestos occupational exposure limit	1986	OSHA	88.1	220.1
Benzene occupational exposure limit	1987	OSHA	10.6	26.5
Electrical equipment in coal mines	1970	MSHA	11.1	13.3
Arsenic emission standards for glass plants	1986	EPA	16.1	40.2
Ethylene oxide occupational exposure limit	1984	OSHA	24.4	61.0
Arsenic/copper NESHAP	1986	EPA	27.4	68.4
Hazardous waste listing of petroleum refining sludge	1990	EPA	32.9	82.1
Cover/move uranium mill tailings (inactive)	1983	EPA	37.7	94.3

Table 3 cont.

Regulation	Year	Agency	Cost per life saved, millions of 1995 dollars	Cost per normalized life saved, 1995 dollars
Benzene NESHAP (revised: transfer operations)	1990	EPA	39.2	97.9
Cover/move uranium mill tailings (active sites)	1983	EPA	53.6	133.8
Acrylonitrile occupational exposure limit	1978	OSHA	61.3	153.2
Coke ovens occupational exposure limit	1976	OSHA	75.6	188.9
Lockout/tagout	1989	OSHA	84.4	102.4
Arsenic occupational exposure limit	1978	OSHA	127.3	317.9
Asbestos ban	1989	EPA	131.8	329.2
Diethylstilbestrol (DES) cattlefeed ban	1979	FDA	148.6	371.2
Benzene NESHAP (revised: waste operations)	1990	EPA	200.2	500.2
1, 2-Dechloropropane in drinking water	1991	EPA	777.4	1942.1
Hazardous waste land disposal ban	1988	EPA	4988.7	12462.7
Municipal solid waste landfills	1988	EPA	22746.8	56826.1
Formaldehyde occupational exposure limit	1987	OSHA	102622.8	256372.7
Atrazine/alachlor in drinking water	1991	EPA	109608.5	273824.4
Hazardous waste listing for wood-preserving chemicals	1990	EPA	6785822.0	16952364.9

Source: W. Kip Viscusi, Jahn K. Hakes, and Alan Carlin, (1997) “Measures of Mortality Risks,” Journal of Risk and Uncertainty, 14(3), 228-229.

Table 4
Benefits and Costs for Changes in Ford Pinto Gas Tank Design

A. Costs

Number of Units	Unit Cost	Total Cost
11 million cars	$11	$121 million
1.5 million trucks	$11	$16.5 million
TOTAL		$137.5 million

B. Benefits – Risks Avoided by Design Change

Outcome of Faulty Design	Ford's Unit Value	Ford's Total Value	Unit Deterrence Value	Total Deterrence Value
180 burn deaths	$200,000	$36 million	$5 million	$900 million
180 serious burn injuries	$67,000	$12.1 million	$2.5 million	$450 million
2,100 burned vehicles	$700	$1.5 million	$700	$1.352 billion
TOTAL		$49.6 million		

Source: Viscusi (1991) and internal Ford engineering analysis for costs and Ford benefit values.

Figure 1
Market Process for Determining Compensating Differentials