This is evidence against the joint hypothesis that the parties are concerned only with their own winnings and that they will bargain efficiently. (In fact, it is evidence of even greater difficulties for theory. The decision to turn down a positive amount of money is not just inefficient bargaining, but irrational individual behaviour for someone who cares only about money.) The failure of either part of the joint hypothesis could explain the data. Perhaps people do act in a rational way and do bargain efficiently, but they have a taste for being treated fairly or for punishing those who appear to take too sharp advantage of their (unearned) positions of power. Moreover, it could be that were the stakes large, the results would be different. When the stakes are small, it is cheap to indulge a taste for 'fair treatment' or 'justice' by refusing an offer whose acceptance gives little gain.

So the conditions under which value maximization hold are not met in general. Yet the assumption of value-maximization are often useful in providing insight, and they may also be a reasonable approximation in guiding decisions.

John Roberts

See also attitudes towards risk; bounded rationality; Coase, Ronald; Coase theorem; experimental law and economics; Kaldor–Hicks compensation; Pareto optimality; private information and legal bargaining; wealth maximization.

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BIBLIOGRAPHY


The character of this result is not that dissimilar from optimal insurance principles in the case of property damage. Financial losses also generate an insurance situation in which it is desirable to have the same marginal utility of income after the accident as before. However, the financial effect does not affect one’s utility function in a fundamental way by altering the person’s ability to derive welfare from monetary expenditures. The utility function for income is the same in the case of accidents that only involve monetary consequences. Consequently, the level of compensation that restores one’s utility after an accident will also yield the same marginal utility of income as in the no accident state. In contrast, fatalities affect one’s utility function, decreasing both the level of utility and the marginal utility for any given level of income, making a lower income level after a fatality desirable from an insurance standpoint.

The second approach to valuing life is the optimal deterrence amount. What value for a fatality sets the appropriate incentives for those avoiding the accident? In the case of financial losses, the optimal insurance amount, the optimal deterrence amount, and the ‘make whole’ amount are identical. However, for severe health outcomes such as fatalities the optimal deterrence amount will exceed the optimal level of compensation. There is consequently an inherent tradeoff between providing the appropriate incentives and optimal levels of compensation to accident victims.

Finally, the ‘make whole’ amount is the level of compensation that is sufficient to restore the accident victim to the pre-accident level of utility. Utility functions may, however, be asymptotic to some finite utility level. Even if compensation after one’s death is fully anticipated when one is alive, it would be quite reasonable to prefer being alive than to be dead, even with an arbitrarily large bequest. Life is an irreplaceable commodity. No amount of compensation may make one whole. This fact does not imply that compensation levels should be infinite. Rather, it suggests that when thinking of the usual objectives for regulation and tort liability the focus should be on the traditional objectives of government policy — insurance of the losses of accident victims and providing appropriate incentives for deterrence. Making accident victims whole may be an efficient outcome if the concern is with these objectives, as in the case of purely financial losses, but this should be an outcome of much more fundamental concerns rather than an objective in and of itself.

1. Compensation in the Courtroom for Fatalities.

Setting appropriate levels of compensation for fatal accidents and illnesses follows a fairly standard approach in liability contexts. The objective of the compensation is to meet the income needs of the survivors as well as to provide some compensation for pain and suffering, loss of consortium, and other non-monetary factors.

Compensation for the financial losses is the most straightforward. The basic building-block in determining such compensation is the human capital measure. In particular, the starting point for the analysis is the present value of the lost earnings that the decedent would have received had the person survived. After the individual’s death, however, the survivors do not lose the entire value of the earnings stream since not all that amount would have been for their support had the victim lived. The level of compensation that will be pertinent will depend in large part on the nature of the family structure.

Consider the case of an accident victim who is married and who has a spouse with a greater life expectancy. The first deduction from the present value of the future earnings, in those jurisdictions in which the court award is not taxed, is for taxes. In addition, there is usually a deduction for the decedent’s consumption, but this is less than a pro rata share because of the economies of scale and local public goods nature of operating a household. The present value of lost earnings plus fringe benefits less the value of taxes and the consumption share consequently serves as the basic component of the financial loss to the survivors.

The second monetized component is the value of the lost services. Had the individual lived, there would have been services provided to the household, such as shopping, child care, yard care, and related activities. For example, the study by Juster and Stafford (1985) indicates that the total amount of such services by the average married male working full-time is thirteen hours per week. One would then value the services amount by the market value of these services to obtain the total services loss.

Non-monetary damages that come under the general heading of pain and suffering are typically not the subject of expert testimony by an economics witness. Rather, it is typically the object of subjective judgments on the part of the jury.

How such awards should be set is, however, a pertinent matter for economic inquiry even if economists cannot pinpoint the exact damages level. The appropriate level of compensation depends in large part on how the accident affects the utility function of the survivors. Would the survivors have wished to have purchased insurance to cover these accident losses? The answer to this question depends on how the accident enters the utility function of the survivors. Clearly, the loss of a loved one will lead to a lower level of utility. Whether compensation is desirable depends on how the accident affects the marginal utility of income at the post-accident income level. If the accident diminishes the survivor’s ability to enjoy spending money, perhaps because of the bereavement caused by the accident, then it will not be desirable to provide financial compensation for pain and suffering from an insurance standpoint. If the accident increases the marginal utility of income, as in the case of accidents that are tantamount to financial losses, then pain and suffering compensation would be desirable from an insurance standpoint. Unfortunately, juries seldom pose the pain and suffering question in such terms.

The other potential rationale for pain and suffering compensation is deterrence. Consider two different accident situations, each of which leads to identical financial losses. In one case, all losses are monetary. The only difference is that in the second situation there is the same monetary loss, but the injurer has also caused the loss of life beyond the quantifiable financial damage. Because of the additional harm that has been caused, it would be desirable from a deterrence standpoint to have a higher level of compensation in such contexts. Punitive damages
situations represent the usual context in which there is a prominent role for such additional deterrence values.

2. VALUING RISKS TO LIFE. Although economics has devoted substantial attention to issues generally termed the 'value of life', this designation is in many respects a misnomer. What is at issue is usually not the value of life itself but rather the value of small risks to life. As Schelling (1968) observed, the key question is how much are people willing to pay to prevent a small risk of death? For small changes in risk, this amount will be approximately the same as the amount of money that they should be compensated to incur such a small risk. This risk–money tradeoff provides an appropriate measure of deterrence in that it indicates the individual's private valuation of small changes in the risk. It thus serves as a measure of the deterrence value for the private value of preventing accidents and as a reference point for the amount the government should spend to prevent small statistical risks. Other factors that enter into the decision include altruistic concerns of others with the well-being of the person at risk.

To see the nature of the value-of-life tradeoff, consider the following thought experiment. Suppose that you are faced with a one chance in ten thousand risk of death. This risk is comparable to the annual occupational fatality rate of the typical American worker. All industries other than government employees are reflected in these statistics. To keep the example well defined, assume that this is a one-time-only risk that will not be repeated. In addition, suppose that you can draw on your future resources to buy out of this risk. The death will be immediate and painless. The issue is how much are you willing to pay to eliminate this risk. To make this risk more concrete it might be useful to think of a stadium in which there are ten thousand people in attendance. It is announced before the game that one individual in the stadium will be killed at random. Faced with such a concrete risk of death, coupled with an inability to leave the stadium, the willingness to pay to eliminate the risk in practice should be quite substantial.

Suppose that the amount people are willing to pay to eliminate such a risk is $400. This amount can be converted into a value of life estimate in one of two ways. First, consider the stadium of ten thousand individuals. If each of them were willing to contribute $400 to eliminate the risk, then one could raise a total amount to prevent the statistical death equal to ten thousand people multiplied by $400 per person, or $4 million. An alternative approach to conceptualizing the risk is to think of the amount that is being paid per unit risk. If we divide the willingness to pay amount of $400 by the risk probability of one in ten thousand, then one obtains the value per unit risk. The value per statistical life is $4 million using this approach as well.

This thought experiment is useful in other ways. Chief among these is that seldom will any respondent indicate an unlimited willingness to buy out of this small probability of death. By failing to commit all of the individual's current and future resources to the reduction in this risk, the respondent has indicated in effect that life has a finite value. Thus, the hypothesis that the value of life is infinite can be rejected. After one's death, even an infinite amount of resources may not compensate one for the loss of one's life. However, the appropriate economic task is to determine the value of prevention of small risks rather than the amount needed to make the decedent whole after the accident.

Posing hypothetical interview questions to ascertain the willingness to pay amount has been a frequent survey technique in the literature on the value of life. Such studies are often classified as contingent valuation surveys in that they seek information regarding respondents' decisions given hypothetical scenarios (see Jones-Lee 1989 and Viscusi 1992). Survey evidence is most useful in addressing issues that cannot be assessed using market data. How, for example, do people value death from cancer compared with acute accidental fatalities? Would people be interested in purchasing pain and suffering compensation and do such an interest vary with the character of the accident? Potentially, survey methods can yield insights into these issues.

One phenomenon that has been illuminated through survey evidence is the gap between the willingness-to-pay and willingness-to-accept amounts. In particular, how does the amount people are willing to pay to achieve a small reduction in risk compare with the amount people must be compensated to face a small increase in risk of the same magnitude? For sufficiently small risks the willingness-to-pay and willingness-to-accept amounts should be equal. For arbitrarily small risks, the tradeoff between money and risk should be the same for risk changes in either direction. However, survey studies suggest that willingness to accept amounts for increases in risk greatly exceed the willingness-to-pay value. Increases from the accustomed risk level tend to be viewed with alarm, particularly relative to the value of risk decreases. People must be compensated substantial amounts for small increases in risk, where these compensation values greatly exceed what they are willing to pay for much more substantial risk decreases.

Evidence from actual decisions that people make is potentially more informative, for situations in which such data exist. Actual decision-makers are either paying money to reduce a risk or receiving actual compensation to face a risk, which may be a quite different enterprise than dealing with hypothetical interview money. In addition, the risks to them are real so that they do not have to engage in the thought experiment of imagining that they face a risk. It is also important, however, that individuals accurately perceive the risks they face. Surveys can present respondents with risk information that is accurate. Biased risk perceptions may bias estimates of the money–risk tradeoff in the market. Random errors in perceptions will bias estimates of the tradeoff downward. The reason for this result can be traced to the standard errors-in-variables problem in econometrics. A regression of the wage rate on the risk level, which is measured with error, will generate a risk variable coefficient that will be biased downward if the error is random. The estimated wage–risk tradeoff will consequently underestimate its true value.

3. EMPIRICAL EVIDENCE ON THE VALUE OF LIFE. A large literature has documented significant tradeoffs between
income received and fatality risks. Most of these studies have examined wage–risk tradeoff, but many studies have focused on product risks as well. The wage–risk studies have utilized data from the United States as well as the United Kingdom, Canada, Japan, and Australia. The primary implication of these results is that estimates of the value of life are clustered in the $3 million to $7 million range, with an average value of life in the vicinity of $5 million.

Since the time of Adam Smith (1776), economists have observed that workers will require a 'compensating differential' to work on jobs that pose extra risk. These wage premiums in turn can be used to assess risk–money tradeoffs and the value of life. The underlying methodology used for this analysis derives from the hedonic price and wage literature, which focuses on 'hedonic' or 'quality–adjusted' prices and wages. In part because of this terminology, there have been proposals that the US courtroom incorporate these so-called 'hedonic damages' as a component of compensation after fatalities. However, this methodology more appropriately addresses issues pertaining to deterrence rather than optimal insurance amounts and is not relevant for routine accident compensation.

The nature of the hedonic model is the following. Workers select the desired job from an available market offer curve. This market offer curve represents the highest wage that is available for any given level of risk. Any given firm is willing to offer a higher wage to the worker for a greater risk (or a lower wage for a safer job) because of the higher costs of providing a safe work environment. However, the cost savings with additional increases in the risk level are diminishing so that the firm's offer curves will be concave. The market offer curve consists of the outer envelope of these different offer curves by firms.

Workers in this model need satisfy only basic rationality assumptions. They should prefer more money to less and rather be not injured than injured. Thus, the basic assumption is that they prefer good health to bad. It is not essential that they exhibit risk aversion with respect to financial losses. Even risk-neutral workers will require additional compensation to face a greater risk of death.

The result of the interaction of the market offer curves and the individual choices will be a series of wage–risk combinations that are observed in the marketplace. The typical hedonic wage model estimates a wage equation as a function of risk to trace out these different tangencies. The result implies a wage–risk tradeoff at each particular level of risk. In the case of a linear wage equation, this tradeoff is constant for all risk levels.

To see what this tradeoff value means, consider the situation in which workers receive an extra $500 to face the annual risk of 1/10,000. This is the local rate of tradeoff that workers are willing to make for very small risks. Although it indicates an implicit value of life of $5 million, this tradeoff value cannot be extrapolated to large increases in risk. The worker would not, for example, accept certain death in return for $5 million.

This difference does not represent an inconsistency in the model or any kind of contradiction of it. Rather, it is simply a reflection of what the wage–risk tradeoff estimates convey. The only information they provide is the local rate of tradeoff of different market participants at observed levels of risk.

Consider the extreme case in which the estimated wage–risk function is linear. Thus, the implicit value of life is the same at some low risk level such as one chance in ten thousand risk of death as it is at a higher risk level, such as one in one thousand risk of death. What is the practical implication of this linearity? Does the result mean that the worker at the lower risk job could be moved to the higher risk job and kept at the same level of welfare based on compensation levels implied by the wage–risk tradeoff? This result will not hold for the usual form of utility functions. The reason for the wage–risk tradeoff at the two different risk levels is that different workers are located there. Had the worker at the low risk been asked to assume a higher risk, the amount of compensation required would be above that implied by the wage equation for a different worker located at the higher risk. The reason for this discrepancy is that the worker's constant expected utility locus is positively sloped with a positive second derivative. Because of this curvature, at the high risk level, the utility function for the worker at the safe job will require a higher wage level to stay on this constant expected utility locus than is provided by the market wage offer curve.

The empirical estimates of the implicit value of life generally estimate a standard wage equation or log wage equation as the dependent variable. Included in this equation are the usual personal characteristics that drive earnings such as age, education, gender, race and personal characteristics. It is also important to control for other job attributes that may drive wages, such as union status. Risky jobs are often unpleasant in other respects so it is important to include job condition variables correlated with riskiness or else the estimated wage–risk tradeoff may be biased by the omission of such influences. The resulting estimate of the wage–risk tradeoff provides information on market equilibrium rates of tradeoff and the pertinent implicit values of life for workers at the different risk levels in the sample.

The estimated magnitudes of the implicit value of life often vary substantially across different studies. Part of this variation stems from the fact that the value of life is not a natural constant. Nor is it likely to be identical for any given population. People will differ in their wage–risk tradeoff in much the same way as they differ in their tastes for any consumer product.

As a practical matter, there are many systematic differences that have become apparent in these studies. Workers at very high risk jobs tend to have lower values of life on average since they have self-selected themselves into the very risky occupation. Through their job choices these individuals have revealed their greater willingness to endanger their lives. Workers at lower risk jobs typically have greater reluctance to risk their lives, which accounts for their selection into these safer pursuits. Such differences are apparent in practice, as the estimated values of life for workers in the average risk jobs tend to be several times greater than those for workers in very risky jobs.

Other differences correlated with worker affluence are also evident. Health status is a normal economic good, and individuals' willingness to pay to preserve their health
increases with income. Blue-collar workers, for example, have a lower value of life than do white-collar workers. In addition, there is a positive income elasticity of the estimated values of risks to life and health.

Because of the substantial heterogeneity, it is not surprising that estimated values of life often differ considerably across empirical studies. These differences are not a sign that such studies are necessarily in error. These samples often consist of workers with quite different risk levels and who are situated differently. International comparisons, for example, are particularly prone to being different across different countries not only because of the aforementioned aspects of heterogeneity but because of the differences in the social insurance and workers' compensation arrangements that may be present in these countries.

Although the basic theoretical elements underlying this theory of compensating differentials have been in place since the time of Adam Smith, it has only been over the past two decades that economists have successfully estimated the value of life. The reason for the time lag stems in part from the difficulty of disentangling wage-risk tradeoffs. Until more recently, empirical studies relied on aggregative data. Labour market studies, for example, focused on data by industry group. To the extent that industries vary along a wide number of characteristics, not simply riskiness, it will be hard to identify the specific contribution of job risks to the industry wage structure.

This difficulty is compounded by the positive income elasticity of demand for good health. As noted by John Stuart Mill (1848) and others, the best jobs in society are also the highest paid. This result does not mean that compensating differentials are inoperative. Rather, better-educated workers compete for different kinds of jobs. Their skills will enable them to command a higher wage rate in the market than those less educated, for any given level of riskiness. Compensation for risk does exist, but for the less-educated workers who choose these risky jobs the level of compensation is not so great as to give lower-skill workers on risky jobs higher wage levels than their better-educated counterparts. The appropriate empirical test for whether compensating differentials exist is not simply to consider an overview of the labour market as a whole but rather to pose the hypothetical question of how much the worker would have been compensated had it not been for the job risk that the worker faced. The multivariate wage equation estimates in effect carry out this experiment by analysing the independent contribution of riskiness to workers' wages, controlling for all the other factors that drive workers' earnings.

The role of heterogeneity is evidenced in estimates for the implicit value for non-fatal job injuries for different worker groups. This analysis follows the same general methodological approach as does the literature on the implicit value of life. The difference is that the focus is on non-fatal job risks rather than fatalities. On average, workers value non-fatal loss injuries on the job at $48,000. Thus, for example, they would require $2,000 to face a one chance in twenty-four of being injured that year.

The estimates of the implicit values of injuries for other labour market groups who have different attitudes towards risk vary substantially from this amount. Valuation of health risks varies predictably from the kinds of other risky choices people make. Cigarette smokers work on risky jobs for an average value of $26,000 per injury, and people who use seat belts in their automobiles require $78,000 per statistical injury in wage compensation. What is noteworthy is that these results are not hypothetical willingness-to-pay values that these different groups have expressed with respect to risks. Rather, they represent actual differences in compensation based on observed patterns of decisions in the marketplace. Markets work as expected in that they match workers to the jobs that are most appropriate for their preferences. This is a constructive role of market sorting that promotes more efficient match-up than if, for example, all individuals were constrained to have the same job riskiness.

Studies of the money-risk tradeoffs are not restricted to the labour market. There have been a number of efforts to assess price-risk tradeoffs for a variety of commodities. The contexts examined by economists include the choice of highway speed, seat belt use, installation of smoke detectors, property values in polluted areas and prices of automobiles. The most reliable of these studies are those pertaining to automobile prices in that they follow the same kind of approach as is used in the wage-risk literature. In particular, the analysts obtain price information on a wide variety of automobile models. Using regression analysis, they assess the incremental contribution of the safety characteristics per se to the product price, controlling for other product attributes. The results of these studies suggest a value of life around $3 million.

4. Ethical issues in the value of life

Because issues examining the value of life are intrinsically entwined with morally sensitive decisions, a variety of important questions has arisen with respect to how value-of-life estimates should be employed. In particular, when making protective decisions for the government in the courts, what weight should be given to these private rates of tradeoff for actual risk reduction decisions? How should variations in the value of life enter these decisions?

An interesting starting point of such discussions is the role of affluence. The value of life increases with income in approximately a proportional manner. Should this heterogeneity be recognized or should lifesaving policies treat all parties symmetrically? To the extent that the beneficiary's own willingness to pay serves as the guide for valuing benefits, as in other public policy contexts, then this heterogeneity would enter. As a practical matter, the result would be that the government would target redistributional efforts and other programmes valued by the poor to those groups and would place greater weight on lifesaving decisions for the more affluent.

Policies based on recognition of such heterogeneity will create substantial controversy. Airline safety is a case in point in that airline passengers are typically more affluent than those who are killed in motor-vehicle accidents. Because of this greater affluence should the government regulate airline safety more tightly than traffic safety?

How we feel about making such difficult distinctions depends in large part on who is paying for the safety improvement. If it is the government that is subsidizing
the higher level of safety through government expenditures, then one might favor treating all parties equally. Doing so would be an implicit form of income redistribution to the poor but would recognize the difficulty of making refined distinctions in the value of life. However, if it is the beneficiaries of the safety improvement who are themselves paying for the greater safety, then the argument against equalization and in favor of recognition of the differences in preferences would be stronger. Higher levels of required airline safety will raise the cost of operating planes and in turn will boost airline ticket prices. If airline fares fully reflect these costs and there are no government subsidies, then the rationale for imposing a more stringent level of safety on airlines than for traffic safety would be quite strong. Failing to provide such a higher level of safety would, in effect, deny airline passengers the level of safety that they would be willing to pay for if they had the chance to do so in a free market exchange. Requiring all citizens to pay for such a higher level of safety through publicly provided risk reduction efforts such as traffic safety may devolve more of their resources to such activities than they would choose to allocate voluntarily.

Some of the quandaries that are apparent in incorporating the role of affluence are made apparent in the following stylized version of the Titanic disaster. Suppose that there were only lifeboats for first-class passengers and that these passengers paid for these lifeboats through their higher ticket prices. Such a differential approach might appear to be consistent with recognition of the role of income differences in the value of life. Even if such an example were well structured by, for example, giving all passengers the opportunity to a seat in a lifeboat for an appropriate surcharge, this example incorporates many elements that are alien to the basic value-of-life approach. Once the ship hits the iceberg and death becomes a certainty after the fact rather than a lottery, the nature of the bargain has changed considerably. Enforcing previous contracts becomes intolerable and infeasible when individuals are confronted with the certainty of death rather than a small probability.

This result highlights the basic nature of the value-of-life enterprise. Its focus is on statistical lives, rather than on identified lives where probabilities of death will drop from one to zero after an appropriate lifesaving initiative. Some examples of identified lives include the much discussed hypothetical girl in a well or a trapped coal miner. In these instances society will generally spare no expense to rescue them. Indeed, even beached whales often command substantial resources to save their lives. One would not, for example, envisage a public official saying that the cost of rescuing the girl exceeded economists’ estimates of the implicit value of her life so that rescue efforts will be abandoned. Society instead will generally spare no expense in the rescue effort.

This difference in the attitude towards identified lives as opposed to statistical lives does not necessarily imply an inconsistency. Identified lives are quite different entities from very small risks of death. However, if there are major disparities in how much society is willing to pay to save identified lives as compared with how much society is willing to pay to save statistical lives, then there should be some careful thinking about what our true underlying preferences toward lifesaving activities are.

Consider the following hypothetical example. Suppose that a random person saved through some lifesaving effort would be Joe. Does knowing the individual's identity alter how much we are willing to pay? Will we likewise alter our willingness to pay to this same level for any member of the random population, not simply Joe? If that is the case, then it may be that we are not properly thinking about the abstract risk, since all concrete realizations of the risk outcome are valued differently after the fact.

A frequent issue that arises in government contexts is how and whether the size of the risk should enter. If there is a village of one hundred people, ten of whom are expected to be killed by some adverse risk, does saving their lives have the same value as saving ten lives out of one million in some nearby city? In each case ten lives will be saved, but in the one instance the risk of death the individuals face will be much greater than in the other.

From a societal standpoint, one would expect the total number of lives saved to be the paramount concern. In terms of individual preferences, the people in the small village would be willing to pay less per unit risk to buy out of their larger risk than would the city dwellers. The reason for this result is that the willingness to pay to purchase successive very small reductions in risk will generally diminish as one makes these successive purchases. Thus, from the standpoint of willingness to pay, a person with an implicit value of life of $5 million for a very small risk such as 1/100,000 will have a smaller value of life if required to buy out of larger risks because of the role of resource constraints. That some person may be willing to pay only $4,000 to prevent a 1/10,000 risk of death, for a value of life of $4 million. In practice, policy biases tend to be the opposite of what one would expect from these differences in individual preferences. Policies often place a greater emphasis on protecting populations from larger individual risks to a small group than from smaller individual risks to a larger group even though the expected lives saved may be the same.

The value-of-life terminology is also misleading to the extent that risk reduction efforts do not confer immortality but simply extend life. Because of that, the major concern should not be with the value of life but with the value of extending life for different periods. In the case of preventing the risk of a young person, the increase in life expectancy that will be generated will exceed that for preventing a risk of death to older people. Some kind of age adjustment may be appropriate. Moore and Viscusi (1990) and Viscusi (1992) have generated various estimates of the discounted value per year of life. These studies indicate that quantity matters, but they are not sufficiently refined as yet to make reliable estimates of which years of life matter most. Is a year of life at age 25 more valuable than a year of life at age five or age 70? How do various health impairments correlated with age affect the value one should attach to such years of life, and should the fact that very young children have not yet received the value of the education and rearing by their parents matter? The total 'human capital', which is the set of personal attributes such as education and training that affect one's income, will be
greater for older children who are further along in their development. Resolving such questions remains highly problematic.

The quality of the life of the years saved clearly matters as well. Life years in deteriorating health may be less valuable to the individual than years in good health. Some analysts, such as Zeckhauser and Shepard (1976), have suggested that the measure should focus on quality-adjusted life years. Making these quality adjustments has yet to receive widespread empirical implementation. Quality distinctions made by the individual through, for example, self-protective actions are less likely to be controversial than quality distinctions made by others. There may be quite legitimate fears of government efforts to target expenditures by, for example, denying health care to those whose life quality is deemed to be low. People often adapt to changes in health status so that external observers may overstate the decline in wellbeing that occurs with serious illnesses.

The value of life also has an international dimension as well. Because different countries are at different stages of economic development with quite different income levels, the citizenry in these countries will exhibit different implicit values of life in their decisions to work on risky jobs and to buy products that are risky. Less developed countries, for example, generally do not meet the same safety standards as do the more advanced Western nations.

Some observers have proposed that there be an effort to eliminate these differences. Rather than permitting international heterogeneity, the policies proposed would attempt to equalize risks in all countries. They would seek to do this by not importing goods produced in a hazardous manner and by imposing the same standards for exports and products sold abroad by companies from the home nation as they would impose for the domestic market.

In some cases these policy proposals are well intentioned. In other instances, they simply represent a protectionist effort to keep out goods produced by lower wage foreign workers. From an economic efficiency standpoint, one would want these other countries to be able to reflect their own risk preferences in the production and consumption decisions. Just as the more advanced countries did not meet current safety standards a half century ago, it would be unreasonable and undesirable to impose these same standards on all countries at the current time. Should Indonesia be forced to meet safety levels prevalent in the OECD nations?

This brief review of the ethical issues arising with respect to the value of life by no means exhausts all pertinent controversies. Fortunately, the level of refinement in value-of-life policy-making and decisions is not so great that all these questions need be resolved at the current time. Most of the difficulties with policy-making stem from fundamental errors in the approach that go beyond some of the nuances discussed here.

A leading example of such a policy error is focusing only on earnings effects. The education and training that give rise to the value of lifetime earnings are known as one’s ‘human capital’. Financial resources clearly matter, but for a considerable time they were the exclusive focus of policy analysts concerned with valuing lives. Only recently has this approach been replaced in policy contexts by the methodology linking the value of life to the willingness to pay to reduce small risks of death. Valuing lives based on the earnings of those at risk greatly understates the value of small risks to these lives, possibly by an order of magnitude or more. Adopting the correct value of life concept for preventing small risks of death is essential to providing a sound basis for risk reduction decisions.

5. REGULATING RISKS TO LIFE. In contexts in which policy-makers seek to maximize the benefits less costs of regulatory policies, the value-of-life estimates provide a useful guideline for policy stringency. In the usual case in which the marginal benefits of controlling the risk decrease and the marginal costs rise with the degree of regulation, it will be desirable to continue saving lives until the marginal cost of doing so equals the implicit value of life. In terms of overall policy effectiveness, policy efforts with a cost per life saved in excess of the value of life would fail a benefit-cost test, while those with a value below the value of life would pass such a test. This approach recognizes that there are limits to how much society is willing to pay to address risks.

These limits arise in part because risks are ubiquitous. Natural carcinogens are, for example, present in most of the major components of quite healthy diets. Wine, lettuce, apples, mushrooms, pears, brown mustard, orange juice, coffee, plums, peanut butter, celery, carrots, potatoes and tap water are all among the many products that contain known human carcinogens. The carcinogenicity arises in part because nature has developed defence mechanisms to protect various food products from invasion by natural enemies that operate in much the same way as do artificial pesticides. The presence of these minimal risks does not imply that we should eliminate these foods from our diet, but it does highlight the fact that our lives cannot be made risk-free. Such a quest is an impossible pursuit, even with unlimited resources.

Risks of death that lead to an annual death risk of one in a million are not restricted to the kinds of risk that are generally the subject of regulation. We incur such a risk at any time when we smoke 1.4 cigarettes, travel ten miles by bicycle, eat forty tablespoons of peanut butter, or live two days in New York or Boston (see Wilson and Crouch 1987). Risks are an intrinsic part of daily lives. This fact surely does not imply that we should accept all the risks we face, no matter how large they are. Rather, it does suggest that we must be selective in our risk reduction activities and recognize that there are other attractive features of many of these risk activities that will lead us to want to continue them even in the presence of some hazard.

A useful starting point for addressing fatality risks is to assess the magnitude of the risk that is to be targeted. Unfortunately, this process is often in error. People tend to overestimate small risks of fatality and underestimate the larger risks they face. There is also a tendency to overestimate dramatic risks and risks outside our control, such as the risk of death from an explosion or being killed in an airplane crash. Highly publicized risks, such as the risk of death from a terrorist attack, also tend to be among the most highly over-assessed.
These patterns of risk assessment biases have implications for the underlying estimates of the implicit values of life and health. To the extent that there is an exaggerated assessment of the risk that is itself embodied in the operation of the market, there will be excessive compensation for the actual risk that is present. In these instances, incentives for safety will be too great since the overreaction to the risk will lead people to pay more for the safety improvement than they would have been willing to pay had they properly assessed the risk. Similarly, if people underestimate the magnitude of the risk, the level of safety will be inefficiently low.

A fundamental feature of risk assessment practices is how the risk probability should be assessed when it is not known with precision. From an economic standpoint, if the concern is with saving the greatest expected number of lives, the focus should be on the mean risk level. In many countries, however, the emphasis is on the upper bound or worst case scenario, such as the 95th percentile of the potential risk distribution. This approach is often labelled as the conservatism approach or as the precautionary principle.

Adopting this type of bias, however, reflects a form of irrationality similar in character to the Ellsberg Paradox. This well-known economic paradox pertains to situations of risk. Consider the chance of winning a prize if you draw a red ball from an urn containing red and white balls. The urn with a precise chance of success has a known mixture of red and white balls, whereas an uncertain risk urn has an unknown mixture. However, you believe the red-white mixture is the same as in the precise risk case, though you are not sure. Under the Ellsberg Paradox, people prefer a precise chance of winning a prize to an equivalent ambiguous chance of success. The loss counterpart of this phenomenon is that people are generally averse to ambiguous chances of a loss as compared with a comparable precise risk of a loss.

Potentially, anomalies can result from the incorporation of a conservatism bias within risk assessment practices. Suppose that policy option 1 saves 500 lives with certainty, and that policy option 2 offers a 50–50 chance of saving either 200 lives or 600 lives. Assume also that each policy is equally costly and that only one policy can be pursued. Adapting the conservatism principle one would choose policy option 2, but this selection would save fewer lives on average than would policy option 1. Indeed, the conservatism principle would suggest that we should pursue policy option 2 even if there were a 50–50 chance of saving either one life or 501 lives, so that the expected number of lives saved could be well below that guaranteed to be saved under policy option 1. Current risk assessment practices that distort the mean risk may confuse risk assessment with risk management. Ideally, risk management should be a social decision based on society’s risk tradeoffs. Disguising the risk level by incorporating a variety of conservatism biases in effect makes it hard to ascertain the true value of the risk, so that policymakers may not be able to assess properly the actual risk that is being posed.

After accurately assessing the risk, the task is then to select which policy options are to be pursued. The need to allocate efficiently is reflected in the presence of the limited resources that are available for risk reduction efforts. In the United States there are just under 95,000 accidental deaths per year. Even if the entire resources of the US economy could be devoted solely to accident prevention, society would be able to spend only under $55 million per death prevented. Such a policy would address only accidents and would not make any headway in reducing illnesses such as cancer or address fundamental health-related consumption items such as food and housing. Clearly some tradeoffs have to be made. The value-of-life estimates provide the guidelines for making such judgments.

The intellectual jump that must be made from the situation of estimating market tradeoffs to utilizing such tradeoffs for policy purposes can be made more compelling by recasting the policy decision in terms of a private decision. Suppose, for example, that there is a very expensive regulation with a cost per statistical life saved of $1 billion. Should that regulation be pursued? It is often helpful to indicate what such a cost would mean in terms of the person’s own risk-taking decision. Spending $1,000 to prevent a risk of one in a million would be consistent with private decisions if the person was willing to spend an extra $10,000 for a car that was 10% safer. Consumer willingness to pay for safety improvements for their private consumption decisions is not on the order of $1 billion per life saved but many orders of magnitude below that. Imposing consistency across the different domains in which we make decisions will lead to inordinately high safety expenditures on an individual basis if government risk regulations are excessively stringent. People would clearly reject such personal protection expenditures as being not reflective of their preferences. However, since the spending of tax receipts is often not seen by the individual as spending his or her money, he or she might be willing that such money should be spent on saving other people’s lives, even though he wouldn’t be willing to spend that amount of his own money on saving his own life; this might be called a model of tax-illusion altruism.

This useful yardstick for the cutoffs for government risk reduction policies is to go back to the underlying risk preferences of the individual. By posing the question of how a government risk–money tradeoff would translate into private protective actions, one can confront the extent to which these decisions diverge from the preferences that people display in their own risk-taking decisions. Moreover, they highlight potential inefficiencies of government policy. If in fact private preferences are substantially out of line with the tradeoffs reflected in government decisions, then it suggests that a potentially productive mechanism for government action might be to provide subsidies or other incentives to increase the degree of care in these private decisions since they could reduce risks more cost effectively than government efforts that have considerably higher implicit values for life saved.

Policy performance has fallen well short of what might be achieved through more effective targeting of risk reduction resources. Many risks are under-regulated, while other risks are greatly over-regulated because the focus has seldom been on achieving the greatest risk reduction possible for the funds expended. In the United States, for example, there tends to be under-regulation of transport-
tion risks and of many carcinogenic hazards, which may not be regulated at all. Cancer risks that have eventually been identified for regulation are often subject to very stringent regulatory targets once the risks are regulated. The previous pattern of under-regulation is followed by over-regulation for those risks that have been explicitly identified for regulation.

If the lifesaving consequences of regulation are the only benefits derived from the regulatory activity, then the objective should be to equalize the marginal cost per life saved across all regulatory efforts. Doing so would reallocate societal resources toward their most effective ends and would save the greatest number of lives for any given expenditure of money.

6. RISK-RISK ANALYSIS. Ineffective regulatory policies are wasteful of societal resources and sacrifice opportunities to use these resources productively in order to save lives with programmes that are more effective. There may be an additional cost of a health-related nature as well. The adverse risk consequences of efforts designed to reduce risk are known as risk-risk tradeoffs. A variety of forms of risk-risk analysis have arisen that highlight some of the fundamental tradeoffs that arise within the context of lifesaving policies.

The first category of effects consists of various substitutability risks. If seatbelts are installed in cars, some economists have found evidence that people tend to drive faster, creating greater risks for pedestrians, motorcyclists and other vehicles. The advent of safety caps to protect children from opening prescription drugs and other risky products has led to parents being more lax about access to these products, thus increasing the risk of poisoning. A recent policy controversy arose with respect to whether a car's seat should be required to be belted in a seat on the plane or whether they can ride in their parents' laps. The belted seat arrangement is safer, but it raises the cost of plane travel to less affluent families, leading more of them to travel by car, which imposes greater risks. The most prominent recent example of risk-risk tradeoffs is that airbags in automobiles cause fatalities to some occupants, particularly those who are short or elderly.

These various kinds of risk offsets require that one should assess the total net mortality effects of the regulatory effort rather than the direct effects alone. In the case of airbags, for example, the net mortality reduction from airbags appears to be favourable, even taking into account the lives that are killed by airbags. Properly identifying the competing effects not only makes the basis for judging the regulation more sensible, but it may also highlight potential mechanisms for improving the performance of the regulation. A recognition of the harm caused by airbags has led to a change in the airbag standard so that these mechanisms should impose less deleterious consequences than the current airbag design.

A second risk-risk tradeoff arises because economic activity is risky. Regulations that require economic production efforts, such as the manufacture of pollution control equipment, will generate some kinds of risks simply because all manufacturing activities are dangerous. If the regulatory effort is extremely ineffective, there is the potential for these effects actually to outweigh the regulation's beneficial consequence. An extreme example is that a regulation requiring digging ditches and filling them back up again will generate risks with no offsetting benefits. Very ineffective risk regulations could similarly have an adverse effect.

The final and potentially most important and controversial risk-risk tradeoff arises because of the role of affluence and its relationship to risk. Put simply, richer people are healthier. They are able to spend more money on health-enhancing goods, such as medical care, a good diet and an unpolluted living environment. Regulations cost society money and represent a real opportunity cost in that they take money away from the usual consumption uses. Several analysts have suggested that these opportunity costs may be substantial. Both a US Federal judge and officials of the US Office of Management and Budget (OMB) have raised this implication of regulations as an important economic concern. Consequently, extremely ineffective regulations can kill more people than they save by diverting resources from other activities that are more health-enhancing, such as the usual basket of consumer goods.

There remains substantial debate over the magnitude of this tradeoff. How many resources must be diverted needlessly to lead to one statistical death? In our private decisions to reduce risk we will not make expenditures unless they are beneficial on balance. Counterproductive risk efforts that cost us money will not be desirable. As a result, the implicit value of saving lives derived from individual risk-averting decisions will necessarily be below the expenditure level that leads to the loss of a statistical life. Thus, a $5 million value of life for prevention could not prevail if an expenditure of $4 million to save a statistical life diverted sufficient resources from health care and other areas to lend to the loss of a statistical life. Otherwise, such lifesaving efforts would not even be a break-even proposition.

7. CONCLUSION. Notwithstanding the substantial regulatory expenditures on lifesaving activities, more progress needs to be made. In addition to the open ethical issues with respect to the value of life, the efficacy of policies could be improved as well. It is, for example, particularly disturbing that there are often waves of risks that are discovered too late. The epidemic of asbestos-related cancers is perhaps the most prominent, as it gave rise to hundreds of thousands of court cases and worker cancer cases.

Other problems are evidenced as well. More familiar risks such as the hazards of food poisoning often receive scant attention compared to the efforts to eliminate microscopic contingencies that we may face, such as newly identified but not particularly potent carcinogens. Objective assessment and evaluation of these risks in a manner that reflects the preferences of the citizens to be protected provide two of the key components for a more effective risk-reduction policy.

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See also ATTITUDES TOWARDS RISK; AUTOMOBILE ACCIDENTS, INSURANCE AND TORT LIABILITY; CONTINGENT VALUATION;
vertical mergers and monopoly leverage. In the Griffith case, the US Supreme Court suggested that monopoly power can be used to 'foreclose competition, to gain a competitive advantage, or to destroy a competitor'. In economic terms, these early opponents of vertical integration claimed that vertical integration by an input monopolist permits the monopolist to leverage his input monopoly to achieve a second monopoly in the output market. They believed that a firm could carry out this leverage strategy by refusing to sell the input to its downstream competitors or by charging them a discriminatory high price. This same leverage theory (and the single monopoly profit critique) could also be applied to other vertical restraints, such as tying and exclusive dealing, that are said to lead to de facto vertical integration 'by contract'. Thus, even if the upstream monopoly was 'legitimate' (i.e., achieved by superior skill, foresight and industry, or luck), its conduct must be regulated in order to prevent the firm from extending its monopoly into a second market.

Chicago School critics such as Bork (1978) and Bowman (1957) argued that anti-competitive leverage would never occur. An upstream (input market) monopolist would have no motive to integrate in order to discriminate against downstream (output market) rivals. This is because an upstream monopolist that vertically integrates into the downstream market would not find it profitable to refuse to deal or price discriminate against its downstream rivals.

Why not? The answer does not rest on ethics. Instead, according to the Chicago School, there is no economic incentive because vertical integration is not necessary to capture the monopoly profits. Instead, a standalone (unintegrated) upstream monopolist can capture all of the monopoly profits simply by pricing the input that it sells to the downstream firms at the monopoly level.

In short, the Chicago School critics state that there is a 'single' monopoly profit that can be extracted by the monopolist only once. It is not profitable to leverage this power by vertical integration to create a second monopoly. It thus follows, say the Chicago School critics, that vertical integration and contractual vertical restraints must be motivated by efficiency concerns - because there can be no logical anticompetitive motive.

NUMERICAL EXAMPLE OF THE SINGLE MONOPOLY PROFIT CRITIQUE. The Chicago School critics' analysis is easy to illustrate with a numerical example. Suppose that an upstream monopolist is selling an input to a set of homogeneous buyers who then compete in a perfectly competitive downstream (output) market. Suppose that the monopolist's input is used in 'fixed proportions' with other inputs; that is, suppose that every unit of output produced by the downstream sellers requires a constant number of units of each input, including the input sold by the monopolist (e.g., every automobile requires one battery and four tyres). Suppose that the downstream firms each have constant marginal costs equal to $10, plus the cost of the input that they buy from the monopolist. Suppose further that the monopolist's own marginal cost of the input equals $40 and, if it integrated into the output market, its downstream marginal costs would be $10, the same as the standalone downstream firms.

Now, consider the profitability of vertical integration. If the monopolist were to integrate vertically into the downstream product and refuse to deal with any of the other firms, it would capture the entire downstream output market. What price would it charge for its output? Obviously, it would sell the product at the monopoly price. Suppose the monopoly output price were $100. If so, the vertically integrated monopolist would earn profits of $50 per unit (i.e., $100 - 40 - 10). This is the vertically integrated monopoly profit level.

It is now straightforward to see the single-monopoly-profit critique of leverage. Suppose that the antitrust laws or particular regulations were to prevent the input monopolist from integrating vertically. Suppose instead that it is limited to just its upstream monopoly. Will that reduce its profits? Will consumers be benefited?

The answer depends on the price it charges for the input. Suppose that the monopolist prices the input at its marginal input costs of $40. In that case, the downstream firms' marginal costs would equal $50 (i.e., $40 + $10). Because the downstream firms are perfectly competitive, the competitive downstream price will equal their aggregate marginal cost. (At a higher price, the firms would compete until the price was driven down; at any lower price, the firms would lose money and exit from the market.) Thus, if the monopolist charges $40 for the input, the downstream equilibrium price will be $50.