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THE VALUE OF LIFE

LEWIS A. KORNHAUSER

In "Natural Law and Legal Reasoning," John Finnis contends, first, that rationality does not dictate a unique resolution of a conflict among incommensurable values though it may distinguish acceptable from unacceptable outcomes; second, that, in cases of first impression, the law may resolve these conflicts as it pleases; but third, that, once a legal decision has been rendered, consistency, or, to use Dworkin's term, integrity, requires that society adhere to its prior resolution of this conflict between competing values. This comment elaborates some of the constraints that this third requirement of consistency imposes on federal health and safety regulation.

Many, if not most, regulations promulgated by federal agencies affect the survival chances of many individuals. For many of these regulations, Executive Order 12291 requires that the agency adopt the regulation dictated by a cost-benefit analysis. Thus, the grounds of choice apparently require the agency to "value" life and then to weigh lives saved against the monetary costs.

Commentators often condemn as inconsistent federal health and safety policy because different agencies have imputed different values to lives saved. This comment asks, in the context of cost-benefit analysis, what consistency requires. How much variation, if any, in valuation of life is justifiable? Inevitably, questions concerning the moral foundations of economic valuations of life will arise.

Section 1 presents some evidence of variation among agency and academic valuations of life. It also outlines three different approaches to evaluation of health and safety projects. These approaches differ along two dimensions: an approach may be wealth-based or preference-based and it may be more or less "aggregated." The variation detailed at the outset of section 1 is among aggregate, preference-based values of life.
The subsequent discussion argues for the following claims. First, the most justifiable, "economic" approach to the evaluation of health and safety regulation is a highly disaggregated, preference-based one. Put differently, the observed variation in the value of life can be explained at least in part⁵ and, further, should have no normative significance. The value of life as usually calculated provides an inadequate and inappropriate summary statistic on which to make decisions concerning the prevention of risks to life.

Second, even the most acceptable of the commonly used preference-based approaches has several counterintuitive policy implications, the most dramatic of which are: (a) It favors the lives of the rich over the lives of the poor; (b) it favors "acute" over "preventive" interventions; (c) on plausible assumptions, it favors the aged over the young; and (d) it will often recommend policies that do not maximize the number of lives saved for a given expenditure. The wealth bias, and in part the age bias, can be avoided by using "hypothetical" preferences normalized to some wealth standard; section 3 suggests a simple, and implementable procedure, of normalization. Adjusting for wealth differences, however, does not alter conclusions (b) or (d).

Discussion of each of the four biases has already appeared at one place or another in the already extant and extensive literature on the problems of valuing life,⁶ though I am not aware of any prior suggestion of the obvious means to eliminate wealth bias. Only the gravity of the issues and the ease with which policy may err on this issue justify the rehearsal of the topic and uniting these various strands of criticism.

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⁵ That is, economic theory itself predicts that the aggregate measures that the agencies purport to use will impute different values to life in different contexts. Theory, of course, may not explain the actual variation observed; such an explanation would require an examination of the actual procedures and data used by the agencies, a study I have not undertaken.

⁶ The literature on valuing life is vast. Zeckhauser, Procedures for Valuing Lives, 23 PUBLIC POLICY 419-64 (1975), provides a survey of some of the earlier studies. Schelling, T.C., The Life You Save May Be Your Own, PROBLEMS IN PUBLIC EXPENDITURE ANALYSIS 127 (S. Chase, Jr. ed. 1968), was an early advocate of preference-based measures. Fried, The Value of Life, 82 HARV. L. REV. 1415-37 (1969), was, to my knowledge, the first to examine the different attitudes towards identified and statistical lives. Because many of the issues that arise in evaluating survival risks also arise in other contexts, the general literature on cost-benefit analysis bears on the discussion. A comprehensive introduction to cost-benefit analysis is MISHAN, COST-BENEFIT ANALYSIS (1971). In the legal literature, much of the debate over cost-benefit analysis has focussed on the offer/asking price problem, discussed briefly infra at section 1.22. The policy implications of cost-benefit analysis that I emphasize do not depend on which measure one adopts. For discussion of this problem see Kennedy, Cost-Benefit Analysis of Entitlement Problems: A Critique, 33 STAN. L. REV. 387 (1981) and Markovits, Duncan's Do Nots: Cost Benefit Analysis and the Determination of Legal Entitlements, 36 STAN. L. REV. 1169 (1986).

Also, I consider the choice of ex ante regulatory rules and not the problems of ex post compensation presented by tort law. For a helpful discussion of this problem, see Arlen, An Economic Analysis of Tort Damages for Wrongful Death, 60 N.Y.U. L. REV. 1113 (1985).
1. Some preliminaries.

1.1 The Range of Economic Estimates of the Value of Life.

1.11 The Variation in Agency Valuations of Life. Virtually every social decision implicitly places a monetary value on a life, or more precisely, on the reduction in the risk of loss of life. Regulations that establish standards for safe consumer products, safe drugs, safe workplaces, ambient air quality, water quality, or highway safety do not insist that the product cause no injuries, the drug no deaths, the workplace no accidents, air and water pollution no disease. At some point the administrative agency acknowledges that an additional reduction in the risk of death does not warrant the additional cost. From this we may calculate the agency's implicit valuation of a life.

When we do so, we discover wide variation within and across agencies. A 1981 study calculated the median value of a life used by several federal agencies. These medians ranged from $50,000 by the Consumer Product Safety Commission and $64,000 by the National Highway Traffic Safety Commission to $2.6 million by the EPA and $12.1 million dollars by OSHA.

Another study calculated a range of $70,000 used by the Consumer Product Safety Commission ("CPSC") in 1980, in regulations concerning space heaters, to $132 million used by the FDA in banning DES from cattle feed. The variation in these valuations is staggering; the CPSC and the FDA measures differ by a factor of roughly 2000, while, in the prior study, OSHA imputed a value to life roughly 240 times greater than that used by CPSC.

1.12 The Variation in Academic Valuations of Life.

The economic literature also contains numerous efforts to estimate the value of life. These studies also exhibit a wide variation, though not as wide as that found in agency practice.

One academic study determined that individuals who voluntarily accept high risks value their lives at $600,000 while involuntary and remote risks are valued at $7,000,000.

One commentator contends that the variations in these estimates reflect only the inability of individuals to discriminate among risks smaller than .001. Consequently, the estimates for small risks inflate the value of life V estimated from larger risks by a factor (.001/r) yielding an excessive valuation V' = (.001V/r).
1.2 Measures of the Value of Life.

Economists have used several distinct methods for the evaluation of projects that affect the survival prospects of some population. I shall discuss three: (1) human capital, (2) "consumer preference" valuations of specific risks, and (3) valuations of life based on (2). A general consensus has now emerged that the human capital approach is inferior to the other two, preference-based methods of valuation.

1.21 The Human Capital Approach. The human capital approach identifies the value of an individual's life with the expected discounted present value of her future stream of earnings. In one sense, this approach measures lost income rather than lost life; it establishes a reasonable price for the difficult-to-imagine contingency in which an individual loses all opportunity to earn an income but otherwise remains healthy and immured in her social situation. In another sense, the human capital measure "captures" the "social" value of the individual's life as it measures her productive capacity.

Two features of the human capital measure might introduce some variation in the estimated value of life. First, the method discounts future income with respect to both time and survival prospects. Thus, a 10% reduction in the risk of death in year 1 increases human capital more than a 10% reduction in the risk of death in year 2 (or any other later year). Thus, the appropriate valuation of a life depends on the particular project. Put differently, a cost-benefit comparison of various projects ought not compare them on the basis of lives saved weighted by some independent value of life; rather, projects would be ranked in terms of the net change in human capital.

Second, the value of life will vary from individual to individual because different individuals face different streams of expected income. Expected income might vary because the individuals face different streams of expected income or because, though facing the same prospects of survival, they have different employment and earnings prospects. Consider the latter case in which each individual in a population of one thousand has different earning prospects. Suppose further that each individual in the group faces an identical risk of death. The population now considers undertaking a proj-

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1 I use "consumer preference" to designate the two "willingness-to-expend" approaches called "willingness-to-pay" and "willingness-to-accept" (or, respectively, "compensating variation" and "equivalent variation"; or, again, "offer price" and "asking price"). For a discussion of the distinction between these two consumer preference approaches see text at notes 18 - 21 infra.

2 Even interpreted in this fashion, the approach ignores any value the individual may place on work itself or the status (or dignity) that being an income earner affords in contemporary society.

3 A variant on this approach explicitly identifies the value of the individual's life with her net social product; thus it sets $V_{NP} = V_{HC} - C$ where $V_{HC}$ is the value of the individual's life measured in terms of her human capital and $C$ is the individual's consumption.

4 In general, the expected value of the future stream of income will depend on the survival prospect $\pi$, in each year $i$; the human capital measure will thus be a function of the vector $(\pi)$. 
ect that will reduce the risk of death to each of them by some small amount. How ought the “society” value this project? On the human capital approach, society ought to calculate the change in human capital to each individual and then sum them. Alternatively, it might determine the average human capital of the population and multiply by a thousand, the population size. Generally, the “value of a life” has this statistical sense; it summarizes some data specific to a given project proposed for an identified population.16

1.22 Preference-Based, Project Specific Measures. Human capital measures of the value of life ignore the “consumer’s” perspective; how much an individual values her life will generally differ from the expected discounted present value of her future income.17 Human capital therefore seems to underestimate the value of a life just as the price of an ordinary commodity understates its “value” or “willingness to pay” of the consumer. Welfare economics thus recommends that the evaluation of a project that reduces an individual’s risk of death by \( \pi \), include as a benefit the individual’s willingness to pay for such a reduction.

To understand the consumer preference approach, we may usefully assume that people have preferences over triples \((m, p, \delta)\) where \(m\) is the individual’s wealth, \(p\) the background risk, and \(\delta\) the change in risk facing an individual.18 Our intuitions suggest that these preferences satisfy:

16 The value of the summary statistic does not depend on the text’s assumptions that individuals face identical pre-project survival prospects and that the project benefits each identically. For further discussion see section 2.2.

17 The relation of the value of life measured as human capital and its value in terms of willingness to pay (discussed below) has been much debated. On this issue see Bergstrom, When is a Man’s Life Worth More than his Human Capital? in THE VALUE OF LIFE AND SAFETY 3-26 (1982) and Linnerooth, The Value of Human Life: A Review of the Models, 17 ECON. INQUIRY 52 (1979).

If perfect capital markets exist, intuition suggests that the willingness-to-pay measure should always exceed a measure based on the change in the individual’s human capital. Consider, for example, some capital good. i’s willingness-to-pay should equal the discounted present value of the stream of income associated with that capital good. Suppose the owner of the capital good learns of some threat to its continued operation; the owner’s willingness-to-pay to avoid that threat should equal the difference in the present value of the stream of income discounted by the likelihood of the threat’s realization. Now suppose that the capital good also provides some consumption value to the owner. Then her willingness-to-pay should exceed the discounted value of the stream of income. (Education may be an example of this phenomenon.) When i’s life is threatened, her income stream is threatened as well; she should therefore be willing to pay at least the (discounted) value of the (human) capital good at which the threat is aimed.

18 More commonly, economists assume that individuals have preferences that can be represented by utility functions of the form \(U(\pi, w) = \pi u(w)\) where \(\pi\) is survival probability and \(w\) is wealth (and implicitly the “utility” of death is 0). Sometimes \(U\) is understood as a von Neumann-Morgenstern utility function. The text “breaks out” the change in risk for expository purposes only. If the preferences in the text met the condition that for all \(m, p, \delta, [p + \delta = p' + \delta']\) implies \([m, p, \delta]\) is indifferent to \([m, p', \delta']\) then the exposition in the text could be derived from the standard model. Some models of individual choice such as prospect theory (Kahneman and Tversky) will violate the above condition because an individual may, in these models, exhibit a preference for the status quo or different attitudes towards gains and losses.
(1) \((m,p,\delta)\) is preferred to \((m,p',\delta)\) for \(p < p'\);

(2) \((m,p,\delta)\) is preferred to \((m,p,\delta')\) for \(0 < \delta < \delta'\);

(3) \((m,p,\delta)\) is preferred to \((m',p,\delta)\) for \(m > m'\).

Suppose we can represent these preferences with a utility function \(U(m,p,\delta)\) such that \(U(m,p,\delta) > U(m',p',\delta')\) if and only if \((m,p,\delta)\) is preferred to \((m',p',\delta')\).

From this information about preferences, one may impute a monetary value to the risks presented (or prevented) by any given project. At the outset, one must distinguish two distinct methods of monetary valuation, willingness-to-pay versus willingness-to-accept, which correspond to the assignment of an entitlement. To understand this point, consider a proposed project that promises to reduce by \(\delta\) each individual \(i\)'s risk of death (in a population of 1000 persons). Assume also that each \(i\) has wealth \(m\) and “but-for” \(\delta\), the background risk is \(p\). Normally, the risk \(\delta\) arises because the activities of others expose the population to this risk. Each \(i\)'s evaluation of this risk in monetary terms may depend on how society “assigns the entitlement” to the risk. If society believes that \(i\) has a right to be free of the risk \(\delta\), then the generator of the risk must buy the rights of the population (including \(i\)) put at risk. Thus the risk generator must pay to each person \(i\) exposed to the risk some sum at least as great as \(w_{ia}\), the willingness-to-accept, defined by

\[ U_i(m,p,\delta) = U(m + w_{ia},p,\delta). \]

The payment \(w_{ia}\) would just induce \(i\) to accept the additional risk of death.

On the other hand, if \(i\) has no right to be free of this risk, then the population at risk, including \(i\), must “purchase” the risk reduction \(\delta\) from the risk generator. Thus, each \(i\) will offer no more than \(w_{ip}\), \(i\)'s willingness-to-pay, defined by

\[ U_i(m,p,\delta) = U(m-w_{ip},p,0). \]

As \(i\) is “wealthier” when she owns the entitlement, one would expect that for each individual \(w_{ia} > w_{ip}\). From a social point of view, the benefits (or costs) equal the sum of the benefits to each individual. Thus, one can define the social willingness to pay and willingness-to-accept by

\[ W_p = \sum w_{ip} < \sum w_{ia} = W_a. \]

Four features of this procedure merit comment. First, both measures of the costs and benefits are project-specific. A different project may offer a different reduction in risk. If we consider two projects in sequence, the order in which they are considered might matter because the first project, if implemented, reduces the background risk \(p\) against which the second project might be measured. Second, as each individual’s valuation of a risk on this method depends on her wealth, the social measure will vary both with the total wealth in the population and with the distribution of that wealth. Third, the dependence of the valuation on the individual implies that the social valuation of the risk may depend on the population threatened. For example, suppose society must place a hazardous waste site either at \(X\) or at \(Y\). Populations of identical size will be exposed to an identical change in risk (from an identical baseline). The population at \(X\) may differ systematically in its valuation of the risk from the pop-
ulation at Y perhaps because the population at X is poorer than the population at Y or perhaps because of different demographic characteristics of the population such as age. Finally, because $W_p < W_a$, the assignment of entitlement may determine whether a project goes forward or not.

1.23 “Aggregate” Values of Life. The values of life listed at the outset of this section are generally calculated from these willingness-to-expend valuations. The values of life calculated from these measures may easily vary because, as noted above, $W_p$ and $W_a$ depend on the background risk, the promised risk reduction, and characteristics of the population at risk. An example will clarify the importance of this dependence. Suppose that Eve would pay $50 to avoid a .00001 increase in the risk of death she faces. Standard methodology calculates the value of life as $50/.00001 = $5,000,000. The methodology thus assumes that Eve values every .00001 increase in risk identically, whether it is a change from .99999 to 1.0000 or a change from .00001 to .00002.19

This assumption of linearity is clearly false; individual valuations of changes in risk will vary with the background risk that is modified. Suppose the background risk is $p$ and that society faces risks from two different activities. The risk from activity 1 can be reduced to $\pi$ and the risk of activity 2 to $\pi'$. If $\pi < \pi'$, we would expect that valuation of life derived from activity 2 to exceed the valuation of life derived from activity 1 (and that more dollars would be spent to reduce the risk from activity 2 than to reduce it from activity 1).20

Those academic studies that estimate a value of life on the basis of occupational data have adopted a willingness-to-accept measure of the value of a risk. If two occupations A and B are identical except that occupation A presents an additional risk of death $\delta$, then employers must offer workers a wage premium to induce them to accept the higher risk.21

19 The literature recognizes the oddity of this assumption and consequently will identify the valuation as a collective valuation of the risk or how much money the exposed group must receive to compensate for the exposure. This formulation should make one more hesitant to transport the valuation of a given risk in a specified group to the valuation of an “equal risk” in a different group but it remains subject to the main criticism of the text that the valuation will be dependent on the background risk that individuals face.

20 The argument runs as follows. Each individual will be willing to pay less to reduce the risk at $\pi$ an infinitesimal amount than she would pay to make the same infinitesimal reduction from $\pi'$. Thus, the valuation of the risk of activity 1 will attribute a lower value of life than that calculated from the risk reduction for activity 2.

21 Empirical studies have generally relied on one of two techniques to measure actual willingness-to-pay or willingness-to-accept. The text refers to a hedonic price method that infers the valuation individuals place on life from data on occupational risks and wages. This method regards each occupation as a complex of characteristics such as, for example, risk of death, quality of working conditions, flexibility in hours, and prestige. The method then attempts to determine how the market values the underlying characteristics from the differing values placed on occupations. For a general review, see, e.g., Smith, Compensating Wage Differentials and Public Policy: A Review, 32 INDUS. & LAB. REL. REV. 339 (1979).
2. Choosing among Measures.

The previous section offered three distinct methods of evaluation of public projects that altered the survival prospects of the population. These methods differed along two dimensions. First, the human capital approach sought to maximize wealth while the other approaches strove to maximize welfare. Second, the approaches differed in their level of aggregation. Each method begins by calculating for each individual within the relevant population some measure of the survival benefits of a proposed project. Two different aggregative steps may then be made: one might calculate a project-specific summary statistic (such as \( W_i \)) or one might employ a measure that applies across projects. The "value-of-life" approach takes both steps. It apparently purports to identify a value of life that applies to each individual and across all projects. The willingness-to-pay (and willingness-to-accept) approaches take only the first step; they compare projects before a given population at a given time on the basis of a summary statistic, \( W_i \). The least aggregative approach would compare projects on the basis of the distribution of the individual valuations calculated at the outset.

In this section, I shall first argue briefly that the appeal of wealth measures derives from an assumed, but weak, connection to consumer


Two difficulties of the hedonic price method bear mention. First, different members of the population may value the risk differently. Suppose we ordered these from the lowest to the highest valuation. Estimation by wage differential takes the valuation of the marginal worker, the wage necessary to attract the last worker desired by the firm to the risk. All other workers in the risky industry place no higher value on the risk and no non-worker in the industry places as low a value on the risk. The valuation of the marginal worker may be appropriate for "voluntary" risks such as those at issue in labor markets but it hardly seems appropriate for "involuntary" risks to which some population may be subjected by the "tortious" actions of a third party.

Second, workers may differ in their initial wealths and their initial background risks as well as in their underlying preferences. Any estimation technique assumes a specific functional relation among these variations in wealth, background risk, and the additional risks posed by the various occupations. The assumed relation is often linear but the actual relation, it was argued earlier, is non-linear.

The labelling is somewhat deceptive here. The aggregation is not strictly by project but by "opportunity" where an opportunity is defined by the population profile of initial wealths and survival prospects \((m_i, pi)\). Society must now choose among various changes to this initial state. These changes might be defined by the vector \((6_i)\) of changes in survival prospects of each person and \(C\), the cost of the program.

As the discussion in this paragraph suggests, section 1 did not offer an exhaustive range of valuation methods. The human capital approach is amenable to implementation at each of the three levels of aggregation suggested and implicitly illustrated by the consumer preference model.

The text does not consider a fourth method in which society takes the second but not the first aggregative step. That is, one might attribute to each individual a value of life that was independent of the project under consideration but then fail to aggregate across individuals.
preference. I shall then investigate the appeal of each aggregative step; this inquiry shall itself question the legitimacy of the willingness-to-expend measures.

2.1 Criteria of Choice among Measures.

Two distinct concerns animate the selection of a measure: ethical desirability and implementation. As the subsequent discussion will suggest, the ethical appeal of "consumer preference" methods of evaluation rests on the commonplace that government should adopt programs that improve the welfare of its citizens. This commonplace, however, may have two distinct analytic foundations: welfare and consent. Individual welfare might be important per se, regardless of the attitudes of the individuals themselves. Alternatively, the justification for government promotion of individual welfare might be consent; health and safety regulations should mandate those programs that the citizenry itself would adopt.24 Welfare and consent justifications run together because we often infer an individual's consent to an action from the observation that the action promotes her welfare.

Administrative agencies, however, are not philosophy departments; they must promulgate rules and regulations in a finite amount of time. This practical consideration pushes a policymaker towards simpler procedures and aggregate measures for two reasons. In some instances, the aggregate measure may be more easily determined than the full range of individual evaluations. More importantly, aggregation facilitates delegation or decentralization. Social preferences that depend only on the aggregate measure will be more simply communicated to the party that actually decides. Similarly, society may have greater faith that its delegates will conform to straightforward sets of instructions than to complex ones. When the aggregation occurs across projects as well as across individuals, the measure serves to "coordinate" the decisions of different policymakers.

Ease of implementation rather than any ethical attribute recommends the human capital method of evaluation of life. The fundamental assumption of welfare economics asserts that social choice should depend (only) on the welfare of those within the society. The human capital method relies not on welfare but on wealth. Individual welfare may (in general) increase with wealth but wealth serves at best as a poor proxy for welfare.

Roughly ten years ago, Richard Posner argued, first on consequentialist25 and then on consensual26 grounds, that policymakers

24 This criterion, "what the citizenry would adopt", is not obviously equivalent to consent. Consent suggests unanimity while adoption might occur on the basis of majority rule (or willingness to expend). Criteria of adoption weaker than unanimity, however, are often justified by "upping the ex ante." The weaker criterion of adoption is itself justified by assuming that, under suitable conditions of uncertainty, the population would have unanimously consented to the given procedure.


ought to choose those legal rules that maximize wealth. That claim stirred a tempest greater than the merits of the claim warranted and I shall not rehearse the arguments made then. Throughout the rest of section 2, I shall assume that the evaluation method employs consumer preference.

2.2 Aggregation Across Individuals.

Consider a society of one thousand equally wealthy individuals, each of whom faces identical survival prospects. Society must now decide whether to pursue (at a known cost C) a specific project A that will increase each individual’s survival prospects equally. Take an aggregate measure W of “consumer” preference for this project. At first glance, W is a useful statistic for a decisionmaker. If W, the willingness-to-expend, is less than the cost C of the program, the policymaker has reason to forego the project. Or, if the policymaker faces a choice among several projects k with different costs Ck, different (uniform) changes δk in survival prospects, and consequently different willingnesses-to-expend Wk, then the criterion which choose that project with the highest ratio Wk/Ck of benefits to costs is one that the population itself might have chosen to govern their choice.

The argument from consent, however, is flawed. In this context, an argument from consent has an initial plausibility because individuals receive equal benefits and begin materially equal (where “material” refers to both wealth and survival prospects). The gap in the argument corresponds to the gap in the description of the policy; I have not stated how the cost Ck will be allocated among the individuals. Given the equal...

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27 See generally, Symposium on Efficiency as a Legal Concern, 8 Hofstra L. Rev. 485 (1980).

28 I do not address two more fundamental and perplexing issues. First, I take the relevant population as given. Any account of social policy based on individual preferences must identify whose preferences count. Each specific policy identifies two potentially distinct sets of individuals as candidates for the relevant population: (a) those individuals whose survival risks are altered by the policy and (b) those individuals who pay for or otherwise bear the economic costs of implementation. Current social policy practice does not necessarily adopt either of these two populations. Many policies concerning air quality, for example, impose risks on individuals outside the borders of the United States and social policy may not consider the risks imposed on these individuals. Similarly, many policies affect survival risks only locally though the costs are spread more widely.

Second, I do not defend the fundamental proposition that social policy should be grounded solely on individual preferences. This proposition has been attacked; indeed some of the arguments in later sections, especially section 5 infra suggest that straightforward reliance on individual preferences will result in adoption of undesirable policies.

Finally, I ignore a third complication. In most instances, a given policy affects not only survival risks (or mortality rates) but also morbidity rates. Much of the discussion of mortality should carry over with little alteration to morbidity but I have not pursued those instances where deviations in the analysis might occur. Section 4.1 infra touches on this issue glancingly.

29 That is, society uses either willingness-to-pay W or willingness-to-accept W. Note that on the assumptions thus far, individuals only differ in their preferences; that is, if we randomly choose two individuals i and j from the population, their preferences w, and w, may differ.
material circumstances of the actors, many readers implicitly assume that the cost will be shared equally. But an equal allocation of costs implies an *unequal* distribution of net benefits \((w_i - c_i)\). Those persons reasonably indifferent to the reduction \(\delta\) will have low net benefits relative to those who care greatly about \(\delta\). Note that, under an equal cost allocation, some individuals may actually suffer a *loss* in net welfare. Such individuals, of course, should not be assumed to consent to the project.\(^{30}\)

One can attempt to resurrect the consent argument with the contention that the population would have consented to the consumer preference criterion of choice. The argument for consent here, however, assumes that, at the time the population adopts the cost-benefit criterion, each individual thinks herself equally likely to profit highly from project evaluation under the criterion.

The hypothetical just discussed provides the most favorable context for use of a summary statistic on consumer preference to choose among projects. The case for use of a summary statistic is shaky even there, resting either on the inherent value of welfare maximization or on a somewhat dubious consent argument. Nonetheless, a brief examination of the use of a summary statistic in more realistic contexts has some interest.

Suppose that individuals differ in their wealths but that they still face identical pre-project survival prospects and that society considers only uniform projects. The aggregate measure \(W\) retains its prior attractiveness though society may perhaps now have to attend more to the method of cost allocation. Indeed, two hypotheticals reveal that the two uniformity assumptions on risk have the same consensual force as the uniform wealth assumption.

(1) Assume as before that each individual faces identical pre-project survival prospects. The group must choose between two projects. Project A benefits each individual identically; suppose the mean “consumer preference” for A is \(W_A\). Project B will be more beneficial to an identified group of 700 and less beneficial to an identified group of 300; its mean consumer preference is \(W_B\). The fact \((W_B > W_A)\) seems no longer sufficient to choose project B over project A. The argument from consent encounters the same difficulty faced earlier. Some people prefer project A to B because A offers them greater benefits. Of course, as long as project B offers each person some (net) benefit, then each person has *some* reason to accept B rather than A and hence might be said to consent to B. If, however, some of those 300 individuals suffer net losses from B, they have no reason to consent to it.

(2) Assume now that individuals differ in their pre-project survival prospects. Society again considers projects A and B from before with the smaller group of 300 consisting of those with the most favorable pre-project survival prospects. Now the fact \((W_B < W_A)\) seems no longer suf-

\(^{30}\) This argument parallels traditional arguments in public finance. One should not be surprised that the consent to a given pattern of benefits will depend on the incidence of costs borne to achieve those benefits.
cient to choose project A over project B. This hypothetical case suggests that society may care about the distribution of post-project survival prospects. Project A yields greater welfare measured in terms of willingness-to-expend but exacerbates pre-existing differences in survival prospects. Society may find this effect unacceptable, particularly if the pre-existing differences are correlated with wealth or race.

2.3 Aggregation across Projects.

The variation in the values of life used by various federal agencies has prompted much criticism. Implicitly, critics advocate that all projects (or project opportunities) employ a uniform value of a “statistical” life. As consumer preference methods of evaluation of risks depend on both the background risk and the extent of the proposed change, such uniformity seems inconsistent with a consumer preference methodology of evaluation.

Two distinct motivations might underlie this drive for uniformity. First, it might be understood as necessary to maximize the number of lives saved. This objective will be discussed at length in section 4. Alternatively, uniformity might be justified as a coordination device. Ideally, society would evaluate all health and safety programs together. It would rank them in order of desirability and then implement them in that order as funds became available. Under current policy, however, different agencies have responsibility for different types of risk. EPA concerns itself with air, water, and ground pollution; FDA regulates the quality of food and drugs; OSHA oversees workplace hazards; and so on. Does this diversity of decision makers require uniform valuation of risks to life to coordinate decisions?

The prior discussion suggests that use of a uniform value of life within an agency will be undesirable. Intra-agency coordination would be better done administratively than through “pricing” life. On the other hand, it is not clear what decisions across agencies a uniform price will coordinate. Full coordination would require the re-allocation of funds from one agency to another. Put differently, knowledge of the value of life used in the “marginal” decision of each agency might assist Congress when it determines agency budgets and when it evaluates agency performance.

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32 Of course, each agency should use a uniformly correct procedure for evaluating projects. As outlined so far, such a procedure will depend on the distribution of individual willingnesses-to-expend.

Some statutory schemes prevent an agency from evaluating all projects within its purview against the same standard. The EPA, for example, is required by Executive Order 12291 to apply cost-benefit analysis to regulations governing water quality but the Clean Air Act, 42 U.S.C. § 7607(d)(1) (Supp. U. 1981) proscribes consideration of economic costs.

33 Unless, of course, administrative reasons argue for intra-agency divisions of authority that remain autonomous.
3. The Wealth Bias in Preference-Based Measures.

Willingness-to-expend measures of the value of life deny (and the directive "maximize number of lives saved" accepts) two appealing criteria for social policy concerning survival risks: (1) the social valuation of a risk should depend only on the number, but not the identity, of those threatened; and (2) equal changes in risk should be valued equally (linearity).

Willingness-to-expend measures may violate the first criterion for two distinct reasons. As already noted, individuals with identical preferences but different wealth will value a specified risk differently. Equalizing wealth, or constructing an equal-wealth measure, corrects for this variation but the improved measure will not eliminate variations caused by differing preferences. Section 3.1 indicates how this bias arises and suggests a method of wealth-adjustment; section 3.2 asks whether, after adjustment for wealth, remaining variations in preference present problems for preference-based measures.

The second criterion imposes a condition on social preferences towards risk that runs counter to actual individual preferences. Individuals simply do not value identically all policies that yield an identical reduction in survival prospects. This aspect of individual preferences results in the bias towards acute interventions; conversely, this bias argues that this feature of individual preferences is not socially rational. Section 4 discusses some of these issues in the context of maximization of the number of lives saved. Section 6, however, raises the possibility that individual (and hence, on a willingness to expend approach, social) preferences might depend on features of the risk.

3.1 The Nature of the Bias.

The discussion in section 2.2 suggested that inequalities of wealth may undermine the attractiveness of an aggregate consumer preference method of evaluation because the inequality in wealth may decrease the likelihood that each individual receives positive net benefits. Inequality of wealth, however, presents another difficulty that also bears attention.

As already noted, willingness-to-expend depends on an individual's initial wealth. Suppose one believes, quite plausibly, that an individual's preference for survival is income-elastic, i.e. "increases" with income. Then any consumer preference approach will weight changes in survival prospects of the wealthy more heavily than changes in survival prospects of the poor. Such a bias may be socially unacceptable; if so, one might consider use of hypothetical consumer preferences based on some "acceptable" level of wealth.

Two baseline measures of wealth suggest themselves: the population median and the population mean. Choice of the population mean, or

34 Consider some individual. Now consider some willingness to expend measure, say \( w \), at two different levels of wealth \( m \) and \( m' \) with \( m > m' \). One may write, for some background risk \( p \) and change \( \delta \), \( U(m,p,0) = U(m+w(m),p,\delta) \) and

\[ U(m',p,0) = U(m' + w(m'),p,\delta) \]

Income elasticity means that, for every pair \((p,\delta)\), \( m > m' \) implies \( w(m) > w(m') \).
average wealth in the population, establishes a baseline based crudely on the social ability to pay. Choice of the population median, a level of wealth which exactly half the population exceeds, establishes, on reasonable assumptions, a baseline that reflects the wealth of the “average” person in society.\footnote{Distributions of wealth skew to the high end. Thus, the mean will in general exceed the median. If the wealth distribution remains unequal, it seems somewhat odd to base the decision on the preferences of a relatively “elite” group of individuals.}

Having chosen a baseline, the actual population with wealths near that baseline should provide a reasonable sample of the preferences of an entire population with that wealth.\footnote{One might have to adjust for underrepresentation of some demographic groups, such as blacks and women, with disproportionately low wealths.} The sample will provide an unbiased estimate as long as which set of preferences an individual has is uncorrelated with her wealth. An example of preferences that violate the condition of no correlation may clarify the concept. Consider the preferences of two individuals, say St. Francis of Assisi who shuns wealth and Donald Trump who revels in it. St. Francis is, because of his preferences, apt to be poor and Donald Trump, because of his preferences, is apt to be rich; consequently, the use of the preferences of those with the actual median wealth will not be an unbiased estimate of the population preferences (on the assumption that St. Francis and Trump also differ systematically in their attitudes towards risk of death).

3.2 Wealth-adjusted, Preference-based Measures.

Several potential problems may plague even a wealth-adjusted preference-based measure of risks to life. To evaluate these problems I shall assume that everyone in the relevant population has equal wealth. Individuals may favor different social policies, however, for one of two reasons: they may have different preferences towards risk; or social policy may affect their risks differently. Moreover, preferences towards risk may vary systematically or unsystematically with some other demographic characteristic.

Before addressing these three contingencies, I note a distinction between “voluntary” and “involuntary” risks.

3.21 Voluntary Risks Characterized. An individual, through her own acts, may avoid exposure to some risks entirely; exposure to other risks may be completely beyond the individual’s unilateral actions. Scaling 8000 meter peaks without oxygen presents risks that all but a few individuals avoid without regret. Individuals born with cystic fibrosis, a congenital disease, face a reduced life expectancy, regardless of their individual choices.\footnote{Of course, first their parents and then they may adopt courses of action that improve or reduce their life chances conditional on the congenital defect.} Most risks fall somewhere between these two extremes.

Product safety risks and occupational health and safety risks fall towards the voluntary end of the spectrum. Markets will often offer similar products that vary in risk;\footnote{Of course, regulation may limit the ability of markets to offer highly risky product variants.} presumably, safer product variants cost more
money. Alternatively, the service provided by the product may be understood as a luxury, or "unnecessary" so that the choice to consume the product is understood to include a choice to bear the associated risk. No one, for example, must ski; risks of ski injuries are therefore seen as voluntarily faced. Similarly, each occupation has a variety of characteristics including risks of death. A sufficiently rich range of available occupations includes, for any given risk of death, a set of occupations that varies broadly in other dimensions such as working conditions, challenge and prestige. Under these circumstances, higher wages will compensate for the higher risks associated with some occupations. The choice of occupation therefore includes a choice of risk.

Inequality of wealth, which this section has assumed away, complicates these assessments of voluntariness. An individual with many dependents and little "wealth" (including few marketable skills) may "willingly" undertake a risky occupation to support her family. Under these circumstances, her choice has a less voluntary air. On the other hand, this individual would, under these circumstances, hardly favor elimination of the risk as it would reduce her wage. When wealth is equally distributed, moreover, the choice of the high-risk, better paid occupation may simply reflect a taste for greater consumption.

Given the prior discussion, one may ask, why regulate voluntary risks? Several answers suggest themselves. First, individuals may not accurately perceive the risks to which they are subject. If some risks are underestimated, the market will underprice them and individuals will face more risk than they would, if perfectly informed, choose. Second, the market may fail to offer adequate variation in product risk or occupational risk. Third, individuals might not see the full social cost of their choices of risk. A head of household may accept greater risks knowing that, upon her death, society must support her dependents. Fourth, certain insurance markets for risks may not form because of moral hazard or adverse selection.

Risks from air and water pollution seem somewhat less voluntary than occupational risks. Of course, these risks may be mitigated by individual actions. One may live in more or less polluted environments. But air and water quality have a higher degree of joint consumption than occupational (or product) risk and the general extent of environmental degradation is clearly outside the control of any single individual.

3.22 Non-systematic, Non-wealth Variations in Preferences. Consider a society in which all individuals face identical risks of death. They must choose among policies that will result in identical reductions in risks to each individual though different policies reduce different risks. If every-

39 The example suggests the complexity of the idea of equal distribution of wealth. To render her circumstances "non-coercive" may require that the individual's "equal" wealth reflect the greater number of dependents she has. On the other hand family size is chosen by the parties and this voluntary element may argue against adjusting wealth for family size.

40 In addition, we may believe that individuals should not have to face certain choices.
one had identical preferences then they would rank policies identically; social choice would present no conflicts. Suppose, however, that individuals do vary in their preferences. Ought social choice to be determined by willingness-to-expend?

For purely voluntary risks, allocation of risk on the basis of willingness to expend seems unobjectionable, even if some regulatory intervention is justified. Suppose, for example, that society introduces a health insurance scheme because adverse selection causes failure in the insurance market. That scheme might specify the set of procedures that will be reimbursed. On what basis could one object to another purchasing on the market a non-reimbursable expenditure? If wealth were unequal, then an objection grounded in the inequality of wealth might lie; otherwise one might object only if the individual expenditures adversely affected the provision of reimbursable procedures.

Consider now an involuntary risk. Specifically, suppose that society must choose between two air quality standards H and L where standard L imposes greater risks on each member of the population than standard H. Let W be the aggregate willingness-to-accept the increased risks of death created by a reduction in air quality from the standard H to the standard L. Recall that W equals the monetary amount necessary to purchase from each member of the threatened population the right to impose the increased risk created by the change standard. To economists, W is attractive because of its incentive properties; unless those who benefit from the reduction in standard see the full cost of the degradation in air quality, they will choose to pollute too much. W, the price the population would accept to suffer the lower quality air, equals the lowest monetary sum necessary to purchase all rights degraded by the lower air quality. If W exceeds the difference in costs between the standards H and L, economists would generally argue that H should be imposed.

If compensation is not in fact paid to the threatened population, one might argue that society ought not to look to the aggregate willingness-to-accept but to some higher number. Use of willingness-to-accept as the measure indicates that society has assigned the right to be free of the involuntary risk to the threatened population. Use of W as the aggregate measure values each individual's right at the mean valuation; thus some individuals will place a much higher price on exposure to the threatened

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41 Of course, much of the controversy over health policy stems from the inequality of wealth. Objections to rationing care to the poor rest in large part on the discrepancy in access of rich and poor. Remedies other than wealth redistribution are difficult to imagine. Equal access in the presence of inequality requires either availability of every procedure to all, an extremely costly policy, or the prohibition of large numbers of treatments, a policy that seems unenforceable given experience with illegal drugs and abortions prior to 1973.

42 I ignore here considerations of future generations whose preferences are unlikely to be captured in W. (They might be captured in two ways: (1) intergenerational altruism on the part of the current generation or (2) some process, adopted by the policymaker, of imputing preferences to future generations.)

43 Caveats to this argument were discussed above in section 2.2.
risk (perhaps because exposure threatens them with greater harm). In the absence of compensation, one might recognize the importance of the right by imposing a standard that protects the rights of individuals who value air quality more highly than average.\footnote{On the other hand, imposing more stringent standards may impose additional costs on individuals who value air quality less.}

### 3.23 Systematic, Non-Wealth Variations in Preferences

The model explicitly assumes that preferences over survival prospects vary with wealth but preferences might also vary systematically with some other demographic characteristic such as age, race, gender, or marital status. Social attitudes towards such variation may depend on its cause. I shall consider two causes of systematic variation: correlation with wealth and correlation with attitudes towards or beliefs about risk. I shall use age as an example.

Preferences may differ across age groups for several reasons.\footnote{Program benefits might also vary systematically with age (or other demographic characteristics) and the nature of the risk. Suppose some invariably fatal disease threatens an entire population. Each person has an equal chance of contracting the disease. At some cost, the society can develop, produce, and distribute a perfectly safe and effective vaccine. Presumably, those with the longest life expectancies will benefit most from this vaccine and hence be willing to pay the most for it. This issue is discussed at greater length in section 3.1.} First, wealth may differ by age. Though the elderly have a shorter stream of earnings ahead of them, they have greater accumulated material wealth. Moreover, the more heavily individuals discount future earnings, new entrants into the labor force will be poorer relative to those further up on a career ladder. Second, attitudes towards risk may differ with age. The young are generally (though perhaps erroneously) assumed to be more risk-loving than the elderly. If so, the young, other things being equal, might pay less to avoid a given risk. Alternatively, perceptions of risk might vary systematically with age. The young may underestimate survival risks (or overestimate the background survival prospects) while the old may overestimate the risks (and underestimate the background prospects). With these perceptual biases, the young would once again be less willing to pay to avoid a given risk.

### 3.24 Variations in Policy Effects

Most regulatory policies impose a standard that has different effects on different individuals. Thus, choosing a low air quality standard L over a high standard H poses a greater threat to individuals with congenital lung problems or other sensitivity to specific pollutants. Use of an aggregate measure here presents problems similar to those encountered when aggregate measures are used to evaluate identical risks faced by individuals whose wealth varies.

### 4. Maximizing the Number of Lives Saved

"Pricing" life naturally arises in two contexts. Most of the prior discussion applies to the broad context in which lives may buy less fundamental goods such as convenience. The decision to build a highway that does not reduce the risk of fatal accidents to as low as point as possible sacrifices some statistical lives for the more mundane benefits that the
cost savings may supply. Often, however, society must allocate a given sum among various life-saving projects. Here, the price of one life is measured in other lives. It seems reasonable to require that society maximize the number of lives it saves with the given fund. In this section, I suggest first, that giving content to this mandate presents difficulties and, second, that preference-based approaches to the evaluation of risk do not imply that society will in fact maximize the number of lives saved.

4.1 Are All Lives Equal?

Suppose society unexpectedly finds $1 billion dollars to spend on life-saving activities. How should it allocate these funds among competing risks? In this context, society confronts a choice between lives rather than a choice between lives and money. Why should society not simply maximize the number of lives it can save? After all, maximization of the number of lives saved is apparently one way to treat all lives as equally valuable.46

At least two factors contradict this simple social rule. First, a “saved life” is not unambiguously defined. How much longer must an individual live for her life to have been saved? Some medical treatments may prolong an individual’s life by hours or days while others may prolong an individual’s life by years or decades. Suppose we identify the provision of some additional life expectancy, say one year as a “saved life.”47 Society must still choose between one policy that extends the lives of many by a single year and one that extends the lives of fewer individuals by twenty years.

Second, not all saved lives are of equal quality. One policy might save many lives from some disease but the side effects of the cure might be debilitating in such ways that those saved must lead more restricted lives than those they led prior to their illness. Another policy, in contrast, might save fewer lives, but those lives saved may have fewer restrictions.

Some authors have suggested that society choose among these conflicting concerns on the basis of individual preferences. These preferences might be extracted by asking individuals to scale various alternatives.48

46 Taurek, “Should the Numbers Count?” 6 Phil. & Pub. Affairs 293 (1977) argues to the contrary that, in certain contexts at least, maximizing the number of lives saved does not treat each individual with equal concern and respect. He considers examples in which an individual must choose between saving identified lives.

47 We might determine this cutoff life expectancy by reference to the ability of the individual to formulate plans or substantially to achieve some goal.

48 Zeckhauser and Shepard, construct a scale of “QALY’s”—“quality-adjusted life-years”, analogously to the von Neumann-Morgenstern procedure for constructing a scale of “risk-adjusted rewards.” Zeckhauser and Shepard, Where Now for Saving Lives? 40 LAW & CONTEMP. PROB. 5, 11 (Autumn 1976), Alternatively, one might ask how much an individual would pay (or accept) to avoid (or suffer) various diminutions in the length and quality of her life. This method probably is more sensitive to various differences among individuals such as wealth and age than “QALY”.

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4.2 Identified vs. Statistical Lives.

The prior exposition of the preference structure that underlies the calculation of the asking prices and offer prices in cost-benefit analysis already implies a phenomenon first identified by Charles Fried: individuals treat the loss of identified lives differently from the loss of statistical lives.49 This different treatment implies that cost-benefit analysis recommends that society not maximize the number of lives saved.

A simple example illustrates this claim. Suppose society has $1,000,000 to reduce one of two risks. In situation A, the expenditure will reduce the risk of death to each of 1000 individuals from .25 to .24. Each of these individuals would pay $5000 to avoid this risk. In situation B, the same expenditure will reduce the risk of death to each of 1500 individuals from .05 to .04. Each of these individuals would pay $3000 to avoid this risk. The willingness-to-pay criterion recommends reducing risk A as those 1000 people would pay $5 million to avoid the risk while those confronting risk B would pay only $4.5 million to avoid risk B. Maximization of lives saved, on the other hand, recommends reduction of risk B, which saves 15 lives against the 10 lives saved from the reduction of risk A.

5. The Bias towards "Acute" Care.

The choice between preventive and acute care is often understood as exhibiting this phenomenon of favoring identified lives. But this conflict may also reflect a different phenomenon: the inability of society to commit itself to a policy that allows some to die when a treatment is available. Suppose there are 1,000,000 people and each faces a .001 risk of contacting a fatal illness. The population then expects 1,000 cases of the disease. Now let us compare two health policies, one preventive and one acute, that are identical in terms of expected lives saved.

First, suppose that the risk of infection can be reduced to .00075 at a cost of $25 per person. Suppose each individual values this reduction in mortality risk at $X. If $X > $25, a cost-benefit analysis would consider undertaking it.

49 Fried, The Value of Human Life, 82 HARV. L. REV. 1415 (1969). The distinction between identified and statistical lives might rest on two differences. It might refer to a difference between a certain loss of life and a (small) probability of a loss of (the same) life. Or, it might refer to the difference between the (probable) loss of the life of a specific individual and the same (probable) loss of the life of an unidentified person. Usually, these two differences are elided by comparing the certain of loss of X's life to the .001 chance faced by each of 1000 individuals (consequently with an identical expected loss of 1 life).

The first distinction challenges the linearity assumption discussed above. The second distinction might be understood in terms of a compound lottery. Suppose X faces a .01 risk of death. Do individuals regard this risk differently from a situation in which one of 1000 individuals will be chosen (in a fair lottery) to face the .01 risk of death? (This hypothetical differs from the standard hypothetical in at least two ways. First, it reduces the role that certainty of death plays in our intuitions. Second, in the standard hypothetical, many deaths might occur because the risks to each individual are independent. In the compound lottery example, at most one individual will die.)
Alternatively, the population might spend $50,000 on each person who falls ill; this treatment increases each person's chance of survival from 0 to .25. Suppose each infected person is willing to pay $1000Y for this treatment; put differently, an insurance premium of $Y paid by each person at risk would underwrite this treatment. If $Y > $50, a cost-benefit analysis would see this project as desirable. If society had only $25 million to spend, the criterion "maximize lives saved" recommends adoption of the preventive policy which saves 250 lives (as opposed to treating only half the infected population which saves only 125 lives). The willingness-to-pay criterion, however, recommends the acute care policy if $Y/X > 4.60

Failure to maximize lives saved in this instance seems perverse because ex ante, at time 0, everyone in the society prefers the policy of prevention. At time 1, however, 750 people will have fallen ill, and each of them would prefer that the treatment were available. Put differently, suppose the market for health care consisted of health maintenance organizations (or other groups) that competed for clients on the basis of health package and price. We can imagine a preventive care package that would provide the preventive treatment at $25 per person while another package offered the acute treatment at $50 per person. Everyone it seems would prefer to purchase the preventive care ex ante but ex post each would desire the acute care.

50 Cost-benefit analysis recommends that the policy with the greatest ratio of costs to benefits be adopted. The text assumes that each individual will value a 50-50 chance of acute treatment (conditional on infection) at $Y/2; this calculation implicitly assumes linearity which the example otherwise denies. A more "realistic" example could be constructed.

51 The discussion in the text may not reveal with sufficient clarity the intricate nature of the example. One can consult individual preferences for the two treatments at two distinct points in time: ex ante, that is, prior to exposure to the risk of infection, or ex post, after identification of all infected parties. $X represents for each individual the ex ante willingness-to-expend for the preventive care; presumably, ex post, willingness-to-expend for preventive care will be 0. $1000Y represents the ex post willingness-to-expend on acute care for each individual; $Y, however, is not necessarily the ex ante willingness to expend on acute care. The earlier discussion of non-linearity suggests that this ex ante willingness to expend on acute care, say $Z, will be less than $Y. Can one conclude that $Z - $X? By assumption, the acute and preventive care programs cause an identical increase in survival prospects; ex ante, it seems that each individual should be willing to pay an equal amount to implement each program. As the preventive program can be implemented at lower cost, each individual should prefer preventive care because the money saved could be employed to reduce some other risk (or to buy some small amount of acute care).

52 I have thus implicitly amended the hypothetical by assuming that the preventive treatment is a private good. Many public health measures may have an aspect of public good to them as they reduce the risk of illness through improvement of water or air quality or by imposing more stringent safety standards on universally distributed goods.

53 A third package might include both the preventive and acute care elements at a cost of $62.50 (the preventive care reduces the expected cost of acute care from $50 to $37.50). I have assumed throughout that prices are set competitively at actuarially fair levels.
Several aspects of this hypothetical merit comment. First, and most important, the bias for acute interventions results from the non-linearity of preferences. It is therefore contingent on the preferences individuals actually have. Let \( w_i(p, \delta) \) be \( i \)'s willingness to expend to reduce the background risk \( p \) by \( \delta \). The bias towards acute intervention follows from the assumption that, for individual \( i \), for each \( \delta \), \([p > p'] \) implies \([w_i(p, \delta) > w_i(p', \delta)]\). Thus, for example, \( i \) would pay more to reduce her risk of death from .99 to .98 than to reduce it from .02 to .01. If her preferences were reversed (so that for each \( \delta \) \([p < p'] \) implied \([w_i(p, \delta) > w_i(p', \delta)]\)), she would exhibit a bias toward preventive interventions.\(^5\)

Second, as mentioned in footnote 51, \( \text{ex ante} \) willingness-to-expend may differ from \( \text{ex post} \) willingness-to-expend. It may be that the non-linearity which induces the bias arises because we compare the \( \text{ex post} \) willingness-to-pay for the acute program to the \( \text{ex ante} \) willingness-to-pay for the preventive program. Such a comparison seems inappropriate in part because one might believe that an infected individual has, in some sense, different preferences than she had when she faced only a risk of infection. Certainly, personal injury that causes blindness or paraplegia radically alters an individual's needs, wants, desires, and other components that give rise to a preference ordering; we are thus inclined to think that the injured individual has different preferences than the healthy individual. This may also suggest that the imminence of death also alters the individual's preferences.

The occurrence of the infection introduces an additional problem, that of \( \text{precommitment} \). Suppose that society decides, on the basis of (linear) \( \text{ex ante} \) willingnesses-to-pay to offer only the preventive care. Later, 750 individuals are infected. Society will be tempted to breach its commitment to preventive care only at this point because medical resources could, at this point, be allocated to these individuals and it will be difficult simply to watch these individuals die. To the extent that wealth is unequally distributed, society will find it more difficult to adhere to its commitment. The wealthy after all will purchase, either legally or illegally, the acute treatment; claims of equality will therefore urge that it be made available to the poor victims as well as the wealthy.

6. What Aspect of the Distribution of Risk Matters?

Section 1.22 described preferences as governed by three factors: the individual's wealth, the background risk to the individual, and the potential change in the individual's risk. Individual preferences, however, might depend on other features of the policy or proposed change in risk. Individuals for example might care about risks that threaten not only them but also others within their family or community; parents, for instance, might choose to fly on separate aircraft to reduce the risk that their children would lose both parents simultaneously. Alternatively, an individual might care about the nature of the risk or the manner in which actual preferences, of course, may exhibit more complex forms of non-linearity. An individual might, for example be willing to pay most to reduce her background risk from .51 to .5, next to reduce it from .02 to .01 and least to reduce it from .99 to .98.

\(^5\) Actual preferences, of course, may exhibit more complex forms of non-linearity. An individual might, for example be willing to pay most to reduce her background risk from .51 to .5, next to reduce it from .02 to .01 and least to reduce it from .99 to .98.
death threatens; that is, she might prefer, for example, death by water
to death by fire.

Self-interested individual preferences are unlikely to distinguish be-
tween risks that threaten many at once and risks that are independent.
Arguably, however, social policy might treat two such risks differently. 55
Consider two cases: (A) Each person in a population of one million (10^6)
faces an independent .00001 (10^-5) risk of death. The population thus
expects 10 deaths. (B) The entire population of 1,000,000 people faces a
10^-11 risk of complete annihilation. Again the population “expects” 10
deaths. Ought these two risks be treated identically? Many individuals,
I think, consider risk (A) preferable to risk (B) even though the expected
number of deaths is identical. They care about the variance inherent in
the distribution of potential deaths.

7. Concluding Remarks.

Citizens and legal philosophers may legitimately demand of their gov-
ernment that it pursue a consistent social policy. In this essay, I have
outlined some difficulties in defining and achieving consistency in one
aspect of federal health and safety regulation: the “valuation” of life in
the regulation of risks of death. I have argued that the conundrum with
which I started, the variation among implicit values of life used by various
federal agencies, is easily resolved: the numbers cited are artifacts, with-
out normative significance, of a consumer preference method for evalu-
ating risks. Appropriate (and hence consistent) application of this method
requires that the policymaker consider the distribution of consumer pref-
erences in the threatened population rather than consider some aggregate
statistic of those preferences.

The use of consumer preferences in the evaluation of social policy to-
wards risk of death, however, presents several anomalies. I proposed a
simple, implementable change in methodology to correct for one of these,
a bias towards the lives of the rich over the lives of the poor; the poli-
cymaker should consider the consumer preferences conditioned on the
individual’s having median wealth. This procedure, however, will not
eliminate the bias towards acute over preventive interventions, a bias
towards the aged over the young, nor a discrepancy with the policies
recommended by the mandate “maximize the number of lives saved.”

These difficulties may, for many, present reasons against the propriety
of preference-based procedures to evaluate policies regulating risk. The
social dilemmas here, however, probably inhere in the problem rather
than the procedure. One can trace the consequences and conundrums of
preference-based procedures because they are well-specified and clear.
Not surprisingly, then, they fare poorly against some vague alternative
that, at least in our imagination, ideally resolves the myriad and complex
decisions that policymakers face daily. The social desirability of prefer-
ence-based measures will be understood only after the analysis of equally
well-specified alternatives.

55 One ground for such a distinction might be the “moral preferences” of the
individuals. In social choice theory, for example, theorists generally impute to
each individual an ordering over social states; that ordering need not conform to
the individual’s personal preferences, those which “dictate” her personal choices.