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Risk in Benefit-Cost Analysis

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In recent years, benefit-cost analysis has been increasingly applied to large societal decision problems (such as developing a fast breeder energy economy) which involve both risks to society and analysis of very long-term consequences possibly extending over many human generations. This paper examines the philosophical underpinnings of the technique which is a special case of utilitarianism, and compares implications of the technique to those arising from alternative ethical systems in analyzing questions of public safety. Ethical systems which emphasize the good of the whole, such as utilitarianism, are shown to differ sharply in decision outcomes from those which emphasize the rights of the individual, such as libertarianism. It is suggested that benefit-cost analysis should be broadened to include alternative weightings of benefits and costs consistent with a variety of ethical views.

KEY WORDS: benefit-cost analysis; risk; enthics; public safety

1. INTRODUCTION

Benefit-cost analysis has long been used to evaluate public works, especially water-resource investments. A large amount of literature exists on this mode of applied economic analysis. This literature treats both conceptual and empirical problems, but for the most part does not question the basic philosphical underpinnings of the technique, which is a special case of an ethical doctrine called utilitarianism.

In recent years, benefit-cost analysis has been increasingly applied to large societal decision problems such as the disposal of nuclear waste, the costs and benefits of developing a fast breeder energy economy, and the desirability of storing helium for the benefit of future generations. These problems have two characteristics which tend to set them apart from the more conventional applications. First, they involve uncertainty and risks to society in a central way. In the case of nuclear wastes there are possible risks to health and in the case of failure to store helium there is the risk that certain energy technologies cannot be developed for the long-term future. Second, they involve the analysis of decisions which may have very long-term consequences, possibly extending over many human generations.

In the case of these issues, concepts and techniques that were developed to help evaluate issues of the shorter term and less uncertain and risky nature are not obviously suitable for large societal decision problems. Ethical questions as to justifiability of imposing risks to life and health on people, possibly people in future generations, and whether it is proper to apply conventional discounting procedures when it would effectively wipe out any consideration of the long-term future, assert themselves strongly.

In view of this, the authors set out to examine the ethical foundations of benefit-cost analysis and what effect the application of alternative ethical criteria would have on the outcome of such analysis.[3] We proceeded by defining some ethical systems suffi-

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ciently simply and rigorously to permit formal quantitative analysis. Then the criteria were used to "weight" benefits and costs in such a way that the outcome would conform to the particular criterion specified. By using this technique, we completed several illustrative case studies, including helium storage and nuclear waste disposal.[4]

We should be clear that we are not the first to apply distributional weights to benefit-cost analysis [see, for example, refs. (1 and 2)]. But so far as we know, we are the first to link these weights both to issues of public safety and to ideas emerging from the formal philosophical field of ethics. Some criteria emerging from this literature, as we will see, emphasize the good of the whole (utilitarianism), and some the rights of the individual (libertarianism).

We should also be clear that this paper contains material from what is essentially an ongoing research project. We plan to continue this line of inquiry and to try to deepen our understanding of the relationships between ethics and economics.

In this paper, we briefly, perhaps cryptically, outline the ethical systems we have examined so far. We then present a theoretical analysis of their implications for handling risk in the context of benefit-cost analysis.

2. ETHICAL SYSTEMS

As just indicated, to examine benefit-cost analysis from the ethical standpoint, it was necessary to define a set of ethical systems in such a way that they could be used as "weights" on the benefits and costs of proposed actions. The following were identified.

2.1. Utilitarian (Benthamite)

A utilitarian ethical system requires "the greatest good for the greatest number," based on ideas put forward by Jeremy Bentham,(3) John Mill,(4) and others. The social objective is to maximize the sum of the cardinal (measurable) utilities of all individuals in a society. For an individual to make an ethically "correct" action, all consequences of that action must be considered. As translated to a social decision rule, the criterion requires that the government should act in such a way as to maximize utility of society as a whole. Depending on beliefs about the nature of individuals' utility functions, any distribution of income can be justified, ranging from a relatively egalitarian to a relatively elitist viewpoint. Benefit-cost analysis can be regarded as a very special subcase of the utilitarian ethic where individuals' utility functions are linear with identical constant marginal utilities across individuals and where future utilities are identically discounted.

In summary, utilitarianism argues that for a two person society with individuals A and B, where utility is denoted U, the social objective should be to maximize $U_A + U_B$.

There do exist ethical systems which are totally egalitarian and totally elitist. These diametrically opposed systems are described next.

2.2. Egalitarian

The egalitarian view holds that the well-being of a society is measured by the well-being of the worst off person in that society. This simple notion would lead, if fully adopted, to a totally egalitarian distribution of utility.[5]

The egalitarian criterion can be expressed mathematically as follows: For two individuals A and B, where utility is denoted U, if $U_A < U_B$, we maximize U_A subject to $U_A \leqslant U_B$; if $U_B < U_A$, then we maximize U_B subject to $U_B \leqslant U_A$. If we reach a state where $U_A = U_B$, then we maximize U_A subject to $U_A = U_B$. The implication of this for redistribution of income in a many-person society is that we begin by adding income to the worst off individual (taking income away from wealthier individuals) until he catches up with the next worst off individual. We then add income to both individuals until their utility levels (well-being) have caught up to the third worst off, etc. Eventually, this process must lead to a state where $U_A = U_B = U_C = U_D \cdots$ for all individuals in a society, where all utilities are identical, or to one where further redistributions will make everyone worse off, e.g., through negative impacts on incentives. This criterion can be written more compactly for a two person society as max min $\{U_A, U_B\}$, so we are always trying to maximize the utility of the individual with the minimum utility. Implicit also in the arguments is the assumption that individuals' utility

[4]A relatively full report on this work is found in a working paper of the Department of Economics at the University of New Mexico entitled *A Study of the Ethical Foundations of Benefit-Cost Analysis Techniques* by Shaul Ben-David, Allen V. Kneese, and William D. Schulze (August 1979).

[5]Contemporary egalitarianism is often associated with the writings of John Rawls [see Ref. (5)].

functions with respect to income are about the same. Thus, this ethical criterion would work towards a relatively equal distribution of income based on need.

2.3. Totally Elitist

An elitist criterion can be derived as the precise opposite of the egalitarian criterion. The well-being of society is measured by the well-being of the best off individual. Every act is "right" if it improves the welfare of the best off and "wrong" if it decreases the welfare of the best off.[6]

Lest the reader dismiss the elitist criterion as irrelevant for a Western democratic society, some elitist arguments should be mentioned. The gasoline shortage of the summer of 1979 moved Senator Hiyakawa of California to comment, "The important thing is that a lot of the poor don't need gas because they're not working." Economic productivity can in this sense rationalize a defined "elite." Thus, concepts of merit can be elitist in nature, e.g., those who produce the most "should" have the largest merit increases in salary (even though they may already have the highest salaries).

The income distribution implied by this criterion is not simply to give all the society's wealth to the best off. This is true because, if between two individuals A and B we are attempting to

$$\max \max \{U_A, U_B\},$$

or to maximize the utility of the individual who can attain the greatest utility, we must first find the solution for $\max U_A$ and then separately for $\max U_B$, and then pick whichever solution gives the greatest individual utility. Obviously, it will usually be better to keep B alive to serve A, i.e., to contribute to his well-being than to give B nothing if A is to be best off. Thus, subsistence is typically required for B. Similarly, if we have two succeeding generations, it may well be "best" for the first generation to save as much as possible to make the next generation better off. This attitude has been manifest among many immigrants to the United States with respect to their children. Thus, an elitist viewpoint may support altruistic behavior.

[6]The elitist view is often associated with the writings of Friedrich Nietzsche [see ref. (6)]. But, as noted in the text, less objectionable arguments for the elitist view can be made.

2.4. Libertarian

The fourth ethical system is an amalgam of a number of ethical principles embodied for example in the viewpoint of the U.S. Constitution that individual freedoms prevail except where others may be harmed. These views which emphasize individual rights have been formalized by Nozick[7] in a strict libertarian framework. We are not concerned here with changing the initial position of individuals in society to some ideal state, but rather in benefiting all or at least preventing harm to others, even if they are better off. This ethic has been imbodied often by economists in the form of requiring "Pareto superiority," that all persons be made better off by a change in resource use or at least as well off as before. Any act is then immoral or wrong if anyone else is harmed. Any act which improves an individual's or several individuals' well-being and harms no one is moral or "right."

The libertarian or Paretian ethic does not define a best distribution of income. Rather, the criterion requires that any change from the existing social order harm no one. If, for example, Mr. A and Mr. B initially have incomes Y_A^0 and Y_B^0, then we require for any new distribution of wealth (Y_A, Y_B)—for example, more wealth becomes available—that

$$U_A(Y_A) \geqslant U_A(Y_A^0)$$

and

$$U_B(Y_A) \geqslant U_B(Y_B^0)$$

or each individual must be at least as well off as he initially was. Any redistribution, e.g., from wealthy to poor or vice versa, is specifically proscribed by this criterion. Thus, this criterion, while seemingly weak —i.e., it does not call for redistribution—can block many possible actions if they do as a side effect redistribute income to make *anyone* worse off, however, slight the effect may be. Often, then to satisfy a libertarian criterion requires that gainers from a particular social decision must *actually* compensate losers [for a discussion of compensation, see ref. (8)].

3. ECONOMICS OF RISK

The economics of risk (or safety) has developed rapidly over the last several years. Unfortunately, earlier attempts at measuring the value of safety

programs have given economists a "black eye" for supposedly advocating that individual human lives could be valued as the lost economic productivity associated with a shortened life span. This view, pursued in great detail by Dorothy Rice[9], and used by Lave and Seskin[10] and others, implied that the value of life of, for example, a 50-year-old carpenter would be the remaining earnings to retirement age. The value of life of a retired female (someone's grandmother) was by the same argument taken to be zero. Similarly, small children, since many years would pass before they could begin to earn productive income, were valued at next to zero, discounting future earnings at a market rate of interest. Elaborate calculations were made for different individuals on the basis of age, occupation, sex, etc. to determine the value of remaining earnings as a measure of the "value of life." On economic theoretical grounds, all of these calculations have been shown to be nonsense. [For a correct economic-theoretical treatment of safety see Mishan[11] or Conley[12].] However, permanent harm remains in that many decision makers now shy away from any attempt to value the benefits of safety programs in dollar terms.

The economist's notion that individuals do voluntarily trade off safety for monetary compensation in no way attempts to value life. Rather, the question is asked, how much do individuals require as *a priori* compensation to voluntarily accept a small additional risk of death? Note, then, that in correctly studying the problem of risk (as opposed to the value of life approach mentioned above), economists utilize data on behavior where monetary compensation is actually paid for accepting risk. We will find in analyzing ethics and risk, that the economist is utilizing a rather special situation to derive estimates of the value of safety. But, for the moment, let us follow through on the notion of a trade-off between safety and monetary compensation.

Imagine a game of Russian roulette in which an individual is offered sums of money to participate voluntarily. If, for example, the risk of the gun firing when the trigger was pulled were only one in ten thousand, and the compensation for accepting the risk was $1000, current economic studies would suggest that most people would accept the risk (this is a much better proposition—risk versus compensation—than driving to work for a typical day's pay!). However, economic theory suggests that as the probability of death increases, monetary compensation would have to increase dramatically. Figure 1 shows the expected kind of relationship between compensation and risk. Clearly, as the probability of death approaches one, compensation approaches infinity—odds are that the participant will not survive the game to enjoy the proceeds, so, absent of some bequeathement motive, no amount of money is sufficient. Note, however, that for small increases in annual risk of death, such as those associated with risky jobs (typically less than 0.001 per year), annual job compensation is increased by $340–$1000 as shown in Fig. 1 [see Smith[13] and Thaler and Rosen[14]]. Thus, economists now focus on the far left-hand side of Fig. 1, only dealing with the dollar values necessary to compensate individuals for small voluntary risks. Total benefits for a safety program may, of course, sum up to a large dollar figure if many people obtain small reductions in risk through a public policy action.

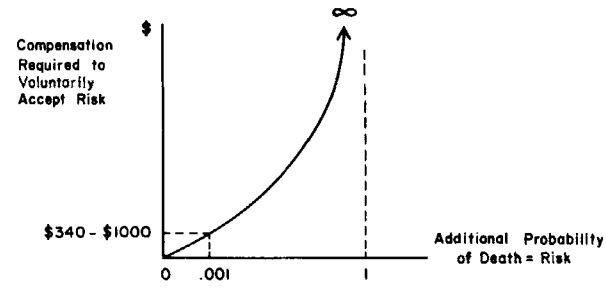

Fig. 1.

However, this method of valuing risk seems at least in part out of accord with observed human behavior. Just as the old value of life measure used by Rice and Lave and Seskin leads to counterintuitive results, (e.g., grandmothers do not take up hang gliding because their lives are "worthless," nor does society place a near zero value on the lives of children), the new measure of the value of safety seems to ignore the special importance many individuals place on involuntary or uncompensated risks. The risks associated with nuclear reactor accidents or nuclear waste storage, risks associated with public transportation including airlines, risks of flood, fire, earthquakes, or other disasters, all seem to be treated differently both in a social and individual perspective than do voluntary-compensated risks. Economic theory, and consequently empirical estimates of the value of safety, have notably failed to account for these differences. Rather, economists have argued that placing a different value on safety in different situations is economically inefficient.

The logic behind this argument is as follows: Given a fixed safety budget, if we have a program that can save one life for $50,000 and another pro-

gram which can save 10 lives for $50,000 we should pick the second program. Further, given a larger total budget, we would wish to pick the combination of programs which we would expect to save the greatest number of lives. We should pursue each of the programs to the extent that each additional life saved by a program cost the same at the margin.

4. ETHICS AND RISK

The obvious counter to the argument just raised is that individuals may well value safety differently in different settings. Are uncompensated risks less ethically acceptable than compensated risks?

We can use the four ethical systems presented above to analyze uncompensated risk as follows: assume we have two identical individuals, A and B, with the same utility functions. If A imposes a small risk on B and receives a benefit equal to B's incremental or marginal value of safety, we have a situation which satisfies traditional benefit-cost analysis, i.e., benefits to A are equal to cost imposed on B in dollar terms, so the situation is accepted. However, from an ethical perspective, A is imposing an uncompensated risk on B.

Technically, we define A's expected utility as

$$E_A = (1-\Pi_A^0)U_A(Y_A^0 + G\Delta\Pi_B),$$

where Π_A^0 is A's risk of death, U_A is A's utility which is a concave function of his initial income Y_A^0 plus the monetary gain G, for imposing a unit of risk on B, times the increase in risk imposed on B, $\Delta\Pi_B$. An example of this situation would be Mr. A building a dam upstream of Mr. B for his own gain. Mr. A receives a net benefit of G for each unit of risk (of failure of the dam which could drown Mr. B), which he imposed on Mr. B. This net gain might result from the value of irrigation water net of the cost of constructing the dam. In this context, benefit-cost analysis, as traditionally practiced, would argue that if incremental net benefits to A equal or exceed incremental costs (of risk) to B, the dam is acceptable.

Mr. B's expected utility, where he is not compensated for risk imposed by A, is then defined as

$$E_B = (1-\Pi_B^0 - \Delta\Pi_B)U_B(Y_B^0),$$

where Π_B^0 is Mr. B's original risk of death, $\Delta\Pi_B$ is the additional risk imposed by A, and U_B is Mr. B's utility, a concave function of his income, Y_B^0.

If we were to compensate Mr. B for voluntarily accepting risk from Mr. A at a rate of C dollars per unit risk, Mr. B would maximize his compensated expected utility,

$$(1-\Pi_B^0 - \Delta\Pi_B)U_B(Y_B^0 + C\cdot\Delta\Pi_B),$$

with respect to $\Delta\Pi_B$ which implies

$$C = \left.\frac{U_B}{U_B'(1-\Pi_B^0)}\right|_{\Delta\Pi_B=0}$$

or that C equals B's marginal value of safety, the economists definition for the right-hand side of the expression above. (Note that the prime in the expression above is used to denote the derivative and we evaluate the expression where additional risk, $\Delta\Pi_B$, is zero.) Thus, traditional benefit-cost analysis requires that G, Mr. A's marginal gain, exceed or equal C, Mr. B's marginal loss, to start construction of the dam, both valued in dollar terms. However, Mr. A does not have to actually compensate Mr. B at a rate equal to or exceeding C, as defined above. Note the criterion that $G \geqslant C$ is only necessarily consistent with the utilitarian criterion when utility functions are linear and constant marginal utilities are equal for A and B.

How, alternatively, would the four ethical systems described above view the situation where B's risk is uncompensated? Where social welfare, W, for the first three criteria is defined as follows:

Utilitarian:	$W = E_A + E_B$
Totally Egalitarian:	$W = \max\min\{E_A, E_B\}$,
Totally Elitist:	$W = \max\max\{E_A, E_B\}$,

the condition for acceptability is that $[dW/d\Delta\Pi_B]_{\Delta\Pi_B=0} \geqslant 0$. If $[dW/d\Delta\Pi_B]_{\Delta\Pi_B=0} < 0$, then the risk, $\Delta\Pi_B$, is rejected. Note that the term $[dW/d\Delta\Pi_B]$ is the slope (rate of increase) of social welfare with respect to an increase in risk to Mr. B. If this slope is positive at the origin ($\Delta\Pi_B = 0$) then an increase in risk to B is justified. For the Libertarian ethic, we require

$$\text{Libertarian:} \quad E_A \geqslant E_A^0 \equiv (1-\Pi_A^0)U_A(Y_A^0)$$
$$E_B \geqslant E_B^0 \equiv (1-\Pi_B^0)U_B(Y_B^0),$$

or that both parties be better off than before the initial state preceeding consideration of the risk $\Delta\Pi_B$ on Mr. B.

Table I presents a summary of an analysis for uncompensated risk using the social welfare, W, criteria established above where we assume that A's incremental gain, G, is equal to B's incremental cost, C, in dollar terms; that the *a priori* risks Π_A^0 and Π_B^0 are identical and that utility functions U_A and U_B are identical as well.

The example is, of course, structured so that traditional benefit-cost analysis just accepts the imposition of an increment in uncompensated risk. However, the utilitarian ethic with identical strictly concave utility functions rejects the situation if Mr. B is initially worse off than Mr. A, i.e., B has a lower income, $Y_A^0 > Y_B^0$, since the risk is not distributed across society in a way that moves towards maximizing total utility. Similarly, the totally egalitarian or Rawlsian ethic rejects the imposition of risk by Mr. A on Mr. B if B is worse off initially since the risk of the dam failing makes the distribution of utility less equal in this case. The totally elitist ethic implies the converse: that if Mr. A is better off, he has the ethical right to impose a risk on Mr. B. Finally, the libertarian ethic rejects the notion of uncompensated risk no matter what the initial distribution of wealth since, by definition, an uncompensated risk makes someone worse off.

Table I is surprising in several respects. First, it is often supposed that benefit-cost analysis can be justified, or at least is supported generally by the Utilitarian ethic. Clearly, at least for uncompensated risk, this is not always the case.

Second, all of the four ethical systems examined reject uncompensated risk at least some of the time. This may in part explain the failure of the traditional economic view of a uniform-smooth risk trade-off, as expressed in Fig. 1, to predict the observed societal aversion to uncompensated public or social risks. All of the ethics consider some uncompensated risks "wrong," at least some of the time, implying no trade-off exists at all! Individuals may, of course, adopt "ethical" preferences in accordance with the ethical systems we have described. In cases where individual preferences reject uncompensated risks as "wrong," the preferences of individuals become lexicographic. This term implies, in the case of safety, that among a set of alternatives, the alternative with the most public safety (least uncompensated risk) is always preferred to all other alternatives. Figure 2 shows a mapping of the preferences of an individual with lexicographic preferences between public and private (uncompensated and compensated) safety. If the individual initially has a combination of public and private safety denoted z^0, all points to the right of z^0, marked as the shaded area, are preferred because they have more public safety, i.e., less uncompensated risk. Thus, any point like z^2, which has less private safety but more public safety than z^0, is preferred to z^0. The only points which do not increase public safety but which are still preferable to z^0 are those marked above z^0 by the solid line, i.e., those which maintain the same level of public safety, but which increase private safety. Thus, with lexicographic preferences, private safety is still desired, but only secondarily to public safety. Clearly, where an individual or society invokes an ethical objection to uncompensated risks, preferences are lexicographic. Economists have always used the assumption of preferences of the sort shown in Fig. 3, where points such as z^1 (or those in the shaded area) which are all preferred to z^0, are bounded below by a smooth curve (or straight line) as shown, implying a continuous trade-off exists. Note, however, that if Table I were to be reworked on the assumption of *a priori* compensation for risk imposed on Mr. B by Mr. A, we would find all of the ethical systems considered accept compensated risk. Thus, the economists' notion of a money-risk trade-off seems perfectly acceptable if *a priori* compensation *actually* occurs.

Table I. Uncompensated Risk A imposes risk on B^a

Ethic	$Y_A^0 > Y_B^0$	$Y_A^0 < Y_B^0$
Traditional B/C (utilitarian with linear utility)	accept	accept
Utilitarian (strictly concave utility)	reject	accept
Totally egalitarian	reject	accept
Totally elitist	accept	reject
Libertarian	reject	reject

[a] A's gain equal to B's loss.

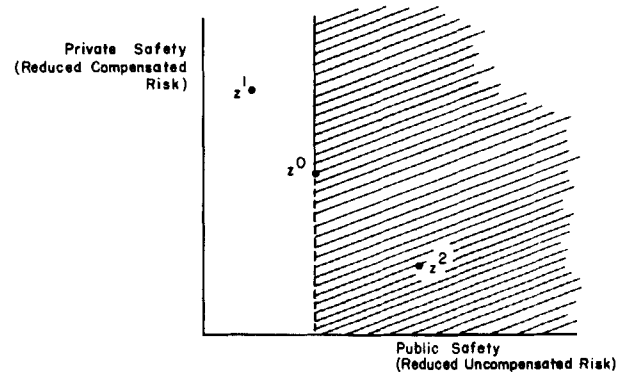

Fig. 2.

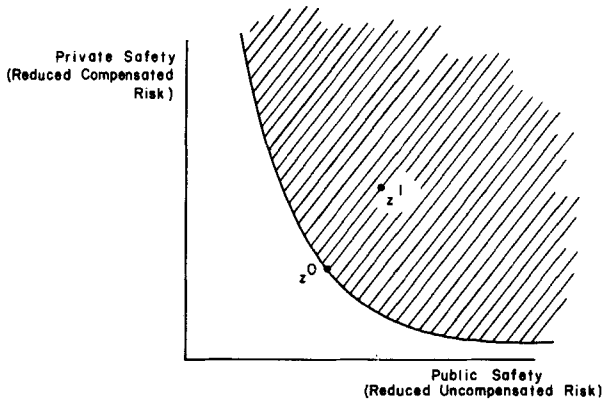

Fig. 3.

Thirdly, the libertarian ethic, with its close relationship to a constitutionalist viewpoint is of special importance for Western democracies. This ethical system, although seemingly weak in not requiring redistribution of income, rejects all uncompensated risks, implying lexicographic preferences as described above.

It is perhaps this last point, when applied in a broad context, which goes furthest in explaining the opposition that benefit-cost analysis has received in analyzing certain issues. For example, in many cases, lawyers and environmentalists have argued that polluting the environment is "wrong" and that economic policies such as selling permits for the right to pollute or taxing pollution are unethical. Similarly, advocates of public safety argue that no amount of effort on the part of airlines, operators of nuclear reactors, or large hydroelectric dams is sufficient when uncompensated risks are involved for the general public. These attitudes, which are reflected in enormously higher expenditures per life saved in some safety programs as opposed to others, seem consistent both with a libertarian ethic and with lexicographic preferences.

5. CONCLUSION

Although the libertarian ethic seems inconsistent with the way economists treat risk in benefit-cost analysis, this view is not inconsistent with an economic perspective. Consider the example of the dam once again. However, let us now take construction of the dam as a public project which would provide benefits of recreation and availability of water to the general public. Also, assume the risk of failure of the dam is imposed on many people. In a libertarian-free market framework we could imagine a perfect world in which *a priori* compensation would take place for all risks. Risks would be commodities traded in perfect markets. Thus, to build the dam, the right to impose risks on those below the dam would have to be purchased. Such a market for risk would, of course, require perfect information on the part of all parties. Further, since all market transactions would be voluntary—the dam builders would have to pay enough to all affected parties to get them to voluntarily accept any associated risks—no real ethical issues would be raised. This conclusion holds because, in the extreme, an individual could demand infinite payment to accept the dam, hence preventing its construction above that individual. Note then, that this particular arrangement protects each individual's rights—no one is forced to accept risk involuntarily —analagous to the perfectly competitive private market case wherein, for example, a worker may voluntarily accept a higher wage to work at a riskier job, but is free not to accept the offered compensation and risk. (The assumption of competitive markets, of course, implies full employment with consequent free choice of occupation, i.e., no one is forced to take a risky job *or* starve. Our society, with actual unemployment, effectively prevents forced employment with welfare programs.) In the private risk case, however, if one individual in the wage market is very risk averse and does not wish to accept a risky job, then another less risk averse individual will likely take the position. Thus, tenth story windows are washed without raising ethical questions or creating a societal crisis over *private* risk. Alternatively, our example of the dam points out an unfortunate problem with public as opposed to private risks. Construction of our example dam might be blocked by *one* very risk averse individual objecting to the imposition of a *public* risk; that is, if the market we proposed for risk were in existence. The distinction between public (joint) risk and private (separable) risk is then an important one, because, if a private market existed for public risk, one risk averse individual could then block joint action.

Another example may be useful in this context. Imagine that the passengers on an airliner are informed that by flying "low and fast" they will arrive at their next stop on time, making up for previous delays.[7] Clearly, a joint decision by the passengers is necessary. Those less risk averse will likely approve the divergence from standard procedures. Those fear-

[7]This situation actually occurred some years ago in Texas. Passengers voted for low and fast.

ful of flying in the first instance would likely resist. Airline risk is thus a public as opposed to private risk, since risks are joint—indivisible—as opposed to separable.

Different ethical systems will view such a situation in very different ways. Those focusing on the good of the whole including democratic or utilitarian viewpoints or benefit-cost analysis would all approve of "flying low and fast" if: (1) the majority voted for this alternative (democratic); (2) the summed utility gain to those less risk averse exceeded the utility loss to those more risk averse (utilitarian); or (3) the willingness to pay of those passengers wanting to fly low and fast exceeded the willingness to pay of those opting for "standard procedures" (benefit-cost). All three are roughly consistent with utilitarianism or benefit-cost analysis from a philosophical perspective in that a very risk averse individual could be outvoted, out-"utilitied," or out-payed by other individuals. Thus these criteria in themselves—including benefit-cost analysis—do not protect individual rights against some concept of majority rule or benefit.

A number of ethical systems alternatively focus on individual rights. These include those proposed by Kant,[15] Rawls[5] and the libertarian view as formalized recently by Nozick.[7] These ethical systems all would reject the imposition of uncompensated risk by the majority onto an objecting minority or individual. Each of these ethical systems might then reject benefit-cost analysis as it is traditionally performed. An alternative to traditional benefit-cost analysis is to weigh benefits and costs in a manner consistent with a number of alternative ethical systems. Clearly, outcomes may be vastly different under ethical systems which look to the "good of the whole," as opposed to those which focus on protecting "individual rights."

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