CSEP MODULE SERIES IN APPLIED ETHICS

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Risk-Benefit Analysis in Decisions Concerning Public Safety and Health

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K H
Kendall/Hunt Publishing Company
Dubuque, Iowa

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ISBN 0-8403-3600-4

Printed in the United States of America

B 403600 01

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The code of Ethics of the American Society of Civil Engineers specifies that "Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties" (Firmage 1980, p. 243). Decisions engineers must make—decisions also facing public officials, corporate executives, juries, insurers, and others who are responsible for public safety and health—turn on the question "How safe is safe enough?" Which risks are acceptable, which are not, and why? No one believes we can have risk-free consumer products, a risk-free workplace, or a risk-free environment; perfect safety never existed and never will. How can we tell, however, how risk-free the workplace or highways or automobiles or tap water should be? And who should be empowered to make that decision?

Risk-Benefit Analysis

During the past ten years, one way of answering these questions has received a great deal of attention in academic circles, in think tanks, and to some extent among governmental officials concerned with public safety and health. This approach borrows principles from cost-benefit analysis and applies them to the evaluation of risk. Risk-benefit analysis (or risk-cost-benefit analysis), as the resulting technique is called, attempts to answer the question "How safe is safe enough?" in economic terms. It proceeds in the following way.

First, one must complete a *risk-assessment,* which is to say, a determination of the probability that some harm will occur as a result of a decision or project. If one were designing a dam, for example, one might remember the Teton Dam failure of 1976. What is the likelihood that the dam now under construction will also fail? Risk-benefit analysis starts from the assumption that risks of this sort can be determined—that the probability of untoward events can be estimated correctly—in most, or at least in many instances.

Second, risk-benefit analysis attempts to determine the cost to society (the "social cost") of a project, decision, or undertaking. This includes, of course, the total cost of all the resources, such as capital, manpower, and materials, that go into its completion and maintenance. It also includes a cost or "price" assigned to the risk of harm the project involves. This might be determined by estimating the cost of the harm—the loss that would be caused by a dam failure, for example—and then multiplying that amount by the probability the harm will occur. One might also estimate the social cost of a risk (especially one involving loss of life or limb) by determining how much people are willing to pay to avoid risks of that kind or how much they will demand to accept them.

So far we have seen that risk-benefit analysis proceeds by

1. Assessing the risk, i.e., the probability of a harm;
2. Estimating the cost of that risk, e.g., by multiplying the economic loss

associated with the harm by the probability it will occur. One might also attempt to price the risk directly by determining how much people would pay to avoid that risk or how much they will demand to accept it.

3. Combining the cost of the risk with the other costs, e.g., the cost of all resources required for the project or the undertaking.
4. Assessing the benefits of a project in economic terms and then comparing these benefits with the combined costs of the project, including the costs associated with the risks it involves.

Those who advocate the use of risk-benefit analysis hold that such a comparison provides the best guidance for public policy decisions since the goal of public policy is generally to maximize the production of things people wish to buy (very much as a private firm may seek to do) while minimizing the costs that people have to pay for those things. On this view, the value of a policy or a decision may be measured by the amounts individuals are or would be willing to pay for (less the costs they would pay to avoid) its consequences. Accordingly, the rational thing for society to do in health and safety policy is to maximize "social profit," that is, the benefits society derives from its choices less the costs society must pay to acquire those benefits.

Those who oppose the cost-benefit approach in public policy, however, deny that a nation or a society should be analogized to a firm; they oppose the theory that public policy attempts primarily to maximize the surplus of goods and services people are willing to buy over the costs people have to pay for them. Instead, they believe the government should sometimes serve goals that may be justified independently on moral and cultural grounds. Safety and health may well belong among these ideals. Ideals and goals that are judged and justified ethically may emerge through the political process, where public values are discussed on their merits rather than priced in markets. The values we believe in and would seek to achieve as a nation and the interests we pursue and satisfy as individuals are, on this approach, not necessarily the same.

The Thesis of This Essay

This essay defends the thesis that risk-benefit techniques, while useful tools for gathering information about what individuals do in markets (or would do in hypothetical markets), cannot in themselves provide answers to questions responsible agents of society, whether in the public or private sector, must answer about public safety and health. Risk-benefit analysis offers guidance for policy decisions, but it does not provide an adequate basis for reaching or for justifying those decisions.

In a sense this is not a controversial thesis since few, if any, commentators would base policy for public safety and health exclusively on risk-benefit considerations. Most policy analysts recognize that moral, legal, and political factors are important; most allow that these cannot be "quantified" in economic terms. Thus, to argue that public safety and health considerations should not be based on risk-benefit and cost-benefit considerations alone may be to argue against a straw man. What we need to find out, however, is not *whether* risk-benefit analysis has a limited usefulness, but *how* limited it is and *what* its limitations are. Then we shall be in a position to use this technique when it is helpful and better to understand how to approach a decision or problem when it is not.

It is not enough, moreover, to criticize cost-benefit techniques; one must also offer a constructive alternative. This essay will argue that society should continue to work in the direction of improving the safety of consumer products, the workplace, and the environment, even if this progress calls for more safety than consumers and workers would purchase as individuals in the context of a voluntary, efficient market.

As Americans, we often speak of the values and virtues we share or aspire to as a community; these include compassion, fairness, and mutual aid and responsibility. These values and virtues caution us not to leave individuals entirely to their own devices in market relationships; rather, they call upon us to provide additional security and welfare beyond what individuals can or will bargain for themselves in private exchange.

We think of ourselves morally and politically as a community not simply as a market, and our interest in improving safety is a moral and political commitment, not simply an individual consumer preference. Accordingly, this essay will propose that engineers, policymakers, and others responsible for making decisions affecting public safety and health should think of the reduction of risk in society as a national moral and political ideal. We should continue to progress towards reducing risks steadily in sensible and cost-effective ways.

An example will illustrate the thesis to be presented here. Martin Bailey, while a Professor of Economics at the University of Maryland, argued that "The most direct evidence of the amount people are willing to pay for their own safety comes from the job market, which offers a variety of working environments with various degrees of personal risk" (Bailey 1980, p. 31). To take a simple case, suppose we know how much employees demand to compensate them for taking a risky job, let us say that of an airline steward or stewardess, where the chance of a non-fatal injury is negligible. Bailey (p. 33) reasons:

> For a person at the margin of indifference between this job and a less risky one that is otherwise comparable — that is, for a person willing to accept either job the extra wage is an accurate indicator of his own value of safety. To convert this information into an amount per life lost or per death avoided, divide the extra wage by the extra risk:
>
> $$x \quad \frac{\text{extra annual wage for the risky job}}{\text{extra annual risk in the risky job}}$$

For example, if the extra risk is 0.001, that is, one death per year per thousand workers, and if the extra wage for risk is $250 per year, then the ratio is X = $250/0.001 = $250,000.

Professor Bailey argues that cost-benefit analysis will help us determine the proper upper limit on resources we commit to life-saving activities. Thus, Bailey does not believe that workplace safety should be valued by society as a political or moral ideal; rather, he believes it should be treated as any other good or service that may be purchased in a market.

Professor Bailey's approach may appeal to us when markets reflect a "value per life saved" of a quarter million dollars or more. Suppose, however, that we look not at the example of stewards and stewardesses (after all, the airline industry is already heavily regulated for safety) but, let us say, at the example of West Virginia miners in the days before mine conditions were regulated by the Occupational Safety and Health Act. Suppose we found death and injury to be very widespread; suppose we found that miners went down into very dangerous mines for low wages even though experience made them painfully aware of the terrible risks they ran. Should we allow the resulting "price" for safety—perhaps a few thousand dollars per-life-saved—to determine social policy? Is the value of safety to be set by markets—fully consensual and fully informed markets—no matter how much mayhem may result? Or should society and its responsible agents find some gauge other than markets to determine the value of safety and to decide how safe is safe enough?

What could such an alternative criterion be? To find one, we can look into efforts to make public places, including workplaces, safer and to improve the safety of consumer products. These efforts were guided not by risk-benefit analysis (that technique is rather a recent development) but by compassion and a widely shared sense of social responsibility. These efforts show us that we can progress in the direction of safety without bringing the economy to a screeching halt. We cannot rely on markets, no matter how consensual, informed, and efficient, to make our moral decisions for us. We shall argue here that responsible officials, whether in the private or the public sector, should be guided by compassion and by an understanding of history when they make decisions affecting public safety and health.

Risk-Benefit Analysis: A Modern Instance

It is helpful to begin by considering an actual application of risk-benefit analysis to an engineering decision. In a famous instance, Ford Motor Company used a risk-benefit study to decide whether to spend an additional $11 per car or truck to improve the safety of the Pinto gas tank. The company estimated that the improvement of the gas tank design would avoid about 180 burn deaths and 180 burn injuries. The following table summarizes the cost-benefit analysis the company prepared (May 1982, p. 38).

Benefits and Costs Relating to Fuel Leakage Associated with the Static Rollover Test Portion of RMVSS 208

Benefits:

Savings—180 burn deaths, 180 serious burn injuries, 2100 burned vehicles.

Unit Cost—$200,000 per death, $67,000 per injury, $700 per vehicle.

Total Benefit—180 × ($200,000) + 180 × ($67,000) + 2100 × ($700) = $49.5 million.

Costs:

Sales—11 million cars, 1.5 million light trucks

Unit cost—$11 per car, $11 per truck.

Total Cost—11,000,000 × ($11) + 1,500,000 × ($11) = $137 million

In this example, the Ford risk-benefit summary put a value on each life saved of $200,000 and a value of $67,000 for each injury avoided. Figures of this sort might be derived (as Martin Bailey derives the value of X in the previous example) from market behavior, i.e., from the amounts consumers appear generally willing to pay to avoid risks or to buy protection, e.g., safety devices. These figures, which may now range from $250,000 to $1,500,000 per life saved or death avoided, represent "ballpark" estimates, but this is not the important factor here. What is important is the use of risk-benefit analysis—the use of this method to make policy decisions—in matters of safety and health.

In the Pinto gas tank example, the Ford Motor Company balanced the benefit of the cheaper gas tank to each consumer (a savings of $11) with the extra risk to the consumer (let us say a 1/30,000 chance of injury or death). Suppose Ford found, in a survey of market data, that people are unwilling to pay $11 to avoid a risk that small, in other words, that consumers would not, on average, pay the extra money for the extra safety, were they free to choose. The company might argue, therefore, that its decision not to equip the Pinto with a safer but more expensive gas tank makes a profit not for Ford, which (let us assume) passes the savings on to the consumer, but for society in general. The risk-benefit analysis, the company may contend, indicates the *right* decision—the decision that maximizes what is good, the things people want, while minimizing the things they want to avoid.

We can put this thought more generally. Society should allocate its resources *efficiently,* which is to say, in ways that maximize "good things," where "good things" are defined in terms of what people want and are willing to pay for, while minimizing "bad things," which are defined as things people do not want and would pay to avoid.[1] The "right" decision, on this approach, would be the "efficient" decision, that is, the decision that allocates resources in a way that maximizes goods over bads or benefits over costs. Health and safety are included among these goods: from the point of view of the risk-benefit technique, health and safety are values to be considered but they are not paramount. Rather, risk-benefit analysis helps society to maximize the production

of *all* goods and services, valued according to the relative amounts people will pay for them, whether or not this production leads to a safer society.

What else could the automaker have done? How else might Ford have determined how safe to make the Pinto tank? It might have surveyed the safety or crash resistance of the tanks of comparable cars and trucks and thus determined the industry standard. It might then have decided to make the Pinto tank somewhat safer than that standard, even if that added to the price of the car or truck. This decision would have envisioned safety as a goal to be achieved even at the expense of overall efficiency; a moral goal, in other words, would take priority over the economic one. Some might argue that efficiency itself is a moral goal; some believe, as we shall see, that risk-benefit analysis leads to morally correct decisions. This possibility takes us to the question of the ethical or the normative basis of risk-benefit analysis or cost-benefit analysis in general. Can these techniques be defended in moral terms and, if so, was Ford Motor Company ethically correct in making safety decisions on risk-benefit grounds?

The next sections of this essay consider the ethical basis for risk-benefit analysis. We shall look critically at possible justifications drawn from moral and political theory. Later, we shall consider the practical difficulties confronting the risk-benefit analyst, for example, the limits of risk-assessment. We shall also discuss the problematic methods cost-benefit analysts use to determine market prices—called "shadow prices"—for goods that, because of some market failure, do not receive an adequate market price.

The Ethical Basis of Risk-Benefit Analysis

Those seeking an ethical justification for the use of cost-benefit analysis might be expected to find it in *utilitarianism,* an ethical theory developed in the nineteenth century by Jeremy Bentham and John Stuart Mill. Mill (1961, p. 407) puts the thesis, in rough and ready terms, as follows:

> The creed which accepts as the foundation of morals *utility* or the *greatest happiness principle,* holds that actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness. By happiness is intended pleasure and the absence of pain, by unhappiness, pain and the absence of pleasure.

Those who defend cost-benefit analysis or, more generally, the efficiency criterion in public policymaking, cannot appeal to the utilitarian principle of maximizing happiness, however, at least not in any direct way. First, the "greatest happiness" principle invites all kinds of devastating objections, now standard in the philosophical literature.[2] Second, utilitarianism, at least in the form Bentham and Mill propose, concerns *satisfaction* in the sense of a feeling or a state of mind: in this sense, "satisfaction" means something like "contentment." The efficiency norm concerns *satisfaction* in a different sense; it seeks the satisfaction of *preferences.* When we say that conditions or equations are "satisfied" we use the term "satisfaction" in this sense, meaning "met" or "fulfilled." The term "satisfaction" when used in this sense has no logical connection with pleasure, contentment or happiness.

The question arises whether the satisfaction of preferences leads to satisfaction in the sense of contentment, in other words, whether people become happier (after their basic needs are met) when they have more of the things they want to buy. This is an empirical question the answer to which, based on current research, seems to be no.[3] Therefore, one cannot defend the efficiency norm—and with it cost-benefit analysis—by a direct appeal to the principle of maximizing happiness.

Economists who defend risk-benefit analysis on ethical grounds are fully aware of this objection; they immediately round it out with another. Pleasure and pains cannot be measured and compared like chemicals or money; therefore, no one can say *how much* pleasure or happiness is produced by any particular action. Earlier in this century political economists often repeated this point. "There is no scientific criterion which would enable us to compare or assess the relative importance of needs of different persons" (Hayek 1935, p. 25). "There is no means of testing the magnitude of A's satisfaction as compared with B's" (Robbins 1932, p. 122).

Economists concerned with issues of public welfare—welfare economists as they are called—struggled for almost a hundred years with the problem of showing how, in the absence of any way of measuring satisfaction in the sense of happiness, one policy or social state could be meaningfully said to be better or more "beneficial" than another. To deal with this problem, they took an idea from the work of Vilfredo Pareto, a turn-of-the-century Italian economist. He argued that social state A is better than social state B if at least one person prefers A to B while no one prefers B to A. If no one prefers B to A if no one complains at the decision to move from B to A—then the policymaker is relieved of the necessity of comparing utilities or making interpersonal comparisons of welfare. Yet the principle, thus stated, seems useless, for no major policy decision changes things in ways that leave no one worse off.

It is possible to imagine, however, that those who prefer situation A to B could compensate those who prefer B to A and still maintain their preference. The "winners" from a social change, in other words, might bribe or pay off the "losers" and still have enough left over to remain winners. In that situation, Pareto's criterion would be fulfilled: for after compensation is paid, no one is worse off in situation A.

Two British economists, Nicholas Kaldor and John Hicks, developed this "compensation test" as a principle for justifying policy decisions and changes. According to their principle, situation A is more beneficial than situation B if those who prefer A *could* compensate those who want B and still have enough left over to maintain their preference. This criterion is intended to establish

which of various situations is most "beneficial" from the point of view of society as a whole. It remains to be settled independently, presumably by the legitimate political authority, whether the "winners" do compensate "losers," so that a social decision or change is equitable to all members of the society.

There are two major objections to the "Paretian" defense for cost-benefit analysis which we have just described. The objection we shall consider first is formal. It argues that the Paretian defense relies on the very interpersonal comparisons of utility that it was adopted to avoid. The second objection is more fundamental. It challenges the risk-benefit analyst to explain why it is a good thing that people get more of what they are willing to pay for, once their basic needs are met.

A. *A Formal Difficulty.* Many welfare economists, eager to make their approach to social choice truly "scientific," have sought a way to *measure* welfare, for example, to find some yardstick in relation to which the well-being, contentment, or happiness of one person can be compared with that of another. Since well-being and happiness seem to be entirely subjective feelings, however, economists have been unable to measure them in an objective "scientific" way.

These theorists are attracted to the Paretian principle because they see in it a means to determine whether society as a whole is better off as a result of some policy or decision, without having to measure any individual's welfare or having to compare one person's welfare or "utility" with that of another. After all, if one person is better off and none worse off as a result of a decision, we can conclude that society as a whole is better off or that overall social utility has been increased. We can reach this conclusion without making any illegitimate, because unmeasurable or untestable, interpersonal comparisons of welfare.

Economists could not rely on the Paretian principle alone, for, as we have just said, no major policy decision changes things in ways that leave no one worse off. Accordingly, welfare theorists add the Kaldor-Hicks compensation test to make the Pareto principle useful. The use of the compensation test—the idea that society is better off as a whole if winners could compensate losers—leads, however, to an important technical difficulty. We cannot use this test to determine whether society as a whole is better off (whether net utility is increased) unless we make the very interpersonal comparisons of utility the Pareto principle was designed to avoid.

To see this, consider the example in which the gainers are millionaires, who are used to throwing around money, and the losers are very poor, down to their last dollar, which they need to feed themselves and their babies. A social decision that gives the millionaires $12 dollars but takes $1 from the same number of starving beggars plainly passes the compensation test—since the millionaires could compensate the beggars ten times over and still come out ahead. Yet the overall welfare or utility of society is decreased since the loss means so much more to the beggars than the gain means to the millionaires. You

cannot know this, however, unless you compare utilities (see Coleman 1980). Gains and losses have different effects—they lead to greater happiness or misery—in different individuals. Accordingly, to make the concept of compensation function normatively, one cannot rely on the measuring rod of money. One must measure utility in some more subjective and therefore less "scientific" way.

B. *The Philosophical Difficulty.* The Paretian defense of cost-benefit analysis assumes that if someone prefers A to B, then, all other things being equal, society as a whole should prefer A to B; in other words, it assumes that preferences are indicators of value. But what justifies this assumption? What takes us from

A is preferred to B

to

A is better than B?

Why should preferences be satisfied? Why is it *good* that resources be allocated so that people get more of the things, or services, or events which they prefer or for which they are willing to pay, once their basic needs are met?

We have already suggested that people are not necessarily happier when they have what they want: they may as easily be disappointed when their wishes are satisfied (Hirschman 1982). Someone might say that if a person prefers A to B then he will be better off if A happens rather than if B happens. But what does "better off" mean in this context? To answer that the person will be better off in the sense that his preferences will be satisfied is merely to argue in a circle. The question we have to answer is this: Why is it *good* that a person's preferences be satisfied?

One might argue that it is good that personal preferences be satisfied, all other things being equal, because this is what the persons who have those preferences want. This answer, however, suggests an "infinite regress," for we must then ask the same question and receive the same answer again and again. Why should this want be satisfied? Besides, people wish preferences to be satisfied at the moment they have them, but later they often change their minds. Disappointment, education, experience, and the like lead people to be glad some of their preferences were *not* satisfied or to be sorry that some preferences were satisfied which they now regret. So it is not even true that people always want their wants satisfied except, perhaps, at the passing moment they have those wants.

Question: W. W. Jacobs, in a popular story called "The Monkey's Paw," describes the devastation that comes to a family that possesses a monkey's paw with magical powers to grant the owners three wishes. The story of King Midas, who desires to turn everything he touches to gold,

makes a similar point. What do these stories suggest about preference-satisfaction as a goal of rational policymaking? Can policymakers take disappointment and disillusion into account?

The Free Market Justification of Risk-Benefit Analysis

Those who defend cost-benefit approaches to public policy, however, need not claim that want-satisfaction is a good *per se* or that efficient decisions or policies make society happier or better in any ethical sense. Instead, they may argue that cost-benefit analysis has its justification in political theory, insofar as it might be based on a hypothetical contract among all members of society. According to this argument, the use of risk-benefit analysis has our implicit consent because it leads to or duplicates outcomes that individuals themselves would have reached in perfectly functioning markets. Markets, when they function well, are unanimous consent arrangements, nearly by definition, since all transactions are voluntary. This first argument has the following form. Consent given in markets leads to efficient outcomes or allocations. Therefore, efficient outcomes or allocations, when determined by cost-benefit analysis, have at least our implicit consent.

Second, those who defend the efficiency criterion in decisions that affect public welfare argue that self-interested rational individuals should or would consent to this criterion since they have a better chance to gain than to lose over the long run. Efficient policies produce losers as well as winners, to be sure, and no one may be said to consent directly to his or her loss. Yet, since the efficiency criterion offers each person better odds on winning than losing, it seems that he or she ought to consent to the loss because it is fair (or perhaps efficient) that he or she bear it. At any rate, were individuals to chose *ex ante* (before they know how things will go for them) between cost-benefit analysis and some other rule for social decisionmaking, they would choose cost-benefit analysis, because the chances are that they would then be better off as a result (Posner 1980).

We shall now consider these arguments. We shall also look at some of the laws Congress has passed which seem to flout efficiency. The Occupational Safety and Health Act, insofar as it sets "feasibility" rather than "efficiency" as the criterion for safety, might be one such law. Other popular legislation of this sort includes the Clean Air Act, the Clean Water Act, and the Endangered Species Act. These laws call for and aspire to a safer, cleaner, more protected environment. This kind of environment, however, would not necessarily result from voluntary transactions even in perfect markets.

The popularity of these laws raises a fundamental problem. The consumer seems to "vote" one preference in the marketplace, but to express an inconsistent one through the political process. For example, most Americans support the Occupational Safety and Health Act, even though, by making the

workplace safer, the law makes products more expensive. Consumers, on the other hand, seem to "vote" for an unsafe workplace by purchasing the least expensive products in markets.

This example suggests that consumer choices and political choices may be harder to assimilate than many analysts would have us think. The individual appears to have one set of preferences that he/she reveals in marketplace transactions and another that he/she expresses in political behavior. It may be hasty, therefore, to substitute cost-benefit analysis, which reflects consumer preferences, for political decisionmaking, which reflects, more or less, citizen beliefs and convictions.

Question: Is willingness to pay an appropriate indication of what is valuable? Is it an appropriate indicator of acceptable levels of risk? Consider the following example. Cigarette consumption remains high although nearly everyone recognizes it as the largest controllable cause of cancer. Clearly, people are willing to pay to smoke although they know the risks. Does it follow that 1) smoking is valuable? 2) smokers believe smoking is valuable and respect themselves for smoking? 3) the benefits associated with smoking are worth the risks?

Some economists meet this criticism by arguing that markets are *more* representative, *more* democratic than majoritarian legislatures. Milton Friedman, in *Capitalism and Freedom,* (1963, pp. 13–14) argues that a free market economy

> is, in political terms, a system of proportional representation. Each man can vote, as it were, for the color of tie he wants and get it; he does not have to see what color the majority wants and then, if he is the minority, submit.

Friedman argues that markets offer a "system of proportional representation" because they price all interests in the same way, according to the cost of satisfying them. "Indeed, a major objection to a free economy," Friedman adds (p. 14), "is precisely that it does its task so well. It gives people what they want rather than what a particular group thinks they ought to want."

Two British economists, D. W. Pearce and C. A. Nash, in their text on cost-benefit analysis (1981, pp. 6–7) provide five reasons to believe that "the kind of 'one-man-one-vote' principle we have in democratic societies" is actually *less* democratic than "the kind of vote which actually gets recorded in a cost-benefit study." First, as these economists explain (p. 7), "The use of money values permits some expression of the *intensity of preference* in the vote: it enables the individual to say how deeply he wants or does not want the project or the good in question." A ballot, in contrast, counts all votes as simply for or against. Second, referenda cannot be taken on every major regulatory de-

cision; cost-benefit analyses, however, can be produced on a routine basis. Third, personalities dominate elections, whereas cost-benefit analyses, insofar as they reflect what markets would do if markets were efficient, are impersonal and concentrate on the issues. Fourth, political systems usually provide only for indirect or representative democracy, while markets (and cost-benefit analyses insofar as they second-guess markets,) provide a mechanism whereby individuals can "vote" their dollars directly. Finally, people often fail to vote in elections, but they do participate in markets.

Let us now consider these five arguments which are intended to show that the kind of electoral democracy our constitution provides is less democratic, less representative, than "the kind of vote which actually gets recorded in a cost-benefit study." The first argument, which refers to the intensity of preference, fails for two reasons. First, citizens express the intensity of their preferences all the time by lobbying their political representatives. What is more, citizens can give arguments and reasons for their political positions, while they do not have, as a rule, this "voice" option in markets. Second, the intensity of preferences expressed in markets depends not just on *willingness* but also on *ability* to pay. Thus markets weigh the preferences of the rich well ahead of the preferences of the poor. To be sure, wealth influences the outcomes of political decisions too—but not as much, since votes are distributed more equally than money.

Second, we are told that cost-benefit analyses can be prepared routinely for most policy issues, while referenda are much more difficult to arrange. This argument assumes, falsely, that we wish major policy decisions to be based simply on the preferences or wishes that exist in society at a particular time. Our constitution, however, envisions a political process that is *deliberative* as well as *representative;* it gives Congress the power to think about policies on their merits rather than simply to "price" policies, as it were, in a market.

Third, we are told that personalities dominate the political process, which is therefore colorful but inefficient, whereas cost-benefit studies are rational, complete, and relevant to particular policy decisions. This argument commits the *fallacy of disparate comparison* which occurs when someone contrasts one recommendation in its reality with another in its ideal or theoretical form (Gewirth 1971). One commits this fallacy when one compares, let us say, a simple but good cake actually baked with a much more ambitious one pictured in a gourmet magazine. Likewise, some economists compare the *reality* of our political life with the *theory* of cost-benefit analysis. It may turn out, however, that cost-benefit analysts are just as human as politicians and that both fall equally short of the ideal they are supposed to reach. Risk-benefit analysts, for example, may fail to assess risks correctly, misinterpret market signals, or make mistaken inferences from these signals.

The response to the fourth argument—that cost-benefit studies provide a kind of "direct" democracy—is the same as the answer to the second. We may not think that *direct* democracy is always a good thing. Rather, we expect our

representatives not simply to reflect our wishes but also to think as well, that is, to use their judgment, their conscience, and their experience in making law. Our political representatives have staffs to help them to determine good policy. They do not try simply to find out what people happen at that moment to want.

Finally, we are told that people participate more in markets than in the political process. This depends upon what one means by "participate." It is true that we buy things in markets more often than we vote, write letters, or otherwise try to influence our political representatives. Yet if the notion of "participation" means expressing views and arguing for them—if it means acting in public to convince others of ideas rather than acting in markets simply to satisfy one's personal wants—then participation may occur primarily in the political realm.

There are some choices which plainly depend only on personal preference or individual self-interest and which, therefore, ought in general to be left to voluntary markets. The decision whether to have one's pants cuffed or to wear them straight, for example, is a consumer choice and has nothing to do with the goals we seek as a nation or with our concept of ourselves as a good society. The question of capital punishment, on the other hand, plainly involves beliefs and convictions we hold as citizens and which we debate and judge through the political process. People who join the American League to Abolish Capital Punishment, for example, are not motivated by self-interest. They are not themselves afraid of being hanged.

The question before us is this: is safety, e.g., in consumer products or the workplace, a moral and political issue that goes to our conception of ourselves as a good society, or is it a consumer choice, to be left to markets and, when markets fail, to market analysis? Are the numbers of dead and injured in the workplace, like the numbers of cuffed pantlegs, a matter of moral indifference, as long as markets are efficient and individuals are free to choose? Is it instead a matter of moral importance (as many people consider capital punishment and abortion to be morally important) which we deliberate over in moral terms and do not automatically leave to the mechanism of markets?

The Rights of Competition vs. The Goals of Community

Can risk-benefit analysis tell us how safe is safe enough? Can it balance our interests and make the tradeoffs we need to make when our values conflict? To answer this question, it is useful to distinguish two quite different ways in which we might describe ourselves, that is, two different ways in which we might say *who we are* as distinct from *what we want.*

Who are we? What is a person? We might think of ourselves, first, as individuals competing with one another for the use of scarce resources to satisfy our particular preferences and desires. On this approach, which we find in economic theory and in political theories which grow from economic theory,

the notion of competition is essential in defining what a person is. We define ourselves in terms of the essential rights and obligations each of us may claim on the basis of being a person in competition with other persons for the use of scarce resources. These rights and obligations are legitimate, we may say, because they are necessary to make competition equitable, just, efficient, or fair.

Many philosophers, from John Locke to John Rawls, have explained the basis of our political life in terms of a social contract. Rawls (1971) presents a version of the social contract according to which it is a hypothetical agreement we would make as rational agents in a situation that is fair between us. This may be a situation in which we do not know about the contingent features of our lives, e.g., our wealth, sex, and social position, and so on. In that situation, we might agree on certain principles to govern the structure of the social and political institutions under which we will later compete—principles that confer rights and obligations on each of us. These rights and obligations may be thought to define our moral personhood; as John Rawls (p. 563) puts it, "The essential unity of the self is already provided by a conception of right."

So far, we have mentioned one way of identifying or describing ourselves, that is, in terms of competition in which each of us defines his or her moral personhood in terms of certain rights or principles that have priority over whatever preferences or desires we may compete to satisfy. On this view, the self is prior to its ends, which is to say, the essential rights and liberties that define moral personhood exist independently of and prior to the particular desires or interests the individual may in fact pursue.

Second, we may suppose that some of our values and goals—the ones we adopt in our actual life not in a hypothetical social contract—are so important to us that they are part of our identity. They reflect not just what we want but who we are. Consider the love of parents for their children. Some parents, probably most, consider their role as parents to be constitutive of their moral personhood, more constitutive of their identity than their role as self-interested maximizers or as competitors for scarce resources. Parents, in other words, would tend to describe their actions toward their children in terms of a virtue like *love* rather than a goal like *efficiency* or a virtue like *justice*. It is only if love fails that we must rely on justice—that we must speak of the rights of parents and the rights of children.

Those who urge the use of risk-benefit analysis in setting policy for public safety do so, as a rule, because they have a vision of society as an arena of competition, and therefore emphasize the goals of efficiency and fairness in order to regulate that competition. Those who question the use of risk-benefit analysis may envision society on the model of a community or an extended family and emphasize the virtues of compassion, sympathy, and shared aspiration. To see this difference, suppose that social relationships are essentially competitive: individuals in society compete to maximize their consumption of scarce resources. We might then define personhood or individuality in terms

of the rights that protect one person from being used or manipulated unfairly by others and thus which assure the fairness or perhaps the efficiency of competition. With this presupposition, markets appear to be attractive means of collective choice. Markets are fair insofar as they are neutral among the goals that we choose: ideally, they set prices simply on the basis of the cost of satisfying preferences, not on the basis of some moral view about those preferences. And markets are efficient insofar as they allocate resources to those who value them most or those who are willing to pay the most for them.

Needless to say, in order to make competition fair and, perhaps, even efficient, we must make sure that each person has a decent opportunity to compete; we must redistribute wealth, opportunities, and other resources in a way that keeps everyone in the "game." Economists and philosophers who view individuals essentially as competitors may disagree about the extent to which "equity" considerations should be balanced against "efficiency" considerations. But whether they emphasize the goals of fairness or the goals of efficiency, they agree that individuals have a right to compete on an equal basis with other individuals, and that some redistribution may be necessary to secure that right.

Under this conception of personhood and society—individuals as competitors, society as competition—risk-benefit analysis makes the most sense. It allows us, at least in theory, to do what equitable and efficient markets would have done but for the costs of making bargains, including the costs of getting information, finding willing trading partners, and so on. Cost-benefit analysis attempts, at least, to determine the outcome people themselves would reach if they could complete all mutually agreeable transactions. In that sense, cost-benefit analysis might be said to serve the interests of individuals while remaining neutral among those interests.

On the other hand, we may not think of society as a kind of competition but as a kind of family or community. In this view, we would say that a community can have goals or projects of its own which people determine not through their competition as individuals but through their conversation as citizens. We may think, for example, that whatever preferences individuals may reveal in the marketplace, our society ought to reduce risk in the workplace, the environment, and in consumer products. This need not express what we think a fair or efficient market would do. It may reflect, rather, the policies of a society that emphasizes empathy over efficiency, the goals of community over those of competition.

If you think we pursue goals as a community that can differ from the interests we may pursue as individuals, then you will probably question the basis of risk-benefit analysis. You will argue that some of the preferences individuals pursue as individuals are less important even to them than are the character and the policies of the community to which they belong. A person, in other words, may conceive of himself or herself as a citizen, not simply as a competitor or as a consumer. As such, he or she will join in making policies

that reflect our character as a nation. He or she will discuss public policy in public terms, rather than leaving safety and health policy to the private preferences individuals reveal in markets.

Question: The Constitution as interpreted by the courts limits the power of political majorities by protecting the rights of individuals and minorities. Congress (and by extension the states), therefore, can make no law that abridges freedom of conscience, speech, assembly, press, and so on. No legal scholar argues, however, that laws like the Consumer Product Safety Act and the Occupational Safety and Health Act violate any of these rights or that they exceed the constitutional powers of government.

All the same, there are many areas where government may become involved without violating constitutional rights and yet where its involvement may nevertheless be unwarranted, unwise, or inappropriate. People have argued, for example, that markets may develop energy resources most beneficially if corporations are left to compete and are not forced to follow policies developed in governmental bureaucracies. How do we decide when to leave a decision (e.g., how neckties are designed) to markets and when to entrust it to government (e.g., the safety of nuclear power plants)? How do we decide which aspects of industry to regulate and which to leave as free as possible from regulation?

Health and Safety as Matters of National Conscience

Nearly everyone recognizes that the government has a duty to protect the public from harm. Nearly everyone agrees, for example, that the government should enforce ordinary criminal laws against murder, robbery, and other assaults upon person and property. The question arises how far beyond that minimum the government—or any responsible official—should go in order to protect public safety and health. Consider consumer product safety. How much safety should be required by regulation? How much should be left to the market?

Example: Suppose that you find a way to save a lot of money in the design of a chain saw by radically diminishing its safety. The head of advertising at your firm promises that he will inform the public; as long as the saw is properly labelled, he says, it involves no fraud. He says he will promote it as a "real saw for real men, men who do not want to pay for all the sissy safety stuff."

Should your company sell the unsafe saw? Should the government allow it to be sold? Remember no fraud or coercion is involved: the consumer could buy a safer but more expensive saw; perhaps your company makes one. Thus, the consumer consents to the risks he or she takes. If he or she loses an arm, that's his or her hard luck, isn't it? Why should you—or the government—limit freedom of choice?

Up until this century, the government protected public safety and health primarily by prosecuting ordinary crime, such as muggings, robberies, and murders. The courts also awarded payments to people who suffered damage resulting from malfeasance or negligence of others. With these exceptions criminal law and the law of tort—markets went generally unregulated. Workers and consumers were free to bargain with manufacturers in determining the prices they would pay, the wages they would receive, and the risks they would take.

Early in this century, magazines began carrying articles which described the horrors American consumers suffered as a result of the unsafe products they bought. This "muckracking" journalism created a climate of public opinion that led to Congressional action, starting with the regulation of the food and drug industry in 1906.

This first wave of Congressional action subsided until the 1930s when, during the New Deal, another spate of books and articles made people aware of and angry about the hazardous nature of consumer products. Consumer activism peaked again in the 1960s in response to journalists who stirred public opinion to political action. Ralph Nader's *Unsafe at Any Speed,* for example, was partly responsible for the passage the following year of the National Traffic and Motor Vehicle Safety Act which for the first time authorized compulsory safety standards for cars and tires. The general public continued to perceive safety as a moral issue; Americans found it unconscionable that companies would sell unsafe products even if consumers, fully informed, would buy them to save a few dollars.

The struggle for safer consumer products and a safer workplace (starting a century ago with the regulation of child labor) has been to a large extent a *political* struggle. This means, first, that consumers and workers looked primarily to their elected representatives to satisfy their needs and to vindicate their concerns; they found less representation and less satisfaction in markets. Second, these groups successfully enlisted public opinion, that is, the beliefs of citizens whose interests might not be served by a particular reform, but who thought a safer society would be a morally better one all the same. Many Americans have thought, correctly, that child labor is simply outrageous and contemptible, impossible in a society that considers itself in any way civilized, whether free market transactions would lead to it or not. Likewise, many Americans who are not themselves directly involved as consumers or as workers, condemn on moral grounds products or workplace conditions that cause frequent injury and death.

In the previous section, we described two models or conceptions of society. One model represents social life as competition; it sees government as justified by an implicit contract we make as individuals to regulate our competition to make it more fair or more efficient. On the second model, which emphasizes the creative role of political or public life, we see ourselves as determining at least some of our values together: we think of society in terms of a social *union* not simply in terms of a social *contract*. We define our purposes as a nation historically and morally not simply in relation to the efficiency or even the fairness of competition.

These two conceptions or models of society suggest the strengths and weaknesses of risk-benefit and cost-benefit analysis. Cost-benefit analysis, at least in theory, has the virtue of indicating how a neutral and efficient market would allocate resources with respect to public safety and health. If you think that society is ideally like a market in which people compete under rules common and fair to all, then you will probably favor the use of cost-benefit analysis.

But if you think of a society as having values, goals, and historical purposes of its own, you are likely to argue that risk-benefit analysis, like the market it imitates, serves only the interests or wants of the private individual, without letting him or her participate in a larger process of cultural and political self-determination. You will say that the image of an interest-haver and rights-bearer found in economic theory fails to reflect all we actually are. To be ourselves, we must participate in forming public values, not just in satisfying private preferences—and these shared values plainly include goals concerning public safety and health.

Why Regulate?

Let us now return to the thesis that efficient markets set the "right" or the "optimal" levels of safety. A market may be called "efficient" if it allocates goods and services to those who are willing to pay the most for them, which it will do if certain stringent conditions are met. First, resources must be fully owned; in other words, goods should not be owned in common or people will just grab them and use them wastefully. Property rights in these resources should be properly enforced so that they are traded voluntarily. Markets must function without externalities, that is, without spillover effects (like pollution) on unconsenting third parties. The price of goods and services will then reflect all the costs of producing or providing them. When these conditions fail to hold—when market failures such as externalities exist—the government may intervene, by allocating resources as an efficient market would. That is the purpose of cost-benefit analysis. The idea is that the government should "correct" markets when markets fail to allocate resources efficiently.

The idea that the government should not intervene in private transactions unless its action can be construed as a rational response to a market failure

leads us to the following question. Suppose the government intervenes instead on moral or ideological grounds. Suppose citizens who know nothing whatever about the abstractions of economic or market theory just believe that child labor is wrong or that too many people are getting killed on the job. May the government intervene for these ethical reasons?

This question can be raised about consumer products. Suppose the Ford Motor Company, instead of conducting risk-benefit analyses, let consumers buy as much safety as they want. The manufacturer might offer as an option any of three gas tanks. With the least safe, you save $50 but take a 1-in-1,000 chance of going up in flames. With the middle option, you save $11 and reduce to 3 in one million your chances of an immolation. The most expensive tank saves you no money but guarantees that you won't be burnt by gasoline even if you are hit by a train.

Let us suppose—as is not unlikely—that most consumers, to save $50, take the 1 to 1,000 chance and buy the cheapest tank. If ten million cars and trucks with this option are sold, ten thousand rather hideous deaths would result. The market has functioned perfectly. Should the government interfere? Suppose consumers ran a 1 in 100 chance of death to save $100 dollars. Would 100,000 burning deaths a year justify political intervention in a completely voluntary, informed, and therefore efficient market?

The reason we regulate safety in consumer products and the workplace is to prevent the mayhem that would result if we did not—that could result, one might add, in markets that appear to function fairly well. We regulate, in other words, for old fashioned utilitarian reasons: to prevent the misery that people would otherwise bring upon themselves. We also regulate to prevent conditions which are simply outrageous, uncivilized, and beneath our dignity and self-perception as a caring and compassionate people even if (like child labor) they result from voluntary transactions.

When Congress passed the Occupational Safety and Health Act of 1970, it estimated that 14,000 Americans had died in that year from job-related hazards. Congress found that of the nation's 79 million workers, over two million were disabled on the job and another 5 million suffered from lesser job-related illnesses. Almost 400,000 new cases of occupational diseases were reported that year.[4] With body counts that high, Congress did not stop to ask whether markets were functioning efficiently, that is, whether workers and employers were contracting with one another freely and in an informed way. Congress cared about the lives of thousands of workers and not about how much workers were "willing to pay" for the safety employers might "sell" them. It passed the Occupational Safety and Health Act, therefore, to achieve a safer and more humane workplace, not to improve the efficiency of markets.

Congress dealt with the problem of occupational safety and health not because workers and consumers were prevented from trading safety for money but precisely because they were not prevented from doing so. Workers too often put safety on the "back burner" and took the money employers offered

instead. The money looks good at the time—and the deaths and injuries happen down the road. This is not a market failure; it is a human failure. One negotiator for industry found "a tremendous tolerance for unsafe conditions among employees in most areas of American business" (Bureau of National Affairs 1973, p. 14). Jack Suarez, then Health and Safety Director for the International Union of Engineers, put the matter bleakly. "In negotiating a contract, it appears that health and safety clauses come after coffee breaks" (p. 15).

Higher "prices" paid for safety often result from regulation, which raises consciousness among consumers and workers. Bernard Kleiman, a negotiator for the Steelworkers, makes this point: "Safety is a very tough thing to negotiate. There are so many levels of consciousness to it. Both sides have to be hit over the head a good deal before they develop the consciousness that permits them to move" (p. 15).

It may not be unfair to say that through legislation we develop our consciousness—our compassion, our pride, and our self-perception—as a nation. As citizens, working through the rule of law, we ourselves change the values we hold. Cost-benefit analysis reflects market data that itself reflects previous regulatory action. In that sense, cost-benefit analysis is conservative: it freezes us at a certain "level of consciousness." Had cost-benefit analysis been done at the time of child labor, company towns, and sweat shops, it would have put a much lower price on safety, a much lower "value" per life saved, even discounted for inflation. Markets today "price" risk more dearly. This is a result not of better markets but better regulation.

Markets and Morals

We have seen that those who advocate the use of cost-benefit analysis may do so on the grounds that it is representative—more representative than the political process—of our preferences. This argument depends, in turn, on the conception of markets as "unanimous consent" arrangements—institutions in which each person gets to "vote" his preferences by paying to satisfy them. Yet we find that markets and the political process do not reflect the same preferences. Markets reflect, ideally, the wants or interests individuals are willing to pay for as consumers. The electoral, legislative, and administrative process together reflect, ideally, the beliefs and opinions that individuals are willing to argue for as citizens. How can cost-benefit analysis present itself as better able than the political process to represent these citizen-preferences when it seems to ignore them or fails to take them into account?

Those who favor the use of cost-benefit analysis have responded to this criticism in several ways. The most extreme position, of course, would reject citizen-preferences altogether and insist that only consumer preferences should count in making and justifying regulatory policy. This extreme position, however, is impossible within the context of our constitutional democracy, which guarantees citizens access to an electoral process. Our Constitution gives us the right to be *heard*—to argue for our community-oriented beliefs and moral values. It gives us the power of self-determination as a community. At the same time, the Constitution establishes the rights of citizens to privacy, freedom of conscience, and so on, in order to protect them from intrusive legislation.

Economist Stephen Marglin (1963) has considered and dismissed the idea that regulatory policy should be based entirely on consumer rather than citizen-preferences. He observes (p. 98):

> The Economic Man and the Citizen are for all intents and purposes two different individuals. It is not a question, therefore, of rejecting individual time-preference maps; it is rather that market and political preference maps are inconsistent.

Marglin speculates that since deeds speak louder than words, perhaps consumer or market-revealed preferences are more genuine. He jokes (p. 99): "One might argue on welfare grounds for authoritarian rejection of individuals' politically revealed preferences in favor of their market-revealed preferences!"

Marglin recognizes the "authoritarian" character of this rejection. The amount of political effort citizens groups exert in favor of health and safety legislation is considerable; that kind of activity involves as many "deeds" as "words." To reject the values individuals express through the political process, moreover, is to rule out the values those individuals can give reasons for and which they believe are worthy of community and perhaps universal acknowledgement. How can one suppose that these values are less considered or less important than those one reveals, often on impulse, often indifferently, when one selects a hairspray or buys a car?

Very few policy analysts, if any, advocate an "authoritarian rejection of individuals' politically revealed preferences in favor of market-revealed preferences." Most who defend cost-benefit analysis try to account for citizen-preferences in other ways. Some analysts would argue that it should be possible to infer, for any individual, a "meta-ordering" of his personal and political preferences that makes both up into a single preference ordering. Markets, to be sure, would *not* reveal this "meta-ordering," for the latter includes politically-expressed values. Yet economists and other investigators, at least in principle, might try to discover the individual's combined preference schedule and to set prices on goods like safety on the basis of what individuals would pay for them on the basis of that combined preference map.

This reply fails for more than practical reasons. To see why it fails, one need only ask why each individual should have a *single* preference ordering rather than several independent ones, one for markets, another for family situations, another when one is with professional colleagues, another in the political context, and so on. Some theorists answer this question by asserting that a person with more than one preference ordering is therefore irrational. Nothing, however, justifies this conception of "irrationality."[3]

Some economists attack the problem of split preference orderings in another way. They note that efficiency need not have anything to do with justice or with concerns about equality. Thus, one might rely on markets or on cost-benefit analysis to determine efficient social policies. Then one could rely on altruistic or political preference orderings to organize the redistribution of opportunities and wealth to achieve greater social equality or justice (Harsanyi 1976, p. ix).

This response fails, however, because many, perhaps most, of our political or citizen preferences have little to do with concerns about equality or justice. People who support the protection of wilderness, the preservation of species, and the improvement of air and water quality, for example, are not, in any obvious way, advocating the improvement of the welfare of the least well off. One commentator observes that federal policy protecting the natural environment "is such that the rich get richer and the poor, poorer" (Krieger 1970, p. 318, italics removed). Environmental laws express community-regarding ideals and convictions which do not seem to flow from a conception of equity or justice.

There are obvious reasons that the "effect of improving the environment may be greater inequities in our society" (Krieger 1970, p. 311). People who use national parks and other protected areas tend to have higher-than-average incomes (Stigler 1970). By taking land out of use, protectionist legislation prohibits the kind of exploitation, for example, housing development, that can serve the poor. Tax deductions for "open space" may mean that the poor pay for the amentities favored by the rich. Toxic waste dumps, which are needed and favored in order to protect the natural environment, may tend to be located in the neighborhoods of the poor. I do not wish to argue as many have that the poor pay the costs while the rich reap the benefits of environmental protection. I wish only to suggest the difficulty of arguing for protective environmental policies on egalitarian grounds.

Similarly, with respect to risk, it is not necessarily the least well off who are helped by protectionist and paternalistic policies. Workers in petrochemical plants, for example, are often paid fairly well and do not constitute an underclass. Laws that increase safety in consumer products apply to power saws and other expensive products; they may be motivated by empathy, not equity. They prevent injury and death of the rich and poor alike. These regulations are not necessarily intended to redistribute opportunities, income, or wealth.

Some may argue, nevertheless, that the goals of safety legislation should be explained in terms of the rights secured by justice rather than in terms of a communal sense of compassion, concern, and responsibility. It is very difficult to see how a doctrine of rights can inform safety policy, however, except in the most egregious cases. To be sure, each of us has a right not to be killed, but what does this tell us? It tells us that no one *ought* to be killed: to add that person has a *right* is not to say very much more than that.

The policy question, moreover, does not turn on qualitative issues; it must be addressed in quantitative terms. Does a worker have a right to a 9 ppm, a 10 ppm, or a 25 ppm limit on benzene exposure in the workplace? The language of rights is far too abstract and general to help very much with these specific policy decisions. Accordingly, those who speak of worker and consumer rights, while correctly pointing toward the general issue of moral obligation, are not necessarily able to help us with the hard choices and tradeoffs we must make. Rather, we need to look with compassion on those who suffer—for a good society, we believe, is a compassionate one. This sense of compassion and mutual social responsibility, more than an abstract doctrine about rights, may motivate us to work as a society in the direction of greater safety in consumer products, the workplace, and the environment.

Plainly, we are concerned with many values other than our personal consumer satisfactions. We care about equity, which is to say, the way benefits and costs are distributed. But we also care about many other community values and moral and aesthetic principles having to do with the way we treat one another and the way we treat the natural environment. We care that individuals be treated as persons, with respect and concern, and thus not merely as means to something, even efficiency and the maximization of wealth. For that reason, we care that individuals have a chance to speak and to be taken seriously within the political process, in which they can share, as persons, in the pursuit of a public happiness. We would not relegate citizens to the role of consumers, that is, self-interested maximizers, seeking only private satisfaction. For these reasons, we could never consent to the substitution of cost-benefit analysis for political deliberation; we would not make policy decisions merely as individuals in a market but also as citizens each of whom has a voice in the decisions of the community.

Risk-Assessment

The next sections of this essay turn the debate to the techniques or practical methods that risk-benefit analysis employs. Specifically, a risk-benefit analysis proceeds by:

1. *Assessing a risk,* which is to say, estimating the likelihood that a particular harm will occur;
2. *Measuring the social cost of the risk,* i.e., the cost of the harm discounted by the probability it will occur. This may require that we attach a monetary value, one way or another, to the loss of life and limb.
3. *Measuring the social benefits* of a decision or action; and
4. *Comparing the benefits* of the action *with the costs* including, of course, the social cost of the risk.

Let us consider first, risk-assessment and the methodological problems it involves. What difficulties do we confront when we try to estimate the likelihood of some untoward event? We will begin with a simple example, namely, the structural failure of dams.

In July 1978, two years after the Teton Dam failure, President Carter directed the Water Resources Council to develop rules and regulations federal agencies could use to take risk and uncertainty more adequately into account in planning the development of water resources. The Presidential directive aimed particularly at engineering risk and was intended "to have the Council develop a procedure that would adequately incorporate the costs and benefits of a structural failure like the Teton Dam into Federal water resources decisionmaking" (Gisel 1981, p. 7).

At the level of statistical theory, the task appears simple: one only needs to calculate the likelihood of a structural failure and then take it into account in the overall cost-benefit analysis. A difficulty developed in practice, however, in determining the chance that a major structure such as a dam would fail. While many dams have failed over the past century, most were small structures built with now outmoded methods; only about a dozen major structures have broken, and those differed widely in materials and designs. Although the Water Resources Council held many hearings and hired a host of consultants, it could not find a way to estimate the likelihood that a modern well-engineered structure would fail. "In short, the sample of structural failures for various types of dams was simply too small to allow estimation of statistical parameters with any kind of reasonable certainty" (Gisel 1981, p. 8). As a result, the Council published regulations in 1980 that do not require estimation of the probability of structural failure. The Council concluded that the risk-assessment could not be done with confidence.

We have enough experience with some harms (automobile accidents, for example) to estimate the likelihood they will occur. The methodological problems involved in risk-assessment become overwhelming with respect to technologies that are new or unfamiliar. First, zero-infinity dilemmas, that is, low-probability high-consequence events, trouble the risk assessor's art. The damage caused by the melt-down of a nuclear reactor, for example, could be catastrophic; the probability that it will happen is small. Merely knowing that it is *small,* however, does not help the policymaker, who needs to know *how* small. No agreed-upon methodology exists, however, to measure the likelihood of extremely rare events in technologies that are new and with which we have little experience. Yet we cannot wait for experience to show us, for example, that a melt-down was not *quite* as improbable as we had thought.

Second, the difficulty of "detecting the signal in the noise" often defeats attempts to assess the likelihood of events that are probable and even familiar. Consider the problem, for example, of determining the additional cancers that might be caused by the use of some toxic substance, such as a pesticide. Occasionally, a particular substance can be associated with a particular kind of

cancer caused by it alone. Most cancers, however, are caused by many factors acting together. To find out how much additional cancer can be attributed to any of these causes one needs carefully designed studies of variance among controlled populations. For obvious ethical reasons, we cannot use human beings as subjects to determine experimentally how much more cancer occurs in an exposed group than in a control group, nor can we raise the two groups from infancy to be alike in every other way. And the latency period between exposure and manifestation of symptoms may be long enough that an epidemiological study of the risk would delay action for many years. We might then be able to close the barn door, so to speak, only after the horse has escaped.

Third, animal studies, which are used when, for ethical reasons, we cannot expose humans to hazards, involve not only moral problems of their own but also methodological difficulties. We must, first, decide whether to use relative body weight or relative surface area (there are reasons for each) to extrapolate low-dose response in large human populations from high-dose response in small animal populations. The results for mice may differ by a factor of thirteen. Likewise, the choice of test animals itself involves an important policy question, since some strains and some species are far more sensitive than others to certain chemicals. Likewise, one makes a policy decision when one makes various technical choices, for example, to use a linear vs. non-linear dose-response model, to count or not to count benign tumors, to administer the chemical one way rather than another, and so on. Each of these technical decisions may result in vast differences in test results; these technical choices, then, raise the very question "how safe is safe enough" for which risk-benefit analysis is supposed to provide an answer in the first place.

Fourth, attempts to assess risks in new technologies generally concentrate on the likelihood of equipment failure and do not sufficiently appreciate the role of human failure, ineptitude, and stupidity in the operation of that equipment. This human factor, working through a series of "small" mistakes, each of which might easily be corrected, seems to have been the cause of the disaster at Three Mile Island. There appears to be no way to assess with certainty the risk of human error in the operation of new large-scale technologies. Risk-assessment itself is such a technology. What is the risk of human error in risk-assessment? How is that risk to be taken into account in the decisionmaking process?

Measuring the Benefits and Costs

Let us suppose, for the sake of discussion, that we can predict harmful events often and accurately enough to make risk-assessment, at least in some instances, practicable. We must next measure the cost of the harm likely to occur. How is this to be done?

In determining the cost of a dam, one might use the price of American or "dumped" steel imported from abroad; one might factor in the price of union or non-union labor. In estimating a monetary equivalent for the resources required or produced by a project, economists generally look for price signals established by free markets. In our economy and in the world-wide economy, however, governmental interventions, e.g., through regulation and taxation, are so general that markets uninfluenced by these interventions rarely if ever can be found. To what extent are the effects of regulatory and other social decisions to be accepted as "market" signals or discounted as irrelevant to the economic estimate of benefits and costs?

In addition to the conceptual and methodological difficulties endemic to all cost-benefit calculations, risk-benefit analysis involves problems of its own. The primary difficulty arises in measuring the value of reducing risk, in other words, the value of saving lives and sparing people from illness and impairment. How are these benefits to be measured? How can we assign a monetary value to lives saved or lives lost?

The question, put this way, is hard—or at least embarrassing—to answer. Most people revere life; they think it sacred or priceless. One might argue, indeed, that life does not *have* a value but it is a necessary condition *for having values* of any kind—since no one can enjoy, appreciate, or believe in anything if he or she is dead.

Those who have developed the techniques of risk-benefit analysis are well aware of the metaphysical and ethical problems that vex any attempt to find out what a life is worth. Economists strive to avoid these problems by applying an economic concept of value not to life itself but to improved health, longevity, or simply to the reduction of risk.

During the 1950s and 1960s, according to one economist (Freeman 1979, p. 169), the "most common approach to the valuation of life in the literature was the so-called productivity or human capital technique." It prices each life lost at the value of the income that individual would have earned had his or her death been avoided. This way of attributing value looks on the individual's life as a resource the destruction of which involves a cost not to that individual but to society as a whole. It assumes that the individual's earnings represent his or her "marginal productivity," that is, the amount the individual contributes to the overall economic output. The loss of that output, then, represents the social cost of that death.

This way of assigning values did not work very well. First, it has no connection with individual willingness to pay to protect life and to reduce risk. It has no connection, therefore, with the arguments that attempt to establish the legitimacy of risk-benefit analysis. Second, this approach to quantifying benefits and costs fails to consider social contributions not measured by markets. Housespouses who are not paid, poets whose work is widely admired but who are poor, parents, etc., provide important social benefits that are not reflected in earnings. Third, this approach assumes markets measure accurately the social benefits provided by the goods and services that they *do* price, but this is plainly a false assumption. Market failures (such as externalities) constantly distort prices; governmental actions (e.g., taxes) affect markets. Finally, this approach values the *lives* of people in terms of their *incomes*—which would be a morally objectionable sort of measurement, even if, contrary to fact, it made economic sense (Self 1975).

In the late 1960s, economists led policy analysts in rejecting the idea that one may evaluate life in terms of livelihood. In a path-breaking paper, "The Life You Save May Be Your Own," T. C. Schelling (1968) criticized earlier attempts to estimate the value of a life, for example, that of a child, as we do livestock, according to its contribution to the gross national product. Schelling (p. 127) moves the discussion from the evaluation of particular lives to the evaluation of statistical lives. He asks: "What is it worth to reduce the probability of death—the statistical frequency of death—within some identifiable group of people none of whom expects to die except eventually?"

Analysts, including Schelling, have sought to base an answer to this question on the preferences or the value judgments individuals reveal in their behavior, particularly in markets. People make these judgments—and thus reveal the value they put on safety—"in the choice of hazardous occupations, in home safety, in residential location, and in risky everyday enterprises like diving and swimming" (Bailey 1968, p. 163). Safety devices are available, for the swimming pool or car, for example, and the sales of these items provide one indication, at least, of the extent to which individuals are willing to pay to reduce the risk of injury or death.

Is the Value X per Life Saved a Useful Datum?

Let us assume that economists can derive from market data (data gathered from labor markets) a value X per life saved. Is this a useful datum? The following arguments suggest that it is not.

First, we may pose the following dilemma. Either markets price risk correctly or they do not. If markets price risk correctly—if workers and employers make voluntary bargains which are not troubled by externalities, transaction costs, etc.—there is no economic rationale for regulatory intervention. If markets fail to price risk correctly, however, then market data do not provide reliable information by which we can correct that failure. Thus it seems that a value X per life saved, derived from market data, would provide decisionmakers either needless or unreliable information.

Second, one may think that data taken from efficient markets can be used to correct behavior in inefficient markets. Yet individuals are plainly willing to pay much more to avoid some risks than others—even though the risks are equally great. Let us suppose that few people buy lightning rods since few fear lightning. Would a low value for X derived in this way, say $1,000, be useful

to policymakers? Can it "correct" values established in other, for example, labor markets?

Third, the amount individuals are willing to pay for safety depends to a large extent on historical and cultural conditions which themselves may call for social intervention. Less than a century ago, when working conditions, by all accounts, were deplorable, the riskier jobs paid less, yet people were willing to take them—and to send their children—in spite of the fact that bitter experience made them aware of the hazards. One might obtain a very low value X in these circumstances, which were the shame of our cities years ago and still shame some cities today. What would this value, $1,000, perhaps, per life saved for a child "hurrying" coal in a mine, tell us about regulatory policy? Is this a figure upon which social decisions ought to be based?

The question is not just rhetorical. The Thaler-Rosen (1976) estimate of worker willingness to pay for safety reflects data taken just prior to, or at the time of, the passage of the OSH Act. It estimates a relatively low value, perhaps about $300,000 in 1978 dollars. Later studies, that of Kip Viscusi (1978) for example, estimate an amount generally more than five times as great. One can only speculate about the causes of this difference. One likely cause was the OSH Act itself, which, as we suggested earlier, changed the "level of consciousness" about safety among workers and their employers. Thus, it appears that regulatory policies, far from being based on market data, in fact control or influence those data, and these policies determine, more than they are determined by, the results of risk-benefit analyses.

Different Risks Have Different Meanings and Involve Different Kinds of Values

Students of risk-assessment and risk-analysis have commented upon an ideological division in their ranks. Some of these professionals, Martin Bailey (1980) and Richard Zeckhauser (1975), for example, study risk as one would study an objective fact or set of facts, social and technological, ultimately amenable to scientific investigation. Others like Harry Otway (1976), Mary Douglas (1966), and Michael Thompson (1980) regard risk and its perception as embedded in a network of cultural and personal attitudes, requiring understanding and interpretation. For the former group, the measurable characteristics of risks are most important, particularly, the degree of likelihood of harm. For the latter, what counts is the social meaning of a risky activity, in other words, the way people perceive, understand, and feel about that risk within a social and cultural context.

The anthropological investigation of risk poses an important challenge to the economic approach to risk-assessment and risk-analysis. The risk-benefit approach assumes, as a rule, that two risks have the same negative value if they have the same *magnitude*, that is, the same objective probabilities of

leading to injury, death, or to some other untoward event. Thus, if an individual is willing to accept one of these risks for a certain benefit, then, to be consistent or rational, the individual should be willing to accept the other risk as well, for the same benefit or for a larger one.

Mountain climbers, race car drivers, construction workers, Green Berets, compulsive gamblers, drug addicts, members of street gangs, boxers, visitors to jungle and wilderness areas, women who get pregnant, and undercover agents all take risks, however, and each of these risks must be appreciated in the context of the beliefs, expectations, needs, loves, hopes, and fears which justify it or which, at least, make it explicable in human terms. It does not add much to our understanding, indeed, it *defeats* our understanding, to think that all these individuals decide to take risks for the same reason or in the same way, e.g., by "pricing" alternative outcomes, making "tradeoffs," or "balancing benefits and costs."

When we make policy as a society to regulate risk, we worry about many ethical, aesthetic, and political considerations. We worry whether a risk is new, whether it comes from some sophisticated technology we do not understand, whether the outcome lies in our control or is affected by our skill, and whether it involves any chance at all, however slight, of a catastrophic loss of life. We are suspicious of risks that are unfamiliar or dangers about which there is not much certainty; we would rather bear the hazards we have than to fly to others we know not of. Dread, fear of the unknown, and cynicism with respect to the probability of human error may be controlling; these may matter more than a blue ribbon report. Considerations of social status, with respect to smoking for example, may determine risk-taking behavior; these social factors, not just the weighing of benefits and costs, tend to determine whether people decide to accept a risk or not (Geertz 1979).

We worry, moreover, whether those who take risks do so intentionally and whether they are able to use skill to avert or lessen the harm that may befall them. Our national policy toward safety in consumer products, the workplace, and the environment reflects a widely shared belief that we should regulate most strictly not when it is most efficient to do so but when innocents would otherwise be hurt, workers would be exploited, and individuals would face "unnatural" rather than "natural" hazards. We ask who is responsible and why. We have ethical concerns—not just economic ones. Thus the negative value of a risk may depend not only on its magnitude but also on its meaning within a shared cultural life. Our social decisions about risk, then, should make moral and cultural, not just economic, sense.

Voluntary vs. Involuntary Risks

The nature or character of a risk, quite apart from its "benefits" and "costs," concerns us as individuals and as a society. We may believe, for example, that

risks we take voluntarily need not be regulated in the same way as risks that are imposed upon us. It is one thing to jump voluntarily and another thing to be pushed—even if the costs and benefits are the same.

Chauncy Starr published a major paper in 1969 on the voluntariness of risk. He argued that markets involving familiar, established technologies generally have achieved an "optimal" tradeoff or balance between risks and benefits. He suggested that this balance or tradeoff between risks and benefits be used as a guide in regulating the safety of new technologies. This seems to suggest that the value X per life saved established in the market for lightning rods might be used as a guide for determining how safe nuclear reactors should be. This would ignore the vast difference in public attitudes toward lightning and toward nuclear energy.

Chauncy Starr appreciated this difference. He attributed it to a crucial distinction in the way that people feel about risks they engage in voluntarily (e.g., by smoking or by failing to buy lightning rods) and risks that they feel are imposed upon them involuntarily (e.g., by industries that pollute the air).

Starr points out, correctly it seems, that people have markedly different attitudes or preferences about voluntary and imposed risks—even if the actual probabilities of injury or death are the same. Starr concluded that preferences consumers reveal about some risks may not be extrapolated to other risks, unless these risks involve the same degree of voluntariness. He argued, indeed, that an involuntary risk, to be acceptable, must confer benefits 1,000 times greater than a voluntary one of the same magnitude.

Most commentators accept Starr's observation that people demand a "double standard" to be applied in assessing voluntary and involuntary risks even if they do not accept Starr's arbitrary factor of 1,000. In other words, most commentators believe that the benefits of an involuntary risk must be substantially greater than those of a voluntary one to have the same value or to outweigh the same costs.

During the past several years, psychological research into risk has revealed several factors beside voluntariness or involuntariness that demand special attention (or "double standards") in risk-benefit analysis. In particular, two researchers, Paul Slovic and Baruch Fischhoff (1980, p. 211) who operate a think-tank in Eugene, Oregon, have attempted to aid policymakers "by examining the opinions that people express when they are asked, in a variety of ways, to evaluate hazardous activities and technologies." Slovic and Fischhoff found that many factors lead people to object vehemently to one risky activity while cheerfully accepting another—even if the benefits and the magnitude of both risks are the same. These qualities include:

1. The immediacy of the outcome: will you die in a year or in twenty years?
2. The control the individual exercises over the outcome;
3. The extent to which the risk is known (a) to the individual, (b) to science;

4. The chronic or catastrophic nature of the outcome;
5. The newness or unfamiliarity of the risk;
6. The dreaded nature of the outcome, for example, whether it involves cancer.

The introduction of a "double standard" to evaluate voluntary and involuntary risk does not signal the end but only the beginning of the methodological difficulties that analysts confront in comparing the benefits and costs of various risky activities. The trouble seems to be that the concept of "voluntariness" is tied up with many other concepts some of which Slovic and Fischhoff have carefully studied. People they interviewed in one set of surveys desired similar double standards for characteristics such as controllability, knowledge, familiarity, and immediacy. As many "double standards" may be necessary as there are cultural and aesthetic attitudes toward risk (Fischhoff *et al.* 1978).

Shadow Pricing "Fragile" Values

The risk-benefit analyst may respond to this argument in the following way. He or she may point out that individuals, for cultural, aesthetic, and moral reasons, are attracted more to some risks than others. They are willing to risk death on the ski slopes but not when they dine. The analyst may then argue that these cultural, aesthetic, and moral factors are values like any other values: they can be assigned a market price. They are "soft" variables or "intangibles," to be sure, since they are not directly bought and sold. Yet, aesthetic and moral benefits are benefits nonetheless and they involve preferences for which people are willing to pay.

Yet it is not obvious that the beliefs, principles, and attitudes that make us accept some risks and reject others are the sort of "preferences" for which markets are appropriate. These values, on the contrary, may involve beliefs that deserve to be respected on their merits rather than to be priced at the margin. To make this point clearer, we may suppose that a citizen believes that 10,000 burnings due to a gas tank are too many per year; we might suppose he believes that 20,000 job-related deaths in the petrochemical industry are too many. He might back up these beliefs with arguments drawn from his conception of what we stand for as a humane, compassionate, civilized society.

Nobody asks cost-benefit analysts how much they are willing to pay for the ideological position that efficiency should be the goal of regulatory policy. Policy analysts are used to treating this belief as an arguable thesis to be defended on its merits. It is. Why, then, should contrary beliefs and positions not be argued as well: why should other views of public policy be regarded as preferences deserving at most to be priced? Surely, they should not. The beliefs

that determine our attitudes toward risk are just that, beliefs about what is fair, compassionate, and decent; these beliefs express moral positions which have been argued and have carried the day before legislatures. They are not desires or preferences for which markets are appropriate or that can be understood by being given a "price."

Earlier in this century, welfare economists and others who developed the theory of cost-benefit analysis justified its use as necessary to correct market failures. They had a clear idea or paradigm of market failure in mind: they used pollution as an example of an "externality" or "spillover effect" the cost of which is not included in the prices paid for goods and services. About twenty years ago (in part because of the work of Ronald Coase (1960))[6] economists changed their paradigmatic conception of a market failure. Instead of asking "What is a cause of what?" they tended to ask "What is a cost of what?"—and so they expanded the idea of an "externality" to include nearly any thing at all (Kennedy 1981). Formerly, an externality, for example, the smoke emitted from a power plant, could be understood in terms of physical damage of the kind treated in the common law of nuisance. More recently, an externality has been conceived as any unpriced cost or benefit, that is, anything that any individual might pay to avoid (or enjoy) but which is not fully priced in a market.

The concept of an "externality" completely runs wild when it is expanded in this way to include anything whatever about which people care that does not receive a "correct" market price. It is easy to tell stories estimating, e.g., how much people are "willing to pay" for the mere knowledge that workers are not exploited, products are safe, dams will not break, or that a nuclear waste facility will not be located near them. Speculation on these matters appears fatuous for at least two reasons. First, most of the issues involve ethical not simply economic questions—and these are worked out through our institutions of political choice, not through markets or cost-benefit analysis. Second, the measurement of willingness to pay, even if that is assumed to be relevant, would involve a vast amount of empirical research which never has been and never will be undertaken.

Risk-Benefit Analysis and Products Liability

We can finally address the question, "How safe is safe enough?" The answer is that nothing is safe enough if even a single person gets killed or maimed. Everyone knows, of course, that the workplace, consumer products, and air and water are never going to be entirely risk free. Some risks or hazards are simply endemic to life. We must face the truth, then, that conditions are unlikely ever to be safe *enough*. We must ask ourselves, then, what amount of death and injury we can accept and still perceive ourselves as a compassionate, caring, decent, and civilized society.

The problem, then, may be not to seek to achieve a risk-free society but to improve safety, which is to say, to strive bit by bit to make conditions safer than they are now. The issue, then, may not be "How safe is safe enough?" It is: "Where shall we start, what shall we attack first, how many of our resources shall we commit to make things incrementally less dangerous than they now are?"

There are many reasons that engineers will be concerned with the safety of the products they design. The immediate ethical reason is obvious: deaths and injuries are bad and actions taken to decrease their incidence are to that extent good. Engineers, moreover, typically work in commercial organizations and serve the interests of the firms that employ them. These firms have an interest in the safety of their products; thus, in serving this interest, engineers fulfill a responsibility to their employers as well.

According to George Eads and Peter Reuter (1983), there are three principal stimuli—regulation, litigation, and what they call voluntary efforts—which control the firm's interest in the safety of its products. The firm may see safety as a regulatory problem, i.e., a problem in meeting the standards, procedures, and requirements of the Consumer Product Safety Commission or some other agency. It may see safety as a legal problem, i.e., a problem in avoiding exposure to product liability claims and suits. And the firm is likely to see safety as a voluntary operational and moral issue, affecting its reputation, the general satisfactoriness of its products, and its position as a "good citizen" rather than as a "bad actor."

Undoubtedly, the most important single force motivating corporations to increase the safety of their products has been the growth of product liability law (Weinstein *et al.* 1978), particularly the development of the doctrine of strict liability and the increasing amounts of jury awards (Peterson and Priest 1982). Engineers who wish to be sensitive to safety issues as they affect not only the welfare of society but also the welfare of the firm should be aware of the ways courts and juries assess liability in cases involving consumer product safety.

We cannot address this large issue here, since it would require a separate discussion, for which see, for example, Thorpe and Middendorf (1979) and Flores (1982). There is one distinction fundamental to products liability law, however, which will help us assess the usefulness of risk-benefit analysis. Some products, like knives, guns, and drugs, no matter how well designed, involve risks by their very nature; in other words, these are unavoidably unsafe products. Manufacturers will not in general be liable for the consequences attending unavoidable risks associated with their products.

On the other hand, some products, because of their defective manufacture, may pose risks that the consumer could not or would not reasonably infer from the nature of those products. When the dangers of a product exceed those that the ordinary consumer might expect when the risks go beyond those ordinarily known to the community using products of that kind then the man-

ufacturer may be liable for the untoward consequences that result from the use of those products.

The engineer who wishes to be responsible both to the firm and to the larger society will concern him or herself with the difference between *reasonable* and *unreasonable* risk. (For the legal context, see Gray 1975). To some extent, risk-benefit analysis can help us understand this distinction. A product like a chain saw might arguably be safe "enough"—its dangers might be countenanced as "reasonable"—if the chain saw industry could not mitigate those dangers and still manufacture the saw at a price people are willing to pay. One might then say that the advantages to society of the availability of chain saws outweigh the disadvantages associated with their "unavoidable" or inherent risks. Society, of course, might decide to prohibit the distribution of chain saws (as it might the distribution of handguns) because of these dangers. This would be a decision for society to make concerning the product as such; it would not be a decision for the engineer designing one version of that product.

On the other hand, an engineer may believe that greater safety in the design of a product could avoid risks at a cost his or her firm—or the industry as a whole—could pass on to the consumer and still market the product at a profit. The engineer may then take a societal point of view in balancing the benefits of safety with the costs of providing it. The engineer should also be sensitive to the important ethical and cultural distinctions which will lead juries of ordinary citizens to think that some risks are reasonable while others are unreasonable. Attention to these distinctions will not only harmonize engineering practice with the moral expectations of society but may also protect the firm against very expensive liability suits and claims.

Question: In products liability law, a condition is said to be *unreasonably dangerous* so as to constitute a defective condition when it is so dangerous that a *reasonable man* would not buy or sell the product if he knew of the risk involved. What must be considered to assess the reasonableness of a risk? Some factors might include the usefulness of the product, the availability of safer substitutes, the probability and severity of injury, the expectations of the public, the presence of warnings, the "state of the art," the costs of making the product safer, and the level of sophistication of the average consumer. To what extent can considerations such as these be expressed and balanced in risk-benefit terms?

Notes

1. The idea that nothing is good or bad but that wanting or not wanting makes it so is an old one; Thomas Hobbes (1588–1679) states
   > But, whatsoever is the object of any mans Appetite or Desire; that is it, which he for his part calleth *Good:* And the object of his Hate, and Aversion, *Evill;* . . . For these words . . . are ever used with relation to the person that useth them: There being nothing simply and absolutely so; or any common Rule of Good and Evil, to be taken from the nature of the objects themselves (*Leviathan,* I, 6.)
2. For discussion and bibliography, see J. J. C. Smart and Bernard Williams (1973).
3. For a survey of the literature, see A. Campbell, P. E. Converse, and W. Rodgers (1975) and Nicholas Rescher (1980), Chapter I.
4. See Robert Smith (1976) Chapter I; also David McCaffrey, (1982), Chapter 2. For further description of the state of the workplace before 1970, see Nicholas Ashford (1976); Daniel Berman (1978); and Gary Z. Nothstein (1981).
5. For discussion, see A. K. Sen (1977).
6. Ronald Coase (1960). The Coase Theorem states that when transactions are costless (the notion of a "transaction cost" being broadly defined) then an efficient allocation of resources will result no matter how initial entitlements to these resources are distributed. Accordingly, analysis concerned with the efficiency of allocation should recommend the distribution of rights or entitlements that will minimize transaction costs—since any distribution, absent these costs, will lead to an efficient allocation. A major effect of this theorem has been to lead economic analysts to construe market failures in terms of the costs of making bargains rather than in terms of spillover effects, in other words, in terms of transaction costs rather than in terms of the infringement of property rights.

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