

The Risk Management Dilemma

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ABSTRACT: Market processes play a central and constructive role in allocating risks, but impediments such as inaccurately perceived risks and externalities create a potential role for government intervention. Individuals overestimate small risks, are averse to imprecisely understood risks, and give excessive weight to errors of commission over errors of omission. The challenge for the government is to strike an appropriate balance in its risk regulation efforts and to avoid institutionalizing common irrational responses to risk. Excessive expenditures on risk reduction, often undertaken by or required by government, not only squander resources but also may increase risks to us all; they can divert expenditures that could have been used to enhance our standard of living and, directly or indirectly, our health. Risk equity concerns often prove problematic: they may direct excessive attention to unimportant risks and hinder efforts to deploy resources to produce the greatest gains in societal health status.

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that the scientific credibility of risk assessment alone will ensure social acceptance of risk management. Public involvement ideals have shifted from opportunities for public comment to an emphasis on open and participatory processes. Our experience with such openness is too limited to judge if scientifically driven risk-based frameworks can coexist with social goals to build political consensus. Complicating matters further is the additional concern about consistency between political consensus and economic efficiency. The task

of reforming environmental risk management is daunting, especially when reform objectives differ so dramatically. Agency willingness to try a number of risk management approaches is important. As we gain more experience in using different approaches to address a range of risk problems, we undoubtedly will discover that some innovations work better than others. More generally, this knowledge may help us understand how better to balance technocratic and democratic ideals in all areas of risk management.

WHEN society allocates resources, three questions must be answered: who should decide; whose values count; and who should pay? In a democratic, capitalist society, the answer is straightforward: individuals and corporate decision makers should decide and pay for themselves, making their own values the basis for decision. The government establishes property rights and enforces contracts but otherwise sits on the sidelines.

The government often participates actively, however, in decisions affecting physical risks, frequently by overriding individual choices. When bad outcomes do occur, payment is often made by insurance companies and government, whose actions may have played no role in the bad outcomes. This approach is understandable because of three common characteristics of physical risks: surrounding uncertainty, significant consequences, and externalities. Even perfectly rational individuals have difficulty making consequential decisions under conditions of uncertainty. Moreover, if adverse consequences are significant, transfer of payment responsibility (risk spreading) is desirable. Finally, in many risk-taking decisions, such as a factory choosing an emissions level, one actor may impose significant adverse effects on others (that is, externalities).

Risk management thus presents a dilemma: challenging circumstances undermine many of the justifications for self-interested decentralized choice, but when we depart from this norm, both legitimacy and efficiency are undermined. We examine this dilemma here, looking first at the

sources of risk and then at challenges to decision making.

SOURCES OF RISK

Nature is the source of many risks, such as earthquakes and hurricanes. But human action—the only avenue for affecting risk costs—usually amplifies (or ameliorates) the consequences. For example, houses built near major faults or coastlines are more likely to be damaged than houses built elsewhere.

Three primary sources of risk are generated by human action: lifestyle choices, contractual arrangements, and externalities from choices by others. Lifestyle choices—drinking to excess, smoking, and failing to eat a nutritious diet or take sufficient exercise—create many of the most important risks to human health.¹ Governments try to influence these choices; for example, they provide nutrition information, punish public intoxication, and require warning labels on cigarette packages.

Other risks are contracted for voluntarily with some other economic agent; for example, people buy potentially risky products and decide to work in hazardous jobs. In return, they expect some offset: higher wages for risky jobs or lower prices for the product. Such trade-offs, and their role in promoting efficiency, have been part of economic thought since Adam Smith. Nevertheless, the rationality of trading risk for resources is often called into question, frequently by the government. For ex-

1. See Willard Manning et al., *The Cost of Poor Health Habits* (Cambridge, MA: Harvard University Press, 1991).

ample, the government intervenes to protect the well-being of those exposed to the risk through mechanisms such as product and job safety regulations, workers' compensation, and tort liability compensation for injuries.

Contracts on risk acceptance often have significant legitimacy and strength. Indeed, even when risks escalate, individuals in high-risk jobs often carry out their obligations; for example, firefighters and police officers rarely renege on their obligations when confronting an extraordinary risk. However, individuals often attempt to exploit the risk terms in a contract. For example, housing prices near toxic waste dumps are substantially depressed, but a purchaser who knows the risk and receives a discounted house price may well lobby or sue government agencies to expedite the cleanup.

In the third group of risks, externalities, actions by one party create risks or costs for others. These are the most obvious candidates for government intervention. In such situations, the firms or individuals imposing the risk have no incentive to care about the adverse external effects of their actions. Water and air pollution by firms, and drunk driving, are classic examples of externally imposed risks. The rationale for regulating externalities is clear-cut, but the optimal degree of regulation rarely is. Externality-regulating efforts can substantially redistribute resources; thus efforts to reduce pollution may benefit the politically influential rather than those who suffer the greatest harm or whose health could be saved most cheaply.

Our perception of the seriousness of a risk often depends on the risk's specific source; as a society, we tend to take some types of risks far more seriously than others. Consider now some important risks that we tend to respond to less than rationally.

Ordinary versus catastrophic risks

From the standpoint of an individual citizen, a reasonable objective would be to target risk regulation efforts to maximize the expected number of lives saved for the resources spent. Such an approach would treat equally two situations: one where one person faces a risk of 1/1000, the other where 100 people together confront a risk of 1/100,000. Yet, while the expected number of lives lost is the same in each instance, the death of 100 people in an airplane crash or natural catastrophe typically receives much more publicity than the separate deaths of 100 individuals. That is, society is especially concerned with large-scale catastrophes.

Except in wars—and recent terrorist attacks—large numbers of people rarely die at the same time in contemporary developed nations. Early in the twentieth century, a natural disaster would frequently account for hundreds of deaths in the United States, but society has adapted to these threats through design improvements, through fire-protection devices, and by locating populations away from the riskiest areas. At least as judged by insurance claims, in many of the most recent catastrophes, such as those related to hurricanes, there are greater losses from

property damage than from personal injury.² Largely because of the high value society attaches to a life—our most fundamental source of value—we have successfully developed substantial expenditures to preserve lives.

Extensive media coverage also leads people to overestimate certain risks and give undue importance to catastrophic events.³ Do not the lives that are lost in unheralded highway accidents merit the same preventive efforts as those that will be lost due to a highly visible catastrophe, such as a hurricane or earthquake? It is noteworthy that we have responded to the isolated automobile accident case by making various kinds of insurance mandatory, whereas our principal response to natural catastrophes has been to offer subsidized federal insurance coverage and massive ex post bailouts once the catastrophes have hit. Interestingly, for

2. The largest losses of life from disasters in the United States, for each major category apart from terrorism, occurred long ago. The largest flood disaster was the Galveston tidal wave of 1900. The most devastating hurricane occurred in Florida in 1928. The most deadly tornado was in Illinois in 1925; the most deadly earthquake occurred in San Francisco in 1906; and the most catastrophic fire was in Wisconsin in 1871. See National Safety Council, *Accident Facts* (Chicago: National Safety Council, 1993), p. 15. By contrast, the largest financial losses associated with disasters have occurred more recently. Other than the Great Chicago Fire of 1871, the most costly fire was the Oakland wildfire of 1991. The most costly insured hurricane was in 1992, and the most costly U.S. earthquake was in 1989. For data on these and other financial losses and catastrophes, see Insurance Information Institute, *Property/Casualty Fact Book* (New York: Insurance Information Institute, 1994), pp. 77-85.

3. For a discussion of the role of publicity, see Paul Slovic, "Perception of Risk," *Science*, 236:280-85 (1987).

both autos and hurricanes, those who impose the greatest risks often get subsidized; many states impose regulations to temper auto insurance rate differentials, and beachfront dwellers pay a fraction of the fair actuarial charges for flood insurance.

Lurking risks

Lurking risks are major long-term risks of particularly catastrophic consequences that we have never experienced but fear greatly. They include nuclear war, major climate change, the chance that Earth will be hit by an asteroid, and new viruses that may emerge from shrinking rain forests. There may be considerable time before these risks are resolved, and by the nature of these risks, past happenings provide little guidance to gauge their likelihood or consequences.

In lurking risks, catastrophic consequences—in some cases, possibly the end of civilization itself—are coupled with small probabilities, so that risk judgments may differ widely. In the 1960s, for example, much of the U.S. public believed that the chance of a nuclear war within a decade was about 1/3, whereas many experts estimated the annual risk to be from 10^{-3} to 10^{-5} .⁴ Such differences in risk perception often cannot be resolved, yet perceived risks must largely determine the size of major national and international risk-reducing expenditures, such as efforts to cut or build nuclear stockpiles or to curb global warming. Assessing magnitudes of loss is often no easier. For example, if a potent new virus

4. Thomas Schelling, personal communication, 1995.

emerges, how likely is it to be more damaging than the acquired immune deficiency syndrome (AIDS) or more than ten times as widespread, or only a tenth? We simply do not know.

What is the source of our fears of lurking risks? One possibility is that society needs a major fear. As the threat of nuclear war has faded, fear about climate change and AIDS has taken hold. Despite increases in most measures of our well-being, we fear for survival of the planet. (Witness the "Save the Planet" motto of the pop culture Hard Rock Cafe chain.)

Yet the scientific community is substantially more worried about climate change than the public is. Its risks are linked with the pollution dangers associated with fossil fuels. And our energy mix is a Hobson's choice: significant reductions in fossil fuel can be achieved only by incurring the dangers of nuclear power. Interestingly, the lower the real risk, the relatively more important is its perception in determining its effect on welfare, for that perception will stir anxiety, which in turn creates a very real loss in utility.

Special status of health risks

Risks of property damage receive far less attention than risks to health. Indeed, this health-over-resources bias is a general phenomenon. For example, society's redistributive efforts focus on health care—Medicaid expenditures significantly exceed welfare expenditures in virtually all cities—although the same dollars might offer substantially greater benefits if spent on transport or appliances. Indeed, controlling for per-

tinuous factors such as age, poor people visit the physician more often than do the affluent.

A desire to control externalities may explain subsidized vaccinations and certainly explains why we pay some individuals for undergoing tuberculosis treatments. It cannot, however, explain our pro-health bias. Rather, we suspect that health status plays an important signaling role: worse health or risk outcomes for the poor are visible and stir the compassion of those who determine political outcomes. Relying on willingness-to-pay to place a toxic waste dump in an impoverished community would be widely perceived as unfair, even if the associated risks were negligible. By contrast, high homicide rates among young black males are treated with relative complacency.

The costs of risks and risk avoidance

As a society, we are doing extremely well in reducing per capita risk costs. Overall death and injury rates, particularly from accidents and natural catastrophes, have fallen dramatically and fairly consistently this century, presumably due to technological advances. Nonetheless, our risk avoidance activities are woefully inefficient. Had the same resources been put where they addressed the greatest reduction, these rates would now be far lower.⁵

The costs imposed by risks are the sum of the value of the losses incurred and the resource costs of re-

5. See Richard J. Zeckhauser and W. Kip Viscusi, "Risk Within Reason," *Science*, 248(4955):559-64 (1990).

ducing risks. We throw away value whenever the same expenditures would produce greater risk reduction elsewhere. Still greater waste, indeed profligacy, is achieved if the expenditures entail such large reductions in income that lives are lost on net. Studies of the relationship between societal income and mortality suggest that a reduction of income in the range of \$12 million may cost one statistical life. In addition to better housing, food, and sanitation, higher incomes are also associated with better diets and exercise habits and less of both smoking and excess drinking. Assessing merely the associated increase in risky health habits alone, the life-costing income loss is on the order of \$15 million to \$18 million.⁶ These numbers are below the regulatory expenditures per statistical life saved for many programs, suggesting that beyond wasting dollars, such programs discard lives.

THE CHALLENGE TO RATIONAL DECISIONS

Economists argue that individuals' preferences are to be relied on and taken as given, while paternalistic critics assert that individuals do

6. For an introduction to these issues, see Ralph Keeney, "Mortality Risks Induced by the Costs of Regulations," *Risk Analysis*, 10(1):147-59 (1994). The health-habit study is presented in Randall Lutter, John F. Morrall III, and W. Kip Viscusi, "Risky Behavior and the Income-Mortality Relationship" (Working paper, Duke University, 1995). The rationale for lower-income people to choose riskier lifestyles is examined in John Pratt and Richard Zeckhauser, "Willingness to Pay and the Distribution of Risk and Wealth" (Working paper, Harvard University, 1995).

not know what they want or are easily manipulated. Yet economists, and their decision analyst fellow travelers, are the first to question the underlying rationality of individuals' choices about risks and to suggest that informed expert opinion offers a superior guide to policy.

Individuals systematically overassess small risks and underassess a range of truly consequential larger risks such as those posed by a poor diet. Increases in risk are much more salient than decreases. Ambiguous risks—ones whose probabilities are hard to estimate—are often the cause for alarm. Moreover, researchers have documented many anomalous behaviors regarding choices involving uncertainty.⁷

Yet the rational decision framework remains the appropriate normative reference point: policies should not institutionalize the errors people make but, rather, should promote the outcomes they would choose if they understood the risks accurately and could make sound decisions that reflected their values. (Individuals who are well equipped to choose between apples and oranges may have difficulty when the oranges are received only probabilistically and there is a small probability that one of the apples is poisoned.)

7. The framing of risk problems has a considerable effect on how risks are viewed and what preferences are expressed. See Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47:263-91 (1979). For example, car accident rates per trip appear negligible, but when expressed as annual or lifetime fatality rates, they seem considerable.

Omission and commission

Actions often generate risks, but sometimes inaction leads to greater risks. In theory, errors of omission and commission should be treated similarly; in practice, the latter count far more heavily. This is partly because they are framed as losses incurred rather than as gains forgone. When a treatment creates a significant risk, it may be rejected, however great the risks avoided. Estrogen-replacement therapy decreases a woman's heart attack risk, but increases her breast cancer risk. A woman should consider the relative utility costs of the two diseases, and the changes in probability entailed by the therapy, and then calculate her expected utility. (The cover story on this issue in *Time* magazine⁸ omitted any risk numbers that could facilitate such a calculation, suggesting that such numbers were hardly relevant.)

The Food and Drug Administration (FDA), which regulates prescription drugs and medical devices, should balance the risks of placing potentially hazardous products on the market and the risks that sick people will suffer if these innovative technologies are not available. The consensus of outside analysts is that the agency has erred on the side of excessive caution, suggesting that society's net risk has been increased by delays in approving beneficial new drugs, such as beta blockers for heart disease.⁹

8. *Time*, 26 June 1995.

9. Asymmetric incentives help explain this. There is little penalty for not approving a drug that would have saved statistical lives, but allowing a drug that has identifiable ad-

Concepts of fairness

Human health is a special commodity. It is an ultimate source of value, and its primary production comes from nature, not people. Given these features, fairness plays a major role when risks to health are discussed. Yet what fairness in risk means is rarely clear. Differences in risk levels are perceived as unfair. For example, if the downwind town of Eastside has a greater risk than Westside, that is unfair. Yet risk increases that might balance matters—locating a toxic waste dump in Westside—are unfair as well.¹⁰ Fairness issues are made still more intractable because money (or other compensation), however efficient an arrangement it may offer, is often regarded as inappropriate compensation for bearing risk.

Risk equity has also been a concern for trade policy. Should we prohibit imports from less developed countries that do not adhere to U.S. safety standards and environmental objectives? While this may appear to be in the best interest of these nations' citizens, it would actually decrease their employment and income, which are the main contributors to economic and physical well-being. Al-

verse effects, such as thalidomide, would impose enormous political costs. For further analysis of the excessive conservatism of the FDA, see Henry G. Grabowski and John M. Vernon, *The Regulation of Pharmaceuticals: Balancing the Benefits and Risks* (Washington, DC: American Enterprise Institute, 1983).

10. Advocates of environmental equity in Chapel Hill, NC, which has traditionally sited landfills in rural areas, have proposed balancing risks by siting a new one near heavily populated residential areas. Severely increased risk will be the inefficient outcome.

lowing such imports is likely to benefit even their health. Japan's enormous growth in per capita income from 1935 to 1975 was accompanied by age-specific reductions in mortality of over 35 percent for individuals under 65.¹¹

Should companies in the United States be permitted to export products that are considered too hazardous for use in this country to other countries that may welcome them, as with many products? For example, pharmaceutical companies may not manufacture drugs in the United States for sale overseas unless they have been approved by the FDA for U.S. usage. Since the FDA drug approval process is lengthy, however, many drugs are first approved in Europe. The result is that U.S. companies have been forced to move operations abroad to supply these markets.

On an even more touchy issue, a less developed country might seek to expand its revenues by becoming a depository for nuclear wastes, as poverty-stricken but geologically blessed Equatorial Guinea was offered—and under pressure refused—just a few years ago. Should it have this privilege, or should more affluent nations interfere with its decision? Although intervention to provide information regarding risks certainly seems well founded, interfering with the actual decision appears to be a much more problematic role for a foreign government or international authority.

11. See Richard J. Zeckhauser, Ryuzo Sato, and John Rizzo, "Health Intervention and Population Heterogeneity: Evidence from Japan and the United States" (Monograph, National Institute for Research Advancement, Dec. 1985), p. 29.

The role of entitlements often affects the zeal with which we undertake risk reduction efforts. If we must pay for the reduction ourselves, there may be substantial reluctance to make the expenditures. For example, many people do not remove lead paint from their houses or asbestos insulation from their basements. However, these same individuals might insist that their children's day-care centers meet the highest safety standards; their insistence might be particularly intense if a large party such as the city or a corporation ran the center.

THE CHALLENGE TO GOVERNMENT

Ideally, society, and the government acting as its agent, should undertake the risk reduction efforts that would best promote the welfare of its citizens.

Balancing risks and costs

The benefit-cost approach, which seeks to quantify the pertinent consequences of alternative policies, can be adjusted to allow for uncertain outcomes and such factors as risk aversion. Appropriately conducted analyses must also seek valuations for such hard-to-assess outputs as damage to a unique ecological resource.

The reality of government policy-making strays far from any careful process of weighing costs and benefits. The legislative mandates of risk regulation efforts almost invariably articulate risk-based objectives and sometimes exclude the consideration of costs altogether.

Executive branch efforts to balance the competing concerns of risk and cost have had limited success. Since the Carter administration, risk regulations must meet a cost-effectiveness test that gives preference to regulations that could achieve the same objective for less money. This requirement eliminates some of the least efficient options, but it does not ensure that an appropriate balance is struck between cost and risk. Since the Reagan administration imposed a benefit-cost test requirement, agencies have undertaken more comprehensive regulatory analyses.

However, these tests are not binding; they are typically inconsistent with the more narrowly written mandates of regulatory agencies, which impose legal constraints. As a result, the U.S. Office of Management and Budget, which oversees the risk regulation agencies, has never rejected a regulation with a cost per life saved of under \$100 million.¹² Most risk and environmental regulations that are adopted have costs far in excess of any established estimate for the value of life, indeed above the amounts (discussed earlier) whose expenditure leads to the loss of a statistical life. This suggests that many programs that are supposed to reduce risk actually cost lives.

As chronicled here and elsewhere in this volume, individuals have difficulty responding to risk appropriately, particularly to low-probability risks. If government responds to individuals' fears and irrationalities rather than the actual risks, we in-

crease the probability of adopting policies that achieve few risk reduction benefits in return for the expenditures made. The gains in health will be as illusory as the fears that generated the policies.

Process

The risk debate parallels the debate over the federal budget. We all want lower taxes, but we do not want to sacrifice the government programs that taxes pay for. Similarly, we all want less risk and demand a lot of improvement in all risk measures, but we do not want to spend the money to achieve these gains. Government proposals to promote energy conservation and decreased air pollution through a nickel-a-gallon gas tax, for example, created a public uproar, suggesting that the public's expressions of unbounded commitment to the environment may in fact have quite narrow financial limits.

The government also reassures the public about risk levels. The FDA, for example, does not state that our food is so safe that only 1 in 10 million Americans will be killed by bacteria contamination. Rather, it declares that our food is safe and makes unqualified commitments to maintaining this safety. In some cases such ceremonial commitments to public safety run counter to the best interests of the citizens exposed to the risk.

Government as insurer

The government also plays an important role in insuring many classes of risks. For example, the major risks of old age—lack of health and wealth—are covered by Medicare

12. See W. Kip Viscusi, *Fatal Tradeoffs: Public and Private Responsibilities for Risk* (New York: Oxford University Press, 1992).

and Social Security. In addition, the government often provides humanitarian relief after major national catastrophes, such as hurricanes and tornadoes. The government also runs subsidized insurance programs for such adverse events. If the government is going to compensate people *ex post* for disaster-related losses, then it is in the government's interest to promote the purchase of insurance to reduce the cost of the humanitarian *ex post* bailout. For massive catastrophes, the government has a risk-spreading advantage over insurers; it has an enormous asset base that it can tax into the future.

Government as referee

In debates on risk issues, all affected parties have standing, making compromises and trade-offs difficult. Individuals' current endowments have legitimacy, as do claimed rights such as the right to a safe environment. Even physical entities may have rights. For example, advocates of stringent hazardous waste cleanup claim that contaminated raw land that does not undergo remediation will simply be "dead zones." That may be true, but it also may be an economically efficient outcome that gets overridden by a rights philosophy. If even undeveloped acreage has standing in the political debate, wholly apart from the potential uses of the land, then it will be difficult to forge the types of political compromises that are necessary for sound risk regulation policies.

Politics is likely to exacerbate inefficiencies. The HAZWRAP Program, which is to clean up the De-

partment of Energy's nuclear material and weapon sites, is estimated to cost between \$100 billion and \$300 billion. Cleanup efforts have been recognized as public works (that is, pork barrel concerns have been legitimized), and expenditures have been spread across states rather than spent where they provide the greatest risk reduction. Significant expenditures will have no effects on human health, often providing cleaned-up land at more than ten times the local price of never-contaminated land.¹³

Risk reduction policies often have their genesis in legal actions between private parties. Many of the most significant hazards, such as those posed by asbestos, first rose to prominence in the courts. Information about these risks was not available when most individuals were exposed. As a result, thousands of people suffered from asbestos exposure. Their illnesses first became well known to legislators and regulators through the workers' compensation and tort liability claims that they filed. This litigation explosion focused public attention on asbestos and led to government regulations that dramatically curtailed exposure.

Compensation through the courts serves three functions. First, it transfers income to those in need, to meet both their medical expenses and their income losses. Second, these income transfers are funded by the parties responsible for the accident or illness, thus creating financial incen-

13. Martin Marietta Energy Systems, "An Application of an Interim Version of the Formal Priority System to Fiscal Year 1992 Environmental Restoration Planning" (Report to the U.S. Department of Energy, Nov. 1990).

tives for safety. Third, such ex post payments highlight the existence of risks not adequately handled at present through risk regulation.

Regulatory costs

In the past, most government regulations consisted of restrictions on telephone rates, restrictions on interstate commerce, and similar kinds of economic regulation. Over the past two decades, health, safety, and environmental regulation has increased in importance and now accounts for the majority of regulatory costs.¹⁴ By 1991, total regulatory costs to the U.S. economy were estimated to be \$542 billion. Of this amount, \$115 billion was accounted for by environmental regulations and \$36 billion by other social regulations, chiefly for health and safety. Only \$73 billion was attributed to traditional economic regulations. Moreover, much of the regulatory burden consists of paperwork costs of \$189 billion; a significant portion of these costs are related to compliance with risk regulations.

IMPROVING WELFARE

Singly and collectively, we have trouble responding to risks. We over-respond to many that are minuscule and ignore some hazards that have significant consequences for our lives. Public attention shifts quickly to the latest publicized hazard, and government policy often follows: wit-

14. For a review of these trends in regulatory expenditures, see W. Kip Viscusi, John Vernon, and Joseph Harrington, Jr., *The Economics of Regulation and Antitrust* (Cambridge: MIT Press, 1996).

ness our ready sacrifice of civil liberties in response to the terrorist threat suggested by the Oklahoma City bombing. Government policy should not mirror citizens' irrationalities but, rather, should promote the decisions people would make if they understood risks correctly and made sound decisions based on this understanding.

Making such policy is a challenge. To begin, scientific information is not always precise. Many important risks are not known with the same precision as are, for example, the familiar risks of automobiles. Scientific debates continue over the risks posed by substances ranging from cellular phones to animal fats to nuclear power.

When the magnitude of the risk is unclear, what should the government do? The current procedure is to focus on the worst-case scenario.¹⁵ Unfortunately, this leads to policies that pay the greatest attention to the risks about which least is known. If chemical A poses a lifetime fatality risk that is known to be .00002, whereas equally widely used chemical B poses a risk that might be .00003 but probably is zero, current practice would first address the risks from chemical B, though we could save a greater expected number of lives if we focused on A. Since our imprecision is often greatest with respect to risks of new technologies, this conservatism often leads us to accept old risks and has impeded the technological and economic progress that have dramatically reduced risk in our society.

15. See Albert L. Nichols and Richard J. Zeckhauser, "The Dangers of Caution: Conservatism in Assessment and the Mismanagement of Risk," in *Advances in Applied Microeconomics*, vol. 4, ed. Kerry Smith (Greenwich, CT: JAI Press, 1986), pp. 55-82.

For these reasons, a flurry of congressional legislation passed in 1995 but not yet, as of this writing, signed by the president requires that federal agencies follow best-estimate risk assessment procedures. Such procedures will have the agencies assess the mean level of the risk and use assumptions regarding best estimates of the likely scenarios that will prevail, rather than focusing on worst-case outcomes.¹⁶

16. A number of pieces of legislation proposed or passed by Congress in 1995 would address both the mean risk and benefit-cost issues. These include Senate bill no. 333 and House bills nos. 1022, 690, 228, and 1923.

Unfortunately, the role of policy analysis within government policy-making is peripheral to much actual decision making. Whether analysis is to be done at all has become a political battle between those who would choose to promote more balanced risk regulation policies and those who wish to pursue the more absolutist approach of maximal risk reduction independent of cost.

If we are to achieve all that is possible with risk regulation efforts, we must understand how these policies will perform, and design them—based on an accurate assessment of the risks—to achieve the greatest expected health gains for the dollars spent.