Following a dramatic expansion of federal health and safety regulation, Americans' gains are uncertain.

Safety at Any Price?

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THE 1970S MARKED THE ADVENT OF A major wave of health and safety regulations. Before that time, the standards that we now take for granted were completely absent from the American economy, with the exception of selected regulations for food safety and prescription drugs. The rise of the consumer movement and environmental concerns led to the establishment of the National Highway Traffic Safety Administration (NHTSA) in 1966, the Occupational Safety and Health Administration (OSHA) in 1970, the Environmental Protection Agency (EPA) in 1970, the Consumer Product Safety Commission (CPSC) in 1972, and the Nuclear Regulatory Commission (NRC) in 1974.

After three decades of experience with that wave of regulations and government oversight, we have a reasonable basis for making an assessment of earlier performance. Agencies have had the opportunity to issue regulations, assess their effects, and revise them accordingly. We believe that health and safety regulations have largely failed to fulfill their initial promise, but many of the initial promises were infeasible goals. There continues to be major opportunities to improve regulatory performance by targeting existing inefficiencies and using market mechanisms (rather than strict command-and-control mechanisms) to achieve regulatory goals.

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WHY THE GOVERNMENT REGULATES RISK

Government action in the health and safety arena can be justified when there are shortcomings in risk information or textbook cases of externalities. Unlike many other regulatory contexts, complete deregulation of health and safety provisions may not be the ideal economic solution; some forms of regulation often are desirable.

The goal of regulatory agencies that address health and safety risks should be to isolate instances in which misinformation about health risks prevents people from making optimal tradeoffs and to isolate instances where health risks are not internalized in market decisions. Of course, it is important that agencies use flexible market-based regulations to achieve their goals at least cost.

The existence of a health risk does not necessarily imply the need for regulatory action. In the case of job safety, for example, perceived risks of job hazards lead to considerable compensating differentials for risk. In a fully functioning market, workers receive wage compensation sufficient to make them willing to bear the risk; the health risk is internalized into the market decision.

In situations in which the risks are not known to workers, as in the case of dimly understood health hazards or situations in which the labor market is not competitive, market forces might not operative effectively to internalize the risk. Those cases provide an opportunity for constructive, cost-effective government intervention.

Eliminating risk? Unfortunately, the rationale of correcting market failures has never been a major motivation of regula-

tory intervention. The simple fact that risks exist has provided the impetus for the legislative mandates of the health and safety regulatory agencies. To this day, very few regulatory impact analyses ever explore in any meaningful way the role of potential market failure and the constructive role that market forces may already play in the regulatory situation that is being considered.

The conventional regulatory approach to health and safety risks is to seek a technological solution either through capital investments in the workplace, changes in the safety devices in cars, or similar kinds of requirements that do not entail any additional care on the part of the individual. The initial faith in the technological approach was so great that proponents envisioned a dramatic improvement in safety from such regulation. A co-sponsor of the Occupational Safety and Health Act of 1970, Rep. William Steiger (R-Wis.), proclaimed that by 1980 injuries would be reduced by "fifty percent or something like that." Even in the case of narrowly specified regulations, there were projections of enormous improvements in safety. Proponents of seatbelt standards for automobiles predicted that, by 1972, the occupant death rate from car crashes would drop by 10 to 25 percent because of the introduction of seatbelts. (Neither the forecasted efficacy of seatbelts or the projected improvements in job safety occurred.)

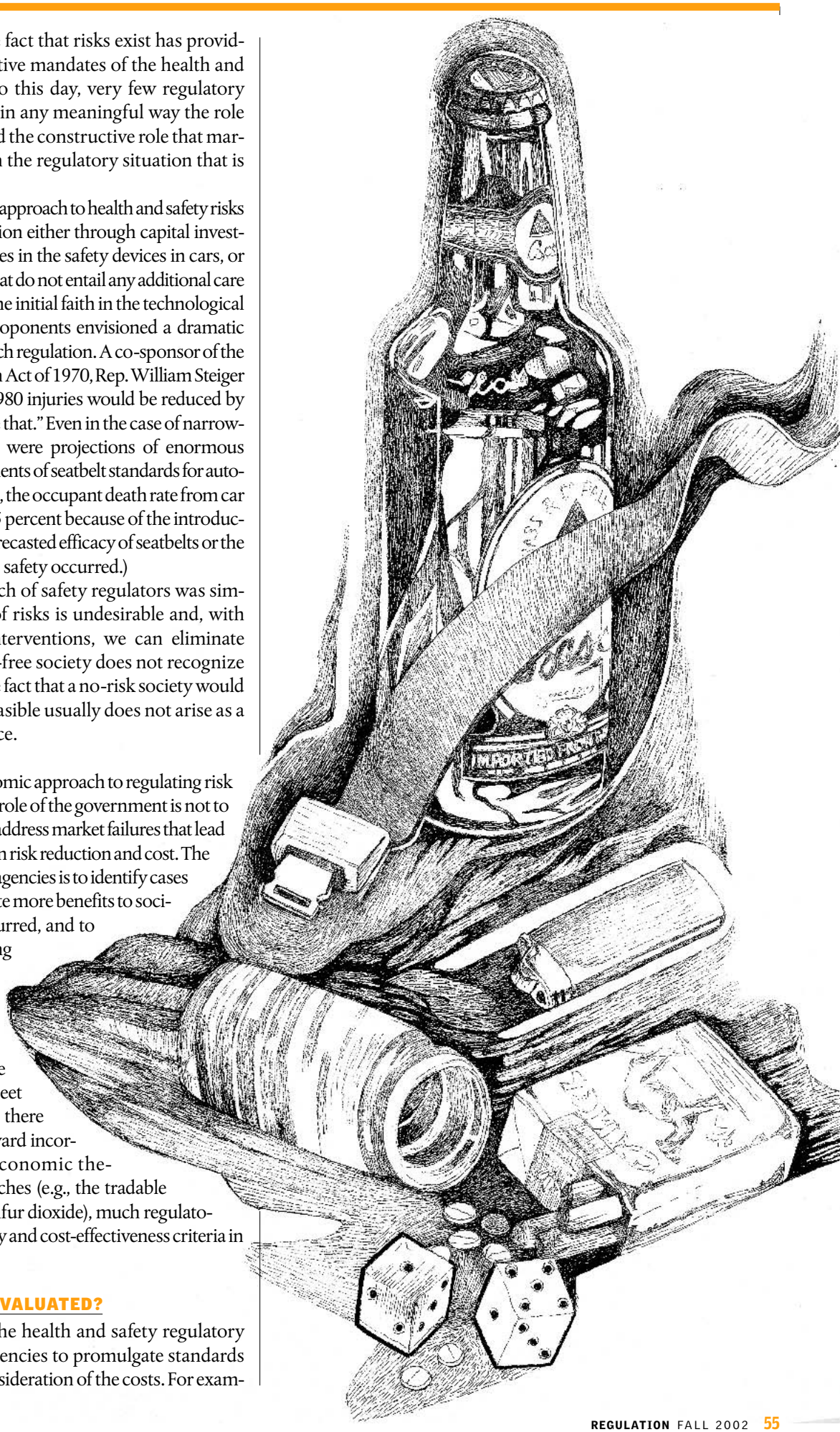
The general policy approach of safety regulators was simple. In their view, existence of risks is undesirable and, with appropriate technological interventions, we can eliminate those risks. The goal of a risk-free society does not recognize the cost tradeoffs involved; the fact that a no-risk society would be so costly as to make it infeasible usually does not arise as a policy concern of consequence.

Risk and efficiency The economic approach to regulating risk is quite different. The potential role of the government is not to eliminate the risk, but rather to address market failures that lead to an inefficient balance between risk reduction and cost. The task of government regulatory agencies is to identify cases in which regulation can generate more benefits to society than the costs that are incurred, and to address the market failures using a cost-effective approach.

In order to achieve those goals, the focus should not simply be on rigid technological standards, but on flexible regulatory mechanisms that meet the performance goals. While there has been some movement toward incorporating those lessons from economic theory into regulatory approaches (e.g., the tradable permit system for reducing sulfur dioxide), much regulatory policy ignores both efficiency and cost-effectiveness criteria in their formulation.

HOW SHOULD RISKS BE EVALUATED?

The legislative mandates of the health and safety regulatory agencies typically urge the agencies to promulgate standards to promote safety without consideration of the costs. For exam-



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ple, the Clean Air Act directs the EPA to set ambient standards for common air pollutants at levels that provide an "adequate margin of safety," and standards for hazardous air pollutants are to be set at levels that provide an "ample margin of safety." The goal of the Occupational Safety and Health Act of 1970 is "to assure so far as possible every man and woman in the Nation safe and healthful work conditions." Judicial review has attempted to define more precisely those ambiguous goals; however, the courts have ruled consistently that the laws do not require consideration of the costs of the standards.

Costs and benefits The costs of that unbounded commitment to safety have proven to be considerable. As an attempt to redress that problem, all presidential administrations since Richard Nixon have established some form of regulatory oversight within the Executive Office of the President. After the initial Nixon and Ford efforts that tracked regulatory costs, the Carter administration expanded the review process to include the requirements that all agencies perform a comprehensive economic analysis of proposed major regulations and that they select the most cost-effective option. Cost-effectiveness helps to eliminate some of the most unproductive regulatory alternatives, but it is still not a guarantee that the regulation is in society's interest because it does nothing to guarantee that the net benefits of the regulation are positive (let alone maximized).

President Ronald Reagan's Executive Order 12291, issued in 1981, was the first to require that agencies explicitly consider the costs involved in a "major rule" (i.e., one with an annual effect on the economy of $100 million or more). The order stated, "Regulatory action shall not be undertaken unless the potential benefits to society for the regulation outweigh the potential costs to society." To strengthen the oversight process, the institutional authority for regulatory oversight was transferred to the U.S. Office of Management and Budget (OMB) and its Office of Information and Regulatory Affairs (OIRA). President Clinton's Executive Order 12866, issued it 1993, slightly amended the cost-benefit criteria. The new order stated, "Each agency shall… propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs." Thus, the criteria shifted from benefits outweighing costs to benefits justifying costs. (See "Bush's Rejuvenated OIRA," Winter 2001.)

While regulatory advocates frequently bemoan the requirement of a benefit-cost test and voice concerns over the authority of the OMB, the benefit-cost requirements have had little practical effect. As mentioned earlier, with the notable exception of regulations from the U.S. Department of Transportation, the legislative mandates of the regulatory agency typically are stated in an uncompromising way that does not require the agency to carry out a benefit-cost test and may, in fact, prohibit basing regulations on such a test. For example, in the OSHA cotton dust decision in *American Textile Manufacturers Institute v. Donovan*, the U.S. Supreme Court interpreted OSHA's enabling legislation regarding the technical possibility of compliance as "capable of being done," which precludes the agency from balancing the benefits against the costs of the regulation. Thus, the executive order requires the agency to conduct a benefit-cost analysis, but the agency is prohibited by law from basing the regulation on the results of the analysis. As a consequence, notwithstanding the calculations of benefits and costs by regulatory agencies, very few regulations actually adhere to a formal benefit-cost test.

Worst case If market failures present risks to society, the proper economic concern for government policy is to assess the expected number of lives saved by a regulation against the costs of the regulation. In contrast, government agencies typically focus not on expected outcomes presented by the risk but on worst-case scenarios on the grounds that doing so reflects "conservatism." In other words, when faced with uncertainty about the estimated risk, the regulatory agencies tend to choose assumptions that lead to higher assessments of the risk, thus representing the upper range of risk (rather than the mean risk) suggested by scientific knowledge.

As A.L. Nichols and R.J. Zeckhauser explained in their Spring 1986 *Regulation* article "The Perils of Prudence," there are two main problems with the regulatory agencies' use of conservative risk assessments. First, overestimating the health risk leads to an overestimate of the benefits of the risk-reducing regulation and thus excessive expenditures on risk reduction relative to non-health policy concerns. The second problem is that the practice of conservatism also leads to a misallocation of resources within the health risk concerns. Because regulatory agencies use conservative estimates for each parameter in a risk analysis, risks with more uncertain parameters will yield a higher risk estimate than those with fewer uncertain parameters. Thus, even though "health risk A" poses a higher risk than "health risk B," if the latter has more uncertain parameters involved in the risk assessment, then the multiplicative effect of conservatism could lead to the agency deeming that the former risk poses a lower threat. That would lead to a misallocation of resources and a missed opportunity for saving lives.

Although proposed regulatory reform bills have repeatedly called for agencies to base policies on best estimates of the risk rather than on improbable worst-case scenarios, such legislation has never passed. The focus on extremely improbable worst-case outcomes as opposed to realistic assessments of the risk continues to dominate government policy.

THE VALUE OF A STATISTICAL LIFE

The dominant concern with most health and safety regulations is to prevent fatalities. In order to conduct a benefit-cost analysis of such a regulation, one must assign a value to the benefit of reducing the risk of premature death. The proper benefit measure is the same as in other benefit contexts: society's willingness to pay for the particular benefit. Because government policies reduce risks of death rather than eliminate certain death for identified individuals, the correct benefit value is society's willingness to pay for the reduction in risk. The willingness-to-pay framework for valuing mortality risk reductions yields a measure of the value of a statistical life. In other words, if a regulation would reduce risk by one in one million to everyone in a population of one million, then the regulation would save one statistical life. If the average willingness to pay for that risk reduction is $6 per person, then the value of a statistical life is $6 million.

Determining the value One approach to obtaining estimates of the willingness to pay for risk reduction is by conducting carefully crafted interviews of those exposed to the risk. However, the hypothetical nature of the survey and the possible incentives respondents have to overstate their answers suggest that asking people questions about amounts of money they would pay to reduce hypothetical risks may not be the best measure of how much they actually would be willing to pay to reduce real risks to themselves.

Economists consequently turn to actual market behavior in which people make tradeoffs between risk and money as part of their economic decisions. In the case of jobs, for example, the wages commanded by the job reflect not only various skill aspects but also premiums for unpleasant characteristics of the job such as the job risks that workers must bear. Similarly, consumer products that are viewed as being safer will command a higher price (all else equal), as is the case with Volvos and some other high-end automobiles. Using detailed data on wages and prices, economists have estimated people's tradeoffs between money and fatality risk, thus establishing a value of statistical lives based on market decisions.

A number of studies began to use extensive labor market data to derive such estimates in the late 1970s. For workers in jobs of average risk, the estimates imply that, in current dollars, workers receive premiums in the range of $600 to face an additional annual work-related fatality risk of one chance in 10,000. Put somewhat differently, if there were 10,000 such workers facing an annual fatality of one chance in 10,000, there would be one statistical death. In return for that risk, workers would receive total additional wage compensation of $6 million. The compensation establishes the value of a statistical life, based on workers' own attitudes toward risks.

By almost any standard, those estimates are substantial. When economists such as W. Kip Viscusi and Robert Smith first developed estimates in the millions of dollars, some critics suggested that they might be too high. They were, for example, higher than estimates developed by Richard Thaler and Sherwin Rosen that focused on workers in very high-risk jobs. Numerous studies over the past several decades have, however, documented the plausibility of estimates in the $3 million to $8 million range.

An interesting implication of those results is that the quite considerable estimates of the value of a statistical life have been derived from actual market decisions involving jobs, products, and housing choices. The estimates suggest that in situations in which there is an awareness of the risk, market forces are enormously powerful and create tremendous safety incentives. Thus, we are not operating in a world in which there are no constraints other than regulatory intervention to promote our safety. Rather, powerful market forces already create incentives for safety that should not be overridden by intrusive regulations, but instead define the overall economic framework in which regulatory interventions can potentially complement the already significant market forces at work.

Regulatory agencies were slow to adopt the emerging value of a statistical life estimates, as they instead clung to more traditional procedures such as the present value of lost earnings (which yield much lower estimates of the benefits of risk reduction) on the grounds that it would be immoral to value human life.

Using the value The estimate of the value of a statistical life has changed over time and varies substantially across — and even within — agencies. The value of the statistical life is not a universal constant. Indeed, there is substantial heterogeneity in the value of a statistical life throughout society as some people are more willing to bear risk than others. Moreover, the quantity of life at risk may be quite different in different regulatory contexts. Patients with advanced respiratory ailments whose lives may be shortened by several months because of pollution exposure presumably place a different value on risk reduction than do people with a normal life expectancy. However, for the most part, such legitimate economic concerns with differences in the value of a statistical life have not accounted for the discrepancies across different regulatory arenas.

At the low end of the value spectrum is the Federal Aviation Administration and other Department of Transportation (DOT) agencies. Until 1987, the FAA used a value of a statistical life that did not exceed $650,000. It then moved to a value of a statistical life of $1 million in 1987, increasing it to $1.5 million in 1990, and then to $2.7 million before finally settling on $3 million in 1995.

The value estimates adopted by OSHA typically have been in the same vein as those developed through labor market estimates. Thus, OSHA has often used such figures as $3.5 million to value the risk reduction benefits of its efforts. The EPA used similar numbers in its early efforts, but most recently has been using figures of about $6 million, which represents the midpoint of market estimates of the value of a statistical life. What is more, EPA, through its Science Advisory Board economics panel and other efforts, has been grappling with frontier issues in the value of a statistical life, such as the differential values that should be placed on the lives of those exposed involuntarily to environmental hazards as opposed to workers who have self-selected themselves into relatively high risk jobs.

ASSESSING REGULATORY PERFORMANCE

Although many agencies use reasonable measures of the value of a statistical life for the purposes of assessing benefits, the cost per life saved for the regulations actually promulgated often far exceeds the estimated benefits. There are, of course, other benefit components that must be taken into account and might increase the benefit estimates of the regulation sufficiently to offset the total costs. However, such influences alone do not account for the fact that the cost expended per statistical life saved often far exceeds the estimated benefits of the risk reduction. Rather, the restrictive nature of agencies' legislative mandates often precludes consideration of costs in the regulatory decision.

Table 1 lists various health and safety regulations and their estimated cost per life saved. The table also lists the cost per normalized life saved (in 1995 dollars), which accounts for the duration of life lost and the existence of discounting of future lives. Because the legislative mandate varies across regulations, one sees great variance in the cost per life saved. Indeed, the cost varies even within certain regulatory agencies. For example, EPA's regulation

TABLE 1

The Cost of Safety

A sample of U.S. health and safety regulations and their cost per life saved

Regulation	Year	Agency	Cost per life saved (millions of 1990 $)	Cost per normalized life saved (millions of 1995 $)
Unvented space heater ban	1980	CPSC	0.1	0.1
Aircraft cabin fire protection standard	1985	FAA	0.1	0.1
Seatbelt / air bag	1984	NHTSA	0.1	0.1
Steering column protection standard	1967	NHTSA	0.1	0.1
Underground construction standards	1989	OSHA	0.1	0.1
Trihalomethane in drinking water	1979	EPA	0.2	0.6
Aircraft seat cushion flammability	1984	FAA	0.5	0.6
Alcohol and drug controls	1985	FRA	0.5	0.6
Auto fuel-system integrity	1975	NHTSA	0.5	0.5
Auto wheel rim servicing	1984	OSHA	0.5	0.6
Aircraft floor emergency lighting	1984	FAA	0.7	0.9
Concrete and masonry construction	1988	OSHA	0.7	0.9
Crane suspended personnel platform	1988	OSHA	0.8	1.0
Passive restraints for trucks and busses	1989	NHTSA	0.8	0.8
Auto side-impact standards	1990	1990	1.0	1.0
Children's sleepwear flammability ban	1973	1973	1.0	1.2
Auto side-door supports	1970	NHTSA	1.0	1.0
Low-altitude windshear equipment	1988	FAA	1.6	1.9
Metal mine electrical equipment standards	1970	MSHA	1.7	2.0
Trenching and excavation standards	1989	OSHA	1.8	2.2
Traffic alert / collision avoidance systems	1988	FAA	1.8	2.2
Hazard communication standard	1983	OSHA	1.9	4.8
Truck, bus, and MPV side-impact standard	1989	NHTSA	2.6	2.6
Grain dust explosion prevention standards	1987	OSHA	3.3	4.0
Rear lap / shoulder belts for cars	1989	NHTSA	3.8	3.8
Radionuclides standards for uranium mines	1984	EPA	4.1	10.1
Benzene NESHAP (original)	1984	EPA	4.1	10.1
Ethylene dibromide in drinking water	1991	EPA	6.8	17.0
Benzene NESHAP (revised)	1988	EPA	7.3	18.1
Asbestos occupational exposure limit	1972	OSHA	9.9	24.7
Benzene occupational exposure limit	1987	OSHA	10.6	26.5
Electrical equipment in coal mines	1970	OSHA	11.0	13.3
Arsenic emissions from glass plants	1986	MSHA	16.1	40.2
Ethylene oxide occupational exposure limit	1984	EPA	24.4	61.0
Arsenic / copper NESHAP	1986	EPA	27.4	68.4
Petroleum sludge hazardous waste listing	1990	EPA	32.9	82.1
Cover / move uranium mill tailings (inactive)	1983	EPA	37.7	94.3
Benzene NESHAP (revised)	1990	EPA	39.2	97.9
Cover / move uranium mill tailings (active)	1983	EPA	53.6	133.8
Acrylonitrile occupational exposure limit	1978	OSHA	61.3	153.2
Coke ovens occupational exposure limit	1976	OSHA	75.6	188.9
Lockout / tagout	1989	OSHA	84.4	102.4
Arsenic occupational exposure limit	1978	OSHA	127.3	317.9
Asbestos ban	1989	EPA	131.8	329.2
Diethylstilbestrol cattle feed ban	1979	FDA	148.6	371.2
Benzene NESHAP (revised)	1990	EPA	200.2	500.2
1,2-Dichloropropane in drinking water	1991	EPA	777.4	1,942.1
Hazardous waste land disposal ban	1988	EPA	4,988.7	12,462.7
Municipal solid waste landfills	1988	EPA	22,746.8	56,826.1
Formaldehyde occupational exposure limit	1987	OSHA	102,608.5	256,372.7
Atrazine / alachlor in drinking water	1991	EPA	109,608.5	273,824.4
Wood-preservatives hazardous waste listing	1990	EPA	6,785,822.0	16,952,364.9

SOURCE: "Measures of Mortality Risks," by W. Kip Viscusi, Jahn K. Hakes, and Alan Carlin, *Journal of Risk and Uncertainty* Volume 14 (1997).

of trihalomethane in drinking water has an estimated cost per normalized life saved of $600,000, whereas the regulation of Atrazine/alachlor in drinking water has an estimated cost per normalized life saved of $274 billion. A regulatory system based on sound economic principles would reallocate resources from the high- to the low-cost regulations. That would result in more lives saved at the same cost to society (or equivalently, shifting resources could result in the same number of lives saved at lower cost to society).

Because many divisions within the DOT do not issue regulations that fail a benefit-cost test, the cost per life saved of their regulations tends to be rather low. For example, among the examples in Table 1, the FAA's regulations have a cost per normalized life saved of no more than $2.2 million. In fact, to the extent that the DOT undervalues statistical lives, in many instances the interventions are less ambitious than is justified on an economic basis.

While the FAA regulations' costs are fairly consistent with benefit values (though perhaps not ambitious enough), other agencies often issue regulations with extraordinarily high costs per life saved. In the case of OSHA, its 1987 formaldehyde exposure standard imposes a cost per normalized life saved of $256 billion. Similarly, some EPA regulations are often quite costly, as in the case of its asbestos ban, which imposes an estimated cost per normalized life saved of $329.2 million.

The natural question to ask is why the regulatory oversight process has not stopped extremely costly regulations? Surely, the OMB must be aware of the inconsistency with its objective to promote a balance between the benefits and costs of regulatory policies. Indeed, the OMB and one of its chief economists, John F. Morrall III, have routinely published widely cited data like those appearing in Table 1. Based on the OMB estimates, the agency has never rejected a proposed rule with a cost below $100 million per life saved.

The estimates in Table 1 indicate that those who criticize the OMB for excessive stringency clearly are mistaken. The policy problem is not that regulatory oversight is too stringent, but rather that it is not stringent enough. That leads to

a severe misallocation of resources, resulting in missed opportunities to improve the welfare of society. That failure has persisted throughout several presidential administrations and is largely a consequence of the restrictive language in the laws passed by Congress that govern the regulatory agencies.

RISK-RISK ANALYSIS

Given that efficient regulatory policy seems unlikely, a less stringent evaluative standard would be the use of a "risk–risk" test. Risk-risk analysis weighs the risk-increasing aspects of a regulation against the risk reduction caused by the regulation. Adopting such analysis would encourage the promulgation of regulations that result in a net risk reduction to society.

The first form of risk–risk analysis is straightforward. Although risks to life may be reduced through various regulations, they may also create new risks. For example, some consumers may be injured in traffic accidents while bringing their cars back to the dealership as part of an automobile recall. Similarly, if a regulation leads to new manufacturing or construction activity, some workers will be injured or killed as part of such efforts. Thus, extremely ineffective regulations could potentially create more risks than they reduce.

A more thorough form of risk–risk analysis pertains to the economic result first developed in the late 1970s that demonstrates a positive relationship between individual wealth and health. As society has become more affluent, our health has improved and we have demanded greater levels of safety of all kinds. Regulations impose costs on society and lead to a reallocation of resources that would have been expended on consumption goods — the net effect of which would have been health enhancing. If policies divert health-enhancing resources to extremely ineffective regulatory efforts, the net effect may be to harm individual health.

Table 2 summarizes four principal studies of that linkage. The first two analyses use direct estimates between changes in individual wealth over time and longevity. That approach has yielded comparatively low numbers that may appear to be implausibly low because society is willing to spend about $6 million to save a statistical life, whereas the lowest of the estimates implies that there would be the loss of a statistical life from expenditures not much more than that. Surely, our private risk-reducing expenditures allow us to do more than break even in terms of our overall risks. The latter two studies in Table 2 explicitly take into account the theoretical relationship between the value of a statistical life and the expenditure per life saved that would lead to the loss of a statistical life. The third study suggests that a regulation that yields a cost per life above $50 million would result in a net increase in fatalities. The fourth study indicates that the cut-off is at $15 million. Thus, according to all four studies in Table 2, many of the regulations in Table 1 actually lead to a net increase in risk to society.

In the 1991 case *UAW v. OSHA*, D.C. Appeals Court Judge Stephen Williams cited risk–risk estimates in his ruling that OSHA's safety standards for accidental startups of hazardous machinery could conceivably result in an increase in fatalities. Following that case, the OMB explicitly used the risk–risk regulatory criterion to suspend its review of an OSHA-proposed regulation of workplace air contaminants. In later hearings held by the Senate Committee on Government Affairs, the General Accounting Office (GAO) advised against use of risk–risk analysis because, in the GAO's view, it constitutes a benefit-cost analysis.

Although the efforts to get the agency to adopt the risk–risk approach were not successful, ultimately there must be some recognition that unbounded cost commitments to modest reductions in risk surely cannot be in society's best interest. The particular cost per life saved cutoff for safety-enhancing regulations remains a matter of substantial debate, but all such estimates in Table 2 are in the range of $50 million or less per statistical life. Thus, we can be confident based on the economic literature that an expenditure of more than $50 million per life saved will not, on balance, enhance individual health because it diverts resources from more effective health-enhancing measures.

Adoption of such a cost-per-life regulatory threshold, which is roughly an order of magnitude greater than the benefit value of a statistical life, might seem to be an excessively lenient standard in that it would permit regulations to be issued with safety-enhancing benefits that have a value of only about one-tenth the size of the costs imposed. However, given that the majority of health and safety regulations issued over the past three decades would not meet such a lenient test for regulatory desirability, the importance of establishing modest limits on regulatory profligacy seems clear.

The focus of policy debates should not be over whether regulations that cost $7 million per life saved or $12 million per life saved are desirable. Rather, policy debates should emphasize the enormous opportunity costs associated with regula-

TABLE 2

Regulatory Costs on Health

Summary of expenditures per life saved that lead to the loss of a statistical life

Author	Income loss per statistical life ($ millions*)	Methodology
Keeney (1990)	12.5	Mortality rate–income relationship for the United States
Lutter and Morrall (1994)	9.3	International data on mortality-income relationship.
Viscusi (1994)	50	Value of life coupled with marriage propensity to spend on health.
Lutter, Morrall, and Viscusi (1999)	15	Same as Viscusi '94 but including harmful health-related expenditures coupled with marginal propensity.

* For comparability, the results from Keeney and Lutter and Morrall have been put in 1992 dollars, which is the same as Viscusi.

SOURCES: "Mortality Risks Induced by Economic Expenditures," by Ralph L. Keeney, *Risk Analysis*, Vol. 10 (1990); "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation," by Randall Lutter and John F. Morrall III, *Journal of Risk and Uncertainty*, Vol. 8 (1994); "Mortality Effects of Regulatory Costs and Policy Evaluation Criteria," by W. Kip Viscusi, *RAND Journal of Economics*, Vol. 25 (1994); and "The Cost-per-Life-Saved Cutoff for Safety-Enhancing Regulations," by Randall Lutter, John F. Morrall III, and W. Kip Viscusi, *Economic Inquiry*, Vol. 37 (1999).

tions that cost hundreds of millions of dollars or even billions of dollars per statistical life saved.

INNOVATIVE POLICY STRATEGIES

As mentioned earlier, the dominant approach to health and safety regulation has been technology-forcing standards. Unlike the environmental policy arena, there has been no discussion of the potential role of marketable permits and other market-based mechanisms for health and safety standards. The two principal areas stressed by economists have been the potential role for performance standards and the desirability of hazard communication strategies.

Performance standards The impetus for performance-oriented regulations is that it is desirable to obtain regulatory objectives in the most cost-effective way possible. The flexibility of performance-oriented regulations (instead of technology-based regulations) allows the regulated entities to achieve the outcomes at least cost.

The original OSHA standards did little to take such cost-effectiveness concerns into account. The first standards involved the adoption of 4,000 general industry guidelines specified by the American National Standards Institute, the National Fire Protection Association, and some existing federal standards from maritime safety. Many of the initial OSHA standards were the objects of ridicule, including those that specified the shape of toilet seats and the requirement that workers on a bridge wear orange-colored life vests even in situations in which the riverbed underneath was dry.

Over time, there have been some minor efforts by OSHA and other agencies to adopt performance-oriented regulations that exploit the superior cost-effectiveness of permitting firms to have some discretion. A chief example is the OSHA grain dust standard, which gave firms a variety of performance-oriented alternatives to choose from in order to achieve compliance with the regulation. By giving firms several options, it is possible for them to select the approach that is least costly given the workplace situation but still meets the desired safety objective. For the most part, however, the specification standards under the initial wave of OSHA regulations have remained in place.

Other kinds of performance-oriented approaches that involve the engagement of protective behavior by workers have not been adopted. For example, one could decrease the control cost of reducing cotton dust exposures by requiring that workers wear light disposable cotton masks or rotating workers out of high-exposure areas. Protective equipment such as respirators also may be desirable in other contexts. However, the emphasis of regulatory policies has been on approaches that do not rely on either protective equipment or increased care on the part of workers.

Hazard warnings A principal exception has been the emergence of hazard warnings regulations. Unlike technology-forcing regulatory policies that constrain individual choice, hazard warnings potentially can work through the market by providing consumers and workers with needed information. To the extent that the rationale for intervention is inadequate information regarding risks, hazard warnings can address that shortcoming directly by eliminating the informational gap, thus allowing people to make market tradeoffs that fit their preferences. At the same time, choices by workers and consumers subject to the receipt of the information would be respected so that market forces would permit people to make choices consistent with their own risk-cost balancing rather than being subject to uniform regulatory standards that almost invariably fail to recognize such differences in individuals' willingness to bear risk.

While hazard warnings are now ubiquitous, that has not always been the case. Beginning in 1927, legislation only required that a dozen of the most dangerous chemicals such as hydrochloric acid and sulfuric acid be labeled "POISON." A decade later, there was required labeling for food, drugs, and cosmetics, where the primary focus was on imminent hazards arising from adulterated and misbranded products. In 1947, Congress established labeling requirements for insecticides, and it was not until 1960 that there were warnings requirements for specified hazards such as flammability and radioactivity.

The modern era of on-product warnings began in 1966 with the requirement that cigarettes bear warnings. The on-product labels were distinctive in that they were for hazards that did not pose an imminent risk of death and arose from a product that was used in a manner intended by the manufacturer. Beginning in the 1980s, there was a right-to-know movement that led to a flurry of such warnings efforts. In 1983, OSHA enacted its communication regulations that for the first time required hazard warnings for dangerous workplace chemicals. Other efforts that emerged in the 1980s included hazard warnings for lawn mowers, on-product warnings for alcoholic beverages, the requirement that many prescription drugs include information inserts, the requirement that sellers of houses built before 1950 inform buyers about the presence of lead-based paints, and EPA's requirement that manufacturing facilities report their annual releases of chemicals above a threshold amount from a list of over 600 substances.

Now, both as a result of regulatory interventions and the threat of liability lawsuits, there are extensive warnings for the multiplicity of risks we face. While warnings and hazard communication efforts of other kinds can potentially play a constructive role, ubiquitous warnings could have a negative effect if they clutter the informational space and lead people to disregard them or prevent people from drawing the necessary distinctions among courses of action. In particular, warnings that simply attempt to change consumer behavior may make other information efforts less effective.

The emerging literature developed by economists and other disciplines has derived many fundamental principles for hazard warnings. Chief among them is that a warning should provide new and accurate information in a convincing manner. Reminder warnings such as the "buckle-up for safety" seatbelt campaign have yielded few dividends. To the extent that warnings efforts stray from the mandate to provide new and honest information in an unbiased manner, there is a danger that the credibility of that warning's effort and government policy more generally will be undermined. Nonetheless, properly designed hazard warnings can be among the most beneficial interventions in that they foster improved market performance

without imposing any regulatory burdens.

BEHAVIORAL RESPONSES TO REGULATION

The health and safety aspects of any activity will be governed by the combined influence of the technological characteristics of the safety context, the attributes of the individual, and the safety-related behavior that the individual takes. Although buckling one's seatbelt potentially could reduce the risk of injury in an automobile crash, buckled-up drivers may change their driving habits such that there would be no overall safety-enhancing effect. Indeed, empirical tests derived by Sam Peltzman failed to indicate any net beneficial effect of seatbelt regulations on occupant safety. While many empirical studies suggest that there is a behavioral response to such regulations, whether the net effect is an increase or decrease in risk is a matter of empirical dispute.

The seatbelt effect stems from a rational behavioral response to the decreased risk of driving, making careful driving less important. Viewed somewhat differently, if the streets were icy, one would want to drive very carefully, but once the streets become dry the incentives to take care would be diminished. Seatbelts, in effect, have the same kind of influence as converting the streets from being icy to dry in that they decrease the risks associated with more intense driving behavior.

A different but related type of behavioral response is the lulling effect observed by W. Kip Viscusi with respect to bottle safety caps. For years, the Consumer Product Safety Commission referred to protective caps as being "childproof." The net result is that parents who previously were more protective with respect to the products became lax with respect to protective actions. The incentives to place medicines and other dangerous products in childproof locations diminished with the introduction of the caps, with the result that there were no net beneficial effects for products that received the regulated caps. Moreover, there is evidence that the greater laxity in storage of dangerous products led to an increase in the risk of other products (such as aspirin). There was also a practical problem of consumers grappling with the caps, leading many consumers to leave the caps off altogether. That, in turn, generated a substantial number of open-bottle poisonings.

Those and other potential behavioral responses to regulation typically have not been recognized in the design of regulatory policies. Rather than alerting consumers to continuing risks of products notwithstanding the presence of safety caps, the CPSC has attempted to dispute the research. There continues to be a substantial gap between economic research that has documented the potential benefits of safety-enhancing behavior and regulatory approaches that continue to emphasize technological solutions. Failure to recognize and exploit individual behavioral responses leads to regulations that are less successful in promoting safety than would be a more comprehensive approach.

ENFORCEMENT

Compliance with health and safety standards is expensive, with costs that often run into the billions of dollars. If compliance were discretionary, many firms would choose simply not to comply because noncompliance would be in their financial self-interest. Those relationships have been the focus of economic analyses, which have shown that firms are more likely to comply with the regulation if the costs of compliance are less than the expected penalties associated with non-compliance.

Achieving compliance is fairly straightforward in the case of mass-marketed consumer products. The CPSC and the NHTSA, for example, regulate products that are readily monitorable in terms of compliance with design standards. Manufacturing errors would be more difficult to detect to the extent that they are random events, but most of the regulations pertaining to those agencies are matters of design, which can be readily ascertained.

Rare decentralized enforcement In contrast, many standards promulgated by OSHA and EPA are decentralized. In such instances, having an effective enforcement effort is essential to establishing the incentives needed to promote compliance on the part of the affected firms. EPA's water enforcement effort represents perhaps a best-case scenario. All major polluters are required to file regular discharge-monitoring reports and are subject to an annual inspection.

That performance contrasts with OSHA, where the enforcement problems have been legendary. In any given year, a firm faces a probability of less than one in 100 that it will see an OSHA inspector. Some economists have compared that probability to being less than the chance at seeing Halley's comet in any given year. Should a firm happen to see an OSHA inspector, he will hand out an average of 2.2 violations per inspection. Most of the violations are for readily monitorable aspects of the workplace, such as loose handrails and slippery staircases.

The financial incentive for compliance stems from the expected penalties given for violations. If the probability of inspection is low, then the only way to decrease violations is to hand out stiffer penalties. For many years, OSHA penalties tended to be negligible – on the order of $10 million or less for the entire U.S. economy.

OSHA penalties have been dwarfed by the influence of financial incentives for safety created by the market through compensating differentials for risk. The Clinton administration made a concerted effort to boost the level of penalties, which is beneficial from an economic standpoint to the extent that they establish incentives for compliance using meaningful standards. One of the difficulties with early OSHA enforcement efforts was that the widespread lack of confidence in the soundness of the regulation led inspectors to avoid imposing penalties on the inspected firms.

OSHA penalties now total $82 million per year. Thus, the average penalty per violation is $1,039. While penalties at that level represent a much-needed improvement in the financial incentives for safety, they are still dwarfed by other financial incentives facing the firm. Remember that each workplace fatality generates wage premiums in terms of compensating differentials for risk on the order of $6 million per statistical death.

Workers' compensation There also are additional safety incentives facing the firm, not the least of which is the influence of workers' compensation benefits. Premiums for workers' compensation are experience-rated, particularly for large firms.

Workers' compensation premiums in 2000 were $25 billion, or over 300 times greater than the OSHA penalties that were levied. From an economic standpoint, one would expect workers' compensation to be a more powerful driver of safety in the workplace than OSHA regulations. For much the same reason, compensating differentials for risk, which exceed even the influence of workers' compensation, should be the most powerful force promoting safety.

The role of workers' compensation in providing financial incentives for safety has been considerable. Empirical estimates indicate that, without the financial incentives, worker fatality rates in the United States would be one-third greater than their current level. In contrast, the effect of occupational safety and health regulations has been comparatively modest. Early estimates of OSHA's impact on worker safety failed to find any statistically significant effect of the agency. More recent estimates suggest that OSHA may have reduced all worker accidents that involve lost days of work by five to six percent.

The greater influence of workers' compensation stems from two factors. First, that effort creates greater financial incentives. Second, the incentives created by workers' compensation are performance oriented in that changes in the rate of workplace accidents will influence a firm's experience rating. Firms, in turn, can adopt a cost effective way to promote safety in response to the incentives. In contrast, command-and-control regulations give firms less leeway, thus leading to fewer safety gains for any given expenditure on safety.

EFFECT OF REGULATION ON ACCIDENT RATES

What has been the overall effect of the emergence of health and safety regulations since the early 1970s? One yardstick of performance is to see whether accident rates have declined. Of course, even that yardstick would likely overstate the effect of regulation because the decision to regulate is endogenous. That is, a random shock that increases workplace risk might lead to an OSHA regulation. It would then be misleading to attribute reversion to the mean to the regulation. With that in mind, Figure 1 summarizes fatality rates of various kinds, including motor vehicle accidents, work accidents, home accidents, public no-motor-vehicle accidents, and an aggregative category of all accidents.

Since the 1970s, accidents of all kinds have declined. The improvements in safety over time typically lead to annual press releases on the part of the regulatory agencies in which they take credit for the improvements and attribute the gains to their regulatory efforts. There are exceptions, as there are some years in which accident rates increase — in which case regulatory officials typically blame cyclical factors for such trends.

The basic message of Figure 1 is that accident rates have been declining throughout the past 100 years. The improvement in our safety is not a new phenomenon that began with the advent of regulatory agencies commissioned to protect the citizenry. There is, for example, no significant downward shift in Figure 1's trend for job fatality risk after the establishment of OSHA.

Perhaps the main exception has been motor vehicle accidents, but assessments of annual death rates associated with motor vehicles is complicated by the fact that many more people drive than in previous years, and there have been considerable changes in the amount of driving, traffic congestion, and highway design.

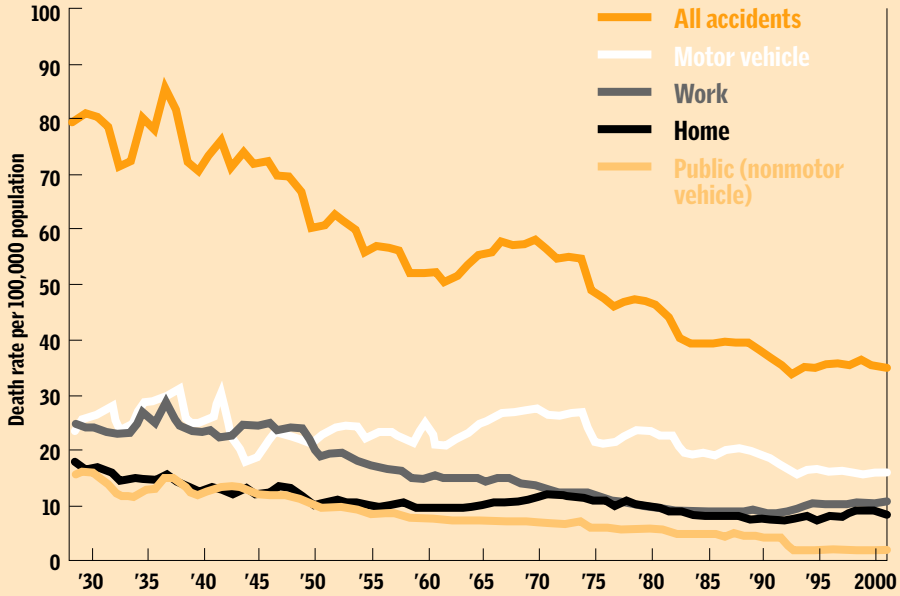
Figure 2 provides an explanation of motor vehicle accident rates that attempts to adjust to some of the aspects of driving intensity rather than simply tallying the motor vehicle fatality rate per person. As can be seen from the figure, deaths per 10,000 motor vehicles as well as deaths per 100 million vehicle miles each have declined steadily throughout the last 100 years. As in the case of the other accident statistics, there is no evidence of a sharp, discontinuous break in the downward trend that occurred with the advent of regulatory policies.

While there may be a beneficial safety-enhancing role played by regulation, the steady decrease in risk throughout the century supports the hypothesis that improvements in societal wealth have greatly increased our demand for safety over time. Coupling that wealth with technological improvements — many of which have been stimulated by the greater demand for safety — have led to dramatic improve-

FIGURE 1

The Good News

Unintentional injury deaths in the United States, 1928-2001

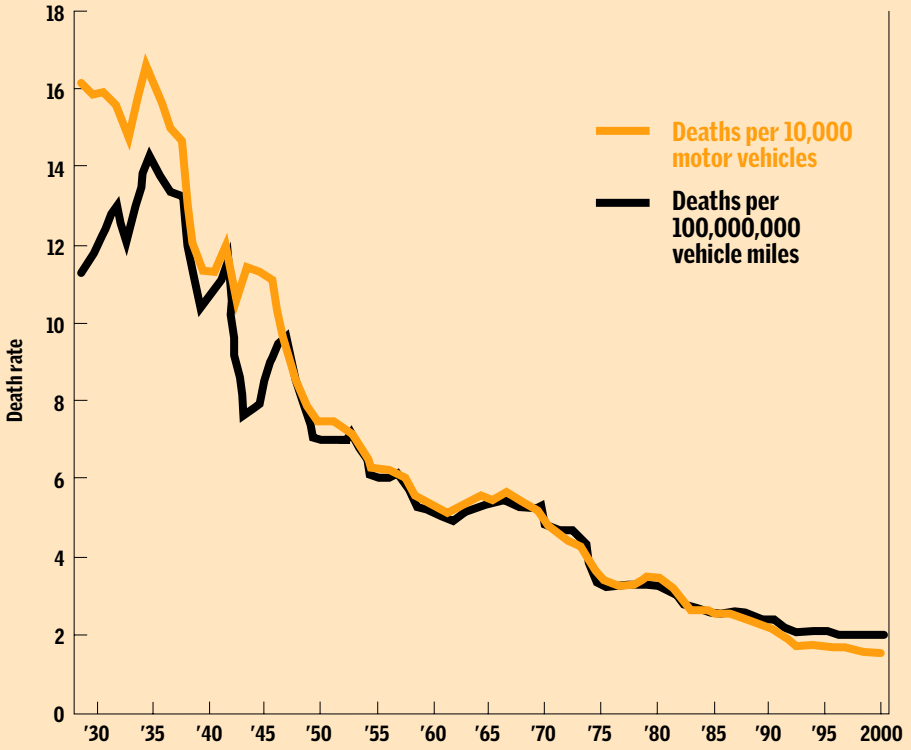


SOURCE: *Accident Facts*, 2001 ed., (Itasca, Ill.: National Safety Council), pp. 34-35.

FIGURE 2

Good News on the Road

Motor-vehicle death rate in the United States, 1928-2001



SOURCE: *Accident Facts*, 2001 ed., (Itasca, Ill.: National Safety Council), pp. 108-109.

ments in our individual well-being. Market forces rather than regulatory policy have likely been the most important contributor to safety improvements since early last century.

REFORM AGENDA

Almost from its inception, health and safety regulation has been the target of proposed reform. Some policy improvements have occurred, such as elimination of some of the nit-picking of safety standards, the increased utilization of informational approaches to regulation, and enhanced enforcement efforts. However, health and safety regulations have fallen short of any reasonable standard of performance.

The underlying difficulty can be traced to the legislative mandates of the regulatory agencies. Rather than focusing regulations on instances of market failure, the emphasis is on reductions of risk irrespective of cost. The regulatory approach has also been characterized by an overly narrow conceptualization of the potential modes of intervention. The emphasis has been on command-and-control regulations rather than performance-oriented standards. More generally, various forms of injury taxes that would parallel the financial incentives created by workers' compensation or various environmental tradable permits programs could establish incentives for safety while at the same time offer firms leeway to select the most cost effective means for risk reduction. A glaring omission from the regulatory strategy has been inadequate attention devoted to the role of consumer and worker behavior and the potential for exploiting the benefits that can derive from promoting safety-enhancing actions by individuals rather than relying simply on technological controls.

The enforcement efforts for regulatory standards, particularly in the case of OSHA, have largely been inadequate. The experience thus far has been characterized by safety standards of dubious relevance coupled with lax enforcement. A preferable approach, if the standards strategy is to be continued, is to couple sensible regulations with a stricter enforcement that provides real financial incentives for safety.

Defenders of the current regulatory approach have long seized the moral high ground by claiming that their uncompromising efforts protect individual health; thus less consequential concerns such as cost should not interfere with that higher enterprise. Economic findings with respect to risk–risk tradeoffs highlight the fallacies inherent in this zero-risk mentality. Health and safety regulations that have the current inordinate imbalance between costs incurred and risk reductions achieved divert society's resources from a mix of expenditures that would be more health enhancing. Agencies that make an unbounded financial commitment to safety frequently are sacrificing individual lives in their symbolic quest for a zero-risk society. It is unlikely that this situation will be remedied in the absence of fundamental legislative reform.

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