

CHAPTER 6

Risk and Responsibility

RISK IS A FACT OF LIFE. Every person balances risks of accident and injury against the attainment of other goals, and trades off some kinds of hazards against others. Whether to smoke, take a particular job, travel by automobile or airplane, use a safety belt while driving, or engage in a dangerous recreational activity are all decisions that involve risk. People are subject to hazards from the actions of other individuals as well. Determination of the proper role of government with regard to personal risk is a complex and important public policy issue.

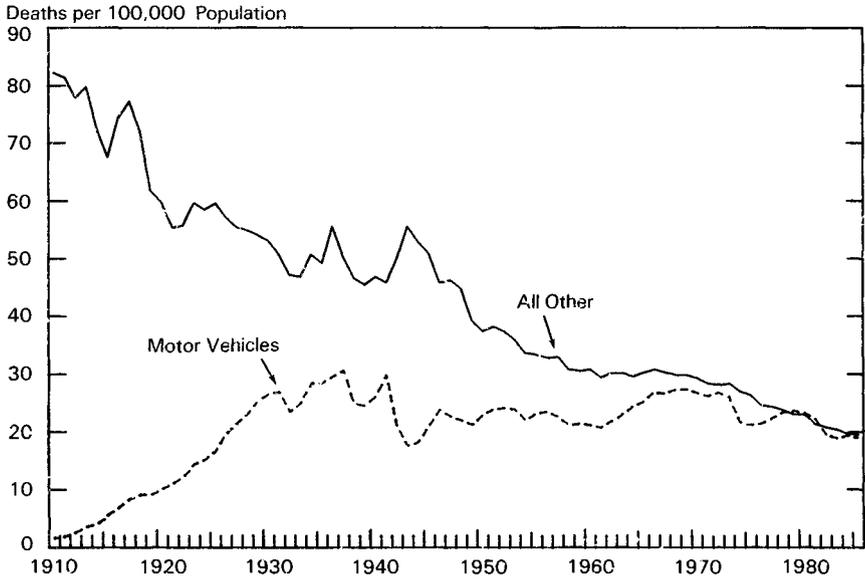
Health and safety have improved dramatically in the United States during the 20th century. Life expectancy at birth increased from 47.3 years in 1900 to 62.9 years in 1940 and, by 1983, had risen to 74.7 years. Much of this improvement is attributable to the decline in infant mortality, but adult life expectancy has also increased. In 1900, a 40-year old could expect to live to age 67.9. This expectation increased to 71 by 1940, and rose further to 77.2 by 1983. This represents a gain of 9.3 years, or a 33 percent increase in the expected number of years remaining at age 40.

Accident fatality rates have declined at the same time. Chart 6-1 shows annual fatality rates from motor vehicle and all other accidental causes. The rate from all causes other than motor vehicles dropped from 82.4 per hundred thousand population in 1910 to 20.9 in 1982. Motor vehicle deaths per hundred thousand population generally have been steady since the late 1930s. Automobile travel has increased substantially over this period, however, and traffic fatalities per hundred million vehicle miles have fallen almost 80 percent, from 10.89 in 1940 to 2.47 in 1985.

Both the home and workplace have become safer. The home accidental death rate per hundred thousand population decreased from 21.2 in 1948 to 8.6 in 1985. The accidental death rate at work has fallen by more than two-thirds since the 1930s (Chart 6-2). Work-related death rates differ across industries, and one cause of reductions in the overall rate has been the change in employment patterns as production has shifted from agriculture and other relatively danger-

Chart 6-1

Rates of Accidental Deaths by Cause



Sources: Public Health Service and National Safety Council.

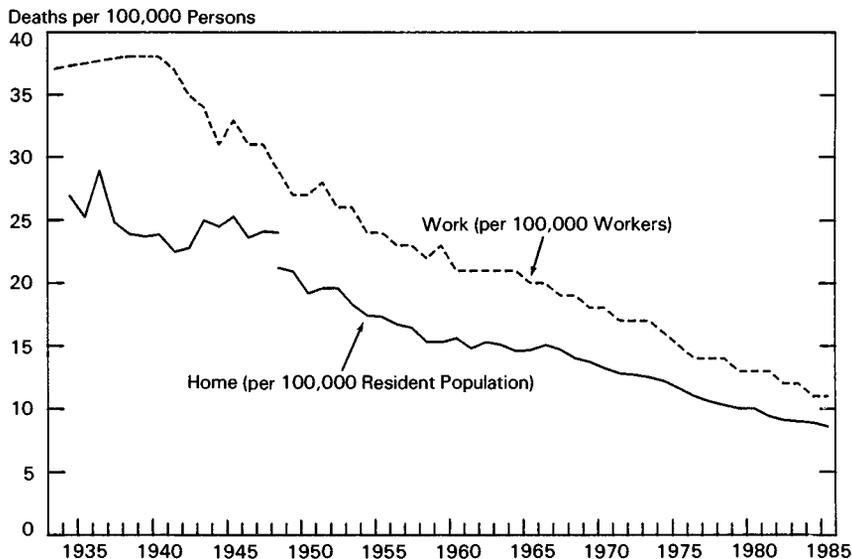
ous goods-producing industries to the relatively safer service industries.

The underlying source of these improvements in health and safety is economic growth and a rising standard of living. Higher incomes enable people to purchase better nutrition, clothing, and shelter as well as more and better medical care. A higher standard of living enables consumers to purchase safer products, safer forms of transportation (including safer automobiles), and safer living environments. Increased wealth supports improved public health measures, from vaccinations to water and sewage treatment. Economic progress has been a major factor leading to advances in science and medicine that have mitigated or eliminated many dread diseases and have improved the treatment of accident victims.

But accidents, injuries, and disease can never be avoided entirely. Individuals do not seek to avoid all risks, and the human lifespan cannot be extended without limit. Increases in health and safety often cannot be achieved without cost, and are only one way in which economic progress can be translated into greater well-being.

Chart 6-2

Rates of Home and Work Deaths Due to Accidents



Note.—A change in classification resulted in a break in the home accident series in 1948.

Source: National Safety Council.

PROTECTION AGAINST RISK

Every individual can reduce risk by exercising personal care. If responsible adults voluntarily undertake risky activities, such as hang gliding, their choices must be respected in a society that values individual liberty and autonomy. This general principle of respecting personal choice is compatible, however, with governmental action to reduce risk in particular circumstances, especially when the actions of some increase the risks to others.

The institutional means for increasing safety and reducing risk are provided through three social arrangements—markets, the legal system, and government regulation. Markets create incentives for safe behavior and allow individual choice in decisions involving risk. Consumers can purchase reductions in risk directly by choosing safer products. Safety is a desirable product characteristic, like durability and energy efficiency. Companies that earn reputations for making unsafe products face retribution in the marketplace, just as if they charged excessive prices or offered shoddy goods. The market also

promotes safety in the workplace. All other things equal, employers must pay higher wages for riskier jobs, which creates an incentive to reduce occupational hazards.

Private insurance enables individuals and firms to protect themselves against the costs of various risks. Consumers purchase insurance against losses from death, illness and accidents, and some kinds of natural disasters. Manufacturers insure against product liability lawsuits, and professional practitioners insure against liability for malpractice. By spreading the costs of risk, insurance can also undermine incentives for safe behavior; but where premiums are closely linked to the likelihood of events insured against, safety incentives are substantially preserved.

Markets cannot entirely protect an individual from being harmed by the actions of others. The legal system, specifically tort law, provides victims the opportunity to be compensated. By transferring to those who cause harm the costs they impose on others, tort law creates incentives for individuals to behave responsibly.

GOVERNMENT MANAGEMENT OF RISK

Government provides the legal and judicial framework for the market and tort systems, offers insurance against some risks, imposes regulatory standards, and operates programs to control risk directly. Government protects the integrity of the marketplace by prohibiting dissemination of false or fraudulent information by sellers. Government supports basic health research, and informs the public about health and safety characteristics of products.

Several circumstances may provide a rationale for government regulation. First, consumers may lack the information or the ability to assess particular risks accurately. Second, individuals or firms fail in some cases to take account of the costs of harm they impose on others. The tort system may not be able to force a person who causes harm to bear these costs if the person's wealth is insufficient to compensate the victim, the cost of using the tort system is too high, or the person who caused the harm cannot be identified. Third, if markets and the tort system cannot adequately control externalities such as those leading to environmental pollution, government regulation may be warranted. Government regulates risk and safety through agencies such as the National Highway Traffic Safety Administration (NHTSA), the Consumer Product Safety Commission (CPSC), the Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (EPA).

Regulatory policy encompasses both risk assessment (determination of the probabilities of harm) and risk management. Risk manage-

ment should reduce and not merely displace risk. If one dangerous product is banned, more harmful ones may be used. Substitutions of this sort can exchange known risks for unknown ones. Effective risk management assesses the relative benefits and costs of actions to reduce particular risks. The benefits of regulation include avoidance of deaths, injuries, and property damage, as well as saving resources that otherwise would be used to mitigate these adverse consequences. Costs of regulation include the resources, both public and private, that must be devoted to meeting regulatory standards, as well as reduced competition in some cases. Government regulation sometimes restricts freedom of individual choice by imposing common standards. Regulation may, in addition, retard innovation and investment, thus slowing economic growth.

If some regulations show a much lower cost per life saved or accident avoided than others, adoption of the more cost-effective ones would save more lives for a given level of risk-reduction costs. Regulatory actions with the highest expected net gains should be undertaken first, leading to consistency in cost-effectiveness across regulations. A policy of consistency should apply to all activities of government that affect risk: for example, statutes and regulations; Federal programs that directly affect safety, such as air traffic control and the oversight of aircraft maintenance; and State and local activities, such as highway construction and firefighting. Complete consistency, however, is neither attainable nor desirable. States determine their own regulatory policies in many areas, in accordance with principles of federalism. Special significance may be attached to reducing particular types of risks, such as those faced by children, or risks that are not assumed voluntarily.

Statutory language sometimes impedes the realization of consistency by setting goals that do not take account of costs. Examples are portions of the Clean Air Act, Clean Water Act, and Occupational Safety and Health Act, as well as the Delaney Clause of the Food, Drug, and Cosmetic Act. Agencies may also fail to promote consistency in their rulemaking by implicitly assigning widely differing values to saving a life. A recent study shows that the average cost per life saved varies across regulations from as little as \$100,000 for NHTSA's 1967 steering column protection rule to \$132 million for the Food and Drug Administration's 1979 ban on diethylstilbestrol (DES) in cattle feed. Some proposed regulations have even higher costs, such as EPA's proposed restrictions on the disposal of dioxins and solvents on land, estimated to cost \$3.5 billion per life saved. The regulatory review and coordination process implemented by this Administration is designed to improve consistency across Federal regulations, to the extent permitted by law.

Regulatory review established under Executive Orders Nos. 12291 in 1981 and 12498 in 1985 is meant to ensure that regulations are worth their costs and that the most cost-effective regulatory activities are given priority. The oversight process is based on the principle that government regulations, when such interventions are appropriate, should maximize the net benefits to society. Where regulation is excessive, deregulation is indicated.

PERSONAL RESPONSIBILITY

Individuals can mitigate or eliminate many of the most serious risks they face by exercising personal choice. Government can inform individuals about the nature of risks, alter incentives that influence individuals' decisions, or require safe behavior. Two risky activities—cigarette smoking and automobile use—illustrate these points.

SMOKING: THE GREATEST AVOIDABLE RISK

Smoking presents the largest single source of health risk in America. Table 6-1 lists risks of various activities in terms of the annual fatalities for every 1 million exposed individuals. The fatality risk of smoking is more than 26 times greater than that of work.

TABLE 6-1.—*Estimated risks of various activities*

Activity or cause	Annual fatalities per 1 million exposed persons
Active smoking.....	2,950
Alcohol.....	541
Accident.....	275
Disease.....	266
Motor vehicles.....	187
Alcohol-involved.....	95
Non-alcohol-involved.....	92
Work.....	113
Swimming.....	22
Passive smoking ¹	19
All other air pollutants ¹	6
Football.....	6
Electrocution.....	2
Lightning.....	0.5
DES in cattlefeed.....	0.3
Bee sting.....	0.2
Basketball.....	0.02
All causes.....	8,748
All cancers.....	1,917

¹ Cancer deaths only.

Note.—Activities are not mutually exclusive; there are overlaps between categories. Differences in fatalities do not imply proportionate differences in years of life lost.

Sources: Office of Management and Budget and Council of Economic Advisers.

Every annual report of the Surgeon General since 1964 has identified cigarette smoking as the single most important source of premature mortality among Americans. Studies estimate that of the 565,000 deaths each year from heart disease, 170,000 result from cigarette smoking. Of the 412,000 deaths each year from cancer, 125,000

result from cigarette smoking, with more than 100,000 of these from lung cancer alone. A 25-year-old man who smokes one pack of cigarettes per day can expect to live 4.6 fewer years than one who does not smoke at all, and one who smokes two packs per day can expect his life to be shortened by 8.3 years. Life insurance companies usually charge smokers higher premiums reflecting their greater mortality risk. Some health insurance carriers have also introduced premium differentials based on smoking.

The issue of smoking goes beyond matters of individual choice; secondary smoke affects others. The Surgeon General reports that a nonsmoker whose spouse smokes more than one pack of cigarettes per day has a risk of lung cancer 1.3 to 1.9 times higher than a nonsmoker whose spouse is a nonsmoker. Passive smoking results in an estimated 2,500 fatal cancers per year. Children of smokers have more respiratory problems, and are more frequently hospitalized for bronchitis, pneumonia, and respiratory allergies. Smoking-related fires led to 1,500 deaths and another 4,000 injuries in 1984.

It is not clear whether the pleasures of smoking outweigh the health risks and other costs, even for smokers themselves. When surveyed, more than 90 percent of smokers say they want to quit, and the majority of smokers have tried to quit at least once and failed.

Most smokers begin to smoke as adolescents. Studies of why people start smoking identify the influences of parents, siblings, and friends as the most important causal factors. School curricula in the past tried to discourage smoking by emphasizing its long-term health effects. Newer curricula, targeted at ages 10 through 14, focus on the social influences that encourage the initiation of smoking. Such programs aim at helping children acquire the behavioral skills to resist these influences and at changing perceptions that smoking is mature and sophisticated. Students who participate in these programs have started smoking at rates 15 to 50 percent lower than those in control groups.

The price of cigarettes also influences whether people smoke. Higher prices discourage young people from starting to smoke, but have a much smaller effect on habitual users. The Federal excise tax on cigarettes was raised from 8 cents per pack to 16 cents per pack in 1983, but was scheduled to revert to 8 cents in 1985. Instead, the tax was maintained at 16 cents, and as a result an estimated 1.9 million fewer people smoke, including more than a million fewer under age 25.

Current Federal agricultural policies toward tobacco do not undermine public health efforts to discourage smoking. A system of allotments allows farmers to produce only specified quantities of tobacco and limits the amount they can market. The net effect of the allot-

ments plus price supports and other subsidies is to hold tobacco prices slightly higher, and quantities slightly lower, than they would be in the absence of these programs.

Evidence suggests that information on the consequences of smoking influences behavior. The largest decline in per capita sales of cigarettes, a fall of 8.9 percent, occurred during 1953–54, following publication of two retrospective epidemiological studies that linked lung cancer to smoking and the first laboratory demonstration that the tar in cigarette smoke could cause cancer in animals. During this time, tobacco companies competed vigorously by advertising purportedly less harmful brands, indirectly reminding smokers of the dangers of smoking. The second largest decline in per capita sales occurred in 1968–69, during the height of the antismoking campaigns on television. The largest decline in the number of smokers followed the 1964 Surgeon General's report.

The effects of tobacco advertising are complex. There is little evidence that advertising results in additional smoking. As with many products, advertising mainly shifts consumers among brands. Evidence from other countries suggests that banning tobacco advertising has not discouraged smoking. Four industrialized countries with market economies—Italy, Finland, Iceland, and Singapore—have completely banned advertising for tobacco products, yet have experienced a rise in the per capita consumption of tobacco. Sweden and Denmark enacted partial advertising bans, yet achieved greater success in reducing consumption than did Norway and Finland, which imposed total advertising bans. After the broadcast advertising ban in the United States, cigarette use continued to decline, but at a slower rate than before the ban.

The ban on broadcast advertising was supported by the large tobacco companies. Tobacco advertising expenses were about 35 percent lower in the 5 years following the ban. It is likely that reduced access to public attention made it harder for new brands of cigarettes to enter the market, thus solidifying the market shares of existing companies and brands. Moreover, with no tobacco advertising on television, the antismoking messages required under the Fairness Doctrine were eliminated.

Increased awareness of the health risks of smoking has brought a change in public attitudes and government policies. Forty-two States and the District of Columbia restrict smoking in public places, including government workplaces. Twelve States restrict smoking by public employees and also by those in private businesses. New rules for Federal employees prohibit smoking in nearly all public work areas, including general office space, and permit smoking only in designated areas.

AUTOMOBILE SAFETY

Many automobile deaths stem from avoidable behavior such as drunk driving and failure to wear a safety belt. In 1985, about 44,000 Americans died in motor vehicle accidents, including 6,800 pedestrians and 890 bicyclists. Nearly half of the fatalities involving occupants of motor vehicles occurred in single-vehicle crashes. Despite this substantial loss of life, 1985 was the safest year on record for motorists: the death rate per hundred million vehicle miles traveled (HMVM) was 2.47, down from 5.50 in 1966 and 21.0 in 1923.

Drunk Driving

Alcohol impairs physical coordination and can increase aggressive behavior. Alcohol contributes to many kinds of accidents and injuries and is involved in more than 50 percent of fatal automobile accidents. Drunk driving is the leading cause of death for persons in the 15-to-24 age group. About one-half of all single-vehicle crashes and two-thirds of nighttime single-vehicle crashes involve alcohol-intoxicated drivers. In 1982, 63 percent of those killed in alcohol-related automobile accidents were drivers, bicyclists, or pedestrians who had been drinking. Twenty percent were passengers (both drinking and sober) of drinking drivers. The remaining 17 percent, nearly 4,000 people, were sober victims.

Evidence from other countries and recent experience in the United States suggest that programs to deter drivers from drinking by increasing penalties and enforcement tend to succeed in the short run to the extent that they alter drivers' perceptions of the certainty of punishment. But the ability of such programs to achieve lasting reductions in drunk driving fatalities has not been established. This may be because none of the programs or experiments to date has been able to sustain an increase in the probabilities of apprehending and punishing drunk drivers.

State and local actions to restrict the availability of alcohol to young people by raising the minimum drinking age have contributed to reduced traffic fatalities. In 1982, 31 States allowed people under 21 to buy alcoholic beverages, but by 1985, only 7 States did. In those 3 years, motor vehicle fatality rates fell 3.0 percent for the general population, but 6.3 percent for drivers aged 24 and under. If the traffic fatality rate for this group had fallen only by the same amount as for the general population, approximately 600 additional young drivers would have died in automobile accidents in 1985.

Higher alcohol taxes would also reduce fatalities. Federal excise taxes on beer and wine have remained constant in nominal terms since 1951. As a result of this and other factors, the real price of beer fell 27 percent, of wine 21 percent, and of hard liquor 48 per-

cent between 1951 and 1983. Studies of teenage drunk driving indicate that if the real excise tax on beer were at its 1951 level, an estimated 1,000 fewer deaths per year would result, primarily of persons aged 18 to 21.

Safety Belts

Motor vehicle occupants who wear a safety belt are less than half as likely to die in the event of an automobile accident as those who do not. If all occupants of motor vehicles wore safety belts, 12,000 to 15,000 fewer persons would die annually. Safety belt use is a clear example of how an individual can reduce risk by taking a simple precaution. For this reason, some State courts, although not going so far as to hold that an accident victim's failure to wear a safety belt constitutes contributory negligence, have reduced the unbelted victim's damage award on the grounds of failure to mitigate the harm.

Even though voluntary safety belt use is an extremely low-cost way to reduce deaths and injuries, as of 1984 only about 12.5 percent of passenger car drivers were estimated to use them. Usage among teenagers appears to be particularly low. Since 1984, 26 States and the District of Columbia have enacted laws requiring use of safety belts (although two States recently repealed theirs). Safety belt usage increases after passage of a belt law, but the longer term effect does not appear to be as great as the initial response.

Compliance with child safety seat laws has been much higher than compliance with safety belt laws, and has been effective in reducing fatalities among young children. In 1977, the first child safety seat law went into effect. Now all 50 States require safety seats for small children. Compliance rates are between 50 and 60 percent. The motor vehicle fatality rate for the overall population fell 10 percent between 1975 and 1985, but for children under 5 it fell 32 percent.

Air bags and automatic safety belts are passive restraints that do not require the cooperation of the driver or passengers. Air bags are more costly to install than either automatic or conventional safety belts. Moreover, their cost-effectiveness relative to safety belts falls with more widespread belt usage. Even if air bags were required in all new cars, they would not come into nearly universal use until about 10 years later. Current Department of Transportation regulations require phased installation of passive restraint systems unless States comprising two-thirds of the U.S. population enact safety belt laws.

The 55-Miles Per Hour Speed Limit

The driver who speeds assumes a higher risk of death and injury but also increases risk for others. It is because of this externality that

a maximum speed limit is in the interest of most drivers. The main cost of a lower speed limit is more time spent traveling.

The primary goal of the National Maximum Speed Limit Act of 1974 was energy conservation. Today, with low real oil prices, debate concerning the 55-miles per hour (MPH) speed limit focuses more on safety than energy conservation. From 1973 to 1974, the overall death rate per HMVM dropped 14 percent from 4.12 to 3.53. (A similar drop of 13 percent in the death rate, from 3.17 to 2.76 per HMVM, occurred between 1981 and 1982.) Although drivers have gradually increased their average speed since the 55-MPH limit was introduced, they have not returned to the speeds at which they were driving before the Federal limit was enacted. The fatality rate per HMVM, however, has continued to fall, suggesting that factors other than speed are important in the declining fatality trend.

Variations in fatality rates across States and types of roads suggest that speed limits should be tailored to local conditions. In 1985, the automobile accident fatality rate ranged from 4.1 deaths per HMVM in New Mexico to 1.6 in North Dakota. The safest roads are the interstate highways in urban areas, with a fatality rate of 1.01 deaths per HMVM. Local rural roads are the least safe, with a fatality rate of 4.99. Driving at night is three times more risky than driving during the day.

Although it left enforcement of the 55-MPH speed limit to the States, the Federal Highway Safety Act of 1978 directed withholding a portion (up to 10 percent) of a State's Federal highway funds if it failed to achieve at least 50 percent compliance. As a result, States assign their highway patrol officers to enforcing the 55-MPH limit, diverting them from other efforts that would be more effective in saving lives. To reach compliance, States have an incentive to allocate most officers to work during the day, when traffic is the heaviest, rather than at night, when a majority of motor vehicle deaths occur. State discretion in the regulation of highway speeds could improve safety more than centralized Federal regulation.

The Unintended Hazards of Fuel Economy Regulation

Like the 55-MPH speed limit, the Corporate Average Fuel Economy (CAFE) regulations are a vestige of the "energy crisis." The CAFE standards (enacted as part of the Energy Policy and Conservation Act of 1975) established minimum average levels of fuel economy for passenger cars sold by each automobile manufacturer. To meet the standards, manufacturers took a number of steps, including switching to lighter materials and reducing the weight and size of cars. Market forces also shifted the automobile fleet in the direction of smaller cars while gasoline prices remained high. Automobiles

have become safer as design has improved. Other things equal, however, small automobiles are less safe than large ones.

In single-vehicle crashes, occupant death rates are inversely related to car size. In multiple-car crashes involving cars of the same size, occupants of small cars have a death rate higher than occupants of large cars. In crashes between cars of different size, the occupants of the larger car have a better chance of survival than if they had been involved in a crash with a car the same size, but occupants of the smaller car have a worse chance of survival than if they had been in a crash with another small car.

There is evidence that drivers of small cars attempt to mitigate their increased risk by driving more carefully. One study indicates that, taking age into account, drivers of small cars are somewhat less likely to be involved in an accident than are drivers of larger cars. Even so, the fatality rate associated with small cars is higher than that of large cars.

The "energy crisis" has passed, but Federal regulation of automobile fuel economy persists. To the extent that CAFE has reduced the size of cars driven by Americans, it also has indirectly reduced automobile safety.

THE TORT SYSTEM

In addition to self-inflicted injury, harm can result from the actions of others. Tort law, the civil law governing harms other than breach of contract, serves to compensate persons injured by the negligent or wrongful conduct of others, and also to deter such conduct.

Two general rules of liability guide accident law—negligence and strict liability. Negligence is determined by reasonableness of conduct. If the injurer acted unreasonably, that is, failed to exercise due care, then ordinarily the injurer would be required to compensate the victim. Strict liability, on the other hand, focuses on whether a product that caused an injury was defective in such a way as to make it unreasonably dangerous for its intended use. Both standards seek to impose a duty of care; strict liability, however, allows demonstration of the breach of that duty by examination of the product itself.

The product user's degree of care also can affect the risk of accidents. In certain instances, the user can more easily eliminate or reduce the risk of injury than can the manufacturer. The rule of contributory negligence limits the scope of liability so that an injurer is not liable for harm that could have been avoided had the victim not been negligent. Many States have adopted the rule of comparative fault, under which an injurer is liable only for that share of the harm corresponding to the injurer's share of responsibility. Determining

the reasonableness of a party's conduct depends in part on the costs of avoiding the accident. When both parties can affect the probability or seriousness of an accidental injury, the rule of negligence (or the rule of strict liability accompanied by the defense of contributory negligence or comparative fault) leads both the potential injurer and potential victim to behave reasonably to avoid accidents.

THE "LIABILITY CRISIS"

During the past several years, products and services as diverse as vaccines and skating rinks have been withdrawn from the market because of the greatly increased price or unavailability of liability insurance. Investment in product innovations, such as new pharmaceuticals, has been retarded because of potential liability costs. Some explanations of the "liability crisis" attribute the scarcity of liability insurance to an expansion in liability exposure under tort law. In particular, the alleged crisis has been linked to trends in legal rules on fault and causation and to larger jury verdicts for damages.

In the early 1960s, courts began to replace traditional common law rules of negligence with strict liability. It was argued that expanding liability would encourage the supplier of a good to prevent accidents; in addition, the supplier would provide insurance for unpreventable injuries. Some courts went so far as to say that business defendants could spread the cost of compensating victims across all consumers simply by charging higher prices for their goods and services. This viewpoint assumed that society would benefit from replacing personal responsibility for accidental injuries with expanded liability for those supplying goods and services. Carried to its extreme, this approach would entirely remove the issue of fault or wrongdoing from the determination of liability.

The growing trend toward no-fault liability has increased defendants' expected tort costs and, therefore, their need for insurance coverage. Historically, tort law required a plaintiff to prove a direct cause-and-effect relationship between the defendant's act and the plaintiff's harm. This requirement of proximate cause eroded as some courts allowed plaintiffs to recover an entire judgment award from any of a number of parties who might have contributed to the harm. This application of joint and several liability to product liability cases increased the potential financial exposure of defendants and further weakened the traditional legal requirements of fault and proximate causation. In practical terms, joint and several liability threatens any defendant having substantial financial resources with the risk of having to pay the entire damage award in a lawsuit involving multiple defendants, even if this defendant was only slightly at fault for the plaintiff's injury.

TORT REFORM

Many States have enacted or are considering reforms in tort law. The Administration has also supported legislation to address the factors that have led to the high price and scarcity of product liability insurance. This legislation would ensure that fault remains a basis for determining legal liability for injury caused by a defective product. For a manufacturer to be found liable under strict product liability, the product would have to be defective and unreasonably dangerous because of its defect. This reform would limit strict product liability to situations in which the doctrine originally applied, before the expansion of no-fault liability.

Another provision of the Administration's tort reform proposal would make joint and several liability inapplicable to product liability cases. A manufacturer found liable for damages would be responsible for at most those damages directly attributable to its share of fault for the injury; the manufacturer could not be held responsible for damages arising from another party's share of fault. However, joint and several liability would still be available where two or more defendants consciously acted together in a common scheme or plan that directly caused the plaintiff's injury.

These proposals seek to ensure that fault and wrongdoing continue to be essential to determining liability for defective products. These reforms should lessen the unpredictability of product liability awards for manufacturers and insurers and, by emphasizing the importance of personal responsibility, reduce accidents.

CONSUMER PRODUCTS AND THE WORKPLACE

Of the 92,500 accident fatalities in the United States in 1985, about half were caused by motor vehicle crashes, 22 percent by accidents at home, and 13 percent by accidents at work. In an effort to improve safety, the government requires consumers and private firms to devote resources to meeting regulatory standards, develops and disseminates information, requires controlled testing of new drugs, and requires injury compensation insurance for workers. Government rules also modify market incentives for safe behavior.

CONSUMER PRODUCT SAFETY

Markets generate strong incentives for the production and safe use of consumer products. Safer products may be more expensive, because of superior materials, product design, and quality control. Many consumers are willing to pay higher prices for safer products as long as they perceive that the benefits of improved safety exceed the additional costs. Consumers acquire safety information through per-

sonal experience and word of mouth, as well as from manufacturers, specialized testing laboratories, and consumer groups. The risks of unsafe products generally are borne directly by consumers, with little spillover of hazards beyond the immediate household. Thus, market incentives will guide manufacturers to produce products as safe as consumers' willingness to pay allows.

The Food and Drug Administration (FDA) regulates food, drugs, and cosmetics. Its standard-setting and inspection activities are designed to reduce hazards about which it is difficult to obtain information in the marketplace. Examples include the safety of food additives and the safety and efficacy of pharmaceuticals.

The Delaney Clause of the Food, Drug, and Cosmetic Act has been interpreted to ban all food additives found by the FDA "to induce cancer in man or animal." In effect, this restriction has grown more stringent over the years, as advances in chemistry have permitted the detection of extremely small amounts of substances in additives. In 1985, the FDA proposed that methylene chloride be banned in hair spray, but that it be allowed as a decaffeinating agent in coffee because its risk in that use is negligible. This *de minimis* interpretation of no-risk statutory provisions is intended to reduce regulation that is overly costly. Recognizing the excessively restrictive nature of the Delaney Clause, Congress has exempted saccharin from its reach.

The Consumer Product Safety Commission (CPSC) has broad authority to set standards and order bans, recalls, and modifications. Its purpose is to reduce hazards by improving products' technological safety characteristics. Such activities, however, may fail to benefit consumers and can have adverse effects. Sometimes safer products are more costly, and regulation may impose higher safety levels than consumers are willing to purchase. To reduce the likelihood of this result, the law mandates cost-benefit analysis for formal CPSC rule-makings. The CPSC has adopted cost-benefit criteria for its other activities, such as implementing voluntary standards.

Even if a product standard meets a cost-benefit test, the market might have achieved an equivalent level of product safety. Moreover, even if the estimated costs of regulation match the benefits, regulated product standards may not be desirable because benefits that stem from product diversity will be lost. Consumers value safety, like other product characteristics, differently, in part because not all consumers use products in the same way. If a household appliance is to be used by children, parents may buy a safer model at a higher price than they would otherwise. Individuals benefit from the opportunity to make their own tradeoffs based on price, quality, and safety.

When product regulation reduces competition and thereby increases prices, it restricts consumers' choices. For example, in 1975

the CPSC issued a bicycle standard that imposed numerous technical design features that would increase costs and exclude some bicycles from the market. Some of these specifications, such as the one that handlebars be between 14 and 28 inches wide, were overturned in court for lack of evidence that their absence would pose an unreasonable risk of injury.

The effectiveness of product regulation in improving safety can be undermined and even reversed by risk displacement. For example, manufacturers of children's sleepwear used the flame-retardant chemical Tris to comply with the flammability standard issued in 1973. Later, when it was discovered that Tris can be carcinogenic, the sale of Tris-coated sleepwear was banned. Some consumers may stop buying products whose prices rise as a result of safety regulation, only to substitute alternatives that are more dangerous.

THE REGULATION OF NEW DRUGS

Advances in pharmacology have produced drugs that prolong life and improve health. Many diseases that took a substantial toll in the past, such as polio and pneumonia, are now inexpensively prevented or treated with vaccines or drugs.

Regulation of the introduction and use of new drugs poses difficult policy questions. Government oversight of the testing and approval of new drugs has both therapeutic benefits and costs. It is not in the public interest to introduce a drug with side effects or risks more severe than the disease it is intended to treat. The relative efficacy of a new drug compared with existing therapies cannot be established without controlled experiments, including clinical trials. However, the time spent in testing means that some potential beneficiaries of a new drug are not able to obtain it. Unnecessarily stringent regulatory requirements can lead to more deaths and lower health levels.

The 1962 amendments to the Food, Drug, and Cosmetic Act added a proof-of-effectiveness requirement that expanded the experimental and testing procedures required by the FDA for new drug approval. Some evidence indicates that the result was a delay in the introduction in the United States during the 1970s of certain innovative therapeutic drugs by as much as 3 to 6 years after their introduction in Great Britain. The 1962 amendments increased costs to pharmaceutical companies of introducing a new drug, and also lengthened the approval process, shortening the time that a manufacturer could retain patent protection. Incentives to innovate were thereby reduced.

Recent legislative and administrative changes have expedited drug review. Legislation in 1984 allowed an abbreviated approval process for generic versions of drugs previously proven safe and effective,

and restored patent life lost during FDA review. In 1985, the FDA rewrote approval procedures for new drugs to reduce paperwork and allow expanded use of valid data from foreign studies. The FDA has also allowed controlled use of experimental drugs that show substantial promise in treating fatal diseases. Limited use of azidothymidine (AZT) has been permitted for treatment of acquired immune deficiency syndrome (AIDS). In certain cases, the agency also allows use of experimental drugs by patients suffering from serious diseases when there is no alternative treatment.

OCCUPATIONAL SAFETY

Risks of death from work accidents, along with other types of safety hazards, have declined sharply. Injury rates, which are less reliably measured than death rates, have also declined, but less rapidly. As people demanded better working conditions and safety on the job, they also sought increased government regulation of workplace safety. Among the many laws and regulations that address job safety, the major ones are State workers' compensation acts and the Federal Occupational Safety and Health Act. Both workers' compensation and the OSHA statute were expected to reduce work injuries, but many of their possible effects on costs were overlooked.

Labor Market Safety Incentives

Work-related accidents and diseases impose costs on employees that include premature death and disability, suffering, loss of earnings, and medical expenses. Safety and health on the job are not produced by employers alone, but are determined jointly by the actions of workers and employers. Individuals can reduce job risks by acquiring information about job safety and using that information to bargain for safer working conditions, as well as by exercising personal care. Workers and employers can enter into contracts or labor agreements that specify safe working conditions or payments to be made in the event of an injury.

The labor market provides strong incentives for employers to improve safety. In order to make a hazardous job attractive to workers, a firm must offer higher wages than it would have to pay otherwise. Wage premiums are a critical device for controlling job hazards because they provide employers with incentives to reduce hazards in order to reduce wage costs. Additional incentives for employers to increase job safety include the desire to reduce work accidents and injuries in their firms and the costs associated with job hazards—absence from work, interruptions in production, and employee turnover. The level of workplace safety is determined in a way that equates the marginal cost of additional safety measures with their marginal

benefit to employers, as indicated by savings in wage premiums and other costs.

In efficient labor markets, wage premiums result in appropriate matching of workers and jobs based on risk and other factors. Workers who are more risk-averse will demand higher wage premiums for risky jobs than workers who are less risk-averse, and thus will be less likely to take jobs with relatively high probabilities of injury. Similarly, the labor market offers incentives to both workers and employers to implement job matches based on differing personal vulnerabilities to job hazards. For example, if short police officers face greater risks of assault, smaller people will be less likely to take police jobs for a given wage. To some extent, however, legal prohibitions against discrimination limit the ability of firms to screen workers on the basis of vulnerability to job risks.

Imperfect information may militate against fully efficient labor market outcomes, thus providing a rationale for regulation or other government intervention. However, studies have found evidence that job safety information, although not perfect, is generally adequate. Workers have reasonably accurate perceptions of risks, and if they acquire new information suggesting risks greater than they originally had expected, their likelihood of quitting increases.

Workers' knowledge of health risks is probably less accurate than their knowledge of safety risks. It is more difficult to link disease and work than accidental injuries and work because of the delayed onset of symptoms, difficulty of detecting many harmful agents, multiplicity of causes, and uncertainties in the relationship between exposure levels and health effects. Workers, however, are often aware of health hazards, and in some cases perceive very high risks from possible carcinogens in the workplace.

Government also has limited knowledge of occupational health hazards, but it can improve the information available to both employees and employers by supporting research on job safety and disseminating the results. Government, however, has no clear advantage over workers, labor unions, and employers in using this information to determine appropriate levels of workplace safety or the best way to reduce hazards.

Pecuniary costs of job injuries are commonly shifted to the general public by income transfers such as social security disability payments, welfare, and food stamps. This reduces firms' incentives to take safety measures, by enabling them to pay lower wage premiums. Even where information is not perfect or pecuniary externalities exist, however, wage premiums serve a useful function in providing safety incentives and in matching workers with jobs.

Workers' Compensation

Workers' compensation statutes were enacted in most States early in the 20th century. Before that, the principal recourse of workers who suffered job injuries was to sue their employers for compensation. Proving that the employer had been negligent and that the worker had not contributed to the accident was difficult, however, and damage awards were highly uncertain. Under workers' compensation, employers assumed no-fault but limited liability for work injuries, and industrial accident victims gained the right to prompt compensation for a portion of lost wages and medical expenses.

Except for the largest firms, which are allowed to self-insure, employers must buy insurance from a private carrier or a State insurance fund to cover their workers' compensation liabilities. Some State funds are exclusive carriers, but others compete with private insurers. Premiums are experience-rated—that is, linked to past loss experience—only for larger firms. The smallest firms generally are rated by industrial-occupational classifications; the degree of experience rating increases with firm size. Most workers are employed by firms that are either experience-rated to some degree or self-insured.

Although the impetus for adoption of workers' compensation was to replace employers' tort liability with a no-fault system, safety incentives were an additional consideration. Workers' compensation was expected to induce employers to provide greater workplace safety because each firm would assume the costs of its workers' injuries more predictably than under tort liability. The costs of industrial injuries thus would be included among other business costs, and employers would be motivated to reduce them by increasing job safety. This expectation of improved safety, however, overlooked factors that would undermine safety: reduced wage premiums in response to lower but more certain recovery of damages, and reduced incentives for employers to increase safety when workers' compensation premiums are not closely related to the injuries suffered by employees.

A growing body of research has found that workers' compensation benefits have unfavorable effects on safety. Higher benefits appear to increase both the frequency of work injuries and the number of compensation claims filed. One explanation for the positive connection is the claim effect. Even if actual injuries remain constant, workers are more likely to file claims when benefits are higher, thereby producing more reported injuries.

Lack of experience rating of workers' compensation premiums reduces an employer's incentives to invest in safety measures. A firm that is not forced to bear the full costs of compensating its workers for their injuries has a diminished incentive to make expenditures that promote safety. Recent research has found that increased bene-

fits produce a smaller increase in injury rates in firms whose premiums are more highly experience-rated than in firms that pay class rates. Employers' safety incentives could be strengthened by requiring them to make a deductible payment and copayment on each claim. Many insurance companies maintain staffs that help their clients correct occupational health and safety problems, such as work-site fire hazards. To the extent that private carriers provide more accident-prevention services than exclusive State insurance funds, more of such services would become available by allowing private insurers to compete with or supplant such funds.

Workers' compensation has improved the reliability of compensation to injured workers. By replacing lost wages, it also has enabled injured workers to recuperate more fully before returning to work. There is evidence, however, analogous to findings on the effects of unemployment insurance, that higher levels of workers' compensation benefits create work disincentives. Recipients whose benefits are relatively high compared with their previous wages have longer durations of work disability. Work disincentive effects can be important: because benefits are not taxable, the after-tax rate of wage replacement for some workers exceeds 100 percent of their prior wages.

Although one goal of workers' compensation was to reduce the high transactions costs of litigation, many workers' compensation claims are still contested. Workers, moreover, are making liability claims with increasing frequency against suppliers of inputs, commonly in situations where adverse effects on health, such as those related to cancer, may be delayed. Such suits are not barred under the no-fault workers' compensation system.

Regulation of Job Safety

The Occupational Safety and Health Act's sweeping mandate is to ensure that "so far as possible every working man and woman in the Nation [has] safe and healthful working conditions." OSHA has issued several thousand workplace standards, the large majority of which were adopted soon after OSHA's formation and formalized existing industry practices. Some of the most obviously ineffective of these have since been revoked. Most of OSHA's rules deal with safety rather than health hazards. Employers continue to complain that OSHA's regulations are costly, but no comprehensive estimates of compliance costs have been made.

Compared with the magnitude of safety incentives provided in the market, OSHA's fines and enforcement activities are small. One estimate of wage premiums generated by job risks is approximately \$90 billion per year, which compares with about \$9 million in OSHA fines. By comparison, workers' compensation benefits are about \$20 billion annually.

A number of studies have found that OSHA's activities have not been effective in promoting workplace safety. Before the establishment of OSHA, evidence was lacking that working conditions were safer or healthier in States with stricter regulatory standards. Over recent decades, the job fatality rate has declined fairly steadily by more than 2 percent per year. OSHA has not made an identifiable difference in this rate of decline. One recent study, however, has found that OSHA's activities have resulted in a small reduction in work injuries. It is more difficult to assess OSHA's effects on health, because of the time lag between a worker's exposure to a toxic chemical or environmental hazard and the manifestation of disease. This Administration has taken steps to enhance the effectiveness and reduce the burdens of OSHA's inspections. Inspections are now less confrontational and are targeted toward high-risk firms and serious workplace hazards.

OSHA's effects on health and safety may be small because of the type of regulations it has promulgated. Many require specific changes in the physical work environment rather than encouraging safe behavior. For example, OSHA has not required the use of automobile safety belts, although motor vehicle fatalities account for about one-third of total work deaths (Chart 6-3). Even in manufacturing, motor vehicle deaths are close to 20 percent of work deaths. Executive Order No. 12566, issued in 1986, requires safety belt use by Federal employees.

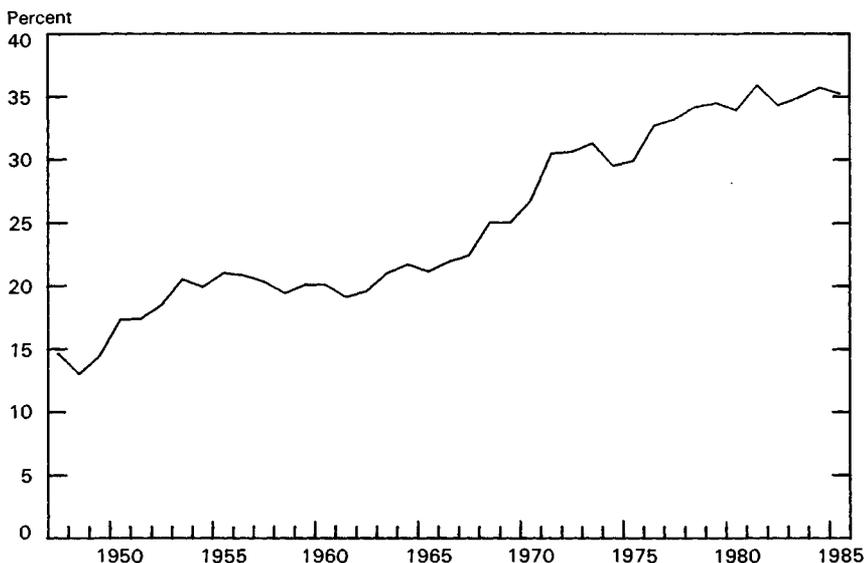
Although precise causation of work injuries is difficult to establish, studies show that individual behavior is a major factor in many work accidents. Studies of occupational fatalities have found that 9 to 40 percent are alcohol-related.

Executive Order No. 12291 broadly requires the use of cost-benefit criteria for agency rulemaking, to the extent permitted by law. The Supreme Court has interpreted OSHA's legislative mandate as prohibiting the balancing of costs and benefits in formulating health regulations. OSHA has adopted a restricted cost-effectiveness approach in accordance with this decision, allowing lowest cost methods of compliance in achieving a given technical standard. Studies of past OSHA rules show that costs typically exceed expected benefits. The recent OSHA hazard communication standard, requiring that workers be informed of workplace hazards, is an important exception.

A major criticism of OSHA is that many of its regulations have unnecessarily increased costs by preventing employers from using flexible means to meet health and safety goals. In contrast, OSHA's hazard communication rule requires that workers be informed about chemical hazards, but leaves employers leeway in implementation. OSHA regulations have tended to specify technical characteristics of

Chart 6-3

Motor Vehicle Deaths as Percent of Total Work Deaths



Source: National Safety Council.

workplace design. Performance standards, which define acceptable levels of workers' exposure to hazards and allow employers to find the most cost-effective ways to meet them, are often at least as effective. In the case of the cotton dust standard, for example, the risk of lung disease could be reduced by allowing the use of disposable masks. OSHA's preference for engineering controls rather than personal protective equipment is based, among other factors, on concerns that protective devices may be cumbersome, may not be used consistently, and may not provide adequate protection over long periods of time.

OSHA's preference for engineering controls is particularly costly in the case of noise control. Relatively inexpensive ear plugs can often protect workers as effectively as reducing the noise level, which generally can be achieved only through costly modifications in work processes, machinery, or plant design. It has been estimated that allowing greater flexibility in methods of compliance would reduce the cost of occupational health regulations by 20 to 80 percent.

Many of OSHA's standards increase costs and reduce productivity and competitiveness. Where OSHA's rules increase capital require-

ments, they also reduce employment opportunities, by encouraging the substitution of capital for labor. Where OSHA's rules specify characteristics of workplace design, they impose fixed costs that tend to favor larger firms over smaller ones.

The evidence on whether workers' compensation and OSHA have improved safety is mixed at best. Most studies indicate that these programs have failed to reduce job injuries in the aggregate. Although workers' compensation achieved some of its goals, it also may have undermined safety incentives. Both workers' compensation and OSHA have generated costs and indirect effects that have tended to reduce productivity.

ENVIRONMENTAL RISK

Environmental externalities stem from the release of harmful substances into a common resource, such as the air, a lake, a river, or the ocean. Lack of private ownership of such resources makes it difficult for those injured or inconvenienced to charge polluters for the losses suffered. The costs of organizing those harmed by pollution hampers the use of tort remedies. Also, the cause of the harm is frequently impossible to identify. The same pollutant may be produced by automobiles, utilities, industrial plants, and natural processes.

Management of environmental risk entails dealing with large uncertainties in the magnitude of potential losses. Environmental risks frequently involve effects extending over a wide area or across international boundaries, and sometimes include effects that may occur far in the future.

CONTROL OF AIR AND WATER POLLUTION

Direct controls have been the most common regulatory strategy for reducing pollution in the United States. Alternatively, if emissions were taxed or if permits for emissions were in a form that could be traded, emitters would take account of the costs of pollution they produce. Actual or implicit market valuation of these permits would induce firms to include the costs of pollution among their other costs of production. A market in pollution permits would result in a reduction of emissions to the required level at the lowest total cost. The Environmental Protection Agency has begun to implement market-based control programs, including "bubbles," which allow several sources to be considered as a group in meeting emissions targets. These emissions-trading strategies ensure that sources having the lowest costs of control will reduce emissions most.

The United States has devoted considerable resources to reducing pollution. In 1984, total public and private expenditures for pollution

abatement and control were approximately \$68.5 billion (1984 dollars), or 1.8 percent of GNP. Of these expenditures, 45 percent was for control of air emissions and 38 percent for water pollution control.

Measurable improvements in environmental quality have been achieved. Average concentrations of the six atmospheric pollutants subject to National Ambient Air Quality Standards (NAAQS) have declined over the past decade (1975-84). The NAAQS have been reached in almost all parts of the country for sulfur dioxide, nitrogen dioxide, and lead. In some areas, carbon monoxide and total suspended particulates standards have not been met. Surface-level ozone is the largest remaining problem, although most people live in counties that meet the ozone standard. Significant improvements in water quality have also been reported. It is difficult to determine, however, whether these gains carry with them benefits larger than the costs of their attainment.

Misallocations of capital and reduced productivity result from certain features of current environmental regulation. One example of this sort of distortion is the "new source bias." New plants must meet more stringent air emissions standards than old ones. Another example is that regions with air that is cleaner than national standards must regulate new sources to achieve "prevention of significant deterioration" of their already superior air quality. The first of these requirements gives an economic advantage to older plants compared with newer ones, while the second favors particular regions over others. Both discourage investment in more modern facilities.

CONTROL OF ENVIRONMENTAL RISKS

Management of environmental risk addresses more than the failure of markets to motivate firms and individuals to take account of the effects of their actions on the environment. Insufficient scientific knowledge often makes it difficult to balance the costs and benefits of alternative environmental policies.

Stratospheric Ozone Depletion

Stratospheric ozone has been a focus of research and policy concern since the 1970s. Certain otherwise useful and harmless chemicals—primarily chlorofluorocarbons (CFCs)—released into the atmosphere eventually diffuse to the stratosphere, where they may interact with and break down the ozone layer. A reduction in the amount of stratospheric ozone would allow more biologically damaging ultraviolet radiation to reach the Earth's surface. Increased ultraviolet radiation has been associated with deleterious effects on health, including various forms of skin cancer, and with reductions in the yields of

some crops. CFCs also are greenhouse gases, like carbon dioxide, which may contribute to global warming.

CFCs and related compounds are stable chemicals used in refrigeration, air conditioning, and fire extinguisher systems; in foam production; as aerosol propellants; and in electronics manufacture. Annual world output of the two most important CFCs increased almost fivefold from 1960 to 1985. Worldwide production of these two chemicals peaked in 1974 and then declined until 1982, primarily because of reduction in their use as aerosol propellants in the United States (which banned nonessential aerosol applications in 1978) and a few other countries. Nonaerosol usage accounts for approximately 70 percent of all CFC applications, however, and total world production of the main CFCs has grown since 1982 by approximately 5.3 percent per year. Because of the long lifetime of the molecules, emissions may affect the ozone layer for many years.

Although the consequences of stratospheric ozone depletion may be extremely serious, estimates of the magnitudes of the potential damages are highly uncertain. The largest unknowns involve forecasts of future emissions of CFCs and other greenhouse gases, the physical and chemical mechanisms of ozone depletion, and the effects of increased ultraviolet radiation on living organisms. The recent discovery of large changes in the seasonal pattern of ozone levels over Antarctica raises doubts about the current state of knowledge about stratospheric ozone dynamics and chemistry. Some scientists claim that CFCs are the cause of these changes, but others believe they have a natural cause.

Ozone depletion is a global issue. Most world CFC production is concentrated in the industrialized countries, with the U.S. share slightly over 30 percent in recent years. Unilateral action to control CFCs is not likely to be effective, and could even reduce the opportunity for international cooperation by removing some of the incentive for other nations to reduce CFC release. International agreement on controls would prevent the loss of competitiveness that could result if the United States were to act alone to control CFCs further.

In 1985, the United States signed the Vienna Convention for the Protection of the Ozone Layer, which provides for international cooperation in research, monitoring, and information exchange. The United States is currently participating in negotiations to implement this agreement, and has proposed a near-term freeze on ozone-depleting emissions, a long-term reduction of emissions, and periodic review of controls. In view of the uncertainties regarding the extent and consequences of ozone depletion, it is appropriate that emissions reduction policy provide for periodic reassessment of the levels and effectiveness of controls as new information becomes available.

Acid Rain

Acid deposition, known as acid rain when it takes the form of liquid precipitation, is another major environmental concern. Acid deposition may have a number of adverse effects on the environment, but few are well established. Emissions of some air pollutants contribute to the acidification of certain sensitive lakes and streams, but other cause-and-effect relationships are not clearly understood.

Combustion of many types of fossil fuels produces oxides of sulfur and of nitrogen. These combustion products can be chemically transformed into acidic compounds, sometimes after being transported hundreds of miles from their source. Rain is naturally acidic, but manmade contributions to acid deposition are much greater than natural sources in industrial regions such as the Eastern United States and Southeastern Canada.

Air pollutants that are precursors of acid deposition are regulated under the NAAQS. The direct effects of these pollutants, such as soot, smog, and haze, as well as their possible hazards to health, are distinct from their indirect effects through acid deposition. Thus, reducing these primary pollutants would have benefits beyond those associated with the resulting reduction of acid rain.

The mechanisms of atmospheric transport in the acid deposition process are not well understood. The areas of North America that show apparent effects of acid deposition are generally downwind of the power plants, smelters, and urban areas that are the main sources of precursor emissions. But it is not known specifically what fraction of acid deposition in the Adirondacks, for example, originates in particular regions. Further, deposition varies from site to site and from year to year at the same site because of meteorological variations.

Uncertainty also surrounds the effects of acid deposition. Visible damage to U.S. forests appears to be confined largely to trees in the East, with most of the damage occurring at higher elevations. The hypotheses that have been advanced to account for the decline of these forests include the effects of climate cycles and other air pollutants as well as acid deposition. The effects of acid precipitation on surface waters are complex. Damage to lakes and streams can occur only if they are sensitive to acidification, that is, only if they lack naturally occurring neutralizing chemicals in their watersheds. Most large lakes in the Eastern United States are not acidified, either because they are not sensitive or are not located in areas of sufficient acid deposition. Although higher acid concentrations present a potential danger of dissolving heavy metals in municipal water supplies, no such contamination has been established in the United States. Adverse effects of acid rain on crops and soils have been suggested, but have not been shown to be significant.

Transboundary deposition is of major concern to Canada. The usual difficulties of assessing environmental risks and internalizing costs are magnified because some costs and benefits occur in another country. Acid rain has been the subject of high-level discussions between the United States and Canada, and the U.S. Government has endorsed a recommendation that it undertake a 5-year, \$5-billion program in conjunction with private industry to develop a more extensive set of commercial control technologies than is now available.

Some proposals to control acid precursor emissions have been made that go far beyond these demonstration projects. Acid rain control programs that have been proposed in Congress would impose costs of \$3 billion to \$9 billion per year. Sulfur dioxide control methods include switching to coal with lower sulfur content, removing some of the sulfur before combustion (coal washing), or removing the sulfur during or after combustion. Costs tend to be lower for programs that involve switching from high-sulfur to low-sulfur coal, but switching would disrupt the regions that mine high-sulfur coal.

Current regulations and laws might be modified to alleviate acid deposition at relatively low cost. The Powerplant and Industrial Fuel Use Act of 1978, for example, prohibits use of natural gas in new industrial or electricity-generating facilities without a special exemption. Natural gas combustion releases minimal levels of sulfur dioxide and fewer oxides of nitrogen than coal burning. Use of coal is also encouraged by obstacles to the construction of nuclear power plants. More stringent air quality emissions standards for new sources have, along with other factors, prolonged the useful lifetime of older power plants, which produce relatively more acid precursors.

A large and rapid reduction in emissions nationwide would be very expensive. Low-cost options, such as liming of lakes, may be able to mitigate acidification in some cases. Identifiable economic benefits of lower levels of acid deposition in the United States appear to be small, although reducing acid precursors might benefit urban areas by improving ambient air quality. For any large-scale control effort, questions remain as to how best to achieve the desired results. For example, better understanding of atmospheric transport mechanisms is necessary to decide whether to target emissions from particular regions. The costs of undertaking an ambitious emissions control program need to be balanced against the relatively low risks of waiting to resolve the scientific uncertainties surrounding the causes and effects of acid deposition.

Biotechnology

Biotechnology is the use of biological systems and organisms in household, agricultural, and industrial production. In its broadest

context, it is an ancient practice that includes such familiar applications as the use of yeast in baking bread and brewing beer and the use of cultures in making cheese and yogurt. The most recent advances include genetic manipulation technologies, such as recombinant DNA, recombinant RNA, and cell fusion, that allow more precise and predictable methods of producing old products or creating new ones.

The benefits of biotechnology to society are substantial, and include opportunities for new and better medicines and therapies for disease, more efficient food production, and pollution control. Biotechnology has already provided new drugs and improved existing drugs and vaccines. It has reduced the cost of insulin and interferon.

Health and safety concerns related to use of living organisms include the effects of accidental release from contained facilities and the side effects of environmental applications. Releases that occur commonly in facilities using low-risk microorganisms to produce products such as penicillin, tetracycline, or industrial enzymes are not harmful to persons or the environment. More stringent containment conditions are employed for hazardous organisms.

Introduction of new plants, animals, and microorganisms into the environment has long been commonplace. It occurs whenever new crop varieties are planted or animals are selectively bred. Microorganisms are released as pesticides and to improve plant growth. For example, large numbers of genetically improved nitrogen-fixing bacteria are added to agricultural soils in the United States each year.

The environmental risk from the release of a genetically engineered organism is that it may have unforeseen effects on plants, animals, or human beings. Because living organisms are self-replicating, it might be difficult to control the spread of an organism whose harmful effects were discovered only after its release. Adverse consequences from bringing an alien species into a new environment, however, are not confined to cases of genetic manipulation. The kudzu vine was introduced to the United States for soil conservation, but rapidly spread, becoming a pest in some areas. Other imported species, such as the gypsy moth, have caused environmental damage.

A framework for coordinating Federal regulation of biotechnology was established in 1986. This framework built on existing legislation and practices, but imposed additional levels of Federal review for certain environmental applications, particularly of new microorganisms. To the greatest extent possible, responsibility for regulating a specific product will be placed with a single agency. Regulatory coordination should reduce uncertainty, encourage consistency in the rigor of scientific reviews across agencies, and provide the flexibility to modify regulations as scientific knowledge advances. The aim of

the Administration's regulatory policy is to safeguard public health and the environment without blocking the development and commercial use of this highly productive new technology.

CONCLUSION

Government regulation can reduce some risks significantly, but it can also reduce productivity, personal income, and individual choice. Risks ordinarily cannot be controlled without cost. The resources used to reduce them are not available for alternative improvements in safety or well-being. When government regulates, makes public expenditures, or requires private expenditures to reduce risk, the cost of these actions should be weighed against their likely benefits.

It is not possible to eliminate all hazards to safety and health, nor is it desirable for the government to attempt to reduce risks that could be controlled in less costly ways. In many cases, government control of risk is neither efficient nor effective. Markets accommodate individual preferences for avoiding risk and produce information that helps people make informed choices. Markets and the legal system provide powerful incentives for reducing personal hazards; government regulatory actions should avoid diminishing the incentives for safety that markets and tort law provide. Because many of the greatest risks are subject to personal control, government regulation can never replace the need for responsible individual action.