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Scope and Complexity

In late December 1977 a grain elevator exploded in Westwego, Louisiana. The explosion was caused by a spark that ignited an excessive accumulation of grain dust. Thirty-five workers died in the ensuing fire. In April 1978 the scaffolding supporting workers constructing a cooling tower for a West Virginia power plant collapsed. The anchor bolts supporting the scaffold failed because they had been set into inadequately cured concrete. Fifty-one workers died. Recently a Senate subcommittee held hearings on the incidence of lung cancer among uranium miners. It appears that these workers die from lung cancer at nearly four times the national average rate for men of the same age.

Few would deny that the United States has an occupational safety and health problem. Although good statistics are hard to come by, the National Safety Council estimates that each year roughly 13,000 Americans die in job-related accidents. It is likely that these figures grossly underestimate the true number of job-related fatalities. Because occupational diseases have long latent periods and are difficult to diagnose, many job-related fatalities are never reported. Estimates of these unreported deaths range up to 100,000 per year.[1] If these estimates are accurate, the annual number of occupational deaths is twice that of traffic fatalities, four times that of deaths resulting from accidents in the home, and five times that of homicides.

The cost of job-related morbidity and mortality is staggering. Occasionally, family members suffer not only grief but disease as well. Workers may carry carcinogenic dust home on their clothes. Some chemicals threaten the fragile existence of the unborn. Even if we could eliminate the pain and suffering associated with occupational disability, job hazards would still constitute a major social problem. Job-related accidents and illnesses impair productivity and tax the already overburdened health-care system. The National Safety Council estimates the non–pain-and-suffering costs of occupational disability at nearly one percent of the gross national product, or over $16 billion annually.[2]

It is difficult to ascertain whether the occupational safety and health situation is getting better or worse. The statistics tell a mixed story. From 1957 to 1970, in manufacturing the lost-time injury rate per million hours worked is said to have increased from 11.1 to

15.2.[3] However, recent analysis casts doubt on the accuracy of these data. Injury rates are sensitive to changes in worker fatigue, worker experience, and pace of production. Adjustment for seasonal changes in overtime, hiring rates, and capacity utilization makes it even more difficult to determine whether the injury rate is going up or down. Depending upon when the trend analysis is started, it is possible to conclude either that there is no trend after cyclical influences are accounted for or that there is a sharp upward trend.[4]

We also cannot determine whether the occupational safety and health situation is getting better or worse merely by looking at the effect of changes in production technology. On one hand, automation and improvements in industrial hygiene have removed many workers from positions of risk. On the other hand, technological advances account for the synthesis of over 3,000 new chemicals per year, each potentially harmful. About all that we can safely conclude from looking at statistics and changes in technology is that occupational safety and health is a big problem that may be getting bigger.

Regulating job hazards is even harder than measuring them. Four characteristics of the occupational safety and health problem make regulation especially vexing.

First, our ignorance about occupational risks is profound. We are not sure how many workers are killed or disabled by job hazards. We do not know what causes many accidents on the job. We are not certain which chemicals are hazardous, or what the effects of mixing otherwise safe substances may be. We do not know the dose-response relationship for known hazardous substances. We often do not know how to measure the benefits from hazard abatement. And we are unable to predict with accuracy the costs of different strategies for eliminating hazards. It is difficult to allocate resources effectively to abate hazards without resolving at least some of these uncertainties.

Second, we lack a clear consensus on the appropriate normative criteria to be used in setting policy. We cannot agree on how to value the benefits from hazard abatement. We cannot agree on what role, if any, considerations of cost should play in determining how to make the workplace safe. We cannot agree on what consti-

tutes an acceptable risk. And we often cannot agree on how to allocate responsibility among labor, management, and government for making decisions about steps to be taken in eliminating hazards from the workplace.

Third, making employment safe in this country involves changing the behavior of an extraordinarily large number of people and institutions. Sixty million workers are employed in the United States in more than five million workplaces distributed over a very large area. To make each workplace safe requires physical changes in each work environment as well as changes in the day-to-day habits of workers and their supervisors.

Finally, workplaces differ—sometimes only slightly and sometimes drastically. Some workplaces are large; some are small. Some produce cars; others produce deposits and withdrawals. Some are inherently dangerous; some inherently safe. Some workers worry about back sprains; others about cancer. Some firms are capital-intensive; others labor-intensive. Some are unionized; others are not. In some industries (such as steel) a worker may be employed by the same company in the same plant for 30 years; in others (such as construction) a worker may work at fifty different sites each year. Each firm has a different production function, cost function, production technology, market position, and ability (and willingness) to respond to government regulation. In effect, each firm has a slightly different health and safety problem. The challenge of regulation is to design a regulatory policy that responds effectively to the diverse conditions encountered among diverse employment situations.

To fully appreciate the complexity of trying to regulate occupational safety and health, let us compare it against the regulatory dimensions of another major public health and safety problem: polio. Before the discovery of an effective vaccine, polio struck without warning, mainly among the young, and left many of its victims paralyzed for life. In 1952 there were over 58,000 reported cases of acute poliomyelitis.[5] Discovery of the Salk vaccine was announced in April 1955. Only 5,787 cases of polio were reported in 1957, and by the mid-1960s fewer than 100 cases were being reported annually. Why was it relatively easy to get rid of the polio problem? Because each person faced essentially the same type of risk, and

therefore the problem was amenable to control by a single solution: the vaccine. In contrast, to solve the occupational safety and health problem we must find a way to eliminate hundreds of thousands of different risks. Similarly, from an immunological perspective the potential polio population was nearly perfectly homogeneous; the same vaccine was effective for almost every person. But workplaces are extremely diverse in ways that influence the effectiveness of hazard-abatement strategies; what may be effective in one may fail in another. To be truly effective, health and safety programs need to be specially tailored for each workplace.

If regulated institutions were perfectly homogeneous, the design of regulatory policy would be a relatively simple task: The regulator would merely study a sample regulatee, determine the actions needed to produce the desired outcome, and then mandate those actions nationwide. Then, the regulator would only have to observe the actual effectiveness of the regulatory program in one firm to monitor its effectiveness throughout the country. Moreover, by observing just one firm the regulator would learn how to adapt the policy to changes in external conditions that affected the success of the overall regulatory program. Enforcement would also be simple. What worked in one firm would work in every firm.

We do not live in the "dream world" just described. Some examples may help to illustrate how the diversity of problems, regulatees, and environments complicates the design of regulatory policy for problems other than job safety and health.

Diversity of Hazards

Consider the problem of regulating consumer-product safety. Millions of products are marketed annually in the United States by thousands of different producers. The risk associated with each product varies with its design; the quality the materials and the workmanship; the directions provided to the user; the user's skill, judgment, and caution; the age of the product; whether the product is being used for its intended purpose; the way the product has been maintained; and the extent to which the product is used with other products. If we wanted to evaluate alternatives for making just one product safe, we would want to gather information about

the size of the population at risk, the cost of different product designs, and the likely reduction in risk for each design. Rarely does a regulator have complete access to this information; much of it must be obtained from the producer. Regulating product safety on a product-by-product basis places extraordinary informational and analytic demands on the regulator.

On close inspection, even problems that appear to be all of a piece reveal themselves to be multifaceted. For example, reclaiming land from which coal has been strip-mined is a fundamentally different operation than reclaiming land from which copper has been taken. Coal is usually found in dense veins just below the topsoil. When it is removed, there usually is very little material left (other than the topsoil) to use in reclaiming the mined area. In contrast, ores usually constitute a much smaller proportion of the total volume of material removed. Because the excess material expands during processing, there may be more material available to fill the trench than is actually needed. Because of these differences, strip mining of coal and strip mining of ores should probably be regulated differently.

Similarly, the regulatory situation differs for strip mining of iron ore and strip mining of copper ore. The vast majority of iron mined in the United States is consumed in the United States, and nearly all U.S. demand is domestically supplied. Prices for iron are determined primarily by domestic market conditions. In contrast, copper is traded in volatile international markets; domestic producers face stiff competition from foreign sources of supply. A mining regulation that increased costs of both iron and copper mining equally would have very different effects on the two industries. In iron, a few marginal operators might be driven out of the market by the cost increases but the structure of the industry would remain stable. In copper, however, the cost increases caused by the same regulation could place domestic producers at a competitive disadvantage relative to foreign sources, severely reducing the U.S. share of the world market.

There is a general tendency to underestimate the complexity of regulatory problems. Popular discussions and congressional debate often focus on the need for regulation and ignore the difficulties inherent in implementing policy effectively. At the level at which

policies are debated, the subtle distinctions among regulated entities that complicate policy design are rarely understood and often overshadowed. To make their case, proponents of new regulation often exaggerate the ease with which government intervention might eliminate a pressing problem. They often stress "need," minimize implementation problems, and concentrate on "horror stories" that are more likely to receive media coverage than detailed discussions. In contrast, opponents of regulatory initiatives take issue predominantly with the declaration of need, because arguing that a proposed regulatory program would be ineffective appears to be a concession on the need issue.[6] Thus, it should not be surprising that the legislative history of the Occupational Safety and Health Act contains numerous references to the thousands of different ways that workers are disabled and little if any consideration of how a single agency with limited resources might formulate policy responses to each of these problems.

It is important to recognize the extent to which regulatory problems consist of many subproblems, because problem diversity affects our choice of regulatory instruments. For example, protecting consumers from product hazards is a fundamentally different regulatory task than protecting people from the radiation hazards of nuclear power. There are only 74 nuclear reactors operating in the United States, and only a handful of substantial technical differences among them. Thus, it is more feasible for the Nuclear Regulatory Commission to prescribe protective measures for each plant than it is for the Consumer Product Safety Commission to identify and eliminate each of the thousands of different hazardous products. Although the NRC may have a more difficult technical task, the CPSC has a considerably more difficult regulatory task. In general, the greater the degree of problem diversity, the less desirable will be centralized regulatory programs that require the government to make complex technical decisions.

Diversity of Regulatees

Regulated institutions differ in many ways. What concerns us about these differences is that they affect the capacity to comply with

regulation. Regulators must be sensitive to variation in compliance capabilities for a number of reasons.

First, ignorance of differences in compliance costs may give rise to inefficient allocation of economic resources. For example, if some firms can curb their air pollution more cheaply than others, it is inefficient to mandate uniform reductions in emissions across all firms. By encouraging greater than average reductions in emissions from firms capable of complying cheaply, the same overall reduction in air pollution could be achieved at a lower total cost to society. As a general rule, if the objective of regulation is to influence behavior in the aggregate (such as reducing total particulate emissions, decreasing national energy consumption, or controlling atmospheric release of fluorocarbons), then it will be economically efficient to permit variations in response based on variations in cost of compliance.

Second, severe implementation problems are likely to result if regulators pretend that firms are organized and managed uniformly. For example, a safety regulation that impairs productivity is likely to meet with intense labor opposition in a shop in which workers are compensated on a piece rate, and little or no labor opposition where workers are paid by the hour. Similarly, it is much easier to implement a minority hiring program in a nonunionized firm than in a unionized firm in which job eligibility, promotion, training, and wage scales are governed by seniority provisions.

Third, because regulatees have different compliance capabilities, regulation often affects the competitive structure of an industry in unintended ways. Consider regulation of automobile fuel economy. To encourage energy conservation, Congress has required automobile manufacturers to meet minimum fuel-efficiency standards. To comply, manufacturers have been forced to redesign their cars to save weight. This is an extraordinarily expensive process that taxes the capital reserves of even the largest corporations. Because of its market position and profitability, General Motors has much better access to capital than either Ford or Chrysler. Chrysler has had a particularly difficult time raising the funds necessary to retool, and as a result has been weakened competitively and been placed in a precarious financial position. Furthermore, because it

produces fewer cars, Chrysler cannot amortize retooling costs as quickly as its larger competitors. Thus, although apparently neutral with respect to competition, the federal fuel-economy standards have enhanced the market position of the nation's largest automobile manufacturer at the expense of its competitors.

To the extent that firms have different compliance capabilities, regulation will always have competitive consequences (not necessarily undesirable). Uniform regulation will not result in equal treatment. If regulation is to have equal impact along a particular dimension, such as competitive standing, then the design of regulatory policy must take into account differences in compliance capability.

Diversity of Environments

The third way in which diversity complicates the design of regulatory policy is through the setting in which the regulated activity occurs. Variations in environmental conditions can radically alter the nature of the regulated problem. For example, energy conservation is a different problem in buildings located along the coast than in inland buildings, as evidenced recently in Florida. For inland structures, the objective is to maximize the efficiency of air conditioning units by minimizing solar heating of the interior; thus, the recently enacted Florida Energy Code restricts the size of windows and establishes minimum requirements for insulation. But houses along the coast can rely upon ocean breezes for cooling. Consequently, the design objective is exactly the opposite of that for inland homes; they should be open and airy, with large windows and doors. A regulatory strategy for energy conservation in buildings should permit variations in design according to location.

A similar problem arises in regulating water quality. The capacity of a receiving body of water to absorb pollution is a function of tides or currents, the concentration of the pollutant, the location of the discharging source, the temporal distribution of the discharge, the temperatures of both the discharge and the receiving body of water, the cross-sectional area of the receiving body of water, and the natural characteristics of the bottom. Many of these factors change as one travels along the shore of a river or lake. Conse-

quently, the capacity of a receiving body of water to accept a given concentration of pollution will vary depending upon the location of the point source. Thus, even if all pollution sources employ the same technology and have similar abatement cost functions, a uniform discharge regulation may not be desirable, because identical discharges will have different effects on water quality depending on their location.

In general, whenever the nature of a regulated activity is influenced by its location, regulatory policy must take that fact into account.

Conclusions

Regulatory problems are invariably complex and multidimensional. Because of the degree to which circumstances vary among different hazards, regulatees, and environments, a strong case can be made that each regulated institution possesses a slightly different regulatory problem. Thus, there is not just one occupational safety and health problem in the United States; each of the nation's five million workplaces has a different problem. The same observation could just as easily be made about most other regulatory issues.

If job hazards are to be removed from a particular work environment (or if toxic substances are to be controlled, or if energy is to be conserved, or if pollution is to be abated), the regulatory procedures employed must respect unique conditions.

With regard to most regulatory issues—especially job safety and health—the world is too diverse and a regulatory agency's knowledge too limited for it to be able to specify the most effective means for achieving the objective in each regulated institution. Instead, the agency must choose between the promulgation of uniform rules that are likely to work poorly in some situations and the creation of incentives for regulatees to look for ways to abate hazards on their own.