13. Assessment of OSHA and NIOSH Activities

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This chapter presents a discussion of several aspects of the activities of the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). It is not a complete assessment of Federal and State activities concerning occupational health and safety, but only a relatively brief treatment of several important areas. First is a presentation of the results of an OTA comparison of the standards and recommendations of OSHA, NIOSH, and the American Conference of Governmental Industrial Hygienists (ACGIH). Second is a discussion of estimates of employer investments in health and safety, followed by a summary of the research on the effectiveness of OSHA in reducing injury rates and toxic exposures. Finally, there is a short discussion of the difficulties in assessing the results of NIOSH activities.

COMPARISON OF RECOMMENDATIONS AND STANDARDS

This section discusses an OTA comparison of current OSHA standards for certain toxic and hazardous substances with NIOSH Recommended Standards and with the Threshold Limit Values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists. This comparison provides an analysis of the stringency of OSHA standards, and NIOSH and ACGIH recommendations. In most cases, OSHA standards for chemical exposure appear to be less stringent.

When there is more than one required or recommended level, engineers and designers can find themselves in a quandary as they seek to design a productive process and a system for the protection of worker health. Obviously, the designers must comply with the OSHA standard and cannot choose to comply only with a less protective recommendation from another organization.

But when the recommendations of NIOSH or ACGIH are more protective than OSHA standards, it would be desirable, from a health standpoint, for companies to adhere to these more protective recommendations. This is especially true when building new facilities or rebuilding old plants, when it is possible to increase worker protection and to take advantage of the reduced costs of controls introduced as part of the design. At the current time, however, this is not required. (As discussed in ch. 16, one option might be to encourage companies to meet more protective limits when undergoing "reindustrialization.")

OSHA currently has standards for about 410 chemical substances. In most cases, OSHA specifies the maximum levels for employee exposures (the Permissible Exposure Limits, or PELs). As described in chapter 12, nearly 400 of these standards were adopted in 1971 by OSHA under section 6(a) and consisted of consensus standards and established Federal standards. In addition, OSHA has issued 18 separate health standards. Twelve of these covered 24 specific substances and one physical agent. Among these 12 standards, there were 10 that set new or revised Permissible Exposure Limits.

Each year the ACGIH publishes a list of TLVs. These are recommended to the ACGIH membership by the TLV Airborne Contaminant Committee—17 members and 9 nonvoting consultants who represent companies and other countries. ACGIH has a second committee that considers recommendations for physical agents. Although qualified technical consultants from unions have been and are sought by ACGIH (244), unions have not participated on either of these commit-

tees in recent years because they believe that standard setting should be a Government activity. The committee members are unpaid and may meet two to four times each year to deliberate. New TLVs that are accepted by the membership at the annual business meeting are placed on a list of "intended changes" for at least 2 years, during which comments and additional data are requested. At the end of this period the membership votes on whether to add the TLVs to the list of Threshold Limit Values.

The 1983-84 TLV list contains recommended exposure limits for 615 chemical substances and mineral dusts. In May 1984, ACGIH adopted TLVs for 15 substances, and proposed to add TLVs for 7 substances not currently on their list as well as to revise the TLVs for 21 other substances (352). Changes in ACGIH TLVs are not automatically incorporated by OSHA, even for the PELs originally based on the 1968 ACGIH list.

As outlined in the Occupational" Safety and Health (OSH) Act, NIOSH makes recommendations, in the form of Criteria Documents or other documents, to OSHA concerning health and safety standards. It was apparently intended that OSHA would issue mandatory standards after receiving recommendations from NIOSH.

A NIOSH list, Recommendations ***for Occupational Health Standards,*** details the proposals made to OSHA since 1971 for exposures to 163 hazardous substances and working conditions. Five of these concern hazardous working conditions: logging, hot environments, coal gasification, confined spaces, and emergency egress from elevated work stations. None of these five has resulted in a completed OSHA rulemaking.[1]

Ten recommendations concern exposures to categories of hazardous substances or to harmful physical agents (benzidene dyes, chrysene, coke oven emissions, fluorocarbon decomposition products, ethylene thiourea, kepone, noise, pesticides, ultraviolet radiation, waste anesthetic gases). Only two of these, coke oven emissions and noise, have resulted in any regulatory action by OSHA. For coke oven emissions, a standard was issued in 1976. For noise, OSHA issued a Hearing Conservation Amendment in 1981 and revised it in 1983. For both versions of the Hearing Conservation Amendment, however, the published provisions covered only monitoring, audiometric testing, hearing protection, training, warning signs, and record keeping. The NIOSH recommendation to lower the Permissible Exposure Limit from an 8-hour time-weighted average of 90 decibels to 85 decibels has not been acted on. (The ACGIH TLV for continuous noise is also ***85*** decibels for an 8-hour exposure.)

Finally, NIOSH has made recommendations concerning 148 specific chemical substances. But only 123 of those recommendations include a specified numerical exposure limit.

Methodology for Comparison

OTA's analysis compares the protective levels either recommended or required by NIOSH, ACGIH, and OSHA, for the 123 specific substances included on the NIOSH list. The use of the NIOSH data set as a basis for comparison does not mean that the NIOSH exposure levels are the most important. The NIOSH data are simply a convenient source for analysis. (See app. A for a discussion of the selection of substances and the major points of inconsistency among these organizations.)

Unfortunately, OSHA, NIOSH, and ACGIH use different terminology for describing their standards and recommendations. OSHA refers to the basic requirement of its health standards as a "Permissible Exposure Limit. " This is the requirement that employee exposures be kept below a specified numerical limit. NIOSH prepares "Criteria for Recommended Standards" and transmits those recommendations to OSHA. ACGIH uses the term Threshold Limit Values for its recommended exposure limits.

For these comparisons, OTA has used the term "Protective Level" to refer to the standards, recommendations, and TLVs. Protective Levels can be specified in two basic ways:

- time-weighted averages (TWAs), and
- ceiling limits, short-term limits, or peak levels.

[1]One other NIOSH recommendation, concerning underwater diving operations, is not included in the NIOSH list. This recommendation was issued in August 1976 after OSHA had already issued an Emergency Temporary Standard on diving operations. OSHA's final standard was published in July 1977.

Protective Levels can have an 8-hour Time-Weighted Average, a Ceiling Limit, or both. ACGIH recommendations often have TLVs for both a TWA and a short-term limit. OSHA standards often have only an 8-hour TWA. NIOSH recommendations also generally have just one Protective Level.

A Protective Level is defined to be only the number listed as the PEL, recommendation, or TLV. No attempt has been made to quantify the number of workers exposed either above or below that Protective Level or to assess the additional protection provided by monitoring, medical surveillance, and other health and safety activities often included in standards and recommendations.

This comparison does not quantify all possible aspects of worker protection. Rather, it represents only a numerical comparison of the standards and recommendations for a group of toxic substances. The results of this comparison are expressed in terms of strictness or stringency. A standard or recommendation is more stringent than another if the specified numerical exposure limit is lower. Depending on the nature of the hazard, the expected health effects, the relationship between exposure and these health effects, "stringency" and the degree of worker protection afforded by a standard or recommendation are usually closely related.

There can be cases for which a more stringent protective level does not provide improved protection. However, for this comparison, OTA has not conducted a detailed analysis of expected health effects and the dose-response relationship for each of these 123 substances. Thus, the results only describe the relative stringency of the standards and recommendations of these three organizations.

Results

The rows of table 13-1 present three different comparisons–OSHA and NIOSH, OSHA and ACGIH, and NIOSH and ACGIH. To simplify presentation, in most cases the table provides only the number of cases for which the first organization listed has a numerical Protective Level that is less than the corresponding Protective Level of the second organization.

For example, the OSHA standard (TWA) for carbon dioxide equals 9,000 mg/m^3, while the NIOSH recommendation is 18,000 mg/m^3 (see table A-13 in app. A). In this case, the OSHA standard is more stringent and would be included in the total number of cases presented in the first column of table 13-1. For phosgene, both OSHA and NIOSH have the same protective level for an 8-hour TWA (0.4 mg/m^3). Because these TWAs are equal, phosgene is not included in the first column of the table. But because NIOSH has also set a Ceiling Limit, while OSHA has not, there would be an entry in the second column of table ***13-I.*** There will be an entry in column 3 or column 4 only if both the TWA and ceiling limits are more stringent or equal. (Although not included in the table, the number of times that two

Table 13-I .—Comparison of Protective Levels for Selected Substances

Case	Number (percent) of substances			
	TWA[b] is more stringent	Ceiling Limit[b] is more stringent	Both TWA and Ceiling Limits are more stringent	Both TWA and Ceiling Limits are **equally** stringent
OSHA standards compared with NIOSH recommendations.	28 (23%)	5 (4%)	2 (2%)	22 (18°/0)
OSHA standards compared with ACGIH TLVs[b].	11 (9%)	12 (10%)	10 (8%)	15 (12%)
NIOSH recommendations compared with ACGIH TLVs[b].	35 (28%)	50 (41%)	28 (23%)	15 (12%)

[a]For 123 substances for which NIOSH has made recommendations to OSHA.
[b]TWA is an abbreviation for Time-Weighted Average exposure level. The TWAs compared are typically calculated for an &hour workday and a 40-hour workweek. Ceiling Limits are defined for this comparison, in most cases, as a 15-minute Time-Weighted Average exposure level ACGIH uses the term Short Term Exposure Limit (STEL) for this. TLV or Threshold Limit Value is ACGIH's term for its recommendations concerning airborne concentrations of substances. See text and app. A for a more complete discussion.
[c]The number presented is the number of cases for which the first organization listed has a protective level more Stringent than the second organization.

SOURCE: Office of Technology Assessment.

organizations have identical TWAs or ceiling limits is included in the following discussion.)

Overall, NIOSH recommendations are more strict than the OSHA standards. Even when the Protective Levels are separated into TWA and Ceiling Limits, OSHA generally permits higher exposures. Only 28 TWA PELs set by OSHA are more stringent than NIOSH's. In all but 2 of those cases (lead and carbon dioxide) the TWAs used by OSHA appear to be more stringent because NIOSH did not set a TWA but only set a Ceiling Limit. In many cases ***(22*** of the ***28),*** this NIOSH Ceiling Limit is lower than or equal to the TWA used by OSHA.

There are, however, 5 instances in which the OSHA Ceiling Limit is more strict than the NIOSH one, although in each case this is because NIOSH has not recommended a Ceiling Limit. There are 33 instances ***(27*** percent) where OSHA PELs are equal to NIOSH recommendations, either in the TWA or Ceiling or both. Of these, 22 represent situations in which both the TWA and Ceiling Protective Levels are identical.

As mentioned, ACGIH updates its TLVs every year but OSHA's PELs remain virtually frozen at the levels adopted by ACGIH in 1968. Obviously, then, OSHA PELs and ACGIH TLVs will be equal in those cases in which ACGIH has not changed its 1968 levels (15 instances). It is noteworthy that ACGIH now has TLVs for over 600 toxic and hazardous substances—some 200 substances more than OSHA regulates.

OSHA standards are stricter overall than ACGIH TLVs in 10 cases ***(8*** percent). ACGIH has no recommendation for 4 of those substances: acetylene, DBCP, ethylene dibromide, and petroleum solvents. OSHA's TWAs are stricter than ACGIH TLVs in 11 cases ***(9*** percent) and OSHA's Ceiling Limits are stricter than ACGIH's in 12 cases (10 percent). In all but ***6*** of these, if the TWA used by ACGIH is weaker than OSHA's, then the ACGIH Ceiling Limit is stricter than OSHA's (or vice versa). On the whole, instances where OSHA is more strict occur because ACGIH has not made any recommendation at all.

NIOSH recommendations are stricter than ACGIH TLVs for ***28*** substances ***(23*** percent) out of the ***123.*** In 4 instances, as mentioned above, this is because ACGIH has not set any TLVs for these substances. NIOSH has stricter TWAs than ACGIH in ***35*** cases ***(28*** percent) and stricter Ceilings in so cases (41 percent). NIOSH recommendations and ACGIH TLVs are equal in 15 cases (12 percent). Sometimes one set of Protective Levels, such as the TWA, is equivalent and the other is not ***(33*** cases), For example, the TWAs for xylene are the same for both NIOSH and ACGIH, but ACGIH's Ceiling is stricter than NIOSH's. There is only one chemical with an OSHA PEL and an ACGIH TLV for which NIOSH has not set an exposure limit (boron trifluoride).

Discussion

These three organizations use different formal decision rules when setting their standards and recommendations. However, in practice, many more informal factors enter into the decisions, including the experience of the individuals involved, their professional judgments on what is protective of worker health, and the values and goals for public policy that are held by these individuals and their organizations.

For OSHA and NIOSH, the formal guidelines for recommendations and standards derive from the OSH Act, which appears to distinguish between the "criteria" developed by NIOSH and the "standards" set by OSHA. NIOSH is required to develop "criteria" solely on health and safety grounds, without consideration of the feasibility of the "criteria. " OSHA, on the other hand, is directed to set standards that are "reasonably necessary or appropriate" and, in the case of health standards, to protect employee health "to the extent feasible. " (For a discussion of OSHA decisionmaking, see ch. 14.)

ACGIH sets its TLVs at levels "under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect." ACGIH cautions, however, that because of variation in individual susceptibility, some workers may still develop an occupational illness from exposures at a TLV. The TLVs "should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations" (8).

This comparison shows, in a limited way, that OSHA has tended to lag behind NIOSH's and ACGIH's Protective Levels. There are several interrelated reasons for this lag. The first, and most important, is that OSHA is a governmental regulatory agency. Employers can, if they wish, ignore NIOSH recommendations and ACGIH TLVs. But even though OSHA's inspection activity is limited (see ch. 12), OSHA standards can potentially be used as the basis for civil penalties and required abatement. Thus they receive more attention.

Opposition has often accompanied that attention. Most of OSHA's health standards have been challenged in the courts. Resolution of these cases has taken time–in most cases, several years. The courts now require that OSHA standards be based on adequate evidence that the hazard addressed by the standard poses a "significant risk" and that compliance is "feasible" for the affected industry. Moreover, Executive Orders since 1974 have required that OSHA examine the economic impact of its standards prior to issuing them. (For a discussion of this aspect of OSHA decisionmaking, see ch. 14.)

In addition, although OSHA is to use NIOSH's recommendations as one element for its standard-setting, it is not required to respond to those recommendations within any specified deadline. Beyond this, OSHA has often concluded that the NIOSH Criteria Documents did not provide an adequate basis for developing standards. Thus OSHA has usually developed its own scientific and technical information concerning hazards and controls. These factual and legal requirements, as well as the requirements of the Executive Orders, have consumed time, stressed OSHA's limited resources for standard-setting, and slowed the agency.

NIOSH and ACGIH have their own resource constraints, too. But they do not have the same potential for public opposition and legal challenge. They can issue recommendations based on their judgments about employee protection from adverse health effects, without formal analysis of the feasibility or costs of these recommendations.

In 1983, it was reported that a memorandum had been prepared by OSHA staff recommending that the agency stop working on the development of revised exposure standards for 116 substances that are regulated under OSHA's startup standards. OSHA's activities concerning these 116 chemicals include requests for information on 61 of the chemicals, preparation of advance notices of proposed rulemaking on 55 of them, issuance of proposed rules for 23, and hearings on rules to regulate 9 of the chemicals. According to the memorandum, a decision to stop working on rules for these chemicals would be practical, as the agency no longer has the staff or resources to pursue this activity, Although OSHA has stated that a decision not to pursue regulation of these chemicals has not been made, there has been little recent activity regarding these ***116*** substances. The last hearing to be held on any of them concerned beryllium, in 1977, and there has been no public activity on any of the others since ***1975 (110,366,*** 517a).

As discussed earlier, from ***1971*** to ***1984,*** OSHA issued 18 separate health standards. But only 12 of these established Permissible Exposure Limits or other requirements for 25 specific exposures. Requirements for 3 of these have been overturned by the courts. Thus, of the approximately 410 OSHA-regulated substances, nearly all are still the same as those OSHA initially adopted in 1971.

In direct contrast to this is the experience of some European nations. For example, in July ***1984,*** Sweden issued a revised list of health standards that included ***18*** revisions of existing exposure limits and the addition of limits for 22 new substances previously not regulated. This is the result of only 3 years of effort, as the last revision of the Swedish health standards was published in June 1981. Although it is generally believed that the Swedes are leaders in occupational health and safety, it is difficult to gather quantitative information on actual exposure conditions in Sweden and the United States. Thus, it is not clear to what extent the Swedish limits are translated into actual protection. It is clear, however, that the process of revising the exposure limits in the United States is dramatically slower.

IMPACTS OF OSHA

Cost of OSHA Compliance

There are a number of difficulties and problems in securing accurate and meaningful information on the costs of health and safety regulation. These problems generally plague both estimates of the costs of any particular regulation or proposed regulatory change and estimates of the total costs of all OSHA regulations.

First, the basic source of data on the costs of compliance with regulations is employers, either because they are the most knowledgeable about day-to-day conditions and equipment in their plants or because they have given permission to outsiders to visit their facilities. But businesses generally do not arrange their accounting systems to keep track of all health and safety expenditures. Although information is sometimes available for certain health and safety expenses (e.g., the salary of a company physician), there is generally no account entry for the ***total*** expenditures for health and safety. Thus, estimates of current costs and predictions of future costs are generally based on inexact information and guesses rather than on data that can be verified and audited.

Furthermore, when asked to provide these estimates, there is a tendency for employers to overestimate regulatory costs. Employers have a strategic interest, if they oppose a particular regulation or Government intervention in general, in overestimating the costs. In addition, lower- and middle-level managers, when asked how much a regulation will cost in their areas of responsibility, will tend to overestimate the costs because, in the words of a senior official at ALCOA, "it is better to be under budget than over budget" (140). Facing the possibility that they will have to budget expenditures within the estimates they make, managers may overestimate costs in order to have a sufficient budget.

Second, compliance cost estimates have generally not been offset by the benefits of health and safety compliance. In fact, in many cases what appear as new costs to the business firm are merely costs that previously had been borne by workers and society. For example, the costs to a business of preventing occupational injuries may merely represent costs previously borne by injured workers in terms of lost wages, pain, and suffering. In addition, the increased costs to employers often represent increased revenues for suppliers of control technologies and an increased number of jobs for health and safety professionals. Moreover, when complying with regulations, employers often are able to offset, at least partially, the costs of compliance with improvements in productivity and reductions in the costs of lost wages, medical care, down time, etc. that are associated with workplace injuries and illnesses.

Third, there are several difficulties in correctly separating and attributing health and safety expenditures. The first of these concerns how to allocate the costs of equipment and personnel that perform multiple functions, including normal business activity, or that enable compliance with several regulations. For example, an employer installs a ventilation system that both reduces the level of a toxic air contaminant and provides heating and air conditioning. What percentage of the cost of the duct work, fans, switches, installation costs, etc. should be attributed to the industrial hygiene function and what percentage is a normal business expense for heating and air conditioning?

A second, and related, difficulty arises most particularly in attempts to estimate the costs related to existing OSHA regulations or proposals for new standards. This concerns how to separate incremental costs (those due solely to the presence of regulation) from total costs, which include spending that would have taken place even in the absence of regulation. These could include the costs incurred because of corporate good citizenship, collective bargaining agreements, and fear of legal liability. For new, more stringent regulations, the distinction is often made between the total costs of compliance and the incremental costs for reducing hazards beyond the existing requirements.

Finally, cost estimates generally assume the use of currently available technologies, neglecting the potential for cost savings with improvements in control technology. Over time, industry may

learn how to control more cheaply and control technologies themselves may improve. Thus control may become less costly. Basing the costs on current technology will thus tend to overestimate the costs of compliance (33).

Estimates of Total OSHA Compliance Costs

Robert Smith ***(446)*** has reported a National Association of Manufacturers estimate that its members needed to spend between $35,000 and $350,000 each to comply with OSHA startup standards. No other details of the methodology behind this estimate were given.

The Economics Department of the McGraw-Hill Publications Co. annually surveys a group of large companies about actual and planned capital expenditures and about the percentage of their capital spending that is for employee health and safety and for air, water, and solid waste pollution control, McGraw-Hill then develops national estimates based on these survey responses ***(298).*** There is no independent verification of the survey responses, although a limited check is conducted to ensure internal validity of survey questionnaires. Information is not collected on annual operating expenses, but only on capital spending. Nor is information collected on what companies would be spending on health and safety even in the absence of OSHA activity.

The total capital spending for occupational health and safety was estimated to be $4.5 billion in 1982 and $4.9 billion in 1983, representing 1.4 percent and 1.6 percent of total capital spending, respectively (table 13-2). When measured in current dollars, capital spending for health and safety has ranged from ***$3.3*** billion to ***$6.6*** billion (from ***$2.4*** billion to ***$4.4*** billion in 1972 dollars). The latest estimate of investment, about $5 billion, is only about one-sixth as large as the National Safety Council estimate regarding the costs of work injuries alone—over $30 billion each year (324, 530).

In both current and real dollars the peak for reported capital spending appeared in 1978. From 1979 to 1983, the expenditure ranged between $2.4 and $2.9 billion (in 1972 dollars). In addition, the share of total capital spending that has been devoted to employee health and safety, which never fell below an average for all industries of 2.0 percent from 1972 to 1978, has been in the range of 1.4 to 1.6 percent for the last 5 years for which data are available (298). This decline in recent years in the percentage share of capital spending devoted to health and safety is similar to the decline in the share of capital spending for pollution control (410).

Table 13-2.—McGraw Hill Survey of Capital Spending for Worker Health and Safety

	Health and safety investment		
Year	Current dollars (millions)	1972 dollars[a] (millions)	Percent of capital spending
1972	3,279	3,279	2.7
1973	3,616	3,552	2.6
1974 ... , . .	4,403	4,028	2.8
1975	3,842	3,044	2.4
1976	3,415	2,550	2.0
1977	4,291	3,043	2.2
1978	6,645	4,439	2.9
1979	4,317	2,719	1.6
1980	4,128	2,441	1.4
1981	5,112	2,848	1.6
1982	4,503	2,459	1.4
1983	4,945	2,704	1.6

[a]Adjusted to 1972 dollars using the implicit price deflator for nonresidential producers' durable equipment Economic *Report of the President* (1984), table B-3
SOURCE (298)

Another source of information on OSHA compliance costs is a study prepared for the Business Roundtable by the accounting firm of Arthur Andersen & Co. They surveyed 48 very large corporations to estimate the incremental costs of Government regulations of six Federal agencies in 1 year-1977. The 48 companies were estimated to incur about $2.6 billion in compliance costs. Of this, only $184 million or about 7 percent was attributed to OSHA. About ***37*** percent of ***the*** OSHA compliance costs were capital costs, ***56*** percent operating and administrative expenses, and 6 percent research and development costs ***(26).***

Wiedenbaum and DeFina have developed what is probably the most widely quoted estimates of the costs of Federal regulation. Their estimate for the total costs of all Federal regulations in ***1976*** amounted to about ***$65*** billion ***(669),*** while for ***1979*** their estimate was over $100 billion ***(670).*** (See 195,428,470 for criticism of these estimates.) They did not, however, develop any new or origi-

nal cost estimates for OSHA compliance. Rather, their estimate for OSHA was based on the McGraw-Hill survey plus an estimate of the costs incurred by universities for OSHA compliance.

OSHA and a number of participants in its regulatory hearings have provided estimates of the costs of complying with many of the proposals offered by the agency. The quality of these estimates has been quite variable and has usually been colored by the controversies surrounding the particular regulatory proposal. Because they have been especially subject to the difficulties discussed above, OTA has not attempted to summarize these estimates.

Impacts on Productivity and Paperwork Burdens

OSHA may also have an impact on economic productivity by diverting resources from "productive" uses to compliance with health and safety regulations. Unfortunately, available information on economic productivity generally does not include the benefits of improved worker health and safety. But even without considering those offsetting factors, the negative effects of OSHA regulation on traditional measures of productivity appear to be small.

Denisen (137) has studied the determinants of U.S. economic growth and has attempted to explain the sources of declines during the ***1970s*** in the economic growth rate. He estimated the incremental costs of occupational safety and health regulation in three areas: costs of safety equipment on motor vehicles used by businesses, costs of mine safety regulation, and the costs of OSHA regulation. He then estimated the percent of economic inputs (land, labor, and capital) that had been "diverted" to provide for health and safety protection. In 1975, the latest year of his estimates, business vehicle safety equipment had diverted 0.09 percent of inputs, mine safety regulation had diverted ***0.24*** percent, and OSHA regulation had diverted 0.09 percent, compared with a 1967 baseline. All three together, then, diverted 0.42 percent of inputs. Thus, if occupational safety and health regulation and other economic inputs had been the same in 1975 as they were in 1967, net output would have been ***0.42*** percent larger than what was actually produced.

Thus, the estimated adverse impact of OSHA on productivity is quite small. Moreover, in some cases OSHA compliance has been accompanied by improvements in productivity. As discussed in box N (in ch. 12) and chapter 16, these cases include the OSHA standards regulating exposures to vinyl chloride and cotton dust.

One other area in which Government regulation may have had an adverse impact is in increasing the burden of paperwork on businesses. Concern about the burden of Federal forms and other record keeping was important in congressional consideration and enactment of the Paperwork Reduction Act of 1980 (Public Law 96-511). But OSHA record keeping is only a very small part of the total record-keeping "burden." For the year ending in September 1983, the time spent in keeping OSHA-required records is estimated to be ***36.9*** million hours. This amounts to slightly less than 2 percent of the total for all Federal information collection activities (171,358).

OSHA's Impact on Injury Rates

During congressional debates concerning the OSH Act, one sponsor of the act expressed the hope that the creation of a Federal regulatory agency would lead to a ***50*** percent decline in injury rates ***(459).*** Have OSHA standards and inspections reduced occupational injury rates? As discussed in chapter 3, analysis of injury rate trends since the creation of OSHA is difficult, but it is hard to find any large changes in national, aggregated injury rates that do not appear to be associated with the effects of the business cycle.

A number of researchers have conducted statistical analyses of the possible effectiveness of OSHA in reducing occupational injury rates. Because of their greater detail, these studies can provide more information than a simple analysis of trends. Two basic approaches have been used. The first is to develop a statistical model to "explain" injury rates and changes in those rates. Such an explanatory model can include a variable that measures the activity of OSHA (usually the number of inspections per year). The analysis can examine whether changes in injury rates correlate with OSHA activity. Another use of this approach

is to extrapolate results from before OSHA existed to predict injury rates. If the actual rates are below those predicted, OSHA may have been the cause.

The second major approach is to compare the injury rate experience of plants that have-been inspected with those that have not. This approach encounters difficulties if OSHA tends to inspect plants with the highest injury rates. A variation is to compare the injury records of plants inspected "early" in the year with those inspected "late" in the year. Because the data are collected annually, the records of "early inspectees" will probably reflect whatever effect OSHA has had during the year, while the records for the "late inspectees" will reflect plant experience before the inspection. Any "OSHA effect" will be seen the following year. Although this approach has the advantage of being able to estimate effects on inspected plants, it will not be able to detect any deterrent effect of OSHA in plants that have not been inspected.

In both approaches, researchers must try to correct for other factors that may influence the number of injuries and injury rates. Some of these factors include the kind of industry, the effects of the business cycle, the pace of production and overtime worked, the demographics of the work force (including age, experience, and family income), changes in the administration of workers' compensation, changes in the practice of medicine, and variations in the mix of industries and occupations.

In addition, several other factors make the task of discovering an "OSHA effect" difficult. The first concerns the low probabilities of inspection, the low average OSHA penalties, as well as variations in inspection probabilities and penalties among industries and geographic areas. Second, many OSHA inspections do not find any violations or any "serious" violations. Research that groups inspections without violations with inspections that found violations may mask OSHA's effect on employers who violate OSHA standards. Third, not all types of injuries are equally preventable by current OSHA safety standards and OSHA's inspection activity. Indeed, it is likely that some types of injuries are better addressed by the current scheme than others are, and that other types (e. g., musculoskeletal problems such as back injuries) are not currently addressed at all. Analyzing data that aggregates all injury types together may mask a favorable OSHA effect on some types of injuries.

Fourth, OSHA's shift from conducting almost entirely safety inspections toward conducting more health inspections may change the expected OSHA effect on injury rates. Fifth, the effectiveness of Federal OSHA and the various State programs may differ. Analysis of a data set that combines safety and health inspections and that groups OSHA activity with State program activity may not detect the positive effects or either OSHA or individual State programs. Sixth, the effectiveness studies that have been done have used data from employer-maintained records. If there are biases in those data, or if employers keep better records after an inspection than they did before inspections, the effects of OSHA may be difficult to evaluate.

To date, research results on this question are mixed. DiPietro (141) found that inspected firms had higher injury rates, a result that DiPietro attributed to a tendency for OSHA to inspect more hazardous plants. Smith **(446)** used a model to predict injury rates in several high-hazard industries targeted by OSHA. He found declines over time, but these were not statistically significant. In a later study (447), Smith compared early and late inspections, finding a significant decline in 1973 and an insignificant decline in 1974. McCaffrey (291) used the same methodology and found no significant OSHA effects in 1976, 1977, or 1978. Cooke and Gautschi (121) compared early and late inspections in Maine for ***1970-76*** and found a statistically significant reduction in the number of lost workdays per worker.

Mendeloff (300) was able to disaggregate injury data for California by type of injury. Using a model to predict injury rates in the absence of OSHA, he found significant decreases in several types of injuries he judged more likely to be preventable by OSHA activity. This parallels research by the State of California that shows large declines in amputations, explosions, and crushing injuries ***(668).*** Mendeloff found no OSHA effect,

however, for California or the Nation using data that aggregated all types of injuries.

Two studies have used variables concerning the level of OSHA inspection activity. Viscusi (658), using data that did not distinguish between Federal and State OSHA programs, found no significant effect related to the level of Federal activity. His results did reveal, however, a significant decline in injury rates over time, which may have been a statistical artifact or the result of a favorable OSHA effect. Bartel and Thomas (45) limited their study to States covered by Federal OSHA, and found that OSHA activity had a significant effect on employer compliance with OSHA standards, but that this compliance led to only a modest reduction in injury rates.

Taken together, these results tend to support the conclusion of chapter 3 that most of the injury rate changes since ***1972*** have been due to the effects of the business cycle and are not related to OSHA activities. (For a more detailed discussion of these studies, see Working Paper #l.)

OSHA has analyzed the effect of one OSHA standard on the reported frequency of injuries. Between 1970 and 1978, about 47 injury-producing accidents occurred each year with one type of wheel rim used on trucks and buses. In 1980, OSHA issued a new regulation concerning the servicing of these wheels, and since then the agency estimates that the frequency of injuries has fallen by 76 percent, to about 11 per year (631). A workplace standard issued by the State of California concerning another type of wheel has also led to an injury reduction of about ***80*** percent ***(631).*** Although these declines are encouraging, they represent only **a very** small change in the total number of work-related deaths from all causes. Moreover, this appears to be the only case for which OSHA has reported the actual effects of any particular safety standard on injury rates.

The Mendeloff (300) and Smith (447) studies have been used to estimate the possible benefits in the United States of OSHA safety regulation. Green and Waitzman (195) have calculated that the 5 percent reduction in fatalities and a 2 to 3 percent reduction in lost-workday cases found by Mendeloff translate into a nationwide reduction of ***350*** deaths and prevention of ***40,000*** to ***60,000*** injuries per year. They also estimated that the Smith findings of 5 to 16 percent reductions in injury rates in inspected workplaces imply a reduction of ***144,000*** to ***450,000*** injuries in a year with 180,000 inspections,

Assigning a dollar value to these reductions is very difficult (see ch. 14). Using one estimate of the minimum social losses due to disabling injuries, Green and Waitzman (195) estimate that the benefits of OSHA safety regulation are, using Mendeloff's results, at least ***$408*** million to $610 million annually. Smith's results for lost-workday cases, they argue, imply monetary benefits of up to $4.59 billion. The reduction of 350 deaths per year might be valued at over $5 billion if one "willingness to pay" estimate of the value of life is used.

The research concerning OSHA can be compared with research about Federal regulation of mine safety. The number of fatalities in mining has fallen during the last half-century. In ***1926-30,*** **a** total of 11,175 miners were killed on the job, while during 1971-75, the figure was 715 (536). Congressional activity concerning coal mining has included legislation in 1941, 1952, 1969, and 1977.

Two studies have evaluated this legislation using aggregated data over time. Lewis-Beck and Alford (270) examined fatality rates from 1932 to 1976 and concluded that Federal legislation passed in 1941 and in 1969 significantly diminished the risk of fatal injuries in mining, but that the 1952 legislation had no significant impact on fatality rates. Weeks and Fox (665) concluded that there had been no change in underground fatality rates from 1950 to 1969, but a significant decline from 1970 to 1980. This decline in mining fatality rates may have recently reversed. Weeks and Fox found that in 1981 the fatality rate was significantly higher than would be expected from the rates from 1970 to 1980.

Three other studies have used more detailed information to control for nongovernmental factors that influence injury rates in mining. Boden ***(63)*** found that Government inspections reduced injuries and fatalities for the period 1973-75. Connerton (114), using data from 1965 to 1975, found that the 1969 Coal Act had reduced fatality rates, but that nonfatal injury rates had stayed the same

or increased slightly. Neumann and Nelson ***(327)*** concluded that the 1969 act had significantly reduced fatality rates (they estimated that in 1976 it had been lowered by 9 percent), but that nonfatal accident rates had risen. It is not completely clear why fatality rates have fallen while nonfatal injury rates have increased since the ***1969*** act. Part of the reason may be improved reporting of nonfatal injuries ***(536).***

Several reasons have been suggested to explain why mine safety regulation appears to have been more effective than OSHA's safety regulation in nonmining industries. First, the funding of the Government agencies has been greater for mine safety, about ***$150*** per worker, as opposed to $3 per worker in general industry. Second, inspection coverage is much greater. Every coal mine is inspected every year—at least twice a year for surface operations and at least four times a year for underground operations. Third, the hazards of mining are more similar from establishment to establishment than for the wide variety of industries covered by OSHA. Thus, standards and inspections can be more narrowly focused. Finally, mine safety regulations require mandatory safety training of all miners, which includes both training for new employees and refresher training for current employees ***(530).***

Some critics believe that safety regulation itself represents the wrong approach to the problem of workplace injuries; they suggest injury taxes, workers' compensation, and tort liability as preferred alternatives (see discussion in ch. 15 and 16). Moreover, some have criticized OSHA's safet y standards because they mostly concern equipment and not worker activities. OSHA's safety inspections can only detect relatively permanent features of the workplace and not the transient hazards that lead to many injuries. ***Thus,*** these critics claim, it is not surprising that the studies on OSHA's effectiveness have found only limited impact or no significant impact at all.

For example, Mendeloff (302) found that only 13 to 19 percent of the 645 deaths reported in 1976 in California were related to violations of safety standards. He then asked a panel of safety engineers to review the written reports of these cases to determine if the violations would have been detected by an OSHA inspection on the day before the accident. Based on the panel's evaluation, Mendeloff concluded that only 55 percent of the serious violations would have been detected.

The California Department of Industrial Relations has analyzed occupational injuries and reports that between ***30*** and 50 percent of the injuries examined in several different industries could have been prevented by compliance with standards. Nearly all of the remaining injuries, they concluded, could be prevented by improved training and education ***(84, 85, 86, 87, 88, 89).*** Bacow (37) concludes that most injuries cannot be prevented by OSHA activity. To reach this he relies on studies of "unsafe acts" and "unsafe conditions" (summarized in ch. 4) and two studies in Wisconsin and New York that found violations of standards to be related to, at most, 30 percent of nonserious accidents and 57 percent of fatalities. A Federal Interagency Task Force on OSHA concluded that only about 25 percent of workplace fatalities could be prevented by current OSHA standards (228).

However, the information contained in inspection reports can be limited, especially for determining injury causes and in designing preventive measures. Moreover, often these studies do not consider how changed standards could prevent injuries. Many of these studies either explicitly or implicitly rely on the belief that most accidents are due to "unsafe acts" by workers. But, as pointed out in chapter 4, oftentimes changes in equipment and workplace design can prevent these "unsafe acts" from occurring or reduce the potential for injury from "human errors." Similarly, new standards concerning design and installation of equipment might increase the proportion of injuries that are deemed "preventable. "

In fact, several of these studies automatically exclude motor vehicle fatalities as "not preventable." Current OSHA standards do not generally address motor vehicle safety, but there are technologies available to reduce the incidence of deaths in vehicle crashes (664). These could be mandated by the Federal Government, probably through regulations issued by the National Highway Traffic Safety Administration.

Critics of safety standards frequently point to the importance of worker training for preventing injuries. Industrial leaders in occupational safety also emphasize worker training programs. Although perhaps more difficult than regulating machinery design, OSHA could encourage or even require safety training programs. Thus, new standards that improve the design of equipment, address hazards not currently regulated, or that improve training programs may have a beneficial effect on injuries.

Trends in Exposure Levels

It is often asserted that exposures to toxic substances have been going down over time. However, data that would permit evaluation of this claim are scarce. Some individual firms have conducted industrial hygiene measurements for some time (see 215 for several examples). But it is not clear, even when records from these firms have been maintained and are available, that it would be appropriate to generalize from their experience. Moreover, while some exposures have declined, others have risen.

The analysis of exposure levels over time could be used to measure the impact of OSHA. Of course, this evaluation encounters similar, but not identical, problems to those found when evaluating OSHA's impact on injury rates. For hazardous exposures, however, comparatively little research has been conducted to identify the factors that influence exposure levels.

Mendeloff ***(301)*** analyzed information contained in the OSHA Management Information System about OSHA health inspections for asbestos, trichloroethylene, silica, and lead from 1973 to 1979. Although there are a number of limitations to those data, the data show substantial declines in asbestos exposures over this period. For trichloroethylene, silica, and lead, Mendeloff's analysis reveals no major changes over time.

Using OSHA inspection data, Carol Jones ***(237)*** has also found declines in asbestos exposures. She estimates that the decline in average exposures from the period 1972-76 to 1977-79 amounted to about three fibers per cubic centimeter. This exposure decline is equal to the decline in 1976 of the permissible exposure limit from five fibers per cubic centimeter to two fibers per cubic centimeter and thus may be linked to the OSHA standard. However, other factors, particularly the increase in the number of lawsuits concerning asbestos-related disease, may also have contributed (see ch. ***15).***

It has been estimated that the OSHA asbestos standard issued in 1972 would result in a reduction of between 630 and 2,563 deaths per year, resulting in social cost savings, in 1970 dollars, of between $110 million and $652 million per year (432). These totals may underestimate the benefits of the asbestos standard (433). In the case of vinyl chloride, exposures declined substantially after the issuance of a new, more stringent OSHA standard (see box N). It has been estimated that this standard would prevent about 2,000 deaths over the years ***1976-2000 (32).***

Two case studies commissioned by OTA for this assessment also show favorable effects after the issuance of new, more stringent OSHA health standards (see ch. 5 for a fuller discussion). Ruttenberg (413) reports that cotton dust exposures have declined substantially in the past few years, halving the number of workers who were exposed above the new permissible limit. Several textile mills appear to be completely in compliance, while others fully expect to be in the near future. In addition, these changes appear to have been accompanied by or created by the installation of new technologies that both decrease employee exposures and increase productivity.

Goble, Hattis, et al. (184) report that in the last two years there have been large declines in both employee exposures to lead in the air as well as in measured employee blood lead levels. For example, the percentage of workers exposed above 200 micrograms/ma in primary smelting has declined by nearly 20 percentage points. Blood lead levels have declined even more dramatically. New OSHA standards for vinyl chloride, cotton dust, and lead have clearly r-educed workplace exposures.

Conclusions About OSHA's Impacts

OSHA's activities can be grouped as standard-setting, enforcement, and public education and service (see ch. 12). OSHA has had the resources to develop only a few new standards each year.

But many of its revised safety standards (see table 12-4 in ch. ***12)*** have been limited in their scope and have not addressed major workplace hazards. There are many areas for which standards could be issued, to improve equipment design, address hazards not currently covered, and establish workplace training programs. Moreover, many of the current safety standards most frequently cited by OSHA inspectors are only rarely involved in workplace fatalities ***(302).***

Many critics of OSHA's safety standards, however, believe that there must still be a role for health standards ***(446, 685)).*** Indeed, analysis of several of OSHA's health standards reveals substantial reductions in workplace exposures, reductions that should lead to improved worker health. However, analysis of OSHA standards and the recommendations of ACGIH and NIOSH reveals that OSHA's adoption of health standards has lagged behind professional recommendations.

Criticisms about OSHA's health standards are less likely to be about whether they are needed than about the desirable level of protection. In particular, employers have been concerned that OSHA has not taken account of the costs of these standards (see ch. 14), or that OSHA requires the use of engineering controls to reduce or eliminate these hazards, instead of allowing the use of personal protective equipment (see ch. 9). Labor, on the other hand, has criticized the slow pace of standard-setting, as well as the increasing attention to the predicted costs of standards.

Finally, OSHA and the State programs have been able to inspect (combining health and safety inspections), at most, 4 percent of all establishments and less than 20 percent of manufacturing establishments each year. In addition, the penalties for violations are, on average, very low, and in most cases, much smaller than the potential costs of controls. Because of the low frequency of inspection and the low penalties, it is particularly important that the people who are always in the workplace—workers and managers—be fully informed about occupational hazards. In addition, steps can be taken to provide other incentives to ensure that appropriate control technology is installed (see chs. 15 and 16).

Analysts can disagree on the number of cases of occupational disease and injury that the current regulatory scheme may be able to prevent. But, in practice, there have been substantial limitations on these regulatory activities. Any changes in this, however, would require agreement by Congress and the executive branch to increase OSHA staff and funding, as well as to expand its ability to influence business decisions on workplace investments and operations.

There is a general belief that the presence of OSHA has increased manager and worker awareness of occupational health and safety. Kochan, et al. ***(253)*** report, from interviews with company and union officials, that "management has assigned a higher priority to plant safety, the ability of the union to influence management decisionmaking on safety issues has increased, and the role of the union-management safety committees has been bolstered" since the passage of the OSH Act. This increased attention has also created a need for health and safety professionals and probably increased their role in company decisionmaking. The presence of a Federal regulatory agency may lead employers to anticipate potential health and safety problems and solve them before regulatory action becomes necessary. The OSH Act also created new rights for worker information and participation concerning health and safety. Although all these changes may be desirable, it appears that OSHA activity has, thus far, not had a very large effect on injury rates. It has had some effect on several clearly defined health hazards, but its effects on the many hazards it has not addressed are still in doubt.

IMPACTS OF NIOSH

OTA has divided NIOSH research activities into three categories: hazard identification, development of controls, and dissemination of information (see ch. 12). Assessing the impact of NIOSH in these areas is even more difficult than assessing that of OSHA. In theory, quantitative

measures of inspection activity and injury rates can be analyzed although, of course, there are great difficulties in doing so. But the impact of an agency that conducts research is not subject to even these limited measures. In fact, quantitative measures can be especially misleading" when assessing research. It is not the number of studies completed or papers published that is important, but the quality of the research.

Does this research and dissemination contribute to the advance of knowledge in the field of occupational health and safety? Are the epidemiologic and toxicologic studies based on well-designed protocols followed by comprehensive and accurate data collection? Can the studies be reproduced? Do the NIOSH-developed sampling and analytical methods provide accurate and valid results? Do the control technologies developed or described actually work as indicated? Is the information provided by NIOSH accurate and useful? Are the educational programs sponsored by NIOSH worthwhile? Finally, do all these activities lead to improvements in working conditions and in the health and safety of the work force?

In the late 1970s, some concern was expressed that the quality of NIOSH research was suffering (primarily following criticism by affected companies and industrial consultants of a NIOSH study of workers exposed to beryllium). When Donald Millar became Director, he took several steps to improve NIOSH research. One of these **was** the establishment of a Board of Scientific Counselors to advise the Director on all aspects of research conducted by NIOSH. The Board consists of 10 scientists who are knowledgeable about occupational safety and health research. The board has only recently been appointed and held its first meeting in early 1984. Although the appointment of a board is a concrete step, it is not clear what effects this will have on the quality of NIOSH research.

As in the case of OSHA, the ideal would be to know what the situation would have been in the absence of NIOSH activities. Certainly some research and information dissemination would have taken place at universities and in the private sector, even without Government activity. Although it is difficult to quantify this, it is unlikely that private sector parties by themselves would have devoted the same level of resources to health and safety research **as** the Federal Government has through NIOSH. Because information is, to some extent, a "public good, " private parties have only a limited incentive to develop it on their own. Once published, many can benefit, but because the information is already public, the original researcher would encounter great difficulty in charging each beneficiary for that information. Thus, it can be argued, the Government needs to be involved in order to provide this "public good."

NIOSH is the only Federal agency dedicated to occupational health and safety research and dissemination. Although NIOSH is not the only organization that conducts or sponsors epidemiologic and toxicologic studies of workplace hazards, its studies have advanced knowledge in this field. Controls are developed in the private sector, but NIOSH has provided many of the detailed sampling and analytical methods used by private sector industrial hygienists. NIOSH publications are widely distributed and serve as an important source of reference on occupational hazards and controls. Today, most newly graduated occupational health and safety professionals in the United States are educated in programs that receive funding from NIOSH, and many come from the programs at the institutions that have been designated as Educational Resource Centers.

SUMMARY

An OTA comparison of the standards and recommendations from OSHA, NIOSH, and ACGIH reveals that OSHA has tended to lag behind the recommendations of both NIOSH and ACGIH. OSHA's startup standards included nearly 400 Threshold Limit Values published by ACGIH in 1968. ACGIH has increased the number of substances on its list to over 600 and has revised the TLVs for many substances from the 1968 list. Since 1971, NIOSH has formally transmitted rec-

ommendations concerning over 160 different substances, classes of substances, or hazardous working conditions to OSHA, After adopting the initial group of startup standards, OSHA has issued new or revised Permissible Exposure Limits and other requirements for 10 substances, and work practice, monitoring, and personal protection requirements for 14 other substances and one physical agent. A detailed numerical comparison for a group of 123 substances shows that, overall, OSHA standards are less stringent than NIOSH and ACGIH recommendations.

The impacts of OSHA and NIOSH are hard to evaluate. Accurate estimation of the costs of OSHA regulation is difficult for a number of reasons. The most comprehensive cost estimates derive from a survey conducted by McGraw-Hill. According to this survey, the share of capital spending devoted to employee health and safety has changed little in the last 5 years, remaining at a percentage substantially below the levels of the 1970s.

Assessing OSHA's impacts on injury rates and exposure levels is also difficult. The research on OSHA effects on injury rates divides into two groups—studies that find a statistically significant, but small effect, and those that do not find any significant effects. The limited research on exposure levels appears to show positive effects for hazards that were the subjects of new or revised OSHA regulations during the 1970s—vinyl chloride, asbestos, cotton dust, and lead.

Because NIOSH's major activity is research, its impacts are even more difficult to quantify. The quality of NIOSH research has been criticized although NIOSH has recently taken steps for improvement. A number of other aspects of its operations have been criticized as well. However, many occupational health and safety professionals have graduated from NIOSH-sponsored training programs. NIOSH has also been an important source for the dissemination of information in this field.

One final impact of both OSHA and NIOSH is that their presence has served to increase the attention given to occupational health and safety* by workers, employers, and health and safety professionals. This increased attention facilitates the identification of hazards and the development of controls. Thus, indirectly, OSHA and NIOSH activities have spurred improvements in worker health and safety, although these effects probably cannot be quantified.