Protecting Workers' Hearing: An Economic Test for OSHA Initiatives

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THE CRESCENDO of criticism directed toward U.S. health, safety, and environmental regulators has given new impetus to the economist's tool of benefit-cost analysis as a means of improving agency performance. Since 1974, all executive-branch agencies have been required, by presidential executive order, to estimate the benefits and costs of their major regulatory proposals. Pending legislation would codify this requirement and extend it to the independent agencies. In its present and prospective forms, however, the requirement is not subject to judicial review, and thus leaves a considerable amount of room for agency discretion.

On the other hand, a few enabling statutes actually require agencies to analyze benefits and costs and to give the results some weight in their decisions. For example, the Supreme Court, in *Industrial Union Department, AFL-CIO* v. *American Petroleum Institute et al.*, recently concluded that the Occupational Safety and Health Administration (OSHA) must establish that its proposed standards for carcinogens would generate substantial benefits. Whether OSHA must also demonstrate that such benefits would be reasonably related to costs—as held by the Fifth Circuit Court of Appeals—is a question on which the Supreme Court did not rule.

Throughout the debate on the utility of benefit-cost analysis, there has been wide-

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spread skepticism over whether the technique is generally applicable and whether imposing such a requirement as a matter of law would not result in excessive and unproductive litigation. In partial answer to these concerns, we describe here a relatively narrow regulatory issue, but one where judicial interpretations have moved in the direction of requiring that the benefits and costs of a proposal be reasonably related and where benefit-cost analysis may be applied in a fairly routine way.

The issue we address is occupational noise. OSHA has determined that workers exposed to certain levels of noise on the job run a significant risk of permanent hearing impairment. The agency's present Noise Exposure Standard limits the noise level in a work place to 90 decibels (dBA) over an eight-hour day, or higher levels for shorter periods.* When the standard is exceeded, employers are required to adopt administrative or engineering controls to reduce the noise. This usually involves the close monitoring of sound levels and the redesign or alteration of equipment (for example, by placing machines further apart and by constructing sound-reducing enclosures around an entire machine or its especially noisy components).

According to OSHA, it is only when those kinds of controls are not "feasible" that the alternative of personal protection equipment —earplugs or earmuffs—may be considered. Moreover, such controls must be employed to the extent "feasible," even if they cannot reduce noise enough to meet OSHA's noise standard (in which case personal protection equipment must also be worn). Thus, the question of "feasibility" has great importance with respect to both the costs of complying with OSHA's standard and the benefits derived.

Neither OSHA nor the courts interpret the term "feasible" in the strictest sense of being possible at less than infinite cost. OSHA's interpretation concedes that administrative and engineering controls are not feasible if their costs would result in shutting down an industry or a substantial part of it, with a consequent loss of jobs. The courts, however, have increasingly gone beyond this, finding "feasible" to mean that the benefits that would result from an OSHA standard must be "reasonably" related to the costs. Consequently, there has emerged a two-part test of feasibility—technical feasibility (would the controls in fact reduce the noise?) and economic feasibility (would the benefits associated with the controls be reasonably related to the costs?).

Our purpose here is to show how the benefits and costs of an OSHA noise-abatement program can be analyzed, and how such economic analysis can provide an appropriate framework for judging the question of economic feasibility. In order to illuminate the development of the economic feasibility test and to give the reader some sense of the institutional setting in which disputes on these issues are resolved, we first review the pivotal legal decisions that have shaped the benefit-cost relationship of OSHA's initiatives for reducing industrial noise. Then we undertake a benefit-cost analysis of OSHA's proposal for reducing noise in a particular General Motors (GM) plant. While this case is not necessarily representative of all of OSHA's initiatives in this field, it illustrates the importance for all concerned—employers, employees, regulators, and the public—of sorting through the ramifications of a proposed regulatory scheme with utmost care.

The Case Law on Occupational Noise

If an OSHA official cites a firm for violating one of the agency's standards, the firm has the right to demand that the agency explain what measures could be taken to correct the problem. The firm may then either acquiesce in OSHA's plan (or an OSHA-approved substitute), or challenge the plan before the tribunal established to hear such complaints—the Occupational Safety and Health Review Commission. If either party (OSHA or the firm) is displeased with the commission's decision, it may appeal to the federal courts. Thus, decisions by the Review Commission and the courts form the case law on occupational noise.

Review Commission Decisions. The first relevant case to come before the Occupational

* 29 CFR 1910. The standard limits the average sound level to 90 dBA for eight hours, 92 dBA for six hours, 95 dBA for four hours, 97 dBA for three hours, 100 dBA for two hours, 102 dBA for 1.5 hours, 105 dBA for 1.0 hours, 110 dBA for 0.5 hours, and 115 dBA for 0.25 hours or less.

Safety and Health Review Commission was *Love Box Company* (April 7, 1975). Here the commission concluded that OSHA's proposal to force a manufacturer of corrugated boxes to employ administrative controls was infeasible because it would have adverse effects on productivity. The commission stopped short of trying to quantify the benefits and costs of OSHA's proposed remedy, but it did find that they were relevant to the feasibility of that remedy.

Almost a year later, in *Reynolds Metals Co.* (February 25, 1976), the Review Commission rejected as infeasible OSHA's recommendation for a Reynolds Metals plant producing tin cans. Principally at issue was the agency's lack of knowledge concerning the ramifications of its proposed remedy. The commission held that for a plan to be deemed feasible, OSHA must demonstrate that the remedy would in fact be effective in reducing the level of noise. The commission also noted testimony by Reynolds' operations manager that some of the proposed noise-suppressing techniques might reduce productivity and perhaps cause other problems such as a build-up of fumes. This suggests the commission's concern with both benefits and costs.

Of all the decisions on industrial noise handed down by the Review Commission, the most important to date has been *Continental Can* (August 24, 1976). The principal facts in the case were as follows. For a development cost of $1.23 million, an installation cost of some $32 million, and an annual maintenance cost of $175,000, the company could have designed, installed, and maintained enclosures that generally would have reduced the level of noise to 90 dBA. This was OSHA's proposal. Continental responded that it already had in place a hearing protection program that cost only $100,000 a year and was generally viewed as effective. The Review Commission ruled in Continental Can's favor. It concluded that OSHA's noise standard, under which the proceeding had been brought, "only requires the implementation of those engineering controls which are economically, as well as technically feasible." It further stated: "In determining whether controls are economically feasible, all the relevant cost and benefit factors must be weighed." Observing that "[c]learly employers have finite resources available for use to abate health hazards," the commission went on to note that these resources should be allocated to the highest priorities first—namely, hazards that are life-threatening.

Thus, in *Continental Can* the Review Commission established the relevance of benefit-cost analysis to judgments concerning the lawfulness of OSHA's compliance measures. Moreover, it enumerated the types of benefits and costs to be considered. But it was not able to provide a precise estimate of the costs per employee affected.

However, using data from the commission's decision for three of Continental Can's twenty-nine plants, we can provide a rough figure. In those three plants, OSHA's plan would have achieved the noise standard for about 125 employees. The estimated one-time costs of developing and installing the engineering controls were $132,000 and $362,000 respectively, the annual maintenance costs were $2,500, and the annual savings from eliminating the existing program of personal protection were $650. Subtracting savings of $650 from annual maintenance costs of $2,500 yields *net* annual operating costs of $1,850. Dividing total development and installation costs of $494,000 by 10 (for a 10 percent discount rate) yields an annual equivalent of $49,400. Adding to that figure net operating costs of $1,850 and dividing by 125 workers yields an estimated cost of $410 per employee per year. In other words,

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Thus, in just a year and a half, the Review Commission's concern for the efficacy and possible adverse effects of an OSHA proposal (*Love Box*) evolved into a requirement that OSHA

give evidence that its proposed remedy would be effective and perhaps would not have significant adverse consequences (*Reynolds Metals*), which, in turn, became a requirement that OSHA demonstrate a reasonable relationship between the benefits and costs of its proposal (*Continental Can*).

Thereafter, following the guidelines laid down in *Continental Can*, the Review Commission concluded in several other cases that the costs of the proposed remedy outweighed the potential benefits. For example, in *West Point Pepperell, Inc.* (April 18, 1977; upheld by the appeals court in February 1979), the commission found economically infeasible an OSHA proposal having a first-year cost of about $5.4 million (which implies an annualized cost of $540,000) and a subsequent annual cost of $2.6 million—for a total yearly cost of over $3.1 million. With only 380 employees affected, the annual cost per employee was some $8,300—a figure far higher than the $410 in the case of *Continental Can.* Similarly, in *Castle & Cook Foods* (May 19, 1977), the commission concluded that the annual costs of an OSHA-proposed remedy (ranging from $451 to $1,410 per protected worker) were excessive in comparison with the benefits. One reason for this finding, the commission said (as it had in *Continental Can*), was that resources to reduce employee safety and health hazards are limited and should first go toward solving more hazardous (life-threatening) problems.

It should be noted that in this case the commission concluded that, without the proposed engineering controls, there would be a greater risk of hearing loss. Nevertheless, it ruled that this risk was not enough to justify the estimated cost. A year later, in *Great Falls Tribune Co.* (May 19, 1977), the Review Commission found that OSHA's proposed program of engineering controls was technologically feasible, but that it would not reduce noise to the agency's standard. Consequently, employees would still be required to wear personal protection equipment (earmuffs in this case). With few benefits identified and total costs amounting to $1,250 per employee per year, the proposed program of controls was found to be economically infeasible.

However, in *Louisiana Pacific Corporation* (October 19, 1977), the Review Commission concluded that engineering controls are economically feasible where the cost per employee is modest and the noise reduction substantial. Evidence in the proceeding suggested that personal protection equipment was less effective than the proposed engineering controls, which would reduce the company's noise to meet OSHA's standard for an annual cost per employee of $300 to $500. The commission came to a very similar conclusion in *Carnation Company* (June 20, 1978), now on appeal. In that case the noise reduction was also substantial, while the annual cost per employee ranged from $200 to $1,000.

In *Samson Paper Bag* (June 13, 1980), the Review Commission unanimously remanded the dispute to the administrative law judge for a new trial based on the benefit-cost test of *Continental Can.* Even though two of the three Review Commission judges expressed dissatisfaction with certain aspects of the *Continental Can* precedent, they could not agree on a superior test of economic feasibility. As a result, both judges concurred that, for now, the *Continental Can* decision is "dispositive" on that issue.

Court Decisions. The first major noise-abatement case to be appealed from the Review Commission to the federal courts was *Turner Company* (August 31, 1977). Here the Seventh Circuit Court of Appeals, in setting aside the commission's decision, concluded that an annual cost per employee amounting to $333 was too high in comparison with the benefits that might have resulted from using engineering controls instead of personal protection equipment.

A year later, in *Continental Can* v. *Secretary of Labor, Marshall* (August 8, 1978), Continental won its appeal to the U.S. District Court for Southern Illinois to enjoin OSHA from citing any of the company's plants not specifically covered in the Review Commission's *Continental Can* decision. The district court said that *Turner* "clearly upholds the requirement of economic feasibility, on a comparison basis with personal protective alternatives. . . ." It also emphasized that the capital outlay involved in the *Turner* decision amounted to "only $30,000 in the single plant involved"—that is, $333 per employee per year. Interestingly, the court expressed a concern that an OSHA mandate for engineering controls

might actually increase employee noise exposure in Continental Can's plants, since a noise reduction to meet OSHA's standard could bring about a situation in which the far more effective personal protection equipment would not be worn.

Finally, in *RMI Company* v. *Secretary of Labor et al.* (March 13, 1979), the Sixth Circuit Court of Appeals rejected an OSHA proposal to require RMI to spend upwards of $100,000 to reduce noise exposure by means of engineering controls. (The employees affected were already wearing personal protection equipment.) Here the court treated the feasibility question as resolved, noting that a "consensus is developing among the circuits that the term [feasibility] should encompass both technological and economic feasibility" and that "[n]umerous cases have held that [OSHA] should weigh the estimated costs of compliance against the benefits reasonably expected therefrom when promulgating or enforcing a regulation." In short, the court explicitly affirmed the need to compare benefits and costs as a means of determining whether a proposed noise reduction measure was economically feasible.

A Case Study Involving a GM Plant

As we have seen, both the Review Commission and the courts have found benefit-cost analysis essential to assessing the economic feasibility of OSHA's proposals for reducing occupational noise. Moreover, the courts have recognized that health and safety resources, just as all other resources, are limited and therefore should be allocated carefully, to ensure workers insofar as possible the greatest protection from the most serious risks. In what follows, we attempt to illuminate these precedents and their broader implications, as a step toward creating a model for future OSHA noise litigation. The case in point is a GM plant that was cited by OSHA in 1978 for having noise levels exceeding OSHA's noise standard in certain areas. At issue were ten types of high-speed stamping presses used to produce automobile components.

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Analysis of Benefits. For many years, GM has maintained an extensive hearing conservation program that uses engineering and administrative controls supplemented by personal protection devices where, in the company's judgment, additional administrative and engineering controls are not feasible. From the standpoint of worker protection, how does this program compare with OSHA's proposal?

Table 1 compares the hearing protection afforded under the two plans. Taking GM's program first, the first three columns give the number of employees working in the areas cited, the ambient or measured noise levels (that is, without any protection for employees), and the level of noise actually perceived by the workers (that is, when wearing protection equipment). The figures for perceived noise in column 3 are based on the ambient noise data in column 2 and on the assumption that the personal protection equipment used in the GM program reduces noise by 26.6 dBA. (This figure is based on tests of the technical properties of the earplugs and earmuffs in use.) Thus column 3 presents our estimates of the levels of noise, around each type of equipment, that actually reach the employees' inner ears. This of course is the key figure in determining the potential for an adverse effect of noise. Under the GM program, the noise levels range from a low of 66.9 dBA for the pole piece press to a high of 80.0 dBA for the slitter press (where the operators presumably do not now wear personal protection equipment because the operation meets OSHA's standard).

Turning now to OSHA's proposal, the last three columns show how it would affect the GM workers. A glance at column 4 indicates that, in some cases, this proposal would actually increase the number of employees working in the noisy areas. This is because more workers would be needed to service the machines and to offset productivity losses if the machines were spaced out and placed in noise-suppressing enclosures (as called for in OSHA's pro-

Table 1
NOISE PROTECTION BENEFITS—
GM PROGRAM VS. OSHA RECOMMENDATION

	GM Program			OSHA Recommendation		
Type of Press	(1) Number of workers	(2) Ambient noise (dBA)	(3) Perceived noise (dBA) [a]	(4) Number of workers	(5) Ambient noise (dBA) [b]	(6) Perceived noise (dBA) [a]
Transfer	31	99.4	72.8	34	92.4	65.8
High Speed	32	98.4	71.8	34	91.4	64.8
OBT	7	94.5	67.9	7	87.5	87.5
Straight Side	22	96.4	69.8	31	89.4	89.4
Welding	26	94.0	67.4	27	87.0	87.0
Pole Piece	2	93.5	66.9	2	86.5	86.5
Slitter	8	80.0	80.0	8	80.0	80.0
Link	10	97.5	70.9	10	90.5	63.9
300 Ton	31	99.4	72.8	32	92.5	65.9
Frame	17	95.4	68.8	17	88.4	88.4
Total/Weighted Average Exposure [c]	186	97.6	72.2	202	90.6	84.6

a Assumes the use of ear protectors producing an attenuation of 26.6 dBA in areas where noise exceeds 90 dBA.
b Assumes enclosures producing a mean attenuation of 7.0 dBA.
c Weighted by the number of workers in each equipment category; decibels averaged in antilog form.

posed remedy). Column 5 is based on the assumption that spacing the equipment out and providing enclosures would reduce the ambient noise level by 7 dBA in each case. (This figure reflects both experience with enclosures of the type OSHA recommended and a computer simulation of machine spacing prepared by a GM consultant.) Column 6, which gives our estimates of the noise levels that employees would perceive under OSHA's program, is based on two assumptions: first, that if ambient noise falls below 90 dBA, workers will no longer wear earplugs or earmuffs, so that perceived noise will equal ambient noise; and second, that if ambient noise remains above 90 dBA, employees will wear the plugs or muffs, which will reduce perceived noise by the 26.6 dBA assumed above. Our estimates of the perceived noise levels under the OSHA plan range from 63.9 dBA for the link press to 89.4 dBA for the straight-side press.

The totals in Table 1 show that, whereas 186 employees are now working in the areas cited, the number would be 202 under OSHA's proposal. Moreover, while the proposal would reduce ambient noise levels by an overall average of 7 dBA, it would actually increase *perceived* noise by 12.4 dBA on average. And presumably it is perceived noise that is of key importance to these GM employees.

Table 2, derived from the data in Table 1, shows the number of employees under both programs who would experience noise levels of 60 dBA and higher (rising in 5 dBA increments). Under OSHA's recommendation, 84 employees would experience noise exceeding 80 dBA, whereas no employees would experience that much noise under GM's program. This may be important because OSHA has claimed that some permanent hearing impairment may occur even at noise levels below 90 dBA (see, for example, 39 *Federal Register* 37773, October 24, 1974). However, there are few who claim that noise levels below 80 dBA do any such harm. These findings and OSHA's expressed concern over noise that is louder than 85 dBA imply that the recommended program, rather than generating benefits for the affected employees, might actually cause them physical harm.

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Analysis of Costs. Compliance with OSHA's recommended program would require both one-time capital costs and recurring costs (wages, operating expenses, utilities, et cetera). In order to compare these two types of costs, we have chosen to convert all the estimated one-time costs to an annual basis, using an assumed interest rate of 10 percent. The results are shown in Table 3. For example, the noise reduction enclosures recommended by OSHA would cost $1.7 million to build and would have a useful life of five years. Using the appropriate amortization formula, we find that this is the equivalent of an annual cost of about $449,000. Similarly, the new press building required would cost about $4.8 million to build and

Table 2
WORKERS EXPERIENCING NOISE OF 60 dBA AND ABOVE—GM PROGRAM VS. OSHA RECOMMENDATION

Perceived noise (dBA)	Number of Workers	
	GM program	OSHA recommendation
Over 85	0	84
Over 80	0	84
Over 75	8	92
Over 70	112	92
Over 65	186	158
Over 60	186	202

Table 3
ANNUAL COSTS OF OSHA'S RECOMMENDATION

Type	Annual Costs (in thousands)
Capital Costs	
Construction of machine enclosures	$ 449
Construction of addition to plant	517
Shutdown of press area	91
Relocation of equipment	159
Subtotal	$1,216
Recurring Costs	
Direct labor	$ 168
Indirect labor	228
Added operating expense	293
Additional utilities	190
Personal protection equipment	(2)
Subtotal	$ 937
Total Costs	$2,153

would be expected to last almost twenty-nine years, which works out to an annual cost of some $517,000. As for the other one-time costs (shutdown and relocation), we have assumed they would not be depreciated, and have converted them to annual costs by multiplying them by 0.10, reflecting a 10 percent rate of discount.

These annualized capital costs, plus the recurring costs shown in the bottom half of the table, produce total compliance costs of a little over $2.1 million. If that cost is assigned to the total number of employees covered (202), the cost per employee is some $10,700 a year. Alternatively, if the cost is assigned just to those 74 employees who, under the proposal, would no longer be required to wear personal protection equipment, the cost per employee is over $29,000 a year. Both figures are, of course, much higher than the costs found economically infeasible by the Review Commision and the courts.

Benefit-Cost Comparison. It is difficult to relate the benefits of OSHA's scheme to the costs, for the simple reason that on the whole the scheme would apparently generate *costs* for workers rather than benefits. In any event, assuming our analysis is correct, adoption of OSHA's program would represent the worst kind of expenditure of the nation's resources. Spending initiatives might be categorized into four types, listed here in order of their desirability: (a) spending a given amount of resources and getting in return something that has greater value, (b) spending a given amount of resources and getting in return something that has less (though positive) value, (c) spending a given amount of resources and getting nothing in return, and (d) spending a given amount of resources and losing something in addition. The noise reduction program that OSHA has recommended for the GM plant appears to be of the last variety—it would impose compliance costs of about $2.1 million in return for more noise reaching the workers' ears.

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Concluding Remark

Our purpose here has not been to provide a simplistic formula for use in all future OSHA noise-reduction disputes. Rather, we have tried to show how economic analysis can help the Review Commission and the courts judge the economic feasibility of proposed noise-abatement programs. Such analysis can also be useful, we believe, to OSHA in carrying out its mandate—as well as to employers and employees in designing and evaluating the desirability of *voluntary* occupational safety and health programs. ■