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GOVERNMENTALLY-IMPOSED STANDARDS:
SOME NORMATIVE ASPECTS

Russell F. Settle and Burton A. Weisbrod

UNIVERSITY OF WISCONSIN - MADISON

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Russell F. Settle
University of Delaware

and

Burton A. Weisbrod
University of Wisconsin-Madison

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ABSTRACT

The central issue examined in this paper is this: Under what circumstances ought governmentally-imposed standards be favored over other policy instruments? The main points made in this paper are as follows.

First, the controversy over whether taxes are preferable to quantitative controls was resolved by demonstrating the formal equivalence of taxes and standards. It is always possible to translate a tax into a standard—or, alternatively, a standard into a tax—by equating the tax function and the penalty function of the standard.

Second, the important distinction between "performance" (or output) standards and "technical" (or input) standards is drawn. In practice, it seems that the key differences between taxes and standards are precisely the same as the differences between performance and technical standards. Our analysis suggests that the debate over taxes and standards could fruitfully be reframed in these terms—that is, performance versus technical standards—rather than in terms of prices versus quantitative controls. It is technical (or input) standards, rather than standards in general, that are objectionable on economic efficiency grounds.

Finally, performance standards may be preferable, on efficiency grounds, to information-provision programs whenever there are significant costs associated with the collection, dissemination, or processing of information. In addition, even if performance standards are inefficient policy instruments (relative to the provision of information) they may nevertheless be justified on equity grounds.

Governmentally-Imposed Standards:
Some Normative Aspects

1. INTRODUCTION

There are many areas of government activities involving the establishment of minimum standards—that is, constraints on or direct controls over behavior. Governmentally-imposed standards serve as the principal policy instrument for governmental regulation of occupational safety and health, environmental protection, consumer product safety, food and drug safety, motor vehicle safety, and building codes. Clearly, law makers perceive direct regulation and enforcement as attractive means for attacking real or apparent "market failures" in a large number of areas. Moreover, policymakers exhibit considerable skepticism over the efficacy of the commonly accepted alternatives to governmental standards, namely, the use of tax-subsidy devices and the provision of information (e.g., regarding job safety and health hazards).

In contrast to the view of policymakers, the general consensus among economists is that standards are inefficient instruments for correcting market failures. Eccnomists tend to view standards as constraints on behavior that restrict freedom of choice.[1] It has been argued, for example, that a system of corrective taxes would ". . . be superior to present safety legislation in that it would leave the firm free to choose its own best strategy to reduce injuries (thus encouraging innovation), eliminate costly inspections, and be more easily adjusted over time" (Smith 1973b, p. 168). Moreover, whenever there is an imperfect information problem,

such as ignorance of job safety or health hazards, the usual economic prescription is to provide people with additional information about their alternatives rather than to restrict individual choice through the establishment of minimum standards. The notion that "more information is better" is a fundamental theorem in economics, so the presumption among economists against restricting individual choice by prohibiting the usage of some technologically feasible uses of resources is understandable (e.g., see Oi 1973; Graff 1957; Henderson and Quandt 1971).

Thus, we have an apparent paradox. On the one hand, there is the widespread governmental use of minimum standards to restrict freedom of choice; on the other hand, there is widespread agreement among economists that such standards are usually, if not always, inefficient relative to other policy instruments.

In the present paper, we address this seeming paradox at a _normative_ level. In particular, we examine the following question: Under what circumstances, if any, are standards preferable, from either an efficiency or equity point of view, to other policy responses? Our fundamental proposition is this: Given the real world in which information on quality and price is not freely available and decision making is costly, the usual allocative efficiency case against standards is incorrect.[2] We will explore the conditions under which restriction of the choice set of individuals is desirable on efficiency grounds, and also investigate some equity arguments in favor of standards.

The next section of our study develops a taxonomy of the alternative resource-control instruments available to policymakers. Section 3 evaluates

the choice between taxes and standards, and concludes that the customary distinction between the two is rather ill-defined and not very useful; a more useful distinction is that between those policy instruments designed to affect inputs and those designed to affect outputs. Section 4 considers the choice between standards and another policy instrument, information-provision, and suggests that there are a number of reasons—grounded in economic efficiency or equity—to favor standards over the provision of information. Finally, Section 5 provides some concluding comments and suggestions for further research.

Much of the following discussion is framed within the context of occupational safety and health (hereafter referred to as OSH). This perspective is adopted for expository convenience and does not limit the generality of the analysis.

2. ALTERNATIVE POLICY INSTRUMENTS: A TAXONOMY

Once a governmental decision has been made to intervene in, for instance, private OSH decisions, and once the target quantities and types of OSH are specified, two related questions arise:

1. What policy instruments are available for dealing with the problem?

2. Which of these instruments minimize the social costs of achieving the goals of the intervention?

This section addresses the first of these two questions. The second question is considered later.

Welfare economics has identified four general types of policy instruments that may be useful in remedying market failures or in attaining

governmentally-specified resource-allocation targets such as in the job

safety and health area.[3] Broadly speaking, these instruments are (1) tax-

subsidy mechanisms, such as effluent charges; (2) direct governmental

controls or mandatory standards,[4] such as minimum-quality effluent

standards or OSH standards; (3) direct governmental provision, such

as of information, highways, and national defense; and (4) nonfinancial

encouragement of private action through, for instance, "moral suasion."

To some extent all of these instruments are presently employed in

governmental efforts to raise the level of OSH. First, state workmen's

compensation laws serve as a tax on (compensable) work-related injuries

and illnesses for firms large enough to be experience rated.[5] Presumably,

such a tax stimulates firms to increase the supply of OSH since reductions

in injuries and illnesses will--if firms are experience rated--reduce their

workmen's compensation premiums. Second, direct governmental controls--

that is, standards--have been, and are, a principal policy instrument in

the United States for collective interventions in private OSH decisions.

Third, direct governmental provision, as a policy instrument for

increasing the supply of OSH, characterizes much of the federal government's

activity involving the development and distribution of OSH-related

information--information that might otherwise not be provided in private

markets. For example, the Occupational Safety and Health Administration

(OSHA) provides safety training for employees and employers, conducts safety

management programs, and offers specialized OSH education services through

the public media (U.S. Department of Labor and U.S. Department of Health,

Education and Welfare 1972, pp. 7-8).[6] In addition, the National Institute

for Occupational Safety and Health (NIOSH) maintains a number of programs

for obtaining and disseminating technical information, employer-employee education, etc. (U.S. Department of Labor and U.S. Department of Health, Education and Welfare, p. 101.)

Finally, some of the federal government's OSH information programs might be classified as nonfinancial encouragement of private action. For instance, posters that implore workers to "be more careful" or to "watch for slippery spots" do not convey new information to workers about recently discovered hazards. They are rather a form of "moral suasion," an encouragement to private action, or a reminder to avoid hazards that are probably well known.

In many instances there is no sharp distinction between information-related activities that constitute a form of direct governmental provision and those that constitute nonfinancial encouragement of private action. To some extent, all information-related activities serve both purposes. Consequently, in the present paper we treat nonfinancial encouragement as merely a special case of direct governmental provision of information.

In short, policymakers have at their disposal three types of instruments for dealing with problems in the work safety and health area: (1) taxes and subsidies to encourage private provision; (2) standards or rules requiring private action; and (3) the provision of information about work hazards and how to avoid or remove them.

3. TAXES VERSUS STANDARDS

It is a widely-accepted proposition (among economists) that taxes and subsidies are preferable, on economic efficiency grounds, to standards or direct controls over behavior as a means for correcting market failures.

In connection with job safety and health, for example, Smith (1976)

offers the following argument:

> . . . an 'injury tax' approach to job safety would not suffer
> from the disadvantages of the standards approach. It would
> focus attention directly on the goal of greater job safety,
> but leave each employer free to select the methods of reducing
> injuries which, in his particular case, would be least-cost.
> The social waste of trying to apply uniform standards to
> every unique situation would therefore be avoided (p. 79).

Similar arguments appear in the environmental economics literature. For

example, Baumol and Oates (1971, p. 52) claim that ". . . the tax-subsidy

approach will automatically generate the cost-minimizing assignment of

'reduction quotas' without recourse to [the] involved calculation or

enforcement [associated with standards]."

In this section we clarify the meanings of, and distinctions between,

"taxes" and "standards," and suggest that the differences between these

two policy instruments are rather ill-defined and may in fact, for most

purposes, be nonexistent. In what follows, precise meanings are given

to the terms "taxes" and "standards" (or direct controls); the theoretic

equivalence between taxes and direct controls is demonstrated; and

finally some differences between taxes and standards that may arise, in

practice, are discussed.

Taxes

A corrective tax is defined as the combination of (1) a system of

governmentally-imposed financial charges designed to reduce undesirable

activities by increasing the cost of such activities to those undertaking

them (e.g., effluent charges on polluters), and (2) an enforcement

mechanism, to ensure that the charges are (for the most part) paid. These

charges can be uniform (i.e., constant) per unit of the taxed activity, or they can be nonuniform, such that the marginal tax rate changes as the tax base changes. As a special case of nonuniformity, taxes can also be discontinuous, e.g., taxing effluent discharge or safety hazards only over certain ranges.

The effects of a tax measure on the behavior of decision-making units depends, in part, upon the relationship between the tax and the costs of avoiding or evading it. Figure 1 illustrates the relationship among these (private) costs to a particular firm for a hypothetical tax on some form of socially undesirable activity (e.g., OSH hazards in the form of asbestos dust concentrations in factory air). The marginal tax curve indicates the tax charge to the firm per unit of the hazard. The marginal abatement cost curve defines the costs of avoiding tax payments by abating the hazard. Finally, the marginal expected fine (MEF) curve indicates the expected costs (fines) that would be occasioned by attempts to evade the tax; these are "expected costs" in that they have already taken into account the probabilities of detection, prosecution, etc.[7] For a given level of enforcement and a given schedule of fines, we can take the expected fine for tax evasion to be a function of (1) the magnitude of the attempted evasion, (2) the number of previous tax law violations, and (3) the level of the hazard per unit of time--the greater the level, the more serious the violation. However, for simplicity (and without loss of generality) we assume that for a given level of enforcement the expected fine depends only upon the level of the hazard.

Prior to the imposition of the tax, the level of the hazard (dust concentration) in a representative firm is d_0. Once the tax is levied,
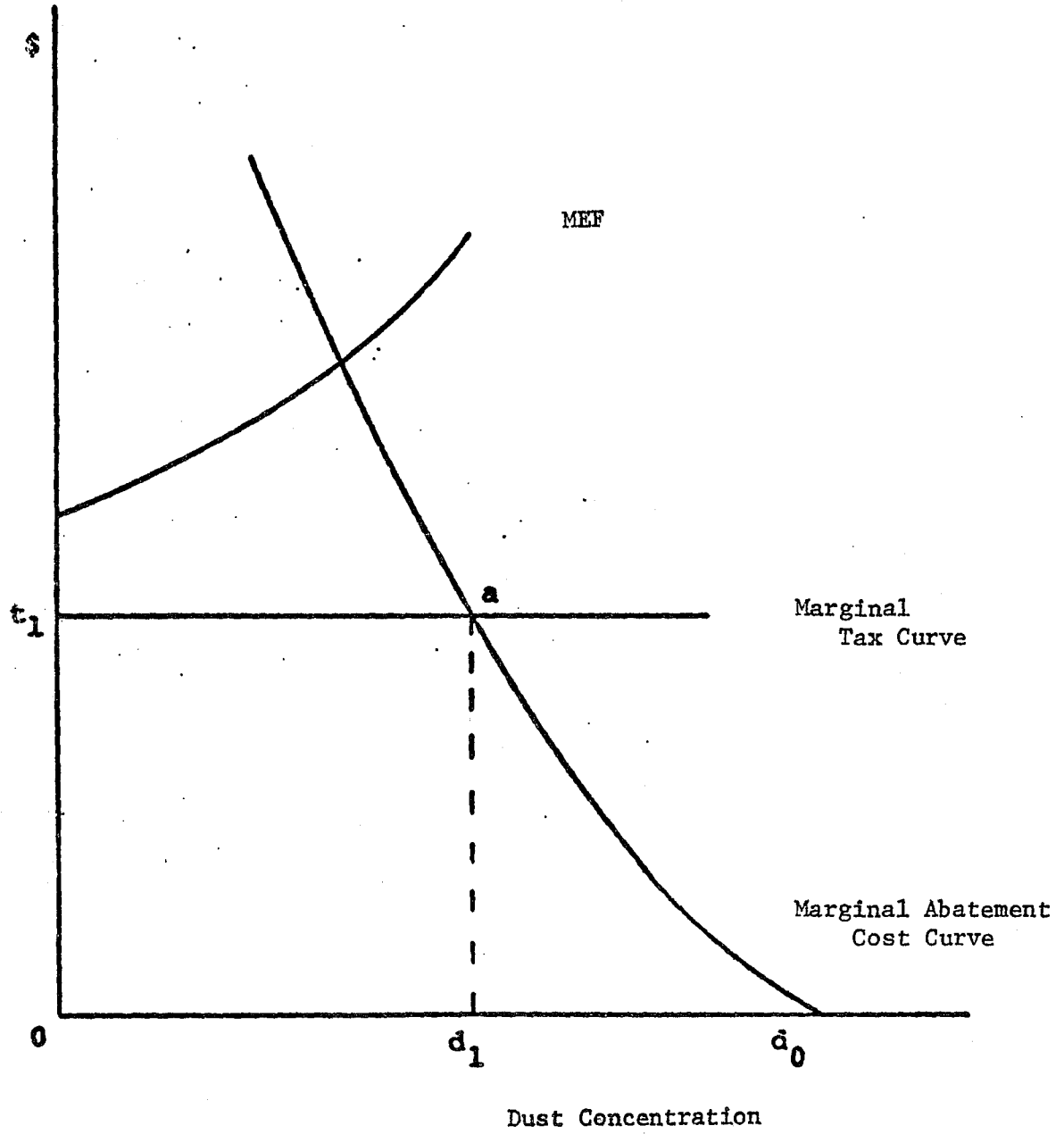
Figure 1. Relationship between the costs of paying, avoiding, or evading an asbestos dust tax.

however, the firm will find it profitable to abate $(d_0 - d_1)$ units of

the hazard, leaving a level of d_1 on which a tax of Ot_1ad_1 is paid.

In this instance, the firm will not attempt to evade the tax because of

the relatively high expected penalty for doing so. Of course, the marginal

fine curve could be positioned such that some tax evasion would be

profitable. In fact, enforcement could be so irregular and infrequent

or the actual fines could be so small that the tax law would offer little,

if any, financial incentive to reduce the hazard. In any event, the

positioning of these curves is arbitrary and not crucial to the analysis.

Standards

A standard or direct control may be defined as the combination of

(1) a rule or regulation regarding "desired" behavior (e.g., no firm is

to expose its workers to asbestos dust concentrations exceeding five

fibers per cubic centimeter of air), and (2) an enforcement system.

As with taxes, it is clear that standards can take a variety of

forms. In the case of pollution, standards might require all firms to

abate a particular effluent by equiproportional amounts (e.g., 50 percent),

equal absolute amounts, or nonuniform amounts; or, rather than establishing

controls for the types and quantities of effluents (outputs) a firm may

discharge, standards could be promulgated for the types and quantities of

abatement equipment (inputs) that firms must install and use. (The various

forms that direct controls--and taxes--can take, are discussed in more

detail below.)

The response by optimizing economic units--e.g., firms or individuals--

to a standard depends, in part, on the relationship between the costs of

complying with the standard or regulation, and the expected costs associated
with violating it.[8] Figure 2 illustrates these relationships for an
asbestos standard. The marginal abatement cost curve defines the cost of
complying with the regulation: A standard restricting the hazard to a
level of d_1 would, if complied with, cost the firm an amount equal to
ad_0d_1. The expected costs associated with violating the standard are
indicated by the MEF curve.

The expected fines for violations in the present instance (indicated
by the solid MEF curve) are high enough relative to marginal abatement
costs to provide for full compliance with the control or standard.
However, if less vigorous enforcement placed the expected penalty curve
at MEF', for example, the regulation would not command full compliance;
in this instance, only $(d_0 - d_2)$ would be abated rather than the desired
$(d_0 - d_1)$.

Equivalence Between Taxes and Direct Controls

It is now easily demonstrated that under the present assumptions—
including (1) that optimizing economic agents respond only to the financial
incentives (that are known with certainty) provided by taxes or standards,
and (2) that taxes or standards change in similar fashions (e.g., become
stricter over time in response to violations)—corrective taxes can be
translated into standards and standards into corrective taxes. In other
words, at the present level of abstraction there is no logical necessity
to distinguish between taxes and standards: Other things equal, they can
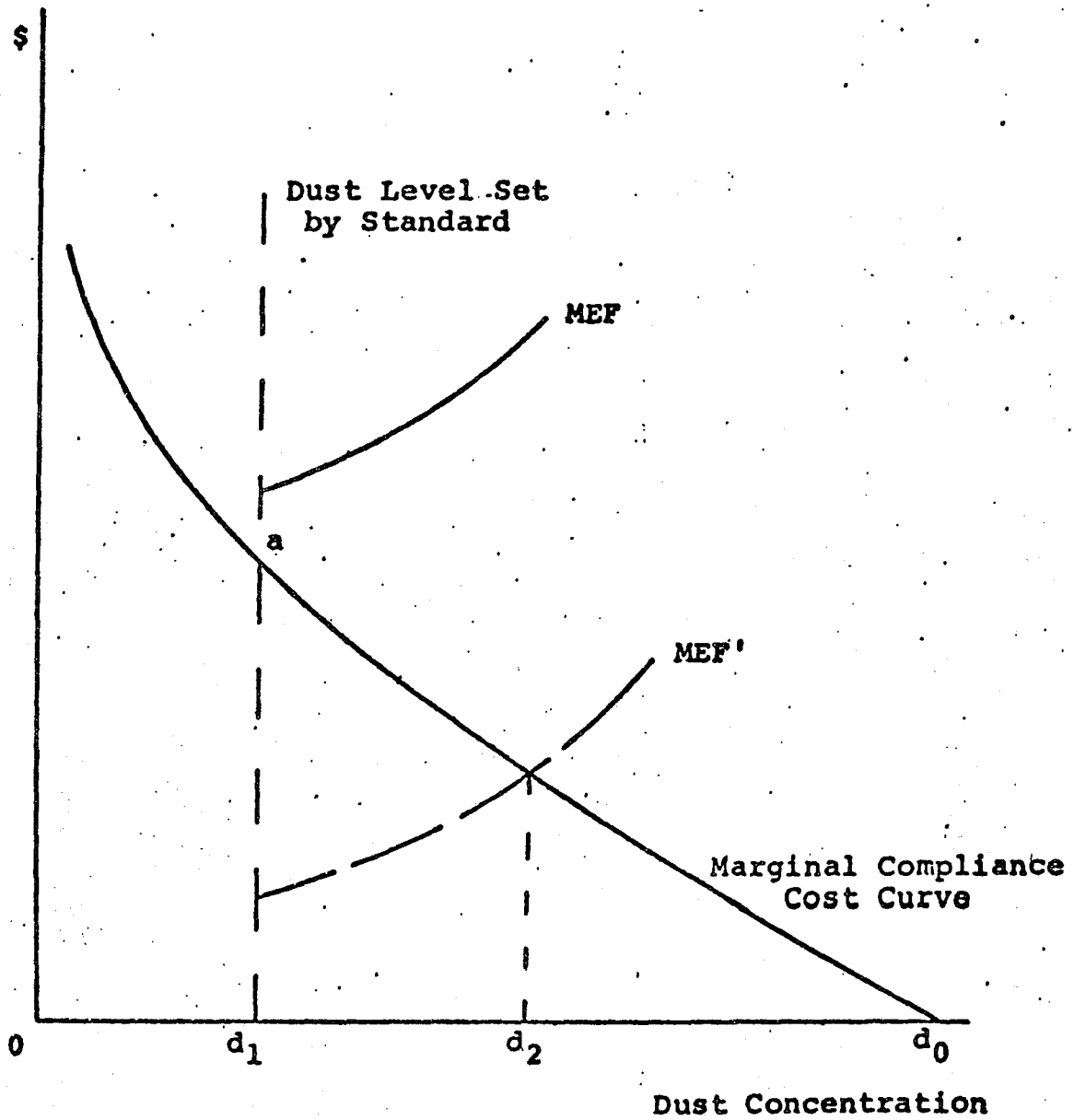be made fully equivalent both in their effects on the behavior of individual

Figure 2. Relationship between the costs of complying with and the costs of violating an asbestos standard.

decision making units and in the quantity of enforcement resources they consume for a given level of enforcement.

Translation of a tax into a direct control. Assume that the expected penalties are high enough to discourage tax evasion, i.e., that there is "100 percent enforcement." (An alternative interpretation of the 100 percent enforcement concept is that no violators go unpunished.) Thus, the firm's response to the tax can be determined by examining the relationship between the tax function and the abatement cost function. For illustrative purposes, we again employ the asbestos dust example. In demonstrating the translation of a tax into a direct control, we first indicate the form taken by the standard and then show that a tax can be defined so that it provides firms with the same financial incentives as the direct regulation.

The financial incentives to obey a standard are provided by the expected fine, F_s, which is assumed to be a function of the level of the dust concentration, D (and the level of enforcement, which is taken as given). Thus, the expected-fine function can be written as

$$(1) \quad F_s = 0, \text{ for } D \leq D_{max}$$

$$F_s = F_s(D), \frac{\partial F_s}{\partial D} \geq 0, \text{ for } D > D_{max},$$

where D_{max} is the allowable level of asbestos dust (e.g., five fibers per c.c. of air).

A tax instrument, t, that will produce responses by firms equivalent to those generated by the standard is clearly

(2) $\quad t = 0$, for $D \leq D_{max}$

$\quad t = F_s(D)$, $\dfrac{\partial F_s}{\partial D} \geq 0$, for $D > D_{max}$.

Thus, to translate a tax into a standard—given the present assumptions—we only need to equate the tax function to the standard's expected penalty function. A standard can be violated, but at a cost, and that cost amounts to a tax.

Translation of a standard into a tax. Corrective taxes are commonly taken as taxing all levels of a "social bad"—in this instance the asbestos dust concentration. Thus, a corrective tax on asbestos can formally be stated as

(3) $\quad t = t(D)$, $\dfrac{\partial t}{\partial D} \geq 0$, for all $D \geq 0$.

To construct a system of standard that would generate responses from firms identical to those produced by the tax function in (3), it is necessary to (a) set the ceiling on the hazard at zero, and then (b) define an expected fine function, $F_s(D)$, such that the expected fine, F_s, under a zero hazard regulation is

$\quad F_s = F_s(D) = t(D)$, $\dfrac{\partial F_s}{\partial D} = \dfrac{\partial t}{\partial D}$, for any given $D \geq 0$.

Thus, it is clearly possible to translate a standard into a tax through appropriate adjustments in the statement of desired behavior and in the expected penalty function. Assuming, again, that the instruments have identical enforcement-cost functions, it follows that the tax and the standard in this example are fully equivalent.[9]

This equivalence between taxes and standards casts serious doubt upon Smith's contention (1976, p. 83) that ". . . characteristics of occupational illness rule out the use of the 'tax' approach in a government occupational health program. Taxes require a definitive taxable event, and in most cases the onset of occupational disease is not even noticed." However, just as taxes require a "taxable event," standards also require a "base," and if a base can be employed in the imposition of standards it can likewise be employed in the imposition of taxes. Smith (p. 83) notes that health hazards such as dust or noise levels could, in principle, be taxed, but ". . . to enforce these taxes would require a monumental inspection and monitoring program, whose administrative costs would almost surely offset the advantages the method could offer." If so, then it surely follows that such costs would also offset any advantage standards could offer in similar situations.

It should also be noted that in order for a tax to achieve the same result as a standard, a different tax function would be required, in general, for each agent (individual or firm). "Thus, a fixed standard applied to all agents implies a discriminatory structure of taxes . . . and, conversely, a fixed tax results in different standards for each agent."[10] A fixed standard, however, is not likely to be allocatively efficient given the variation in individual preferences and firm cost functions.

In principle, there is no advantage to distinguishing between taxes and standards. They are identical policy instruments, at least at a certain level of abstraction. But herein lies a paradox; if taxes and standards are, or can be made, identical why is there so much literature

arguing the advantages of taxes over controls? One answer may be simply

that this equivalence is not widely recognized, suggesting that much of

the debate over taxes and standards may have been misdirected. Alternatively,

it may be that, in practice, standards and taxes are employed in systematically

different ways by policymakers. We discuss two such possible systematic

differences below.

Standards as Constraints and Taxes as Penalties

One implicit distinction the literature makes between taxes and

direct regulation is that standards constrain "undesirable" behavior

whereas taxes merely put a price on it. That is, standards seem to be

viewed (at least in those arguments abstracting from enforcement problems)

as essentially inviolable constraints on behavior;[11] taxes, on the other

hand, are seen as governmentally-imposed "prices" or "charges" that make

certain behavior more costly (to those undertaking it) but do not

necessarily prevent it.[12]

This particular distinction is clearly made, for example, by Freeman,

Haveman, and Kneese (1973) in their discussion of alternative approaches

to attaining a given level of water quality.

> One [approach] is for the authority to impose and
> enforce discharge regulations, in which each firm is
> forced to reduce its waste load by [a given amount] per
> day (emphasis added).
>
> Another way would be for the authority to force each
> firm again through discharge regulation, to reduce its waste
> loads by [equi-proportional amounts] (emphasis added).
>
> Finally, it would be possible for the authority to set
> a charge on the use of the stream for waste disposal. This
> effluent charge would have to be paid on every pound of
> waste deposited in the river by a polluter (emphasis added)
> [pp. 112-113].

Standards are used to "force" individuals into certain behavioral modes, whereas taxes are employed to increase the price of particular activities.

This same distinction--that is, treating standards as inviolable constraints and taxes as merely a pricing mechanism--has been made in the literature examining the impact of uncertainty and imperfect information on the choice of control instruments (for instance, see Weitzman 1974; Adar and Griffin 1976; Yohe 1976). The fundamental issue addressed in this particular literature is the following: If a regulatory agency is to some extent uncertain about either the benefits or the costs of its actions (intended, say, to control pollution), should it rely upon taxes (prices) or standards (quantitative restrictions) in seeking to achieve an economically efficient outcome? Basically, the conclusion arrived at by those investigating this issue is that the choice between taxes and quantitative restrictions in the presence of such uncertainty depends on the shape of the imperfectly-known marginal benefit and cost functions. Such conclusions, which appear to highlight the importance of uncertainty and imperfect information, depend crucially upon the assumption that taxes merely alter the financial incentives confronting the firm or individual, whereas standards or quantitative restrictions represent a binding constraint to the firm or individual.

It is clear, of course, that any given quantitative control may simultaneously constrain the activities of some individuals and increase the price of those activities to others--individuals who place a relatively high value on the activities in question. In fact, standards (or any other instrument) will surely never serve as completely binding constraints. Once it is recognized that standards also commonly rely upon financial

incentives (namely, financial penalties) to alter behavior and that they
do not constitute inviolable constraints, the distinction between taxes
(prices) and quantitative restrictions is blurred. Our discussion suggests
that the key distinction is not between taxes and quantitative controls
but rather between the tax function and the penalty function. Unless
there is uncertainty about the relationship between the tax function and
its equivalent expected penalty function, taxes and standards will have
identical behavioral implications.

Imposition of Taxes and Standards on Different Bases

In comparing taxes and direct controls some economists suggest
that there is a crucial distinction between these two instruments
related, not necessarily to the penalty-constraint distinction, but
to the base that is taxed or subjected to control. Smith (1973b, p. 174)
argues, for example, that a tax would ". . . be superior to present
safety [and health standards] in that it would leave the firm free to
choose its own best strategy to reduce injuries . . . ." Thus, he seems
to view standards as taxing the particular safety and health equipment
employed by firms, whereas taxes tax some other base--possibly the levels
of the occupation safety and health hazards (e.g., the concentrations of
airborne asbestos dust).

This type of distinction is equivalent to the one made by safety
and health officials between "specification (or technical) standards" and
"performance standards" (U.S. Department of Labor, various issues). The
term "performance standards" is used to refer to output standards--imposed
either on the level of a hazard (e.g., asbestos dust concentrations) or
the number of injuries and illnesses. Such regulations--if enforced--

provide firms with incentives to reduce the level of hazards or the number of injuries and illnesses, but do not affect the relative prices of alternative methods for achieving these targets--they "leave the firm free to choose its own best strategy."

"Specification standards," by contrast, may be thought of as input standards--controls that take particular work practices, abatement techniques, or equipment as their base. For instance, technical standards might require the installation and use of a certain machine or safety device, in which case they would not "leave the firm free to choose its own best strategy."

Thus, some writers (such as Smith) may be arguing in favor of performance standards over technical standards, but referring to the former as "taxes" and the latter as "standards." Thus the conventional economic efficiency argument against standards turns out, for the most part, to be an argument against technical standards rather than a blanket criticism of standards per se.

The point is this: There are, in general, many techniques with which a problem can be attacked; if a government establishes technical standards, which specify particular techniques, then individual firms do not have an incentive to search for the most efficient methods by which to achieve greater safety and reduce health hazards. This is the basis for economists' preference for performance standards over technical standards. We believe, however, that a qualification is in order; it may be easier and cheaper, from an inspection (enforcement) point of

view, for government to determine whether a particular safety device has
been installed and is in operative condition than to determine what
the ex post rate of job-caused accident or illness has been. If there
were no costs of monitoring compliance, the preference for performance
standards would be clear. Given the existence of such costs, however,
the preference is less clear.

4. INFORMATION-PROVISION VERSUS STANDARDS

As noted previously, information-provision constitutes a potential
alternative to the imposition of both types of standards and to the
levying of taxes. In this section we discuss the circumstances under
which information-provision could be an efficacious policy instrument,
and compare the efficiency and equity implications of information-provision
as an alternative to standards.

Information can be imperfect for two reasons: (1) the relevant
facts may not be known to the economic actors; or (2) the facts--even
though readily available--may not be easily interpreted and understood.
An alternative way to illustrate these two types of information imperfections
is to note that there are two forms of information costs: the cost of
obtaining the facts, and the cost of interpreting or _processing_ these
facts. Thus, we can think of information being imperfect because the
facts are too costly relative to the benefits to obtain, or because the
facts--even though available--are too costly relative to the benefits
to accurately interpret.

To determine the characteristics of the behavior that results when
either of these costs exist, we first examine a model in which there are

discovery costs but no processing costs, and then turn to a model in which there are processing costs but no discovery costs.

Discovery Costs

There are two types of OSH facts that may not be known completely: the causes of any of the various impairments that may occur, and the probabilities of being so impaired. These facts--which may be viewed as constituting the production function for OSH--can be known (or not known) independently of one another. Thus the implications of discovery costs can be evaluated by examining two polar cases: (1) the case where probabilities of illness and accident are known but specific causes can only be determined at some cost; and (2) the case where causes are known costlessly but probabilities are not.

Implications of discovery costs: unknown causes. Workers may suffer damage from work-related injuries and from occupational illnesses. It is likely that the causes of on-the-job injuries are well known or at least relatively easy to discover. For instance, if a worker loses a finger to a saw blade, the cause of the injury is easily perceived to be the contact between the worker's finger and the blade.[13] However, the causes of many occupational illnesses and diseases are not well known or easily discoverable. For example, workers employed in the cotton processing industry have a much higher than average chance of developing lung cancer, and this danger (i.e., the probability of being damaged) has been known for some time. Yet, it was just recently discovered that the carcinogen is not the cotton particles inhaled by the millworkers as was previously thought, but the tiny wooden fibers originating from the cotton stem.[14]

If workers are fully informed as to the probabilities of suffering
damage from the hazards in a particular job and of the consequences of
such damage, they will demand—and in reasonably competitive labor markets,
receive—compensation in the form of risk premiums. Consequently, even
though the true cause of, e.g., lung cancer among cotton mill workers was
not known, the workers may nevertheless be paid for the risks they run as
long as they know that the risk is caused by working for a particular
employer or industry.[15] At first glance this might suggest that the
private market for OSH operates efficiently under these conditions;
this, however, would be a specious conclusion, as is explained below.

In the absence of knowledge as to the specific causes of damage to
workers, OSH is apt to be undersupplied, in an allocative efficiency
sense. To illustrate this contention, we refer to the cotton processing
example again. Suppose that relative to the damage caused, the removal
of the wooden fibers prior to processing is inexpensive. Obviously,
if the cotton processors had the relevant information, they would immediately
undertake stem-removal activities and, in the process, increase the supply
of OSH as a profit maximizing endeavor (since they could save on risk
premiums).[16]

It may be efficient for the processor (or workers) to finance the
discovery of this information about the carcinogen. However, the
collective-good nature of information or knowledge, combined with the
associated cost of overcoming the free rider problem, makes it difficult
for private arrangements to capture, at the margin, all of the social
benefits from the production of information. The implication is, of
course, that socially efficient investments in certain kinds of information—
including information about causes of damage to workers—will not be

undertaken privately. Thus, in the absence of collective action, information about, e.g., the true cause of cancer, may not be discovered even though the aggregate willingness-to-pay for such information exceeds the cost of providing it.

To summarize, the presence of information-discovery costs can lead to an undersupply of information about the causes of occupational injuries and diseases and about methods for dealing with or preventing them. This information shortage, in turn, can cause an undersupply (or oversupply) of occupational safety and health. Thus, an economic efficiency argument can be made for some sort of collective action in the area of OSH information.

This collective action could be undertaken by an ad hoc group of workers[17] or producers affected by the problem of work hazards, or by some previously existing organization, such as a trade association or union. Transactions costs may be so high, however, as to make such voluntary collective action inefficient also, suggesting that under certain circumstances government support or provision of R & D in the area of OSH may be necessary to achieve economic efficiency.

Such imperfect knowledge can, therefore, offer an efficiency justification for governmental financing or provision of information.[18] However, it would seem to offer little justification for direct governmental controls over OSH hazards. Under the present assumptions—especially regarding the costless processing of information—direct governmental controls over OSH are justified (on efficiency grounds) only if the costs of direct intervention are less than the real costs of distributing the relevant information to firms (or to employees, if they are the

least-cost avoiders). Since direct intervention by governments also occasions information-distribution costs (e.g., to inform firms of the OSH standards by which they will have to abide) the presumption seems to be that information provision would be the more efficient strategy.[19] We should be careful to note, however, that the presence of information-discovery costs is not a sufficient condition for collective action on efficiency grounds: Sufficiency requires that the benefits of the action exceed the costs.

Implications of discovery costs: unknown probabilities. In the case just examined, it was assumed that (1) the causes of damage were not known but could be determined at some cost, (2) the probabilities of being injured or becoming ill from occupational causes were known, and (3) information-processing costs were zero. Still retaining the assumption about zero information-processing costs (an assumption that will be dropped later), we now assume that specific causes can be costlessly determined, but that to ascertain probabilities involves costs. This model can be thought of as one in which workers know that there is some danger of, say, developing lung cancer if they work in a cotton processing firm, but they do not know--and can only find out at some cost--just how great the probabilities of developing the disease actually are.

When probabilities are unknown, individual workers (or firms) may not find it privately efficient to determine, with any accuracy, those unknown probabilities. While each worker (or firm) probably has some individual stake in apprehending what the true job hazards are, this stake may be small relative to the costs any one individual economic actor

would incur in making such a determination.[20] Thus, due to the
collective-good nature of this type of information, it does not seem
likely that private firms could profitably undertake to provide and sell
this information even though it would be "socially desirable" in the
sense that aggregate willingness-to-pay for additional information exceeds
the cost of providing it.

The cost of determining the true probabilities and severity of damage
may thus prevent workers from incorporating efficient levels of information
about job hazards into their job choice decision. Such decisions, made
in ignorance of certain crucial facts, will generally result in an
allocation of resources that is inefficient relative to the allocation
that would obtain were all the facts known. It is not clear, however,
whether the inefficiency will be manifested as an oversupply or an
undersupply of occupational safety and health--and as an oversupply or
undersupply of labor to hazardous industries or employers. Decisions
based essentially on guesses as to the probability and severity of
impairment in a particular job or with a particular employer could produce
excessive risk premium demands (and an oversupply of OSH) in certain
industries, and inadequate demands with an attendant undersupply of OSH
in other industries.

One element that does appear to produce a definite bias toward
undersupply of OSH is the incentive firms have to maximize profits. Firms
could conceivably profit from efforts designed to convince employees that
work hazards were less severe than they in fact were. Thus, to save on
risk premiums, firms might propagandize skeptical workers, refuse workers
or the public access to the firm's medical and accident records, and slant

their hiring practices toward workers prone to underestimate the true risks. Such obscurantist practices by firms may be particularly successful in the absence of some countervailing force (e.g., from a union, which could keep its own medical and accident records).

As in the case where the causes of impairment could be determined only at some cost, it appears that an economic efficiency argument for government action with respect to OSH can be made when the probabilities of impairment--information with collective-good characteristics--are costly to determine. This collective action could be undertaken by voluntary groups of workers (or firms), but transactions costs can make such undertakings privately inefficient. Because a large number of workers (or firms) would be needed to finance such R & D undertakings, the free rider problem may be insurmountable without strong unions or legal sanctions. In addition, the inevitable antagonistic attitude on the part of the firms would make voluntary action by workers even more difficult.

It may be efficient, therefore, for the government to support the research necessary to discover unknown probabilities. Suppose that governments can collect this information at small cost relative to its social value. What should governments do with such information once it is collected? It could distribute it to workers (or firms), who would presumably use it to make better-informed judgments regarding OSH. As an alternative, governments could use this information as the basis for direct intervention. The particular approach taken should, according to an efficiency criterion, depend on the relative costs of undertaking the alternatives, granted that they are equally effective.

So far, we have identified two instances where government action
may be needed to remedy a failure in the private market's provision
of OSH. These market failures arose because of the combined effects
of positive discovery costs, and the collective-goods aspects of
information. It was assumed throughout the analysis that once the
information became available it could be costlessly interpreted by all
affected parties. But government's role in enhancing efficiency may
or may not be limited to financing or undertaking directly the discovery
and distribution of certain occupational safety and health facts. Depending
upon the costs of direct intervention (e.g., with OSH standards) relative
to the costs of distributing the information to workers,[21] it could
be efficient for the government to intervene directly in the private
market's provision of OSH.

Processing Costs

Insufficient information about the OSH hazards involved in particular
jobs is not the only basis on which governmental intervention might be
justified. The concept of information-processing costs is developed here
and its implication for economic efficiency is examined. When information,
once obtained, is costly to interpret and understand, an unregulated
labor market is not likely to produce efficient quantities and types
of OSH. This seems to be particularly the case when decision-making units
must contend with the combined effects of positive processing and discovery
costs.

The traditional competitive economic model assumes not only that
workers have correct information about (1) the work hazards in different

industries, (2) the probabilities of impairment associated with each

hazard, (3) the possible impairments the hazards might cause, and (4) the

losses impairment would impose through reduced earnings, increased medical

expense, and the concomitant pain and suffering; but also assumes implicitly

that workers (on the margin) <u>understand</u> all of this information and act

upon it in a rational manner.[22]

The problems associated with simply obtaining this information would,

in many instances, deter all but the most diligent and risk-averse

individuals from expending much effort at gathering this data. Suppose,

however, that this problem is obviated by a government information program

that provides workers (or firms) with facts regarding hazards, probabilities

of various sorts of impairment, earnings profiles, rehabilitation costs,

etc. Is it plausible to assume that workers would, or even could, process

(i.e., come to understand) this information and then translate it into

the various minimum risk premiums they should demand in return for working

at any of the various jobs under consideration?

Decision making or the processing of information is costly. By

"decision making" or "processing of information" we mean the method by

which one chooses among alternative courses of action after all of the

relevant information has been acquired. The processing of facts--that is,

coming to understand their meaning, implications, and relationships--can

be costly inasmuch as it consumes time, requires mental effort, leads

to boredom or frustration, or creates anxieties, fears, or worries about

having made a "wrong" decision. Consequently, workers, suffering as we all

do from limitations on their time, intellect, and interests, may generally

fail to make the "correct" translation (in an efficiency sense) from
the facts about job hazards, etc., to the risk-premium wage demand.

Small probabilities of large events. One reason workers may fail
to correctly process information about work hazards is that it is very
difficult for many or perhaps most people to cope with tiny probabilities.
Moreover, this difficulty is no doubt compounded when those small probabilities
attach to important, infrequently experienced events such as bodily injury
or death.

Schelling's discussion (1968) of this difficulty seems especially
relevant and is quoted below. While he was concerned exclusively with
the problem of valuing reductions in mortality rates, many of his comments
are equally applicable to injury and morbidity rates and, thus, to OSH
hazards in general.[23]

> A difficulty about death, especially a minor risk of death,
> is that people have to deal with a minute probability of an
> awesome event, and may be poor at finding a way--by intellect,
> imagination, or analogy--to explore what the saving (from a
> reduction in that risk) is worth to them.
>
> . . . What it would be like to grow old without a companion, to
> rear a family without a mother or father in the house, to endure
> bereavement, is something that most of us have no direct knowledge
> of; and those who have some knowledge may not yet know the full
> effects over time. Many of us think about it only when we make
> a will or buy life insurance, suffer a medical false alarm or
> witness the bereavement of a friend or neighbor (pp. 144-145).

When choosing among jobs with different work hazards and different
probabilities of impairment, workers may find that the costs, in terms of
time and psychological stress and strain, associated with making a correct
judgment about expected losses and appropriate risk-premium demands more
than offset the expected benefits from making the "right" decisions. This
fact can encourage workers to make hasty, uninformed decisions that are
apt to be incorrect.

Unfortunately, there has been relatively little empirical research on the payment of risk premiums for occupational hazards, and, thus, on whether workers have historically made correct judgments about such things.

Gordon (1973) tested the hypothesis that hazardous employments give rise to risk premiums, using data on wages and employee accident rates for United States class-I railroads for the years 1926, 1939, and 1966. He concludes that his ". . . results seem to provide some support for the existence of positive wage differentials arising from accidents, especially fatalities. The size of the differentials remains a question of which only scanty evidence is available however" (p. 74). Gordon's results seem fairly mixed, and they are certainly consistent with the hypothesis that no risk premiums are paid. His fatality rate variable, for example, generated negative coefficients (suggesting that, ceteris paribus, increased risk reduces the wage rate) in 3 out of 13 different regressions, and in no instance were coefficients on the fatality rate variable significant at generally accepted levels (the highest t-value being 1.4, the lowest positive one being 0.185).

Smith (1973a) tested the same hypothesis with data on 3183 white males from the Current Population Survey. His claim is that "the results indicate that the probability of death may be fully reflected in wage rates, but the evidence of compensating differentials related to nonfatal injuries is scant" (p. 10). His results, however, seem somewhat unbelievable: "The coefficient on the risk of death suggests that an increase in expected deaths of one per million man-hours will roughly double wages . . ." (p. 10). This result implies that a risk-neutral person earning $10,000 a year values his life at about $5,000,000.[24] If individuals, on average, do value their lives so highly, we should observe them taking much greater

precautions or demanding much larger risk premiums than casual empiricism

suggests they do. For example, if individuals valued their lives so highly

(and if they were aware of the risks of death in various occupations) we

ought to find risk premium differentials of $30,000 to $40,000 a year

between the more hazardous and least hazardous jobs in the economy.

Finally, Thaler and Rosen (1975) tested the risk premium hypothesis

using data on risks by occupation and industry obtained from the Society

of Actuaries, which they matched with SEO data on individuals. The risk

variable in their regressions reflected the probability of death from all

causes, not simply those that are employment related, for persons classified

by occupation and industry of employment.[25] Moreover, no variables

reflecting the risks of nonfatal injury or illness were entered into their

regressions. For the most part, their results seem inconclusive. Only

one of the eight equations tested produced a significant risk-coefficient.

It is interesting to note, however, that their point estimates of the

impact of risk (of death) on wages imply that workers, on average, value

their lives at about $200,000 in 1967 prices.

In short, the empirical research that has been done on the risk

premium question fails to confirm the hypothesis that workers are paid

for the risks they run on the job; or alternatively, it supports the

hypothesis that private markets pay suboptimal risk premiums, and thereby

rise to (potentially) suboptimal types and quantities of OSH. We should

be careful to note, however, that even if we were certain that private

markets do pay suboptimal risk premiums, we still have only indirect

evidence that decision-making or processing costs were at fault, since

the magnitude of the risk premium is presumably sensitive not only to

the costs of processing information, but also to the costs of obtaining it.

Nonrepeatable events. In addition to the difficulty workers may have coping with small probabilities of large and possibly unique losses, workers may also find it hard to understand how probability calculations apply to single, essentially nonrepeatable events like individual accidents and occupational illnesses.[26] The theory of probability assumes a fixed stochastic system in which trials are repeated indefinitely; thus, probability statements indicate population tendencies. But for any single event that may never be experienced by the same individual again, population tendencies may reveal little or nothing (see Shackle 1947; Fromm 1968). "While there may be a negligible variance to the population probabilities of death (injury, or illness), there can be substantial variance for individual probabilities" (Fromm 1968, p. 173).

The following example from Fromm may further illuminate this problem.

> . . . if expenditures are made to increase aviation safety, it may be possible with absolute certainty to reduce the number of annual fatal accidents on scheduled air carriers from five per three million flights to four, and passenger fatalities from 120 per 70 million persons carried to 100. The government can use this as a basis for evaluating the desirability of the expenditures. But no assurance can be given to any particular passenger that it is his plane or life that will be saved; consequently, he may tend to undervalue many life-saving proposals [p. 174].

Likewise, in choosing among jobs with unequal probabilities of impairment or with different work hazards, or in evaluating collective efforts to improve OSH, workers can be given no assurance that it is their life or limb that will be lost—or saved; so they may tend to ignore or depreciate risk differentials between jobs and undervalue efforts to reduce the hazards they face.[27]

To summarize, if it is granted that information is not costless
to obtain or to process, then it follows that workers and firms will
have a willingness-to-pay--a demand derived from these information-related
costs--for guidelines as to what constitutes safe work practices, health
hazards, safe and unsafe jobs, etc. Once the potential importance of
information-processing costs is recognized, it follows that it could be
that efficiency required these guidelines to take the form of direct
controls or standards. Whether information provision or standards is
the more efficient instrument when the costs of obtaining and processing
information are significant can only be determined empirically with
quantitative information on the relative magnitudes of the inefficiencies
created by each instrument. But to say that the issue is an empirical
one is to say something important--<u>rational workers or consumers may prefer
standards</u> (and the restrictions on choice that they imply) <u>to information</u>.
Individuals may be willing to give up some freedom of choice in return
for greater certainty about the implications of making various choices and
for lower costs of decision making.

Equity Considerations

In addition to economic efficiency considerations, notions of
"equity" or "fairness" play a role in directing social policy and in
determining whether standards are a desirable policy instrument. An
important function of government is to contravene the outcome of private
decisions and the free marketplace when those outcomes are perceived,
through the political process, as unfair or inequitable. For example,

the country's massive income transfer system represents an attempt
to alter a distribution of income that the political process has judged
to be inequitable. Likewise, the equal opportunity and antidiscrimination
laws, while part of the mechanism for altering the distribution of
income, also strive to alter private behavior (e.g., discrimination based
on race, sex, religion, or ethnic affiliation) deemed by the political
process to produce unfair or inequitable outcomes.

It is not unlikely that the collectivity could choose to intervene
in private decisions regarding OSH on the grounds that those decisions
lead to unfair or inequitable outcomes, particularly hurting the poor,
the uneducated, and the disadvantaged. Indeed, the development of
workmen's compensation programs in this country can be seen essentially
as a response to inequities in the common law and in employers' liability
laws for compensating victims of work-related accidents. Furthermore,
the language of the preamble to the OSH Act of 1970 suggests that the
desire to do the right or fair thing was an important cornerstone in
Congress' decision to pass this piece of legislation: "The Congress
declares it to be its purpose and policy . . . to assure so far as possible
every working man and woman in the Nation safe and healthful working
conditions. . . ."

In what follows, we suggest a number of possible reasons why private
decisions about OSH--even though they may produce efficient outcomes--may
be viewed as producing unfair or inequitable results. The list of reasons
discussed here is not necessarily an exhaustive one. In fact, it is very
difficult to say with any precision and confidence what is seen as fair and

equitable by society. Partly, this difficulty arises because notions
of fairness and equity change over time and with changing circumstances.
Several decades ago, the prevailing view—at least as accepted by the legal
institutions under the "assumption-of-risk" doctrine—held that workers
freely and willingly accepted the risks and dangers inherent in their jobs,
whereas the modern view—as expressed in the OSH Act—holds that the
government ought to act ". . . to assure safe and healthful working
conditions . . . ."

Horizontal equity considerations. On an ex ante basis all workers
in a particular occupation may face roughly the same probabilities of
suffering losses from some sort of job-related incident; however, ex post,
once the loss occurs a few workers will have suffered perhaps very large
losses, including their lives, while the other workers—those who ran
the risks and perhaps were even paid for running them—were fortunate
enough to avoid such losses.[28] Consequently, a situation that is apparently
fair on an ex ante basis, in that all workers face equal probabilities
of a loss, may be considered unfair and inequitable when a relatively
few suffer and many go unharmed.[29] Arthur Okun (1975, p. 21) argues,
for example, that workers who knowingly accept dangerous jobs must be
acting out of desperation and it is society's and the government's duty
to eliminate such choices, regardless of the social efficiency costs.

Every OSH hazard involves this ex ante-ex post distinction. Thus,
if ex post horizontal equity is an important social goal as regards OSH,
and if workers cannot, or do not, ensure against all the OSH hazards they
face, an intervention in the market's provision of OSH may well be
warranted on equity grounds. Of course, the only way complete ex post
equity could be attained would be through elimination of OSH hazards or

through complete compensation, e.g., through compulsory insurance against the full value of all losses. Neither of these approaches seem practical: Elimination of all OSH hazards is likely an impossible task—certainly a prohibitively expensive one—and complete and full compensation would provide a very strong incentive to counterfeit work injuries and illnesses, and little or no financial incentive to be cautious in hazardous situations. Realistically, therefore, about all one could hope for through government intervention would be an improvement in ex post equity, either through the provision of partial insurance coverage (e.g., of the workmen's compensation type)[30] or through a reduction in work hazards and, thus, in injuries and illnesses.

Intervention may also be necessary to achieve horizontal equity in OSH—both ex ante and ex post basis—as between union and nonunion workers. Unionized workers are probably in a stronger position, vis-à-vis nonunion workers, to bargain for improvements in OSH, or for higher risk premiums. In fact, there is some empirical evidence that, at least in very risky occupations,[31] unionism increases risk premiums paid to workers (see Thaler and Rosen 1975).[32]

Income distributional objectives. Government intervention with OSH standards may also be viewed as a means of achieving certain income distributional objectives. Selective intervention in those jobs held by the poor could serve as in-kind transfers of safety and health to the poor. Whether or not such transfers could actually increase the real income (for our purposes defined as money income minus expected financial losses from OSH hazards) of the poor depends on the extent to which

wages reflect the risks workers run, and on the fate of those workers,
if any, laid off as a result of the governmental intervention in private
arrangements. If wages do reflect fully the risks of a job, then further
improvements in job safety and health would be accompanied by reductions
in money wages, which would more than fully offset any gains (at least
to the marginal workers) in expected real income from the improvements
in working conditions. On the other hand, if wages do not fully reflect
hazards of the job, in-kind transfers of job safety and health could improve
the (expected) real income position of at least those workers not laid
off as a result of the intervention.

Layoffs would be expected to occur because the intervention would
presumably increase production costs, which when translated into higher
output prices,[33] would reduce the quantity of output demanded and, thus,
the level of production and employment in the industries covered by the
standard. Real income losses suffered by workers temporarily unemployed
or forced to take jobs that involve a less satisfactory (to the worker)
combination of pecuniary pay, job hazards, and other job attributes
would--to the extent that this occurs--mitigate, if not eliminate, whatever
distributional gains intervention in OSH could achieve. Furthermore, these
employment effects may well violate certain notions of horizontal equity
themselves in that some workers may be involuntarily unemployed, forced to
take a less preferred job, etc., because of the intervention, while other
workers, more fortunate, continue working in the now safer jobs.[34]

To summarize, possible justifications for governmental intervention
in private OSH decisions are provided by certain interpretations of the

horizontal equity principle. Private arrangements in connection with OSH may give rise to situations that are viewed by society, through the political process as fair on an ex ante basis, but unfair and inequitable on an ex post basis when only a few are harmed while most workers escape injury (cf. Tobin 1970). This type of inequity may be especially severe when the absence of well-developed insurance markets prevents workers from insuring against all, or a substantial portion, of their losses and governmental insurance is not offered. This form of inequity may warrant collective action either to improve and extend the availability of OSH insurance or to reduce OSH hazards and, thus, the frequency of job-related injuries, illnesses and deaths. Moreover, unionized workers may be in a stronger position vis-à-vis unorganized labor to obtain not only improvements in working conditions, but also risk premiums for hazardous work. To the extent that such power differentials occasion differences in working conditions as between organized and unorganized labor, horizontal equity may indicate a need for governmental intervention in the private market's provision of OSH. Finally, actions by governments to improve OSH may be justifiable as a means of redistribution through in-kind transfers of OSH.

5. CONCLUDING REMARKS

The central issue examined in this paper is this: Under what circumstances ought governmentally-imposed standards be favored over other policy instruments? The main points made in this paper are as follows.

First, the controversy over whether taxes are preferable to quantitative controls was resolved by demonstrating the formal equivalence of taxes and standards. It is always possible to translate a tax into a standard—or, alternatively, a standard into a tax—by equating the tax function and the penalty function of the standard.

Second, the important distinction between "performance" (or output) standards and "technical" (or input) standards is drawn. In practice, it seems that the key differences between taxes and standards are precisely the same as the differences between performance and technical standards. Our analysis suggests that the debate over taxes and standards could fruitfully be reframed in these terms—that is, performance versus technical standards—rather than in terms of prices versus quantitative controls. It is technical (or input) standards, rather than standards in general, that are objectionable on economic efficiency grounds.

Finally, performance standards may be preferable, on efficiency grounds, to information-provision programs whenever there are significant costs associated with the collection, dissemination, or processing of information. In addition, even if performance standards are inefficient policy instruments (relative to the provision of information) they may nevertheless be justified on equity grounds.

The analysis in this paper has a number of implications for further research. On the normative side, it would be useful to have additional empirical work done on the benefits and costs of specific governmental standards. In the area of occupational safety and health standards, for example, only two such studies have been done (Settle 1975, and Smith 1976). Research into the benefits and costs of information-provision programs

would also be desirable. The results of such studies could prove useful in developing generalizations about the circumstances under which information-provision is an efficacious and efficient policy instrument. Moreover, our essentially static analysis ignores the possibility that the normative case for OSH standards—and perhaps others—may be stronger in developed countries than in underdeveloped ones. If safety and health are normal goods, and if private markets fail to accommodate increases in demand for safety and health, increases in per capita income will increase the demand for governmental intervention as an economy develops.

Other questions remained unanswered. Casual empiricism suggests that the use of governmental standards is widespread and growing. How widespread is their use, and at what rate are they growing? At a more analytical level are the tasks of developing a positive theory of standards and of making it empirically operational. The central issue to be addressed by such a theory is "What explains the widespread use of standards, that is, of restrictions over people's choices?" Our analysis has shown that efficiency and equity considerations may justify restrictions on choice, and perhaps these considerations help explain the widespread use of standards. We would also conjecture that the popularity of the regulatory approach is partly explained by the fact that the majority of congressmen are lawyers—people trained to think in terms of rules and regulations.[35] Another potentially important explanation for the prevalence of standards is governmental paternalism—that is, the belief among policymakers that they and their experts can best decide what is in the interest of individuals. Thus, paternalism would dictate that restricting behavior

is preferable to merely disseminating information upon which people would act, or not act, as they saw fit. For instance, it is possible to interpret the federal standard (now repealed) requiring new automobiles to have seatbelt interlock devices that forced drives and front-seat passengers to "buckle up" as one such paternalistic standard.

We have offered some analysis of the paradox of economists' general condemnation of standards in favor of information and, frequently, in favor of taxes or subsidies, while public policy seems to be using standards increasingly. We believe that the costs to individuals of processing information—including price as well as quality information—is an important source of the apparent trend toward increased use of standards. More research is needed into the nature of information-processing costs, changes in those costs through time as a result of technological change and rising levels of education, and the efficiency and equity of private and governmental mechanisms for coping with such costs.

NOTES

[1]On economic efficiency grounds, similar criticisms can be levied against any sort of arrangement that is unresponsive to individuals' willingness-to-pay, e.g., commodity rationing or import quota systems that prohibited trading of ration tickets or importing rights.

[2]The alleged superiority of price signals (e.g., taxes and subsidies) over quantity signals (e.g., direct controls) has also recently been questioned, for example, by Baumol and Oates (1975), Desai (1975), Rose-Ackerman (1973), and Weitzman (1974).

[3]For other taxonomic discussions see Davis and Kamien (1970) and Smith (1976).

[4]There is equivocation in the literature regarding the usage of the term "standard." Baumol and Oates (1975), for example, use the term to refer to a goal or target that society (through its policymakers) would like to move toward. Once these standards (i.e., targets) are established, a number of instruments--including taxes or direct controls--can be employed to move society toward them.

In the present paper, we use the term "standard" synonymously with "direct controls"; that is, we view a standard as an instrument--one of several that can be used in achieving social targets. In short, the distinction between our meaning and that of Baumol and Oates is the distinction between targets and instruments.

[5]Basic premiums for workmen's compensation policies are based on the safety experience of classes of employers. For larger firms this

rate is modified by the firm's actual safety experience relative to other firms in the same insurance class.

According to the National Commission on State Workmen's Compensation Laws (1972, p. 95), "firms with fewer than 10 employees, however favorable their accident experience, are too small to be experience rated. A firm must have almost 300 employees before an accident rate 50 percent of the average [for its class] warrants a 25 percent reduction in its insurance premiums."

[6]In addition, the OSH Act established a mandatory system of recording and reporting of occupational injuries and illnesses that will provide basic information on the dimensions of OSH problems in this country. This information is presumably useful to policymakers for identifying risky industries, evaluating the effectiveness over time of OSH standards, etc. However, it is not clear that the collection and distribution of this particular information (e.g., on injury rates by industry) will serve to alter the behavior of private decision-making units. Thus, it is not apparent that this particular statistical program should be referred to as an instrument for intervention in OSH decisions.

[7]We restrict our analysis to financial penalties; that is, nonfinancial penalties such as imprisonment are left lurking in the background.

[8]It may be that the mere statement of a rule or regulation by public officials, church leaders, etc., without any enforcement mechanisms whatsoever to back it up, will change the behavior of some individuals by altering their perception of the benefits and costs of alternative acts. We abstract from this possibility.

[9]This equivalence between standards and taxes is analogous to the equivalence that occurs under certain circumstances between commodity rationing and commodity taxation (see, e.g., Houthakker and Tobin 1950-51), and also between import quotas and import tariffs (see, e.g., Bhagwati 1970).

[10]This quotation is from the comments of an anonymous reviewer of this paper.

[11]All behavioral constraints are violable--though perhaps not repeatedly since one can be imprisoned--if one is willing to pay the penalty (if caught). For analytical purposes however, it may be useful to view them as binding.

[12]Another way of stating this distinction is that standards may generally have the intent of preventing an activity whereas taxes do not--they represent a _charge_ on the activity.

[13]At a different level of causation, whether or not the accident was caused by a careless worker or by the lack of protective devices is unimportant for this analysis.

[14]There are many such examples in which the hazard was not known at the time, e.g., painting radium on watch dials, black lung disease of coal miners, asbestos-related diseases among workers.

[15]If all workers are fully informed as to the risks and expected losses from working in a particular industry or for a particular employer, they will all receive, at a minimum, their opportunity cost (as measured by what they could earn in the next-best job) plus a risk premium just equal

to the monetary value of their expected losses (both financial and psychological). Inframarginal workers will receive an economic rent. Thus, if an OSH hazard is introduced in an industry (or job) such that it endangers only inframarginal workers, the money wage rate in that industry may, or may not, increase. If the expected loss is less than (or equals) the economic rent for all endangered workers, there would be no effect on the money wage rate: Part of what was formerly an economic rent would now be labeled a "risk premium." If, on the other hand, expected losses exceeded the economic rent, those workers would no longer be inframarginal, and consequently the money wage would be forced up.

[16]If transactions are costless, it is both privately and socially efficient for the least-cost "avoider" to provide reductions in OSH hazards. In the stem-removal example, if the cotton processor is the least-cost avoider he would remove the stems either in order to reduce the risk premiums or because workers bribed him to do so. If losses to fully-informed workers occur on the margin, then the money wage will increase by the amount of the expected marginal loss; if the expected losses are inframarginal, the money wage rate is not affected--the losses merely reduce an economic rent enjoyed by the workers. In the former case, the processor would remove the stems in order to reduce the risk premium; in the latter case, workers would bribe him to do so.

[17]Within the strict confines of the present model, at the margin, workers would actually have no incentive to improve their occupational safety and health. Since they know the probabilities, they can demand the appropriate risk premiums, and, thus, will be indifferent between hazardous and nonhazardous jobs.

[18]In fact, the federal government, through the National Institute
for Occupational Safety and Health, expended about $26 million in 1972
for research into the causes of job-related injuries, illnesses, and
deaths (and related OSH activities) (see U.S. Department of Labor and
U.S. Department of Health, Education and Welfare 1972, p. 108).

[19]It is plausible, however, that direct intervention could be the
more efficient strategy in this particular model. If the information-
provision required, for example, the transmission of relatively large
amounts of data to all workers affected by a particular OSH hazard, while
direct intervention merely required the imposition of simple, easily
communicated, OSH standards to a relatively small number of firms, the
information-distribution costs of the information-provision approach could
conceivably outweigh all of the costs associated with direct intervention.

[20]The small stake that any individual worker will generally have
in determining the true nature of the job hazard is illustrated by the
following example. If a worker risks a $250,000 loss during a given year
with a probability of .003, a relatively high probability for such a large
loss, (see, for example, Gordon 1973; Thaler and Rosen 1975), the expected
annual loss is only $750--a small loss relative to the millions of dollars
that are sometimes required to determine the true nature of many occupational
health hazards.

If workers on the margin demand risk premiums (and they may demand,
in the absence of complete information about probabilities, suboptimal
or supraoptimal risk premiums) then firms will have a stake in discovering
the true probabilities, that is, to the extent that they believe that

additional information about probabilities of damage will result in risk premium reductions. While an individual firm's stake may be considerably greater than any one worker's, it may still fall far short of the costs of discovering the relevant facts.

[21]It is assumed that the costs of collecting the information would be the same under either regime; i.e., either information distribution or direct intervention.

[22]Psychological studies indicate that individuals, in fact, are relatively poor at processing information. See, for example, Miller (1956). He concludes that ". . . the span of absolute judgment and the span of immediate memory impose severe limitations on the amount of information that we are able to receive, process, and remember" (p. 95).

[23]For somewhat similar comments see also Bailey (1968), Fromm (1968), and the report of the National Commission on State Workmen's Compensation Laws, (NCSWCL 1972).

[24]This figure was computed with the following formula: (expected loss) = (actual loss, if it occurs) x (probability of loss occurring). The expected loss is assumed to equal the wage increase workers would demand. If an increase in expected deaths of one per million man-hours doubles wages and wages are initially $10,000 a year, then we can write $10,000 = (actual loss) x (.002). Therefore, the actual loss (the value of a life) according to Smith's analysis, would be $5,000,000.

[25]That is, their data include all deaths, according to occupation and industry of employment, rather than just job-related deaths. Thus,

if non-work-related death rates differ across occupations (e.g., as they

might if certain occupations required workers to pass rigid physical

exams whereas others did not), these data are conceptually incorrect for

detecting risk premiums. An alternative approach to detecting risk

premiums would involve a longitudinal study of a situation where job

risks changed over time.

[26]Even though an individual may see or hear of, say, fatal accidents

among workers in his occupation, the prospect of the accident happening

to him remains a single, essentially nonrepeatable event (in this example,

it is _strictly_ nonrepeatable).

[27]Arrow (1951) has pointed out that such reasoning as this may involve

one in a contradiction:

> . . . suppose that we find an exhaustive set of mutually
> exclusive indivisible events, each of which has a probability
> less than the critical value (at which it would no longer be
> neglected). It would be contradictory to say that all of
> them were impossible, since one must occur. This case
> actually occurs when a continuous random variable is
> considered [pp. 414-15].

Furthermore, this argument that probabilities reveal little that is useful

about single events implies that consumer behavior is not compatible with

the von Nuemann-Morgenstern axioms of consumer behavior. However, the

von Nuemann-Morgenstern theory is, as all theories are, conceivably

refutable (p. 432).

Thus, it would seem that on purely theoretical grounds, the case

for either line of reasoning is inconclusive. To paraphrase Arrow, while

it may seem hard to give a justification for not using probability statements

when the event occurs only once, the contrary position also seems difficult

to defend.

It is interesting to note that the argument that probability theory does not apply to single or perhaps a small number of events provides an alternative to the Friedman-Savage explanation of why individuals may both gamble and purchase insurance. For example, probabilities indicate that as a group, people who gamble against "the house" will lose; otherwise, the house (e.g., Las Vegas casinos) would not find it profitable to stay in business. Yet, not everyone loses: some win, some lose, and some break even. Thus, while a person realizes that, on average, the house will win from the public, that person may not be convinced that he will, in fact, be one of the losers: "Today is my lucky day."

[28] If it were possible to insure fully against all losses (both financial and nonfinancial), and if workers were completely informed of the work hazards they faced and understood the financial and psychological ramifications of the various injuries and illnesses they might suffer, then both ex ante and ex post horizontal equity could, in principle, be maintained through private insurance markets. Such full coverage would, of course, give rise to moral hazard problems. Moreover, difficulties in discriminating among various risk classes provide incentives for an equalization of premiums, which might be interpreted as a distortion in ex ante horizontal equity.

[29] Essentially the same horizontal equity argument was made prominently in the debate over the military draft.

[30] Of course, even partial coverage can be expected to create problems of moral hazard, although they are presumably less severe than those posed by full coverage of losses. Furthermore, partial coverage is a form of coinsurance that should maintain some incentives to avoid losses.

[31]Jobs in which 1 to 3 people per 1000 are killed annually are the very risky occupations, e.g., lumberman, boilermaker, structural iron worker, railroad conductor, guard, watchman, and doorkeeper. See Thaler and Rosen (1975) for more details on this point.

[32]This line of reasoning could be pushed much further. For example, one could maintain that certain notions of horizontal equity would call for governmental intervention to obtain for nonunion workers all the benefits of unionism. We are not arguing that policymakers should adopt this horizontal equity viewpoint, we are merely pointing out that this position could be adopted.

[33]Conceivably, they may not affect marginal costs, implying no short-run effect on output, prices, or employment. Also, OSH standards might be imposed across all industries and in such a fashion as to affect only the absolute price level, leaving relative prices unchanged. In practice, however, standards are promulgated one or a few at a time and generally apply only to certain industries. For an elaboration, see Safety Standards, Occupational Safety and Health Administration.

[34]This type of conclusion probably applies to all programs which, while having income-distribution objectives, are conditioned on something other than income, e.g., minimum wage laws.

[35]This point has been noted, for example, by Allen Kneese and Charles Schultze (1975):

> One reason for the congressional propensity to rely upon regulation as the solution to complex social problems is the fact that most congressmen are lawyers. In recent years from 55 to 60 percent of the members of the Senate and the House have a legal background. . . . Legal training necessarily, and quite properly, concentrates on the speci-fication of rights and duties in law or in regulations, and

on the case-by-case adjudication of individual situations
in the light of the law and the regulations. If it is in
society's interest to change social behavior, lawyers go
about the task by changing the specified rights and
duties [p. 116].

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