Compensation Alternatives for Occupational Disease and Disability

Ronald W. Hansen, Paul W. MacAvoy and Clifford W. Smith, Jr.

ABSTRACT

Occupational disease and disability compensation programs differ in four basic dimensions: (1) the standard of proof required to document a claim; (2) criteria for eligibility under the program; (3) the source of program funding; and (4) the size of the award to a successful claimant. In this paper the authors examine how changes in these four dimensions establish incentives that influence: (1) the level of administrative costs; (2) investments in safety; (3) level of disease incidence; (4) Type I errors; and (5) Type II errors. This analysis suggests it is unlikely any single program will be optimal for all occupational diseases. The political constituencies which have incentives to lobby for programs and program changes with particular characteristics are then examined.

Introduction

In a recent issue of this journal, Danzon (1987) compares alternative occupational disease compensation systems and argues for reliance on a modified form of workers' compensation as the sole remedy. Barth (1984) proposes a no-fault fund for cancer death compensation financed by a payroll tax on industry. Several authors favor reliance on the tort system but do not agree on the forms or changes in liability statutes. No consensus has been reached in designing an ideal occupational disease compensation system.

Diverse programs have evolved to compensate victims of occupationally related disability and disease. Some are private (such as employee group health insurance) while others are public (such as workers' compensation); some treat general disabilities or diseases (such as Social Security disability benefits); some are occupation specific (such as Longshoremen's and Harbor Workers' Compensation); and some are disease specific (such as the Black Lung Program). Nevertheless, the rate at which new legislation is being

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introduced suggests significant dissatisfaction with the current package of programs remains.

In this paper, the authors seek a coherent framework for assessing policy choices in structuring compensation programs. Alternate specifications change incentives with respect to practices and conditions in the workplace. Making intelligent choices requires that policymakers understand how these private incentives differ across program provisions.

Setting parameters of occupational disease compensation programs occur both in the private marketplace and in the political arena. Given that implementation of government programs is dependent on the forces in the political market, it would be difficult to defend the proposition that the decisions reached in the political arena represent maximization of a social objective function. Therefore, in order to evaluate programs in terms of their political acceptability, it is useful to consider the nature of the wealth transfers that are (or appear to be) implicit in alternative compensation programs. Hence, while the focus in the initial analysis will be on efficiency measures, the political appeal of program features is addressed subsequently, followed by brief concluding comments.

Criteria for Program Evaluation

Although existing and proposed compensation programs differ in operational details, their principal parameters can be characterized in four dimensions: (1) the standard of proof required to document a claim; (2) criteria for program eligibility; (3) the source of funding of the program; and (4) the size of the award to a successful claimant. For example, superfund programs (such as the black Lung Program in the coal industry and most proposed superfunds for asbestos claims) are open to industry employees, specify a no-fault standard of proof, are funded by an output tax on the industry (and thus are not experience-rated for the firm), and award damages fixed by class of disability. The Social Security Disability Insurance program is open to all covered workers, employs a no-fault standard of proof, is funded from Social Security taxes (a very broad-based non-experience-rated tax) and the level of compensation is fixed by the nature of the disability and previous earnings. In liability lawsuits, the plaintiff must have standing to bring a specific action, the employee must show negligence, the award is typically paid only by the defendant or his insurer and the compensation scheme ranges from full compensation plus punitive damages to some implicit calculation of incremental damages. Other specific programs can be broken down in similar ways.

Program Objectives

In evaluating compensation programs for occupational disease and disability, implications in five dimensions are important: (1) the number of uncompensated valid claims (type I errors); (2) the number of compensated invalid claims (type II errors); (3) administrative costs of the program; (4)
opportunity costs associated with investments in safety or changes in production; and (5) the induced incidence of disability and disease. In general, in designing a compensation program, it is expected that most individuals would seek to reduce program costs in each of these dimensions, although there would be disagreement about their relative importance.\footnote{For a valid claim one could class the payment of inadequate (or excessive) compensation as a type I (or type II) error. It would be possible to alter the discussion of error to include a dimension relating to the amount of deviation from the level judged to be appropriate. A possible formulation for society's trade-off would incorporate not only the error rate but also the amount of deviation. This requires a determination of the level of compensation deemed "appropriate," a determination which itself requires knowledge of society's values. Since we do not want to specify these values, for analytical purposes, we find it more useful to discuss the trade-off in terms of type I and type II errors.}

The objectives of the individual actors can be described in terms of their functions and changes can be described in terms of increasing or decreasing an individual's well-being. However, the work by Arrow (1950) and others has clearly demonstrated the impossibility of deriving a non-dictatorial social objective function from individuals' preferences. Since there is no generally agreed upon relative value for these tradeoffs, a compensation program cannot be identified as optimal if another program improves upon one objective but at the expense of others. Thus a weaker standard of efficiency is employed:\footnote{Efficiency (or non-dominance) in this context parallels the concept of Pareto optimality for resource allocation. Generally there are multiple Pareto-efficient allocations and without a specific objective function, one cannot identify one Pareto efficient point as superior to another.} an efficient program is one in which no one objective can be enhanced without detriment to another. Rather than impose an objective function, attention is focused on identifying the trade-offs and providing estimates of their likely magnitudes (but here the paucity of empirical studies limits the precision of estimates).

The Market for Safety

Several attributes of occupational disease and disability should be noted first. Too often overlooked is the role of the employment contracting process in compensating for occupation risk. Both employees and employers incorporate occupational safety considerations in the employment decision. Employees are directly concerned not only with job responsibilities but with workplace safety and benefits such as medical, life, and disability insurance. Since some jobs are more dangerous than others, to induce workers to accept those jobs with a higher probability of injury, disability or death, workers must receive some form of additional compensation—a higher salary, more paid time off, additional job training, improved future job prospects, greater job security, more extensive pension or insurance benefits, etc.\footnote{For estimates of the risk and compensation trade-off, see Thaler and Rosen (1975); Viscusi (1976); Dillingham (1979); Arnold and Nichols (1983); Olson (1981); and Low and McPheters (1983).} These concerns affect the employee's choice of occupation as well as specific employer.
Compensation Alternatives for Occupational Disease and Disability

In competing for employees, employers bear costs and reap benefits by structuring job characteristics, including safety programs and insurance benefits, to reflect the concerns of the labor force. Employers can reduce the salary or benefits required to attract workers of a given quality by investing in safety equipment or restructuring the job in order to lessen the workers’ risk. Moreover, a safer workplace reduces the cost of providing medical, life and disability insurance. Thus, humanitarian motives aside, the necessity to compensate for risk provides an economic incentive for firms to invest voluntarily in workplace safety. In sum, firms face higher costs in hiring for riskier jobs since individuals are willing to accept those jobs only when there is a compensating differential. In economic terms, this trade-off could be described as representing a market for risk of disability. The focus of this paper is on how alternative compensation programs impact this contracting process.

Susceptibility to hazards varies across the population and in a well-functioning labor market, self-selection by workers in job choice reduces disability and disease incidence. Hence, individuals with respiratory problems are less likely to select occupations in dusty environments. (Note that this is not inconsistent with the observation that individuals working in dusty environments have higher rates of respiratory distress.) This argument also extends to hazards arising as by-products of a worker’s lifestyle. Therefore, growing evidence on the interactive effects of smoking with exposure to asbestos and some chemicals should also affect job selection. Finally, workers’ actions, such as wearing safety equipment or exercising care in hazardous situations, also affect the probability of disability.

The implications of the converse of this self-selection argument generally have been unrecognized. If a program compensates workers who incur a disability or disease, the greater the payment the weaker the incentives for workers to sort on their ex ante susceptibility to a hazard. Thus, where a workplace hazard is well known and workers have better information about their susceptibility to the hazard than employers, realized disability or disease rates will be higher with ex post payments to workers. For example, if a compensation program systematically over-compensates workers, the firm would tend to attract an applicant pool of most susceptible workers. Because of the differential incentives with respect to self-selection, the impact of compensating differentials in labor contracts in response to over or under-compensation for a specific disease is not symmetric.

Occupational Disease vs. Injury: Assessing occupational risk and providing compensation for that risk typically is harder for cases of occupational disease than occupational injury. Injuries generally involve specific identifiable events and are immediately apparent. (Admittedly, events are characterized on a continuum. With back injuries, for example, it is often difficult to determine the specific cause or severity; consequently, there is more potential for dispute

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over the workplace contribution or for faking an injury.) In contrast, occupational diseases are harder to link to a specific event in the workplace.

The occupational diseases which appear to generate the greatest concern are cancer, heart disease and respiratory disease. Compared to most disabling injuries, causation is difficult to establish for these diseases since they have multiple and interactive causes. For example, while both smoking and asbestos exposure increase the probability of lung cancer, the risk is substantially multiplied for smokers who are exposed to asbestos. Moreover, some studies suggest that substances which by themselves are not carcinogens can increase the likelihood of cancer in combination. Even when a particular agent is identified as responsible for a disease, there can be a substantial latency period between exposure to the causal agent and the onset or manifestation of the disease, so that attribution to a specific exposure is difficult.

**Diagnostic vs. Actuarial Evidence:** In discussing occupational disease causation, it is important to distinguish between two different types of evidence: actuarial and diagnostic. Actuarial evidence is that typically discussed by the epidemiologists who estimate in a statistical or actuarial sense the contribution of factors like workplace hazards to a disease's occurrence. If epidemiological studies demonstrate that exposure to a particular substance increases the probability of cancer by 5 percent then in an exposed population which would otherwise develop 200 cases of cancer, 210 cases would now be expected. But this evidence cannot identify the specific cases which would otherwise not have occurred. This distinction requires diagnostic or etiological evidence.

Most workplace related cancers, heart diseases, respiratory diseases, etc., are diagnostically indistinguishable from those unrelated to the workplace. Thus, research is generally limited to probabilities of causation rather than specific diagnostic evidence. Even when the etiology of the diseases is established, it generally is not possible to pinpoint a specific exposure as the cause. The difficulty in establishing diagnostic causation for occupationally related disease creates problems for compensation programs which seek to compensate only those individuals affected by the workplace hazard.

**Joint Compensation Programs**

Policy discussions generally proceed as if workers have access to only one compensation program. For most diseases, this is not the case. An employee can collect through personal health insurance, workers' compensation benefits, the disability provision of the credit insurance policy associated with his mortgage and automobile, the tort system by suing a supplier of hazardous material, and Social Security disability and retirement provisions.

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7 A similar distinction is made by Schmalz (1981).
Compensation Alternatives for Occupational Disease and Disability

When a worker has access to multiple compensation programs, the standard for evaluation becomes significantly more difficult. Expected total compensation is the sum of the awards under each of the programs adjusted for the probability of an award. Expected administrative expense per worker is the sum of the administrative expenses under each of the programs adjusted for the probability of a claim's being filed. Type I and type II errors become a vector-valued function. In each of these cases, as well as in the case of disease incidence, policy questions involve the total impact on compensation, administrative costs, type I and type II errors, and incidence. Thus, each of the programs establishes what can be thought of as a partial derivative. To estimate the total effect on the work place, these partial effects must be summed.

Although a system of overlapping compensation programs could be efficient under certain circumstances, there are potential problems. The first is the impact of total compensation on disease incidence. Access to multiple programs can lead to systematic overcompensation. This is more likely to occur when compensation across individual programs are not coordinated. In the insurance industry, the problem has long been recognized and controlled by policy exclusions. For example, a standard homeowners insurance policy will exclude liability to employees included under workers' compensation laws. Coordination of compensation payments varies across programs. Social Security and workers' compensation are explicitly coordinated, and many private disability plans incorporate an offset provision for SSDI income (Danzon 1984). In contrast, under tort laws, evidence on the plaintiff's other sources of compensation is generally not admissible.

A second consideration is the impact on the trade-off between administrative expenses and error rates. Compared to one comprehensive hearing, several independent hearings might lower error rates, but only by raising administrative expenses. Also, a comprehensive exclusive program specifying compensation depending on the case's strength, is likely to produce a different set of awards than would a set of non-exclusive programs specifying different standards of proof (e.g., Social Security is no-fault, tort laws specify negligence, etc.) and providing different awards.

Analysis of Compensation Program Parameters

Representative alternatives in the choice of program parameters are analyzed with respect to the resources devoted to safety improvements, production decisions, disease incidence, type I and II errors, and administrative costs of the program.

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4For a discussion of the interaction of the tort system with other means of compensation, see Danzon (1984).
Standard of Proof

For cases involving work place hazards, three standards of proof are frequently suggested: (1) negligence with the burden of proof on the employee; (2) negligence with the burden of proof on the employer; and (3) no-fault or strict liability. In the first case, employees must prove that damage occurred and was related to the work place, that the firm did not exercise reasonable care with respect to their exposure to the hazardous substance, and that the firm knew or should have known the consequences of the exposure. In the second case, employees must only demonstrate that damage has occurred; they recover unless the firm demonstrates that the damage was not related to work place exposure, or that the firm exercised reasonable care with respect to exposure and did not know or reasonably could not have been expected to know the consequences of the exposure. In the third case, employees recover as long as they can show that damage occurred and is work place related.

The standard of proof affects the probability of error in the process, the number of claims brought, as well as the number of successful claims. For simplicity, two kinds of cases being brought to court are defined as valid and invalid. A valid case exists if work place conditions contributed to the disease or disability. Validity is distinguished from legitimacy which refers to the correspondence between the case and the governing regulation. Obviously, the definition of a legitimate claim is endogenous to the program. For example, under a no-fault program there are legitimate claims which would be illegitimate under a compensation system specifying negligence. A disease or disability claim's illegitimacy under a specific program only implies the disease is not appropriately compensated through that program. (For example, known disadvantages of a job not subject to ex post compensation programs are expected to be reflected in an ex ante compensating differential in wage rates or other job characteristics.)

Type I vs. Type II Errors: A perfect system would find for plaintiffs whenever they brought valid cases and against plaintiffs when they were invalid. However, no system is perfect, and the poorer the correspondence between valid and legitimate claims, the greater the probability of both finding against the plaintiff with a valid claim (type I error) and finding for the plaintiff with an invalid claim (type II error). Even when the correspondence between valid and legitimate claims is high, increasing the standard of proof reduces the probability of type II errors primarily at the expense of increasing type I errors.

Due to the limited diagnostic evidence and the resulting problems of establishing causality for occupational diseases, the evidence required to substantiate a claim is an important characteristic of compensation programs. As noted above, the combination of multiple possible causes and a long latency period makes it difficult to link a disease with a specific triggering mechanism. The problems in establishing the etiology for occupationally related diseases underscore the importance of the burden of proof: given current medical knowledge, it is virtually impossible for an employee to prove
that a given exposure caused a case of cancer. (Conversely, it is equally difficult for an employer to prove that it did not.)

Administrative Costs: A higher standard of proof lowers the probability of a claim's success, causing fewer cases to be brought. However, raising the standard of proof increases administrative costs imposed on the plaintiffs. The product of average plaintiff-borne costs per case and the number of cases, total plaintiff-borne administrative cost, depends on the responsiveness of both costs and frequencies to changes in the standard. If the number of cases filed is less responsive than average costs to the choice of standard, plaintiff-borne costs are minimized with a low standard. Defendant-borne administrative costs are likely maximized with a negligence standard and the burden of proof on the defendant. (Although, as will be discussed later, the funding of the program has important implications for the real resources expended by the defendant.) Therefore, the relation between total administrative costs and the standard of proof is an empirical question. Total administrative costs are expected to be highest for negligence with the burden of proof on the employer, next for no-fault and lowest for negligence with the burden on the employee. However, the dramatic extent to which black lung cases exceed the number estimated during the legislative deliberation suggest there are situations in which no-fault is highest.⁹

Investments in Safety: Resources devoted to safety are most directly affected by the private incentives established for the employer and employee. For employees, the higher the standard of proof, the more difficult it is to collect in the event of disability or disease. Imposing a higher standard of proof raises the incentives of the employee to invest in work place as well as non-work-place safety (i.e., wearing goggles and breathing filters on the job and smoking less).

Employers have strong incentives to be concerned with employee health and safety in any case. The more dangerous a job, the higher the compensation necessary to hire and retain a work force of a given quality. Either through a specific ex-post compensation program, or a higher ex-ante wage rate, the employer ultimately pays the bill for known work place hazards.

Shavell (1980) argues that under a no fault (or strict liability) standard the injurer's incentives to reduce accidents are greater than with a negligence standard because the injurer's liability is reduced by the total reduction in cases, rather than by just by that subset determined to be caused by the injurer. However this analysis omits two potentially important complications: (1) With a negligence standard, employer investments in safety reduce not only disease incidence but type II errors as well. Where the sensitivity of type II errors to the employer's safety investments is great but the sensitivity of overall disease incidence to employer safety investments is small, a no fault standard can reduce employer safety investments. (2) Employer incentives to invest in safety are not independent of employee safety investments. If employer and employee investments are complements in the production of safety, a

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⁹United States Department of Labor (1980).
reduction in employee investments in safety reduces the employer's incentive to invest in safety.

Information production leading to disease or disability prevention is simply a special case of employer or employee investment in safety. When the information is for evidence in a compensation proceeding, however, incentives differ. Under a negligence standard, the party with the burden of proof is expected to invest more heavily in evidentiary information. One special case is noteworthy: if a legitimate defense for the firm is ignorance of a product's or process' hazards, that lowers the firm's incentive to invest in information. Moreover, if liability is higher when evidence in the firm's files indicates that a product or process might be hazardous, a similar disincentive to invest in information exists.

Disease Incidence: Disease incidence will be affected by the resources devoted to safety improvements as well as by self selection in the work force. As noted above, a higher standard of proof imposed on employees will result in greater care by employee, including more investment in safety. To the extent that some individuals may be more prone to particular work place hazards, the higher the standard of proof the greater is their incentive to avoid employment where those hazards exist. The incentives facing employees will produce lower disease rates when their standard of proof is higher.

A higher standard of proof for employers provides a somewhat greater incentive to invest in safety improvements for known hazards. However, their incentive to invest in information about potential hazards or to communicate information to workers will depend on the manner in which information increases their liability. Since this information is important in preventing future disease occurrences, the manner in which new information affects a firm's liability is thus a critical element of an occupational disease compensation program.

Criteria for Program Eligibility

One parameter of occupational disease compensation programs is who qualifies for compensation under the program. In the special case of liability lawsuits, this is the issue of standing. In essence, standing is "what sort of interest is 'sufficient' for the plaintiff to be regarded as a proper party to bring the action." (Scott (1973, p. 647, note 15). Under common law, workers had standing to sue their employer for exposure to unsafe conditions but could not bring suit against one of the employer's suppliers; thus only an employee in the asbestos industry could sue an asbestos manufacturer. However, a shipyard employee could sue the shipyard owner and the shipyard owner could sue the asbestos supplier. Traditional notions of privity or prior contractual arrangement have more recently been severely eroded.

A specific example of a change in legal procedure that produced a major expansion in effective standing is the 1966 revision of Rule 23 of the Federal Rules of Civil Procedure. Prior to the 1966 revision, class action suits bound only those class members who were parties to the action. The 1966 revision binds all members of a class who do not explicitly request exclusion. This
change allows individuals with small claims to retain expensive counsel on a contingent fee and to initiate suits, thus reducing costs of forming and maintaining an effective coalition and thereby expanding the set of people likely to recover damages. (However this change also increases the costs for individuals to negotiate separate, tailored solutions to their problems.) As Jensen, Meckling, and Holderness (1986) argue, such expansions of standing reduce the ability to privately contract around a particular property right assignment through side payments, since the required number of side payments in the limit is unbounded. This effectively undercuts the Coase (1960) Theorem.

Type I vs. Type II Errors: Broadening program qualifications (increasing the set of people with standing) has offsetting effects on type I and type II errors. Broader criteria for eligibility should reduce uncompensated valid claims but increase compensated invalid claims. In evaluating this tradeoff, disease incidence rates are likely to be important. For example, if 95 percent of the cancers for a given industry's employees were employment-related, compensating all workers in that industry who develop cancer would eliminate type I errors and result in a type II error rate of only 5 percent. The same program applied to an industry where only 5 percent of cancers were work related would result in a type II error rate of 95 percent.

For certain programs, pre-conditions have been imposed on claims. Under workers' compensation laws, most states limit compensation to diseases that are peculiar to or characteristic of a particular worker's occupation; many states prohibit compensation for diseases which are "ordinary to life;" some states have minimum exposure requirements for all diseases, and set time limits which bar compensation for exposure earlier than a set date. Without such restrictions, a no-fault program or one which places the burden of proof on the employer can be virtually equivalent to coverage of all disease and disability.

Administrative Costs: The number of claims filed is expected to be greatest with broader program eligibility criteria. While the average plaintiff-borne or defendant-borne costs per case could go either up or down depending on whether in marginal cases the incentives to incur more legal costs go up or down, these effects are of a second order of magnitude. Therefore, the total administrative costs are expected to be higher with broader criteria for program eligibility.

Investments in Safety: By broadening eligibility criteria, employers have greater incentives to invest in safety to reduce their expected claims under the program. Of course the magnitude of this incentive depends on the other parameters of the program; for example, it is greater if the payments are funded on a firm-specific basis.

Broadening eligibility criteria should reduce the employees' incentives to invest in safety. The higher the probability that if employees contract an

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occupational disease they will not qualify for a disease compensation program, the greater their incentive to invest in safety.

Disease Incidence: If changing program eligibility criteria has different effects on employers' and employees' incentives to invest in safety, the net impact on disease incidence is ambiguous. However, broader eligibility criteria reduce workers' incentive to sort on ex ante susceptibility to hazards, increasing disease incidence.

Program Funding

Four types of program funding plans have been suggested: (1) firm-specific payments; (2) an industry fund with experience rating; (3) an industry fund with an output tax; and (4) general tax revenues. In the first plan, the firm (or its insurer) is directly responsible for the payment. In the second plan, the tax on a firm would be an increasing function of employment and claims. The third plan establishes a fund financed by a tax on industry output. The fourth alternative finances the fund from general tax revenues.

Type I and Type II Errors: A connection exists between the effective standard of proof and the program's source of funding. In the case of firm-specific payments, there is a concentrated incentive to defend against the claim: the more effective the defense, the lower the number of successful claims. With government-run funds financed by an industry-wide output or wage tax, firms frequently cannot directly challenge claims filed by former employees. But even if firms are allowed to challenge claims, the more indirect the funding, the wider the benefits of a successful challenge are distributed across the industry or economy and, hence, the lower any firm's incentive to aggressively challenge an employee's claim. Moreover, the administrators of some government funds have an incentive to pay more claims, expand their budget and authority. The more indirect the funding, the greater the expected type II, and the fewer the expected type I errors.

Administrative Costs: While making program funding more experience-rated raises administrative costs per case, it also reduces the number of successful cases, and thereby the expected number of cases filed. Again, the impact on total administrative cost depends on the responsiveness of case numbers versus costs. While this is obviously an empirical issue, administrative expenses are expected to be highest with firm-specific payments.

Making individual firms responsible for their claims creates the greatest potential administrative problems associated with corporate bankruptcy. Especially for a disease with a long latency period, potential corporate insolvency reduces the value of access to courts. While imposing a broader-based fund is one method to reduce the bankruptcy problem it is more frequently addressed through private insurance markets rather than public programs. For example, for licensing, many states require drivers to maintain a minimum amount of liability insurance. Effective bonding through liability insurance markets provides a mechanism which partially controls the financial insolvency problem. However, problems arise if firms switch insurance carriers. When a firm has been covered by several insurers,
particularly on an occurrence basis, administrative costs are likely to be higher because each insurer has an incentive to argue the claim resulted from exposure indemnified by another insurer. These problems, however, should be internalized and reflected in the premium quoted by an insurer competing for the firm’s business.

In the case of funding government-run liability programs, as with liability insurance, the experience-rated premium (or tax) should be determined on a before-the-fact actuarial basis, not on after-the-fact realizations. Given the latency periods, an after-the-fact rating of premiums subsidizes firms with younger, less experienced workers. Exacerbating this problem is the movement within the insurance industry to policies on a claims-made basis. Claims-made policies eliminate private insurance coverage as a viable solution to the corporate insolvency problem.

Labor force mobility introduces significant administrative problems for diseases with long latency periods and multiple potential causes. Workers with several different employers over their careers have a more difficult case to make when program funding is on a firm-specific basis. Given current medical knowledge, an employee faces difficulty in proving that one specific exposure caused the disease. These problems could be internalized with an industry-wide fund if the typical damaged worker has changed employers but stayed with the same industry.

Investment in Safety: A disability program’s funding has several implications. First, programs which more directly make the offending firm responsible for the damage create the strongest incentives for workplace safety. Firm-specific payments establish stronger incentives than does an industry fund. The use of an industry fund financed with an output tax (such as the Black Lung Program) taxes safer, more efficient firms while subsidizing riskier, less efficient employers. However, with an industry-specific tax, at least the costs to firms in a risky industry are raised, reducing employment in those industries. Financing from general tax revenues subsidizes the riskiest industries and taxes the safest, providing the weakest of all incentives for workplace safety.

Again, if the firm can challenge claims submitted by employees, the firm’s incentives to defend are greatest when funding is firm-specific and weakest when from general tax revenues. Compensation is thus less assured with firm-specific payments, implying that workers will have stronger incentives to invest in safety.

Disease Incidence: Firm-specific funding provides the strongest incentive for safety investments by employers and employees and thus should result in the lowest disease incidence. Moreover, as contrasted to funding from general tax revenue, it raises the cost of employing individuals in hazardous firms and industries relative to safe work places. This will reduce employment in the hazardous environments, further reducing occupational disease incidence.

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Level of Compensation

Four possible compensation systems have been suggested: (1) full compensation plus punitive damages; (2) compensation by case; (3) compensation by class; and (4) incremental damages. In the first, employees receive full compensation for damages plus an extra amount typically called punitive damages. Full compensation includes out-of-pocket expenses, forgone wages and the dollar equivalent of the disutility of the disease (pain and suffering, mental anguish, and loss of consortium). General damages are particularly difficult to evaluate and results in disagreements about whether a particular payment fully compensates for the damage.

The second and third systems lie on a continuum. To estimate damages, people are placed into classes. The question centers on how detailed the class definition is in the estimation of damages. These systems may also provide full compensation but differ in the method for determining the payment. If the class definitions are very detailed, the third plan resembles a case-by-case determination of awards. Some plans are hybrids of the second and third plans. For example, a program may pay actual medical expenses plus a fixed amount or percentage of pre-injury earnings depending on the nature of the injury. Plans which cover medical expenses and replace lost wages fall short of full compensation to the extent that there is no payment for general damages.

The fourth system is fundamentally different in its explicit recognition that most diseases have multiple potential causes, and that the best available evidence is usually epidemiological, not diagnostic. If the evidence suggests that the chance of contracting a disease in a given population is 10 percent greater than in the general population, the damage award reflects the 10 percent increase in risk—not total damages. Moreover, such a plan recognizes that if the probability of developing lung cancer is greater for employees who smoke than for those who do not, then the compensation awarded employees who smoke and contract cancer is reduced to reflect the contribution of their smoking.

Note the administrative problems when a compensation system specifies incremental damages and there are important interaction effects among causal agents. In such a case, the incremental impact of, for example, asbestos exposure on an employee who smokes is ambiguous. Reported index numbers indicate the joint impact of smoking and asbestos exposure on cancer are: for non-smokers without asbestos exposure, 1; asbestos alone, 7; smoking alone, 11; both smoking and asbestos, 77. What is the incremental cancer incidence for a smoker? Six, because smoking is voluntary and is attributable for the incremental 70? Or 66 because smoking is a personal right, and the employee

\[\text{Note that some argue that punitive damages should be taken out of civil court proceedings and relegated to criminal proceedings for several reasons. First, for a given class of damage, it can generally only be awarded once. Thus, the award resembles a lottery among the damaged class. Second, for such court-enforced punishment, the appropriate standard is that of a criminal court, "beyond a reasonable doubt", not that of a civil proceeding, "the preponderance of the evidence." (See the discussion on punitive damages in "Symposium: Punitive Damages," 1982).} \]
is entitled to exercise that right? If the second answer is accepted, then private
disincentives for smokers to avoid occupations with asbestos exposure are
weakened.

_Type I and Type II Errors:_ Increasing the compensation for successful
claims has offsetting effects on type I and type II errors. Higher compensation
raises employees' incentives to file claims, reducing uncompensated valid
claims but increasing compensated invalid claims. However, higher compen-
sation also increases employers' incentive to challenge claims thereby reducing
employees' incentive to file, raising type I but reducing type II errors. Whether
the direct or the indirect effect is greater depends on the program's other
parameters. The more firm-specific the funding, the greater the indirect effect
through more vigorous defense leading to higher type I and lower type II
errors.

_Investment in Safety and Disease Incidence:_ Increasing compensation raises
the incentives for an employer to invest in safety but reduces those of the
employee. Higher compensation not only reduces the employees' safety
incentive on the job but also lowers their concern about safety in job selection.
For example, smokers will be less likely to avoid environments which increase
the incidence of respiratory disease. The impact of compensation on disease
incidence depends on the relative responsiveness of employees versus
employers.

For analytical tractability, the level of compensation, and type I and type II
errors have been discussed separately. Obviously, what is important is total
compensation compared to total costs of disability or disease. As noted above,
total costs can be divided into three components: (1) out-of-pocket expenses;
(2) forgone wages; and (3) the dollar equivalent of the disutility of the disease.
Full coverage would compensate workers for total costs. Partial compensation
could be considered a form of type I error. There are important differences,
however, between expected under-compensation and expected over-compensa-
tion. The important difference is not in the expected cost of the compensation
program: expected under-compensation should be reflected in a wage
premium for risky employment, while expected over-compensation should be
reflected in a wage discount. The important difference is that expected
under-compensation produces stronger incentives for people with a prior
predisposition to a particular disease to avoid employment in areas with
significant exposure, while expected over-compensation undermines or
reverses those incentives, leading to higher disease incidence.

The analysis in this section on the effect of program characteristics on
policy objectives is summarized in Table 1. As the Table indicates, there is no
set of program characteristics which clearly dominates all others.

_Evidence on Program Tradeoffs_

In evaluating a compensation system, there are several important empirical
magnitudes to consider: (1) the responsiveness of the number of claims filed to
changes in the standard of proof, the source of funding, or the level of
Table 1
Effect Of Occupational Disease Compensation Program Characteristics On Program Objectives

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<tr>
<td></td>
<td>Number of claims filed</td>
<td>Plaintiff borne-costs per case</td>
<td>Defendants borne-costs per case</td>
<td>Total administrative costs</td>
<td>(Uncompensated valid claims)</td>
</tr>
<tr>
<td>Standard of Proof:</td>
<td>lowest</td>
<td>highest</td>
<td>high</td>
<td>ambiguous¹</td>
<td>highest</td>
</tr>
<tr>
<td>neg W/ burden on employee</td>
<td>highest</td>
<td>lowest</td>
<td>highest</td>
<td>ambiguous²</td>
<td>lowest</td>
</tr>
<tr>
<td>neg W/ burden on employer no fault</td>
<td>lowest</td>
<td>ambiguous³</td>
<td>lowest</td>
<td>ambiguous²</td>
<td>highest</td>
</tr>
<tr>
<td>Criteria for Eligibility narrow broad</td>
<td>highest</td>
<td>ambiguous³</td>
<td>ambiguous³</td>
<td>highest</td>
<td>highest</td>
</tr>
<tr>
<td>Source of Funding:</td>
<td>lowest</td>
<td>highest</td>
<td>highest</td>
<td>ambiguous³</td>
<td>highest</td>
</tr>
<tr>
<td>Firm-specific Industry tax</td>
<td>highest</td>
<td>lowest</td>
<td>lowest</td>
<td>ambiguous³</td>
<td>lowest</td>
</tr>
<tr>
<td>w/ exp. rating Industry tax</td>
<td>ambiguous⁴</td>
<td>highest</td>
<td>highest</td>
<td>ambiguous³</td>
<td>ambiguous⁴</td>
</tr>
<tr>
<td>w/ output basis General tax revenue</td>
<td>ambiguous⁴</td>
<td>lowest</td>
<td>lowest</td>
<td>ambiguous³</td>
<td>ambiguous⁴</td>
</tr>
</tbody>
</table>

Notes: 1. The response of total administrative costs depends on whether the costs per case or number of claims is more sensitive to changes in the program characteristic. For example, the administrative cost per case is lowest for no-fault but the number of cases is highest.
2. The response depends on the sensitivity of incidence rates versus type II errors to investments in safety and the extent to which employer and employee safety investments are complements.
3. Broader program qualifications will increase the plaintiff-born or defendant-born costs per case if the marginal case provides greater incentives to cover more legal expenses.
4. The change in disease incidence depends on the relative responsiveness of the employer's increased incentive to invest in safety versus the employer's reduced incentive.
5. Higher compensation will increase the plaintiff's incentive to file but also will increase the firm's incentive to defend in experience-rated programs. The threat of a vigorous defense may result in fewer claims filed. Administrative cost will rise with compensation levels unless the threat of a vigorous defense significantly lowers claims.
compensation; (2) the responsiveness of both the plaintiff-borne and defendant-borne costs to changes in program parameters; (3) the responsiveness of type I and type II errors to changes in program parameters; and (4) the responsiveness of employer and employee incentives for investments in safety to changes in program parameters. Unfortunately, the policy debates over the choice of compensation programs have included little discussion of evidence; moreover, the evidence offered is difficult to translate into the dimensions here identified. The empirical magnitudes typically offered are: (1) total disease incidence in the population; (2) number of claims filed in a given program; (3) award data for a given program; (4) epidemiological calculations of diseases attributable to a given workplace hazard; and (5) estimates of the fraction of awards which go for lawyers' fees and other administrative expenses.

Estimates of the extent of occupational disease vary widely, particularly for those diseases which are not specific to an occupation. Since the estimates generally are based on disease incidence rates among different populations rather than on diagnostic evidence, there often is considerable difficulty in obtaining comparable data sets not contaminated by other factors such as the worker's non-workplace environment or lifestyle. The latency between exposure and manifestation of many occupational diseases and the mobility of many individuals in the labor force further complicate the estimation process. Doll and Peto (1981) calculate that less than 5 percent of cancers are occupationally related whereas other authors place the percentage significantly higher.13

The disparity of estimates makes it very difficult to use the existing epidemiological studies to analyze the effects of broad-based programs. To make sensible choices, epidemiological data on diseases must be disaggregated by industry. However, movement of workers among different industries would contribute to difficulties in estimating relative contribution factors. By limiting a study to a narrowly defined industry and a specific disease, then one may be able to obtain better epidemiological data.

Note also that measured disease incidence will be partially endogenous to the compensation program. A textile worker suffering from chronic respiratory distress in the 1980's is much more likely to be diagnosed as having brown lung disease now that there is a specific compensation program in place for that disease. This helps explain why simple extrapolations of past disease incidence tend to underestimate future case loads when disease-specific compensation programs are instituted.

When one considers the available evidence, the problems of deriving the numbers required to evaluate compensation programs become clearer. Convincing estimates are most difficult to achieve on type I and type II errors; moreover, designing an ethical experiment to produce them is problematic, even in principle. By limiting a study to a narrowly defined industry and a specific disease, then one may be able to obtain better epidemiological data.

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Data on investments in workplace safety is also limited. The cost of safety improvements incorporated in the design of new machinery or production processes are often difficult to separately identify or allocate. With that degree of arbitrariness, it's not surprising little data are available. Employer monitoring for workplace safety or employee investments in safety are harder to measure. While administrative costs directly associated with a program are easier to calculate, some costs borne within the firm or by the employee are difficult to identify separately.

Evidence From Existing Programs

The diverse occupational disease compensation systems provide information that suggests the direction and magnitude of the effects of different program characteristics, but the quality of the evidence is insufficient to allow refined estimates. Observations about these programs relevant to the effects of program characteristics will be highlighted, but a detailed description of each compensation system will not be attempted.

Black Lung: The Black Lung Program was initially designed as a temporary program to be replaced by state or company plans, but has remained a comprehensive federal program. The plan covers individuals working in coal mines, their dependents and certain other individuals living in proximity to coal mines. To receive benefits these individuals must demonstrate that they suffer from black lung or a related condition. The Black Lung Fund has been financed by an industry-wide tax on coal production and by borrowings from the U.S. Treasury. The tax is higher for shaft-mined coal than for open-pit mineral coal, (50 cents per ton and 25 cents per ton, respectively), but within the two segments, there is no firm-specific experience rating.

The number of beneficiaries under the Black Lung Program is much larger than original projections. Moreover, the General Accounting Office has reported that 88.5 percent of the claims approved by the Social Security Administration did not have adequate medical evidence. While this observation is not sufficient to conclude that the claims were invalid (type II errors), it is consistent with a reduced incentive for employers to challenge claims in a no-fault system absent firm-specific experience rating. The administrative costs per case are low, (10 percent of current expenditures), but the number of claims is large relative to initial estimates. By 1981, black lung beneficiaries had received $11.5 billion, 35 times the initial cost projection. It would be difficult to measure the program's impact on black lung cases because of: (1) the significant changes in the safety regulation governing coal mines that were implemented along with the passage of the Black Lung Program; (2) the long latency period between exposure and disease (and thus between changes in exposure levels and observable changes in incidence); and

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14 Ibid.
16 Victor (1982).
(3) the allegation that the many reported cases of black lung are not supported by adequate diagnostic data.

Worker's Compensation: Workers' compensation programs' variation by state permits some assessment of the effects of program characteristics. Most empirical work focuses on injury claims rather than disease claims. In most states, smaller firms pay workers' compensation premiums based on workplace classification and are not subject to experience rating. Larger firms are typically experience rated or in some plans self insured.\(^\text{17}\) Attempts to empirically measure the effect of firm-specific experience rating on injury rates is confounded by the suspected effects of firm size on injury rates. States with higher benefit levels (usually measured as percentage wage replacement) also have higher reported injury rates. This evidence is consistent with (1) reduced incentives of workers to sort on the basis of ex ante susceptibilities, (2) an increased incentive to file a claim, and (3) a reduced safety incentive by employees.

LHWCA: Similar responses to changes in benefits can be seen in reviewing the effects of the 1972 and 1984 amendments to the Longshoremen's and Harbor Workers' Compensation Act (LHWCA). This Act provides coverage to employees injured while engaged in U.S. maritime employment. In 1972, amendments were passed which increased benefits levels, extended coverage shoreside, and allowed benefits to be paid to survivors of injured employees who died from causes unrelated to the compensable injury. After passage of these amendments, benefit costs and the number of injury claims filed increased dramatically, (726 percent and 156 percent, respectively) from 1972 to 1982. The Consumer Price Index increased only 130 percent over this same period. The 1984 amendments to the LHWCA addressed escalating costs by reducing the extent of coverage and placing a cap on benefit increases.\(^\text{18}\)

FECA: The Federal Employees' Compensation Act provides disability coverage to Federal workers. Like workers' compensation, the system is no-fault but the employee must demonstrate that the injury is work related. Since the program is financed by a single employer, it might be considered experience rated. However, since the employer is the federal government rather than a private firm, incentives are probably more similar to a non-experience rated program. In 1974, legislation made several changes in the program, most notably, significantly increasing benefits and liberalizing eligibility criteria. On an after-tax basis, employees in higher pay grades received more than 100 percent wage replacement. By 1976, the first full year following implementation of the changes, the number of cases was 191,172 as compared to 123,009 in 1974, an increase of 55.4 percent.\(^\text{19}\)

The changes in the FECA program in 1974 had a particularly large impact on claims filed by federal air traffic controllers. Stress, which was the basis for many disability claims by controllers, shares some of the complicating

\(^{17}\) Brine (1985a).
\(^{18}\) Brine (1985b).
\(^{19}\) Barth and Hunt (1980); Doll and Peto (1981); Efron (1984).
attributes of other occupational diseases. Stress-related problems can be due to non-occupational as well as occupational factors. There can be considerable latency between the triggering event and the outward symptoms; and there is a potential for faking or altering a diagnosis. In their study of the effects of the 1974 changes on the performance of FAA controllers, Staten and Umbeck (1982) report that "Occupational disease claims more than doubled from about 200 during the twelve months prior to the FECA amendments to 453 during the twelve months following the amendments, and continued to rise . . . (T)he evidence also supports the argument that claims continued to rise due to the work disincentives created by making generous compensation payments easier to obtain" [p. 1029]. They note that the 1984 changes for the first time also permitted the testimony of clinical psychologists as primary medical evidence of a disability. Moreover, employees were allowed to select the private physician of their choice to provide testimony. They also argue that "in attempting to formalize the criteria for adjudicating controller psychological claims, [Office of Workers' Compensation Programs] created an incentive for controllers to demonstrate deteriorating performance." [p. 1036]

The above cases demonstrate the responsiveness of compensation claims to changes in program characteristics and demonstrate the importance of trying to measure the elasticity of claims with respect to program changes. This discussion has focused on the direction of the expected change and factors which affect their predicted magnitude. However, due to idiosyncracies in occupational diseases and other variations in circumstances, obtaining elasticity estimates which can be applied reliably to all program changes is unlikely.

**Political Economy of Disease Compensation**

The considerable political activity associated with redesigning compensation systems was noted above. Most modifications seem directed toward increasing the level of compensation and lowering the standard of proof. One impact of increasing ex post compensation for cases of disease and disability is to reduce the ex-ante wage differential for riskier occupations and to change incentives which result in higher disease and disability rates. Ultimately, the cost of inefficient compensation policies is imposed on employers if the firm has firm-specific or industry-specific assets that produce significant quasi-rents and/or on consumers through higher prices if it reduces the companies' competitive position in international markets.

However, to fully understand the political constituencies for legislation, it is important to examine the winners and losers in work place regulation and tax policy. Such changes can produce significant wealth transfers, and thus provide strong political incentives for changing the parameters of these programs. For example, Maloney and McCormick (1982) suggest that imposing higher standards of work place safety differentially affect producers
in the industry. In the case of the imposition of cotton dust standards in the textile industry, they argue that the largest firms benefitted at the expense of smaller competitors. The Black Lung Program also redistributes wealth among producers; but in contrast to the transfers produced under the cotton dust standards, by imposing an output tax on the industry the safer, more efficient producers are taxed and the riskier, less efficient producers are subsidized.

Compensation programs can also redistribute wealth between employers and employees. Opportunities for wealth transfers are greater in industries with significant investment in long-lived, industry-specific capital. This helps explain why extensive special compensation programs are observed in industries like mining and shipping. Since such long-lived, industry-specific investments are also associated with higher levels of unionization, it also helps explain why these compensation programs are more frequently observed in unionized industries.

Employees’ reactions to compensation policy changes are unlikely to be homogeneous. While workers with a genetic pre-disposition to cancer, respiratory or cardiac disease will likely favor compensation programs for those diseases; the most important constituency for change is likely to be older workers. For a 55-year-old worker, any wage premium received for hazardous employment is now sunk. Changing the compensation package to include greater disease compensation effectively allows older workers to collect twice. Since labor unions typically are controlled by older workers, labor’s support for extensive disease compensation reflects a political investment which would transfer wealth from employers, consumers and younger workers to older workers.

Organized labor is also a potential political constituency for a patchwork of programs rather than a coordinated system of compensation programs. While any individual might stop seeking additional programs to file for additional compensation for a given disease or disability simply because of the additional search and information costs, organized labor can afford to hire individuals specialized in exploring program eligibility and procedures. If this hypothesis is correct, then program proliferation with non-exclusive remedies would transfer wealth to unionized employees.

Finally, one explanation for the paucity of empirical evidence corresponding to the dimensions identified in this analysis is simply that it reflects the lack of demand for the production of such estimates in the political process. If the motivation for modification of the compensation policy is ultimately based on providing wealth transfers, then more precise evidence on the magnitude of the trade-off is less important.

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Maloney and McCormick (1982).
Conclusion

The employer-employee contracting process provides mechanisms to compensate for occupational hazards as well as providing employers and employees with incentives to improve work place safety. In evaluating a specific program, one must be careful to note its effect on existing programs, including the employment contracting process, and on the incentives confronting the employer and employee. The program structure affects not only the amount and allocation of compensation, but alters the incentives to reduce occupational disease and disability.

While the choice of rules for existing occupational disease and disability programs is not fully understood, it seems difficult to believe that they are the result of a well meaning political process which has simply made errors in attempting to construct an efficient system. Key insights come from recognizing the differences in impact of program changes on older versus younger workers, unionized versus non-unionized workers, and marginal versus intramarginal firms.

Given the diverse nature of occupational disease, changes in compensation program characteristics will have different impacts across industry and disease categories. Advocates of specific compensation schemes often implicitly if not explicitly assign relative importance to the multiple objectives of compensation programs or the effects of particular program characteristics on these objectives. These weights or the failure to consider some factors may be affected by the specific diseases of greatest interest to the authors. However, this analysis suggests that it is unlikely that any single remedy will be optimal for all occupational diseases. The empirical data necessary to estimate the effects of alternative features on each of the program objectives is sketchy at best. One must also consider the relative merits of the uniform compensation system versus a pluralistic system. Hopefully the factors identified in this paper will help focus future debates on program structure and produce a more rational compensation policy.

References
