Compensation for Occupational Disease: Evaluating the Options

Patricia M. Danzon

ABSTRACT

This paper evaluates alternative rules of liability and compensation for occupational disease. The criterion applied is minimization of the sum of the costs associated with occupational disease, disease prevention, uninsured risk costs, and litigation and insurance overhead or transaction costs. Options considered include the workers' compensation system, the tort system, first party insurance, and potential government programs. It is argued that the costs of insurance and uninsured risk significantly affect the optimal liability rule for occupational disease, because the long latency of many occupational diseases undermines diversification of risk through liability and first party insurance. The workers' compensation system, with pro rata division of liability among contributing employers, appears to be superior to the alternatives.

Introduction

Current debate over occupational disease is highly influenced by the crisis of asbestos litigation. The inadequacy of reserves to pay claimants and the enormous expenditure on litigation have led to proposals for federal intervention to ensure adequate funds and streamline the administration process. This unprecedented confusion is the result of imperfect foresight of both the latent health hazards of asbestos and of the legal rules assigning liability for these hazards [9]. The injuries that have emerged since the mid-sixties are the result of exposure in the 1930s, 1940s and 1950s. At that time, an employee's sole remedy would typically have been a workers' compensation claim against his employer. But since the 1970s, courts have sanctioned tort claims against asbestos manufacturers in their capacity as product suppliers, under expanded doctrines of duty to warn, design defect,

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and failure in testing.[1] Courts have also sanctioned tort claims against employers under novel doctrines of dual capacity and willful misconduct. Because this future liability under tort was not anticipated, asbestos manufacturers purchased inadequate insurance coverage. Moreover, insurance contracts were written in language that leaves totally ambiguous whether the insurer is liable for latent injuries arising out of *exposure* in the policy period or for injuries *manifest* in the policy period.

However, it would be unfortunate if the problems arising from these past failures in foresight were allowed to dominate the design of liability rules that are to have prospective impact. Liability rules perform two functions. The first is to determine who should pay for injuries already incurred and, if someone other than the victim is assigned liability, how much should be paid. In assigning liability for past losses, the public policy issues are primarily equity and minimization of the deadweight costs of litigation.

But the second function of liability rules is prospective. The anticipation of liability creates incentives for persons involved in hazardous activities to take precautions and to buy insurance, thereby affecting the allocation of resources to prevention and exposure to risk or uninsured loss. Prevention is particularly important in the case of occupational disease, which frequently entails "irreplaceable" loss due to permanent disability and death. Because such loss cannot be fully compensated by money [4, 21], insurance (or compensation) is an imperfect substitute for prevention. Therefore the design of optimal liability rules must consider the prospective impact on efficiency in injury prevention and allocation of risk.

Since the pathbreaking work by Calabresi [2] and Posner [17], a large literature has developed analysing the efficiency of alternative liability rules for accidents.[2] Rules most commonly considered include first party liability (losses rest with the victim, who may buy first party health and disability insurance); strict third party liability (the "injurer" is liable regardless of fault, as in workers' compensation); negligence (the "injurer" is liable only if he or she failed to meet some "due" standard of care); comparative negligence (allocation of liability in some proportion to fault); and the defense of contributory negligence (which may bar a plaintiff from collecting under either a strict liability or a negligence standard). In evaluating alternative liability rules, the objective commonly assumed is to minimize the social costs associated with accidents. These social costs have four sources: prevention costs; the costs of compensating injuries; litigation, enforcement and other overhead costs; and the disutility of uninsured risk.[3] This framework highlights the inevitable tradeoffs: since reducing injuries typically entails higher prevention costs, the optimal investment in safety involves weighing the

[1] For example, Borel v. Fibreboard Paper Products Corporation, U.S. Court of Appeals, Fifth Circuit (1973).

[2] For a review of some of this literature, see Polinsky [16].

[3] If personal injury entails some irreplaceable loss, then ex ante potential victims cannot be fully insured and the disutility of this uninsured risk is a social cost. Even for replaceable losses, less than full insurance may be optimal because of loading charges.

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marginal costs of prevention against the marginal benefits, in terms of injury and overhead costs avoided. Another important inference [20] is that efficiency in injury prevention often entails precautions per unit of the activity (individual deterrence) and reduction in the level of the hazardous activity (market deterrence).

Most of this literature on optimal liability rules has been developed with reference to traumatic injuries between strangers. The occupational disease context has some unique features that have not been adequately addressed. The contribution of hereditary and environmental factors, in addition to multiple human agents, vastly complicates the determination of "cause." The allocation of risk also merits more careful consideration in the case of occupational disease than for traumatic injuries. Because of the long latency period of many such diseases—cancers may take 20 years to become manifest—the standard assumption, that risk can be costlessly diversified through either first party or liability insurance mechanisms, does not apply. This argument is explained below.

The purpose of this paper is to evaluate alternative liability rules for occupational disease. Part I reviews the lessons from standard economic analysis of optimal liability rules for traumatic injuries. A model of workplace injuries is developed to show in what circumstances employer liability is or is not necessary to provide optimal incentives for prevention and optimal compensation to workers. Part II discusses important features that differentiate occupational disease from the traumatic injury paradigm used in Part I. Part III evaluates four specific liability assignments for occupational disease and the associated insurance arrangements: employer liability, with workers' compensation insurance; tort liability of product manufacturers, with product liability insurance; leaving losses with victims, who may insure through first party coverages; and special public funds or programs, such as Black Lung. The criterion applied is minimization of the social cost of injuries, as defined above. The criterion of cost minimization is often criticized because it is concerned only with efficiency in resource allocation without regard to equity or distribution of income; however, it could also be viewed as equitable between all parties ex ante (before victims and injurers are identified), given the distribution of income.

I. Lessons from Economic Analysis of Liability Rules

Consider a simple model in which the probability of injury (p) depends on safety precautions of two types, X and Y, with p_x, $p_y < 0$.[4] The costs of prevention can be written S(X, Y). Let D denote the damage if an injury occurs, which is assumed independent of the level of X and Y. Assume initially that all parties are risk neutral and fully informed, that the damage is

[4] In the workplace injury context, safety inputs controlled by the employer could include installing safety devices on machines, providing warning and protective clothing, etc. Safety measures controlled by employees could include wearing the clothing provided, observing safety warnings and procedures, etc.

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purely monetary, and loss adjustment expense is zero. The social cost of injuries (C) can be written:

$$C = S(X,Y)) + p(X,Y)D. \tag{1}$$

The optimal (cost minimizing) investment in the jth prevention input is defined by equating marginal costs and benefits:[5]

$$S_j = p_j D \qquad j = X, Y \tag{2}$$

If X and Y are controlled by the potential victim, a rule of first party (victim) liability yields optimal incentives for prevention. If X and Y are controlled by a single third party (the "injurer"), strict liability yields optimal incentives. But if X is controlled by the victim and Y by the injurer and if contracting between them is prohibitively costly, optimal prevention requires exposing both parties to potential liability.[6] Specifically, it can be shown [1, 11] that optimal prevention can be achieved under three alternative liability rules: strict liability with a contributory negligence defense; negligence with a contributory negligence defense; and comparative negligence.[7] The intuition is simply that if efficient investment in prevention requires effort by more than one party, the liability rule should require each to meet a standard of due care.

Dropping the simplifying assumptions, risk aversion, errors by the courts, costs of insurance, and claim adjustment costs may tip the balance in favor of one of the three potentially efficient rules, as discussed below. Further, if efficient prevention requires reducing the level of activity by at least one party (market deterrence) as well as an optimal level of care per unit of the product or service (individual deterrence), the optimal rule may be affected [20, 15].

Consider now the application of these principles to workplace injuries.[8] Assume a rule of first party liability (workers bear the cost of injuries); that employers control all relevant prevention inputs; and that workers are risk averse and negotiate for first party health and disability insurance as part of the employee benefits package. Also assume initially that workers are fully informed about the hazards of alternative employments. A worker of a given skill level then chooses among alternative jobs that offer different wages (W),

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[5] If D_x, $D_y < 0$, the optimal level of precautions is greater, but the analysis is qualitatively unaffected. Similarly, loss adjustment expense raises the optimal level of prevention.

[6] For proof of these statements, see Brown [1], Haddock & Curran [11]. Each party is assumed to minimize his or her private costs, including costs of prevention and expected liability. Then it is intuitively clear that if the party who controls all relevant prevention inputs is also liable for all damage costs, minimization of private costs also implies minimization of social costs. But if one party bears all liability but controls only a subset of prevention inputs, private optimization may fail to yield a socially optimal level of safety and mix of safety inputs.

[7] A further assumption of these models is that the courts costlessly enforce optimal standards of due care defined by equating the marginal costs and marginal benefits of additional precautions. Failure to meet this standard constitutes negligence by a defendant or contributory negligence by a plaintiff.

[8] For related models, see Oi [14], Viscusi [22], Danzon [7].

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levels of risk (p), and compensation (M), to maximize his or her expected utility (assumed to be dependent on the state of health):

$$E(U) = (1-p)\,U_1[W(p,M] + pU_0[W(p,M),\ M] \tag{3}$$

where U_1 = utility if no injury occurs

U_0 = utility if an injury occurs

$U_1'(W) \gtreqless U_0'(W)$ as disability lowers, leaves unchanged or raises the marginal utility of wealth.[9]

First order conditions for a maximum with respect to p and M imply:

$$W_p = \frac{U_1[W(p,M)] - U_0[W(p,M),\ M]}{\overline{U}'} \tag{4}$$

where $\overline{U}' = (1-p)U_1' + pU_0'$, and

$$-W_m = \frac{pU_0'}{\overline{U}'} \tag{5}$$

Equation (4) defines the increment in wages (compensating wage differential) that fully-informed workers would require for an increment in risk of injury. Equation (5) defines the reduction in wages workers would accept for an increment in insurance coverage.

For a given labor force, a profit-maximizing employer will seek to minimize the sum of the costs of prevention and the cost of injuries, which includes the compensating wage differentials and the cost of employee benefits:

$$\min_{X,Y,M} S[p(X,Y)] + W[p(X,Y),\ M]L + kpML \tag{6}$$

where L = number of employees.

$k \geqslant 1$ is the insurance load.

The employer's (private) cost-minimizing level of prevention equates the marginal cost of each safety input with the marginal savings from injury costs avoided:

$$S_j = -[W_p + kM]L \qquad j = X,Y \tag{7}$$

The (private) cost-minimizing level of benefits equates the marginal cost of higher insurance coverage with the marginal value to workers, as reflected in the decrease in the compensating wage differential:

$$kp = -W_m \tag{8}$$

[9]Some disabilities may raise the marginal utility of wealth if the marginal utility derived from expensive medical and custodial care is very high. Other disabilities may lower the marginal utility of wealth by reducing the range of possible consumption activities.

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Substituting from equation (4) and (5) into (7) and (8) and using * to denote equilibrium values:

$$-S' = \frac{[U_1[W(p^*,M^*)] - U_0[W(p^*,M^*), M^*] + kM^*]L}{\overline{U}'} \tag{7'}$$

$$k = \frac{U_0'(p^*,M^*)}{\overline{U}'(p^*,M^*)} \tag{8'}$$

Equation (8′) defines the preferred level of compensation—the level chosen by fully-informed workers as reflected in compensating wage differentials. Rearranging yields:

$$\frac{U_1'(p^*,M^*)}{U_0'(p^*,M^*)} = \frac{1-kp}{k(1-p)} \leqslant 1 \text{ as } k \geqslant 1 \tag{8''}$$

This equation implies that with zero load, preferred compensation may be more or less than full replacement of monetary loss, depending on whether disability raises or lowers the marginal utility of wealth. Relative to this benchmark, preferred compensation is lower, the higher the insurance load. From equation (7′), preferred prevention (the level implicitly "chosen" by fully-informed workers through compensating wage demands) is defined by equating the marginal cost of prevention with the marginal cost of injuries, which includes the cost of compensation (kM^*) and the worker's utility cost of uninsured risk ($(U_1-U_0)/\overline{U}'$), given optimal compensation.

The values of $p^*(X^*,Y^*)$ and M^* that maximize private profits are also socially optimal, provided that workers are fully informed and that injuries entail no externalities (such as disability costs born by social insurance programs). Thus, this model demonstrates the familiar result, that if workers are fully informed, employer liability for workplace injuries is not necessary to achieve optimal prevention and compensation. Compensating wage differentials demanded in competitive labor markets "internalize" to employers the value that workers place on safety and compensation.

However, if workers are not fully informed, compensating differentials may not yield optimal safety incentives to employers. In that case, a rule of strict employer liability can, in theory, correct this market failure. Equation (8″) shows that the optimal compensatory award (M^*) under a rule of employer liability should be set at the level of compensation that workers would have "chosen" through an implicit wage reduction, given the load of the employer's liability insurance.[10] Equation (7′) implies that if there remains an irreplaceable loss, given optimal monetary compensation (M^*), and if this potential loss is not internalized through compensating wage differentials,

[10]This result assumes that the cost of providing workers' compensation benefits is born by labor, through the operation of competitive labor markets. If labor does not bear this cost, the design of optimal compensation depends on the equity or distributional consequences of the compensation system.

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then the compensatory award alone provides suboptimal safety incentives to employers. In principle, this problem can be corrected by a fine, over and above the compensatory award, equal to the uninsured cost of injury (the first term on the right side of equation 7′). This term may be interpreted as what informed workers would be willing to pay for prevention, given optimal compensation.[11]

Summarizing, economic analysis of liability rules suggests the following guidelines for designing compensation policy for workplace injury. If employees are well-informed about workplace hazards, employer liability is unnecessary. But if employees are imperfectly informed, employee demands for compensating wage differentials may provide suboptimal incentives for safety; this deficiency may be corrected through a rule of employer liability. The optimal compensatory award to be paid by a liable employer is the amount of compensation fully-informed workers would have been willing to purchase implicitly, through a compensating wage differential. If the minimum cost method of injury prevention requires care by multiple parties (employees as well as employers), a rule of contributory or comparative negligence may be necessary to achieve efficient incentives for prevention (but see below).

II. Application to Occupational Disease

Occupational disease differs from the simple traumatic injury paradigm discussed in Part I in that (1) multiple parties, as well as environmental and hereditary factors may contribute to the probability of disease, and (2) the disease may not be manifest until many years after the damaging exposure. This section discusses the effect of these two factors on optimal liability rules.

1. *Multiple Parties*

Efficient prevention of occupational disease may require actions by product suppliers, employers, and workers. For example, the exposure of an asbestos insulation worker depends on the asbestos content of the insulation materials supplied by asbestos manufacturers; on ventilation measures taken by successive employers; and on whether the worker smokes. The theory of optimal liability rules for injuries involving strangers described above concluded that efficient prevention requires holding each potential contributor to a standard of due care. However, this conclusion does not apply where the parties are informed and contracting costs are low because of an ongoing market relationship [3, 8]. For example, if X is purchased from external suppliers, employers who are strictly liable have incentives to contract for optimal quality of supplies; alternatively, employers may require indemnification contracts from suppliers. Similarly, if X is controlled by employees (for example, wearing a respirator), employment contracts can be used to transmit

[11] The fine should be refunded as a subsidy to the industry, to avoid excessive market deterrence (Spence [21], Danzon [7]).

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appropriate incentives to employees. Thus, where the potential contributors to prevention are linked by a chain of market or contractual relations, prices or contract terms can transmit incentives. Imposing a legal duty on each party individually may add litigation expense with little gain in prevention efficiency. The optimal liability rule may then be to place liability solely on the party with lowest costs of contracting with the other parties. In the occupational disease context, this party is likely to be the employer.

However, successive employers of an individual worker are not contractually linked. Efficient prevention then requires holding each employer liable for his or her marginal contribution to the risk (assuming workers are uninformed so compensating wage differentials are not adequate). Consider a worker who has a probability of developing cancer (p), given hereditary factors and prior employment. Efficient prevention requires that the next employer should minimize the costs associated with the incremental exposure:

$$\underset{X,Y}{\text{Min}}\ C = S(X,Y) + W[\tilde{p}(X,Y), M]L + k\tilde{p}(X,Y)ML$$

where $\tilde{p}$ is the incremental or excess risk. For example, if the incremental occupational exposure raises the incidence of cancer from 10 to 11 cases among 100 workers, the employer should be liable either for 1/11 of the cost of each case or fully liable for one of the eleven cases.[12] If the employer is liable for all cases of cancer among his or her employees, liability for the 10 cases that would have occurred anyway operates as an excessive tax on labor. It may induce nonoptimal safety precautions (if $p_x \neq \tilde{p}_x$) or nonoptimal employment and/or output (nonoptimal individual and market deterrence).

2. *Delay*

Delay between the toxic exposure and the disease manifestation adds at least three dimensions of uncertainty. First, if learning the true toxicity of new substances requires accummulated experience, the technological relationship $\tilde{p}(X,Y)$ is uncertain ex ante.

Second, delay complicates the determination of the marginal contribution of multiple parties, because evidence decays and the number of potential contributors tends to increase with time. This adds risk under a system of third party liability that does not exist under first party liability. The expected liability loss to each potential defendant depends not only on the excess risk created by occupational exposure but also on the conditional probability that a claim is filed and that the court finds for the plaintiff, and on the apportionment of damages between multiple defendants. Uncertainty as to liability is particularly severe under the tort rule of joint and several liability, whereby any one of multiple parties found liable can be assigned the full damages.

[12] See, for example, Landes and Posner [12].

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Third, delay permits liability rules to change between the time of exposure and time of injury manifestation and claim filing. If claims are judged by the compensation and liability standards prevailing at the time of injury manifestation, and if this future liability is accurately anticipated and prefunded at time of exposure (through the purchase of occurrence liability insurance coverage), the early generation is forced to pay for the standards of the later generation. Retroactive application of new standards is common in tort law.[13] It cannot be judged inefficient since the optimum standard of care is ambiguous when prevention costs and damage costs are borne by different generations. But if wealth is rising over time, the intergenerational transfer from early to later generations may be considered undesirable.

More important, uncertainty as to legal rules creates a "sociolegal" risk, which, because it increases with the duration of liability and is common to all policyholders in a particular line of insurance, cannot be reduced by increasing the size of the insurance pool. In principle, diversification should be possible through multiline insurance portfolios or through stockmarket portfolios. In practice, nondiversifiable risk appears to persist in lines of insurance with a long tail of delayed claims, notably product liability and medical malpractice. With nondiversifiable risk, the "safe" insurance premium includes a mark-up over the pure premium.[14] This mark-up is equivalent to a tax on policyholders in the early generation. It can be avoided only by limiting the duration of liability by a statute of repose (which limits the time allowed to file a claim), running from the date of toxic exposure, not from manifestation or discovery of the disease. While a statute of repose curtails the defendant's risk and hence the cost of liability insurance, it thereby transfers to victims the risk of discovering long latent injuries. They could in principle purchase first party coverages. But even if first party insurance were available on actuarially fair terms, it would provide incomplete insurance against the risk of becoming high-risk. Thus, in the context of occupational disease with delayed manifestation, the standard assumption of actuarially fair and complete liability and first party insurance—which is adopted by most theoretical analyses and (implicitly) by many judicial rulings—is particularly unrealistic.

Summarizing, an evaluation of alternative liabilty rules for occupational disease must consider their effect on incentives for prevention by multiple parties, some but not all of whom are contractually linked; the expense of determining marginal contributions of multiple parties, many years after exposure; and the costs of providing for long latent injuries through either liability or first party insurance.

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[13] Carrying the notion of strict liability to an extreme, in Beshada v. Johns-Manville Products Corp., 90 NJ 191, 447 A2nd 539 (1982) the New Jersey Supreme Court ruled that a manufacturer can be held liable for its failure to warn, even if the hazard in question was unknowable at the time of the product's sale.

[14] If the pure premium distribution is normal, the mark-up is $Z_r \varsigma_c$, where Z_r is a standard normal ordinate for confidence level r, ς_c is the limiting value for large n of the standard deviation of pure premium per policy holder. Danzon [7] shows that delay increases ς_c through parameter uncertainty and nondiversifiable sociolegal risk.

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III. Alternative Assignments of Liability

This section applies the principles developed so far to evaluate four possible assignments of liability and corresponding sources of insurance for occupational disease: (1) employer liability under workers' compensation law, with workers' compensation insurance; (2) tort liability of product manufacturers, with product liability insurance; (3) employees with private first party health and disability insurance, Social Security Disability (DI) and Medicare; and (4) special government programs, such as the Black Lung program. Because of the complexity of formally modelling the effect of each liability rule on the four components of cost—injuries, prevention, overhead, and uninsured risk—the discussion is qualitative. But it draws on the main conclusions of the formal models, that an optimal rule should ideally provide efficient incentives for prevention to all relevant parties; that some trade-off may be inevitable if providing optimal incentives entails high overhead or transaction costs; and that optimal compensation is not necessarily "full" compensation.

1. *Employer Liability Under Workers' Compensation*

Placing liability on employers through the workers' compensation system has advantages in prevention, compensation, and overhead costs. Employers control many inputs to workplace safety and are contractually linked to other potential contributors—product suppliers and employees. As noted in part II, dividing liability between multiple potential contributors is not necessary for optimal prevention incentives, provided contracting costs between the parties are low. Thus, placing liability solely on employers may be sufficient for optimal prevention, provided appropriate incentives are given to all relevant employers (see below).

For purposes of compensation, the workers' compensation norm of replacement of after-tax earnings plus medical and rehabilitation expense (economic loss) is probably closer to optimal insurance than is the tort principle of full compensation for all economic and non-economic loss. As show in equation (8″), optimal insurance (assuming zero load) depends on the marginal utility of income when injured, which presumably varies by type of injury. Because this marginal utility cannot be determined from theory, it must be inferred from the preferences revealed in voluntary market purchases of health and disability insurance. This evidence shows a willingness to pay for full replacement of after-tax earnings, plus reasonable medical expenses. But the data reveal little evidence of willingness to pay for "compensation" for pain and suffering, presumably because money cannot replace the attributes lost. Thus this evidence suggests that the tort norm of full compensation for non-economic loss exceeds the level of insurance for which people would voluntarily pay. The workers' compensation norm of compensation for

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economic loss only is closer to the optimum revealed by private choices.[15]

Third, litigation and insurance overhead costs are lower under the compensation system than the tort system, because benefit levels and eligibility criteria are defined by statute, within broad limits. Statutory guidelines reduce the range of issues to be litigated. They also reduce the sociolegal risk facing insurers, by making losses more predictable.

Nevertheless, the search for other remedies—tort or special government funds—has been fueled in part by the perceived inadequacy of workers' compensation benefits. This criticism is invalid, to the extent it uses as a benchmark the tort norm of full compensation for non-economic loss, which is not necessarily optimal compensation, as has been shown. The criticism may be valid, to the extent that statutory benefits provide less than full compensation of after-tax wage loss, because benefit levels lag behind inflation.

The criticism that some statutory definitions of occupational disease clearly exclude victims of long latent disease is harder to evaluate, because some statutory limits of this type may, in fact, be optimal. Some appearance of inadequate or arbitrary exclusion from compensation is inevitable, if the sole remedy and the all-or-nothing principles of workers' compensation are to be reconciled with imposing only the appropriate liability on industry. By these principles, a worker receives either full benefits, if the disease is deemed of occupational origin, or gets nothing. This all-or-nothing standard must either deny benefits to some with valid claims to partial compensation, or impose an excessive burden on industry. Using the example above, if employers are to bear only the incremental cost of disease caused by occupational exposure, either only one of eleven workers should receive full compensation or all eleven should receive partial compensation. The former solution will appear arbitrary; the latter leaves all victims less than fully compensated, and violates the sole remedy principle.

One proposed solution to this dilemma is that workers' compensation should pay full benefits but only for a subset of individuals or diseases, where occupational exposure is the "predominant factor of causation." Because this rule implies either an excessive or a suboptimal liability tax in all cases, it is unlikely to yield optimal individual deterrence.[16] Making employers liable for incremental damages in all cases yields more accurate individual deterrence, but entails higher costs of determining each employer's share of liabilty, and

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[15] This result is not surprising, since workers' compensation benefit levels are determined by a collective choice ex ante, before the actual beneficiaries are identified. Tort compensation is determined after beneficiaries are identified, in a courtroom context that invites extreme moral hazard and is subject to none of the constraints that insurers normally impose to limit moral hazard, such as ceilings or offsets to prevent double recovery. This comparison is discussed further in Danzon (7).

[16] It is theoretically possible but unlikely that overpayment on some cases would exactly balance zero payment on others, so total liability would equal the incremental disease cost caused by occupational exposure in an industry, yielding correct market deterrence (given the nonoptimal level of individual deterrence).

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costs of coordinating compensation from multiple sources. Which rule—incremental damages in all cases or full compensation for a subset of cases—is more efficient on balance is an empirical question, and may vary depending on the disease in question.

Another proposal that is widely advocated in order to reduce litigation expense is to place liability solely on the last employer contributing to the injury [5, 8]. Since long latent diseases are more likely to be manifest at older ages, employers would face higher expected liability costs for older workers. This rule would therefore provide suboptimal prevention incentives to employers of young workers, and may expose older workers to risk of job discrimination.[17] In principle, second injury funds could assume liability for pre-existing conditions and leave to the last employer only the marginal damage. In practice, the scope of most of these funds is very limited [13]. Thus, if the last responsible employer were solely liable, the likely outcome is pressure from employers and employees to shift the costs of occupational disease to special funds. Such a shift has been the experience of the Black Lung program. Under the enabling legislation enacted in 1969, the Federal government was to pay only for claims filed through 1973; claims filed thereafter were to be assigned to the last responsible operator. In response to political pressure, subsequent amendments have shifted more of the cost to the federal government and to the Black Lung Disability Trust Fund, financed by an excise tax on coal.

An alternative rule is to prorate liability among all employers in proportion to the duration of employment. Prorating liability would reduce incentives to discriminate against job applicants with prior exposure, assuming the total liability on all employers is only for the marginal damage due to occupational exposure. But to provide optimal incentives for safety, liability should be prorated according to contribution to risk, for which employment duration is only a crude proxy. While use of this proxy would avoid costly investigation of each employer's safety precautions, years after the fact, the employment rule eliminates incentives to improve workplace safety. Thus, individual deterrence would take the form of reducing employment, not reducing exposure per employee. Again, the additional costs of attempting a more accurate attribution of liability may be worth incurring if these costs are outweighed by benefits in injury prevention.

Note that the costs of attempting attribution of liability among multiple defendants should not be over-estimated by inference from the costs of the current asbestos litigation. These costs stem in part from the ambiguity of old liability rules and insurance contracts, in part from the tort rule of joint and several liability which provides no guidance as to the allocation of liability among the multiple tort defendants. A clear rule, known at time of exposure

[17] See Cummins and Olson [16] for a similar criticism of the Black Lung program. With fully flexible wages, expected employer liability would be translated into a flatter age-earnings profile for workers.

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and enforced at time of manifestation, that prorates liability in proportion to marginal damage, may not be excessively costly to enforce.

Having assigned liability among employers, there remains a question of assignment of liability among insurers if the insurer on the risk at the time of exposure differs from the carrier on the risk at the time the injury is manifest and the claim is filed. Prospectively, this assignment can be—and probably optimally should be—left to private contracts to determine. The ambiguous language of past contracts was an inevitable by-product of the failure to anticipate the issue. Thus once the liability rule is clearly determined, competitive insurance markets will, in principle, optimally allocate risk if all parties are fully informed.

Nevertheless, it is of some interest to speculate on what is likely to occur. If the insurer at time of exposure is liable, the insurance contract is an occurrence contract, which, because it forces internalization and prefunding of expected future liability, yields optimal deterrence (ignoring intergenerational transfers). If the insurer at time of manifestation is liable, the insurance contract is a claims-made contract. Workers' compensation insurance is currently written this way. With competitive rating, a claims-made contract creates incentives for an insurer to underwrite selectively and to base premiums on prior exposure. While this approach is necessary to transmit appropriate safety incentives, it transfers to employers the risk of unanticipated changes in liability rules. Since current liability costs arising out of past actions cannot be passed on in competitive product markets, farsighted employers may attempt to prefund future claims-made insurance premiums through self-insurance reserves. Employers with shorter time horizons may take suboptimal safety measures and plan to declare bankruptcy when the day of reckoning comes, thereby leaving workers without compensation. Occurrence coverage is therefore likely to be superior for purposes of deterrence, compensation of victims, and insurance of employers, if insurers have a comparative advantage in predicting and reserving for future liability costs.

Administered pricing of insurance could, in principle, be used to limit firm-specific experience-rating of premiums.[18] Past liability costs could be included in the rate charged to all firms in an industry, including new entrants. This approach would permit some pass-through of liability from past actions in higher product prices to current consumers. Administered pricing could also be used to permit a partial pay-as-you-go system, spreading the collection of a separate occupational disease premium over the average latency period for the occupational diseases.[19] But in competitive insurance and final product markets, the occurrence contract, assigning liability to the insurer on the risk

[18] "Administered pricing" is used loosely here to mean control over rates such that all insurers use a uniform rate structure and rate levels. Under administered pricing in practice, some firm-specific rating occurs through retrospective adjustments and dividend payments. Self-insurance by large firms also limits effective uniformity of rates.

[19] This pass-through is discussed in [5], page 76.

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at the time of exposure, appears to provide superior allocation of risk, because it provides more protection to employers and employees. Contrary to this prediction, however, workers' compensation remains on a claims-made basis and the current trend is toward claims-made coverage in all long-tailed insurance lines, including product liability. If product markets are competitive, the frequency of bankruptcy filings arising out of unfunded liability for occupational disease and product liability in general may increase. If so, a case may exist for mandatory occurrence insurance, but further analysis is necessary.

Where multiple insurers covered a particular employer at different times of the victim's exposure, prorating coverage in proportion to time on the risk is the analog of prorating liability. The alternative of placing all liability on the last insurer would expose the employer to risk, as under a claims-made policy.

While prorating liability over employers and their insurers with occurrence coverage provides optimal prevention incentives and allocation of risk in a static world, it entails costs of allocating liability among multiple defendants. Moreover, insurance overhead costs may be high if the long duration of liability creates a nondiversifiable sociolegal risk. Because workers' compensation standards are set by statute, they are less volatile than tort standards set by the courts, which is an added reason for handling occupational disease through workers' compensation rather than tort Statutory control over the compensation system can be used in three ways to curtail sociolegal risk and intergenerational transfer: (1) a statute of repose that sets an outer limit on the duration of the employer's liability from the date of the exposure; (2) setting benefits at the lower of (a) the level prevailing at the time of victim's exposure, adjusted upward by a price or wage index[20] and (b) the level at time of disease manifestation; (3) a special fund to cover liabilities incurred due to any expansion of eligibility standards between the date of exposure and date of manifestation. If standards of damages and eligibility are not codified, curtailing risk to employers might require a statute of repose of less than 20 years, which would bar many long latent disease claims, including most cancer claims, thereby severely undermining deterrence. A superior alternative in terms of prevention and risk allocation, is to codify eligibility and benefits.

2. *Tort Liability of Product Manufacturers*

Tort actions against product manufacturers, brought on expanded theories of design defect and failure to warn, have been permitted only since the 1970s. The prima facie rationale for allowing such actions is that product suppliers control product safety. But as argued above, when the supplier and the potentially liable employer are in a seller-buyer relation, appropriate incentives can be transmitted through contract terms and prices. This contractual transmission of safety incentives applies only if liability is assigned

[20]This adjustment would preserve real or relative purchasing power, respectively, and would approximately equal the rate of return on insurance reserves, if the nominal rate of interest is approximately equal to the rate of inflation plus the growth rate of real wages.

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to all employers contributing to the toxic exposure. Thus this logic justifies extinguishing tort claims against suppliers provided that liability to injured workers is prorated among all employees in proportion to their marginal contribution.

However, if the rule places all liability on the last employer, safety incentives for product suppliers transmitted through supply contracts with employers would be suboptimal. This deficiency creates a prima facie case for considering tort liability or direct regulation, provided that they yield deterrence benefits to outweigh the implementation costs. In the case of tort liability, these costs include those of determining, many years after the event, the quantity and quality of multiple suppliers' products used during the various periods of an employee's exposure, and of assigning liability between supplier(s) and employer(s), which is unlikely to be done with sufficient accuracy to yield valuable deterrence.[21] In addition, as argued above, tort tends to provide excessive compensation and entails nondiversifiable sociolegal risk. In the absence of statutory limits on tort awards, a reasonable curtailment of sociolegal risk might require a statute of repose sufficiently short, say 10–15 years, to bar many latent disease claims.

Thus the preferred solution appears to be to place liability on all contributing employers, through workers' compensation, and rely on contractual incentives for product suppliers. Tort actions by workers against product suppliers would be disallowed.[22] However, if appropriate safety incentives are not transmitted to suppliers via their contracts with potentially liable employers, regulation may be useful. The optimal form of such regulation is an important topic but beyond the scope of this paper.

3. *Employee Liability*

In the case of temporary injuries with no lag in manifestation, the allocation of liability between the employer, through workers' compensation, and the employee with first party insurance may be of little consequence. Workers' compensation premiums and first party health and disabilty premiums are experience rated to a similar degree; the employee's co-payments and benefit levels are also similar. Thus, both systems create similar safety incentives to employers and employees and provide similar levels of compensation.[23]

This similarity is less for permanent disabilities. The cost of purchasing first party insurance rises dramatically if disability forces a worker to quit or change jobs and he or she has to seek non-group coverage. Moreover, deterrence is undermined if the worker is totally disabled and eligible for DI

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[21] Moreover even if product suppliers are held liable, if the liability standard is essentially a negligence standard, in principle suppliers can avoid liability by conforming to the standard, but market deterrence will be suboptimal [18].

[22] Employers might still bring an action in tort or contract against a supplier of a defective product. The optimal limits of such tort rights are not addressed here.

[23] Strictly, this conclusion requires the further assumption that the incidence of workers' compensation and health insurance premiums is similar.

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and Medicare, which are funded from tax revenues without experience rating. Since workers' compensation benefits run indefinitely in the event of permanent injury, and premiums are experienced-rated, at least for large firms, both risk allocation and deterrence argue for erring in the direction of placing more burden on workers' compensation rather than first party coverages, in what will inevitably be a somewhat arbitrary division of liability.

In the case of injuries with delayed manifestation, even more pronounced differences emerge between employer liability under workers' compensation and employee first party coverages. Employer liability (assuming an exposure rule with occurrence insurance coverage) forces prefunding of future liability, whereas first party employee coverages are funded on a pay-as-you-go basis. The worker with past exposure will then face employment discrimination. In principle, with perfect anticipation, workers would seek compensation for this future risk in their wage demands to the original employer. But this demand is best met by providing long term, group insurance such as the right to worker's compensation. A compensating wage differential of equal actuarial value could not buy equivalent coverage because of higher marketing costs and adverse selection in the market for non-group first party coverages.

4. *Government*

Several of the recent proposals for a federal role in occupational disease resemble the proposal advanced here, in that they would extinguish tort remedies against product suppliers and employers, and rely primarily on workers' compensation claims against employers. In addition, however, they place all liability on the last responsible employer, set standards of compensation,[24] and provide for compensation from federally administered special funds,[25] if state benefits do not meet prescribed standards or if a responsible employer cannot be identified. Typically, these proposals would fund the federally administered compensation through a special tax on the industries responsible for the exposure, such as tobacco and asbestos.

The case for a special federal fund is strongest if the program is of limited duration, designed to handle the purely retrospective problem of compensating for unfunded liabilities arising from unanticipated disease risks or changed liability rules. As argued above, if the fund applies only to injuries already incurred, deterrence or prevention are not at issue. The issue is purely distributional, and any equity argument for funding through a special tax on the offending industries as a whole rather than a general tax on all taxpayers must depend on the rather tenuous assumption that at least some members of the current generation of shareholders, workers and consumers, who will bear

[24] For example, S. 1643, the Asbestos Hazards Compensation Act, introduced by Senator Gary Hart (D-Colo.).

[25] For example, H.R. 853, the Brown Lung Benefits Act, introduced by Congressman Phillip Burton (D-Cal), the Occupational Health Hazards Act, H.R. 5735, introduced by Congressman George Miller (D-Cal), and the Asbestos Health Hazards Compensation Act, H.R. 5224, introduced by Congresswoman Millicent Fenwick (R-N.J.).

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the burden of the special tax, are the same as those who benefited from inadequate internalization of costs in the past. However, unlike the original Black Lung Act, the current proposals are not intended to be temporary.

A permanent federal program that applies prospectively is likely to yield non-optimal deterrence and compensation. With respect to prevention, unless financing of a government program is through experience-rated premiums, individual deterrence is undermined. If funding is pay-as-you-go, through a tax on the offending industry to cover payments as they occur, accurate market deterrence is achieved only if this future liability is anticipated and internalized into prices at the time of exposure. But this internalization is unlikely because an industry-wide tax, levied at time of injury manifestation, can be at least partially passed on to current consumers and workers, in contrast to unfunded liability of a few firms.

With respect to compensation, a system that provides federally funded benefits to states that fail to meet federal standards is an open invitation to moral hazard. Any state has an incentive to set standards too low to comply with the federal standards, if it can thereby shift part of the cost to out-of-state taxpayers. Since state residents will typically pay a larger fraction of their workers' compensation costs than of a federal tax, this incentive is likely to be pervasive. Thus most of the recent proposals are likely to induce states to lower benefit levels but expand eligibility criteria, thereby shifting compensation of the maximum number of individuals to federal funds. A replay of the explosion of federal costs for black lung is highly likely, under any formula that sets a federal standard and promises unlimited federal funds to make up any discrepancy between this federal standard and state-set standards. If federal funding must be used, this moral hazard can be controlled by using a declining matching federal share, based on the number of victims, the state population and per capita income, with the federal share falling to zero as benefit levels and eligibility levels are liberalised [10]. But a trade-off is inevitable: the formula that perfectly controls moral hazard will reduce to a compulsory level of compensation benefits.

The case against uniform national benefit levels is distributional.[26] Compensating victims of occupational disease may have some public good component at a national level (some concern about all victims) but also a state-specific component (greater concern for those in close geographic proximity), and the value placed on this compensation may depend on tastes, income, etc. For example, if compensating occupational disease victims is a normal good, setting standards federally may force low income states to provide higher benefit levels than they would choose. Of course, this imposition is avoided if states are free to set their own standards and victims in states failing to meet federal standards are compensated out of federal funds levied on states that dictate the higher standards. In practice, the special levy is unlikely to allocate the costs in proportion to demand for higher standards.

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[26] For an analysis of this issue in the context of Medicaid, see Grannemann and Pauly [10].

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Finally, the argument that special federal funds are needed because many victims have no alternative source of compensation is often overstated, given the extent of private health insurance and public programs. The employee who is partially disabled remains employable, provided either prior employers or a second injury fund is liable for prior exposure. If employed, he or she is typically eligible for first party health and possibly disability insurance to cover any new mishaps. The victim whose disability prevents all employment and who is not compensated through workers' compensation (because the occupational exposure is judged not a significant cause of the disability) is eligible for DI and Medicare, provided he or she meets the prior employment requirements for eligibility. Rather than create new programs, a more useful reform would eliminate these prior employment requirements from existing social disability insurance programs, since they tend to exclude precisely those who lack employement-based private or workers' compensation coverage, and therefore are most in need of a public program.

Conclusion

The design of liability rules for occupational disease should consider their prospective impact on incentives for prevention and exposure to uninsured risk, as well as implementation costs. The analysis here suggests the following:

- extinguish tort actions against product suppliers and employers;
- make workers' compensation the sole remedy;
- prorate liability among prior employers in proportion to their marginal contribution to the worker's exposure;
- set benefits at the lower of (a) the level prevailing at time of exposure, adjusted upward by a price or wage index, and (b) the level at time of manifestatión;
- allow the market to determine the optimal insurance contract (occurrence or claims-made) if the rating regime is competitive. If the rating regime is adminstered pricing, with rates controlled by a bureau, by regulation or by the state, prorate liability among the carriers on the risk at time of exposure (an occurrence contract).

The potential benefit of such a system lies in efficient incentives for injury prevention and allocation of risk. If these potential benefits are in practice outweighed by the costs of implementation—a real possibility that can only be verified empirically—the next best alternative appears to be first party insurance supplemented by existing social insurance programs (DI and Medicare), which should be reformed to eliminate gaps in eligibility and to introduce experience rating into the payroll-tax system of funding.

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