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OCCUPATIONAL SAFETY AND HEALTH
REGULATION

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Abstract

An employer will invest in safety and health precautions until the cost is more than the expense of paying higher wages, workers' compensation, and other accident and illness costs. Employees receive additional protection because governments have chosen to augment these financial incentives with regulation. Studies indicate that all three approaches cause employers to invest in health and safety precautions, but the extent to which injuries and illnesses are reduced is difficult to verify and may be limited in numerous work situations. The literature has identified potential reforms, but the viability of key reforms is uncertain. Thus, labor markets, compensation and regulation are highly imperfect alternatives concerning the reduction of occupational accidents and illnesses. As a result, continued reliance on all three approaches is indicated.

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A. Introduction

1. Imperfect Alternatives

Economic theory predicts that workers will demand additional wages, or a 'wage premium', to compensate them for workplace safety and health risks. Employers will respond by reducing such risks until it is less expensive to pay workers additional compensation than it is to invest in additional health or safety precautions. In this manner, labor markets should produce the abatement of some safety and health hazards, and workers should be compensated for the risks that remain.

Since the early 1900s, governments have intervened to augment these labor market incentives. According to Darling-Hammon and Kniesner (1980), virtually every state in the United States enacted some quasi-administrative

scheme to award compensation for workplace accidents between 1911 and 1920. Today all 50 states and the federal government administer such programs. In 1970, Congress enacted the Occupational Safety and Health Act (OSH Act) which established the Occupational Safety and Health Administration (OSHA) in the Department of Labor to regulate workplace conditions. States have the option to accept federal regulation of employers or to administer their own safety and health regulations subject to OSHA's approval and supervision. Other countries have also implemented administrative regulation. These governmental efforts indicate a political judgment that labor markets produce insufficient protection for workers.

This essay describes how economic theory explains the role of labor markets, compensation, and regulation in addressing occupational injuries and illnesses. I also report on studies that have tested the effectiveness of each of these methods, and I discuss reforms to improve the effectiveness of each approach.

Readers seeking an overview of these issues can consult several books and articles. Chelius (1974), Oi (1974), Rea (1983), Viscusi (1983, 1992), Dickens (1984), Schroeder and Shapiro (1984) and Robinson (1991) offer general comparisons of the impact of labor markets, compensation and regulation on workplace safety and health.

This chapter confirms Komesar's (1994) insight about options for making society safer and healthier. When governments choose between market, compensation, and regulatory approaches, Komesar contends that '[t]he choice is always a choice among highly imperfect alternatives'. Labor markets, compensation, and regulation are 'imperfect' alternatives concerning the reduction of occupational accidents and illnesses because none of these alternatives is reliable. Instead, each is limited by significant constraints, which are explained below.

Reformers seek to address these constraints, but the constraints are intractable in many instances. Thus, it appears to be necessary to rely on all three approaches, because no one (or even two) approaches is likely to produce an appropriate level of occupational safety and health. Together, however, labor markets, compensation and regulation can come closer to this elusive goal.

B. Labor Markets

2. Introduction

Economic theory establishes that labor markets create several incentives for employers to reduce occupational safety and health risks. Economic studies confirm the existence of one such incentive: the demand by workers for additional compensation, or a 'wage premium', for exposure to safety risks.

The adequacy of such wage premiums, however, is in dispute. Moreover, analysts generally concede that workers are unlikely to be compensated for most health risks. Governments have attempted to aid workers in obtaining additional compensation by promoting the distribution of information about workplace risks and by addressing workers' lack of bargaining power.

3. Economic Theory

An employer will determine whether to prevent workplace accidents or illnesses by comparing the cost of prevention with the cost of not taking such action. Employers that fail to reduce workplace hazards can expect to pay increased labor costs because workers will demand additional compensation for enduring occupational safety and health risks. For a given level of workers' compensation, workers will demand a wage premium that compensates for any inadequacies in *ex post* compensation. In other words, assuming workers are fully informed about job risks, they will seek compensation equal to the expected cost of an injury or illness not covered by workers' compensation. In addition, the employer may have to pay for the cost of recruitment and training of additional workers to replace those persons who are injured or killed and other related costs. To avoid these expenses, an employer will make safety and health improvements until the cost of additional precautions is more than paying wage premiums and other related costs.

In this manner, labor markets should produce the abatement of some safety and health hazards and workers should be compensated (*ex ante* and *ex post*) for the risks that remain. The employer's assumption of these costs will make the market for the employer's product or service more efficient. Because the employer assumes these costs, the price of the product or service will reflect the cost to society of the production of the good or service, including the cost of occupational illnesses and injuries.

4. Empirical Evidence

Studies by Viscusi (1983) and other analysts (listed and described by Viscusi) find that workers in risky jobs receive higher wages after controlling for education, experience, and other market characteristics. Viscusi estimates that average annual compensation for all job risks in the United States totals about \$400. Similarly, Robinson (1991) estimates that workers exposed to significant risks of occupational injuries received annual wage premiums of about \$300-\$500. This amounts to about a 5-8 percent increase above the earnings of unexposed blue-collar workers. Fishback (1986) cites empirical evidence that

miners in the United States in the 1900s received risk compensation. Weiss, Maier and Gerking (1986) discovered risk compensation in Austrian labor markets.

By comparison, Leigh (1991), who reviewed several prior studies, found that only variables which reflected job hazards resulting in death were associated with compensating wages, and that among studies using death rates, only some studies found evidence of wage premiums. Further, among studies finding evidence of such wages, the amount of compensation paid for the risk of death varied widely. Leigh's own study found evidence of compensating wages based on Bureau of Labor Statistics fatality data, but he found no correlation based on workers' compensation fatality data. A review by Dorman (1996) of the literature on compensating wages, including Leigh's study, characterizes the evidence for wage premiums as 'weak at best'.

5. Evaluation of Empirical Data

The empirical evidence is mixed concerning the extent to which workers obtain wage premiums for dangerous work. Moreover, even when workers obtain compensating wages, there is an issue of the adequacy of the compensation. As the last section revealed, studies finding compensating wages indicate that workers receive only modest wage premiums. Even a small wage premium, however, is significant if workplace risks are not very large. For example, Viscusi (1983) concludes that once analysts take into account the nature of a risk and the population exposed to it, it is evident that workers are well paid for the risks that they face. According to Viscusi, 'most' of the 'reasonable' estimates indicate that workers demand between \$3 and \$7 million compensation for exposure to potentially fatal accidents. Workers, however, may receive less compensation than Viscusi estimates.

First, if the risk of a fatal accident is greater than the data on which Viscusi relies, workers receive less compensation than he estimates. McGarity and Shapiro (1993, 1996) found that experts believe existing statistics understate the extent of workplace fatalities (and injuries) in the United States by an unknown and perhaps significant extent.

Second, the amount of additional compensation that a worker will seek for hazardous work is a function of the worker's knowledge and understanding of existing risks. Robinson (1991) cites survey data which reveal that workers' knowledge is incomplete. He found, for example, that 33 to 50 percent of workers in occupations with high rates of disabling injuries and illnesses reported that they faced no significant safety or health hazards. Carmichael (1986) adds that because the dissemination of safety information in labor markets takes time, workers may lack adequate information when they seek a job. Oi (1974) notes, however, that full information by all workers is not

necessary to obtain adequate compensating wages. What is important is that the marginal worker possess full information.

Third, workers must be able to discern marginal differences in risks to bargain effectively for hazard pay. Yet, as Lave (1983), Dickens (1984) and McGarity and Shapiro (1993) discuss, such distinctions are especially difficult to make in the context of occupational illness, where huge uncertainties befuddle attempts to predict the precise effects of health risks on longevity and the quality of life once a disease has manifested itself.

Further, as Dorman (1996) discusses, a worker's evaluation of risk may be distorted by psychological effects in the way individuals process risk information. Studies in the psychological literature suggest that people do not process risk information in the rational manner that economic theory assumes. For example, people engage in several forms of 'bounded rationality' which simplify and filter risk perceptions. Risk perceptions are also impacted by attitudes towards risk, such as the fact that persons tend to fear more acutely those risks they cannot control. Cognitive dissonance is another factor, because it induces people to ignore or alter their perceptions of risk in order to avoid unpleasant conflicts with established beliefs.

Fourth, the additional compensation that a worker can obtain for hazardous work is a function of the worker's bargaining power. Boden and Jones (1987) point out that estimates of wage differentials are substantially higher for unionized employees than for nonunionized employees. Moreover, Robinson (1991) cites data indicating that only poorly educated and low-skilled employees are likely to take dangerous jobs. His calculations reveal that hazardous jobs pay 20-30 percent less than safe employment after taking into account education and skill levels. He concludes that persons with training and education avoid such jobs because safer employment pays more, and that hazardous jobs are more likely to go to minority workers. Robinson found that Hispanic males were 80 percent more likely to suffer a disabling injury or illness than whites in California, and that black men were 40 percent more likely.

McGarity and Shapiro (1993) argue that even educated and skilled workers may hesitate to leave dangerous jobs because the hazardous pay is inadequate. Such workers may be hesitant to change jobs because of the loss of health benefits, pension rights, and seniority, the expense and disruption of relocation, and the difficulty of becoming familiar with a new employer. Boden and Jones (1987) hypothesize that these reasons explain the relatively low wage premium received by asbestos installation workers who were familiar with the significant risks that they faced. A study by Kahn (1987) finds that occupational safety levels in nonunionized firms reflect only the preferences of workers with three or less years of job tenure, who are, he presumes, the most mobile workers in the firm.

Dorman (1996) proposes that game theory be used to study the relationship of workers and employers concerning issues such as risk compensation. He argues that because game theory accounts for strategic behavior, it can clarify how cooperation and conflict inside a corporation impacts issues of public policy such as the protection of workers.

6. Reform

Workers may be inhibited in obtaining wage premiums for workplace safety and health risks because of the lack of information or inadequate bargaining power. Analysts have discussed what steps governments can take to address these problems.

Regulatory policies that increase workers' access to risk information should improve market performance. Government action is likely to be necessary because, as Viscusi (1983) points out, the 'aberrant characteristics of information as an economic good' inhibit the creation of market arrangements to produce such information.

OSHA's hazardous communication standard is a good example of this type of government mandate. The regulation requires chemical manufacturers to provide a material safety data sheet, based on the available literature, for each hazardous product that they produce or use. The information is then made available to workers who are exposed to these products. Carle (1988) proposes improvements in OSHA's regulation, while Viscusi (1983) supports additional regulation. He recommends that employers be required to apprise workers of the nature of the risks that they face, the risk level of the firm (death, injury and illness rates), its relative risk as compared to other firms in the industry, and other relevant risk information.

The impact of additional information will depend on the ability of workers to use risk information. As noted in the last section, workers may have limited cognitive capacities or psychological defense mechanisms that impede rational use of risk information. Government can address these limitations by requiring that employers train workers to evaluate the information that they receive.

A worker's ability to obtain a wage premium is also dependent on the person's bargaining power. Workers would have more bargaining power if they could not be fired for their refusal to undertake hazardous work. Rea (1983) reports that some Canadian provinces have given workers the right to refuse unsafe work. McGarity and Shapiro (1993) support similar reforms for the United States.

C. Compensation

7. Introduction

The wage premiums received by workers constitute *ex ante* compensation for occupational accidents and diseases. Workers also receive *ex post* compensation through workers' compensation and tort law.

Spieler (1994) provides a detailed description of the role of workers' compensation in the United States. Prior to the early 1900s, workers could sue their employers for negligence if they were injured at work, but these tort suits were frustrated by a number of legal doctrines that prevented workers from recovering. According to Chelius (1976), many state legislatures had abolished some of these defenses prior to 1911. Recovery under the tort system remained inadequate, however, which prompted the passage of workers' compensation laws. These laws discarded most of the remaining legal obstacles to recovery and, as a tradeoff, established two important limitations on workers. States prohibited workers from suing their employers under tort law, and they limited the types and amount of damages that workers could recover. Morgenstern (1982) has a general description of the role of compensation in other countries.

Employers should respond to higher compensation costs by investing in safety and health improvements. Yet, analysts have been unable to establish a clear correlation between such higher costs and a reduction in workplace injuries and fatalities. Despite the lack of evidence, some analysts argue that workers' compensation provides a significant incentive to make safety and health improvements, but other analysts dispute this conclusion. What is clear is that workers' compensation fails to reimburse employees for accident and illness costs that are not paid by wage premiums. Government may improve the function of workers' compensation by requiring employers to pay higher compensation, mandating that insurance rates more accurately reflect an employer's safety experiences, or imposing a tax-based system of compensation.

8. Economic Theory

An employer will determine whether to prevent workplace accidents or illnesses by comparing the cost of prevention with the cost of not taking such action. For risks that are not prevented, the employer will be responsible for paying workers' compensation to injured or ill employees. A firm will invest in safety and health precautions until the cost is more than the cost of paying higher wages, workers' compensation, and other accident and illness costs. If workers are fully compensated (*ex post* and *ex ante*) for the accidents and illnesses which are not prevented, the market for an employer's product or

services will be more efficient. The market is more efficient because the price of the product or service will include the cost of occupational accidents and illnesses associated with its production. In this manner, the price will reflect the actual cost to society of the production of the good or service. The actual cost to the firm of paying compensation, however, will depend on the nature of its insurance arrangements. Insurance arrangements can reduce a firm's incentive to prevent future accidents and illnesses as explained below.

9. Empirical Evidence

Although employers pay billions of dollars for workers' compensation, analysts have been unable to verify that higher costs are associated with a reduction in workplace injuries. Some studies even find that higher costs are associated with an increase in injuries.

The cost of workers' compensation in the United States was about \$62 billion in 1992 according to Boden (1995). Viscusi (1992) points to this cost as evidence that workers' compensation is more influential than OSHA in promoting workplace safety because employers paid only about \$10 million in OSHA fines in the same year.

The empirical evidence, however, is equivocal concerning whether workers' compensation induces employers to take safety precautions. Boden (1995) reviewed sixteen studies (which he lists and describes) which tested the relationship between an increase in workers' compensation costs and workplace injuries, as measured by injury statistics or workers' compensation claim rates. Most of the studies concluded that injuries increased or remained unchanged when benefit levels rose. A study by Moore and Viscusi (1989), however, concludes that the average fatality rate would have been 22 percent higher if there had been no workers' compensation. By comparison, Butler and Worrall (1991) report that 'virtually' all studies of claim usage in workers' compensation find that an increase in indemnity benefits increases workers' compensation claim frequency.

10. Evaluation of Empirical Data

Some analysts interpret the previous data as supporting the conclusion that workers' compensation provides a significant incentive to make safety and health improvements. They argue that the data do not reveal this correlation because various actions by employees offset the reduction in compensation claims attributable to employer safety improvements. Other analysts argue that workers' compensation does not create significant incentives for employers to

invest in safety and health improvements because of the impact of insurance and other factors.

The impact of workers' compensation on occupational safety and health also depends on the extent to which workers are compensated for their injuries and illnesses. Despite the large cost of workers' compensation, employers pay for only a portion of the cost of workplace accidents and for almost none of the cost of occupational illness.

11. Employee Behavior

Employee behavior may explain why increases in workers' compensation costs may not have produced lower injury rates. According to Butler and Worrall (1991), an increase in benefits will increase the propensity of workers to file claims for two reasons. When benefits are increased, workers are willing to undertake greater risk than previously and more injuries will occur. Also, workers have a greater incentive to file a claim for any given level of risk. Butler and Worrall characterize the former response as a 'risk-bearing moral hazard' and the latter behavior as a 'claims-reporting moral hazard'. In addition, claims may increase because higher benefits induce additional fraud. The additional claims which result from these three types of behavior, if large enough, could offset any reduction in compensation claims attributable to employer safety or health improvements undertaken in response to increased compensation costs.

According to the 'risk-bearing moral hazard' theory, workers are less vigilant and therefore suffer more (and more serious) injuries because higher benefits diminish the personal economic risks associated with such injuries. If such behavior offsets the impact of safety improvements by employers, as Fishback (1986, 1987), Lyttkens (1988), Moore and Viscusi (1990) and Butler and Worrall (1991) suggest, this theory would explain the positive relationship between increased workers' compensation costs and injury rates. McGarity and Shapiro (1996) are skeptical of this explanation, however, because workers have strong economic and other incentives to avoid injuries. As discussed below, workers receive less, sometimes far less, than the actual costs of their injuries and illnesses. McGarity and Shapiro also doubt the idea that the prospect of money in the future will persuade a significant number of people to risk severe pain, hospitalization, dismemberment, and even death in the present.

The second explanation of employee behavior focuses on the 'claims reporting moral hazard', which is also characterized as a 'reporting' effect. According to this explanation, higher workers' compensation only increases the number of accident reports and not the absolute number of injuries. Since workers lose less income if they miss work, they may report more injuries and stay off work longer.

Researchers have evaluated this second type of moral hazard by focussing on the link between workers' compensation rates and events that should not be subject to a reporting effect. Some studies have focussed on the relationship between higher compensation rates and fatalities. Because fatalities are clear-cut events, there should be no overreporting. Moore and Viscusi (1990) and Ruser (1993) found that increased benefits levels were associated with reduced fatality rates, but Butler (1983) discovered that benefit increases were associated with higher fatality rates. A study by Robertson and Keeve (1983) compared the impact of benefits levels on sprains and strains as compared to more 'objective' injuries, such as lacerations and fractures. This comparison revealed that reported injuries of both types increased with benefit levels, although the effect was stronger for sprains and strains. Kniesner and Leeth (1989) claim to establish the validity of the reporting theory based on a computer simulation.

A study by Butler, Durbin and Helvacian (1996) attributed most of the significant increase in workers' compensation claims for soft tissue injuries in the 1980s to moral hazard responses by employees and also by physicians. A physician in a health maintenance organization (HMO) may earn more by misclassifying a soft tissue injury as compensable in the workers' compensation system, because this permits the physician to avoid a payment cap imposed by the employee's health insurance company.

Higher benefits might also induce more cases of fraud. For example, Staten and Umbeck (1986) propose that the practical need for administrators to screen compensation applicants on the basis of observable characteristics creates the potential that workers can manipulate the evidence at critical margins. They found evidence to support such a 'signaling effect' among air traffic controllers who sought compensation for stress-induced impairment. Burton (1992), however, concludes there is a 'lack of supporting quantitative evidence' and a 'paucity of compelling qualitative analysis' that significant fraud occurs.

12. Employer Behavior

Moral hazard behavior may explain why analysts have had difficulty finding a correlation between higher compensation costs and a reduction in accidents and illnesses. Another explanation is that workers' compensation does not create significant incentives for employers to invest in safety and health improvements. Employers may fail to take safety precautions in response to higher compensation costs for two reasons. First, workers' compensation insurance accurately reflects an employer's safety experience only for the largest firms. Second, there may be less expensive ways for employers to decrease compensation costs than to make safety and health improvements.

Spieler (1994) explains that the price of workers' compensation insurance does not reflect, or only partially reflects, the claims experience of most employers. The sensitivity of premiums to claims experience varies inversely with the size of the firm. The smallest firms, which constitute the majority of purchasers of all insurance, pay premiums that have no relationship to their actual claims experience. Because small firms have so few employees, insurance companies view their individual claims experience as too random to have any predictive value. Insurance companies therefore base the cost of insurance for small employers on the claims experience of a class of similar employers. Thus, small employers have only a weak economic incentive to take safety precautions because their actual claims experience will have little effect on their future premiums.

Larger firms, which pay premiums based in part on claim losses, have a greater incentive to engage in injury prevention. The extent to which these firms are rated according to their claims experience depends on the credibility or predictive value of that experience.

Only the largest employers are self-rated, which means they pay rates that are based entirely on their claims experience. These firms, and firms that self-insure, therefore have the greatest economic incentive to reduce workplace risks. According to Victor (1982), however, the incentives for prevention are greater for self-rated firms in hazardous industries than for firms that self-insure in the same industries.

Analysts have compared the reduction in injuries at large and small firms to determine if there is an 'experience-rating effect'. Some studies have found that higher compensation costs are associated with a decrease in injuries at large firms as compared to small firms, but other analysts have been unable to confirm this result. A study by Worrall and Butler (1988) revealed that reported injuries declined more at large firms than small ones when compensation costs increased. By comparison, Ruser (1985, 1991) found that higher benefits led to higher rates of nonfatal injuries at large and small firms, but that these effects were smaller for larger firms. Ruser considers this result as evidence that experience rating does matter, and that it counteracts other incentives for increased injuries. Another study by Ruser (1993) found an experience rating impact for injuries, but not for fatalities. Chelius and Smith (1983, 1993) were unable to verify an experience rating effect.

Employers will not invest in safety or health improvements if there are lower cost methods to avoid compensation payments. The literature suggests that employers may have two such options.

First, Spieler (1994) and Ison (1986) specify a number methods by which employers can discourage employees from filing claims or if claims are filed, from prevailing. Employers can pressure employees not to file claims, delay the

completion of necessary paperwork, aggressively contest claims, and persuade employees who file claims to return to work prematurely.

Second, as Spieler (1994) documents, employers have reacted to higher compensation costs by engaging in political activity to reduce future payments to workers. In response, states have reduced the level of benefits for some types of injuries, made other types of injuries noncompensable, limited allowable medical costs, capped physician fees, adopted administrative changes to make it easier to discontinue benefits to workers, and reduced lawyers' fees. At the same time, however, states have also adopted various types of injury prevention and safety incentives or requirements. The literature does not indicate whether the net effect of these two types of actions has been to reduce or increase the incentive of employers to take safety precautions. The impact may vary from state to state depending, among other factors, on the relative political strength of employers and organized labor.

Spieler also hypothesizes that employers may seek to reduce workers' compensation payments by methods other than safety improvements because they 'often perceive themselves as having less influence over the occurrence of injuries than they in fact have'. More generally, Veljanovski (1982) demonstrates that compensation systems will not produce optimal results under conditions when employers, as well as workers, have imperfect and asymmetrical information.

13. Adequacy of Compensation

Analysts debate whether the cost of workers' compensation creates an incentive for employers to reduce workplace accidents and illnesses. Even if it is assumed that such an incentive exists, spending on accident and illness prevention will not be optimal unless employers compensate employees for inadequacies in *ex ante* compensation. The evidence suggests however, that workers' compensation does not reimburse workers for the costs of an injury or illness not covered by wage premiums.

Schroeder and Shapiro (1984), Spieler (1994) and Boden (1995) establish that the states have established damage caps and other limitations that significantly restrict workers' compensation for accidents. In most states, the level of compensation varies inversely with the seriousness of an injury. Compensation for temporary disabilities is controlled by statutory prescribed formulas that limit compensation to less than the direct wage losses of better paid employees. Compensation for permanent partial disability payments often does not equal the total wage loss of any employee. Compensation for fatalities is often less than for temporary and permanent disabilities. Furthermore,

workers' compensation does not include in damage calculations the loss of fringe benefits or nonpecuniary losses to workers and their families.

Moreover, employers pay very little compensation for workplace-induced illness. Statistics cited by Weiler (1986) indicate that states compensate only 250 cancer cases per year as compared to the thousands of cancer fatalities that may be work related. Government studies cited in Schroeder and Shapiro (1984) indicate that only 2-3 percent of all workers' compensation payments are for occupational disease.

Schroeder and Shapiro and Barth (1984) hypothesize that several factors explain this low compensation rate. Workers and their physicians often fail to recognize that many illness are work-related. Moreover, employers are often successful in contesting those claims which are filed because of the difficulty of proving causation and because many states have restrictive standards for recovery. The few disease victims that do prevail face the same statutory limitations on compensation amounts that apply to injury victims.

Even if more workers were compensated at higher rates, employers may still lack a strong economic incentive to invest in health precautions. A manager's decision to invest in disease prevention is not based on current compensation expenses, which result from past actions, but on the likelihood that the investment will prevent future illness. Since occupational diseases are frequently characterized by long latency periods between exposure and disease onset, the manager can discount heavily the consequences and spend little or nothing on prevention. The manager's decision to discount the costs of future illnesses may accurately reflect the current costs to the employer of future illnesses. A manager, however, may be tempted to discount the cost of future illnesses for another reason: any consequences for the employer will occur long after the manager has retired. Moreover, managers know that many workers will change jobs during the long latency period which frees the employer from paying compensation when the worker becomes ill.

14. Tort Compensation

Few workers can seek additional compensation in a tort suit. Workers' compensation laws in the United States almost always prohibit an employee from suing an employer for a tort remedy.

As a result, a worker can seek a tort remedy only if some third party is responsible for an accident or illness. Viscusi (1989, 1991) reports that product liability claims for work-related injuries constitute about 13 percent of all product liability claims. After a detailed analysis of such law suits, he concludes that both workers' compensation and tort liability have 'important' roles to play and that further research is necessary to understand the relationships of the two

remedies. Boden and Jones (1987) found that the product liability compensation in asbestos cases 'may' provide substantial incentives for manufacturers to warn of future hazards, but that workers' compensation provided 'extremely' low incentives for the control of asbestos.

Schroeder and Shapiro (1984) believe few workers are likely to receive tort compensation for occupational illnesses. They list the array of legal hurdles that such workers must overcome. Moreover, Wiggins and Ringleb (1992) demonstrate that bankruptcy can be a viable shield from compensation payments in cases involving long-term hazards.

15. Workers' Compensation Reform

The government, as Phillips (1976) discusses, has three options to increase the financial incentive of employers to make safety and health improvements. First, it can require employers to pay higher amounts of workers' compensation. Second, it can require insurance companies to base rates to a greater extent on the actual accident experience of employers. Finally, the government can impose a tax on employers that would reflect the costs associated with workplace accidents and illnesses. This last option is discussed in the next section.

An increase in workers' compensation payments should stimulate greater investment by employers in safety and health precautions, but an earlier discussion indicated that employers may not react in this manner. Moreover, there are significant practical and legal hurdles to adopting this reform in the United States. An increase in compensation would require action by 50 states and overcoming the opposition of employers who could expect to pay higher insurance costs.

Greater reliance on experience rating should encourage employers to improve workplace safety and health because an employer's insurance costs would be more closely tied to the firm's actual safety and health record. Phillips (1976) discusses Ontario's experience with a 'penalty' rating system that is intended to increase experience rating by insurance companies. Spieler (1994) explains that insurance companies in the United States have fought attempts to increase experience rating because it increases their costs. Governmental attempts to impose experience rating will therefore draw the political opposition of both insurance companies and high injury rate employers. Low injury rate employers, however, may support such changes.

The previous reforms would improve how workers' compensation functions to reduce workplace accidents. Most analysts agree with Lave (1983), however, that it 'seems inconceivable' that workers' compensation can be reformed to handle occupational disease. Dewees and Daniels (1988) discuss the difficulties

of designing a system that addresses the constraints, discussed earlier, which impair disease compensation.

16. Injury and Illness Taxes

Instead of reforming workers' compensation, many analysts have expressed interest in imposing injury and illness taxes. Analysts recommending imposition of an injury tax include Smith (1974, 1976), Nichols and Zeckhauser (1977), Mendeloff (1980), Rubin (1984), Sider (1984) and Sunstein (1990). Employers can be expected to oppose vigorously a new tax. This may explain why so few governments have tried this approach despite its theoretical attractiveness.

An injury tax would have several advantages. It would create an additional incentive for employers to reduce workplace accidents and illnesses. Further, the amount that an employer would pay would be a function of its safety record. Thus, unlike workers' compensation, an employer's incentive to take safety precautions is not diluted because of the impact of insurance. As explained earlier, the cost of workers' compensation insurance for many firms does not reflect, or does not fully reflect, their safety record. Finally, as compared to OSHA regulation, a tax is a more efficient method by which to reduce workplace risks. Under OSHA regulation, all employers must comply with the level of safety that OSHA specifies regardless of the cost of compliance. Under a tax approach, an employer would have the option of paying the tax if it was less expensive than the cost of abatement of a hazard.

Shapiro and McGarity (1991) dispute that a tax would necessarily be more efficient than regulation. First, they contend that OSHA regulation is not as inefficient as the agency's critics believe. They note that OSHA relies on performance standards, which permit an employer to choose the method of compliance, and on variances, which give employers with high costs additional time for compliance. Second, they predict that employers are likely to engage in the same types of tax avoidance as they now practice concerning other taxes.

A tax approach can also be used for occupational disease, but calculation of an appropriate tax rate might not be possible. Dewees and Daniels (1988) caution that the determination of an appropriate exposure charge would be difficult because it would require information that is not readily available. An exposure charge based on health effects requires knowledge of a quantifiable dose-response function, which measures the number of workers likely to become ill at different levels of exposure. Dose-response estimates, however, are not available for most chemicals, and the estimates that are available often vary by several orders of magnitude. Barth (1984) and Viscusi (1984) would avoid this problem by financing compensation for employees with a broad-based tax levied on their employers. This approach, however, would not

generate appropriate incentives for illness avoidance, because the tax would not be based on extent to which individual firms exposed workers to dangerous chemicals.

D. Regulation

17. Introduction

Labor markets and compensation of injured and ill workers create financial incentives for employers to take safety and health precautions. Regulation offers a more direct means to accomplish the same result.

Most of the literature on regulation addresses OSHA regulation in the United States. OSHA's mandate is to 'assure so far as possible every working man and woman in the Nation safe and healthful working conditions'. The OSH Act requires employers to comply with safety and health regulations, or 'standards', promulgated by OSHA. OSHA is authorized to inspect employers for potential violations and to assess civil penalties if violations are found. OSHA may also seek criminal penalties in limited circumstances if an employee has been killed.

McGarity and Shapiro (1993) and Mendeloff (1980, 1988) generally summarize and evaluate OSHA's role in promoting workplace safety and health. Wilson (1985) and Kelman (1981) compare OSHA regulation to regulation in Great Britain and Sweden respectively. Lanoie (1992a, 1992b) has analyzed the impact of occupational safety and health regulation in Canada.

18. Economic Theory

An employer will make safety and health improvements until the cost of these precautions is more than the cost of paying additional wages, workers' compensation premiums (if experience rated), and other related costs. If, however, such financial incentives fail, employers will underinvest in safety and health improvements. Such incentives can fail for the reasons discussed earlier, including the inability of workers to obtain full compensation for their injuries and illnesses from wage premiums and workers' compensation.

Regulators can address this shortfall by ordering employers to undertake safety and health precautions improvements up to the point where the costs of such improvements exceed their benefits. If benefits are measured as the value of the improvements to workers, administrative regulation will produce about the same level of investment in safety and health precautions as fully effective financial incentives. In other words, the government would order the same level of protection as would be produced if employers fully compensated workers for their injuries and illnesses.

Although economic theory favors the use of such a cost-benefit approach, Congress has chosen another standard to control health and safety regulation in the United States. This standard requires OSHA to seek the level of protection for workers which is available from the 'best-available technology' (BAT). Once OSHA establishes that a workplace hazard is a 'significant risk', it must order an employer to reduce that risk to the extent that is 'feasible'. A standard is feasible when it is technologically achievable and when employers can afford the cost of implementing it. A standard is not economically infeasible because it is financially burdensome or even because it threatens the survival of some firms in an industry. As discussed below, many analysts favor replacing this technology-based approach with a cost-benefit standard.

19. Empirical Evidence

Analysts have attempted to confirm that OSHA's activities have led to an improvement in workplace safety. They have isolated OSHA's impact on fatality and injury rates in three types of studies. All three efforts have produced inconsistent results.

Some studies have projected the trend of pre-OSHA injury rates and compared the projected results with the actual results. Smith (1976) compared the actual injury rates in several high-hazard industries that OSHA had targeted for enforcement with projected injury rates. The comparison revealed that actual rates were not significantly lower than projected rates. Mendeloff (1980), by comparison, found that the actual rates were significantly lower than the projected rates for several individual types of injuries in California. His study, however, found that OSHA had no impact on the aggregate injury rate for California and the nation. Curington (1986) likewise had mixed results. The frequency rate for all injuries in manufacturing industries in New York was no lower than the projected rate for such injuries, but there were reductions in injuries resulting from being struck by a machine (43.6 percent) and in the severity of all injuries (13.2 percent).

Other studies have tested the correlation between aggregate industry level injury rates and OSHA inspection activity. For example, when Viscusi (1992) tested whether injury rates were affected by the frequency of OSHA inspections and penalties, he found that OSHA caused a 1.5-3.6 percent decrease in the lost workday rate. The 'lost workday rate' measures the number of days of work that an employee misses after an injury. Viscusi indicates that earlier studies by himself and others found no measurable correlation between the number of OSHA inspections and injury rates.

Finally, some studies have sought a correlation between individual plant level injury data and an employer's inspection experience. Gray and Scholz

(1993) found that an inspection imposing a penalty reduced injuries by 22 percent and lost workdays by 20 percent in the following three years. Using the same methodology, Cooke and Gautschi (1981), Robertson and Keeve (1983), and Scholz and Gray (1990) found similar impacts, but Smith (1979), McCaffrey (1983), and Ruser and Smith (1991) found no association using a different testing technique.

Other analysts have measured the relationship between OSHA inspection activity and compliance with OSHA safety regulations. Gray and Jones (1991a), for example, found a significant relationship between OSHA enforcement and compliance at individual plants. Bartel and Thomas (1985) also found that OSHA enforcement significantly increased compliance (by a total of 26 percent relative to no enforcement), but they found only a weak link between compliance and injury rates.

Only a few analysts have attempted to confirm that OSHA's activities have led to an improvement in workplace health. Gray and Jones (1991b) found that OSHA inspections reduced the exposure of workers to hazardous substances and increased compliance with health regulations.

20. Evaluation of Empirical Evidence

Bartel and Thomas (1985) explain there are two conflicting explanations for the lack of empirical evidence that OSHA activity results in fewer workplace accidents and injuries.

The 'inefficacy' explanation proposes that administrative regulation is unable to address many of the causes of workplace accidents. The 'noncompliance' explanation proposes that the OSHA lacks the resources to undertake effective enforcement. In addition, Mendeloff (1988) offers a theory for the lack of effective regulation of health risks, which is considered in the next section.

The 'inefficacy' theory posits that administrative regulation does not increase workplace safety because there is a tenuous link between regulation and the causes of accidents. Administrative regulation focusses on making workplace equipment safer to use. Analysts argue, however, that the cause of most accidents is a complex interaction of labor, equipment and workplace environment. In light of this mismatch, Barcow (1980) predicts that OSHA may be incapable of preventing more than 25 percent of all workplace accidents. Moreover, Rea (1981) hypothesizes that moral hazard may reduce the level of safety because workers will attempt to substitute wages for safer jobs.

Bartel and Thomas (1985) ask why Congress has failed to reform, or even eliminate, OSHA in light of its apparent inefficacy. They observe that OSHA regulations may give large firms a competitive advantage over their smaller rivals because the smaller firms are less able to afford expensive regulations.

They hypothesize that larger firms support OSHA because the gains from this competitive advantage exceeds the costs of complying with OSHA regulations. Bartel and Thomas (1987) offer empirical evidence that larger firms have such a competitive advantage concerning OSHA regulations. Fuess and Loewenstein (1990) have similar evidence for coal mine regulation. Their study finds the imposition of expensive engineering controls shifted production to large mines by driving smaller, less safe mines out of business. Hughes, Magat and Ricks (1986), however, were unable to establish that OSHA's cotton dust standards permitted large firms to gain in profitability at the expense of smaller producers.

Similarly, Miller (1984) asks whether organized labor is rational in support of OSHA. He offers some empirical support for the proposition that engineering controls may increase the demand for labor.

The 'noncompliance theory' proposes that OSHA lacks the statutory and budgetary authority to enforce its standards effectively. McGarity and Shapiro (1996) point out that OSHA inspections have had a greater impact on the injury rates of inspected firms than on aggregate injury rates. They also point out that the industries with the most significant decline in injuries and fatalities are the industries with the highest levels of enforcement. They attribute OSHA's limited impact on aggregate injury rates to the fact that the agency's limited resources do not permit it to inspect the vast majority of employers that it regulates.

21. Overregulation Causes Underregulation

The previous theories address OSHA's impact on workplace accidents. Mendeloff (1988) attempts to explain OSHA's limited impact on occupational disease. He identifies OSHA's mandate as the cause because it requires the strict regulation of toxic substances. The problem is that such 'overregulation' causes 'underregulation'. Overregulation occurs when the costs of a regulation exceed its benefits. Underregulation occurs when the costs of additional regulation are less than the benefits. Mendeloff argues that strict regulation of toxic substances causes less protection of workers than the promulgation of more lenient regulations.

Strict regulation protects workers less than more lenient regulations because of how employers react to each type of regulation. OSHA has been able to promulgate very few health regulations because employers vigorously resist overregulation. As a result, OSHA spends inordinate time and resources defending strict standards. Mendeloff proposes that OSHA could successfully promulgate more standards if it balanced costs and benefits. OSHA would be more successful because industry would be less likely to challenge more lenient regulations in court, and, if such regulations were challenged, OSHA would be more likely to prevail. In this manner, workers ultimately would receive more

protection from a more lenient approach. Although each OSHA regulation would be less protective of workers, the sum total of protection for workers would be greater because the agency could promulgate more standards overall.

McGarity and Shapiro (1993) and Shapiro and McGarity (1991) object that employers will oppose even lenient regulations. They offer evidence that employers gain financial benefits from delaying even modest health and safety regulations. If the problem is employer intransigence, McGarity and Shapiro propose that Congress changes OSHA's statutory mandate to make it easier for OSHA to prevail when it is sued. McGarity and Shapiro (1993) and Shapiro and McGarity (1989) also propose rulemaking reforms that OSHA can undertake to speed up rulemaking and make it more rational. These include improving how OSHA sets its regulatory priorities and focussing on types of regulations that yield the greatest protection for workers.

22. Reform of OSHA's Regulatory Standard

Mendeloff proposes that OSHA should balance costs and benefits in health regulation because employers would be less likely to challenge more lenient regulation in court. Other analysts favor adoption of a cost-benefit standard for OSHA safety and health regulation because this approach is more consistent with economic theory. Economic theory favors a cost-benefit approach for regulation because it equates the marginal benefits of safety and health improvements with the marginal cost of such precautions. Besides Mendeloff, supporters of a cost-benefit approach include Viscusi (1983, 1992) and Sunstein (1990, 1996). More generally, Litan and Nordhaus (1986) propose that Congress establish a regulatory budget for OSHA and similar agencies which would establish caps for the regulatory costs that the agency could impose.

Arguments that OSHA should be subject to a cost-benefit approach follow the arguments made in general for using cost-benefit analysis to specify the extent of safety, health and other social regulation. Sunstein (1990, 1996) and Breyer (1993) contain a useful statement of the general arguments.

The primary benefit of the cost-benefit analysis is that it addresses safety and health risks in light of the fact that society will always have limited resources to spend on safety and health. Cost-benefit balancing promotes rationality by helping to ensure that those resources are spent in the most efficient manner possible. By comparison, critics find that OSHA regulations often impose costs that exceed benefits sometimes by hundreds of millions of dollars. For example, Morrall (1979) objects to OSHA's noise regulation because it mandated the use of expensive engineering controls rather than much less expensive personal protection equipment such as ear plugs. Analysts have made similar criticisms of other workplace safety regulation. French

(1988), for example, suggests that railroad safety regulation in the United States is inefficient because excessive burdens are imposed on firms.

A second benefit of the cost-benefit approach is that it makes agencies more accountable to the public. Safety and health regulation will inevitably require tradeoffs among regulatory goals because of society's limited resources. Without a cost-benefit approach, the public has difficulty learning about such tradeoffs. By comparison, a cost-benefit approach requires agencies to make these tradeoffs more explicit.

A third advantage is that the cost-benefit approach responds to the problem of regulatory 'perversity'. Critics of regulation, such as Sunstein (1997), warn that an attempt to reduce one safety or health risk can increase other safety or health risks. This would occur, for example, when the regulation of one chemical leads manufacturers to use more dangerous substitutes. More generally, Sunstein cites to an incipient literature that considers whether costly regulation increases risks because such regulations reduce wealth. This possibility is suggested by the fact that persons who are unemployed or poor tend to be more unhealthy and to live shorter lives. Cost-benefit analysis addresses this problem by requiring agencies to examine the 'substitution risks' that might result from a proposed regulatory action.

23. Support of OSHA's Standard

McGarity and Shapiro (1993, 1996) and Shapiro and McGarity (1991) defend the current technology-based approach to regulation. Their arguments, summarized below, follow the arguments made in general by Cranor (1993), McGarity (1991), Sagoff (1988) and others against using cost-benefit analysis to specify the extent of safety, health, environmental, and other social regulation.

One criticism is that cost-benefit analysis is too unreliable to constitute an effective method to implement regulations. Critics point out that current risk assessment techniques do not have the power to permit precise calculations of the number of lives saved or injuries avoided, and that methods used to reduce these benefits to dollars amounts are highly contestable. As a result, the cost-benefit approach ordinarily raises difficult methodological issues that are exceedingly expensive and time-consuming for agencies to resolve and defend in court. In comparison, a technology-based approach more simply sets industry-wide limitations on the basis of the level of precaution that the best performers in the industry are capable of achieving.

Supporters of a technology-based approach also deny that it leads to the type of regulatory excesses identified by the supporters of the cost-benefit approach. As just noted, estimates of costs and benefits are highly imprecise. In light of this imprecision, critics of a cost-benefit approach are skeptical regarding

claims that the cost of OSHA regulation greatly exceeds the benefits.

A second criticism is that the cost-benefit approach is at its core 'incoherent' because it cannot yield a single numerical value. According to this argument, the general tendency of individuals to buy and sell goods for roughly the same price (the market price) does not apply when credible risks to health and safety are being traded. Instead, individuals are normally willing to sell the right to be free from increased mortality risks for considerable more money than they are willing to pay to reduce such risks. The reason is that most persons can demand more in a bargain in which they are asked to sacrifice something of great value, to which they have a right, than they can afford to pay for that same thing, if someone else has the right to take it from them. Thus, use of a 'willingness to sell' measure of the benefits of a safety or health regulation yields a different, and higher, value than use of a 'willingness to buy' measure of such benefits.

Despite this incoherence, regulators must rely on a 'willingness to buy' measurement because it is the only one for which there are data. Estimates of wage premiums indicate how much workers are willing to pay for a safer workplace. When workers seek safer jobs, they will forfeit the wage premiums paid for riskier work.

Critics also argue that reliance on a 'willingness to buy' measurement of the value of human life is ethically objectionable. This argument contends that poor people are not likely to sell the right to be safe for any less than a rich person would. By comparison, a person's wealth will affect the amount that he or she can pay to purchase the right to be safe.

A fourth criticism is that discounting future benefits to present value biases the cost-benefit approach against the prevention of occupational disease. Although employers must immediately pay for prevention, the benefits of such actions will not show up for years. The latency period for occupational disease is usually 20 or 30 years. As a result, the benefits of a regulation that would prevent such losses can be outweighed by even modest present costs.

Supporters of a cost-benefit standard defend the use of a discount rate. They argue that if workers had the opportunity to spend money on prevention today, which would result in lower wages, in return for a lower probability of cancer 30 years later, the workers themselves could likely discount the future costs of the disease. In other words, individuals put different values on dying 30 years from now and dying today. Defenders also dispute that the use of discounting results in a lack of appropriate regulation. They assert that an investment in abatement should earn a sufficiently large return over 30 years to justify the protection of workers. When this is not true, evaluators should verify that they are using an appropriate discount rate.

Finally, critics charge that use of a cost-benefit standard as the primary decision criterion effectively elevates economic efficiency to a 'meta-value' that trumps all other conflicting values. OSHA's mandate, which reflects both

economic and noneconomic considerations, rejects the idea that the maximization of material wealth is the only goal of a good society. Instead, it seeks to balance 'efficiency', 'fairness', and other important social values.

24. Reform of Enforcement

An earlier discussion explained that empirical studies suggest OSHA inspection activity has not led to a reduction in aggregate injury rates. One explanation is that many causes of workplace accidents cannot be addressed by safety regulations. Another explanation is that OSHA has insufficient resources to expand its successful enforcement efforts at some plants to most employers. The literature on enforcement focusses on how OSHA can promote greater compliance in light of its limited resources.

Viscusi (1986a, 1986b) analyzes this issue in terms of an employer's economic incentives to comply with OSHA regulations. Employers will comply when it costs less to make safety improvements than to risk an adverse OSHA inspection. The risk to an employer of an inspection is a function of the likelihood that the firm will be inspected and the penalties that the firm will suffer if violations are detected. These penalties include OSHA fines as well as any adverse effect on the employer's reputation. If the employer's reputation is adversely affected, there may be worker turnover, increased demands for wage premiums, or other adverse consequences.

In light of these incentives, Viscusi proposes that OSHA can improve compliance by increasing the likelihood that the most dangerous workplaces are inspected and that large fines are assessed for serious violations. McGarity and Shapiro (1993) support these recommendations and amplify how they might be implemented.

OSHA can increase the likelihood that it will find the most dangerous work conditions by focussing its inspection activity on the most dangerous employers and its individual inspections on identifying the most serious violations. Analysts, such as Bardach and Kagan (1982) and Howard (1994), have criticized OSHA for zealously enforcing detailed rules in circumstances where enforcement is counterproductive, unfair, or even nonsensical. OSHA, however, has a potential problem in using injury records to target inspections. Ruser and Smith (1988) show that using injury records to target inspections creates an incentive for employers to underreport injuries in high-hazard industries. If OSHA uses such records for purposes of targeting, it must audit employers to reduce underreporting.

Fry and Lee (1989) propose that the 'real teeth' of OSHA citations may be the impact on the stock market value of a firm. They found that the announcement of fines produces an immediate and pronounced decline in the

value of the firm subject to the penalties. They hypothesize the decline may reflect the additional costs a firm can expect such as the need to make safety improvements.

Regulators might also enhance compliance with regulations by mandating that employers establish joint employer-employee health and safety committees to monitor workplace conditions. Such committees may improve safety by focussing the attention of employers and employees on workplace hazards, and by providing a forum for the exchange of information. These committees might be especially effective in the absence of a union to give workers a voice concerning safety issues. Spieler (1994) documents that a number of states have instituted such a requirement. Rea (1983) discusses Canadian laws which require such committees. He notes that because joint safety committees were already in existence in larger unionized establishments, the main impact of the legislation is to extend the practice to small firms and nonunionized work places. Walters and Haines (1988) found, however, that workers in Ontario had only weak links with their health and safety representatives, and few workers made use of this resource.

E. Conclusions

25. Market, Compensation and Regulatory Alternatives

An employer will invest in safety and health precautions until the cost is more than the expense of paying higher wages, workers' compensation, and other accident and illness costs. Employees receive additional protection because governments have chosen to augment these financial incentives with regulation. Economic theory would have governments order the same level of protection as would be produced if employers fully compensated workers for their injuries and illnesses and paid any additional accident and illness costs. In the United States, however, Congress has established a technology-based goal for OSHA, which requires the agency to seek the highest level of protection which is technologically feasible.

Analysts have studied the impact of compensatory wages, workers' compensation, and regulation on safety and health. These studies indicate that all three approaches promote investments in safety and health protection, but the extent of such improvement is difficult to verify and may be limited in numerous situations. There are various explanations for this lack of efficacy, some of which conflict, but all of which suggest that labor markets, compensation and regulation are impeded by significant constraints.

Various reforms have been proposed to address these constraints, but the literature has not reached a consensus concerning some key proposals. In particular, there is a considerable debate concerning whether OSHA should be

subject to a cost-benefit test. There is also a question of political viability concerning some reforms. In the United States, for example, reform of workers' compensation requires action by all 50 states.

This analysis confirms that labor markets, compensation, and regulation are highly imperfect alternatives concerning the reduction of occupational accidents and illnesses. It also suggests that it is necessary to rely on all three approaches. Each approach alone, even if reformed, is unlikely to produce an appropriate level of occupational safety and health. The combination of the three, by comparison, is more likely to move countries closer to this elusive goal.

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Bibliography on Occupational Safety and Health Regulation (5540)

- Barcow, Lawrence S. (1980), *Bargaining for Job Safety and Health*, Cambridge, MA, MIT Press, 158 p.
- Bartel, Ann P. and Thomas, Lacy Glenn (1985), 'Direct and Indirect Effects of Regulation: A New Look at OSHA's Impact', **28** *Journal of Law and Economics*, 1-25.
- Bartel, Ann P. and Thomas, Lacy Glenn (1987), 'Predation through Regulation: The Wage and Profit Effects of the Occupational Safety and Health Administration and the Environmental Protection Agency', **30** *Journal of Law and Economics*, 239-264.
- Barth, Peter S. (1984), 'A Proposal for Dealing with the Compensation of Occupational Diseases', **13** *Journal of Legal Studies*, 569-586.
- Boden, Leslie I. (1995), 'Workers' Compensation in the United States: High Costs, Low Benefits', **16** *Annual Review Public Health*, 208-218.
- Boden, Leslie I. and Jones, Carl Adaire (1987), 'Occupational Disease Remedies: The Asbestos Experience', in Bailey, Elizabeth E. (ed), *Public Regulation: New Perspectives on Institutions and Policies*, Cambridge, MA, MIT Press, 321-346.
- Burton, John F., Jr (1992), 'Workers' Compensation Costs, 1960 - The Increases, the Causes and the Consequences', *John Burton's Workers' Compensation Monitor*, Mar.-Apr. 1993, 1-23.
- Butler, Richard J. (1983), 'Wage and Injury Rate Response to Shifting Levels of Workers' Compensation', in Worrall, John D. (ed), *Safety and The Workforce*, Ithaca, NY, ILR Press, 61-86.
- Butler, Richard J. and Worrall, John D. (1991), 'Claims Reporting and Risk Bearing Moral Hazard in Workers' Compensation', **63** *Journal of Risk and Insurance*, 191-204.
- Butler, Richard J., Durbin, David L. and Helvacian, Nurhan M. (1996), 'Increasing Claims For Soft Tissue Injuries in Workers' Compensation: Cost Shifting and Moral Hazard', **13** *Journal of Risk and Uncertainty*, 73-87.
- Carle, Susan D. (1988), 'A Hazardous Mix: Discretion to Disclose and Incentives to Suppress Under

- OSHA's Hazard Communication Standard', *97 Yale Law Journal*, 581-601.
- Carmichael, H. Lorne (1986), 'Reputations for Safety: Market Performance and Policy Remedies', *4 Journal of Labor Economics*, 458-472.
- Chelius, James R. (1974), 'The Control of Industrial Accidents: Economic Theory and Empirical Evidence', *38(4) Law and Contemporary Problems*, 700-729.
- Chelius, James R. (1976), 'Liability for Industrial Accidents: A Comparison of Negligence and Strict Liability Systems', *5 Journal of Legal Studies*, 293-309.
- Chelius, James R. and Smith, Robert S. (1983), 'Experience-Rating and Injury Prevention', in Worrall, John D. (ed), *Safety and The Workforce*, Ithaca, NY, ILR Press, 128-137.
- Chelius, James R., and Smith, Robert S. (1993), 'The Impact of Experience-Rating on Employer Behavior: The Case of Washington State', in Durbin, David and Borba, Philip S. (eds), *Workers' Compensation Insurance: Claims Costs, Prices, and Regulation*, Boston, Kluwer Academic Publishers, 293-306.
- Cooke, William N. and Gautschi, Frederick H. (1981), 'OSHA, Plant Safety Programs, and Injury Reduction', *20 Industrial Relations*, 245-257.
- Curington, William P. (1986), 'Safety Regulation and Workplace Injuries', *53 Southern Economic Journal*, 51-72.
- Darling-Hammon, Linda and Kniesner, Thomas J. (1980), *The Law and Economics of Workers' Compensation*, Santa Monica, Rand Institute for Civil Justice, 86 p.
- Deweese, Donald N. with Daniels, Ronald J. (1988), 'Prevention and Compensation of Industrial Disease', *8 International Review of Law and Economics*, 51-72.
- Dickens, William T. (1984), 'Occupational Safety and Health Regulation and Economic Theory', in Darity, William, Jr (ed), *Labor Economics: Modern Views*, Boston, Kluwer-Nijhoff, 133-173.
- Dorman, Peter (1996), *Markets and Morality: Economics, Dangerous Work, and The Value of Human Life*, Cambridge, Cambridge University Press, 274 p.
- Fishback, Price V. (1986), 'Workplace Safety during the Progressive Era: Fatal Accidents in Bituminous Coal Mining, 1912-1923', *23 Explorations in Economic History*, 269-298.
- Fishback, Price V. (1987), 'Liability Rules and Accident Prevention in the Workplace: Empirical Evidence from the Early Twentieth Century', *16 Journal of Legal Studies*, 305-328.
- French, Michael Thomas (1988), 'An Efficiency Test for Occupational Safety Regulation', *54 Southern Economic Journal*, 675-693.
- Fry, Clifford L. and Lee, Insup (1989), 'OSHA Sanctions and the Value of the Firm', *24 Financial Review*, 599-610.
- Fuess, Scott M., Jr and Lowenstein, Mark A. (1990), 'Further Analysis of the Theory of Economic Regulation: The Case of the 1969 Coal Mine Health and Safety Act', *28 Economic Inquiry*, 354-389.
- Gray, Wayne B. and Jones, Carolyn Adaire (1991a), 'Longitudinal Patterns of Compliance with Occupational Safety and Health Administration Health and Safety Regulations in the Manufacturing Sector', *26 Journal of Human Resources*, 1623-654.
- Gray, Wayne B. and Jones, Carolyn Adaire (1991b), 'Are OSHA Health Inspections Effective?: A Longitudinal Study in the Manufacturing Sector', *73 Review of Economics and Statistics*, 1504-508.
- Gray, Wayne B. and Scholz, John T. (1993), 'Does Regulatory Enforcement Work: A Panel Analysis of OSHA Enforcement', *27 Law and Society Review*, 177-213.

- Hughes, John S., Magat, Wesley A. and Ricks, William E. (1986), 'The Economic Consequences of the OSHA Cotton Dust Standards: An Analysis of Stock Price Behavior', **29** *Journal of Law and Economics*, 29-59.
- Ison, Terence B. (1986), 'The Significance of Experience Rating', **24** *Osgoode Hall Law Journal*, 723-742.
- Kahn, Shulamit (1987), 'Occupational Safety and Workers Preferences: Is There a Marginal Worker?', **69** *Review of Economics and Statistics*, 262-268.
- Kelman, Steven (1981), *Regulating America, Regulating Sweden: A Comparative Study of Occupational Safety and Health Policy*, Cambridge, MA, MIT Press, 270 p.
- Kniesner, Thomas J. and Leeth, John D. (1989), 'Separating the Reporting Effects from the Injury Rate Effects of Workers Compensation Insurance: A Hedonic Simulation', **42** *Industrial and Legal Relations Review*, 280-293.
- Lanoie, Paul (1992a), 'The Impact of Occupational Safety and Health Regulation on the Risk of Workplace Accidents: Quebec, 1983-1987', **27** *Journal of Human Resources*, 642-660.
- Lanoie, Paul (1992b), 'Safety Regulation and the Risk of Workplace Accidents in Quebec', **58** *Southern Economic Journal*, 1950-1965.
- Lave, L.B. (1983), 'Viscusi's Risk by Choice: Regulating Health and Safety in the Workplace', **14** *Bell Journal of Economics*, 607-610.
- Leigh, J. Paul (1991), 'No Evidence of Compensating Wages for Occupational Fatalities', **30** *Industrial Relations*, 382-395.
- Litan, Robert E. and Nordhaus, William D. (1986), 'Regulatory Reform and OSHA Policy: Comments', **5** *Journal of Policy Analysis and Management*, 467-481.
- Lyttkens, C.H. (1988), 'Workers' Compensation and Employees' Safety Incentives in Sweden', **8** *International Review of Law and Economics*, 181-185.
- McCaffrey, David P. (1983), 'An Assessment of OSHA's Recent Effects on Injury Rates', **18** *Journal of Human Resources*, 131-146.
- McGarity, Thomas O. and Shapiro, Sidney A. (1993), *Workers At Risk: The Failed Promise of the Occupational Safety and Health Administration*, Westport, Conn., Praeger, 362p.
- McGarity, Thomas O. and Shapiro, Sidney A. (1996), 'OSHA's Critics and Regulatory Reform', **31** *Wake Forest Law Review*, 587-646
- Mendeloff, John M. (1980), *An Economic and Political Analysis of Occupational Safety and Health*, Cambridge, MA, MIT Press, 219 p.
- Mendeloff, John M. (1988), *The Dilemma of Toxic Substance Regulation: How Overregulation Causes Underregulation at OSHA*, Cambridge, MA, MIT Press, 321 p.
- Miller, James C., III (1984), 'Is Organized Labor Rational in Supporting OSHA?', **50** *Southern Economic Journal*, 881-885.
- Moore, Michael J. and Viscusi, W. Kip (1989), 'Promoting Safety Through Workers' Compensation: The Efficacy and Net Wage Costs of Injury Insurance', **20** *Rand Journal of Economics*, 499-515.
- Moore, Michael J. and Viscusi, W. Kip (1990), *Compensation Mechanisms For Job Risks: Wages, Workers' Compensation, and Product Liability*, Princeton, NJ, Princeton University Press, 188 p.
- Morgenstern, Felice (1982), 'Some Reflections on Legal Liability as a Factor in the Promotion of Occupational Safety and Health', **121** *International Labour Review*, 387-398.
- Morrall, John F. (1979), 'Exposure to Occupational Noise', in Miller, James C. and Yandle, Bruce

- (eds), *Benefit-Cost Analysis of Social Regulation: Case Studies from the Council on Wage and Price Stability*, Washington, American Enterprise Institute, 33-58
- Nichols, Albert, L. and Zeckhauser, Richard (1977), 'Government Comes to the Workplace: An Assessment of OSHA', **49** *Public Interest*, 39-69.
- Oi, Walter Y. (1974), 'On the Economics of Industrial Safety', **38(4)** *Law and Contemporary Problems*, 669-699.
- Phillips, Jerry J. (1976), 'Economic Deterrence and the Prevention of Industrial Accidents', **5** *Industrial Law Journal*, 148-163.
- Rea, Samuel A., Jr (1981), 'Workmen's Compensation and Occupational Safety Under Imperfect Information', **71** *American Economic Review*, 80-93.
- Rea, Samuel A., Jr (1983), 'Regulation of Occupational Health and Safety', in Dewees, D.N. (ed), *Quality Regulation*, Toronto, Butterworths, 109-140.
- Robertson, Leon S. and Keeve, A. Phillip (1983), 'Worker Injuries: The Effects of Workers' Compensation and OSHA Inspections', **8** *Journal of Health, Politics, and Law*, 581-597.
- Robinson, James C. (1991), *Toil and Toxics: Workplace Struggles and Political Strategies for Occupational Health*, Berkeley, University of California Press, 226 p.
- Rubin, Jeffrey (1984), 'Economic Incentives and Safety Regulation: An Analytical Framework', **28(1)** *American Economist*, 18-24.
- Ruser, John W. (1985), 'Workers' Compensation, Experience-Rating, and Occupational Injuries', **16** *Rand Journal of Economics*, 498-503.
- Ruser, John W. (1991), 'Workers' Compensation and Occupational Injuries and Illnesses', **9** *Journal of Labor Economics*, 325-351.
- Ruser, John W. (1993), 'Workers' Compensation and the Distribution of Occupational Injuries', **28** *Journal of Human Resources*, 593-618.
- Ruser, John W. and Smith, Robert S. (1988), 'The Effect of OSHA Records-Check Inspections on Reported Occupational Injuries in Manufacturing Establishments', **1** *Journal of Risk and Uncertainty*, 415-435.
- Ruser, John W. and Smith, Robert S. (1991), 'Reestimating OSHA's Effects: Have the Data Changed?', **26** *Journal of Human Resources*, 212-236.
- Scholz, John T. and Gray, Wayne B. (1990), 'OSHA Enforcement and Workplace Injuries: A Behavioral Approach to Risk Assessment', **3** *Journal of Risk and Uncertainty*, 283-305.
- Schroeder, Elinor P. and Shapiro, Sidney A. (1984), 'Responses to Occupational Disease: The Role of Markets, Regulation, and Information', **72** *Georgetown Law Journal*, 1231-1309.
- Shapiro, Sidney A. and McGarity, Thomas O. (1989), 'Reorienting OSHA: Regulatory Alternatives and Legislative Reform', **6** *Yale Journal on Regulation*, 1-63.
- Shapiro, Sidney A. and McGarity, Thomas O. (1991), 'Not So Paradoxical: The Rationale For Technology-Based Regulation', *Duke Law Journal*, 729-752.
- Sider, Hal (1984), 'Economic Incentives and Safety Regulation: An Analytical Framework', **28(1)** *American Economist*, 18-24.
- Smith, Robert S. (1974), 'The Feasibility of an 'Injury Tax' Approach to Occupational Safety', **38(4)** *Law and Contemporary Problems*, 730-744.
- Smith, Robert S. (1976), *The Occupational Safety and Health Act: Its Goals and Its Achievements*, Washington, American Enterprise Institute, 104 p.
- Smith, Robert S. (1979), 'The Impact of OSHA Inspections on Manufacturing Injury Rates', **14** *Journal of Human Resources*, 145-170.

- Spieler, Emily (1994), 'Perpetuating Risk? Workers Compensation and the Persistence of Occupational Injuries', **31** *Houston Law Review*, 119-264.
- Staten, Michael and Umbeck, John (1986), 'A Study of Signaling Behavior in Occupational Disease Claims', **29** *Journal of Law and Economics*, 263-286.
- Veljanovski, Cento G. (1982), 'The Employment and Safety Effects of Employers' Liability', **29** *Scottish Journal of Political Economy*.
- Victor, Richard B. (1982), *Workers' Compensation and Workplace Safety: The Nature of Employer Incentives*, Santa Monica, CA, Institute for Civil Justice, Rand Corporation, 68 p.
- Viscusi, W. Kip (1983), *Risk By Choice: Regulatory Health and Safety in the Workplace*, Cambridge, MA, Harvard University Press, 200 p.
- Viscusi, W. Kip (1984), 'Structuring an Effective Occupational Disease Policy: Victim Compensation and Risk Regulation', **2** *Yale Journal on Regulation*, 53-81.
- Viscusi, W. Kip (1986a), 'Reforming OSHA Regulation of Workplace Risks', in Weiss, Leonard W. and Klass, Michael W. (ed), *Regulatory Reform: What Actually Happened*, Boston, Little Brown, 234-268.
- Viscusi, W. Kip (1986b), 'The Structure and Enforcement of Job Safety Regulation', **49(4)** *Law and Contemporary Problems*, 127-150.
- Viscusi, W. Kip (1989), 'The Interaction between Product Liability and Workers' Compensation as Ex Post Remedies for Workplace Injuries', **5** *Journal of Law, Economics, and Organization*, 185-210.
- Viscusi, W. Kip (1991), 'Product and Occupational Liability', **5(3)** *Journal of Economic Perspectives*, 71-91.
- Viscusi, W. Kip (1992), *Fatal Tradeoffs: Public and Private Responsibilities for Risk*, New York, Oxford Press, 306 p.
- Walters, Vivienne and Haines, Ted (1988), 'Workers' Use and Knowledge of the "Internal Responsibility System": Limits to Participation in Occupational Health and Safety', **14** *Canadian Public Policy*, 411-423.
- Weiler, Paul (1986), *Legal Policy for Workplace Injuries*, Philadelphia, American Law Institute Project on Compensation and Liability for Product and Process Injuries, 141p.
- Weiss, Peter, Maier, Gunther and Gerking, Shelby (1986), 'The Economic Evaluation of Job Safety: A Methodological Survey and Some Estimates for Austria', **13** *Empirica*, 53-67.
- Wiggins, Steven N. and Ringleb, Al H. (1992), 'Adverse Selection and Long Term Hazards: The Choice between Contract and Mandatory Liability Rules', **21** *Journal of Legal Studies*, 189-215.
- Wilson, Graham, K. (1985), *The Politics of Safety and Health: Occupational Safety and Health in the United States and Britain*, New York, Oxford Press, 179 p.
- Worrall, John D. and Butler, Richard J. (1988), 'Experience Rating Matters', in Borba, Philip S. and Appel, David (eds), *Workers' Compensation Insurance Pricing: Current Programs and Proposed Reforms*, Boston, Kluwer Academic Publishers, 81-94.

Other References

- Bardach, Eugene and Kagan, Robert A. (1982), *Going By The Book: The Problem of Regulatory Unreasonableness*, Philadelphia, Temple University Press, 375 p.
- Breyer, Stephen (1993), *Breaking The Vicious Circle: Toward Effective Risk Regulation*, Cambridge, MA, Harvard University Press, 127 p.
- Cranor, Carl F. (1993), *Regulating Toxic Substances: A Philosophy of Science and The Law*, New York, Oxford Press, 252 p.
- Howard, Philip K. (1994), *The Death of Common Sense: How Law is Suffocating America*, New York, Random House, 202 p.
- Komesar, Neil K. (1994), *Imperfect Alternatives: Choosing Institutions in Law, Economics, and Public Policy*, Chicago, University of Chicago press, 287 p.
- McGarity, Thomas O. (1991), *Reinventing Rationality: The Role of Regulatory Analysis in the Federal Bureaucracy*, New York, Cambridge University Press, 384 p.
- Sagoff (1988), *The Economy of the Earth: Philosophy, Law, and the Environment*, New York, Cambridge University Press, 271 p.
- Sunstein, Cass R. (1990), *After the Rights Revolution: Reconceiving the Regulatory State*, Cambridge, MA, Harvard University Press, 284 p.
- Sunstein, Cass R. (1991), 'Administrative Substance', *Duke Law Journal*, 607-646.
- Sunstein, Cass R. (1996), 'Legislative Forward: Congress, Constitutional Moments, and the Cost-Benefit State', **48** *Stanford Law Review*, 247-309.
- Sunstein, Cass R. (1997), *Free Markets and Social Justice*, New York, Oxford Press, 407 p.