

Safety, Economics of

John F Burton, Jr., Cornell University, Ithaca, NY, USA; and Rutgers University, New Brunswick, NJ, USA

© 2015 Elsevier Ltd. All rights reserved.

Abstract

The economics of safety examines workplace injuries. In neoclassical theory, employers pay a risk premium for hazardous work and invest in safety to reduce the premium. 'Modified neoclassical theory' argues that limited types of government regulation improve the operation of the labor market. The 'old institutional economists' emphasize the unequal bargaining power of individual workers. One strain of 'new institutional economics' asserts that, when transaction costs are significant, changing the legal rules about liability can affect the allocation of resources. The government mandate theory argues that government standards improve safety. Evidence supporting the various theories is evaluated.

Introduction

The economics of safety is concerned with the causes and prevention of accidents resulting in economic losses. The primary focus is on accidents causing workplace injuries and diseases. The topic is examined using several variants of economic theory. In 'pure' neoclassical economics, employers pay a risk premium to workers for hazardous jobs and invest in safety to reduce the premiums. There is evidence of risk premiums, but the amount may not fully compensate workers for their risks. Modified neoclassical economics recognizes that some types of government intervention are appropriate in order to overcome the attributes of the labor market that do not correspond to the assumptions of pure neoclassical economics. Old institutional economics (OIE) emphasize the unequal bargaining power of individual workers as another limitation of the labor market as envisioned by pure neoclassical economics. Workers' compensation is a no-fault program providing benefits to injured workers that is endorsed by critics of neoclassical economics because premiums are experienced rater – they vary among industries and firms based on prior benefit payments – which in theory provides economic incentives to employers to improve safety. However, recent studies have cast doubt on whether experience rating improves workplace safety. Consistent with OIE, evidence suggests that collective action by workers improves workplace safety.

New institutional economics (NIE) includes devotees of the Coase theory and transaction cost economics, who argue that when transactions costs (including the expenses of drafting and enforcing agreements) are high, changes in liability rules can affect the allocation of resources, including those devoted to safety. Evidence supporting this theory includes the improvement in workplace safety when the workers' compensation program replaced tort remedies in many states in the early twentieth century.

Law and economics (L&E) theory draws on neoclassical economics and transaction cost economics in the examination of legal institutions. One application considers the stimulus of tort law to safety: while theory postulates a positive effect of tort suits on safety, the evidence suggests these suits do not provide much assistance in deterring accidents.

Government mandate theory argues that government promulgation and enforcement of standards will improve

workplace safety and health. However, several studies suggest that safety standards in the United States have done little to improve workplace safety and that, rather than overcoming deficiencies of an unregulated labor market, have often been excessively stringent.

'Pure' Neoclassical Economics

The neoclassical theory of work injuries is examined in [Thomason and Burton \(1993\)](#). Workplace accidents are undesirable by-products of processes that produce goods for consumption ([Oi, 1974](#)). Several assumptions are used in the neoclassical analysis of these processes. Employers and workers have an ongoing relationship. Employers maximize profits. Workers maximize utility, not just pecuniary income. Workers at the margin are mobile and possess accurate information concerning the risks and consequences of work injuries. One implication of these assumptions is that employers pay higher wages for hazardous work than for nonhazardous work. On the assumption that accident insurance is not provided by employers or the government, the equilibrium wage for the hazardous work will include a risk premium equal to the expected costs of the injuries, which includes lost wages, medical care, and the disutility caused by the injury. If workers are risk averse, the premium will also include a payment for the uncertainty about who will be injured.

The employer has an incentive to invest in safety in order to reduce accidents and thus the risk premium. The firm will make safety investments until the marginal expenditure on safety is equal to the marginal reduction in the risk premium. Since there is a rising marginal cost to investments in safety, equilibrium will occur with a positive value for the risk premium, which means that in equilibrium there will be some work injuries.

Evidence Consistent with the Neoclassical Model

There is an extensive literature on compensating wage differentials for the risks of workplace death and injury. [Ehrenberg and Smith \(2012\)](#) report that recent estimates suggest wages are about 1.0% higher for workers facing a fatality risk twice the average risk of job fatalities (about 1 per 25 000 workers

per year). The evidence on risk premiums can be used to estimate a value of statistical life (VSL), which represents evidence from the market about the willingness of people to pay for a reduction in the risk that they will be killed. Shapiro (2009) provides an example: if the average annual wage premium for the risk of work-related death is \$400 and the annual fatality risk is 1 out of 10 000 workers, then the VSL is \$4.0 million (\$400 divided by 0.0001).

Viscusi and Aldy (2003) reviewed more than 60 studies of mortality risk premiums from 10 countries and approximately 40 studies estimating injury risk premiums. Estimates using US labor market data typically show a VSL in the range of \$4–\$9 million (in 2000 dollars). Their review included 20 studies of non-US labor markets, including those of the United Kingdom (with significantly higher VSLs than in the United States), Canada (with the most VSL estimates in the range of US\$3–US\$6 million), and several developing countries, including India and Korea, in which VSL estimates are generally much lower than in developed countries. Across countries, the VSL generally increased with levels of income (income elasticities of about 0.5–0.6). Other general results include higher VSLs for union workers and decreasing VSLs for older workers. Leigh and Ruser (2003) found that compensating wage differentials for fatal and nonfatal injury risks vary according to gender and race.

Qualifications Concerning the Neoclassical Theory

The model that postulates workplace safety results from risk premiums, which provide financial incentives to employers to invest in safety, has been challenged. Some critics assert that risk premiums are inadequate because workers lack sufficient information about the risks of work injuries and/or have limited mobility to move to less hazardous jobs. However, Viscusi (1993) refers to a sizable literature in psychology and economics documenting that individuals tend to overestimate low probability events, such as workplace injuries, which could result in inappropriately large risk premiums. Ehrenberg and Smith (2012) conclude that workers have enough knowledge to form judgments about the relative risks of various jobs ‘with some accuracy.’ Both Ehrenberg and Smith (2012) and Viscusi (1993) argue there is sufficient worker mobility to generate risk premiums. Another challenger to the neoclassical model is Rose-Ackerman (1992), who argues that the labor market does not generate proper risk premiums because certain costs resulting from work injuries are not borne by workers but are externalized.

The empirical evidence on risk premiums has also been challenged or qualified. Ehrenberg and Smith (2012), for example, conclude that the studies of compensating wage differentials for the risks of injury or death on the job “generally, but not always, support the prediction that wages will be higher whenever risks on the job are higher.” Viscusi (1993) concludes: “The wage-risk relationship is not as robust as is, for example, the effect of education on wages.”

The most telling attack on the compensating wage differential evidence is by Dorman and Hagstrom (1998), who argue that most studies have been specified improperly. They argue that, after controlling for industry-level factors, the only evidence for positive compensating wage differential pertains

to unionized workers. For nonunion workers, they argue that properly specified regressions suggest workers in dangerous jobs are likely to be paid less than equivalent workers in safer jobs.

The Dorman and Hagstrom attack on the previously generally accepted view – dangerous work results in risks premiums for most workers – was challenged by Viscusi and Aldy (2003). However, even if every empirical study finds risk premiums for workplace fatalities and injuries, the evidence would not conclusively validate the neoclassical economics approach. Ehrenberg (1988) provides the necessary qualification: if there are any market imperfections (such as lack of information or mobility), the “mere existence of *some* wage differential does *not* imply that it is a fully compensating one.” And if the risk premium is not fully compensating (or is more than fully compensating), then *inter alia*, the market does not provide the proper incentive to employers to invest in safety.

Modified Neoclassical Economics and the Old Institutional Economics

Some economists rely on a ‘modified’ version of neoclassical economics theory that recognizes some types of government intervention are appropriate in order to overcome the attributes of the labor market that do not correspond to the assumptions of pure neoclassical economics. These attributes include the lack of sufficient knowledge and mobility by employees, and the possible lack of sufficient knowledge or motivation of employers about the relationship between expenditures on safety and the reduction in risk premiums. Proponents of the OIE would agree with these critiques of lack of knowledge and mobility, and would also emphasize factors such as the unequal bargaining power of individual workers as another limitation of the labor market as envisioned by neoclassical economists.

An example of government promulgation of information in order to overcome the lack of knowledge in the labor market is the Occupational Safety and Health Act (OSHAct) Hazard Communication standard, which requires labeling of hazardous substances and notification to workers and customers and which is estimated to save 200 lives per year (Viscusi, 1996). (Other aspects of the OSHAct are discussed below.)

Workers' Compensation

Workers' compensation programs represent another type of government intervention in the labor market in order to prevent workplace injuries and diseases, as well as to improve compensation for injured workers. Until late in the nineteenth century, the principal approaches used to achieve the goals of prevention and compensation were reliance on the risk premiums generated in the labor market and on negligence (tort) suits by injured workers against their employers (discussed below). Because of the dissatisfaction with these approaches, many countries enacted workers' compensation programs, beginning with Germany in 1884. Workers' compensation programs are a form of social insurance

providing cash benefits and medical care to disabled workers on a no-fault basis.

The enactment of workers' compensation programs result in moral hazard, which [Harrington and Niehaus \(1998\)](#) define as "the effect of insurance on the insured's incentives to reduce expected losses." Three types of moral hazard for workers resulting from the introduction of a workers' compensation program or from increases in workers' compensation benefits have been identified ([Guo and Burton, 2010](#); [Butler et al., 2013](#)): (1) the true injury effect – workers may be less concerned about job safety and more willing to accept risk, which results in an increase in injury frequency and injury severity; (2) the reporting effect – workers will be encouraged to submit more claims for losses they otherwise would not have bothered to report; and (3) the duration effect – workers will extend the period for which they claim benefits.

Workers' compensation programs rely on several strategies to reduce moral hazard for workers, including (1) deductibles – workers do not receive benefits in the initial period after the workplace injuries occur because of waiting periods; (2) co-insurance – benefits only replace a portion of lost wages (generally 66 2/3% of wages in US state programs); (3) limits on eligibility for benefits – benefits are limited to those workers who meet legal tests included in workers' compensation statutes; and (4) limits on duration of benefits – some programs limit the duration of benefits, especially for long-term disabilities.

Moral hazard for employers also results from the introduction of a workers' compensation program or from increases in workers' compensation benefits, with the nature of the moral hazard depending on the method used to finance the program. Some workers' compensation programs are financed by premiums (or assessments) that are uniform for all employers. In contrast, the workers' compensation programs in the United States and to some degree in other countries, including Canada, France, and Germany, are financed by experience-rated premiums. The US variant of experience rating has two levels: industry-level experience rating, which largely bases the insurance rate for each industry on prior benefits in the industry, and firm-level experience rating, which determines the premium for each firm above a minimum size by comparing the firm's prior benefit payments to those of other firms in the industry. Analysts have identified three types of moral hazard for workers' compensation programs that rely on experience rating as opposed to programs financed by premiums that do not vary among employers ([Guo and Burton, 2010](#); [Butler et al., 2013](#)): (1) the safety effect – employers will have more incentive to keep the workplace safe; (2) the underreporting or monitoring effect – employers will have more incentive to deny claims, which may be fraudulent, questionable, or legitimate; and (3) the rehabilitation or return-to-work effect – employers will have more incentive to adopt claims management practices that reduce the duration of benefit payments.

Two studies of US workers' compensation programs examined whether the moral hazard (or incentive) effects for workers or the incentive effects for employers dominate. [Bronchetti and McInerney \(2012\)](#) used a national data set on individuals in the United States and found that higher benefits resulted in fewer workers' compensation claims (the benefits-claims elasticities were less than 1.0). [Guo and](#)

[Burton \(2010\)](#) examined the determinants of interstate differences in the Bureau of Labor Statistics (BLS) injury rate for two periods (1975–89 and 1990–99). The coefficients on expected benefits were statistically insignificant in both periods. The authors indicated that "One interpretation of these results is that true injury effect is offset by the safety effect." [Guo and Burton](#) also examined the determinants of interstate differences in workers' compensation cash benefits per 100 000 workers. The authors found that "the benefit elasticity (the association between expected benefits and actual benefit payments) was significantly less than 1.0 in both our study periods (1975–89 and 1990–99)." One interpretation of this result is that the monitoring and rehabilitation effects for employers were stronger than the reporting and duration effects for workers.

The Effects of Experience Rating according to Different Economic Theories

Experience rating has received considerable attention in recent decades. In the neoclassical economics model, the introduction of workers' compensation with experience rating should make no difference in the safety incentives for employers compared to the incentives provided by the labor market without workers' compensation. Under assumptions explicated by [Burton and Chelius \(1997\)](#), such as perfect experience rating, risk neutrality by workers, and actuarially fair workers' compensation premiums, the risk premium portion of the wage paid by the employer will be reduced by an amount exactly equal to the amount of the workers' compensation premium. Also, under these assumptions, the employer has the same economic incentives to invest in safety both before and after the introduction of the workers' compensation program. Under an alternative variant of the pure neoclassical economics approach, in which the assumption of perfect experience rating is dropped, the introduction of workers' compensation will result in reduced incentives for employers to reduce accidents.

In contrast, the OIE approach argues that the introduction of workers' compensation with experience rating should improve safety because the limitations of knowledge and mobility and the unequal bargaining power for employees mean that the risk premiums generated in the labor market are inadequate to provide employers the safety incentives postulated by the pure neoclassical economics approach. [Commons \(1934\)](#), a leading figure in the OIE approach, claimed that unemployment is the leading cause of labor market problems, including injuries and fatalities, because slack labor markets undercut the mechanism that generates compensating wage differentials. Commons asserted that experience rating provides employers economic incentives to get the 'safety spirit' that would otherwise be lacking. Many modified neoclassical economists also accept the idea that experience rating should help improve safety by providing stronger incentives to employers to avoid accidents, although they place less emphasis on the role of unemployment in undercutting compensating wage differentials and more emphasis on the failure of employers to recognize the cost savings possible from improved safety without the clear signals provided by experience-rated premiums.

Evidence on the Effects of Experience Rating

A number of studies of experience rating provide evidence that should help assess the virtues of the various economic theories. Almost without exception, the studies find that experience rating reduces the number of workers' compensation claims, which supports the argument that 'pure' neoclassical economics does not provide a sufficient explanation of the operation of the labor market. What is unclear, however, is whether the reduction in claims is a result of the safety effect – with fewer actual injuries – or is due to the monitoring effect – with employers denying more claims. The evidence on this issue is inconclusive. The survey of experience-rating studies by [Boden \(1995\)](#) concluded that "research on the safety impacts has not provided a clear answer to whether workers' compensation improves workplace safety." In contrast, [Thomason \(2005\)](#) asserted that most (11 of 14) studies he surveyed found that experience rating improves safety and health and concluded: "Taken as a whole, the evidence is quite compelling: experience rating works." A markedly different conclusion was reached by [Mansfield et al. \(2012\)](#), who concluded that:

Although experience rating is intended to stimulate safer workplaces, a growing body of literature reveals that it has not achieved that effect . . . The absence of a safety effect may arise because employers focus on managing reported claims rather than prevention.

[Mansfield et al. \(2012\)](#) is contained in a collection of articles that provide largely negative assessments of experience rating. For example, [Tomba et al. \(2012\)](#) conclude their study of Ontario "suggests that experience rating provides an incentive for secondary prevention, but less so for primary prevention." There are also largely skeptical assessments of experience rating in Australia ([Clayton, 2012](#); [Purse, 2012](#)) and in New Zealand ([Armstrong and Bunn, 2012](#)). The only 'good news' for experience rating was provided by [Seabury et al. \(2012\)](#), who found that workers injured at self-insuring employers (who are perfectly experience rated) have significantly improved return-to-work experience for up to 5 years after the date of injury.

The recent evidence that experience rating does not improve safety is inconsistent with the positive impact on safety postulated by the OIE approach and is also contrary to the views of some proponents of modified neoclassical economics. Additional studies of experience rating can be anticipated, as can disagreements about the wisdom of relying on this approach to promoting safety, in part because of recent studies demonstrating that many workers with disabilities caused by work do not receive workers' compensation benefits ([Spieler and Burton, 2012](#)).

Collective Action

While some modified neoclassical economists and the OIE largely agree on the desirability of several prevention approaches, such as the use of experience rating in workers' compensation, the OIE endorsed another approach that many modified neoclassical economists would not support, namely, the use of collective bargaining and other policies that empower workers. Collective bargaining agreements can

minimize unsafe activities or at least explicitly require employers to pay a wage premium for unsafe work. Many agreements also establish safety committees that assume responsibility for certain activities, such as participation in inspections conducted by government officials. If workers are injured, unions can help them obtain workers' compensation benefits, thereby increasing the financial incentives for employers to improve workplace safety.

The beneficial effects predicted by the OIE approach for these collective efforts appear to be achieved. Several studies, including [Weil \(1999\)](#) concluded that Occupational Safety and Health Administration (OSHA) enforcement activity was greater in unionized firms than in nonunionized firms. [Moore and Viscusi \(1990\)](#) and other researchers found that unionized workers receive larger compensating wage differentials for job risks than unorganized workers. [Hirsch et al. \(1997\)](#) found that "unionized workers were substantially more likely to receive workers' compensation benefits than were similar nonunion workers."

There are also safety committees in some jurisdictions that are utilized in nonunionized firms. [Burton and Chelius \(1997\)](#) reviewed several studies involving such committees in the United States and Canada, and found limited empirical support for their beneficial effects. [Reilly et al. \(1995\)](#) provided a more positive assessment for their accomplishments in the United Kingdom. These studies provide some additional support for the beneficial role of collective action postulated by the OIE.

The New Institutional Economics

NIE authors generally argue that market forces encourage efficient forms of economic organization without government assistance and that opportunities for efficiency-improving public interventions are rare. This section considers only the Coase theory/transaction costs economics strain of NIE.

The Coase Theory and Transaction Costs Economics

In the absence of costs involved in carrying out market transactions, changing the legal rules about who is liable for damages resulting from an accident will not affect decisions involving expenditures of resources that increase the combined wealth of the parties. The classic example offered by [Coase \(1988\)](#) involves the case of straying cattle that can destroy crops growing on neighboring land. The parties will negotiate the best solution to the size of the herd, the construction of a fence, and the amount of crop loss due to the cattle whether or not the cattle rancher is assigned liability for the crop damages.

Coase recognized that the assumption that there were no costs involved in carrying out transactions was 'very unrealistic.' According to [Coase \(1988\)](#):

In order to carry out a market transaction, it is necessary to discover who it is that one wishes to deal with . . . and on what terms, to conduct negotiations . . . , to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. These operations are often . . . sufficiently costly . . . to prevent many transactions that would be carried out in a world in which the pricing system worked without cost.

The goal of transactions costs economics is to examine these costs and to determine their effect on the operation of the economy. As scholars of transaction costs have demonstrated, when transactions costs are significant, changing the legal rules about initial liability can affect the allocation of resources.

Evidence Concerning Changes in Liability Rules

Workplace safety regulation provides a good example of a change in liability rules, since in a relatively short period (1910–20), most US states replaced tort suits (the employer was only responsible for damages if negligent and employers had extraordinary defenses even if negligent) with employer liability acts (the employer was required to be negligent but some or all of the extraordinary defenses were abrogated), which in turn were replaced with workers' compensation (the employer is required to provide benefits under a no-fault rule) as the basic remedy for workplace injuries. Fishback (1998) and Butler and Worrall (2008) provide excellent reviews of the empirical studies of these changes in liability rules, which are summarized in Burton (2009).

Studies differ on whether the changes in liability rules increased or decreased workplace accidents, depending on the workers' occupation and industry. The overall conclusion of Butler and Worrall (2008) was that "those who argue that the tort system generated better safety incentives than workers' compensation are wrong." This conclusion suggests that high transaction costs associated with the determination of fault in negligence suits were an obstacle to achieving the proper incentives to workplace safety, and that the institutional features of workers' compensation, including the no-fault principle, provided a relatively more efficient approach to the prevention of work injuries than tort suits for most workers. The transaction economics component of the NIE theory thus appears to provide a useful supplement to neoclassical economics, since institutional features, such as liability rules, can have a major impact on the economic incentives for accident prevention.

Law and Economics

L&E theory draws on neoclassical economics and transaction cost economics, but is distinctive in the extent to which it examines legal institutions and legal problems. This section examines the tort law branch of L&E theory, while the next section examines the employment law branch.

Theoretical Stimulus of Tort Law to Safety

Tort law typically is used when one party harms another party, and the parties do not have an ongoing relationship. However, even though workers and employers have a continuing relationship, tort suits were generally used as a remedy for workplace accidents in the United States until workers' compensation programs were established. When negligence is the legal standard used for tort suits, if the employer has not taken proper measures to prevent accidents and thus is at fault, the employer will be liable for all of the consequences of the injury. The standard for the proper prevention measure was

developed by Judge Learned Hand and restated by Posner (1972) as:

The judge (or jury) should attempt to measure three things in ascertaining negligence: the magnitude of the loss if an accident occurs; the probability of the accident's occurring; and the burden (cost) of taking precautions to prevent it. If the product of the first two terms, the expected benefits, exceeds the burden of precautions, the failure to take those precautions is negligence.

Posner argued that proper application of this standard would result in economically efficient incentives to avoid accidents. Burton (2009) examines some qualifications to this conclusion.

Evidence on the Tort Law Stimulus to Safety

Two types of empirical evidence suggest that skepticism is warranted about the stimulus to workplace safety from tort suits. First, tort suits were used as the remedy for workplace injuries in the late 1800s and early 1900s. As previously discussed, most studies find that replacement of the negligence remedy with workers' compensation led to a general reduction in workplace fatalities.

Second, in other areas of tort law, there is a major controversy among legal scholars about whether the theoretical incentives for safety resulting from tort suits actually work. One school of thought is exemplified by Landes and Posner (1987), who state that "although there has been little systematic study of the deterrent effect of tort law, what empirical evidence there is indicates that tort law ... deters." An opposing view of the deterrent effects of tort law is provided by Priest (1991), who finds almost no relationship between actual liability payouts and the accident rate for general aviation and states that "this relationship between liability payouts and accidents appears typical of other areas of modern tort law as well, such as medical malpractice and product liability."

A study of tort law by Schwartz (1994) distinguished a strong form of deterrence (as postulated by Landes and Posner) from a moderate form of deterrence, in which "tort law provides a significant amount of deterrence, yet considerably less than the economists' formulae tend to predict." Schwartz surveyed a variety of areas where tort law is used, including motorist liability, medical malpractice, and product liability, and concluded that the evidence undermines the strong form of deterrence but provides adequate support for the moderate form of deterrence. Dewees et al. (1996), after reviewing the evidence from several fields involving personal injury, including accidents involving automobiles, medical practice, and products, concluded that "the tort system performs unevenly in deterring the causes of personal injury, so its scope should be restricted to situations where its effect seems likely to justify its high cost." They recommended expanding the no-fault approach exemplified by workers' compensation to the motor vehicle and medical malpractice fields.

Burton and Chelius (1997) concluded and Burton (2009) affirmed that based on both the historical experience of the impact of tort suits on workplace safety and the current controversy over the deterrence effect in other areas of tort law, "the law and economics theory concerning tort law does not

provide much assistance in designing an optimal policy for workplace safety and health.”

Government Mandate Theory vs Law and Economics Theory

The Government Mandate Theory

The government mandate theory argues that the government promulgation of health and safety standards and enforcement of the standards by inspections and fines will improve workplace safety and health. This is basically a legal theory, although many of the supporting arguments involve reinterpretation or rejection of studies conducted by economists. For example, proponents of the theory object to the evidence on compensating wage differentials and object in principle to economists' reliance on cost-benefit analysis. Supporters of the theory, such as McGarity and Shapiro (1996), also provide a positive case why OSHA is necessary:

OSHA's capacity to write safety and health regulations is not bounded by any individual worker's limited financial resources. Likewise, OSHA's capacity to stimulate an employer to action does not depend upon the employees' knowledge of occupation risks or bargaining power.

The government mandate theory would not be endorsed by many economists, including the OIE. Commons and Andrews (1936), for example, criticized at length the punitive approaches that used factory inspectors in the form of policemen, since this turned employers into adversaries with the law. The minimum standards supported by the OIE were those developed by a tripartite commission, involving employers, employees, and the public, rather than standards promulgated by the government. While the OIE theory is, thus, unsympathetic to the government mandate theory, the sharpest attack is derived from the L&E theory.

The L&E Theory Concerning Government Regulations

L&E scholars make a distinction between mandatory, minimum terms (standards) and those terms that are merely default provisions (or guidelines) that employers and employees can agree to override. Most employment laws, including workplace safety laws, create standards and are thus objectionable to the L&E scholars.

Willborn (1988) articulated the standard economic objections to mandatory terms. Employers will treat newly imposed standards like exogenous wage increases and in the short run will respond by laying off workers. In the long run, employers will try to respond to mandates by lowering the wage. The final wage-benefits-standards employment package will make workers worse off than they were before the imposition of standards – otherwise the employers and workers would have bargaining for the package without legal compulsion.

Evidence on the Effects of OSHA Standards

Shapiro (2009) concluded that the studies of OSHA's activities to improve workplace safety produced inconsistent results. For

example, Viscusi (1992) found that OSHA inspection activity reduced the lost workday rate by 1.5–3.6% at the industry level, but he indicated that other studies at this level of aggregation found no such effect. There were also conflicting results from studies at the individual-plant level. For example, Gray and Scholz (1991) found that inspections imposing a penalty reduced injuries, while Ruser and Smith (1991) found no such effect. On particular interest, Gray and Mendeloff (2005) found a decline over time in the effect of OSHA inspections on injury rates, with insignificant reductions in the most recent period in their study (1987–91).

Overall, the evidence suggests that the Occupational Safety and Health Act (OSHAct) has done little to improve workplace safety, thus lending more support to the L&E theory than to the government mandate theory. OSHA's ineffectiveness in part may be due to the lack of inspection activity, since Weil and Pyles (2005) note that the annual probability a US workplace will be inspected is well below 0.001. But the evidence also suggests that allocating additional resources to plant inspections may be imprudent, given the mixed results of inspections on safety.

In addition to the questionable effectiveness of OSHA inspections, some standards promulgated by OSHA have been criticized as excessively stringent. Viscusi (1996) examined OSHA standards using an implicit value of life of \$5 million (derived from the compensating wage differential studies) as the standard for an efficient regulation. Four of the five OSHA safety regulations, but only one of the five OSHA health regulations adopted as final rules, had costs per life saved of less than \$5 million. This evidence caused Burton and Chelius (1997) to provide a strong critique of the government mandate theory:

To be sure, cost-benefit analysis of health standards issued under the OSHAct is not legal, and so those standards that fail the cost-benefit test (considering both the lives saved plus injuries and illnesses avoided) do not violate the letter and presumably the purpose of the law. But to the extent that the rationale offered by the government mandate theorists for regulation of health is that workers lack enough information to make correct decisions and therefore the government is in a better position to make decisions about how to improve workplace health, the evidence on the variability of the cost/benefit ratios for OSHA health standards is disquieting. Rather than OSHA standards reflecting interventions in the marketplace that overcome deficiencies of the marketplace, the explanation of why the stringency of regulation varies so much among industries would appear at best to be a result of technology-based decisions that could well aggravate the alleged misallocation of resources resulting from operation of the market and at worst could reflect relative political power of the workers and employers in various industries.

Conclusions

This article suggests that understanding the economics of workplace safety involves a rather eclectic mix of theories. Burton and Chelius (1997) were least impressed with the arguments and evidence pertaining to the pure neoclassical economics and the government mandate theories. They concluded that, among the other economic theories pertaining to safety, no single theory provides an adequate understanding of the causes and prevention of workplace accidents. Rather,

a combination of the theories, though untidy, is needed. Their conclusion has stood the test of time.

See also: Environmental Health and Safety: Social Aspects; Institutionalism and Neo-institutionalism: History of the Concepts; Occupational Health and Safety, Regulation of; Old and New Institutionalism in Economics; Regulation, Political Economy of; Value of Life, Economics of; Workplace Safety and Health.

Bibliography

- Armstrong, Hazel, Bunn, Kristen, 2012. Experience rating and occupational diseases: a New Zealand case study. *Policy and Practice in Health and Safety* 1, 63–75.
- Boden, Leslie I., 1995. Creating economic incentives: lessons from workers' compensation systems. In: Voos, Paula (Ed.), *Proceedings of the 47th Annual Meeting*. Industrial Relations Research Association, Madison, WI, pp. 282–292.
- Bronchetti, Erin T., McInerney, Melissa, 2012. Revisiting incentive effects in workers' compensation: do higher benefits really induce more claims? *Industrial and Labor Relations Review* 65, 286–315.
- Burton Jr., John F., Chelius, James R., 1997. Workplace safety and health regulations: rationale and results. In: Kaufman, Bruce (Ed.), *Government Regulation of the Employment Relationship*. Industrial Relations Research Association, Madison, WI, pp. 253–293.
- Burton Jr., John F., 2009. Workers' compensation. In: Dau-Schmidt Kenneth, G., Harris, Seth D., Lobel, Orley (Eds.), *Labor and Employment Law and Economics*. Edward Elgar, Cheltenham, UK, pp. 235–274.
- Butler, Richard J., Worrall, John D., 2008. Wage and injury response to shifts in workplace liability. *Industrial and Labor Relations Review* 61, 181–200.
- Butler, Richard J., Gardner, Harold H., Kleinman, Nathan L., 2013. Workers' compensation: occupational injury insurance's influence on the workplace. In: Dionne, Georges (Ed.), *Handbook of Insurance*, second ed. Springer, New York.
- Clayton, Alan, 2012. Economic incentives in the prevention and compensation of work injury and illness. *Policy and Practice in Health and Safety* 1, 27–43.
- Coase, Ronald H., 1988. *The Firm, the Market, and the Law*. University of Chicago Press, Chicago, IL.
- Commons, John R., 1934. *Institutional Economics: Its Place in Political Economy*. MacMillan, New York.
- Commons, John R., Andrews, John B., 1936. *Principles of Labor Legislation*, fourth ed. MacMillan, New York.
- Deweese, Don, Duff, David, Trebilcock, Michael, 1996. *Exploring the Domain of Accident Law: Taking the Facts Seriously*. Oxford University Press, Oxford.
- Dorman, Peter, Hagstrom, Paul, 1998. Wage compensation for dangerous work revisited. *Industrial and Labor Relations Review* 52, 116–135.
- Ehrenberg, Ronald G., 1988. Workers' compensation, wages, and the risk of injury. In: Burton Jr., John F. (Ed.), *New Perspectives on Workers' Compensation*. ILR Press, Ithaca, NY, pp. 71–96.
- Ehrenberg, Ronald G., Smith, Robert S., 2012. *Modern Labor Economics: Theory and Public Policy*, twelfth ed. Addison-Wesley, Reading, MA.
- Fishback, Price V., 1998. Operations of "unfettered" labor markets: exit and voice in American labor markets at the turn of the century. *Journal of Economic Literature* 36, 722–765.
- Gray, Wayne B., Scholz, John T., 1991. Does regulatory enforcement work: a panel analysis of OSHA enforcement. *Law and Society Review* 27, 177–213.
- Gray, Wayne B., Mendeloff, John, 2005. The declining effects of OSHA's inspections on manufacturing industries 1979–1998. *Industrial and Labor Relations Review* 58, 571–587.
- Guo, Xuguang, Burton Jr., John F., 2010. Workers' compensation: recent developments in moral hazard and benefits payments. *Industrial and Labor Relations Review* 63, 340–355.
- Harrington, Scott E., Niehaus, Gregory R., 1998. *Risk Management and Insurance*. McGraw-Hill, Columbus, OH.
- Hirsch, Barry T., Macpherson, David A., Dumond, J. Michael, 1997. Workers' compensation reciprocity in union and nonunion workplaces. *Industrial and Labor Relations Review* 50, 213–236.
- Landes, William M., Posner, Richard A., 1987. *The Economic Structure of Tort Law*. Harvard University Press, Cambridge, MA.
- Leigh, J. Paul, Ruser, John, 2003. Compensating wage differentials for fatal and nonfatal injury risk by gender and race. *Journal of Risk and Insurance* 27, 257–277.
- Mansfield, Liz, MacEachen, Ellen, Tompa, Emile, Kalceovich, Christina, Endicott, Marion, Mi, Natalie Y., 2012. A critical review of literature on experience rating in workers' compensation systems. *Policy and Practice in Health and Safety* 1, 3–25.
- McGarity, Thomas O., Shapiro, Sidney A., 1996. OSHA's critics and regulatory reform. *Wake Forest Legal Review* 31, 587–646.
- Moore, Michael J., Viscusi, W. Kip, 1990. *Compensation Mechanisms for Job Risks: Wages, Workers' Compensation, and Product Liability*. Princeton University Press, Princeton, NJ.
- Oi, Walter Y., 1974. On the economics of industrial safety. *Law and Contemporary Problems* 38, 669–699.
- Posner, Richard, 1972. A theory of negligence. *Journal of Legal Studies* 1, 29–66.
- Priest, George L., 1991. The modern expansion of tort liability: its sources, its effects, and its reform. *Journal of Economic Perspectives* 5, 31–50.
- Purse, Kevin, 2012. Experience rating: an Australian post mortem. *Policy and Practice in Health and Safety* 1, 46–61.
- Reilly, B., Paci, P., Holl, P., 1995. Unions, safety committees and workplace injuries. *British Journal of Industrial Relations* 33, 275–288.
- Rose-Ackerman, Susan, 1992. *Rethinking the Progressive Agenda: The Reform of the American Regulatory State*. Free Press, New York.
- Ruser, John, Smith, Robert S., 1991. Reestimating OSHA's effects: have the data changed? *Journal of Human Resources* 26, 212–236.
- Schwartz, Gary T., 1994. Reality in the economic analysis of tort law: does tort law really deter? *UCLA Law Review* 42, 377–444.
- Seabury, Seth A., McLaren, Christopher F., Reville, Robert, Neuhauser, Frank, Mendeloff, John, 2012. Workers' compensation experience rating and return to work. *Policy and Practice in Health and Safety* 1, 97–115.
- Shapiro, Sidney A., 2009. Occupational health and safety regulation. In: Dau-Schmidt, Kenneth G., Harris, Seth D., Lobel, Orley (Eds.), *Labor and Employment Law and Economics*. Edward Elgar, Cheltenham, UK, pp. 273–295.
- Spieler, Emily A., Burton Jr., John F., 2012. The lack of correspondence between work-related disability and receipt of workers' compensation benefits. *American Journal of Industrial Medicine* 55, 487–505.
- Thomason, Terry, Burton Jr., John F., 1993. Economic effects of workers' compensation in the United States: private insurance and the administration of compensation claims. *Journal of Labor Economics* 11 (Part 2), S1–S37.
- Thomason, Terry, 2005. Economic incentives and workplace safety. In: Roberts, Karen, Burton Jr., F. John, Bodah, Matthew (Eds.), *Workplace Injuries and Diseases: Prevention and Compensation*. W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, pp. 9–35.
- Tompa, Emile, Hogg-Johnson, Shelia, Amick, Benjamin C., Wang, Ying, Shen, Enquig, Mustard, Cam, Robson, Lynda, 2012. Financial incentives in workers' compensation: an analysis of the experience-rating programme in Ontario, Canada. *Policy and Practice in Health and Safety* 1, 117–137.
- Viscusi, W. Kip, 1992. *Fatal Trade-offs: Public and Private Responsibilities for Risk*. Oxford University Press, New York.
- Viscusi, W. Kip, 1993. The value of risks to life and health. *Journal of Economic Literature* 31, 1912–1946.
- Viscusi, W. Kip, 1996. Economic foundations of the current regulatory reform efforts. *Journal of Economic Perspectives* 10, 119–134.
- Viscusi, W. Kip, Aldy, Joseph E., 2003. The value of a statistical life: a critical review of market estimates throughout the world. *Journal of Risk and Uncertainty* 27, 5–76.
- Weil, David, 1999. Are mandated health and safety committees substitutes for or supplements to labor unions? *Industrial and Labor Relations Review* 52, 339–360.
- Weil, David, Pyles, Amanda, 2005. Why complain? complaints, compliance and the problem of enforcement in the U.S. workforce. *Comparative Labor Law and Policy Journal* 27, 59–92.
- Willborn, Steven L., 1988. Individual employment rights and the standard economic objections: theory and empiricism. *Nebraska Law Review* 67, 101–139.