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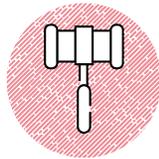# Risk without reward

The myth of wage compensation for hazardous work

By Peter Dorman and Les Boden • April 19, 2021

Unequal Power

Part of the Unequal Power project, an EPI initiative to reestablish the understanding in law, politics, economics, and philosophy, that equal bargaining power between workers and employers does not exist. Recognizing this inherent workplace inequality will bolster freedom, economic fairness, workplace protections and democracy.

I. Executive summary

A small but dedicated group of economists, legal theorists, and political thinkers has promoted the argument that little if any labor market regulation is required to ensure the proper level of protection for occupational safety and health (OSH), because workers are fully compensated by higher wages for the risks they face on the job and that markets alone are sufficient to ensure this outcome. In this paper, we argue that such a sanguine perspective is at odds with the history of OSH regulation and the most plausible theories of how labor markets and employment relations actually function. In particular, the imbalance of power between employers and employees and lack of information alone prevent employees from obtaining safe working conditions in market transactions with employers. We also find that the empirical claims purportedly buttressing the free-market view do not stand up to scrutiny, and that the profound shortcomings of OSH performance in the United States, brought to vivid light by the current pandemic, are attributable to too little public intervention in labor markets, not too much.

In the English-speaking world, OSH regulation dates to the Middle Ages. Modern policy frameworks, such as the Occupational Safety and Health Act in the United States, are based on the presumption of employer responsibility, which in turn rests on the recognition that employers generally hold a preponderance of power vis-à-vis their workforce such that public intervention serves a countervailing purpose. Arrayed against this presumption, however, has been the classical liberal view that worker and employer self-interest, embodied in mutually agreed employment contracts, is a sufficient basis for setting wages and working conditions and ought not be overridden by public action—a position we dub the "freedom of contract" view. This position broadly corresponds to the *Lochner*-era stance of the U.S. Supreme Court and today characterizes a group of economists, led by W. Kip Viscusi, associated with the value-of-statistical-life (VSL) literature.

The theoretical basis for the VSL approach assumes a full-employment labor market in which no worker would willingly exchange their job for another they would be qualified to fill. This situation has little similarity to real world labor markets, which are typically in a state of excess supply (unemployment), where compensation for equally qualified workers varies substantially by industry and employer, and where outcomes are determined not only by initial contracts but also worker and employer performance over time. OSH is one dimension of employer performance.

The problem of ensuring safe and healthy work is not just theoretical. Although workplaces are much less dangerous now than they were 100 years ago, more than 5,000 people died from work-related injuries in the U.S. in 2018. The U.S. Department of Labor's Bureau of Labor Statistics (BLS) reports that about 3.5 million people sustained injuries at work in that year. However, studies have shown that the BLS substantially underestimates injury incidence, and that the actual number is most likely in the range of 5-10 million. The vast majority of occupational diseases, including cancer, lung diseases, and coronary heart disease, go unreported. A credible estimate, even before the Covid-19 pandemic, is that 26,000 to 72,000 people die annually from occupational diseases.

Many high-risk workers are also poorly paid. For example, the 1.5 million nursing assistants, whose injury rates are over twice the workforce average, have median annual pay that barely exceeds the poverty level for a family of four, and the 2.16 million janitors and cleaners have median annual pay below the poverty level. In addition, temporary and short-term employment is associated with elevated injury rates, even within the same occupation.

There is also growing evidence that workers of color, particularly Black workers, have elevated injury risk because they are overrepresented in relatively hazardous occupations. This is the case even for workers of the same age, education, and sex as their white counterparts. Structural racism is a likely cause of these disparities.

When workers are injured, they incur substantial financial and nonfinancial burdens. Injuries involving a week or more off work lead to average lost earnings of around 20% over at least 10 years following injury. Only between one-half and three-fourths of injured workers eligible for workers' compensation cash benefits actually receive them. For those who do, less than a fifth of lost wages are replaced.

Many families do not have adequate liquid savings or access to credit. As a result, financial losses caused by occupational injuries and illnesses can lead to difficulty covering everyday expenses, including rent or mortgage payments, car payments, and even food. Latinx and Black workers are much less likely than white workers to have adequate savings to cover these expenses.

Injury impacts stretch beyond the financial. Injured workers experience limitations in household roles, including those as spouse and parent. They suffer post-injury depression and opioid use disorder. They also die at higher rates than their fellow employees from causes including suicide and drug overdose.

The United States stands poorly in international comparisons of work-related fatal injury rates. The U.S. rate is 10% higher than that of its closest rival, Japan, and six times the rate of Great Britain. This difference cannot be explained by differences in industry mix: The U.S. rate for construction is 20% higher, the manufacturing rate 50% higher, and the transportation and storage rate 100% higher than that of the E.U.

This is the real world context of statistical studies claiming to find wages compensating for voluntarily accepted OSH risk. Following Viscusi, such researchers employ regression models in which a worker's wage, typically its natural logarithm, is a function of the worker's demographic characteristics (age, education, experience, marital status, gender) and the risk of occupational fatality they face. Using census or similar surveys for nonrisk variables and average fatal accident rates by industry and occupation for risk, these researchers estimate the effect of the risk variable on wages, which they interpret as the money workers are willing to accept in return for a unit increase in risk. This exercise provides the basis for VSL calculations, and it is also used to argue that OSH regulation is unnecessary since workers are already compensated for differences in risk.

This methodology is highly unreliable, however, for a number of reasons:

- It rests on assumptions regarding risk perception and behavior at variance with most research.

- It assumes workers are accurately informed about the risks they face by employers who have an incentive to conceal them.

- It ignores extensive existing regulation of OSH risk and the effects this regulation has on choices made by workers and employers.

- The risk variable, on which the entire empirical strategy depends, is mismeasured: It applies large-group averages to the individual level, and it excludes fatal diseases, which are far more numerous than fatal accidents.

- It suffers from omitted variable bias; in particular, omission of employer- and industry-level variables likely results in very large overestimation of compensation for risk.

- It fails to adequately incorporate the different labor market experiences of men versus women, white workers versus workers of color, and other relevant distinctions.

Given these issues, it is striking that hazardous working conditions are the *only* job characteristic for which there is a literature claiming to find wage compensation.

While the findings of individual studies have little credibility, the pattern of results across different samples might convey useful information. If so, we note that greater compensation has been found for white, native-born, unionized, and higher-paid workers than for their Black, immigrant, nonunion, and lesser-paid counterparts—suggestive of the role of social and economic power differentials.

The shortcomings of the U.S. OSH system have been laid bare by the novel coronavirus pandemic. Workplaces in meatpacking and other industries have functioned as superspreading venues, and broader surveys reveal widespread worker concern over exposure. Key underlying factors include limited employer protection efforts, the failure of OSHA to assume regulatory responsibility, the inadequacy of occupational disease surveillance, the absence of a social safety net that would permit lower-paid workers to take time off from work if they test positive or have been exposed to identified cases, insufficient coverage by the workers' compensation system, the lack of hazard pay for workers at greatest risk, and the unequal distribution of risk along lines of race and class. The policy measures needed to protect workers during the pandemic reflect a larger agenda that preceded this episode and will remain after it is over: Raising the bottom end of the labor market to acceptable levels of wages and productivity; revamping labor laws to encourage unionization; rebuilding the occupational and public health infrastructure; taking assertive action to combat discrimination on the basis of race, ethnicity, and immigrant status; and embarking on initiatives to enhance worker voice in the 21st-century economy.

II. Introduction

By early summer of 2020 wildcat strikes or other job actions were underway at over 900

workplaces across the United States, largely over issues of health and safety related to the novel coronavirus (Payday Report 2020). Workers were demanding timely information, protective equipment, and changes in work arrangements to reduce their risk of infection and resorting to collective action to bring the changes about. As the confrontational nature of these events makes clear, employers did not always go along.

How should we understand such conflicts over health and safety at work? What do they tell us more generally about fairness, efficiency, and the role of inequality and power in employment? This paper examines these questions by reviewing a longstanding debate about occupational safety and health (OSH): Is it an obligation that ought to be assumed by employers, or do competitive markets under a presumption of equal power between employers and employees ensure safe conditions and adequate compensation for any risks that would be too costly to eliminate? As we will see, in modern economics our answer to this question often comes down to whether or not we believe workers are fully compensated for the risks they encounter at work, compensation they might reasonably demand if they could negotiate with employers from a position of approximate equality.

In this paper we will argue:

- The "freedom of contract" view of occupational safety and health fails both theoretically and econometrically. It is based on an inherently implausible view of labor markets and the employment relationship, and it is not supported by the empirical evidence.
- The inadequacy of the free market view is not a secondary matter. Rather, the failure of unregulated markets to ensure adequately safe working conditions and health equity for the workforce has urgent health as well as economic consequences, including those now visible as a result of the ongoing pandemic.

We will begin by briefly reviewing the history of OSH regulation in the English-speaking world, highlighting the changing assumptions on which regulation has been based. This will lead to an examination of modern theoretical perspectives on the employment relationship and its health and safety aspects, and we will contrast the anti-regulatory view held by some economists with alternatives that recognize power imbalances between workers and employers. In the following section we will document the extent and distribution of occupational injury and disease, demonstrating that their impact reflects and exacerbates economic and social inequality. It will be clear from our review of the evidence that, even in a technologically advanced economy like that of the United States, the toll of workplace accidents, illnesses, and deaths remains unacceptably high. After this we will turn to the "value of statistical life" (VSL) literature, which supposedly documents substantial wage compensation for risk, and expose problems in theory, measurement, and methodology. Moreover, we will show that, even on its own terms, this literature presents evidence for the importance of centering workplace inequalities when assessing compensation for risk: More-vulnerable workers (i.e., low-wage, Black, and/or immigrant) not only face greater risk on the job but also receive less compensation for it. In the final section we will return to a discussion of health and safety at work in the age of Covid-19, demonstrating how our analysis is applicable to this extraordinary episode.

One clarification about terminology: In this paper we will use the term *freedom of contract* to refer to the labor market perspective underlying the presumption that OSH risks are fairly and efficiently negotiated between workers and employers on an equal footing. Strictly speaking, this usage is not quite precise, since freedom of contract is a concept drawn from legal theory and is intrinsically normative, not necessarily descriptive of any particular labor market setting. In practice, however, there is a close correspondence between the legal and economic perspectives. Advocates of freedom of contract generally make the following assumptions about how labor markets work: (1) labor markets are in a more or less continuous equilibrium in which labor supply equals labor demand, (2) all relevant aspects of employment are determined in the initial moment of contractual agreement, (3) there is no regulation of the legal rights and obligations of the employment relationship on either side, (4) social norms and hierarchies are either nonexistent or can be regarded as fixed and are therefore ignorable background influences on individual choice, and (5) in the absence of regulation (or possibly excessive market concentration) the concept of power is inapplicable. In addition, in the context of OSH it is further assumed that risk to life and health is an ordinary consumption good, evaluated on a single dimension (from less to more) and without regard to additional social or psychological considerations. There is no generally accepted term that represents this constellation of assumptions, but, since certain strands of legal and economic thinking align so closely, we have chosen to use the legal designation. Of course, freedom of contract as an idealization applies to the entire range of economic outcomes in which markets play or could play a role, not just the labor outcomes we consider here (Atiyah 1979).

III. Two views of the risk of injury and illness at work

Under English common law dating from the Middle Ages, masters were deemed to be responsible for ensuring that work was acceptably safe for their servants (Henshaw et al. 2007). The underlying philosophy was paternalism, based on the view that masters were more knowledgeable, commanded more resources, and assumed reciprocal obligations because they benefited from their servants' devotion. Acceptability meant that risks should be no more than typical of such employments, so if disputes made their way to court the relevant evidence consisted of comparisons between the working conditions of this particular master and his peers. Indeed, paternalistic entailments limited the scope of contractual freedom over a wide swath of social and economic life (Atiyah 1979).

Gathering force in the 17th and 18th centuries, however, was a new doctrine, freedom of contract. Under this view, parties are assumed to act in their best interest in the marketplace or, if they don't, they must be made to suffer the consequences so they will learn to do so in the future. Thus, neither party is to be regarded as having obligations toward the other except insofar as they have agreed to them, and both sides to a contract are free to agree to any terms they choose. The only role of the state is to enforce the terms of such contracts on parties that resist carrying them out. Applied to matters of

health and safety at work, this view entailed rejection of the paternalistic view that masters (employers) had inherent obligations to protect servants (workers), relying instead on the judgment both should exercise in pursuing their separate interests. Thus was born the notion of occupational risk as the outcome of a mutual, and presumably optimal, employment agreement (Atiyah 1979).

It is important to recognize that these new terms do *not* describe an evolution in which one view of OSH was progressively supplanted by another. On the contrary, with changes in the economic role of business, repeated revolutions in technology, and the emerging centrality of the employment relationship in modern life, a version of the older employer responsibility approach to OSH took on new life and became, in one form or another, the dominant understanding by the end of the 19th century (Henshaw et al. 2007). Rather than resting on the paternalism of medieval caste hierarchies, however, the modern view had these elements:

- It recognized that technology had become far more complex and opaque, with serious new dangers best regulated at their source. This meant that businesses had to take worker health and safety into account when devising new methods and products.

- It increasingly viewed the workplace as a sort of society, with workers at least partly in the role of citizens. Thus, the exercise of care by the employer was demanded because it reflected the reciprocity and mutual concern on which industrial cooperation ought to be based.

- It acknowledged the disparity of power between business owners and workers, especially in times of excess labor supply. Indeed, the worst-off workers, those with the least education and fewest outside options aside from their current job, were visibly subjected to barbarous conditions in the absence of social protection (Mill 1871).

For these reasons, the employer responsibility view of OSH freed itself from the ancient *noblesse oblige* paternalism of the law of masters and servants.

Employer responsibility was codified in the British Factory Acts beginning in 1833, and it crossed the Atlantic after the American Civil War. Massachusetts became the first state to regulate working conditions in 1877, and in the decades that followed nearly every other state followed suit (MacLaury, undated). This is not to say that regulation was sufficient; horrendous conditions could be found in mining, railroads, and meatpacking, as well as manufacturing. The political debate, however, was not over whether some measure of regulation was necessary but where and how much.

Workers often took the initiative to demand responsibility from their employers when the government failed to take action. Along with wages, the call for greater safety on the job was a prime motivator for the unionization drives of the late 19th and early 20th centuries. Eventually labor movement pressure resulted in the Occupational Safety and Health Act of 1970, which created the Occupational Safety and Health Administration (OSHA) and initiated a nationally harmonized system of workplace standards, record-keeping, inspection, and enforcement. It would not be an exaggeration to say that the employer

responsibility view of OSH is the law of the land.

A small but dedicated group of economists, legal theorists, and political thinkers, however, resisted this tide.[1] They drew on the contract-centered ideal of classical liberalism to argue that government regulation of working conditions was unnecessary, since they were already regulated efficiently by competitive markets. Workers who felt that a particular employer was too inattentive to safety could look for other work more to their taste. Employers, feeling the pressure of worker preferences, would have to invest in better working conditions, offer extra wages or other compensation for the risks they asked workers to undergo, or both. Indeed, labor market agreements drawn up by self-interested individuals aware of their own circumstances and preferences were believed to offer the *best* form of regulation; government interference could never improve such outcomes and would most likely make them worse.

There is debate among legal scholars over the extent to which such classically liberal ideas were influential in judicial oversight of the emerging regulatory state. In most cases courts upheld the regulation of working conditions, but the most important exception, *Lochner v. New York* (1905), established a precedent that held for three decades. John Lochner was a baker who challenged New York state regulation of working hours in his industry; state courts upheld the rule, but the U.S. Supreme Court deemed it an infringement on the right of individuals to "purchase and sell labor" (Rosner and Markowitz 2020). Yet even in this ringing assertion of freedom of contract the court was at pains to argue that employer responsibility for safety was unaffected: "To the common understanding the trade of a baker has never been regarded as an unhealthy one" (Justice Peckham, cited in Bale 1988). Regardless, the reversal of the *Lochner* precedent by the New Deal era court has generally been seen as the end of strict freedom of contract as applied to OSH and related aspects of employment.

It is remarkable, then, that beginning in the 1970s a research project arose in economics to estimate the amount of extra pay received by workers in exchange for bearing greater occupational safety and health risks. The research was based on the *assumption* that such risks were voluntarily agreed upon by self-interested parties and reflected their corresponding preferences. In other words, these economists assumed a *Lochner*, freedom-of-contract world and erected an edifice of theory and statistical research on top of it. This approach has proved to be an influential strand of analysis and advocacy, and one of the main purposes of this paper is to scrutinize it in the larger context of what we know about labor, employment relations, and the role of unequal bargaining power.

Here we will briefly summarize the freedom-of-contract approach to OSH that has gained a foothold in economics in order to see how it fits into the long evolution of thinking on this question—or doesn't. In a later section of the paper we will return to give it much more careful scrutiny.

As presented by its chief advocate, W. Kip Viscusi, over a series of many books and articles, the contract-centered view takes the following forms. To begin with, it is assumed that the national labor market comprises innumerable markets for specific types of labor, each properly modeled as a relationship between supply (workers with particular

productivity-related attributes offering their labor) and demand (employers offering pay for particular jobs). Each market clears where supply equals demand, establishing a single level of compensation for all labor of that type.

If there were no compensation except for money wages, a single wage would be paid to each type of worker; economists refer to this as the "law of one price," which is thought to hold in competitive markets. (There are reasons why such a law might be violated even under conditions of unrestricted competition, but we won't consider them here.) But now let us also suppose workers care not only about the wages they are paid but also the working conditions they will experience. From the employer's point of view (in this theory), improvements in these conditions, including OSH, are expensive. Since productivity is assumed to be equal across firms (the result of competition), and all excess or deficient rates of profit will be competed away, all employers appearing as purchasers of labor in a given labor market will pay the same wages-plus-working-conditions expense. In this sense the law of one price remains in effect.

On the worker's side it is a bit more complicated. Workers care about safety, so any job that is more dangerous than the available alternatives—the ones offered to workers of the same productivity type—has to pay a higher wage, otherwise it would get no takers. Of course, workers differ individually in how they trade off the benefits of income against the costs of risk, so in subjective terms there isn't a law of one price anymore; a given worker will likely find one job offer more appealing than another, since it better matches that worker's own subjective tradeoff. Nevertheless, in the new equilibrium of job offers and acceptances, no workers in the equation would willingly exchange their employment for any other offered to workers of their productivity. Any truly better job, one that offered a preferred combination of wages and working conditions, perhaps better in both respects, would be available only to those with more marketable productivity attributes than theirs.

Thus, in the freedom-of-contract world every labor market, comprising workers of the same type, would display a range of wages and working conditions corresponding to different costs of making work safer (employers) and subjective benefits from safety (workers). Riskier jobs would pay more and would be preferred by more risk-tolerant workers. The extra amount of money employers in this hypothetical world must pay to attract a labor force if their jobs are more dangerous is called a compensating wage differential (CWD). It is important to note that the story underlying this term requires that the CWD be *fully* offsetting; if it isn't, the job in question won't be filled. We will see that this backstory plays a critical role in the interpretation given to statistical findings: Economists wedded to the freedom-of-contract view regard any evidence of wage compensation for risk as a measure of the *full* value placed on safer work that extra wages are needed to replace. Since we are not beholden to this view ourselves, however, we are able to imagine *partial* compensation for risk—a monetary increment that might be given to workers laboring under more dangerous conditions that nevertheless leaves them worse off than they would have been had those conditions been improved instead.

Returning to the freedom-of-contract story, it's worth spending a moment to consider how far-reaching the consequences of this set of assumptions must be. First, the level of safety in every single job would be efficient. Employers would make all investments that result in

safety improvements that workers value (and are willing to accept correspondingly lower wages for) above the cost of implementing them, and none whose cost exceeds workers' valuations. Employers with high costs of making jobs safe would offer more dangerous jobs but pay higher wages; workers with a higher tolerance for risk would accept more dangerous work but would be compensated with the additional wages they require. No regulator would be able to make any alteration that would improve the level and allocation of safety at work. Second, all workers who offer labor of the same type would end up at jobs they value at least as highly as any other they might qualify for. Some would get more dangerous jobs and more pay, others less on both counts, but no one would prefer to switch. Regulation would not be needed to protect anyone from anything. Third, by reflecting workers' subjective valuation of occupational risk, CWDs could be used to estimate a value of statistical life for society in general insofar as workers are representative of the whole population. If the equilibrium CWD is $1,000 for a 1-in-10,000 increase in the risk of death on the job, the VSL would be $1,000 times 10,000 or $10 million. This third property of CWDs has given economists like Viscusi prominence in the world of public policy analysis, and estimates of compensating differentials are factored into regulatory decisions ranging from air pollution to vehicle speed to climate change mitigation.

Despite the publicity given to this strand of modeling, specialists in labor market research have long known that the law of one price for employers and the no-switch condition for workers are routinely violated; workers of similar observable skills doing essentially the same work under comparable conditions are typically paid quite differently, and sometimes those with lower wages also face greater occupational risks. There are better and worse jobs, and much of the modeling and econometric work of the past several decades has been devoted to trying to understand the forces behind these outcomes and what they imply for public policy. The starting point was the work of Richard Lester in the 1940s, such as "Wage Diversity and Its Theoretical Implications" (1946). It was clear that the simple supply-and-demand story could not be an adequate account of how labor markets operate, since competition should enforce equal compensation for equally productive workers.[2]

In subsequent years many approaches have been put forward. Some depend on dropping the assumption of perfect competition by dividing either firms, workers, or both into more-versus less-favored segments (Dickens and Lang 1993). Since the 1980s, one wage dispersion of interest has been that of inter-industry (and now also intra-industry) wage differentials. Other economists have revolutionized market analysis by looking more carefully into "search theory," i.e., how workers search for jobs and employers search for workers. Two progenitors of this approach, Christopher Pissarides and Dale Mortensen, were awarded a Nobel Memorial Prize in Economics in 2010 in recognition of the centrality of the approach to modern labor economics, particularly at the macro level.[3] In search models, as we will see, it is expected that the law of one price will be violated, a point emphasized in Mortensen (2003). Yet another approach foregrounds bilateral bargaining between employer and worker, either individually or in the context of collective bargaining. This process is referred to as "rent-sharing," and bargaining models are often grafted onto underlying mechanisms, such as barriers to competition, that give rise to rents themselves.

Meanwhile, closer collaboration between economists and management scholars has generated a range of modeling strategies that incorporate more complex and realistic employer choice options. These include "efficiency wage" models (pay for performance and not just showing up) and incorporation of on-the-job training and other investments or practices that use human resources as a basis for competitive advantage.[4] Finally, there has been extensive research into the role of racial, gender, and other forms of discrimination in generating unequal outcomes for workers of comparable productivity.[5]

Nevertheless, despite all these important theoretical insights, a word of caution is in order. For institutional and other reasons we will not consider here, economists working on a particular departure from the freedom-of-contract model typically treat it as the *only* such departure; its significance is thought to be the difference it alone would make. Thus, we see an array of labor market models in the literature that are at variance with the freedom-of-contract approach only in one respect even though, taken together, they would point to a radically different vision. This strategy is important in practice because it is common for economists to propose policy responses that address only the single "imperfection" they are studying, and these frequently fall short of the scope of commitment embodied in regulatory interventions like OSHA. Without going into detail, we would like to explicitly stipulate a core set of characteristics of the employment relationship that, in combination, remove it decisively from the freedom-of-contract world:

- All employment contracts are necessarily incomplete. Worker and employer performance cannot be fully specified in advance, and thus an ongoing relationship with procedures for designating required, permissible, and prohibited activities is inescapable.

- The rights, opportunities, and obligations pertaining to each worker individually depend on those for their co-workers, including those above and below them in the chain of hierarchy. Thus, separate individual agreements (contracts) extending to all terms of the employment relationship are not feasible.

- Because of incomplete contracting, what workers sell is their subordination to the employer. This subordination is bounded, of course, by their freedom to terminate, but it is usually so costly for workers to exercise this option that they often accept substantial depredations and still remain on the job. This is the core power imbalance between worker and employer.[6]

- In all societies, employment is a legal status with associated rights and responsibilities for both parties. The ability to benefit from the provisions of this status also differs among workers for both legal and socioeconomic reasons, constituting another dimension of power.

- Provision of safe working conditions is largely a matter of ongoing performance and not a once-and-for-all commitment made at the moment of contract. In practice it entails such activities as housekeeping and maintenance, work pacing and scheduling, honest and timely risk communication, and the consideration of health and safety factors in the introduction of new materials and technologies. The determination of safe working conditions is subject to voice as well as exit influences from the workforce (Hirschman 1970).[7]

- Thus, regulatory systems like OSHA, which contribute to the legal status of employment, are essential. They reduce the effect that differences in power would otherwise have on safety and health outcomes, strengthening the ability of workers to engage in individual (whistleblowing) and collective action, and creating legal and financial incentives for improved employer performance. The necessity of regulation can mostly clearly be seen in its breach, as we will document in our concluding section on the coronavirus pandemic. If an economic model has the property that OSH regulation is generally unnecessary or even harmful, this points to a defect with the model, not regulation.

These foundations of our alternative view of OSH and employment do not negate the role of markets but supplement it. Employer costs and worker preferences do matter in the ways specified in market analysis, but they comprise only part of the story. We prefer to consider the theoretical departures of search theory, behavioral economics, and other branches of modern economics as extensions of an institutionally complex view of the employment relationship, not a stripped-down freedom-of-contract benchmark.

IV. The real world of dangerous work in the United States

A. The overall risk to the working population

In this section, we will summarize information about the extent, severity, and impact of injuries and illnesses related to work. We will see that there are a considerable number of work-related injuries and illnesses in the U.S. and that their financial and health impacts are substantial. We will also see that the impacts of these injuries tend to be unequally distributed, concentrated among lower-wage workers, Black and Latinx workers, and temporary, contracted, and online platform workers. In the United States, we have good information about fatal injuries at work, but we know less about nonfatal injuries. Moreover, we have only very indirect ways of trying to capture the extent of work-related illnesses, which are, by far, the largest category of risk.

1. Fatal injuries

Before 1980, the only source of occupational fatality data in the U.S. was the annual Survey of Injuries and Illnesses (SOII) conducted by the Bureau of Labor Statistics (BLS). In principle, the SOII covers all employers except for agricultural employers with fewer than 10 employees and federal government employees (whose injuries are reported separately). Employers are the only source of information for the SOII, so it depends on their diligence and willingness to report. From 1980 through 1991, the National Institute for Occupational Safety and Health (NIOSH) implemented a new source of occupational fatality data, the National Traumatic Occupational Fatality database (NTOF). The NTOF used death certificates, rather than employer reports, as a source of occupational fatality data. Unlike the SOII, it included all employment, including employees of small employers

Annual number of fatal occupational injuries, 1992–2018
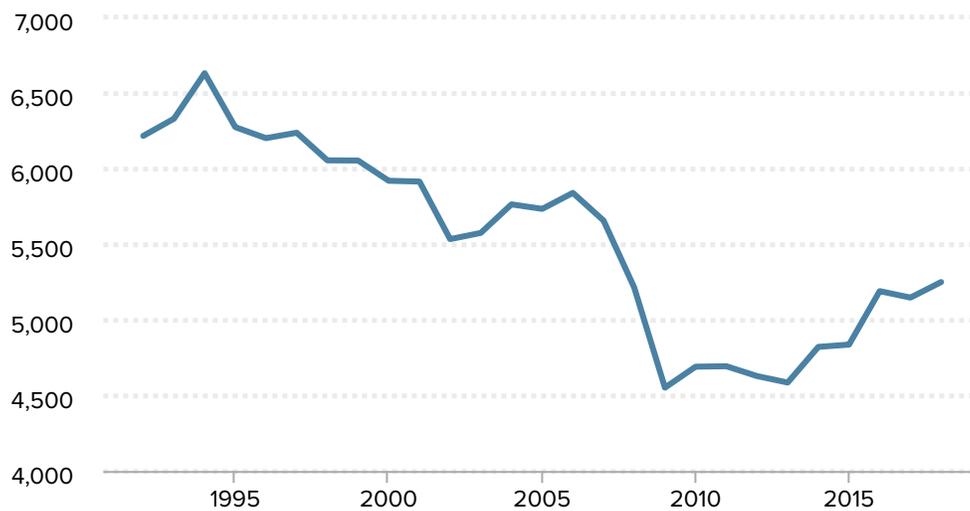
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and the self-employed. It found much higher fatality numbers than reported by the SOII, particularly in the high-risk agriculture and construction sectors (Stout-Weigand 1988; Leigh and Garcia 2000).

Since 1992, U.S. national data about work-related fatalities have been collected by the BLS and published as the Census of Fatal Occupational Injuries (CFOI). The CFOI includes fatal injuries of both employees and independent workers (the self-employed and online platform workers). It is generally acknowledged to be a virtually complete accounting of these deaths and includes worker demographic information, industry, and injury characteristics. **Figure A** shows that, from 1992 through 2009, the annual number of fatal on-the-job injuries was generally declining, from over 6,000 to a little over 4,500. However, after four years of little change, the number of fatalities rose in 2014-2018. Because the number of people working rose during that period, the fatality rate remained about the same, 35 fatalities per million full-time workers. In 2018, 5,250 workers died from injuries at work. Another way of looking at this is that an American worker died on the job every 100 minutes.

2. Nonfatal injuries

Surprisingly, no source provides an accurate count of the number of nonfatal injuries in the U.S. The only national source of information for the number and rate of nonfatal occupational injuries is the BLS's annual SOII, which reported that 3.5 million work-related injuries and illnesses occurred in the private sector and state and local government in 2018. This translates into 3.1 injuries per 100 full-time workers. However, as noted above, the SOII omits self-employed and online platform workers, somewhere between 8% and 10% of total employment, and it also omits federal employees and workers on small farms.

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Although it does not omit household employees, their work-related injuries may escape reporting. Even for covered workplaces, researchers, the Government Accountability Office (GAO 2009), and the BLS itself (Ruser 2008) have agreed that it misses many injuries. This under-recording is not random, but is affected by many factors, including industry, occupation, duration of time off work, type of injury, and the state where the injury occurred (Boden, Nestoriak, and Pierce 2010; Boden and Ozonoff 2008; Fan et al. 2006). Also, as noted above, the SOII data are submitted to BLS and OSHA by employers only, a practice that may limit completeness of reporting (Rappin, Wuellner, and Bonauto 2016).

Injuries are underreported by workers, employers, and medical providers. Reasons for worker underreporting include fear of current and future employer retribution, employer bonuses for zero reported injuries (so-called safety bingo), and lack of understanding about reporting (Azaroff, Levenstein, and Wegman 2002; Frederick and Lessin 2000). Employers may underreport because of the economic incentives to do so (e.g., they wish to reduce workers' compensation costs); because middle-manager evaluations include only reported, as opposed to actual, injury rates; because some contract bidding takes into account reported injury rates; or because of poor reporting systems and lack of understanding (Rappin, Wuellner, and Bonauto 2016; GAO 2009). Medical providers, who are workers' compensation gatekeepers in addition to treating injured workers, have indicated that they frequently perceive pressure from employers to downplay injuries and illnesses (GAO 2009). These factors may be particular problems for low-wage and contingent workers, immigrants, and minorities (Castillo 2018; Premji and Krause 2010).

Researchers looking at different states have estimated that, on average, the SOII misses anywhere between 30% and 70% of injuries involving time lost from work (Boden and Ozonoff 2008; Rosenman et al. 2006). If we assume that the SOII misses half of all injuries, then 2018 saw about 7 million work-related injuries, over 6 per 100 full-time workers each year. Employers reported that about one-third of these injuries involved more than a day off work.

3. Occupational disease

Chronic occupational disease deaths are not covered by the CFOI. The SOII covers occupational illnesses in principle, however in practice chronic occupational illnesses are virtually uncounted (Leigh et al. 2000). There are many reasons for this, perhaps the most important of which is that these illnesses often go unrecognized by both workers and their physicians. Some states have programs targeting specific occupational diseases, like lead poisoning, work-related asthma, and pesticide poisoning. The only exception to the considerable undercount of chronic occupational diseases may be for coal workers' pneumoconiosis, a disease that NIOSH has focused on for decades.

Because no record-keeping adequately captures occupational diseases, estimates of mortality from these causes have relied on epidemiological studies of specific diseases to estimate the fraction attributable to work. These estimates are then combined with overall U.S. mortality from these diseases (Steenland et al. 2003). The authors of an important study in this area estimated that about 49,000 people die annually from occupational illnesses, with a wide range of uncertainty—from 26,000 to 72,000. Even the low estimate

of occupational disease deaths is much greater than the number who die from occupational injuries: If we take 5,500 as the annual average of fatal injuries, then occupational illnesses are responsible for roughly five to 13 times as many deaths each year.

The main causes of death from occupational exposures are cancers, noncancer respiratory disease related to dust and chemical exposures, and coronary heart disease, largely related to job strain (high job demands combined with low worker control) (Steenland et al. 2003).

4. Overall risk

In conclusion, except for traumatic fatal injuries, occupational injuries are substantially underreported in the United States. This underreporting varies by many categories, including worker characteristics, occupation, industry, injury severity, and state. Both incidence of and mortality from chronic occupational disease are barely reported at all. Experts can only guess at these risks, so it would seem unlikely that workers would have a reasonable sense of the probability of dying from disease hazards at work.[8] One consequence of this lack of information is that workers can't base their wage demands on the true risk they face on the job, a shortcoming that calls into question estimates of the value of a statistical life predicated on the assumption they can. Our best estimates are that, each year:

- 5,500 people die from work-related injuries.

- Another 49,000 people die from work-related illnesses.

- 7 million people are injured at work every year, and over 2 million of these lose at least a day from work.

- Many people suffer discomfort and disability from work-related illnesses, but we don't know how many. However, work-related chronic lung and heart diseases can have life-altering consequences that last for decades before they result in premature death.

B. The distribution of risk

Of course, not all jobs are equally risky. **Table 1** shows nonfatal injury rates for some high-risk occupations compared with the average for all occupations, and **Table 2** shows fatal injury rates. Many of these high-risk jobs have relatively low wages. More generally, groups that have less power, knowledge, or ability to affect workplace hazards and groups that are discriminated against are more likely to be at risk of injury in the workplace.

Temporary, contracted, and online platform employment. Temporary agency workers often have higher fatal and nonfatal injury rates than do workers in standard jobs (Foley 2017; Julià et al. 2016; Smith et al. 2010). Similarly, studies of subcontracted employment have shown higher risks than in standard work (Kochan et al. 1994). Low-wage workers also tend to have higher injury rates. One study showed workers in low-income families had higher risk of injury, even accounting for industry and occupation (Dembe, Erickson,

Table 1

Selected occupations with high nonfatal injury rates, 2018

Occupation	Percent of overall average
Laborers and freight, stock, and material movers, hand	318%
Heavy and tractor-trailer truck drivers	322%
Janitors and cleaners	177%
Nursing assistants	327%
Maintenance and repair workers, general	236%
Stock clerks and order fillers	203%
Police and sheriff's patrol officers	873%
Light truck drivers	311%
Construction laborers	266%

Source: Authors' analysis of U.S. Department of Labor Bureau of Labor Statistics data (U.S. DOL-BLS 2020a).

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Table 2

Selected occupations with high fatal injury rates, 2018

Occupation	Percent of overall average
Logging workers	2800%
Fishers and related fishing workers	2200%
Aircraft pilots and flight engineers	1690%
Roofers	1480%
Refuse and recyclable material collectors	1270%
Driver/sales workers and truck drivers	750%
Structural iron and steel workers	680%
Waste management and remediation workers	610%
Landscaping services	540%
Miscellaneous agricultural workers	520%

Source: Authors' analysis of U.S. Department of Labor Bureau of Labor Statistics (U.S. DOL-BLS 2020c).

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and Delbos 2004), another that people earning less than $50,000 per year reported a greater risk of injury than those with higher earnings (Fan et al. 2006).

Temporary and short-term workers, frequently hired through temporary employment agencies, may be particularly vulnerable to workplace safety risks. As noted in an OSHA white paper:

New workers often lack adequate safety training and are likely to be unfamiliar with

the specific hazards at their new workplace. As a result, new workers are several times more likely to be injured in the first months on the job than workers employed for longer periods. Consistent with these findings, OSHA has investigated numerous incidents in recent months in which temporary workers were killed on their first days on a job.

Temporary workers are also likely to be newly assigned to unfamiliar workplaces multiple times in any given year and may carry this increased risk as long as they are in the temporary workforce. For employers, there is less financial incentive to invest training resources on temporary employees because shorter tenure will yield a lower return on investment than similar investments for permanent employees.

OSHA has encountered many situations, including some in which temporary workers have been killed, in which employers have chosen to not provide required safety training to temporary workers. And the temporary workers themselves, recognizing the precarious nature of their employment, are less likely to complain to their employers, or to OSHA, about the existence of even serious hazards (OSHA 2015).

Workers in temporary employment relationships are often subject to the same occupational hazards faced by others in the same work environments in standard employment relationships. In addition, these workers are likely to have little control over their work schedules or pace, may be hired only during periods of high demand, and have few social supports in the workplace. They may also have limited training in job tasks, job risks, and prevention of injury or adverse health exposures. They may not have access to personal protective equipment and training in its use. And, in some cases, they may be assigned to the most dangerous jobs (Mehta and Theodore 2006).

ProPublica reporters compared injury rates for jobs held by temporary workers with jobs held by regular employees, accounting for whether the jobs they held were particularly hazardous. For jobs with similar injury risk they found that the odds of injury for temporary workers were almost four times as high as for regular employees (Pierce, Larson, and Grabell 2013).

Short-term and seasonal workers may be more subject to job strain and its adverse health consequences and less likely to benefit from the workplace conditions that may mitigate these effects (Cummings and Kreiss 2008). Job strain can result in both physical and psychological disruption; prolonged job strain leads to increased cardiovascular disease, musculoskeletal disorders, sleep disruption, and psychological problems. Exposure to workplace conditions like job insecurity, low job control, high job demands, and low social support at work may explain a substantial proportion of observed inequality in life span in different demographic groups in the U.S. (Goh, Pfeffer, and Zenios 2015). The growth in temporary, contracted, and online platform employment relationships that results in increased exposure of less-educated and ethnic minorities to harmful workplace practices is likely to result in poorer health.

Also, temporary, contracted, and online platform workers may have less access to health insurance and workers' compensation benefits (Asfaw 2014; Mehta and Theodore 2006),

causing greater financial strain and interfering with recovery from injury or illness. For a more detailed look at these issues, see *The Fissured Workplace* (Weil 2014) and *The Changing Structure of Work: Implications for Workplace Health and Safety in the U.S.* (Boden, Spieler, and Wagner 2016).

Workers of color. There is also evidence that workers of color, particularly Black workers, have elevated injury risk. Loomis and Richardson found that Black workers were 30-50% more likely to die from an occupational injury compared to similar white workers (Loomis and Richardson 1998). The disparity in fatal injury risk was primarily accounted for by differences in the underlying hazards of their occupations. Another study indicates that Black men have greater fatality risk than white men working in the same industry. Black agriculture workers' fatal injury rate is 26.9 per 100,000 workers, compared to 21.2 for whites (CDC/NIOSH 2004). Within the same industry Black and white workers may have very different jobs.

Another study examined six occupations, employing 16% of private-sector workers in the U.S., at high risk of nonfatal work-related injury. The authors found that Latinx, Black non-Latinx, and American Indian/Alaska Native workers were substantially overrepresented in these occupations (Baron et al. 2013). A more recent study found that non-Latinx Black workers and foreign-born Latinx workers were more likely to work in riskier jobs than white workers, leading to higher rates of work-related disability (Seabury et al. 2017). These results held even after accounting for education, age, and sex. Other research has shown increased risk of fatality and injury among immigrant Latinx construction workers (Dong and Platner 2004) and Latinx hotel workers (Buchanan et al. 2010).

Although studies of occupational disease in this context are rare, there is evidence that Black workers have elevated occupational disease risk. For example, a 1971 study found that, among steel workers, coke oven workers had the highest lung cancer mortality (Lloyd 1971). Moreover, Black coke oven workers were largely working on the topside of the coke ovens—hot, dirty work that resulted in heavy exposure to carcinogenic emissions. A more recent study of lung cancer among chromium smelter workers also found Black workers at higher risk (Rosenman and Stanbury 1996).

Some studies did not find increased injury rates among nonwhite workers. One found substantial excess risk of occupational fatalities among Latinx and immigrant workers, but not among Black non-Latinx workers (Marsh et al. 2013). Studies using the National Longitudinal Survey of Youth 1979 did not find higher injury rates among nonwhite workers, but one found longer absences from work (Berdahl and McQuillan 2008; Strong and Zimmerman 2005). However, most of the evidence supports the view that white non-Latinx workers have the lowest risk.

Using another way of looking at relative power, Peter Smith and his colleagues have studied the relationship between injury and worker vulnerability (Smith et al. 2015). Their concept of vulnerability combines potential exposure to hazards with the ability to mitigate those hazards. Mitigation resources include workplace policies and procedures, workers' awareness of their rights and responsibilities, and workers' empowerment to protect themselves. Workers who reported being more empowered had much lower injury rates

(Lay et al. 2017).

C. The burden of injuries at work

1. Lost earnings

Although there is a history going back to the early 20th century of studies on earnings lost because of injuries at work, researchers have applied modern statistical methods only over the last two decades. Beginning in 1999, a series of studies using workers' compensation data from California, New Mexico, Oregon, Wisconsin, and Washington has consistently shown that injured workers who received workers' compensation benefits for lost wages had substantial earnings losses and that these losses persisted for as long as the injured workers were followed. One study focusing on permanent partial disability (PPD) cases in five states estimated that affected workers had lost about 20% of their earnings over a five-year period (Reville et al. 2001). A 2014 study following New Mexico workers for 10 years after injury found average losses of about 20% over the full 10-year period (Seabury et al. 2014). Indeed, all studies have found losses that continue for as long as the study can follow injured workers, and from these studies we conclude that PPD injuries cause a lifetime of substantial lost earnings.

Some studies of lost earnings have also looked at temporary disability (TD) cases, where benefits were paid for time lost from work but not for permanent impairment or disability. The New Mexico study just cited (Seabury et al. 2017) found that in TD cases with one to eight weeks off work workers lost an average of about 10% of earnings averaged over the 10 years after injury. These losses looked like they would continue far into the future, but the workers were followed only for 10 years. Those losing 8 weeks or more lost almost as much on average as those with PPD injuries. A California study found that workers with injuries occurring from 2005 to 2017 who lost at least four days from work lost about 20% of earnings over the two post-injury years (Rennane, Broten, and Dworsky 2020).

A study examining differences in injured workers' lost earnings by income found that workers in the highest wage quartile had the lowest percentage loss in earnings, while workers in the second quartile had the greatest percentage loss in earnings (Rennane, Broten, and Dworsky 2020). Differences in lost earnings among earnings or racial/ethnic groups have not been well studied.

Workers' compensation programs only partially cover the earnings losses of injured workers who receive benefits. The extent of this coverage depends both on whether injured workers receive benefits and the proportion of lost wages covered when benefits are paid.

2. Proportion of injured workers receiving workers' compensation benefits

Studies of the take-up of workers' compensation benefits have uniformly shown that many injured workers never receive any benefits. Because state systems vary substantially, the

proportion of injured workers receiving benefits can vary widely. A six-state study of injuries eligible for cash benefits (lost-time cases) found that workers' compensation benefits were paid to about 90% of eligible injured workers in two states but to just 50-70% of cases in the other four (Boden and Ozonoff 2008). To be eligible for cash benefits that replace lost earnings, states require that the number of days lost from work exceed the waiting period, which varies between three and seven days. A similar study in Michigan found that 66% of eligible injuries received workers' compensation benefits (Rosenman et al. 2006). A study of workers' compensation take-up in 10 states found that, of work-related injuries involving medical treatment or at least one day lost from work, workers' compensation benefits were received in 47-77% of cases (Bonauto et al. 2010). Presumably all the injuries in this study would have been eligible for workers' compensation medical benefits, but not necessarily for cash benefits.

Aside from specialized federal compensation programs (the Black Lung Program, the Radiation Exposure Compensation Program, and the Energy Employees Occupational Illness Compensation Program), virtually no chronic occupational disease victims receive compensation. This means that, since occupational illnesses have a far greater incidence than injuries, the bulk of occupational illnesses and injuries go uncompensated.

3. Proportion of lost wages replaced among injured workers receiving workers' compensation benefits

Several of the studies of lost earnings that used modern statistical methods also calculated the proportion of injury-related lost wages replaced by workers' compensation cash benefits. The earliest of these studies—the five-state PPD study referenced above—found that workers' compensation benefits replaced 38-60% of after-tax lost earnings for PPD cases in these states (Reville et al. 2001). (After-tax earnings are used because workers' compensation benefits are not taxed, while wages are. We note, however, that lost fringe benefits are not considered in this calculation, meaning that the actual income-replacement rate is even lower than what these studies report.) A more recent study in New Mexico, using more complete data, estimated replacement of only 16% of after-tax earnings lost in the 10 years after injury (Seabury et al. 2014). This study also found that workers' compensation benefits replaced less than 10% of after-tax losses for injuries classified as temporary disability cases. The reason for this somewhat surprising result is that even people receiving less than eight weeks of TD benefits, on average, have losses that continue far into the future.

Some of these lost earnings may be partially covered by sick pay, private disability insurance, public short-term disability insurance (in some states), unemployment insurance, Social Security Disability Insurance, Supplemental Security Insurance, etc., but the information about this is limited. One study estimated that workers' compensation cases annually account for about $9 billion in Social Security Disability Insurance benefit payments and about the same amount in Medicare payments (O'Leary et al. 2012).

4. Proportion of medical costs replaced among injured workers receiving workers' compensation benefits

In principle, workers' compensation pays all injury-related medical costs for covered injuries. Of course, a substantial number of workers with occupational injuries and almost all workers with chronic occupational diseases do not receive workers' compensation, so their medical costs are not covered. There is virtually no information about the cost of uncovered injury-related medical expenses, nor is there information about how much of those expenses are covered by general health insurance, Medicaid, Medicare, workers and their families, or other sources.

5. Work-related injuries and financial distress

Many working families live paycheck to paycheck and have little or no savings to fall back on. A 2018 survey asked people whether they could cover an unexpected expense of $400; only 61% said they could cover it with cash, savings, or a credit card paid off by the next statement. A 2017 survey asked people whether they could cover a $2,000 unexpected expense within a month. Over 40% said they could not, even including cash from credit card advances, payday loans, or checking account overdrafts; even greater proportions—54% of Latinxs and 64% of Blacks—gave this response (Stavins 2020). Not surprisingly, the proportion who could not cover the expense fell as incomes rose.

Reductions in income after injury can lead to problems in covering rent or mortgages or car loan payments, increased credit card debt, and general difficulties in making ends meet (Keogh et al. 2000; Morse et al. 1998). Even spending on food declines after injury (Galizzi and Zagorsky 2009). Groups with no or minimal savings are particularly hard hit by occupational injuries and illnesses, with Latinx and Black workers much more likely than white workers to fall into this category. Generally, low-income workers with relatively little savings are more likely to be injured than are other workers (Galizzi and Zagorsky 2009).
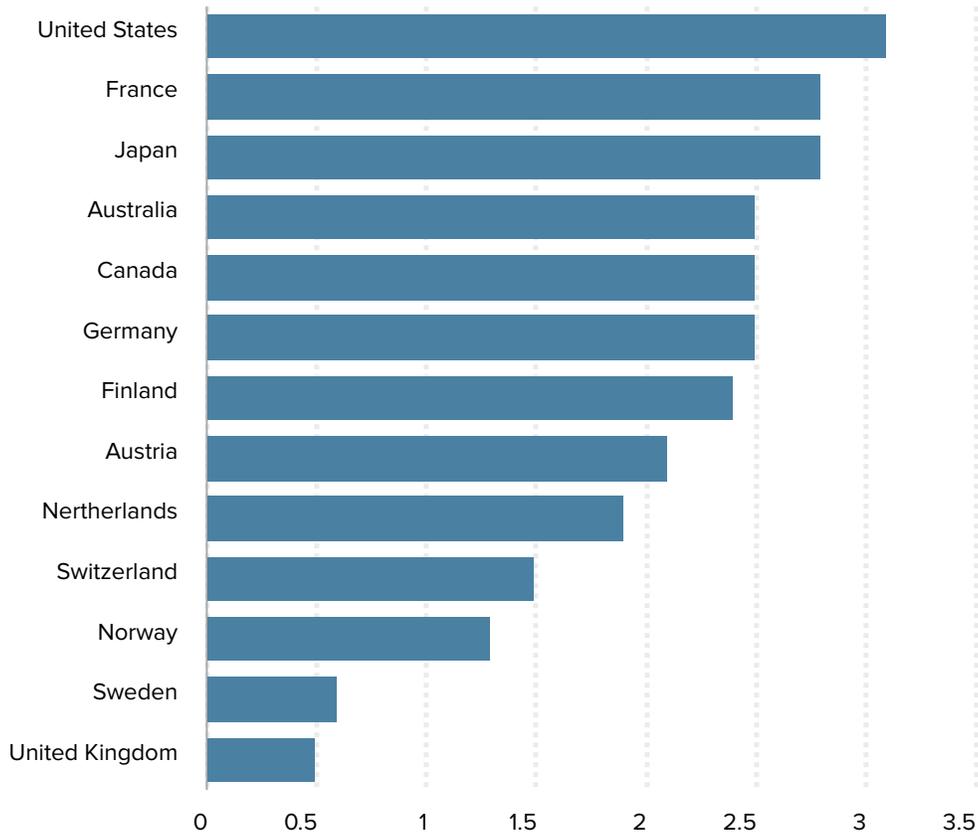
6. Other costs

Lost household production. People with work disabilities may not be able to engage fully in household tasks like caring for children, cleaning, or taking out the trash. Several interview studies have shown the considerable extent of these impacts on home life (Imershein, Hill, and Reynolds 1994; Keogh et al. 2000; Strunin and Boden 2004).

Depression and drug and alcohol use disorders. A substantial number of injured workers can't do the same work or household tasks, lose their jobs, live with intermittent or constant pain, or can't participate fully in many aspects of family life. There is substantial and growing evidence that these injury effects can lead to depression (Asfaw and Souza 2012; Dersh et al. 2007; Kim 2013) and drug use (Asfaw and Boden 2020). These health consequences have recently been coined "diseases of despair" and have been cited as important reasons for recent declines in U.S. life expectancy (Case and Deaton 2017).

Deaths indirectly caused by workplace injuries. Deaths from suicide and drug overdose,

Fatal occupational injury rates per 100,000 workers, 2013

Country	Rate
United States	3.1
France	2.85
Japan	2.85
Australia	2.55
Canada	2.55
Germany	2.55
Finland	2.45
Austria	2.1
Nertherlands	1.9
Switzerland	1.55
Norway	1.3
Sweden	0.65
United Kingdom	0.55

Note: Selected countries with gross domestic product per capita in 2018 greater than $40,000.

Source: Ujawi Kharel dissertation, "The Global Epidemic of Occupational Injuries: Counts, Costs, and Compensation" (Kharel 2016).

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in particular, have been growing in recent years and have become major public health concerns. Moreover, work-related injuries have been shown to increase the risk of dying from both of these causes (Applebaum et al. 2019; Martin et al. 2020).

D. International comparisons

Information from two studies of fatal workplace injury rates in the U.S. and other high-income countries strongly suggests that U.S. rates are higher. The first of these studies compared fatal injury rates among countries around the world. For reasonable comparison, we chose to compare the U.S. with other countries whose 2018 gross domestic product per capita was at least $40,000 (in U.S. dollars). As is evident in **Figure B**, the U.S. had the highest work-related fatality rate of these countries (Kharel 2016).

It is possible that differences in industry composition skewed this comparison. That is, if

Table 3

Fatal injury rates per 100,000 workers in the United States and the European Union, 2010

Industry	E.U. Rate	U.S. Rate	U.S./E.U.
Agriculture, forestry, and fishing	9.4	18.4	200%
Manufacturing	2.2	3.3	150%
Electricity, gas, steam, and air conditioning supply	2.9	4.7	160%
Water supply; sewerage, waste management, and remediation activities	6.0	12.4	210%
Construction	7.9	9.6	120%
Wholesale and retail trade; repair of motor vehicles and motorcycles	1.4	2.0	140%
Transportation and storage	6.8	13.5	200%
Accommodation and food service activities	0.6	1.0	170%
Information and communication	0.6	1.3	220%
Financial and insurance activities	0.6	0.2	30%
Real estate activities	1.0	2.0	200%
Professional, scientific, and technical activities	0.8	0.5	60%
Administrative and support service activities	1.8	2.5	140%

Source: William J. Wiatrowski and Jill Janocha *Monthly Labor Review* article, "Comparing Fatal Work Injuries in the United States and the European Union" (Wiatrowski and Janocha 2014).
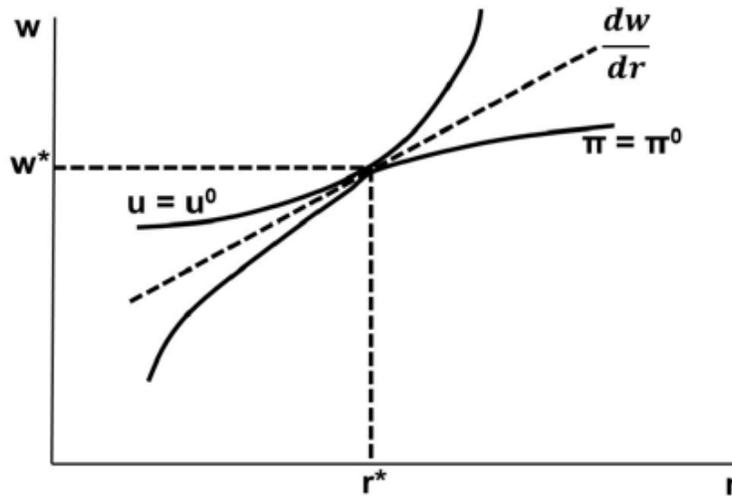
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the U.S. workforce was more concentrated in hazardous industries, one might expect the overall work-related fatality rate to be higher. A second study by Bureau of Labor Statistics economists takes this possibility into account by comparing work-related fatality rates between the U.S. and the European Union by industry sector (Wiatrowski and Janocha 2014). **Table 3** shows that U.S. rates are higher than E.U. rates in 11 of 13 industry sectors. Indeed, in three of the four most hazardous sectors U.S. rates are about twice those of the E.U. U.S. rates are lower only in the financial and insurance sectors and the professional, scientific, and technical sectors, the two with the lowest fatality rates. Not only is the overall U.S. fatality rate higher, but disparities between the safest and most hazardous industries are greater than in the E.U.

Because nonfatal injury rates are underreported in the United States, and because we do not know the proportion of injuries reported in other countries, we don't know how U.S. nonfatal injury rates compare with those of other countries.

V. The value-of-statistical-life literature: What it says, what it gets

Figure C

An idealized model of wages and occupational risk in equilibrium for a single worker and a single firm

Source: Authors' analysis.

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wrong

The title of Kip Viscusi's second book, *Risk by Choice: Regulating Health and Safety in the Workplace (1983),* in which he developed the perspective that has governed the VSL literature ever since, states bluntly its freedom-of-contract assumptions. Without referencing the actual legal, medical, and social history of OSH, it posits an ideal model of how occupational risk would be transacted if the market for labor services were determined solely by self-interested agents whose only concern was to strike the best possible bargain. Employers are assumed to maximize profits, treating both wages and safety as costs of production with no corresponding benefits. Workers are assumed to maximize utility derived positively from both safety and wages. Competition assures that employers all earn the same profit, i.e., zero in economic terms (net of the cost of capital), and workers of a given type all receive the highest level of utility attainable given the jobs they and their peers are offered. The market for each type of labor clears, so no employer faces an unfilled job or worker a spell of unemployment. Employers and employees have equal power to contract or walk away from any bargain.

This equilibrium can be depicted in **Figure C**, where wages are measured on the y-axis and risk on the x-axis.

Here *w* represents the wage and *r* the level of risk of death on the job. For a given worker utility function, the curve $u = u^0$ traces combinations of wages and risk that leave combined utility unchanged at the market-clearing utility level u^0. The curve incorporates increasing marginal disutility of risk (the curve becomes nearly vertical as a critical level of risk is approached). The other curve, $\pi = \pi^0$, traces the corresponding combinations that

leave employer profit π unchanged at the competitively determined level of zero. The employer faces increasing marginal costs of reducing risks (diminishing marginal return to safety investments), so the curve becomes steeper as one goes from right to left. Profits and utility are jointly maximized at the tangency indicated by *dw/dr*, the marginal tradeoff between wages and risk for this particular contracting pair. At market equilibrium for a worker with this productivity (which determines u^0) and utility map and for an employer with this cost-of-safety schedule, an equilibrium wage of *w** will be established along with an equilibrium risk *r**. In a more complete representation of this model there would be many iso-utility curves reflecting different worker attitudes toward money income and risk and many iso-profit curves representing different employer cost-of-safety conditions. More safety conscious workers would sort to be matched with employers with less expensive safety options and vice versa. An upward-sloping contract locus would connect all these individual tangencies.

Here we can see all three properties of compensating wage differentials in a purely contract-centered world:

1. The level of risk is perfectly efficient, since the marginal cost of an additional increment of safety is exactly equal to the marginal benefit (in monetary equivalent) it would provide to workers. Safety is neither too low (where improvements inexpensive for the employer to provide would be highly valued by workers) nor too high (where the cost of providing some of the improvements exceeds workers' valuation of them). Regulation cannot improve this outcome.

2. Workers in dangerous jobs would be no better off if they switched jobs with equally productive workers in safer ones. The dangerous jobs pay higher wages so that each worker receives that worker's u^0 in overall compensation. True, with their subjective differences, some workers will end up more satisfied with their work than others, but there is no a priori reason why such differences should have any systematic relationship, positive or negative, to safety.

3. The marginal tradeoff between wages and risk, *dw/dr*, can be employed to calculate the implicit value of life voluntarily chosen by workers at this point in the contract curve. Multiply this incremental equivalent by the number of such increments required to sum to a single statistical life (1 divided by the marginal risk change) and the result is the aggregate money that many such workers would collectively require to reduce expected occupational deaths by one. If workers are viewed as representative of the larger society, this VSL can be applied to any policy change that reduces expected mortality but imposes other costs, e.g., mitigating climate change, reducing toxic emissions from power plants, or, for that matter, regulating risk in the workplace.

Before moving forward, it is important to emphasize that this model *begins* with the core assumptions of a freedom-of-contract world. Workers care only about their individual well-being, a function of their income and the disutility they experience from occupational risk, and they perform this calculation rationally and consistently, unaffected by social or ethical considerations. Similarly, firms care only about profits, which depend on the wages they pay and the safety investments they make; neither worker commitment nor market reputation plays a role. The labor market is in continuous equilibrium, defined as a state in

which supply equals demand and there is no opportunity for any party to improve its outcome by altering the terms it offers to either supply labor or employ it. All relevant outcomes of employment, including actual safety on the job, are determined at the moment employment offers are accepted. Employers and employees have equal bargaining power, a claim increasingly contested by empirical research. There is no regulation of the terms of employment, either by government or collective bargaining agreements; in fact, the legal status of "employment" itself is undefined because none of the questions employment law resolves are at issue. These aren't claims supported by historical, institutional, or empirical research; they are assumptions made prior to any theoretical or statistical analysis.

On the basis of the preceding model, VSL researchers estimate a wage equation of the following form:

$ln\ w_i = \alpha + \beta X_i + \gamma r_i + \varepsilon_i$

where w_i is the wage of worker i, α an intercept, X_i a set of control variables for worker i, β a vector of coefficients on these variables, r_i the occupational risk faced by worker i, γ the coefficient on this risk, and ε_i the error term. By incorporating control variables, the intent is to isolate the effect that risk has on wages for equivalent jobs, with the coefficient γ representing the wage effect of a unit change in this risk, which, when multiplied by the level of risk r becomes the compensating wage differential; for instance, if $\gamma = 0.02$, average w = $50,000, and average r = 1/10,000 per year, estimated VSL (at these averages) would be [2% of $50,000] x 10,000 = $10,000,000. (These numbers are only for purposes of illustration.) Referring again to Figure C, it is assumed that each worker is of a given productivity type, where this type is a function of attributes like age, gender, experience, education, race, union membership, and marital status. (Note that gender, race, and union membership are routinely interpreted as signaling differences in "productivity.") Each productivity type applies its utility maps to the same set of wage offers in the competitive market, so including these variables is expected to strip away this potential confounder.

A large number of studies have been conducted along these lines, and most of them find positive coefficients γ on risk, representing wage compensation for more dangerous working conditions. When these marginal tradeoffs are multiplied by the mean change in risk of death, a VSL of several million dollars is typically estimated. Government agencies in the United States and a few other countries have officially adopted these estimates for use in benefit-cost analyses of regulations and public programs, thereby influencing the ability to regulate pollution, workplace safety and health, vehicle speeds, and every other regulatory issue affecting life and health. The VSL also enters into calculations of the "social cost of carbon," used to justify and calibrate measures to combat climate change (Melillo, Richmond, and Yohe 2014).

The procedure is endorsed by leading lights in the "law and economics" movement, such as Cass Sunstein (e.g., Sunstein 2014), for what they regard as its rational approach to valuing lives. VSL calculations have made their way into introductory economics textbooks as examples of the insight that comes from applying "the economic way of thinking" to

problems usually considered fraught or vexing (Mankiw 2014). For many whose only analytical exposure to labor issues occurs in the undergraduate economics classroom or in the use of VSL studies, the freedom-of-contract perspective represents the "economic" approach to OSH.

It is important to recognize, however, that the VSL literature and its underlying analytics are strongly disputed within the economics profession, particularly by those with a deep background in the study of labor markets. For a striking example, consider *Labor Economics* by Pierre Cahuc, Stéphane Carcillo, and André Zylberberg (2014), which has established itself as the leading graduate textbook in its field. Much of Chapter 5 in the second edition is devoted to disputing the modeling and empirical approach of VSL proponents, which the authors find simplistic and misleading. In the pages that follow we will explain some of these criticisms and add several of our own.

At the theoretical level it should already be clear that the modeling framework used by VSL proponents assumes away nearly all the problems that have preoccupied labor economists in the decades since the pioneering work of Richard Lester and have recently reemerged as central to our understanding of labor market trends. In Figure C, the determination of the slope of the contract curve by the marginal rate of substitution between wages and safety for each corresponding worker embodies the law-of-one-price constraint, but modern labor economics begins by asking why this law *doesn't* hold: There is an array of wages paid to workers with similar skills or occupations. The most widely subscribed approach in the discipline today is search theory, in part because it provides a plausible, readily modeled explanation for both wage dispersion and involuntary unemployment. A formal proof that fully compensating wage differentials are a special rather than general case in a search framework was provided by Lang and Majumdar (2004).[9] As they demonstrate, a search theoretic version of Figure C would portray many iso-utility and -profit tangencies, and the locus of them could as well be downward as upward sloping—lower wages *and* greater risk for workers of equivalent potential productivity. With search frictions there is no guarantee that competition will prevent the emergence of good and bad jobs corresponding to safer and more dangerous ones.

Similarly, a formal proof by Dorman (1998) shows that wage differentials will not be fully compensating if worker effort depends on the pay and working conditions provided by the employer—the efficiency wage case. This effect can only be magnified when the theorist takes into account the many other linkages between compensation, worker commitment, investments in training and promotion, and the role of problem-solving for flexibility and innovation characteristic of strategic human resource management (Bartling, Fehr, and Schmidt 2012). Compared to the more realistic models on which modern labor market analysis is based, the unadorned supply-and-demand framework of the VSL researchers can only be regarded as naive. Indeed, what is remarkable about employment as viewed through the freedom-of-contract lens is that it is modeled as a one-off bargaining game played by workers and employers, rather than a repeated game in which performance and not just acceptance or rejection of an employment contract is part of the strategy set. Worker performance is about how much effort is supplied as well as engagement in problem-solving and the exercise of initiative, while firms perform on such dimensions as job security, working conditions (including health and safety), opportunities for training and

promotion, and their demonstration of respect and appreciation in general. It is clear that in a more realistic model the level of worker protection will likely play an important signaling role.

A second set of criticisms targets the behavioral assumptions of the freedom-of-contract approach. A useful starting point is the way occupational risk is represented in the VSL literature. Recall the regression equation above, for which it was explained that r_i is "the occupational risk faced by worker *i*." This risk is typically measured as the annual occupational mortality rate faced by workers in a given job type, ranging from zero, if the job has no such mortality at all, to some number of deaths per 100,000 workers or other denominator. Each increment to this measure—each additional death tabulated for this job type—is modeled as having exactly the same effect on workers' subjective perception of how dangerous their work is. This notion that goods are valued on a continuous, absolute scale violates one of the best-supported theories at the intersection of economics and psychology: prospect theory (Kahneman and Tversky 1979). According to prospect theory, evaluations are *comparative:* People typically have reference levels (norms) for goods and respond differently depending on whether the amount offered is above or below this level.

In most applications the reference quantity is assumed to be the status quo, with the behavioral distinction pertaining to gains or losses relative to it, but the theory itself is general. In the context of OSH, prospect theory suggests that workers may distinguish between largely acceptable (at or below the norm) and unacceptable risk. If this is correct, the risk variable in VSL studies is misspecified, failing to register risk differentials that matter most while (perhaps) exaggerating others. For instance, a small difference in fatal risk between two jobs may have little effect on workers' valuation of the jobs if both are seen as acceptably safe, but if the difference pushes one of them over the acceptability threshold the effect may be substantial. This threshold may apply to a particular source of risk, one workers may think should not be a source at all; in other words, the norm for some types of risk may be zero. That people put up with substantial risks in some aspects of their life and work while vehemently opposing them in others is not irrational if we recognize the ethical—normative—dimension of risk.

Closely related is the observation that the behavioral model implicit in the treatment of risk in the VSL literature assumes that workers care only about the amount of risk they are exposed to and not the process by which the risk level was determined. This assumption has been widely contradicted by studies that show that individuals perceive less risk or are less perturbed by the risk they perceive when they believe they have control over it. [10]

That is, self-imposed risk is evaluated as more acceptable than externally imposed risk—important when, as we will soon see, vehicle accidents play a large role in traumatic occupational fatalities. In this respect risk is like many other goods, where procedural utility supplements and modifies outcome utility (Frey and Stutzer 2005; Bartling, Fehr, and Herz 2014). The sensitivity workers often express toward how they feel themselves treated by employers in safety and other aspects of work extends two arguments we have already seen. First, insofar as employment is better modeled as a repeated rather than a one-off game, signaling becomes a crucial aspect of bargaining and performance, and how well employers mitigate safety and health risks can well serve as a signal of their overall

intentions. Second, to the extent that a certain degree of risk can be viewed as intrinsic to the type of employment at issue, risk levels above it are likely to be regarded as discretionary—as imposed by actions or inactions deliberately chosen by the employer. Thus, the reference point at the heart of prospect theory can logically be the level of risk above which employers can be assigned responsibility, along the lines of the earlier discussion of the evolution of OSH law.

Finally, behavioral research has identified many cognitive processes that mediate between objective risks and subjective risk perception. In the field of OSH the most important is probably the avoidance of cognitive dissonance, among the most firmly established results in all of social psychology. The core idea is that if new information casts doubt on beliefs individuals rely on to make meaning of their world or undergird their sense of self-worth, consideration of it is painful. To avoid this pain individuals will often refuse to receive or accept such information. The common name for this behavior is denial, and responding to dangerous working conditions with denial is widespread enough to be regarded as normal. "You have to get it out of your mind" is a refrain often heard on the part of workers at risk, but the consequence is diminished risk perception and less disutility from dangerous working conditions than the standard regression model is predicated on (Akerlof and Dickens 1982; Nelkin and Brown 1984). [11]

Aside from perception and interpretation issues, however, there is another obvious reason why subjective and objective risk may differ: Employers have an incentive to obscure the risks to which their workers are exposed. Indeed, the symbiotic interaction between the complex etiology of industrial diseases, employer disinformation, and worker denial may well place a substantial portion of true risk beyond the purview of labor markets. The problem is further exacerbated by the ability of employer-financed institutions to fund studies with the purpose of obscuring the hazards workers face from chemical exposures, repetitive trauma, and other risks identified by independent health professionals (Michaels 2008; Michaels 2020). Note that the complications associated with perverse incentives for risk disclosure rest on top of the irreducible complexities of expectation and trust that arise from safety being the result of performance over time and not an upfront, tangible commitment, as discussed earlier in this chapter.

Aside from simplistic economics and inappropriate behavioral assumptions, the freedom-of-contract approach to OSH encounters another problem: It is factually incorrect. It is based on the presumption that the relevant terms of the employment relationship are freely negotiated between workers and employers, but as we've seen, they aren't. It is not true to say that workers "accept" the working conditions they encounter at their place of employment, not legally at least. As discussed earlier, occupational safety and health has been regulated in one form or another since the Middle Ages in the English-speaking world. The current legal framework is established by the Occupational Safety and Health Act, which proclaims at the outset that employers bear responsibility for ensuring that the workplace is free of hazards. Just how this legal framework affects worker perception and decision-making is a complex question, but the categorical answer that it doesn't—the premise on which the freedom-of-contract approach rests—is surely false. To put it differently, it is not, nor should it be, unreasonable for workers to expect their employers to live up to the language of the law and address workplace hazards as they become

evident.

Up to this point we have considered the theoretical underpinnings of the CWD model; now we turn to its statistical implementation. Consider once more the regression equation above: What are the pitfalls?

Perhaps the most obvious difficulty is that, when we apply such a model to a sample of thousands of workers, while we know with some confidence how much they earn, how old they are, how much education they've had, and so forth, we don't have very accurate measures of the degree of risk they face at work. In U.S. studies the now-standard approach, epitomized by the many studies conducted by Viscusi and his coauthors, is to apply the following formula to each individual i:

$$ r_i = \frac{deaths_{jk}}{employment_{jk}} $$

where j is the occupation for i and k is the industry. This is an average mortality over that industry-occupation pair, and it is applied to each worker who shares those same occupational and industry codes. To give a feeling for the scale of this procedure, the regression reported in Viscusi's 2013 paper, referenced below, assigns fatal injury risk to over 126,000 workers across 50 industries and 10 occupations, giving an average of just over 250 workers sharing the same injury rate. An obvious concern is that this generates a poor measure of individual risk, since some will face less than this average and others more. Indeed, if one accepts the notion that there are better and worse jobs even within the same intersection of industry and occupation, it is plausible that a *negative* relationship between risk and wages is being obscured at the individual level. (In this scenario, individuals with higher incomes given their industry and occupation would also enjoy safer jobs.) Such a presumption is supported by research that shows that a substantial portion of overall wage inequality is accounted for by variation across individual employers (Lane, Salmon, and Spletzer 2007; Appelbaum 2017; Card et al. 2018). Similarly, as we saw in the previous section, Black workers have been found to be concentrated in more dangerous jobs than their white counterparts even within the same industry; it would be optimistic to believe that such discrimination would be fully captured by adding occupational to industrial sorting. It is common for economists to brush aside these concerns under the presumption that any negative association between wages and safety found at the level of occupations and industries should also apply within these cells at the employer and individual levels, but this is simply an instance of the "ecological fallacy" (Piantadosi, Byar, and Green 1988).[12] Aside from the potential for bias, even measurement error orthogonal to the variables of interest due to assigning an average risk measurement to individuals reduces the likelihood that a given estimated effect of risk on wages reflects a "true" process; if there is conscious or unconscious methodological selection on statistical significance, such as choosing control variables or sample exclusions that generate a low p statistic for the risk coefficient, the effect size—in this case the estimate of CWDs—will be biased upward (Loken and Gelman 2017).

A second problem with the risk variable employed by Viscusi et al. is even more dramatic.

Recall from the previous section that, while accurate data exist for fatal occupational *injuries*, we have only the most limited data on fatal occupational *diseases*—and to the extent we can compare their magnitudes, the second is from five to 13 times the first. Worse, we know nothing about the distribution of these nontraumatic fatalities across industries and occupations, the basis VSL researchers use to assign occupational risk measures to individuals. Consider the two polar cases, and for simplicity let the number of disease fatalities be 10 times fatal injuries. Assume first there is a perfect negative correlation between fatal risks from injury and disease. In that case, the industry-occupation cells deemed most safe by Viscusi would actually be the most dangerous, and the wage-risk relationship would be nearly the opposite of what he claims to have found. At the other extreme, the distribution of these two risks across industries and occupations is perfectly coincident, which would preserve the CWD effect, but the measured wage increment would correspond to a risk differential that is approximately 10 times as great. This calculation means the VSL would be just a 10th of its current estimation. Of course, neither of these polar cases is likely, but the actual relationship between the distribution of the measured risk of a fatal injury and the unmeasured risk of a fatal disease is simply unknown—a revealing indicator of how little actual concern a true measure of risk at work arouses in this group of researchers ostensibly studying it.

In this connection it should also be noted that the subset of occupational fatalities captured by the CFOI only loosely corresponds to the commonplace notion of "dangerous working conditions." Approximately 40% of all fatal injuries each year are the result of motor vehicle accidents, including both those in which the worker was behind the wheel, where driving was a component of work responsibilities, and many others where the worker was on the receiving end. Such injuries might be disproportionately born by better-paid workers whose work is less restricted to a single location, but if so should this be viewed as wage compensation for risk? Somewhat less than another 10th of all CFOI-recorded deaths were caused by homicides, some of which might well be the result of foreseeable risk (night shift at a convenience store), but others would be essentially random events (U.S. DOL-BLS 2020b).[13] One of the disadvantages of measuring risk with only traumatic fatalities and not the far more numerous toll of fatal illnesses is that the latter may more closely reflect what is commonly understood to be "hazardous" work.

Yet another problem is the likelihood of missing variables in the regression model. Nearly all the literature that addresses this issue considers only missing variables that might capture differences in worker productivity. Recall that the underlying model behind the VSL studies implies that wage compensation for risk should arise only within labor markets specific to a particular worker type. If the variables included in the vector of X_i fail to fully distinguish between these different types of workers—which inevitably they must—the model will be comparing wages and safety levels for at least some workers across different labor markets. Since we expect workers in a higher-productivity labor market to have both higher wages and better working conditions on average, this statistical shortcoming will introduce a downward bias to measured wage compensation *within* each market. Not surprisingly, the general view among economists is that the VSL literature struggles to capture labor-market-relevant worker differences and probably underestimates true CWDs.[14]

There is less recognition, however, of the reciprocal problem: The econometric model is likely to be missing variables that would capture relevant differences on the employer side of the market, meaning differences between factors that affect worker compensation at the industry and occupation level as well as those stemming from different types of firms. In particular, some industries, occupations, or firms will offer higher wages because of features like greater product market power, higher capital-labor ratios (which reduce the labor share of production cost), and a greater concentration of workers with above-average clout, like union members or simply white males. If some industry-occupation cells have both more fatal injuries *and* other attributes that lead to higher wages, estimates of CWDs would be biased upwards, and incorporating a fuller set of such variables would cause the estimates to fall. Indeed, that is exactly what Dorman and Hagstrom (1988) found in a study published in the mid-1990s based on data from about a decade earlier: Inclusion of variables found to have explanatory power in the interindustry wage differential literature, which looks at differences in wages at the industry level, reduced measured compensation to the point where the only discernible wage compensation for risk was acquired by members of labor unions, and even their CWDs were lower than the average differentials found by Viscusi and his coauthors using the same data. [15] It is interesting to note that, in the more than two decades since the importance of incorporating industry-level variables was first documented, no further study by economists specializing in VSL estimation has used them.[16]

The final issue that arises with the empirical specification employed by Viscusi and others is that it assumes by construction that all variables have the same wage effects for all workers; that is, workers are permitted to differ according to their age, race, gender, education, experience, and average measured risk, but the coefficients on these characteristics—the effects they are estimated to have on wage outcomes—are the same for all. For example, the effect that education is assumed to have on how much a worker earns is forced to be equal for male and female workers, white and Black, and young and old, and the same, of course, goes for exposure to risk. In this way, discrimination and other forms of unequal power or treatment in the labor market are simply assumed away. At the very least, conscientious modeling would permit personal and industry-level factors to have different effects based on race, gender, experience, education, union status, and similar power-related distinctions, and ideally a multilevel modeling approach would be employed to capture the systematic aspects of these forms of social and labor market diversity.

Considering all of these issues together, we have little reason to put much faith in the numbers that purport to represent a statistical value of life based on wage compensation for risk. This impression is only reinforced by the recognition that risk of fatal injury is just one of many aspects of work that affects the well-being of workers and, according to the simplest version of supply-and-demand theory, ought to generate compensating wage differentials; others include the stability of employment, workplace autonomy, the degree of general work comfort or discomfort, opportunities for training and advancement, provision of sick leave, employer-provided child care, flexibility in scheduling, and commuting distance. For several decades economists have searched for these wage differentials with little success, as indicated by the very title of one study, "The Pervasive

Absence of Compensating Differentials" (Bonhomme and Jolivet 2009). A recent paper, for instance, asserts, "While the theory on the relationship between job characteristics and wages is clear...the empirical literature documenting the existence and magnitude of such tradeoffs has lagged behind, often finding the opposite relationship that theory would predict" (Maestas et al. 2018) [17]. And indeed, their carefully conducted investigation into the value workers place on nine job attributes finds that, rather than offsetting wage inequality, as it would if less-desirable work paid more, bringing them into a combined wages-and-amenities measure of compensation actually *increases* it. Thus, the VSL literature, with all its red flags, stands out as the only corner of the compensating differential literature in which researchers claim to have regularly found that, all else equal, disagreeable work pays more.

But for now let us put all these doubts temporarily to the side and examine the results the VSL researchers claim to have uncovered. Why do this? Even if the absolute levels of compensation estimated by Viscusi et al. are unreliable, it is possible the patterns in their results may hold some meaning. This would be the case if the various confounding factors we reviewed apply with more or less equal force to each subsample of the workforce; greater or lesser wage compensation for risk across them might be discernible in the findings despite the misestimation they all share. Of course, it is also possible that the confounding factors don't apply equally, so the patterns we will describe have to be taken with an extra dollop of caution.

What we will find, if these studies are to be believed, is that the relative position of different categories of workers in the social hierarchy are reflected not only in absolute wage and risk differentials, as we saw in the previous section, but also in the extent to which higher risk is compensated by higher wages. It turns out that the pattern of estimated compensating differentials corresponds to what would be expected if workers with less bargaining power are not fully compensated, or at least receive less compensation for comparable risks. Perhaps the place to start is with a rather basic study published by Kip Viscusi in 2013 to demonstrate the usefulness of the BLS's Census of Fatal Occupational Injuries (Viscusi 2013). Using aggregate worker hours as the denominator of the fatality variable and regressing on the log of wages, and using the results for the average wage in his sample, he estimated a VSL of $9.9 million. This is a rather typical result in his oft-repeated wage-risk regressions, uncomplicated by the various adjustments and disaggregations he has sometimes made to his procedure, so it can serve as a baseline. Note that Viscusi interprets this sum as *fully* compensating the worker who receives it—an inference based on the theoretical model we have already considered, but, as we have seen, unwarranted if the model is adjusted for greater realism. What interests us in this context, however, is the effect of altering the regression model to accommodate a range of risk coefficients across the workforce or applying the same model to different subsamples of workers. To repeat, while we have ample reason to be skeptical of any particular result using this modeling approach, there may still be interest in the pattern of relative results that emerges from it.

Here we review studies of compensating differentials that have disaggregated the workforce into subsamples by wage levels, race, immigrant status, and unionization:

Position in the wage hierarchy. The econometric technique used to estimate wage compensation for risk already incorporates the worker's wage level, since the dependent variable is the log of wages; this means the coefficient on the risk of fatal injury corresponds to a percentage increase or decrease in what the worker is paid. The VSL calculation converts this to a monetary amount by applying the percentage change to a particular wage within the distribution, such as the median or mean. But there is no rule that says there can be only one such VSL; on the contrary, the percent increment (or decrement) can be taken at multiple points along the wage spectrum. Doing so will produce a range of estimated values, but the elasticity of the VSL with respect to wages will remain constant, since the same percent change is used in each case.

In order to compute VSLs for different wage groups in a way that allows this elasticity to vary, Kniesner and his coauthors conducted a wage-risk regression using panel data; the data incorporated changes in wages and attributed risk levels for the same workers over time as they moved between jobs. (Since few workers change jobs in this fashion over a short multiyear period, their sample was only a bit over 2,000 unique individuals, rather than 126,000 as before.) Thus, since the methodology assumes worker utility is unchanged across moves—there are no good or bad jobs for workers of a given "sort"—there is a sort of compensating wage differential for each of these individuals. Establishing any sort of gradient over the entire sample, however, requires making some simplifying adjustments that modify the independence of these wage-risk relationships. There is no single best way to do this, and Kniesner, Viscusi, and Ziliak (2010) provide results for a range of such "tunings." Taking one such choice, where the tuning parameter is set at 1, the coefficient on the risk variable, which measures the percentage effect of a change in fatal risk on worker pay, is almost 50% higher for those in the top fourth of the wage distribution compared to those in the bottom fourth. Thus, not only are lower-wage workers estimated to get a smaller pay boost from having to cope with work hazards, they also get a much smaller percentage increase, despite facing far greater risk, as the previous section documented.[18] (Kniesner, Viscusi, and Ziliak).

This result is interpreted by the authors in psychological terms: Occupational safety is described by Kniesner et al. as a "normal good" whose value to the worker increases with income. It could just as well be understood in terms of the foundational observation of Lester and those who followed him that there are better and worse jobs for workers with the same skills and personal attributes. A bad job is one with relatively lower pay and higher risk, all else being equal. As long as job segments overlap in the labor market, it follows that at any level of the wage hierarchy higher pay means a higher likelihood of having a good job. One of the characteristics of a good job is that it compensates workers for bearing extra risk. It's not necessarily that higher-paid workers care more about safety; they are treated as if they do compared to those earning less, a consequence of their greater market power and in contrast to the relative disempowerment experienced by lower-wage workers in bad jobs.

Race. A 2003 study by Viscusi focused specifically on differences between white and Black workers in the degree of risk they face at work and the amount of wage compensation they are estimated to receive for it. He used CFOI data for fatal injuries and SOII data for nonfatal, assigning to both white and Black workers the average risk for the

industry in which they were employed.[19] (Risk categories were based only on industries, not occupations, since many industry-occupation cells would be too small if disaggregated by race.) Not surprisingly, he found that Blacks are relatively more concentrated in the most dangerous industries and receive lower pay overall. In addition, however, he estimated substantially lower compensating differentials for Blacks: Their coefficient on fatal risk, which measures the percentage effect on their earnings from a unit change in the average risk of their industry, was not quite 60% that of whites, while the coefficient on nonfatal risk was just under two-thirds. Note that these smaller percentage effects apply to the lower wages Black workers already face.

If valid, these results are important for many reasons. They indicate that racial inequality in pay is not offset but exacerbated by un- or insufficiently compensated risk of injury and death. They offer further support for our view that the extent of OSH risks and possible compensation for them are strongly influenced by the relative power a particular group of workers can draw in bargaining and at the workplace. Finally, they undermine the case for the freedom-of-contract view as it might apply to *any* set of workers. According to these regression results, Black workers receive less compensation than whites for the risks to which they are exposed. If we agree it makes little sense to argue that Blacks are somehow less aware of or concerned by these risks, this reduced compensation shouldn't be interpreted as evidence for a lower Black VSL. In that case, however, why should the larger coefficients on risk for white workers be viewed as the basis for *their* VSL? Indeed, faced with these racial disparities, one is forced to either accept both the VSL (freedom-of-contract) interpretation of them and a racially pejorative view of relative attitudes toward risk or, conversely, reject both of them, as we do.[20]

Immigrant status. This was explored in a 2010 paper by Joni Hersch and Kip Viscusi, and then in a followup 2020 study by Viscusi and Nick Marquiss.[21] Since the second paper largely follows the methodology of the first and updates it, we will focus on the most recent version. The main innovation in both papers was to add to the standard wage-risk regression additional terms that interact the fatality risk variable with binary variables indicating whether the worker in question is an immigrant either in general or from Mexico in particular.[22] (Hersch and Viscusi also interact with indicators for other regions.) This means that native workers have a coefficient on their estimated fatal risk, while immigrants have that same coefficient plus the coefficient on their interaction term. In their published specification, for example, the baseline coefficient on risk was 0.0029 for 2007, while the coefficient on the interaction between risk and being an immigrant from Mexico was -0.0075, so the overall coefficient for native workers remained at 0.0029 but was -0.0046 for Mexican immigrants and 0.0013 for non-Mexican immigrants. In **Table 4** we give a selection from their results.[23]

What is striking in this exercise is that the combined coefficient was strongly negative for immigrants in three of the four cases (two types of immigrants, for 2007 and 2015 each) and was essentially zero for the other case. In addition, when Hersch and Viscusi in the earlier paper included a variable for English fluency, they found that non-English-speaking immigrants from Mexico received less—which is to say more negative—wage compensation for risk than those with English language skills.[24] A negative compensating differential, if you accept the interpretation Viscusi and his coathors give to coefficients on

Table 4

Impact of risk on wages for immigrants and nonimmigrants

	Coefficients on risk, dependent variable = log wages	
	2007	2015
Variable coefficients and standard errors		
Fatality rate	0.0029	0.0029
	(0.0004)	(0.0006)
*Fatality rate * Mexican immigrant*	-0.0075	-0.0077
	(0.0012)	(0.0015)
*Fatality rate * non-Mexican immigrant*	-0.0016	-0.0045
	(0.0013)	(0.0016)
*Estimated impact of risk on wages**		
Nonimmigrant	0.0029	0.0029
Mexican immigrant	-0.0046	-0.0048
Non-Mexican immigrant	0.0013	-0.0016

* Sum of coefficient on fatality rate plus interaction term

Notes: N and adj R2 not reported; adjustment for clustering not reported.

Source: W. Kip Viscusi and Nick Marquiss *Seton Hall Review* article, "*A Regulatory Policy Strategy for Protecting Immigrant Workers*" (Viscusi and Marquiss 2020).

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risk, would somehow imply that immigrants have a positive appetite for risk of death, a bizarre claim not supported by any independent assessments, such as survey questionnaires. Such results, however, are broadly consistent with the perspective proposed in this paper that those with less workplace power have difficulty obtaining compensation for risks. Of course, care should be taken in drawing any conclusions. It is noteworthy that the risk variable in both studies assigned fatal risk on the basis of industry only, again because of the difficulty in populating a large number of industry-by-occupation cells. Moreover, all the other caveats we examined regarding this stream of research apply to these papers as well.

Unionization. The relationship between unionization and wage compensation for risk is complex. From a bargaining power perspective, the effect ought to be clear: In general, being a member of a union or covered under a collective bargaining agreement should give workers a greater ability to demand extra pay if there are extra risks of injury or illness. On the other hand, unions often resist resolving OSH issues through hazard pay, demanding instead employer adherence to more stringent safety standards or the establishment of a joint health and safety committee; that is, unions attempt to lower the risks. Moreover, the likelihood of a union being established is itself related to the presence of OSH hazards, either in the past or currently. And unions vary greatly among themselves, of course, in the amount of attention they give to OSH risks and the leverage they provide

workers for addressing them.

That said, one might suppose that, compared to the situation workers find themselves in when unions are absent, collective bargaining ought to increase the pressure on employers to compensate workers for risk exposure. This was the general pattern found in the most influential meta-analysis of VSL studies, which Viscusi and Aldy published in 2003:

> Regardless of estimation strategy, most assessments of the U.S. labor market found higher risk premiums for union workers than for non-union workers....Of the ten U.S. labor market value of life studies we reviewed that evaluated the role of unions in risk premiums, nine found union workers enjoyed greater compensating differentials for bearing risk than nonunion workers. In contrast to [our] accepted theory, several of these papers found that non-union workers had insignificant or statistically significant negative compensating differentials for risk. (Viscusi and Aldy 2003, 44, with our clarification)

It is important to note, however, that this summary is now nearly two decades old, and no published studies have looked at the union effect on compensating differentials in the United States since then.

Overall, the pattern of empirical results in the VSL literature, taken at face value (as if they were correctly estimated), is consistent with the view that wage compensation for hazardous work is not an automatic feature of unregulated labor markets, as proposed by freedom-of-contract theory, but a benefit to be achieved according to the influence or power workers can bring to bear on employers; a higher status in the labor market and more power on the job mean more likelihood of receiving this compensation. It would be too much to regard these statistical results as convincing evidence, however, since the methodological assumptions underlying them are so problematic, and this uncertainty may extend to the pattern as well as the overall direction of results. To take just one example, the exclusion of fatal occupational diseases from risk measures may mean that, on average, industries and occupations deemed safer by VSL researchers might actually be more dangerous. Similarly, the omitted explanatory variables, like measures of capital intensity and market concentration, that characterize this literature might, if included, change the picture of which groups in society are most likely to receive compensation for risk. The most we can say is that the evidence, such as it is, does not contradict the view that the degree to which risk is rewarded with greater pay, as well as every other outcome of the employment relationship, is the product of economic institutions, public policy, and the relative power each side brings to the table.

When we pull back and consider VSL methodology as a whole, what stands out is its focus on presumed commonalities that cut across different strata of the labor force. In the environmental, health, and other policy arenas that employ monetary measures of the value of life-saving, the demand is for a single value for all lives, or at most a small set of values for the specific populations that might be affected by a policy choice.[25] Not surprisingly then, the statistical procedure we have surveyed attempts to pick out percent

changes in wages corresponding to changes in fatal occupational risk averaged over broad swaths of the workforce. Workers differ in the risk they face, but the coefficient γ on the risk variable r applies to all of them. At the end of our survey we looked at a handful of studies that disaggregated by wage levels, race, and immigrant status and found these groups receive less compensation for the risks they face, which is especially problematic since these groups face the most risks. We also found indications that workers with a union are able to increase the compensation paid for risks. Still, even these estimates average effects over very large portions of the population. One is reminded of the story about two statisticians who went deer hunting. One took aim but fired two feet to the left. The other then fired two feet to the right. "Congratulations," they said to each other, "we got it!"

From a realistic labor market perspective it makes no more sense to ask what is "the" compensating differential for risk than to ask what is "the" level of pay or number of hours in the work week; compensation for risk is just one more dimension along which labor market experience varies. It is surely the case that some workers are amply rewarded for taking on additional risk, others rewarded somewhat but not fully, and still others not at all or even penalized, in the sense that they are stuck in bad jobs that are worse in both respects. Thus, the presumption that estimated compensating wage differentials always represent *full* compensation for risk is unsupportable. What ought to interest us is the *variation* of compensating differentials: who tends to get how much compensation and why. Answering that question would call for entirely different study designs, drawing on both the analysis of large data sets and case studies of specific work contexts to capture, among other factors of interest, differences in labor market and workplace power. In this context it is worth noting that case study research is nearly absent from the VSL literature.

VI. Occupational safety and health in the era of the coronavirus: Challenges and policy

Years can go by with little public notice given to issues in occupational safety and health, at least in higher-income countries. But the advent of the Covid-19 pandemic has moved OSH to front pages and Twitter feeds, since the risk of infection has made work suddenly more dangerous, and in some communities workplaces are the most important sites of transmission. In this as in other aspects of our society, the virus has brought once-hidden flaws out into full view.

Before we can discuss the role of the workplace in the pandemic, however, it will be useful to sum up the main conclusions from the preceding analysis.

- Despite the Occupational Safety and Health Act and the other programs created over the past century, poor working conditions remain a concern. Workers exposed to excessive risk of accidents and illnesses face not only a health but also an economic problem, due to uncompensated medical costs and the loss of current and future

income. The network of state-level workers' compensation programs provides benefits to too few of these workers and provides too little income support.

- OSH reporting systems are incomplete and inaccurate. While the Bureau of Labor Statistics now provides a comprehensive census of fatal occupational injuries, nonfatal injuries are often missed and most occupational diseases pass completely beneath the radar. This is a problem at the national level, since it limits the guidance we need for policy and implementation; it is also a problem at the enterprise level, where workers remain uninformed about the true risks they are exposed to.

- While there is sometimes economic and ethical justification for hazard pay, such payments are rarely offered explicitly, and there is little reason to believe they are commonly implicit in wage offers either, despite the claims of some researchers. This is not to say no workers ever receive compensating wage differentials for risk, but evidence for the view that such differentials are widespread does not survive scrutiny. Moreover, there is no reason to assume that when extra wages are offered the differential fully compensates workers for the risks they bear. For these reasons, it is likely that the existence and extent of hazard pay in any form, explicit or implicit, reflect the relative power workers are able to draw on to advance their interests.

- The view of the labor market associated with the freedom-of-contract perspective, which holds that OSH risks are efficiently negotiated between workers and employers, is at odds with nearly everything we know about how labor markets really work. It cannot accommodate the reality of good and bad jobs, workplace authority based on the threat of dismissal, discrimination, and the pervasive role of public regulation in defining what employment entails and what obligations it imposes. It also fails to acknowledge the social and psychological dimensions of work, which are particularly important in understanding how people perceive and respond to risk.

The current pandemic has thrown all of these observations into vivid relief. In the remaining portion of this paper we will show how abiding economic, social, and public health aspects of OSH have been magnified under the impact of the coronavirus. We will conclude by briefly sketching some of the measures that would mitigate the impacts on workers, their families, and their communities. The place to begin is with the recognition that the pandemic is, to a significant extent, a crisis in occupational safety and health. Transmission occurs mainly in social settings when uninfected people come into proximity with others who are shedding the virus; this can occur at home, in school, and while shopping, traveling, and recreating. But another prime venue is the workplace. Those at greatest risk are often either classified as "essential" workers or unable for economic reasons to avoid going to work no matter how great the risk.[26]

Particular work environments have been singled out as coronavirus hotspots. Health care facilities, of course, belong in this category, although extra effort has gone into measures like frequent testing, isolation, and provision of personal protective equipment. At the opposite extreme, meatpacking plants are by nature conducive to spreading, with their crowded production lines and cool temperatures, but many companies have failed to address the risk (Narea 2020; Schlosser 2020; Swanson, Yaffe-Bellany, and Corkery 2020; Thompson 2020).[27] Instead they have often used their political clout to prevent public

health officials and journalists from learning the full extent of the problem (Corkery 2020; Foley 2020; Grabell, Perlman, and Yeung 2020; NC Watchdog Reporting Network 2020). A recent report from the Centers for Disease Control and Prevention (CDC) tallies over 16,000 confirmed cases and 86 deaths nationwide in meat and poultry facilities, but a brief concluding statement on "limitations" makes it clear their partial, self-reported numbers are likely to be a substantial underestimate (CDC 2020).[28]

Food production facilities in general have been recognized as spreading venues. Workers in these jobs are more likely to be immigrants, Latinxs, or both, and half again as likely to earn less than twice the official poverty cutoff—$12,760 for an individual and $26,200 for a family of four—making them more likely to keep coming to work even if they are infected (Artiga and Rae 2020). Of course, low-income, minority, and immigrant workers are also likely to come home to more crowded living conditions while also having fewer options to avoid contact in shopping and other off-work activities. The result is that each infection acquired at work means more transmission in the community. For instance, when it is reported that confirmed cases in Nebraska's meatpacking plants constitute a fifth of the state's total (Goodwin 2020), it should be taken as a lower bound for the contribution of this one sector to the state's caseload. While the actual contribution is unknown, with plausible estimates of *R0* (the transmission rate) for these workers, and recognizing some infections were transmitted to rather than from the workplace, it could be as large as half.

When we add the many other sectors potentially conducive to spreading—retail, in-person care, transportation, etc.—it becomes clear how large a role the workplace plays in the pandemic. Among the inadequacies exposed are:

- *Insufficient employer protection*. There is substantial evidence of worker discontent with the measures employers have, or have not, taken to reduce the risk of infection. To take one example, over 17,800 complaints have been filed by workers to the Los Angeles County Department of Public Health alone (Roosevelt, Martin, and Avery 2020). The Payday Report website documents over 900 wildcat job actions nationwide over pandemic-related issues (Payday Report 2020). Polls show a minority of workers working outside the home are dissatisfied with precautions taken by their employers (17% in the *Washington Post*-Ipsos Coronavirus Employment Survey, 8% in an Economic Policy Institute poll), but the samples are drawn from all occupations and industries and may significantly understate the level of concern in the most affected workplaces (Dorman and Mishel 2020; *Washington Post*-Ipsos 2020). It is also possible that, while many workers fear being exposed to the virus at work, they don't hold their employers responsible for this risk.

- *Regulatory failure*. The primary regulatory agencies for OSH in the United States, the U.S. Occupational Safety and Health Administration and the state OSHAs that take on responsibility for regulation in the 25 states that have assumed this role, have largely been silent bystanders. As of July 21, 2020, OSHA had received over 7,000 Covid-19 complaints but issued citations to only two workplaces. In both cases at least six workers had been hospitalized before the citations were issued (OSHA 2020; Department of Labor 2020). Incredibly, a recent ruling from OSHA effectively absolves employers of responsibility for reporting *any* occupational exposures from Covid

resulting in hospitalization—this despite the general obligation on employers to log and report occupational events resulting in hospitalization. In its September 30, 2020, guidance, OSHA interpreted the statute as requiring notification only if the hospitalization occurs within 24 hours of the worker's initial exposure to the virus, virtually an impossibility in light of the delayed onset of Covid symptoms (Edwards 2020; Moyer 2020; Jamieson 2020). Above all, OSHA has not translated CDC guidelines into enforceable mandates for employers in line with its core responsibilities (Covert 2020; Michaels and Wagner 2020).

- *Surveillance failure*. As noted just above, employer resistance and weak public health authority, compounded by drastic shortfalls in testing capacity, have rendered workplace infection numbers unreliable. Although the workplace is a prime venue for coronavirus transmission, our knowledge of where the risks are concentrated is inadequate.

- *Economic coercion*. Low-income workers are afraid to stay home from work, even if they or another household member is infected; many are also afraid to criticize employers for policies that penalize workers for putting health and family obligations first. In one poll conducted by the Roosevelt Institute, over 40% of all workers who said they would be unable to pay all their bills if they took time off from work either largely or strongly agreed they would continue going to work if they came down with a fever (Hertel-Fernandez et al. 2020). In the same poll, only a third were sure they would receive paid sick leave if they stayed home due to the virus; this drops to about a quarter for the bottom half of the wage distribution. To some extent, the intimidation of low-wage workers was reduced by the additional unemployment insurance payments voted by Congress, but this program is set to lapse, and in any case laid-off or dismissed workers would also lose health insurance coverage and any other nonwage benefits from work, with no guarantee that another job would be available when unemployment insurance benefits expire.

- *Noncoverage by workers' compensation (WC)*. Although the WC system is state-based and varies according to jurisdiction, as we have seen there is little coverage of occupational disease anywhere. Few workers or their survivors have received benefits for contracting Covid-19 during the pandemic, and where they have the payouts have been inadequate (Bailey and Jewett 2020). Of the five states that have taken action to make their WC programs substantially more responsive to the ongoing pandemic, three have done so by executive order and two by legislative enactment; of these, two are for all workers and three for essential workers only (Cunningham 2020; National Council on Compensation Insurance 2020).[29]

- *Limited financial compensation for risk*. At the outset of the pandemic there was much publicity about wage boosts given the "heroes" working in essential positions. Indeed, some workers received hazard pay, as evidenced by the Economic Policy Institute survey that found 30% of all workers working outside their homes receiving a wage increase. This is corroborated by the previously cited Roosevelt Institute study in which less than half of all workers received a pay boost, with the average increase coming to just over a dollar per hour (Hertel-Fernandez et al. 2020). But a team of researchers using a real-time human resources management database also found

that a 10th of all workers had their wages *cut* between the beginning of the pandemic and the end of May (Cajner et al. 2020). Later, from the vantage point of eight months into the publicly visible phase of the pandemic, a team of researchers at the Brookings Institution found that hazard pay in the retail sector was short-lived and dwarfed by increased profits. Examining data for the 13 biggest retailers whose markets grew during the pandemic and for which financial information has been reported, they found, while a few instituted permanent wage increases, none sustained hazard pay throughout the period, and (after dropping one outlier) the average date for eliminating this premium was the end of May. For the six of these firms reporting wage data, outlays for hazard pay were just 38% of the *increase* in profits during the pandemic (Kinder, Stateler, and Du 2020).

- *Unequal burdens*. Every study of the pandemic to date that has looked at the issue has found higher infection rates among Blacks, Latinxs, Native Americans, and immigrants. These disparities can be found in polls, studies, and reportage of workplace exposures specifically, some of which have already been referenced above. To take one example, the Roosevelt Institute poll found that, while 23% of white workers reported they were "extremely concerned about being infected at work," the numbers for Latinx and Black workers were 33% and 42%, respectively (Hertel-Fernandez et al. 2020). Of course, this is not about the relative attraction of the virus to people of these different backgrounds; it reflects the greater concentration of minority groups in riskier jobs with less employer protection, subject to heightened economic coercion from low income and fewer benefits.

These are readily observable aspects of the pandemic as an occupational health crisis. Our findings in this paper, however, direct us to several underlying factors that help explain why these harsh outcomes have occurred.

- *The extent of the low-wage economy*. Decades of increasing wage dispersion have left the U.S. with a substantial portion of the labor force whose pay is at or approaching the poverty level even during times of economic expansion. Such workers are subject to economic coercion in all significant life decisions, including what jobs to accept and when to put family or similar obligations temporarily above work attendance.

- *Limited employer and government benefits*. Paid sick and family leave are privileges for the upper strata of the labor force, not rights all workers can rely on. Health insurance is also largely employment-based, with only partial supplementation through the Affordable Care Act. The state unemployment insurance systems are designed primarily to make it difficult to claim and to not reach as many of the jobless as possible, and they generally replace less than half the worker's prior earnings.

- *Deunionization*. Unions help inform workers about the risks they face and use the lever of collective action to improve conditions at work. At the same time, they diminish economic coercion by giving workers procedural rights on the job, yet the share of the private-sector labor force covered under a collective bargaining contract has fallen to just 7%.

- *Lax regulation*. The federal agencies responsible for regulating working conditions,

the Occupational Safety and Health Administration and the Department of Labor's Wage and Hour Division, have been weakened by prolonged underfunding and little policy impetus from political leadership. OSHA in particular was completely unprepared to meet the challenge of the pandemic.

- *Marginalization of minority, immigrant, and low-income communities*. Social hierarchies corresponding to what this paper has called power differentials largely structure the country's economy and politics. Workers concentrated in the worst jobs also tend to live in crowded residences, sequestered in neighborhoods with little political influence. Policies like sheltering in place and commercial reopening are chosen with little input from or attention to the needs of these communities.

With these considerations in mind, we can suggest several lines of reform that not only address the current pandemic but have the potential to set in motion a more fundamental reshaping of public health and labor market outcomes for the post-pandemic world.

- Workplace measures for impeding the spread of the novel coronavirus should be mandated by an emergency temporary OSHA standard. No new statutory language is needed. Indeed, the 25 states with OSHA state plans can take this step on their own, since the law requires them to meet federal standards but leaves them free to exceed them. Adequate guidance has already been issued by the CDC; there is no reason for either OSHA or the states to delay action.

Legislative action at the federal or state level could mandate the establishment of joint worker–management health and safety committees with jurisdiction over protection measures against the virus. These could take advantage of workers' on-the-ground knowledge in translating OSHA standards into detailed workplace actions while promoting an atmosphere of public health collaboration (Lichtenstein 2020).

- There should be a default presumption of work-relatedness for coronavirus infection for workers' compensation eligibility, applicable to all workplaces and not only those categorized as essential. This would conform to the practice in Germany (among other countries), where, early in the pandemic, the Labor Ministry identified Covid-19 as a potential occupational disease and stipulated that employer responsibility could be voided only by strict adherence to specified distancing and personal protective measures (Bundesministerium für Arbeit und Soziales 2020). Federal and state OSHAs, coordinating with public health authorities, should establish mandatory record-keeping for all employee infections, to be transmitted to the relevant agencies and open to public inspection. There should be no more uncertainty about workplace hotspots, either for the workers directly at risk or members of the public concerned about community health conditions.

- Adequate paid sick leave for any employee who is infected by the coronavirus and family leave for those with pandemic-related obligations in their household should be universal and mandatory. During the transition to such a system the federal government can assume part of the financing burden.

- While avoidable infection risks should be minimized through the enforcement of science-based standards, there will still be occupations more exposed to the

pandemic, like health care, in-person education and other services, and some retail employment. Workers facing these residual risks should be identified and awarded extra compensation—hazard pay—as a matter of fairness. These extra wage payments should supplement and not replace existing wages. As with paid leave benefits, hazard pay can be partially financed by the government to facilitate implementation.

In addition to the immediate actions suggested above, we need a fundamental redirection of labor and public health policies so future challenges don't find us as unprepared as the current pandemic has. These include:

- shrinking and eventually eliminating the low-wage sector through more comprehensive and higher-targeted minimum wage requirements along with training and other productivity-enhancing measures;

- revamping labor laws to encourage unionization under centralized systems of bargaining;

- rebuilding the occupational and public health infrastructure with more funding and a broader scope for standard-setting and regulation;

- taking assertive action to combat discrimination on the basis of race, ethnicity, and immigrant status, the most salient forms of bias in occupational health outcomes; and

- embarking on initiatives to enhance worker voice in the 21st-century economy, such as extending rights to workers in online platform or otherwise "fissured" occupations and promoting new institutions for worker participation at the worksite and top management levels.

It is beyond the scope of this paper to do more than enumerate the items on this agenda, but they are logical consequences of the perspective on labor markets we have developed in the preceding pages.

About the authors

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Les Boden is a professor of public health at Boston University School of Public Health. Much of his research has focused on the economic and human consequences of occupational injuries and illnesses. He has also written on workers' compensation, occupational safety and health regulation, gender and racial disparities, and the legal and public health use of scientific information. He has a Ph.D. in economics from MIT.

Acknowledgments

Endnotes

1. This group includes W. Kip Viscusi, who will be discussed shortly, and his various coauthors, as well as legal theorists like Cass Sunstein, who has written extensively on the use of compensating wage differentials for the purpose of valuing statistical lives (VSL). An overview of Sunstein's views, which address complexities in the application of VSL findings but largely accept the labor market analyses on which they are based, can be found in Sunstein (2014). The group also includes policy analysts like John Graham, who served as the director of the Office of Information and Regulatory Affairs of the Office of Management and Budget—the so-called regulatory czar—under the George W. Bush administration. This position was occupied by Sunstein after the election of Barack Obama.

2. Lester pointed out that the existence of involuntary unemployment is another anomaly supply-and-demand theory cannot account for. Although it remains germane, we will not pursue that critique here.

3. A third economist, Peter Diamond, shared the reward for his work on search in nonlabor contexts.

4. For a relatively recent example, see Bartling, Fehr, and Schmidt 2012.

5. The literature on discrimination in labor markets is far too large to be distilled even into a few reviews. For two influential examples, see Lang and Lehmann 2012 and Bertrand 2011.

6. It might be tempting to reclaim subordination for markets—treating it as a disutility of employment for which a compensating differential would need to be paid—along the lines of the VSL literature and as Nozick (1974) attempted to do with alienation. This fails, however, because the alternative to greater subordination is more delegation of authority to the workforce, and economic theory is clear that, to work, such a strategy requires greater pay, not less. The role of wages in self-regulation and intrinsic motivation is modeled under different conditions by efficiency wage and gift exchange theory (Akerlof 1984).

7. The relationship between safety performance and the degree of worker subordination is not uniform. Greater worker autonomy, for example in controlling the pace of work, is often conducive to safety. On the other hand, greater managerial supervision of work behavior, such as requiring personal protective equipment, can also be risk-reducing if it is motivated by safety concerns.

8. Clearly, if workers cannot determine the probability of having an occupational illness, this probability cannot be reflected in their wage demands. As a result, estimates of the value of a statistical life based on their wages will not be meaningful.

9. The main point of their paper is to demonstrate that safety regulation can improve efficiency if workers differ in their risk preferences, due to externalities resulting from statistical discrimination by employers during search. This does not bear on the argument developed here.

10. See for instance the essays collected in Slovic 2000.

11. Dorman 1996 provides a simple model in which the salience of cognitive dissonance avoidance in worker risk perception depends inversely on the degree of agency experienced at work.

12. Their important conclusion: "inferences should be confined to the level of observation" (p. 902).

13. The CFOI website shows the distribution of vehicular and homicide deaths across occupations but doesn't provide denominator data.

14. Because the limited suite of observations on age, education, experience, and marital status is not sufficient to capture many employer-relevant differences in qualification and skill, VSL studies routinely exclude white-collar or managerial occupations from their sample. Of course, these filters bias their findings toward a more positive coefficient on risk, since the excluded occupations generally feature both higher wages and lower fatal accident rates. Such sample pruning is problematic, however, since individuals often move between blue- and white-collar jobs, and the potential for promotion to lower-level management is also an important incentive for line workers.

15. This result somehow did not make its way into the widely cited meta-analysis by Viscusi and Aldy (2003), although they did incorporate the larger positive coefficient on risk found by Dorman and Hagstrom, when, for the purpose of comparison, industry-level control variables were excluded.

16. There is some confusion on this score, because VSL studies commonly employ industry and occupational dummies, and advocates like Viscusi claim this procedure picks up non-OSH factors associated with where and how workers are employed. Such a claim is false, however, since the statistical effects of including variables like average capital-labor ratios and percent female are entirely different than those of binary categorical indicators—as they also are for average risk measures, which don't duplicate the information conveyed by dummies.

17. By "theory," the authors mean the simple supply-and-demand framework reflecting a freedom-of-contract view of the labor market.

18. A similar result was found in Evans and Schaur 2010: The bottom quarter of the income distribution, aggregated across age differences, received minimal if any wage compensation for risk, while compensation was substantial for the upper quarter. Their purely cross-sectional wage and risk data were less suitable for quantile regression, however, with no opportunity for identifying the worker's occupation, compared to Kniesner,Viscusi, and Ziliak 2010.

19. Viscusi does not explain his decision to not take advantage of the breakdowns by race in these data sources. It is possible the data were not reported by race crossed with industry, and he didn't have access to the detailed records to construct these crosses himself. Incidentally, calculations based on SOII should be taken with an extra grain of salt since, as we saw in the previous section, it is an incomplete and biased accounting of traumatic injuries.

20. In his 2003 paper, Viscusi too rejects the VSL interpretation of racial disparities in estimated risk compensation, arguing they are due to employer discrimination. It is not possible, however, to simultaneously acknowledge that white and Black workers typically are employed side-by-side in the same jobs, reject racial differences in risk preferences, and yet maintain the interpretation of risk coefficients as revealing both worker preferences and employer costs in the face of these disparate results. While we have criticized the standard VSL model, which makes no provision for different coefficients for demographic or identity groups, it is derived from a logically consistent model of a labor market in equilibrium (Rosen 1974). No such model can generate a VSL depiction of racially disparate risk coefficients without unacceptable assumptions about race and risk preference or getting mired in conundrums resulting from employers engaging in discrimination in hiring and pay while also being held to an iso-profit frontier in safety provision.

21. Viscusi and Marquiss (2020) examine other issues in addition to the wage-risk regressions discussed here, but we will not take them up.

22. They also allow the intercept of the estimated wage equation to shift by including a term with just the immigration dummy, uninteracted.

23. Adjustment for clustering was not reported in their results, and this may be consequential, since adjusting for clustering—mandatory because the risk variable is assigned the same value for all workers in each industry—rendered most of the corresponding coefficients "insignificant" in Hersch and Viscui 2010.

24. It is not clear why Viscusi and Marquiss (2020) did not report a comparable regression specification, since their recommendations all center on communication issues due to different native languages.

25. In some contexts, the demand is for the value of life-years saved rather than lives as such.

26. For just one of many examples, see Hubler et al. 2020.

27. Note that the increased risk of transmission in these facilities is associated with cool temperatures produced by air conditioning and doesn't imply that risk of aerosol transmission is associated with lower temperatures per se.

28. See the disclaimer on p. 5 of the report.

29. We exclude reforms that identify Covid-19 only as a potential occupational disease without altering the burden of proof for establishing work-relatedness; address only health care workers, first responders, and public employees; or have provisions that have already expired.

References

Akerlof, George A. 1984. "Gift Exchange and Efficiency-Wage Theory: Four Views." *American Economic Review* 74, no. 2: 79–83.

Akerlof, George A., and William T. Dickens. 1982. "The Economic Consequences of Cognitive Dissonance." *American Economic Review* 72, no. 3: 307–319.

Appelbaum, Eileen. 2017. "What's Behind the Increase in Inequality?" Center for Economic Policy Research.

Applebaum, Katie M., Abay Asfaw, Paul K. O'Leary, Andrew Busey, Yorghos Tripodis, and Leslie I. Boden. 2019. "Suicide and Drug-Related Mortality Following Occupational Injury." *American Journal of Industrial Medicine* 62, no. 9: 733–741.

Artiga, Samantha, and Matthew Rae. 2020. "The COVID-19 Outbreak and Food Production Workers: Who Is at Risk?" Kaiser Family Foundation Issue Brief.

Asfaw, Abay. 2014. "Disparities in Access to Health Insurance and Workers' Compensation Benefit Between Non-Contingent and Contingent Farm Workers in U.S. Agriculture." *Journal of Health Disparities Research and Practice* 7, no. 3: Article 6.

Asfaw, Abay, and Leslie I. Boden. 2020. "Impact of Workplace Injury on Opioid Dependence, Abuse, Illicit Use, and Overdose: A 36-Month Retrospective Study of Insurance Claims." *Occupational and*

Environmental Medicine 77, no. 9: 648–654.

Asfaw, Abay, and Kerry Souza. 2012. "Incidence and Cost of Depression After Occupational Injury." *Journal of Occupational and Environmental Medicine* 54, no. 9: 1086–1091.

Atiyah, P.S. 1979. *The Rise and Fall of Freedom of Contract.* Oxford, England: Oxford University Press.

Azaroff, Lenore S., Charles Levenstein, and David H. Wegman. 2002. "Occupational Injury and Illness Surveillance: Conceptual Filters Explain Underreporting." *American Journal of Public Health* 92, no. 9: 1421–1429.

Bailey, Melissa, and Christina Jewett. 2020. "Families of Health Workers Killed by COVID Fight for Denied Workers' Comp Benefits." *Kaiser Health News,* July 13.

Bale, Anthony. 1988. "Assuming the Risks: Occupational Disease in the Years Before Workers' Compensation." *American Journal of Industrial Medicine* 13: 499–514.

Baron, Sherry L., Andrea L. Steege, Suzanne M. Marsh, Cammie Chaumont Menendez, and John R. Myers. 2013. "Nonfatal Work-Related Injuries and Illnesses—United States, 2010." *CDC Health Disparities and Inequalities Report—United States* 62, no. 3: 35–40.

Bartling, Björn, Ernst Fehr, and Holger Herz. 2014. "The Intrinsic Value of Decision Rights." *Econometrica* 82, no. 6: 2005–2039.

Bartling, Björn, Ernst Fehr, and Klaus M. Schmidt. 2012. "Screening, Competition, and Job Design: Economic Origins of Good Jobs." *American Economic Review* 102, no. 2: 834–864.

Berdahl, Terceira A., and Julia McQuillan. 2008. "Occupational Racial Composition and Nonfatal Work Injuries." *Social Problems* 55, no. 4: 549–572.

Bertrand, Marianne. 2011. "New Perspectives on Gender." In *Handbook of Labor Economics*, Vol. 4B, edited by O. Ashenfelter and D. Card. Amsterdam, Netherlands: Elsevier.

Board of Governors of the Federal Reserve System. 2019. "Report on the Economic Well-Being of U.S. Households in 2018." May.

Boden, Leslie I., Nicole Nestoriak, and Brooks Pierce. 2010. "Using Capture-Recapture Analysis to Identify Factors Associated with Differential Reporting of Workplace Injuries and Illnesses." *JSM Proceedings (2010)*, Section on Survey Research Methods.

Boden, Leslie I., and Al Ozonoff. 2008. "Capture–Recapture Estimates of Nonfatal Workplace Injuries and Illnesses." *Annals of Epidemiology* 18, no. 6: 500–506.

Boden, Leslie I., Emily A. Spieler, and Gregory R. Wagner. 2016. "The Changing Structure of Work: Implications for Workplace Health and Safety in the U.S." Future of Work Symposium, U.S. Department of Labor.

Bonauto, David K., Joyce Z. Fan, Thomas W. Largo, Kenneth D. Rosenman, Mandy K. Green, Jennifer F. Walters, B.L. Materna, J. Flattery, T. St. Louis, L. Yu, S. Fang, L.K. Davis, D.J. Valiante, K.R. Cummings, and J. J. Hellsten. 2010. "Proportion of Workers Who Were Work-Injured and Payment by Workers' Compensation Systems—10 States, 2007." *MMWR Morbidity and Mortality Weekly Report* 59, no. 29: 897–900.

Bonhomme, Stéphane, and Grégory Jolivet. 2009. "The Pervasive Absence of Compensating Differentials." *Journal of Applied Econometrics* 24, no. 5: 763–795.

Buchanan, Susan, Pamela Vossenas, Niklas Krause, Joan Moriarty, Eric Frumin, Jo Anna M. Shimek, Franklin Mirer, Peter Orris, and Laura Punnett. 2010. "Occupational Injury Disparities in the U.S. Hotel Industry." *American Journal of Industrial Medicine* 53, no. 2: 116–125.

Bundesministerium für Arbeit und Soziales. 2020. "SARS-CoV-2 Occupational Safety and Health Standard" (SARS-CoV-2-Arbeitsschutzstandard). April 16.

Cahuc, Pierre, Stéphane Carcillo, and André Zylberberg. 2014. *Labor Economics.* Second Edition. Cambridge, Mass.: MIT Press.

Cajner, Tomaz, Leland D. Crane, Ryan A. Decker, John Grigsby, Adrian Hamins-Puertolas, Erik Hurst, Christopher Kurz, and Ahu Yildirmaz. 2020. "The U.S. Labor Market During the Beginning of the Pandemic Recession." Becker-Friedman Institute Working Paper No. 2020-58.

Card, David, Ana Rute Cardoso, Jörg Heining, and Patrick Kline. 2018. "Firms and Labor Market Inequality: Evidence and Some Theory." *Journal of Labor Economics* 36, no. S1: S13–70.

Case, Anne, and Angus Deaton. 2017. "Mortality and Morbidity in the 21st Century." *Brookings Papers on Economic Activity.* Spring: 397–476.

Castillo, Carla G. 2018. "What the Doctors Don't See: Physicians as Gatekeepers, Injured Latino Immigrants, and Workers' Compensation System." *Anthropology of Work Review* 39, no. 2: 94–104.

CDC (Centers for Disease Control and Prevention). 2020. "Update: COVID-19 Among Workers in Meat and Poultry Processing Facilities—United States, April–May 2020." *Morbidity and Mortality Weekly Report,* July 7.

CDC/NIOSH (Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health). 2004. *Worker Health Chartbook.* NIOSH Publication no. 2004-146.

Corkery, Michael. 2020. "As Meatpacking Plants Reopen, Data About Worker Illness Remains Elusive." *New York Times,* May 25.

Covert, Bryce. 2020. "How OSHA Went AWOL During the Pandemic." *American Prospect*, October 6.

Cummings, Kristin J., and Kathleen Kreiss. 2008. "Contingent Workers and Contingent Health: Risks of a Modern Economy." *Journal of the American Medical Association* 299, no. 4: 448–450.

Cunningham, Josh. 2020. "COVID-19: Workers' Compensation." National Conference of State Legislatures, July 28.

Dembe, Allard E., J. Bianca Erickson, and Rachel Delbos. 2004. "Predictors of Work-Related Injuries and Illnesses: National Survey Findings." *Journal of Occupational and Environmental Hygiene* 1, no. 8: 542–550.

Dersh, Jeffrey, Tom Mayer, Brian R. Theodore, Peter Polatin, and Robert J. Gatchel. 2007. "Do Psychiatric Disorders First Appear Preinjury or Postinjury in Chronic Disabling Occupational Spinal Disorders?" *Spine* 32, no. 9: 1045–1051.

Dickens, William T., and Kevin Lang. 1993. "Labor Market Segmentation Theory: Reconsidering the Evidence." In *Labor Economics: Problems in Analyzing Labor Markets*, edited by William Darity Jr. Dordrecht, Netherlands: Springer.

Dong, Xiuwen, and James W. Platner. 2004. "Occupational Fatalities of Hispanic Construction Workers from 1992 to 2000." *American Journal of Industrial Medicine* 45, no. 1: 45–54.

Dorman, Peter. 1996. *Markets and Mortality: Economics, Dangerous Work, and the Value of Human Life.* Cambridge, England: Cambridge University Press.

Dorman, Peter. 1998. "Compensating Differentials for Dangerous Work in a Labour Discipline Model." *Metroeconomica* 49, no. 3: 364–385.

Dorman, Peter, and Paul Hagstrom. 1998. "Wage Compensation for Dangerous Work Revisited." *Industrial and Labor Relations Review* 52, no. 1: 116–135.

Dorman, Peter, and Lawrence Mishel. 2020. "A Majority of Workers Are Fearful of Coronavirus Infections at Work, Especially Black, Hispanic, and Low- and Middle-Income Workers." Economic Policy Institute.

Edwards, Johnny. 2020. "OSHA Eases Reporting Requirements on Worker Infections." *Atlanta Journal-Constitution,* October 5.

Evans, Mary F., and Georg Schaur. 2010. "A Quantile Estimation Approach to Identify Income and Age Variation in the Value of a Statistical Life." *Journal of Environmental Economics and Management* 59, no. 3: 260–270.

Fan, Z. Joyce, David K. Bonauto, Michael P. Foley, and Barbara A. Silverstein. 2006. "Underreporting of Work-Related Injury or Illness to Workers' Compensation: Individual and Industry Factors." *Journal of Occupational and Environmental Medicine* 48, no. 9: 914–922.

Foley, Michael. 2017. "Factors Underlying Observed Injury Rate Differences Between Temporary Workers and Permanent Peers." *American Journal of Industrial Medicine* 60, no. 10: 841–851.

Foley, Michael, John Ruser, Glenn Shor, Harry Shuford, and Eric Sygnatur. 2014. "Contingent Workers: Workers' Compensation Data Analysis Strategies and Limitations." *American Journal of Industrial Medicine* 57, no. 7: 764–775.

Foley, Ryan J. 2020. "Coronavirus Outbreak at Iowa Pork Plant Was Larger than State Reported." *Des Moines Register,* July 22.

Frederick, James, and Nancy Lessin. 2000. "Blame the Worker: The Rise of Behavioral-Based Safety Programs." *Multinational Monitor* 21, no. 11: 10.

Frey, Bruno S., and Alois Stutzer. 2005. "Beyond Outcomes: Measuring Procedural Utility." *Oxford Economic Papers* 57, no. 1: 90–111.

Galizzi, Monica, and Jay L. Zagorsky. 2009. "How Do On-the-Job Injuries and Illnesses Impact Wealth?" *Labour Economics* 16, no. 1: 26–36.

GAO (Government Accountability Office). 2009. "Enhancing OSHA's Records Audit Process Could Improve the Accuracy of Worker Injury and Illness Data." GAO-10-10.

Goh, Joel, Jeffrey Pfeffer, and Stefanos Zenios. 2015. "Exposure to Harmful Workplace Practices Could Account for Inequality in Life Spans Across Different Demographic Groups." *Health Affairs* 34, no. 10: 1761–1768.

Goodwin, Connor. 2020. "Nebraska Meatpacking Workers Continue to Struggle During the Pandemic." *American Prospect,* August 11.

Grabell, Michael. 2013. "The Expendables: How the Temps Who Power Corporate Giants Are Getting Crushed." *ProPublica,* June 27.

Grabell, Michael, Claire Perlman, and Bernice Yeung. 2020. "Emails Reveal Chaos as Meatpacking Companies Fought Health Agencies over COVID-19 Outbreaks in Their Plants." *ProPublica,* June 12.

Henshaw, John L., Shannon H. Gaffney, Amy K. Madl, and Dennis J. Paustenbach. 2007. "The Employer's Responsibility to Maintain a Safe and Healthful Work Environment: An Historical Review of Societal Expectations and Industrial Practices." *Employee Responsibilities and Rights Journal* 19: 173–192.

Hersch, Joni, and W. Kip Viscusi. 2010. "Immigrant Status and the Value of Statistical Life." *Journal of Human Resources* 45, no. 3: 749–771.

Hertel-Fernandez, Alexander, Suresh Naidu, Adam Reich, and Patrick Youngblood. 2020. "Understanding the Covid-19 Workplace: Evidence from a Survey of Essential Workers." Roosevelt Institute Issue Brief.

Hirschman, Albert O. 1970. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States.* Cambridge, Mass.: Harvard University Press.

Hubler, Shawn, Thomas Fuller, Anjali Singhvi, and Juliette Love. 2020. "Many Latinos Couldn't Stay Home. Now Virus Cases Are Soaring in Their Communities." *New York Times,* June 26.

Imershein, Allen, A. Hill, and A. Reynolds. 1994. "The Workers' Compensation System as a Quality of Life Problem for Workers' Compensation Claimants." *Advances in Medical Sociology* 5: 181–200.

Jamieson, Dave. 2020. "OSHA Doesn't Expect Employers to Report COVID-19 Hospitalizations Anymore." *Huffington Post*, October 15.

Julià, Mireia, Carlos Catalina-Romero, Eva Calvo-Bonacho, and Fernando G Benavides. 2016. "Exposure to Psychosocial Risk Factors at Work and the Incidence of Occupational Injuries: A Cohort Study in Spain." *Journal of Occupational and Environmental Medicine* 58, no. 3: 282–286.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision Under Risk." *Econometrica* 47, no. 2: 263–291.

Keogh, James P., Iman Nuwayhid, Janice L. Gordon, and Patricia W. Gucer. 2000. "The Impact of Occupational Injury on Injured Worker and Family: Outcomes of Upper Extremity Cumulative Trauma Disorders in Maryland Workers." *American Journal of Industrial Medicine* 38, no. 5: 498–506.

Kharel, Ujwal. 2016. "The Global Epidemic of Occupational Injuries: Counts, Costs, and Compensation." Pardee RAND Graduate School, Dissertations.

Kim, Jaeyoung. 2013. "Depression as a Psychosocial Consequence of Occupational Injury in the US Working Population: Findings from the Medical Expenditure Panel Survey." *BMC Public Health* 13, no. 1: Article 303.

Kinder, Molly, Laura Stateler, and Julia Du. 2020. "Windfall Profits and Deadly Risks: How the Biggest Retail Companies Are Compensating Essential Workers During the COVID-19 Pandemic." Brookings Institution Report.

Kniesner, Thomas J., W. Kip Viscusi, and James P. Ziliak. 2010. "Policy Relevant Heterogeneity in the Value of Statistical Life: New Evidence from Panel Data Quantile Regressions." *Journal of Risk and Uncertainty* 40, no. 1: 15–31.

Kochan, Thomas A., Michal Smith, John C. Wells, and James B. Rebitzer. 1994. "Human Resource Strategies and Contingent Workers: The Case of Safety and Health in the Petrochemical Industry."

Human Resource Management 33, no. 1: 55–77.

Lane, Julia I., Laurie A. Salmon, and James R. Spletzer. 2007. "Establishment Wage Differentials." *Monthly Labor Review* 130, no. 4: 3–17.

Lang, Kevin, and Jee-Yeon K. Lehmann. 2012. "Racial Discrimination in the Labor Market: Theory and Empirics." *Journal of Economic Literature* 50, no. 4: 959–1006.

Lang, Kevin, and Sumon Majumdar. 2004. "The Pricing of Job Characteristics When Markets Do Not Clear: Theory and Policy Implications." *International Economic Review* 45, no. 4: 1111–1128.

Lay, A. Morgan, Ron Saunders, Marni Lifshen, F. Curtis Breslin, Anthony D. LaMontagne, Emile Tompa, and Peter M. Smith. 2017. "The Relationship Between Occupational Health and Safety Vulnerability and Workplace Injury." *Safety Science* 94: 85–93.

Leigh, J.P., and J.A. García. 2000. "Some Problems with Value-of-Life Estimates Based on Labor Market Data." *Journal of Forensic Economics* 13: 127–143.

Leigh, J. Paul, Steven B. Markowitz, Marianne Fahs, and Philip J. Landrigan. 2000. *Costs of Occupational Injuries and Illnesses*. Ann Arbor: University of Michigan Press.

Lester, Richard A. 1946. "Wage Diversity and Its Theoretical Implications." *Review of Economics and Statistics* 28, no. 3: 152–159.

Lichtenstein, Nelson. 2020. "It's Workers Who Should Determine When Their Workplace Is Safe." *American Prospect,* April 29.

Lloyd, J. William. 1971. "Long-Term Mortality Study of Steelworkers: V. Respiratory Cancer in Coke Plant Workers." *Journal of Occupational and Environmental Medicine* 13, no. 2: 53–68.

Loken, Eric, and Andrew Gelman. 2017. "Measurement Error and the Replication Crisis." *Science* 355, no. 6325: 584–585.

Loomis, Dana, and David Richardson. 1998. "Race and the Risk of Fatal Injury at Work." *American Journal of Public Health* 88, no. 1: 40–44.

MacLaury, Judson. Undated. "Government Regulation of Workers' Safety and Health, 1877–1917." U.S. Department of Labor.

Maestas, Nicole, Kathleen J. Mullen, David Powell, Till von Wachter, and Jeffrey B. Wenger. 2018. "The Value of Working Conditions in the United States and Implications for the Structure of Wages." National Bureau of Economic Research Working Paper no. 25204.

Mankiw, N. Gregory. 2014. *Principles of Economics, Seventh Edition*. Boston, Mass.: Cengage Learning.

Marsh, Suzanne M., Cammie Chaumont Menendez, Sherry L. Baron, Andrea L. Steege, and John R. Myers. 2013. "Fatal Work-Related Injuries—United States, 2005–2009." *MMWR Supplements* 62, no. 3: 41–45.

Martin, Christopher J., Chuanfang Jin, Stephen J. Bertke, James H. Yiin, and Lynne E. Pinkerton. 2020. "Increased Overall and Cause-Specific Mortality Associated with Disability Among Workers' Compensation Claimants with Low Back Injuries. *American Journal of Industrial Medicine* 63, no. 3: 209–217.

Mehta, Chirag, and Nik Theodore. 2006. "Workplace Safety in Atlanta's Construction Industry:

Institutional Failure in Temporary Staffing Arrangements." *WorkingUSA* 9, no. 1: 59–77.

Melillo, Jerry M., Terese Richmond, and Gary W. Yohe, eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program.

Michaels, David. 2008. *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health.* Oxford, England: Oxford University Press.

Michaels, David. 2020. *The Triumph of Doubt: Dark Money and the Science of Deception.* Oxford, England: Oxford University Press.

Michaels, David, and Gregory R. Wagner. 2020. "Occupational Safety and Health Administration (OSHA) and Worker Safety During the COVID-19 Pandemic." *Journal of the American Medical Association* 324, no. 14: 1389–1390.

Mill, John Stuart. 1871. *Principles of Political Economy, Vol. 1.*

Morse, Timothy F., Charles Dillon, Nicholas Warren, Charles Levenstein, and Andrew Warren. 1998. "The Economic and Social Consequences of Work-Related Musculoskeletal Disorders: The Connecticut Upper-Extremity Surveillance Project (CUSP)." *International Journal of Occupational and Environmental Health* 4, no. 4: 209–216.

Mortensen, Dale T. 2003. *Wage Dispersion: Why Are Similar Workers Paid Differently?* Cambridge, Mass.: MIT Press.

Moyer, Merriell. 2020. "OSHA Clarifies Reporting COVID Illnesses, Deaths." *Safety News Alert*, October 6.

Narea, Nicole. 2020. "Why Meatpacking Plants Have Become Coronavirus Hot Spots." *Vox,* May 19.

National Council on Compensation Insurance. 2020. "COVID-19 Regulatory and Legislative Activity."

NC Watchdog Reporting Network. 2020. "How NC Chose Cooperation over Transparency on Meatpacking Plants with Virus Outbreaks." *Raleigh News & Observer,* August 11.

Nelkin, Dorothy, and Michael S. Brown. 1984. *Workers at Risk: Voices from the Workplace.* Chicago, Ill.: University of Chicago Press.

Nozick, Robert. 1974. *Anarchy, State, and Utopia.* New York: Basic Books.

O'Leary, Paul, Leslie I. Boden, Seth A. Seabury, Al Ozonoff, and Ethan Scherer. 2012. "Workplace Injuries and the Take-Up of Social Security Disability Benefits." *Social Security Bulletin* 72, no. 3: 1–17.

OSHA (Occupational Safety and Health Administration). 2015. "Adding Inequality to Injury: The Costs of Failing to Protect Workers on the Job." (Citing Foley et al. 2014 and Grabell 2013).

OSHA (Occupational Safety and Health Administration). 2020. "COVID-19 Response Summary."

Payday Report. 2020. "COVID-19 Strike Wave Interactive Map."

Piantadosi, Steven, David P. Byar, and Sylvan B. Green. 1988. "The Ecological Fallacy." *American Journal of Epidemiology* 127, no. 5: 893–903.

Pierce, Olga, Jeff Larson, and Michael Grabell. 2013. "How We Calculated Injury Rates for Temp and Non-Temp Workers." *ProPublica,* Dec. 18.

Premji, Stéphanie, and Niklas Krause. 2010. "Disparities by Ethnicity, Language, and Immigrant Status

in Occupational Health Experiences Among Las Vegas Hotel Room Cleaners." *American Journal of Industrial Medicine* 53, no. 10: 960–975.

Rappin, Christina L., Sara E. Wuellner, and David K. Bonauto. 2016. "Employer Reasons for Failing to Report Eligible Workers' Compensation Claims in the BLS Survey of Occupational Injuries and Illnesses." *American Journal of Industrial Medicine* 59, no. 5: 343–356.

Rennane, Stephanie, Nicholas Broten, and Michael Dworsky. 2020. "Wage Loss Monitoring for Injured Workers in California's Workers' Compensation System: 2016–2017 Injury Year Findings (Third Interim Report)." RAND Research Report.

Reville, Robert T., Leslie I. Boden, Jeff E. Biddle, and Christopher Mardesich. 2001. *An Evaluation of New Mexico Workers' Compensation Permanent Partial Disability and Return to Work.* Santa Monica, Calif.: RAND.

Roosevelt, Margot, Hugo Martín, and Taylor Avery. 2020. "Workers Fear Returning to Work. Many Are Resisting the Call." *Los Angeles Times,* July 23.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82, no. 1: 34–55.

Rosenman, Kenneth D., Alice Kalush, Mary Jo Reilly, Joseph C. Gardiner, Mathew Reeves, and Zhewui Luo. 2006. "How Much Work-Related Injury and Illness Is Missed by the Current National Surveillance System?" *Journal of Occupational and Environmental Medicine* 48, no. 4: 357–365.

Rosenman, Kenneth, and Martha Stanbury. 1996. "Risk of Lung Cancer Among Former Chromium Smelter Workers." *American Journal of Industrial Medicine* 29, no. 5: 491–500.

Rosner, David, and Gerald Markowitz. 2020. "A Short History of Occupational Safety and Health in the United States." *American Journal of Public Health* 110, no. 5: 622-28.

Ruser, John W. 2008. "Examining Evidence on Whether BLS Undercounts Workplace Injuries and Illnesses." *Monthly Labor Review* 131, no. 8: 20-32.

Schlosser, Eric. 2020. "America's Slaughterhouses Aren't Just Killing Animals." *Atlantic,* May 12.

Seabury, Seth A., Ethan Scherer, Paul O'Leary, Al Ozonoff, and Leslie Boden. 2014. "Using Linked Federal and State Data to Study the Adequacy of Workers' Compensation Benefits." *American Journal of Industrial Medicine* 57, no. 10: 1165–1173.

Seabury, Seth A., Sophie Terp, and Leslie I. Boden. 2017. "Racial and Ethnic Differences in the Frequency of Workplace Injuries and Prevalence of Work-Related Disability." *Health Affairs* 36, no. 2: 266–273.

Slovic, Paul. 2000. *The Perception of Risk.* London, England: Earthscan Publications.

Smith, Caroline K., Barbara A. Silverstein, David K. Bonauto, Darrin Adams, and Z. Joyce Fan. 2010. "Temporary Workers in Washington State." *American Journal of Industrial Medicine* 53, no. 2: 135–145.

Smith, Peter M., Ron Saunders, Marni Lifshen, Ollie Black, Morgan Lay, F. Curtis Breslin, Anthony D. LaMontagne, and Emile Tompa. 2015. "The Development of a Conceptual Model and Self-Reported Measure of Occupational Health and Safety Vulnerability." *Accident Analysis & Prevention* 82: 234–243.

Stavins, Joanna. 2020. "Unprepared for Financial Shocks: Emergency Savings and Credit Card

Debt." *Contemporary Economic Policy* 36, no. 1: 59–82.

Steenland, Kyle, Carol Burnett, Nina Lalich, Elizabeth Ward, and Joseph Hurrell. 2003. "Dying for Work: The Magnitude of US Mortality from Selected Causes of Death Associated with Occupation." *American Journal of Industrial Medicine* 43, no. 5: 461–482.

Stout-Weigand, N. 1988. "Fatal Occupational Injuries in U.S. Industries, 1984: Comparison of Two National Surveillance Systems." *American Journal of Public Health* 78: 1215–1217.

Strong, Larkin L., and Frederick J. Zimmerman. 2005. "Occupational Injury and Absence from Work Among African American, Hispanic, and Non-Hispanic White Workers in the National Longitudinal Survey of Youth." *American Journal of Public Health* 95, no. 7: 1226–1232.

Strunin, Lee, and Leslie I. Boden. 2004. "Family Consequences of Chronic Back Pain." *Social Science and Medicine* 58, no. 7: 1385–1393.

Sunstein, Cass. 2014. *Valuing Life: Humanizing the Regulatory State.* Chicago, Ill.: University of Chicago Press.

Swanson, Ana, David Yaffe-Bellany, and Michael Corkery. 2020. "Pork Chops vs. People: Battling Coronavirus in an Iowa Meat Plant." *New York Times,* May 10.

Thompson, Alexander. 2020. "Ohio Meatpacking Plants Stayed Open Despite Coronavirus Outbreaks." *Columbus Dispatch,* August 12.

U.S. Department of Labor. 2020. "U.S. Department of Labor Cites Ohio Nursing Facilities for Failing to Fully Implement Respiratory Programs to Protect Employees from Coronavirus." News Release, July 21.

U.S. Department of Labor, Bureau of Labor Statistics (U.S. DOL-BLS). 2019. "2018 Annual Averages, Employment Status of the Civilian Noninstitutional Population in States by Sex, Race, Hispanic or Latino Ethnicity, and Detailed Age."

U.S. Department of Labor, Bureau of Labor Statistics (U.S. DOL-BLS). 2020a. "Case and Demographic Characteristics for Work-related Injuries and Illnesses Involving Days Away From Work."

U.S. Department of Labor, Bureau of Labor Statistics (U.S. DOL-BLS). 2020b. "Census of Fatal Occupational Injuries (CFOI)—Current and Revised Data."

U.S. Department of Labor, Bureau of Labor Statistics (U.S. DOL-BLS). 2020c. "Census of Fatal Occupational Injuries (CFOI)–Fatal Injury Rates."

Viscusi, W. Kip. 1983. *Risk by Choice: Regulating Health and Safety in the Workplace.* Cambridge, Mass.: Harvard University Press.

Viscusi, W. Kip. 2003. "Racial Differences in Labor Market Values of a Statistical Life." *Journal of Risk and Uncertainty* 27, no. 3: 239–256.

Viscusi, W. Kip. 2013. "Estimating the Value of a Statistical Life Using Census of Fatal Occupational Injuries (CFOI) Data." Vanderbilt Law and Economics Research Paper no. 13-17.

Viscusi, W. Kip, and Joseph E. Aldy. 2003. "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World." *Journal of Risk and Uncertainty* 27, no. 1: 5–76.

Viscusi, W. Kip, and Nick Marquiss. 2020. "A Regulatory Policy Strategy for Protecting Immigrant Workers." *Seton Hall Law Review,* forthcoming.

Washington Post-Ipsos. 2020. "Washington Post-Ipsos Coronavirus Employment Survey, April 27-May 4. 2020." May 20.

Weil, David. 2014. *The Fissured Workplace.* Cambridge, Mass.: Harvard University Press.

Wiatrowski, William J., and Jill Janocha. 2014. "Comparing Fatal Work Injuries in the United States and the European Union." *Monthly Labor Review* 137, no. 6.