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3 The Economic Impact of the Switch to Workers' Compensation

After various state governments tinkered with the negligence liability system by altering some of the common law defenses, the legislatures turned their attention to the more radical reform of introducing workers' compensation. Between 1911 and 1921, forty-three states adopted workers' compensation laws at the behest of political coalitions combining workers, employers, and insurers. To fully understand what each of these groups expected to gain from the legislation, it is necessary to examine the changes wrought by the introduction of workers' compensation. The new laws raised the average accident benefits paid to workers in workplace accidents. The rise in accident benefits, in turn, led to reductions in the wages paid by employers, reductions in savings and insurance purchases by households, and changes in the care taken by employers and workers to prevent accidents.

The switch to workers' compensation eliminated fault as an issue in determining accident compensation. All workers injured in accidents "arising out of or in the course of" employment were compensated. The new compensation rules caused a substantial increase in the percentage of injured workers receiving compensation. Further, the average amount paid to the families of fatal accident victims jumped several-fold. When considering both fatal and nonfatal accidents together, the percentages of wages or payrolls that were paid out in benefits and/or medical expenses to accident victims rose anywhere from 75 to 200 percent with the introduction of workers' compensation.

The rise in postaccident payment led many contemporary reformers to hail workers' compensation as a substantial improvement in workers' welfare, providing them better protection against the financial consequences of workplace accidents. Many observers anticipated an added benefit that

employers would take more actions to enhance workplace safety and reduce accident rates. The expectations were reasonable, but changes in social insurance programs often lead to adjustments in labor markets and in the behavior of workers that have consequences that are contrary to what reformers anticipate. Therefore, the de facto redistribution of workplace accident costs associated with the switch to workers' compensation might have been much smaller than what social reformers presumed.

In this chapter we discuss how the introduction of workers' compensation changed the nature of postaccident benefits in the early twentieth century. We then investigate its impact on wages, household saving and accident insurance purchases, and fatal accident rates. In the case of wages, numerous studies of the economic impact of government-mandated benefits find that employers are able to pass at least part of their costs back to workers through reduced wages (see Moore and Viscusi 1990, 24; Gruber and Krueger 1991; Chelius and Burton 1994; and Gruber 1994). A close examination of wages in three dangerous industries when workers' compensation was first introduced suggests that employers were able to pass some of the costs of workers' compensation on to nonunion workers through lower wages, but were less successful in passing the costs on to unionized workers.

Even though many workers may have "bought" the higher benefits associated with workers' compensation through lower wages, we argue in this chapter that they were nonetheless better off as a result of the legislation. We establish that workers were better insured against workplace accident risk under workers' compensation than under negligence liability. Using a large cross-sectional data set of working class households' financial decisions in the period 1917 to 1919, we show that in workers' compensation states households bought slightly less accident insurance and held substantially lower precautionary savings, holding everything else constant. It appears that workers were not able to purchase their desired levels of accident insurance under negligence liability, in part because insurance companies faced significant informational problems in selling workplace accident insurance to individual workers. Instead, many workers were forced to rely on precautionary savings, which were a relatively expensive means of insuring against accident risk. The guarantee of accident benefits from workers' compensation allowed workers to reduce their precautionary saving and, thus, increase their consumption of other goods.

Finally, as long as insurance premiums were experience rated—that is, employers with more dangerous workplaces paid higher insurance premiums—higher workers' compensation benefits imposed higher costs on employers. Since workers' compensation insurance was somewhat experience rated in the early twentieth century, we might anticipate that employers would seek to create safer workplaces if the expected damages they paid for accidents were higher than the costs of preventing the accident. On

the other hand, given that they received higher benefits, workers' costs of incurring an accident were reduced, which might have led to their taking less care in preventing accidents or reporting phantom injuries. In this chapter we cite the results of studies that show that workers' compensation was associated with a decline in fatal accident rates in manufacturing industries, but an increase in fatal accident rates in the coal industry. We speculate that differences in the employers' costs of preventing accidents across these industries produced this dissimilar effect on fatal accident rates.

3.1 Accident Compensation under Workers' Compensation

Workers' compensation laws mandated that employers remunerate all workers for their injuries arising "out of and in the course of employment."[1] Accident benefits paid out under workers' compensation were determined by statutory provisions that varied by state and within states over time. The laws typically provided that injured workers (or the families of the deceased) were to be paid a percentage of their weekly wage for a maximum number of weeks, subject to maximum weekly payouts and some maximum total level of compensation. Variations in state patterns are discussed in detail in appendix B. In many states the percentage of the wage replaced varied with respect to the number of family members. In the discussions below we assume that the worker was married with two children, ages eight and ten.

The families of workers killed in workplace accidents typically received benefits under state laws patterned after the New Jersey law of 1911. In New Jersey employers were expected to offer the widow and children of a fatal accident victim weekly payments equal to 45 percent of the workers' wage for up to three hundred weeks. Weekly benefits could not be lower than $5 a week or higher than $10 a week, and the sum of the payments could not exceed $3,000 or be lower than $1,500. In addition, New Jersey offered the family $100 for funeral expenses. Nearly all states focused on paying the money weekly over an extended period of time. Thus the family of a New Jersey worker who was earning a national average wage of $14.83 per week in 1911 could expect to receive $6.67 a week for nearly six years. The present value of this stream of payments using a discount rate of 5 percent was $1,840. This present value reflects how much a family would have had to invest at 5 percent compounded interest at the time payments began to generate the stream of weekly workers' compensation payments. The family would have therefore received a stream of payments with a present value of about 2.5 times the annual income the worker had been earning. New Jersey's initial workers' compensation law was substantially less generous than the laws in Washington, New York, Oregon, West Virginia, and South Dakota, where the present values of fatality benefits ex-

ceeded five times annual income. Georgia, Vermont, and Virginia adopted the least generous initial laws with present values of fatality payments that replaced two years' income.

Workers' compensation laws also established benefit parameters for nonfatal accidents, which were far more common than fatal accidents. Nonfatal accidents were separated into three major categories: permanent total disability (e.g., full paralysis), permanent partial disability (e.g., loss of a hand), and temporary disability (e.g., broken leg). In most states, the compensation for nonfatal accidents followed the general pattern of that for fatal accidents. During his disability the worker was paid a percentage of his weekly wage, subject to statutory minimum and maximum payments, for a maximum number of weeks. Each state established a waiting period, ranging from three days to two weeks from the date of the accident, during which time no accident compensation was paid. Injured workers who were out of work for a period less than the waiting period received no compensation. The rules for permanent total disability payments, say for full paralysis, were similar to the rules for fatal accident payments (without the funeral expense payments) in nearly every state.

The relative generosity of the states varied for different types of accidents. We have combined the present values of the accident payments for each type of accident into a summary measure of workers' compensation benefits, the expected benefits. The expected benefits measure takes the present value of the benefits of each of the broad categories of accidents and weights each present value with the probability that such an accident might occur. Rough estimates of the number of manufacturing accidents per thousand workers each year range from 0.14 permanent total disabilities, 2 fatalities, 10 permanent partial disabilities (loss of a hand, finger, or eye), to 120 short-term injuries that disabled the worker longer than the waiting period. In essence, the expected benefit shows what an insurance company might have expected to pay to the families of workplace accident victims earning the national weekly wage during the course of a year. For such workers in New Jersey in 1911, an insurer might have anticipated paying out $8.81 per worker, or approximately 1.19 percent of the worker's annual earnings, in workers' compensation benefits. The expected benefits as a percentage of annual earnings in the first year of operation are shown in table 3.1. Expected benefits ranged from 0.87 percent of annual earnings in Georgia in 1921 and Virginia in 1919 to 2.93 percent of annual earnings in North Dakota in 1919. More details on the calculation of expected benefits are provided in appendix B. The states amended their benefit levels every few years; therefore, the relative generosity of benefits across states varied from year to year. In chapter 7 we discuss the factors determining the choice of benefit levels and table 7.1 compares the expected benefits in each state from the first year of operation through 1930.

Mary Conyngton's (1917) surveys of workers' compensation in Ohio

Table 3.1 Expected Workers' Compensation Benefits in the First Year of Operation

State	First Year	Expected Benefit as Percentage of Annual Earnings	State	First Year	Expected Benefit as Percentage of Annual Earnings
Cal.	1911	1.78	Colo.	1915	1.00
N.J.	1911	1.19	Ind.	1915	1.33
Nev.	1911	1.33	La.	1915	1.21
Wash.	1911	2.23	Mont.	1915	1.35
Wis.	1911	2.02	Okla.	1915	0.85
Ill.	1912	1.54	Vt.	1915	1.06
Kan.	1912	1.28	Wyo.	1915	1.08
Mass.	1912	1.72	Ky.	1916	1.63
Md.	1912	1.33	Me.	1916	1.30
Mich.	1912	1.19	Pa.	1916	1.26
Ohio	1912	1.67	N.M.	1917	1.03
R.I.	1912	1.29	S.D.	1917	1.22
N.H.	1912	1.26	Utah	1917	1.43
Ariz.	1913	1.74	Del.	1918	1.01
Minn.	1913	1.21	Idaho	1918	1.47
Neb.	1913	1.34	N.D.	1919	2.93
Tex.	1913	1.91	Tenn.	1919	1.08
W. Va.	1913	1.73	Va.	1919	0.87
Conn.	1914	1.24	Ala.	1920	1.09
Iowa	1914	1.22	Ga.	1921	0.87
N.Y.	1914	2.42	Mo.	1927	1.79
Or.	1914	2.49	N.C.	1929	1.59

Note: See appendix B. The expected benefit is the weighted sum of the present value of fatal accident payments, the present value of hand payments, and the present value of the five-week disability payment. The weights are the probability of this type of accident. The same probabilities were used for all states and are based on averages for manufacturing in Oregon (Oregon Industrial Accident Commission 1919, 28–42). The probability of a fatal accident over the course of a year was 0.001895, for a permanent total disability 0.000136, for permanent partial disability 0.0099, and for temporary total disability 0.1199. We used the fatal accident present value as a measure for the permanent total disability benefits because they were so similar in nearly all the states. We scaled the hand present value down to 21.8 percent of the level listed above because the average value paid for permanent partial disabilities was about 21.8 percent of the hand value (see accident statistics reported in Wisconsin Industrial Commission [1915, 41; 1916, 44; 1917, 6–7] for 1914 to 1917).

and Connecticut in 1915 found that the families of fatal accident victims generally received the benefits to which they were entitled. In Ohio the families' actual death benefits were on average equal to 98.8 percent of the weekly payment that we estimated the families should have received using the statutory rules and each worker's reported weekly wage. In fact, 46 percent of the actual payments were the same as predicted by the statute, 34 percent were slightly higher, and 20 percent were slightly lower. In

Connecticut, the actual payments averaged 99.9 percent of the predicted payments based on the statute. Therefore, cross-state comparisons of estimated workers' compensation payments using the statutory rules should give a reasonable measure of the actual amounts that injured workers and their families received. Note, however, that both Ohio and Connecticut had established state bureaucracies to ensure that workers' compensation benefits were paid to workers and families who were entitled to them. In the states that did not establish a bureaucratic commission and instead relied on the courts to settle compensation disputes between injured workers and employers, the correlation between what workers received and what employers were legally obligated to pay may not have been as strong.

3.2 A Comparison of Postaccident Payments under the Negligence Liability and Workers' Compensation Systems

The primary objective of social reformers and others who lobbied for workers' compensation was to raise the expected benefits that injured workers or their heirs received in the event of an industrial accident. Raising expected benefits meant increasing the percentage of accident victims who received remuneration and/or the average level of benefits they would receive. A priori, we cannot state with certainty whether expected benefits were higher under the old negligence liability system or under workers' compensation. If the old system followed the common law rules to the letter, an injured worker who could show employer negligence and get past the three defenses (assumption of risk, fellow servant, and contributory negligence) was supposed to be fully compensated for the damages, including full replacement of wages. Meanwhile, under workers' compensation all injured workers received at most two-thirds of their lost income. Thus, the properly working common law system compensated fewer workers, but the workers who received payments should have recovered more of their losses than they would have under workers' compensation. It becomes an empirical question whether workers' compensation raised the expected accident payments by sufficiently increasing the percentage of injured workers compensated to offset the lower replacement rate. The potential rise in expected benefits under workers' compensation might have been still larger because, as we point out in chapter 2, it is not clear how well the de facto employers' liability system followed the dictates of the common law. For example, the payments to the families of most fatal accident victims who received some positive amount covered only about one year of the worker's income. Thus, for some types of accidents, workers' compensation might have led to an increase in both the percentage of families compensated and the amounts that they received.

Measuring accident remuneration under the negligence liability and workers' compensation systems is complicated by the various types of

accidents. The easiest and most accurate comparisons can be made for fatal accidents. When considering fatal accident payments, there is no question about the severity of the accident because we know that the victims of such accidents had the same fate. Moreover, there are fewer reporting problems when studying fatal accidents because the event was not easily concealed. Comparing nonfatal accident compensation is fraught with difficulty because there exist few data to compare accidents of similar severities across the two legal institutions. In this section we focus first on the payments made to the heirs of fatal accident victims and then turn to comparisons of the two legal systems when all accident types are considered as a whole.

3.2.1 The Rise in Average Compensation for Fatal Accidents

The shift to workers' compensation raised the expected amount of post-accident compensation for fatal accidents in two important ways. First, the percentage of families that received no compensation fell to close to zero. For example, Mary Conyngton's (1917, 109) survey of Ohio and Connecticut families of fatally injured workers in 1915 revealed that only 2.9 and 9.4 percent, respectively, received no benefits under workers' compensation. In those cases where the families received nothing, there was a strong likelihood that the accident did not occur in the workplace or occurred because the worker was intoxicated or had maliciously caused his own accident, either of which barred monetary recovery. The percentages of those not receiving compensation under workers' compensation are substantially lower than even the lowest percentages reported for the negligence liability system in table 2.1.

Second, for those families that received a positive amount of compensation for the death of their primary wage earners, the average payments were significantly higher under workers' compensation than under negligence liability. The information on fatal accident payments under negligence liability in table 2.1 shows that average payments to those families receiving positive amounts ranged from 0.58 of a year's earnings in Virginia coal mines in the period 1916 to 1918 to 1.48 of a year's earnings for nonrailroad workers in Illinois prior to 1911. The average for all the samples was a negligence liability payment of about one year's earnings. By contrast, under workers' compensation the present value of fatal accident payments ranged from 1.94 to 8.26 times annual earnings in most states (see appendix table B.1). The gap between fatal accident payments under workers' compensation and negligence liability is still larger when we factor in the probability of receiving a payment under the negligence liability system. In expected terms, then, the heirs of fatal accident victims could expect to receive only about one-half year's earnings prior to the adoption of workers' compensation.

3.2.2 The Rise in Expected Compensation for All Types of Accidents

When the analysis is expanded to include both nonfatal and fatal accidents, the available data further show that when workers' compensation was introduced, average expected accident benefits increased substantially. Various estimates of the accident compensation paid out under the two systems suggest that the workers' compensation system was, on average, 1.7 to 4 times more generous than negligence liability.

We have attempted to calculate expected benefits under the two systems, holding the underlying risk of a workplace accident constant. We define the expected benefit $E(B)$ as follows:

$$E(B) = p_f B_f + p_n B_n, \tag{1}$$

where p_f is the probability of a fatal accident, B_f is the average benefit paid out for a fatal accident, and the subscript n refers to nonfatal accidents. To make comparisons across time, we then normalized the expected benefits by dividing by average annual income. Thus, the final comparisons are quoted in terms of percentages of annual income or percentages of employers' payrolls. We made the comparisons from two types of sources: workers' reports of the remuneration they received when injured at work and employers' reports of what they paid out to workers.

Comparisons Based on Workers' Reports

To make the calculations based on workers' reports, we used the same probabilities of fatal and nonfatal accidents for both regimes.[2] We then calculated expected benefits under negligence liability using the average amounts of payments reported in the workers' samples. Information on individual workers' remuneration under negligence liability was collected from the New York Commission on Employers' Liability (NYCEL 1910, 246–50), which reported medical payments and wage replacement amounts that workers received from their employers. The data were originally collected from a series of direct interviews conducted on a random sample of workers who had been injured and whose accidents had been reported to the New York Bureau of Factory Inspection in 1907 (NYCEL 1910, 210–11). To calculate expected benefits under workers' compensation, we used the 1914 New York workers' compensation law to determine the present value of the stream of payouts for different types of accidents. In addition, we have limited the comparison to wage replacement only and have ignored how medical payments differed under the two legal systems. Our impression is that medical coverage was better under workers' compensation; therefore, the elimination of medical payments would bias the comparison against finding that workers' compensation benefits were relatively higher.

The New York wage replacement comparisons suggest that the expected wage replacement benefits under workers' compensation were at least 1.75 times as generous as the expected benefit under negligence liability. The estimate that workers' compensation on average paid about 1.75 times as much as negligence liability treats the sample from the NYCEL report as a random sample of the "true" number of accidents under the negligence system. Large numbers of nonfatal accidents that would have been compensable under workers' compensation, however, probably went unreported under negligence liability. In addition, it is likely that the unreported injured workers received little or no compensation; therefore, the average compensation reported for nonfatal injuries under employers' liability in the NYCEL study is likely overstated. By making conservative adjustments for the underreporting of accidents, we have calculated that workers' compensation benefits in New York were 2.5 times as generous as those under the employers' liability system. See appendix C for more details on these calculations.

Even this estimate of a 2.5-fold rise may be understated if we are correct that medical benefits were more generous under workers' compensation. The measured increase in benefits also understates the rise in the net amount that workers received after they paid their legal expenses. Evidence from various sources suggests that when workers hired a lawyer under the negligence system, contingency fees ranged from 20 to 50 percent. Since many workers did not hire lawyers to represent them, the payments to lawyers probably amounted to between 13 and 23 percent of the total amount that workers received under negligence. Some workers also used lawyers to contest claims under workers' compensation, although legal expenses probably consumed less than 5 percent of the total amount that workers received. Thus, after making adjustments for legal payments, the net expected amount an injured worker received might have risen by as much as 300 percent with the introduction of workers' compensation.

Comparisons Based on Employers' Reports

As a second way of comparing the generosity of benefits under the two systems, we examined how much employers reported that they and their insurance carriers paid out in accident benefits, settlements, and medical payments as a percentage of their payrolls. One of the advantages of using employer-reported evidence is that the underreporting of accidents is much less of a problem than for the data collected from workers. Employers reported how much they paid out for insurance and in direct payments to workers, and they did not have to reveal any information about accidents for which they made no payments. Thus, when making their reports about accident compensation, employers did not have to worry about giving factory inspectors specific information about accident problems in their establishments. In fact, to the extent that the generosity of accident

benefits enhanced an employer's reputation, firms may have had an incentive to overstate their accident payments.

How much employers paid out for accident compensation conflates both the probability of occurrence and the amount actually paid. Thus, we try to hold the underlying accident risk constant by comparing the same industries in the same state during a period when there would have been little change in accident rates. The Wisconsin Bureau of Labor and Industrial Statistics (WBLIS) in 1906 conducted a survey of employers to determine their accident expenses and how much of this money actually went to workers in the form of wage replacement and medical benefits (WBLIS 1909, 31, 34–35). The WBLIS survey found that employers paid approximately $0.245 in wage and medical compensation for every $100 they paid in wages. Under workers' compensation in 1913, by contrast, the Wisconsin Industrial Commission (1915, 32–38) calculated that workers received wage and medical benefits of $0.82 for every $100 of payroll. This comparison suggests that workers' compensation in Wisconsin was 3.35 times more generous than the negligence liability system.

We were concerned that this Wisconsin comparison might be unreliable because the coverage of industries in 1906 and 1913 differed. To examine this issue more carefully, we matched industries from the 1906 and 1913 listings and found that in all but one of the twenty-three comparisons workers' compensation benefits exceeded those under negligence liability (see appendix table C.1). In fifteen of the twenty-three comparisons, workers' compensation was greater than two times more generous than negligence liability, and in nine of the twenty-three comparisons workers' compensation was more than three times as generous.

As a second measure, we examined the records of the Stonega Coke and Coal Company in Virginia before and after the introduction of workers' compensation on 1 January 1919. During the years 1916 to 1918, Stonega spent roughly $0.97 per $100 on the payroll in compensating injured workers or their families. During the period 1919 to 1923, after workers' compensation was established, Stonega spent approximately $1.70 per $100 on the payroll, which is about 74 percent higher than the payouts under negligence liability.[3] It should be noted that this rise in accident benefits is smaller than those we calculated for Wisconsin and New York in part because Virginia in 1919 had one of the least generous workers' compensation laws in the United States. Virginia's statutory benefit levels in 1919 were roughly half the benefit levels in Wisconsin in 1913 and 40 percent of New York's benefit levels in 1914 (see table 3.1 for a comparison).

The rise in benefits that we have documented for workers' compensation using the employer-reported data may be understated in two ways. The benefits under workers' compensation do not include medical payments or funeral expenses, and we know that employers did pay some medical and funeral expenses under the negligence system that were most likely

included in their aggregate expenditure statistics. Furthermore, we did not subtract legal fees that workers paid under the two systems, which would have made workers' compensation look even more beneficent than the negligence system.

3.3 The Impact of Workers' Compensation on Wages

The substantial rise in postaccident benefits led reformers and many social historians to hail workers' compensation as a dramatic improvement in worker welfare. Economists since Adam Smith, however, have suggested that improvements in nonpecuniary benefits are often offset by compensating reductions in wages. In fact, studies of changes in workers' compensation benefits over the past twenty years have shown that increases in benefits are associated with reductions in wage rates (Moore and Viscusi 1990, 24–25; Gruber and Krueger 1991). If labor markets in the early 1900s operated in a similar fashion, the rise in postaccident compensation when states switched to workers' compensation potentially would have been offset by a decline in the risk premium implicit in wages.

At least some employers were aware of this phenomenon when workers' compensation was being discussed. A prominent Washington employer described how a cost-increasing provision in the state's 1911 workers' compensation law would ultimately affect workers: "[T]hey were working a hardship on the laboring man, because this 2 cents that the employer is supposed to pay will not eventually come from the employer, but will come from the laboring man by necessary reduction of wage scale. . . . Competition in all lines in this day is so keen that every employer of labor has to figure his expenses down to the lowest item, and as Washington will have to compete with Oregon, Montana, Idaho, and even California in her productions, eventually the employer is going to take this 2 cents, this small amount to him and a small amount on paper, out of his employee."[4] Of course, most employers who supported workers' compensation were not likely to make these statements very forcefully in public for fear of chilling the support that workers provided the program.

To examine how wages adjusted in response to the introduction of workers' compensation, we constructed three separate panel data sets for relatively dangerous industries in the early 1900s. The first sample covers hourly wage rates from payrolls collected by the U.S. Bituminous Coal Commission. The sample contains state averages for ten jobs from the twenty-three leading coal producing states at the end of each year from 1911 to 1922. The second sample is hourly earnings collected from payrolls by the U.S. Bureau of Labor Statistics for ten different jobs in the lumber industry for the years 1910 to 1913, 1915, 1921, and 1923 in the twenty-three major lumber producing states. The third sample is the wage scales listed in union contracts in the building trades for thirteen occupa-

tions in seventy-seven cities for each year between 1907 and 1913.[5] All three data sets allow examination of differences across states and over time during the period when nearly all the workers' compensation laws were adopted.

For each of the three samples we estimated standard wage equations. The equations can be used to assess the impact of changing expected post-accident benefit levels, while controlling for fluctuations in the product market, the skill levels of the workers, restrictions on working time, geographic differences in labor markets, and nationwide changes in the labor market specific to each year. In the coal industry we had enough information to control for several additional factors, including strikes and union strength. A more complete description of the model and the results is presented in appendix D. The wage equations generally confirm relationships found in numerous other wage studies. Wage rates rose when product prices increased and when business was improving. More productive and higher-skilled workers earned higher wages. Strikes and unionization were associated with higher earnings.

The impact of workers' compensation can be assessed in a variety of ways. As a simple starting point, we measured the impact of workers' compensation using a dummy variable with a value of one for states and years in which the workers' compensation law was in effect and a value of zero otherwise. Using this measure, workers' compensation was associated with a decline in wages in two of the three industries. In coal mining the presence of a workers' compensation law reduced hourly earnings by 2.16 percent, while in the lumber industry the reduction was 1.60 percent. In both cases statistical tests reject the view that workers' compensation had no effect on wages. In the building trades, however, the decline was smaller at 0.33 percent, and we cannot reject the hypothesis that workers' compensation had no effect on wages.[6]

The use of a dummy variable provides only a rough estimate of how workers' compensation affected wages across the United States because the laws were associated with more complex changes in accident benefits than a 0–1 variable can capture. A dummy variable fails to represent the substantial variation in accident compensation paid out to workers both under negligence liability and under workers' compensation. The generosity of workers' compensation benefits varied a great deal across states and across time within states (see tables 3.1, B.1–B.4, and 7.1). There also appear to have been differences in the average benefits paid out across states under negligence liability. Inspection of employers' liability insurance manuals shows that rates for this insurance were adjusted depending on a state's liability rules and the outcomes of litigation in the state. For example, holding the type of industry constant, a firm in Ohio under negligence liability would have paid insurance premiums that were 1.8 times larger than the rates a similar firm in Illinois would have paid (DeLeon

1907, 26–27). These differentials presumably correspond to the different amounts of compensation workers in these two states would have received if they were injured under the negligence liability system.

To capture this variation in compensation we have developed a measure of expected benefits in each of the industries. Expected benefits under workers' compensation are constructed by first calculating the gross benefits a worker or his family would have received had he been killed or suffered a permanent total disability, a permanent partial disability, or a temporary four-week disability. We then converted these gross benefit estimates into an expected benefit measure by weighting each of the four types of accident benefits by the probability that each type of accident would occur and then summing the four expected compensation estimates (see appendix B for details of these calculations).[7]

The expected benefits variable measures the monetary value that a risk-neutral worker would place on his expected accident compensation.[8] If workers were risk-averse, however, our measure of expected compensation actually provides a lower-bound estimate of the value that workers would have placed on these postaccident benefits. The expected benefits measure also is strongly correlated with the employers' costs of purchasing workers' compensation insurance because workers' compensation insurance and employers' liability insurance were experience rated.[9] Employers probably would have paid insurance premiums that were about 1.67 times the expected benefit measure, based on administrative load factors quoted by contemporary insurance texts on workers' compensation insurance (see Kulp 1928, 246).

Table 3.2 contains estimates of the sizes of the wage offset from the wage regressions. The letter superscripts mark estimates for which we can reject the hypothesis that workers' compensation had no effect at conventional levels of statistical significance. A coefficient of -1 implies that workers fully paid for increases in the expected benefits that they received, although the worker would not have fully paid for the employer's cost of purchasing the insurance to provide those benefits. Coefficients around -1.67 imply that employers were able to pass on their full insurance costs

Table 3.2 **Wage Offsets Associated with the Introduction of Workers' Compensation**

Sample	Linear	Semilog
Coal	-1.72^{a}	-2.50^{a}
Lumber	-1.04^{a}	-0.69^{b}
Unionized building trades	0.02	-0.17

Sources: See table D.1 and Fishback and Kantor (1995, 732).

[a]Statistically significantly different from zero in a one-tailed test at the 1 percent level.

[b]Statistically significantly different from zero in a one-tailed test at the 15 percent level.

to workers. Using modern data, Gruber and Krueger (1991) estimate that workers in the 1970s and 1980s paid for between 56 and 86 percent of their employers' workers' compensation costs. Their results suggest that workers more than paid for the value of the expected benefits that they actually received, but did not fully pay for the insurance costs that employers bore. On the other hand, Moore and Viscusi (1990, 50–51) find wage offsets of approximately 3 times the expected value of the worker's accident benefits and 2.4 times employers' insurance costs.

Our estimates of the wage offsets using the full samples and the most complete set of control variables are listed in table 3.2. Coal and lumber workers in the early 1900s experienced wage reductions that were similar to the ones found in modern studies, while the contractual wages in the unionized building trades barely responded to the increase in postaccident benefits. The estimates in the coal and lumber industries are generally within the range found in modern data. The coal estimate of −1.72 in the first column implies that hourly earnings fell 1.72 cents for each 1 cent increase in the worker's expected accident benefits. Thus, coal workers paid not only for increases in the benefits they expected to receive, but also for the consequent 1.67 cent increase in their employers' insurance costs. Using an alternative semilog specification that is often used in wage analyses, the estimated offset in the second column for the coal industry is somewhat larger at −2.5. In the lumber industry the estimated offset is not as large, ranging from −1.04 to −0.69, but it is still in the range that Gruber and Krueger found in their study of the modern workers' compensation system. By contrast, contractual wages in the unionized building trades did not adjust downward to increases in accident compensation. The coefficient is positive (0.02) and not statistically significant. These results are generally robust to changes in the control variables and time periods covered in the analysis. A complete discussion of the robustness of the results can be found in appendix D and Fishback and Kantor (1995).

The finding of no wage offset in the building trades might be due to the unionization of the industry. Unionization enabled workers to fend off wage reductions in the face of increased employer mandates. We might expect such a result from the building trades, which were the most stable labor organizations in the United States in the early 1900s (Taft 1964, 203). Other studies have shown that workers in unions receive larger compensating differentials for accepting accident risk (Dickens 1984). Moore and Viscusi (1990, 110–20) find that unionized workers experience smaller wage offsets when workers' compensation benefits increase. Dickens (1984) suggests that the union–nonunion variation might arise purely from the differences in the bargaining power of the two sets of workers. Alternatively, Moore and Viscusi (1990) argue that unions obtain better benefits because they represent the preferences of the average worker, whereas the preferences of the marginal worker determine compensating differentials

Table 3.3 Union and Nonunion Wage Offsets in the Coal Industry

	1911 to 1922		1911 to 1915	
Sample	Linear	Semilog	Linear	Semilog
Coal nonunion	−2.68[a]	−2.29[a]	−2.46[a]	−2.57[a]
Coal union	−0.44	−2.80[a]	−0.49	−1.94

Sources: See appendix table D.2 and Fishback and Kantor (1995, 735).
[a]Statistically significantly different from zero in a one-tailed test at the 1 percent level.

in competitive markets. Union wages might also be slower to adjust to changes in postaccident compensation because the wages are set in explicit contracts that might be renegotiated every two to three years.[10]

We can further test the impact of unionization on wage offsets by examining the coal sample. In the coal industry the differences in unionization were based on geography, not occupations, because the United Mine Workers of America (UMWA) sought to unionize workers in all jobs into a single union. Using the percentage of workers in the state with paid-up membership in the UMWA as a measure of unionization, we have reestimated the wage offsets for the coal industry allowing for different wage responses for union and nonunion workers. Table 3.3 shows the offsets calculated from the regression equation with the union–expected benefits interaction term included, for both the overall sample and the sample for the period prior to 1916. Under the linear specification, the offset for a worker in a completely nonunion district would have been −2.68. Meanwhile, the offset for a worker in a completely unionized district would have been −0.44, and we cannot reject the hypothesis that unionized workers experienced no wage offset. The effect of unionization is sensitive to specification in the full sample, however. The union offset in the semilog specification in the second column of table 3.3 is slightly larger than the nonunion effect, although the difference between the two is not statistically significant.

The impact of unionization on wages can be explored further by restricting the sample to the years prior to 1916. The differences in the results for the two specifications using the full sample might be driven by measurement error in the union variable during and after World War I. The union membership variable might not fully reflect the long-term strength of the union during and immediately after World War I. The U.S. Fuel Administrator had forced many coal firms to negotiate contracts with the union during the war, thus union membership might understate the union's strength in some areas during World War I. After the war a substantial number of firms repudiated the contracts while union membership was still increasing. When we limit the sample to the pre-1916 years, as reported in the third and fourth columns of table 3.3, the union wage offset

is substantially smaller than the nonunion offset under both specifications.

Our analysis of wages near the time workers' compensation was enacted suggests that nonunion workers essentially "bought" a portion of the higher benefits under workers' compensation in the form of lower real wages. Unionized workers, on the other hand, seem to have benefited directly from the higher de jure benefits because they were able to stave off the wage reductions that nonunion workers experienced.[11] The presence of wage offsets for nonunion workers also helps to solve one of the major puzzles in the political economy of the passage of workers' compensation. Even though workers' compensation transferred a significant part of the legal burden of postaccident compensation onto employers, many employers led the way in supporting the legislation (Lubove 1967; Weinstein 1967). Many employers may have supported the legislation in anticipation of passing a substantial portion of their costs onto their workers in the form of lower wages, as the quotation from the Washington employer above suggests.

Politically, workers' attitudes toward workers' compensation may have been influenced by the extent of the wage offset that they could anticipate. In the final analysis both workers and employers might have benefited from the legislation because the wage offsets implied that the employer mandate did not create a large-scale redistribution of income. By supporting workers' compensation, employers could satisfy their workers' demands for better postaccident benefits without having to fully pay for the apparent largesse. Finally, even though their wages might have fallen, risk-averse workers might have benefited from workers' compensation if they were poorly insured against workplace accident risk in the early twentieth century. In the next section, we provide evidence that workers indeed faced difficulty insuring their workplace accident risk privately prior to the adoption of workers' compensation.

3.4 The Impact of Workers' Compensation on Household Saving and Insurance Purchases

By raising the average accident benefits that accident victims or their families received and by making the payment of these benefits more certain, workers' compensation in essence became the first widespread social insurance program in the United States. Since the introduction of workers' compensation, the United States has implemented a number of additional social insurance programs, including social security, unemployment insurance, and subsidized health insurance. Because these programs reduce the uncertainty of future income fluctuations, economists predict that social insurance programs should reduce workers' incentives to hold precautionary savings and should crowd out private insurance purchases.[12] Numerous empirical studies of modern programs confirm these predictions.[13]

One reason precautionary saving would fall as a result of the introduction of a social insurance program, such as workers' compensation, is that workers beforehand could not purchase complete insurance coverage to insure against misfortune's occurrence. In this section we examine how the introduction of workers' compensation affected precautionary saving and insurance purchases using a sample of over seven thousand working-class households canvassed for the 1917–1919 Bureau of Labor Statistics (BLS) cost-of-living survey. We find that workers used precautionary saving to insure against workplace accident risk in the early twentieth century. Because saving was a relatively expensive means of insuring against accident risk, we conclude that workers probably faced limits in the amounts of workplace accident insurance they were able to purchase prior to workers' compensation. Qualitative evidence drawn from insurance industry sources confirms our view that the insurance market around the turn of the century constrained workers' ability to insure their workplace accident risk.

3.4.1 Insuring against Accident Risk

Contemporary evidence suggests that working-class families in the early 1900s insured against workplace accident risk in a variety of ways. Most families saved. Some purchased limited amounts of commercial life and accident insurance. Others insured through employer-based funds or fraternal societies. A number of families sent children or spouses to work, took in boarders, and/or moved in with extended family when an accident occurred.

Various state and federal government surveys prior to the turn of the century give some indication of the extent to which workers purchased insurance prior to workers' compensation. Whaples and Buffum (1991, 102) found that 16 percent of the 5,020 Michigan furniture workers in an 1890 survey purchased some form of life insurance, while 40 percent claimed accident/sickness insurance through membership in a benefit society.[14] Surveys of Kansas nonagricultural workers from 1884 through 1887 show that 26 percent belonged to benefit societies, while 5.5 percent had bought some form of accident insurance (Ransom and Sutch 1989). In an 1890 survey of Maine workers, 22.8 percent claimed to have had life insurance, while 32.6 percent were members of a benefit society (Ransom and Sutch 1990).[15]

Several other surveys provide evidence on insurance coverage just prior to the introduction of workers' compensation. The Minnesota Bureau of Labor, Industries, and Commerce (1909–1910) found that 46.3 percent of the families of fatal accident victims collected insurance that replaced an average of 1.4 times the deceased's annual earnings prior to the establishment of compensation legislation in that state. In Conyngton's (1917) survey of Pennsylvania families of workers killed in workplace accidents in

1915, which was before the state's adoption of workers' compensation, 82.1 percent of the families received payments from some form of insurance, compared with 63 percent in the workers' compensation states of Ohio and Connecticut.

The most comprehensive picture of household purchases of insurance during the early 1900s can be found in the U.S. Bureau of Labor Statistics (BLS) 1917–1919 cost-of-living survey (1986). Table 3.4 shows the percentages of households from the survey that held various forms of insurance. By the early 1910s, families who sought to purchase private insurance against workplace accident risk had several options. The most widely held life insurance was industrial insurance, purchased by 67.6 percent of the households in the BLS sample. The industrial policies were also known as "burial" insurance because the average payout of $138 generally covered only the cost of a burial (Kip 1953, 18; Dryden 1914, 384; Ackerman 1926, 5–12).

About half of the families in the BLS sample sought to replace part of the household head's income if he died through the purchase of old-line insurance or fraternal life insurance. In the BLS sample, 29.2 percent of the households held old-line (or whole life) policies that insured lives and incorporated the accumulation of dividends that could be borrowed

Table 3.4 **Insurance Coverage among Households Surveyed for the BLS Cost-of-Living Study, 1917–19**

Type of Insurance	Percent of Households Claiming One or More Policies
Old-line life insurance	29.2
Industrial life insurance	67.6
Fraternal life insurance	25.9
Establishment life insurance	3.4
Other life insurance	1.4
All types of life insurance	85.2
All types of life insurance except industrial	51.6
Accident insurance	10.0
N	7,475

Source: Fishback and Kantor (1996, 425). The original data are from a survey by the U.S. Bureau of Labor Statistics, Cost-of-Living in the United States, 1917–19, which is available through the Inter-University Consortium for Political and Social Research, No. 8299.

Notes: A number of households held multiple insurance policies. For example, 3.8 percent of the households (or 12.8 percent of the policyholders) held old-line insurance policies on more than one member of the household; 58.4 percent of the households (or 86.4 percent of the policyholders) held industrial life insurance on more than one member of the household; 6.9 percent of the households (26.6 percent of the policyholders) held fraternal life insurance on more than one member of the household; 0.1 percent of the households had establishment life insurance on more than one family member; and 0.6 percent held other life insurance on more than one family member.

against or surrendered. Roughly one-fourth of the households that were interviewed bought life insurance through fraternal societies. These were mostly national organizations bound together by religious, occupational, ethnic, or fraternal ties. Most local societies belonged to a national parent organization that issued "certificates" of membership that entitled members' beneficiaries to death benefits and usually provided for a limited stream of payments in the event of disability (Nichols 1914; Insurance Research and Review Service 1938; Kip 1953). There were no standard death benefits and disability plans, so each worker's access to fraternal insurance varied depending on his religion, occupation, industry, or labor organization (see, e.g., U.S. Commissioner of Labor 1909). Considering all forms of life insurance together, the typical household in the BLS sample seems to have purchased enough insurance to replace about one year's income.[16]

The three types of life insurance discussed above were not directly targeted at workplace accidents because they insured against all causes of death. Mortality statistics for the working-age population suggest that workplace accidents probably accounted for at most 2 percent of all deaths from 1915 to 1920.[17] Insurance companies therefore designed accident insurance that limited their liability to injury and death arising from "external, violent, and accidental means." Precisely defining an accident was an evolving enterprise as insurers and insureds relied on the courts to settle vast differences in interpretation (Cornelius 1920). Accident insurance was clearly written with an eye toward insuring occupational accident risk, as each industry and occupational class was categorized according to its level of danger (Aetna Insurance Company 1919).[18] Evidence offered by Faulkner (1940, 27) suggests that occupational accidents accounted for approximately 63.3 percent of all accidental deaths in 1913, although the percentage had fallen to 28.3 percent by 1938 because of advancements in safety programs and devices.[19]

Although accident insurance represented the most direct way for workers to insure against occupational accident risk, the personal accident insurance business was very limited in the early twentieth century. Only $18.8 million in accident premiums were collected by commercial insurance companies in 1911, compared with $564.7 million in whole life premiums and $750.9 million in industrial life premiums (*Hayden's Annual Cyclopedia of Insurance* 1913, 4, 154–55, 180–81). Among the households that the BLS surveyed in 1917 to 1919, 10 percent had an accident insurance policy.

The commercial accident insurance market was clearly limited by the informational problems of insuring an individual worker's accident risk. With little information on the accident-proneness of the individual, the insurance industry based insurance premiums on occupational averages. But even the information on occupational averages was limited. The na-

tional information flows that were useful for experience rating in other lines of insurance were poorly developed in the accident insurance line. The national organization formed in 1914 was described by insurance executive G. F. Michelbacher (1942, 159) as "largely ornamental" with an inadequate staff providing "inconsequential statistical exhibits" compiled with data collected by other organizations. The lack of effective information for setting rates would have led to adverse selection problems, as more accident-prone workers would have purchased the insurance and more careful workers would not. Insurance companies could expect no help from employers in identifying accident-prone workers because negligence liability rules allowed employers to invoke the contributory negligence defense to avoid compensating careless workers. Thus, employers had less incentive to fire irresponsible workers or to impose restrictions on their behavior.

The standard means of reducing problems of adverse selection is to limit the amount of insurance a worker can buy or to establish pricing policies designed to discourage more accident-prone individuals. Accident insurers followed both practices. The Aetna Insurance Company (1919, 96) imposed limits on the risks they would insure, setting death benefit maximums as low as $250 for coal miners, who faced the most dangerous working conditions in the early twentieth century. Physicians, on the other hand, could insure up to $10,000 for accidental death. Further, accident insurance was noted for its high load factors. Even with the high loads, a number of companies writing accident insurance failed over the period 1917 to 1926, while the surviving stock companies suffered a slight underwriting loss (Kulp 1928, 576). The end result was that many workers were unable to purchase complete coverage, and possibly some were shut out of the market altogether.

Workers also tried to obtain insurance through union funds and establishment funds, which were nearly entirely financed by workers' contributions. These funds expanded the range of insurance that workers could obtain, but typically the amount of coverage they provided was small.[20] In 1908, the average death benefit was $109 in establishment funds and $89 in union funds, perhaps enough to cover burial expenses. Many funds offered no temporary disability benefits. In the establishment and union funds where temporary disability benefits were available, the average maximum benefit was about five dollars, and the payments only lasted for an average of fifteen weeks (U.S. Commissioner of Labor 1909, 234–67, 448–87). In contrast, five dollars was typically the minimum payment under workers' compensation and benefits for long-term disabilities lasted up to three to five years.

In general, the BLS survey shows that a wide range of workers purchased at least some form of insurance. In most cases the amount of insurance they purchased was limited either by choice or because there were

specific constraints on the amount of coverage insurers or benefit societies offered to workers. Absent full insurance coverage, families could always save against the possibility of an accident. However, saving was a relatively costly means of insurance. At an interest rate of 5 percent, for example, a family that sought to hold a year's income in reserve would have had to forgo consumption of 95 percent of their income in the current year or wait several years to reach its goal. Families could also rely on children to work if the primary wage earner was injured or killed in an accident.[21] Numerous scholars have found that sending children to work was an important means by which families survived hard times and accumulated savings at the turn of the century (see Modell 1979; Goldin 1981; Haines 1985; Keyssar 1986, 158–60; and Rotella and Alter 1993).

3.4.2 The Theoretical Impact of Workers' Compensation on Saving and Insurance

Given that many households had relatively little life or accident insurance coverage in the early twentieth century, families may have relied strongly on precautionary saving to insure against accident risk. The increase in postaccident benefits that workers' compensation guaranteed may have affected households' decisions in two ways. As Cutler and Gruber's (1996) study of the modern Medicaid system implies, households may have reduced their accident insurance purchases, seeing the higher workers' compensation benefits as a replacement for private insurance. Similarly, as Leland (1968) and Kotlikoff (1989, 145–51) predict, if households were using precautionary savings to protect themselves against workplace accident risk, they would also have reduced their precautionary saving as the introduction of social insurance benefits reduced the uncertainty of future income loss from an industrial accident.

In fact, observed changes in family saving patterns in response to changes in postaccident compensation enable us to determine whether workers' access to accident insurance was constrained or not. In appendix E we develop theoretical predictions from a two-period model of saving and insurance choices when workers are faced with a positive probability of a workplace accident. The predictions from the model indicate that if workers were able to purchase all of the insurance that they desired at actuarially fair premiums, then an increase in postaccident benefits would have led to an increase in saving and a reduction in insurance purchases. In other words, workers would have perceived the increase in postaccident benefits as an increase in their expected incomes, which they could have funneled either into saving or consumption. On the other hand, the model suggests that the only condition under which workers would reduce their saving when postaccident benefits rise is when they faced binding limits on the amounts of insurance coverage they could purchase. Faced with such rationing, workers were forced to rely on precautionary saving to

help protect themselves against accident risk. The introduction of workers' compensation and its relatively generous postaccident benefits provided better insurance than workers were able to obtain privately, which, in turn, would have allowed them to use income previously targeted for precautionary saving for other purposes. Workers faced with binding limits on insurance availability might still have reduced their insurance coverage when postaccident compensation rose if their desired level of coverage was below the limits imposed by the insurer. That is, workers' compensation might have crowded out private accident insurance consumption under certain circumstances.

The theoretical and empirical research of other scholars suggests that the certainty and generosity of the workers' compensation benefits should have led to a reduction in workers' private insurance, whether through formal or informal channels. At the same time, our theoretical analysis indicates that a decline in precautionary saving as a result of the introduction of workers' compensation might signal that workers had problems purchasing their desired levels of accident insurance prior to the laws' passage. Therefore, risk-averse workers, even if they "bought" the higher benefits through wage reductions, might still have gained from workers' compensation. In essence, they were able to obtain a higher level of protection against accident risk than was available to them under the negligence system.

3.4.3 Empirical Estimates of the Impact of Workers' Compensation on Insurance and Saving Behavior

To examine how variations in expected postaccident benefits influenced precautionary saving and private insurance coverage, we analyzed a cross-section of data on working-class households' financial decisions in both workers' compensation states and negligence liability states around 1918. Between late 1917 and early 1919 the U.S. Bureau of Labor Statistics conducted an intricate survey of the consumption patterns of working-class families in industrial centers of the United States. The study established the budget weights for the consumer price index (U.S. Bureau of Labor Statistics 1924). Agents interviewed 12,817 families of wage earners or salaried workers in ninety-nine cities in forty-two states. From this group we extracted a sample of 7,475 families where the household head was a laborer, operative, or craft worker. For more details on the sample and the analysis, see appendix F and Kantor and Fishback (1996).

We used the information from the cost-of-living survey to examine the impact of workers' compensation on the household's saving and purchases of accident and life insurance. That impact is estimated using an expected benefits measure similar to the one we used in the wage analysis above. In addition, the analysis controlled for other factors that might have influenced saving and insurance decisions.[22]

Table 3.5 **Effect of Rising Accident Benefits on Saving and Insurance Purchases**

Variable Affected	
Change in probability of purchasing life insurance (%)	0.1
Change in probability of purchasing accident insurance (%)	1.9
Change in savings ($)	
Full sample	−11.58[a]
Full sample (alternative specification)	−8.29[a]
Sample focused on workers' compensation states	−16.06[a]

Sources: See Fishback and Kantor (1996, 432–37) and appendix table F.1.

Notes: The effects reported here show how a one-standard-deviation increase ($7.15) in expected benefits, evaluated at the sample means in the sample, would have affected the variables in the table. The effects reported are based on coefficients from a probit analysis of insurance purchases and ordinary least squares analysis of saving. The assumed $7.15 increase in expected benefits is roughly half the size of the mean level of expected benefits in the sample.

[a]Statistically significant at the 5 percent level.

The effects of an increase in expected postaccident benefits are summarized in table 3.5, which shows the impact of a one-standard-deviation increase in expected benefits ($7.15) from the mean level in the sample ($14.67). We chose to look at the impact of a one-standard-deviation increase because it is close to the change in expected benefits that might have occurred with a shift from negligence liability to workers' compensation.

Life insurance was largely unaffected by changes in expected postaccident benefits. A one-standard-deviation change in the expected postaccident benefits would have lowered the probability of purchasing life insurance by only 0.1 percentage point—from 86.1 percent to 86.2 percent. We cannot reject the hypothesis of no effect on statistical grounds. Workers may not have changed their life insurance coverage much in response to changes in postaccident benefits because they were largely insuring against fatality risks not associated with the workplace. Recall that workplace accidents accounted for no more than 2 percent of the fatalities for the working-age population during this time period.

Changes in expected accident benefits had more influence on the probability of purchasing accident insurance, as a one-standard-deviation change in the benefits would have lowered that probability by 1.9 percentage points. However, we cannot reject the hypothesis of no effect. A change of 1.9 percentage points is relatively large given that only 10 percent of the households in the sample were purchasing accident insurance. As workers' compensation shifted the financial incidence of industrial accidents onto employers, those workers who were purchasing some private accident insurance substituted the guarantee of higher postaccident benefits for their own personal coverage.

The results from the saving regression show clearly that in the absence of complete insurance coverage, working-class families reduced their pre-

cautionary saving in response to increases in postaccident benefits. Using the full sample, a one-standard-deviation increase in expected benefits was associated with a reduction in saving of between $8.29 and $11.58, depending on the specification. In all cases statistical tests reject the hypothesis that a rise in expected benefits had no effect.[23] As one example of the impact of a switch from negligence liability to workers' compensation, consider a worker who moved from Virginia, where negligence liability was still in force, to the neighboring workers' compensation state of Maryland. All else equal, his expected postaccident benefits would have risen by approximately $11. Such an increase would have allowed him to reduce his precautionary saving by between $12.88 and $17.82, or between 18 to 25 percent of the mean level of savings in the sample.

To check the robustness of these estimates, we also conducted the analyses by limiting the sample to those states with workers' compensation. One potential criticism of the full-sample estimates is that states without workers' compensation in 1918 tended to be southern states, where saving might have been lower. Further, there may be questions about measurement error in the non–workers' compensation states because we could not rely on explicit laws to estimate the expected accident benefits in such states. Such concerns are unfounded, however. When we estimate the saving equation on a sample that eliminated the non–workers' compensation states, the effect of a one-standard-deviation change in expected benefits was actually larger. For more details on other tests of the robustness of the results, see appendix F.

In general, the regression results show that the higher benefits under workers' compensation were associated with some crowding-out of private insurance purchases and substantially lower saving. The reduction in saving is consistent with the view that workers faced binding constraints on the amount of workplace accident insurance that they could obtain. Therefore, the introduction of workers' compensation may have benefited workers by giving them better protection against the financial losses from an accident. This result also helps to explain why many workers favored the introduction of workers' compensation, even though they may have fully paid for the law's benefits in the form of lower real wages.

3.5 The Impact of Workers' Compensation on Accident Rates

Another metric for comparing the effectiveness of accident liability regimes is the impact on accident rates. Support for workers' compensation legislation among reformers was partially based on the expectation that the new laws would reduce workplace accidents. If employers bore a larger share of the full legal financial burden of workplace accidents, they would have an incentive to increase their accident prevention activities and, thus, lower their costs.[24] This prediction at face value seems reasonable, but it

fails to examine the impact of workers' compensation on workers' accident prevention activities. While a rise in postaccident compensation increases employers' incentives to prevent accidents, it reduces workers' incentives because they are able to relax their cautiousness with regard to accidents while keeping the same or even a higher expected income. In the economic literature on safety and insurance, this phenomenon is known as moral hazard.[25] Employers and contemporary lawmakers were well aware of the potential moral hazard problems that might have resulted from workers' compensation. In fact, employers fought vigorously to limit the level of benefits to at most two-thirds of earnings to help reduce incentives that might lead to moral hazard. Limiting benefits, however, does not completely eliminate moral hazard problems. Modern studies suggest that the problem has increased in severity over the past two decades as benefit levels have come close to replacing 100 percent of after-tax income.[26]

Since the rise in postaccident compensation changed accident prevention incentives in opposite directions for workers and employers, it is not clear, a priori, whether workers' compensation would have raised or lowered accident rates. Accident rates tend to fall in settings where employer prevention increases more than worker prevention declines, and vice versa. Empirical studies of modern data on the impact of changes in workers' compensation benefits show that the relative strength of changes in employer and worker prevention efforts vary depending on the particular context. Most studies of the modern era tend to show that increased generosity of benefits leads to increases in nonfatal injury rates.[27] On the other hand, Moore and Viscusi's (1990, 120–35) study of modern fatal accidents suggests that the presence of workers' compensation lowers fatal accidents.

The differences between nonfatal and fatal accident rates could be driven by several possibilities. First, nonfatal accidents typically are much less expensive to the employer than fatal accidents, thus employers may find it more cost effective to focus on fatal accident prevention over nonfatal accident prevention. Second, the moral hazard problem is less severe for accidents that the worker anticipates will lead to more painful disability. The moral hazard problem, therefore, is probably least severe for accidents that lead to fatalities because the worker loses his life and does not share in the postaccident income. The moral hazard problem is exacerbated in settings where the expected disability from the accident is less painful or where it is easier to feign a disability. However, it should be noted that the relationship between the severity of the disability and moral hazard depends on workers' knowledge of the type of disability an accident will cause. In settings where the same type of morally hazardous behavior might lead to outcomes ranging from an ankle sprain to death, we are likely to see death rates and nonfatal accident statistics follow simi-

lar patterns. Third, some of the rise in modern nonfatal accident rates might be a result of increased reporting of accidents rather than a rise in the underlying accident rate. As noted in appendix A, the introduction of workers' compensation led to a huge increase in the reporting of nonfatal accidents and much smaller increases in fatal accident reports. All of the modern studies have tried to carefully control for a possible rise in reporting, but all agree that they cannot be certain that the reporting problem is completely eliminated.

Studies of the impact of the introduction of workers' compensation have focused on fatal accident risk. The studies by Chelius (1976), Fishback (1987, 1992), and Buffum (1992) suggest that the introduction of workers' compensation had substantially different effects on fatal accident rates in different industries.

Chelius (1976) examined the impact of workers' compensation laws on deaths using information from the mortality statistics collected by the U.S. Bureau of the Census for twenty-six states during the years 1900 to 1940. The data were collected from a variety of states using standardized death certificates and uniform definitions of causes of death. From these statistics Chelius focused on deaths caused by non-motor-vehicle machinery accidents, which he found to be the only consistent series of data reflecting industrial accident risks. Eighty-seven percent of the deaths in this category occurred in workplaces, while non-motor-vehicle machinery accidents accounted for about 16 percent of deaths. He then created a death rate by dividing the number of fatal accidents by the labor force in each of the states.[28] While controlling for the presence of safety regulations in each state, Chelius found that both employers' liability laws and workers' compensation laws led to reductions in the non-motor-vehicle machinery accident death rate.[29]

Buffum (1992, 102–9, 149–55) reanalyzed the same set of data with more control variables.[30] He reported that when using Chelius's specifications with his control variables he found the same reduction in the death rate that Chelius found. However, using alternative specifications, he found a negative effect of workers' compensation, but the effects are smaller and he could not reject the hypothesis that workers' compensation had no effect on fatal accident rates.[31] Buffum (1992, 101, 143–48) also studied the impact on railroad accidents of the Federal Employers' Liability Act of 1906, which limited the fellow servant and contributory negligence defenses in the interstate railroad industry. Similar to the results reported by Chelius, Buffum found that the federal law reduced accident rates in railroading.

In contrast, the coal industry experienced an increase in accident risk with the introduction of workers' compensation. Fishback (1987; 1992, 116–26) examined the impact of workers' compensation and employers' liability laws on fatal accident rates using a panel data set with information

on death rates in coal mining from the twenty-three leading coal states for the years 1903 to 1930.[32] The analysis also controlled for a wide range of state regulations of coal mining, the price of coal, the use of coal cutting machines, the number of days the mines were open, and strike activity. Both employers' liability laws and workers' compensation laws were associated with relatively higher accident rates. The presence of an employers' liability law was associated with a 20 percent increase in the coal death rate, while the presence of a workers' compensation law was associated with a 28 percent increase in fatal accident rates. A 20 percent increase in accident rates meant that an additional man died for every 965 men working an average work year in the mines.[33] Buffum (1992, 86, 140–42) found similar results with a slightly different sample he constructed independently. In his analysis he found that the adoption of workers' compensation increased fatalities by 19 percent and the passage of employers' liability laws increased fatalities by 25 percent.

The rise in accident rates in coal mining is in some ways a perplexing phenomenon. We cannot completely dismiss the possibility that the rise in fatal accident rates reflects better reporting of fatal accidents, but there may have been other forces at work to cause this rise. Coal employers certainly had incentives to enhance safety because the payments they made to injured miners rose with workers' compensation. Furthermore, both state compensation funds and private insurance companies either inspected the mines or reviewed their accident records and rewarded safer mines with lower premiums.[34] Employers responded by adopting safety measures, like first-aid teams and more safety training, that led to lower insurance premiums. This heightened emphasis on safety became more prominent in the operating reports of the Stonega Coke and Coal Company after the Virginia workers' compensation law was implemented.[35]

Yet the rise in accident rates under workers' compensation shows that the employers' increased efforts were either cosmetic or insufficient to resolve the moral hazard problems at each miner's workplace. Since coal loaders and pick miners were paid by the ton of coal they produced, these workers realized that by working a little faster and taking more risks they could earn higher incomes. All too often, a roof fall injured or sometimes killed a miner who tried to finish loading the car before he set new props for the roof. Under negligence liability, the miner had extra incentive to work more slowly and safely because if he was injured in a roof fall, he was likely to get little or no compensation because of the employer's contributory negligence defense. Under workers' compensation, however, he could take more risks to increase his earnings because he was assured injury compensation that was very likely to be higher than what he would have received under negligence liability.[36]

The resulting rise in risk-taking led to more accidents like roof falls. The problem was that roof falls in the miner's workplace, often in remote

sections of the mine, were the types of accidents that employers could not prevent at low cost. Effective prevention required constant attention to changing natural conditions; therefore the miner could prevent accidents in his room at much lower cost than the employer could. For the employer to be as effective at preventing roof falls as the miner, the employer had to hire large numbers of supervisors to check the rooms constantly. The costs of hiring supervisors to prevent the extra accidents caused by moral hazard appeared to be higher than the expected cost of paying the workers' compensation benefits to injured workers. Rather than take these costly preventive measures, employers chose instead to pay the extra damages in the form of workers' compensation claims.

The question remains why the results from the coal industry differ from those that Chelius reported for machinery accidents and Buffum found for railroads. When workers' compensation was introduced, it appears that the efforts of manufacturing employers to reduce accident rates more than offset moral hazard problems. The difference between the industries probably can be traced to the differences in employers' costs of preventing accidents. Supervisors could monitor workers' use of machinery more easily in manufacturing than in coal mining. Instead of tramping long distances through a mine to visit sixty men in a day, the manufacturing foreman could probably meet with sixty men in two hours and still had the option, unavailable in a mine, of standing on catwalks above the factory floor and observing overall activity. Further, manufacturing companies discovered that they could eliminate many machinery accidents by putting more footguards and handguards near whirring blades and gears. In general, both manufacturers and railroads were in a position to reduce accidents by improving the safety of machinery. In contrast, many of the accidents in the miner's room in a coal mine were a result of natural conditions that the employer could not fix at low cost.

In sum, the introduction of employers' liability laws and workers' compensation led employers to increase their accident prevention efforts and workers to relax theirs to some extent. The impact on accident rates varied from industry to industry. Employers' increased prevention efforts appear to have dominated in manufacturing and on the railroads, where their costs of accident prevention through changes in machinery and supervision were relatively low. In contrast, in the coal industry where workers had always played a much greater role in accident prevention deep within the mines, accident rates rose. The problems with moral hazard led to the type of accidents that were very costly for the employer to prevent. Therefore, employers chose to pay the extra damages to workers instead of incurring high monitoring costs. Were coal workers made worse off by this increase in accident rates? Certainly not. Given that coal workers were paid piece rates, they relaxed safety precautions only because they were trading safety for higher earnings. The increased benefits offered by work-

ers' compensation allowed workers to increase their current earnings by working faster, while giving them better compensation in case they were injured.

3.6 Summary

The introduction of workers' compensation led to a substantial increase in the benefits workers could expect to receive on average if they were injured at work. The increase in benefits led to a number of individual-level and market readjustments. Wages adjusted in response to employer-mandated accident benefits and workers modified their choices regarding saving and purchasing accident insurance. Further, workers' compensation changed both workers' and employers' incentives to prevent accidents.

Although reformers considered workers' compensation to be a redistribution of income from employers to workers, employers were able to pass at least some of the costs of the higher benefits back to workers in the form of wage reductions. Nonunion workers in the coal and lumber industries "bought" the higher benefits associated with workers' compensation, while unionized workers in the building trades and in the coal industry were more effective at staving off the wage offsets. If these industries are representative, then our analysis suggests that the vast majority of workers who were nonunionized paid for some portion of their increased postaccident benefits in the form of lower real wages.

Even though some workers paid for workers' compensation, they still potentially gained from the legislation because they were better insured against workplace accident risk than before. Under negligence liability workers tried to insure themselves against accident risk in a variety of ways, some through purchases of commercial insurance, others through fraternal societies, still others through employer- or union-based funds. Typically, the insurance that was available offered relatively meager disability benefits and did not completely satisfy workers' desires for income protection against accident risk. Many households therefore accumulated precautionary savings, which was a relatively expensive means of insuring against accident risk. The introduction of workers' compensation reduced the uncertainties of postaccident compensation and raised the level of postaccident benefits. As a result, many households were able to reduce their insurance purchases and were able to free that portion of their incomes targeted for precautionary saving for other purposes.

Although many reformers and even employers predicted that the introduction of workers' compensation would lead to a decline in accident rates, the new legal institution gave workers and employers conflicting incentives for accident prevention. Increased accident benefits gave employers an increased interest in preventing accidents, but some workers were

able to relax their attentiveness to accident prevention because the social insurance guaranteed their expected incomes. As a result, in settings where employers could prevent accidents at relatively low cost, accident rates fell. Where the additional accidents from the workers' relaxed prevention were costly for employers to prevent, such as in coal mining, accident rates rose.

In general, the empirical results reported in this chapter suggest that both employers and workers could have benefited from the introduction of workers' compensation. Employers in most settings were probably no worse off because they were able to pass the costs of higher accident benefits back to workers. Workers, even if they bought workers' compensation through lower wages, were better insured against accident risk, and could free income used for precautionary saving for other purposes. Even the rise in accident rates in some industries did not imply that workers were harmed by workers' compensation. In the industries where accident rates rose, workers themselves had chosen to relax prevention in order to obtain higher earnings from working faster, knowing that they were financially protected in the unlikely event an accident occurred.[37]

Notes

1. There were many exceptions to this mandate, however. Most states exempted firms with fewer than five workers. In many states, moreover, agriculture, domestic service, casual labor, and public service were excluded from the compensation laws. Sometimes, specific industries were exempted. For example, Maine excluded logging, Maryland exempted country blacksmiths, and Texas excluded cotton ginning. The laws also precluded compensation in cases where the worker was intoxicated at the time he was injured or if he had maliciously caused his own accident. For a more comprehensive summary of the exemptions across the United States, see U.S. Bureau of Labor Statistics (1918, 58).

2. The probabilities we used in the calculations are the probability of an accident over the course of a year to workers across all industries in Oregon, as reported in Oregon Industrial Accident Commission (1919). The probabilities were calculated by taking the number of compensable accidents in each accident class and dividing by the number of workers covered.

3. See appendix C for more details on the calculations for Stonega.

4. *Seattle Daily Times,* 6 January 1911. The "2 cents" to which the employer referred was a proposed employer contribution to a first aid fund.

5. We have focused the analysis on thirteen occupational classes from the forty specific occupations for which the U.S. Bureau of Labor Statistics reported wage scales by 1923. The occupations chosen reflect a wide and representative characterization of the important building trades in the early twentieth century.

6. These results are based on using real wages as the dependent variable and our calculations are based on the mean earnings in the sample. When the equations are

run in semilog form, the wage reductions in response to workers' compensation are similar: coal at 1.51 percent, lumber at 1.91 percent, and the building trades at 0.35 percent. See appendix D.

7. For our purposes here, the expected benefit index is calculated using the national average wage for each occupation in each year. We did not use the wage corresponding to each observation because the expected benefits would have been a function of the wage, thus imparting a positive bias to the estimated coefficients of the expected benefits index. Similarly, we could not use the ratio of expected benefits to wages because in some cases maximum allowable benefits became binding and the ratio of expected benefits to wages would have imparted a spurious negative bias. To eliminate these problems, we used the national average wage for each occupation in each year, which allowed the expected benefits index to rise in response to rising wages during the period as well as to reflect differences in expected benefits driven by differences in wages at each skill level. We have also experimented with using the maximum real expected benefits as allowed by law as an instrument for the expected benefits for all observations, and the results suggest a negative and statistically significant wage offset in all cases. We did not focus on these results because the wages in many occupations were not high enough to reach the legal maximums.

8. The concepts of risk-neutrality and risk-aversion are best shown by an example. Say an individual faces a choice between two options: Option A pays him ten dollars for sure, while option B offers him a 50 percent chance of receiving twenty dollars and a 50 percent chance of receiving nothing. A risk-neutral individual would be equally satisfied with either option because on average she would receive ten dollars in option B. A risk-averse person would choose option A, preferring the certain $10.

9. Experience rating forces employers to pay higher premiums if there are more accidents or more severe accidents in their workplaces than the averages on which the basic premium is based. Insurance companies used experience rating across industries and states to set the workers' compensation premiums. The National Council on Workmen's Compensation, the major interstate ratemaker at the time, typically used the national accident experience in each industry to establish a base accident rate and then adjusted the rates for each state to reflect the generosity of benefits there (Kulp 1928, 235–57). Some states were large enough that they could use their own accident evidence to experience rate, while insurance companies used national averages to determine premiums in states with smaller populations. Insurance companies and state funds also adjusted premiums for individual firms based on inspections and some experience rating, but the experience rating at this level was less accurate than the comparisons across industries (Kulp 1928, 258–96).

10. Our experiments with lagged (up to three years) expected benefit terms, however, never showed any signs that the building trades experienced a wage offset.

11. It is possible that union members' compensation packages adjusted along other margins that we cannot measure. For instance, the availability of hours, jobs, working conditions, or other fringe benefits may have responded to higher postaccident payments.

12. Numerous theoretical studies show that when faced with uncertain future income, households may develop a precautionary motive for saving. See, e.g., Leland (1968), Sandmo (1970), Cantor (1985), Skinner (1988), Kotlikoff (1989, 141–51), Zeldes (1989), Kimball (1990), Caballero (1991), Deaton (1991), Carroll (1992), and Hubbard, Skinner, and Zeldes 1994. Skinner (1988) argues that such precautionary saving may account for as much as 56 percent of total life cycle savings.

13. For analyses of the impact of social security on savings, see Feldstein (1974, 1980, 1982), Leimer and Lesnoy (1982), and Hubbard, Skinner and Zeldes (1995). In an empirical study of how increases in social insurance affect private insurance coverage, Cutler and Gruber (1996) find that the expansion of Medicaid coverage from 1987 to 1992 crowded out the purchasing of private health insurance.

14. Unfortunately, Whaples and Buffum provided no estimates of the amount of insurance coverage (even though these data were available), only probability estimates on whether the workers were insured or not.

15. See Ransom and Sutch (1989). The Kansas sample is skewed toward skilled workers and workers in cities far more than the actual distribution of Kansas workers, as reported in the census occupational statistics.

16. This estimate is based on answers to the BLS's questions about the value of insurance. We do not try to use the BLS estimates of the value of insurance further because there seems to be substantial measurement error in the data. It was not clear whether the value of the insurance meant the benefit to be paid upon death or the current cash value of the policy. Further, in the case of accident insurance, the presence of disability benefits makes the evaluation of the policy's value far more complicated. The confusion about the values of policies shows up in the large number of households that offered inconsistent answers to the different questions about insurance. Of the 6,682 households that claimed to have life insurance policies, 1,493 households reported a value of zero for their life insurance. Of the 780 households with accident insurance policies, 521 reported a zero value for their policies. We therefore focus on the question of whether people had insurance or not.

17. This statistic was derived from the U.S. Bureau of the Census, *Mortality Statistics* (1917, 444–45; 1918, 294; 1919, 320; 1920, 296; 1921, 288; 1922, 310). Because the Census did not report which deaths were caused by workplace accidents, we assumed that all accidental deaths from "absorption of deleterious gases," "traumatism by cutting or piercing instruments," "traumatism in mines and quarries," "traumatism by machines," and "railroad accidents and injuries" were work related. Moreover, because railroad deaths also included passengers, we deflated the *Mortality Statistics* figure by the percentage of passenger deaths as reported by the Interstate Commerce Commission (these data are reported in U.S. Bureau of the Census 1975, 740). Although our measure of job-related deaths is very crude, it does suggest that relatively few people died as a result of a workplace accident.

18. Payment of benefits, moreover, followed strict guidelines: benefits were paid provided that the accident did not occur while the insured unnecessarily exposed himself to "obvious danger" or while he was engaged in an occupation more hazardous than that in which he had elected to be classified and insured. If he was employed in a more hazardous occupation at the time of injury, then benefits would be paid according to the insurance his paid premium would have purchased in the more hazardous class (*Hayden's Annual Cyclopedia of Insurance* 1913, 3).

19. Faulkner (1940, 27) reports that the rate of occupational fatal accidents was 45.7 per 100,000 population in 1913 and had fallen to 20.4 by 1938. The death rate from all accidents was 72.2 per 100,000 population in 1938, but Faulkner did not report the same statistic for 1913. Thus, in estimating that 63.3 percent of all fatal accidents occurred on the job, we have assumed that the death rate from all accidents was the same in 1913 as it was in 1938. This assumption seems reasonable given that the overall accidental death rate per 100,000 was 69.6 in 1922.

20. Of the 461 establishment funds surveyed by the U.S. Commissioner of Labor (1909, 339, 538–53) in 1908, 69.2 percent received no funding at all from employ-

ers. Eight percent of the funds received more than 50 percent of their funding from employers. Employers, across the sample, contributed an average of 10.6 percent of the funds' reserves.

21. See Kotlikoff and Spivak (1981) for a theoretical discussion of the use of family members to pool the risk associated with potential income loss.

22. These factors include household earnings, income from other sources, the number of children of various ages, the age of the head of the household, his occupational skill level, the riskiness of his job, possible membership in labor organizations, differences in the cost of living across cities, and geographic characteristics.

23. We have also experimented with other specifications in the saving regression by adding an interaction term between the accident-rate measure and the expected-benefits variable. The magnitudes and *t*-tests of the expected benefits and accident risk coefficients are similar to the ones reported in appendix table F.1.

24. This statement holds even in the presence of the wage offsets described earlier (see Fishback 1992, 253–54). We can see this by examining the comparative statics of the following maximization problem for an employer. The employer chooses the amount of labor to hire (L) and accident prevention capital to purchase (A) to maximize his profits from production, where profits are

$$A(L,A) = pQ(L) - rA - w[C,d(A)]L - Cd(A).$$

The employer sells output (Q) at a price (p) in the product market. For simplicity assume that output is a function of the amount of labor hired. Costs include the rental price (r) of safety capital, the wage rage ($w[C,d(A)]$), postaccident compensation (C), and accident risk ($d(A)$). Increases in safety capital lead to reductions in the accident rate ($d_A < 0$) at a diminishing rate ($d_{AA} > 0$). Output increases with increases in labor ($Q_L > 0$) at a diminishing rate ($Q_{LL} < 0$). The theory of compensating differentials implies that wages would decrease with increases in postaccident compensation ($w_C < 0$) and would increase with increases in accident rates ($w_d > 0$). Following standard maximization techniques and deriving the comparative statics, it can be shown that the employer will increase his safety capital when postaccident compensation increases as long as wages do not rise at an increasing rate with increases in accident risk, i.e., $w_{dd} \leq 0$.

25. For discussions of this phenomenon, see Viscusi (1992, 84–93, 181–85) and Fishback (1992, 253).

26. When workers' compensation was introduced, hardly any workers paid income taxes because under the tax rate structure prior to 1940 less than 10 percent of households had to pay them. Workers' compensation benefits are exempt from income taxes. As tax rates have risen, workers' compensation benefits have replaced higher and higher percentages of after-tax income. Until the 1970s weekly maximums on benefits still strongly limited the benefits paid out to workers, but a nationwide movement to raise the weekly maximums in the 1970s led to the situation where benefit levels come close to fully replacing after-tax income (see Moore and Viscusi 1990, 54; Kniesner and Leeth 1991, 67–68).

27. See Moore and Viscusi (1990, 28–33, 121–35) for a summary.

28. Lack of accurate definitions of the cause of accidents forced Chelius to use machinery fatalities in the numerator of his accident measure, which might not be a good proxy for all types of fatal accidents. A more serious problem exists in the denominator, which is intended to normalize the number of machinery accidents by exposure to risk from such accidents. The size of the labor force is not a good proxy for hours of exposure to dangerous industrial machinery. In the early 1900s, hours and days worked varied across states and time, as did the mechanization of work. Chelius tried to control for this in the analysis by taking the ratio of the

state death rate to the national death rate, but that does not adequately eliminate the measurement error problem because the changes in hours and use of machinery in each state were not uniform across the nation. The measurement error in Chelius's accident rate may be perverse enough that it outweighs the component of his measure that truly reflects the risk of death by machine.

29. Chelius tried to control for per capita exposure to machinery, the business cycle, and technology of medical care by using the ratio of the death rate in each state to the national death rate for that year as the dependent variable. He also experimented with various controls for fixed effects.

30. His control variables included an alternative measure of resources devoted to safety inspection, employment in mining, employment in railroading, percent female, percent foreign-born, percent illiterate, percent unionized, percent of workers in large firms, and measures of relative manufacturing risk.

31. Buffum (1992, 109–11, 153–55) also examined the impact of workers' compensation using industrial fatalities reported by various states. In this analysis he found that workers' compensation led to an increase in fatalities. Buffum noted, however, that the states had a wide variety of reporting rules, which may have changed over time. These data were not collected in a consistent manner, as the mortality statistics were, therefore we believe that much of the increase found in this data set may be a result of increased reporting.

32. The data for coal mining have fewer problems with measurement error because the U.S. Bureau of Mines and U.S. Geological Survey collected statistics specifically for coal mines, thus all types of accidents in the mines were covered. Further, the measure of exposure to risk in the denominator is subject to less measurement error because the Bureau of Mines and the U.S. Geological Survey collected information on hours worked per day, days worked per year, and average number of workers.

33. In the text we focus on the results from Fishback (1992). The results in Fishback (1987) were very similar, although the control variables differed to some extent and he used a set of dummies to describe different types of workers' compensation systems. In the 1987 paper the analysis showed that employers' liability laws were associated with accident rates that were 17 percent higher. Workers' compensation laws establishing a monopoly state fund were associated with a 23 percent increase in the fatal accident rate, and laws allowing both private and state insurance were associated with 20 percent higher rates. The impact of workers' compensation laws with no state funds was smaller and not statistically significant.

34. The inspections followed schedule ratings that checked the mine against the "ideal" mine. See Graebner (1976, 149–51) and Hookstadt (1922, 53).

35. See Graebner (1976, 151–52) and Stonega Coke and Coal Company, *Operating Reports,* 1916–1925, in Hagley Museum and Library, Wilmington, Del.

36. Since dead miners received no income, there might not be a moral hazard problem for fatal accidents. However, the moral hazard problem arose because miners did not expect each accident to result in death. Roof falls, for example, led to injuries ranging from bruises to crushed limbs to deaths. Only one in fifty to one hundred accidents were fatal. Any regression analysis of fatal accidents implicitly assumes that they are a random sample of all accidents.

37. This argument does not imply that workers were anticipating full compensation for injuries. It suggests instead that workers received, on average, higher post-accident benefits under workers' compensation than under negligence liability, although still less than full compensation. Since the probability of being injured from marginally relaxing accident prevention was still relatively low, the higher earnings workers received from taking more risks would more than offset their expected additional damages from an injury.