

Research Article

Social Insurance and Truncated Benefits: Measuring the Impacts of Workers' Compensation

Samuel K. Allen

Department of Economics & Business, Virginia Military Institute, 333 Scott Shipp Hall, Lexington, VA 24450, USA

Correspondence should be addressed to Samuel K. Allen, allensk@vmi.edu

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This study addresses the indirect impacts of state-mandated workers' compensation benefits on workers' wages. The benefit structure of workers' compensation causes a fundamental estimation problem. I develop a new strategy to limit the biases inherent in earlier models. I utilize individual-level census data (between 1940 and 1990) to exploit benefit variation that occurs both across states and within the fifty states over time. The results suggest that wage offsets are not constant across time and may be larger for workers at lower-wage levels.

1. Introduction

State workers' compensation laws require nearly all employers to purchase insurance to provide benefits to workers injured on the job. This type of government mandate imposes direct costs on employers, especially in dangerous industries beset with expensive and volatile insurance premiums. In principle, rational employers will pass a portion of the extra costs on to workers indirectly in the form of lower wages. Thus, assessing the real economic impacts that such social insurance mechanisms have on workers requires an estimate of how wages respond to benefit changes. Mandated benefits, and the corresponding insurance premiums, vary from state to state, and therefore one can exploit the variation in benefits to infer their role in determining equilibrium wages. Economic theory suggests that states guaranteeing higher benefits to injured workers will exhibit lower wages, *ceteris paribus*.

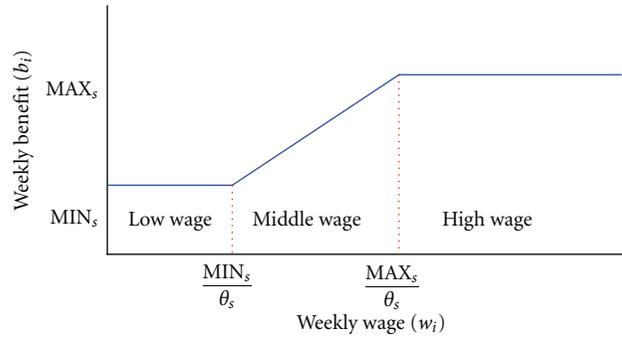
Several studies explore this idea in order to draw conclusions about how mandated workers' compensation insurance is valued in the market¹. Despite the straightforwardness of the underlying economic theory, empirical studies find quite dissimilar results. One could argue, as Moore and Viscusi [1] do, that contradictory or insignificant estimates arise from problems of data quality or improper measurement of the true conditions faced by workers. More likely, however, these disparities arise from the fact that workers' compensation

benefits are determined by a nonlinear function of the workers' own wage.

This paper adds to the understanding of workers' compensation and compensating differentials in several ways. First, it explicitly describes the fundamental estimation problem that has resulted in a disconcertingly broad range of estimates. Second, it provides comparisons from the existing estimation procedures using data from several different decades for 10 dangerous occupations in narrowly defined industry groups in order to more accurately control for accident risk. Third, it offers a novel estimation approach that mitigates the biases induced by previous estimators. Fourth, estimation is also conducted using a measure of benefits that is considerably more comprehensive than measures used in similar studies with modern data. Finally, the results show that we do not yet have a fully robust way of measuring the impact of workers' compensation benefits on wage rates. This is a disappointing result and suggests that the profession needs to reconsider the issue more closely and find new alternatives for dealing with the issue.

2. Workers' Compensation Benefits

2.1. Benefit Determination. In all states, workers' compensation insurance programs provide benefits to workers injured "out of and in the course of employment." Depending on the severity and duration of the injury, workers may be eligible

FIGURE 1: Wage-benefit relationship in State S .

for cash benefits to replace lost wages. Thus, economic theory suggests that employers may indirectly pass the burden of insurance premiums on workers through lower wages. Following this logic, one might reasonably expect that, all else equal, employers in a state with higher benefit payments to injured workers would tend to pay lower wages to workers in risky occupations².

However, testing the hypothesis that increased benefits yield lower wages poses some significant empirical problems. First, in nearly all states the benefits are calculated as a function of the particular worker's previous wages. Therefore, the benefits that a specific worker may expect to receive will necessarily be directly related to the worker's preinjury wages³. As a result, any empirical analyses using individual-level data must address this issue when selecting the proper variable(s) to represent expected benefits. The remainder of the paper focuses on the powerful biases that may be imparted by different measures of benefits. It is critical to note that the statutory mechanism that determines the amount of benefits for injured workers can significantly alter the final conclusions drawn about wage offsets.

2.2. Truncated Benefits. Benefits to injured workers are calculated using functions of workers' wages; however, these functions exhibit important nonlinearities. Benefits are generally determined as a percentage of preinjury wages, yet if workers' wages are in certain (prespecified) dollar ranges then the corresponding benefit amounts will be restricted to state-specified minimum or maximum amounts.

In particular, the exact correspondence between wages and benefits imposes a specific structure on the benefits a worker will receive. This benefit formula forces a positive, mechanical correlation between wages and benefits. Thus, empirical studies expecting to uncover the theoretically predicted negative relationship between wages and benefits in the labor market may arrive at false conclusions. The benefits mechanism could blur the overall picture and could suggest that market forces are causing a spurious positive relationship.

The amount of monetary compensation that injured workers receive directly depends on their previous wage and their state of employment. Injured workers are compensated for lost wages; however, they do not typically receive full replacement of their preinjury wages. Instead, workers are

TABLE 1: (a) Proportion of workers at the binding temporary maximum weekly benefit. (b) Proportion of workers at the binding temporary minimum weekly benefit.

(a)		
Year	Proportion in "high wage"	Average maximum benefit*
1940	0.38	\$19.91 (3.06)
1950	0.88	\$28.96 (6.50)
1960	0.76	\$47.46 (13.72)
1970	0.80	\$69.50 (17.75)
1980	0.57	\$201.15 (65.66)
1990	0.37	\$364.48 (108.17)
(b)		
Year	Proportion in "low wage"	Average minimum benefit
1940	0.024	\$7.92 (2.39)
1950	0.040	\$11.54 (3.11)
1960	0.120	\$15.68 (6.22)
1970	0.127	\$22.12 (9.31)
1980	0.012	\$55.71 (36.66)
1990	0.023	\$78.17 (54.95)

These estimates are based on the IPUMS samples drawn for this study. The interpretations are as follows. First, among observed individual wages, in 1940, 38 percent of the sampled workers would "expect" to receive the state-mandated maximum weekly benefit if injured. Second, in 1980, the average maximum weekly payment across all states was \$201.15.

*Standard deviations are in parentheses.

generally entitled to a smaller proportion, denoted by θ , of their average weekly wage; payments of 66.67% of the weekly wage are the most prevalent in the United States today⁴. Within states, all covered workers fall into one of three categories: low-wage, middle wage, or high-wage. Consider Figure 1.

Workers with particularly low average wages will receive the state minimum benefit⁵ should they incur an injury in the course of work. Workers earning moderate incomes, those in the "middle-wage" category in Figure 1, simply collect the specified proportion of their wage. This means that an additional dollar of income will yield θ additional dollars of benefits following a temporary total injury. Finally, for "high-wage" workers, an additional dollar of income will have no impact on their postinjury benefits. Thus, the benefits of high-wage workers are "truncated" at the state maximum. Table 1 presents estimates of the relative

proportions of workers that fall into the three different wage categories for the various years.

Notice that the positive spurious correlation occurs within the “middle-wage” section of the labor force. In contrast, the “low-wage” and “high-wage” groups do not seem to impose any complications.

3. Modeling Wages and Benefits

3.1. The Basic Wage-Benefit Model. The econometric complications introduced above have been acknowledged by previous studies in the literature (see [1, 2, 4–7]). Economists have adopted different approaches in order to avoid erroneous conclusions. I focus on analyses conducted at the individual level because these allow the econometrician to control for other important human capital characteristics influential in determining wages. Wages are determined by some function of both the workers’ individual characteristics and the state-mandated benefits. Equation (1) depicts a simplified wage model for a worker in a specific, risky occupation in state s . The benefit amount, b_i , is determined in most states through a function described by $f_s(\cdot)$:

$$\begin{aligned} w_i &= \alpha_0 + X_i\beta + \gamma b_i + \varepsilon_i \\ &= \alpha_0 + X_i\beta + \gamma f_s(w_i, Z_i) + \varepsilon_i, \end{aligned} \quad (1)$$

where i refers to the individual and s refers to the individual’s state of residence. $w_i \equiv$ worker i ’s actual wage (or its natural logarithm), $X_i \equiv$ a vector of worker i ’s observable characteristics that influence the wage, $Z_i \equiv$ a vector describing worker i ’s marital status and number of dependents, which affect workers’ compensation benefits, $b_i \equiv$ worker i ’s potential workers’ compensation benefit [$b_i = f_s(\cdot)$], $f_s(\cdot) \equiv$ a function for the potential benefits worker i would receive in state s , $\varepsilon_i \equiv$ worker i ’s unobserved human capital traits and idiosyncratic error shock, and $\delta_s[\cdot] \equiv$ a state-specific function that determines additional benefits for injured workers with dependents⁶:

$$f_s(w_i, Z_i) = \left\{ \begin{array}{l} \text{MIN}_s + \delta_s^{\text{min}}[Z_i], \\ \quad \text{if } w_i < \frac{\text{MIN}_s + \delta_s^{\text{min}}[Z_i]}{\theta_s} \\ \theta_s \cdot w_i + \delta_s^{\text{mid}}[Z_i], \\ \quad \text{if } \frac{\text{MIN}_s + \delta_s^{\text{mid}}[Z_i]}{\theta_s} < w_i < \frac{\text{MAX}_s + \delta_s^{\text{mid}}[Z_i]}{\theta_s} \\ \text{MAX}_s + \delta_s^{\text{max}}[Z_i], \\ \quad \text{if } w_i > \frac{\text{MAX}_s + \delta_s^{\text{max}}[Z_i]}{\theta_s} \end{array} \right\}. \quad (2)$$

Intuitively, each worker maximizes his expected utility by selecting the optimal combination of wages, expected benefits, and probability of injury. After conditioning on a given level of risk (by comparing identical job titles within the same industry), then rational workers will select their preferred job based on their preferences for wages and

benefits. In equilibrium, one ought to expect that states with lower benefits will tend to have higher average wages in order to compensate workers for the possibility of receiving less in the event of a work-related injury. However, within each state, benefits may be better understood by focusing on two critical parameters—the replacement proportion, θ_s , and the maximum possible weekly benefit, MAX_s . For workers in the “middle-” wage regime, the MAX_s is relatively unimportant because it will not be binding in the event of an injury. Instead, “middle-” wage workers will focus on the tradeoff between wages and the replacement ratio. In contrast, the state-mandated replacement proportion, θ_s , will be practically irrelevant to the workers in the “high-” wage regime since a lower MAX_s will lead directly to a lower effective replacement ratio. In other words, the statutory replacement ratio and benefit maximums matter to workers; yet for a given worker, he or she ought to be concerned with only one of the two⁷.

4. Estimation Techniques

Since benefits are determined as a function of the wage, the econometrician must adopt appropriate techniques to avoid drawing misleading inferences. In the next section, I briefly describe the intuition and evaluate the implications of different model specifications. These specifications vary based both on their estimation procedure and their choice of the appropriate variable to measure worker’s compensation benefits.

4.1. Two-Stage Least-Squares. Viscusi and Moore [7] and Kaestner and Carroll [6] claim that the replacement ratio is the most appropriate benefit measure⁸. They argue that the proportion of earnings that are replaced by workers’ compensation for injured workers reflects what workers are most concerned with⁹. The individual-specific replacement ratio, denoted R_i , is the weekly workers’ compensation benefit divided by the individual’s preinjury weekly wage:

$$w_i = \alpha_0 + X_i\beta + \gamma R_i + \varepsilon_i. \quad (3)$$

Their approaches estimate (3) and implement it through a two-stage least-squares (2SLS) procedure. The replacement ratio, R_i , is a function of the wage and is therefore endogenous. By dividing by the individual’s actual wage, the regressor benefit variable is transformed in an important manner. Let’s consider the relationship between the actual wage and the replacement ratio adopted by Viscusi and Moore [7] and Kaestner and Carroll [6]. As illustrated in Figure 2 below, the mechanical relationship between wages and the benefit variable has changed significantly. Now, it is the “low-wage” and “high-wage” regions which may be suspected of mechanically causing a strong negative relationship.

Here the model induces no positive correlation on the “middle-wage” group. However, this comes at a cost. Notice the potential *negative* spurious correlation between wages and benefits resulting from the structure of the replacement

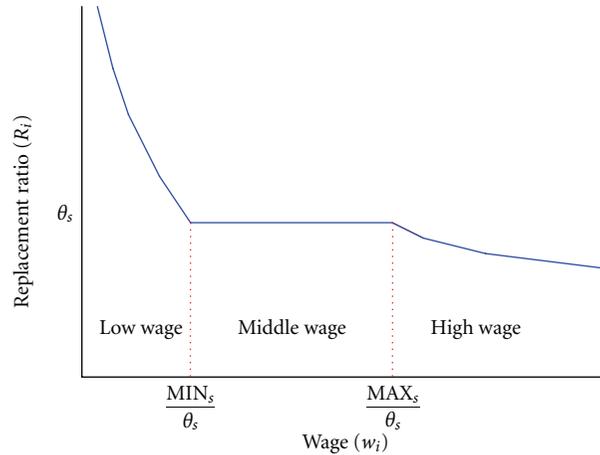


FIGURE 2: Replacement ratio-wage Relationship in State S.

ratio variable, R_i , in the “low-wage” and “high-wage” groups¹⁰. This feature is critically important because a huge fraction of workers in dangerous occupations fall into the “high-wage” classification. For example, in 1970, approximately 80 percent of sampled workers were “high-wage” workers. This large proportion of the sample likely plays a significant role in determining the estimates in the following modeling framework.

The basic structure of the Viscusi and Moore [7] and Kaestner and Carroll [6] model is presented below:

$$w_i = \alpha_0 + X_i\beta + \gamma\hat{R}_i + \varepsilon_i, \quad (4)$$

where $R_i \equiv$ Replacement ratio

$$R_i = \left(\frac{b_i}{w_i} \right) \quad \text{or} \quad \left(\frac{b_i}{w_i(1-t_i)} \right), \quad (5)$$

$t_i \equiv$ worker i 's marginal income tax rate¹¹.

The specification of (4) makes the selection of instruments particularly important since the regressor, R_i , is a function of the dependent variable. Their instrumental variables approach is designed to purge the endogeneity present in the individual-specific replacement ratio. In the first stage, Viscusi and Moore [7] regress R_i on state dummy variables, the number of dependents, a dummy for marital status, and all exogenous variables in the wage equation¹². Then, the second stage is a wage regression that uses the predicted values of the replacement rate from the first stage. The authors further note that it is the differences across state average benefits that provide most of the variation. However, one could reasonably argue that their individual-specific instruments, marital status and the number of dependents (Z_i), and the state dummy variables also belong in the wage equation.

4.2. Ordinary Least Squares (with a Benefit Index). The next approach taken in the literature uses a proxy variable to avoid the direct function of the workers' wages on the right-hand

side of the regression equation. Specifically, the wage-benefit relationship is estimated using the following equation:

$$w_i = \alpha_0 + X_i\beta + \gamma b_s(\bar{w}) + \varepsilon_i, \quad (6)$$

where $b_s(\bar{w}) \equiv$ the benefit in state s , for a married worker with two children earning the national average manufacturing wage¹³, \bar{w} .

Here the national average wage, \bar{w} , is used as a proxy for each worker's actual wage. The benefit measure, $b_s(\bar{w})$, is an index that does not vary within states for a given year. This is effective at representing the variation in the generosity of benefits across states but does not reflect the exact situation for specific workers. Fishback and Kantor [4] avoid using the wage corresponding to each individual (in their benefit calculation) to prevent spurious, biased coefficient estimates that would result from having a function of the dependent variable as a regressor, and therefore this method avoids the mechanical relationship between actual wages and the benefit variable that plague the two previous versions of the wage equation model¹⁴.

Additionally, I also estimate the model using a more comprehensive index to better reflect the overall costs associated with paying workers' compensation benefits. In this case, I approximate the full present value of the future stream of benefits a worker could expect to receive if injured in each state for each census year.

However, as Fishback and Kantor [5] note, using the individual-specific wages here will necessarily induce spurious estimates. Therefore, I compute the benefit that a worker would expect to receive if he earned the national average wage in the manufacturing industry. This present value is based on the temporary total, permanent partial, and fatality benefits that are associated with each state's workers' compensation statutes. The corresponding probabilities for each injury category are based on national averages reported by the National Safety Council. This measure more fully reflects differences (across states) in the time limits for receipt of benefits which is especially important for fatality benefits. Additional details regarding this procedure are included in Appendix C.

While the methods described above are creative, each exhibits some undesirable qualities. First, the benefit index approach does not incorporate individual differences in wages, and therefore it may potentially introduce bias via correlation between the regressors and the error term¹⁵.

Second, the specification adopted by Viscusi and Moore and Kaestner and Carroll that utilizes the proportional replacement measure of benefits possesses two important shortcomings. While it reduces the potential for bias for workers in the “middle-wage” regime, it may induce a spurious negative bias for workers in the “high-wage” regime. In addition, the benefit variable, R_i , is a non-linear function of an endogenous variable. Kelejian [8] show that two-stage least squares in this context yields inconsistent estimates. For consistency, the set of instruments must also include power functions of the exogenous variables. However, this problem is not easily corrected, as the majority of the exogenous variables in the model are zero-one indicator variables. Thus, both major approaches carry significant risk of false inferences and biased coefficients, so it is not apparent which method should be selected.

In addition, practical concerns regarding the model specification and the different wage “regimes” persist. An important consideration is that the replacement ratio model (4) differs from the benefit-level model (1) only in that the benefit variable, b_i , is divided by the individual’s actual wage. This transformation makes these competing models that cannot both be properly specified. Nonetheless, if the two-stage least-squares procedure successfully purges all the endogeneity from R_i in the estimation of (3), then surely it ought to be similarly capable of removing the endogenous bias from (1). Therefore, one might expect the inferences derived from the two specifications to lead to approximately equivalent conclusions. If this is not the case, then this could suggest that some endogeneity remains and the presence of the individual’s wage on the right-hand side continues to influence the coefficient estimates. This concern will be addressed by estimating both the benefit level (1) and the replacement ratio (3) using two-stage least squares and comparing the results.

Lastly our attention is drawn to the restrictions placed on benefits for workers with incomes in certain ranges. For “high-wage” workers in a given state, the estimated benefits will be equal to a constant. Thus, for the replacement ratio model (4) this will result in a constant divided by the dependent variable as a regressor. For individual observations in the “middle-wage” category, the replacement ratio method reduces to using state-specific proportional replacement parameter, θ_s , as the benefit regressor. The replacement rate exhibits very little variation, especially since the late 1970s when nearly all states mandated two-thirds replacement¹⁶. Therefore, it is plausible that the “high-wage” group is influencing much of the observed result.

In 1980, roughly 57 percent of workers would have had their benefits truncated at the maximum allowed in their state, and only about 1 percent of individual workers have wages low enough to receive the state-mandated minimum benefit in the event of an injury¹⁷. For additional detail of the regime breakdowns over time, see Appendix B.

4.3. Two-Stage Regime-Sensitive Approach. To address the numerous concerns described above, I implement an alternative two-stage approach that addresses both the potential biases caused by the different measures of benefits and takes the wage regimes into account.

A modification of Heckman’s [9] two-step procedure is used. I first estimate the probability of being in the high-wage or low-wage regime¹⁸. Then, conditional on being in a given regime, I estimate a wage equation for those individuals with the workers’ compensation benefit measure least likely to cause bias for that regime. In addition, state-specific characteristics are used in lieu of state dummy variables in the first stage; these are denoted by K_s in the following equations¹⁹. These include the percentage of unionized labor in nonagricultural employment, percentage of mining employment in nonagricultural employment, the state’s average earnings, and the accidental death rate²⁰. These variables describe conditions within states and are exogenous for each individual worker. They are likely correlated with the states’ maximum benefit levels and at the same time are not impacted by the wages of an individual worker²¹. This modeling technique is depicted through the following equations²².

$$\text{Let } V_i = [X_i \ Z_i \ K_s]$$

$$\text{REGIME}_i = \begin{cases} 1, & \text{if “high” wage} \\ 0, & \text{if “middle” wage} \end{cases} \quad (7)$$

$$\text{prob}(\text{REGIME}_i = 1 \mid V_i) = \text{prob}(V_i' \psi + v_i > 0).$$

Equation (7), the selection equation, determines if worker i is in the “high-” or “middle-” wage regime. This is a function of individual traits influencing wages, X_i , family characteristics, Z_i , and state-specific qualities, K_s . I assume that v_i and ε_i are joint normally distributed with zero mean, constant variance, and correlation $\rho \neq 0$.

If the worker is in the “high-” wage regime, then I use the real dollar value as the benefit measure:

$$w_i = \alpha_0^{\text{HIGH}} + X_i \beta^{\text{HIGH}} + \gamma_1 \text{MAX}_S + \gamma_2 \lambda_i^{\text{HIGH}} + \varepsilon_i^{\text{HIGH}}, \quad (8)$$

where $\lambda_i^{\text{HIGH}} \equiv$ inverse of Mill’s ratio derived from the selection equation, $\lambda_i^{\text{HIGH}} = \phi(V_i' \psi) / \Phi(V_i' \psi)$, where $\phi(\cdot)$ and $\Phi(\cdot)$ denote the standard normal density and distribution functions, respectively. If the worker is in the “middle-” wage regime, then the replacement ratio is used as the benefit measure:

$$w_i = \alpha_0^{\text{MIDDLE}} + X_i \beta^{\text{MIDDLE}} + \gamma_3 \theta_s - \gamma_4 \lambda_i^{\text{MIDDLE}} + \varepsilon_i^{\text{MIDDLE}}, \quad (9)$$

where $\lambda_i^{\text{MIDDLE}} = \phi(V_i' \psi) / (1 - \Phi(V_i' \psi))$.

This approach eliminates both the negative and positive spurious biases that are imposed by the actual calculation of workers’ compensation benefits since the high-wage regime utilizes a dollar value and the middle-wage regime uses the proportion of replaced wages. This technique differs from Heckman’s original because no natural censoring of the observable data underlies this approach; however, it is in the same spirit because of the fundamental truncation of benefits described earlier.

I will be primarily concerned with the γ_1 and γ_3 in the above equations. These coefficients both reflect the change in wages related to differences in workers' compensation benefits; yet they are not directly comparable. The benefit measure in (8), MAX_S , is a dollar value, so γ_1 describes how wages change when the state's maximum benefit is increased by an additional dollar. In contrast, θ_S represents the percentage of a worker's wage that is returned as monetary compensation in the event of an injury. Therefore, γ_3 reveals how wages change in response to a one-unit change in the percentage of wages being replaced.

The differences in these measures are addressed in the following way. I utilize the estimated coefficients to calculate estimated benefit-wage elasticities and provide examples of how additional benefit dollars will impact wages for each specification.

5. Data

The data come from the United States Censuses taken in the middle and late twentieth century. Information on individuals has been extracted from random samples provided by the *IPUMS* (Integrated Public Use Microdata Series) database maintained by the University of Minnesota. Utilizing these specific microlevel data allows for more detailed investigation of the socioeconomic characteristics of individual workers within the given industries. The data were randomly extracted from all available data recorded during the census in the spring of 1940, 1950, 1960, 1970, 1980, and 1990. The benefits are matched to individuals in statutory information by state²³.

These data have been selected for several important reasons. Information is provided for numerous individual workers, and occupational and industrial categories are consistently defined across states and over time. Previous studies required indicator variables to distinguish between different jobs and various risk levels and industries. This issue can be completely avoided by restricting estimation to workers within the same high-risk occupation and the same industry²⁴. In addition, past studies included measures of risk (usually by including the number of lost workday cases within that industry), but since each separate sample comes from the same specific job, there will be substantially less variation in risk. Because other studies typically include risk measures given at the industry level, a jobs' riskiness will likely be confounded with other industry-specific effects.

Unfortunately, the union status of individual workers is unavailable. Moreover, the Bureau of Labor Statistics provides estimates of union membership only for broad occupational categories. Unionization may have an important impact on the wage offsets for the occupations being analyzed here. Previous studies have found that offsets for union workers were lower or nonexistent. Membership information reported by the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) suggests that membership remained quite steady between 1955 and 1989. Thus, as a percentage of the workforce, membership has declined²⁵.

Our concerns about the potential impacts of unionization induced us to consider pooling observations across

occupations and account for any important differences in job traits through occupation dummy variables. However, *F*-tests suggest that in most cases the coefficient estimates are sufficiently different to warrant separate estimations for each occupation²⁶.

6. Results and Implications of Model Specification

To represent each of the various modeling approaches, specific comparisons are provided for *machinists* in 1990. The results for machinists are used because there are a significant number of observations in all years. This section will focus specifically on the benefit coefficients estimates from each specification that are reported in Table 2; however, the full set of regression coefficients for machinists is listed in Appendix D. The usual wage-equation regressors exhibit expected signs²⁷. In addition, all elasticities are reported for each year and specification by occupation in Table 3. In most cases, the results for machinists are qualitatively similar to those of the remaining nine occupations.

As I have already established, the OLS estimates of (1) and (3) likely contain mechanical bias. I anticipate a negative mechanical bias in the OLS estimate of (3) because a large portion of the sample is composed of workers who receive the maximum workers' compensation benefit. Thus, OLS coefficients are estimated using the individual-specific benefit replacement ratios. The estimates for machinists in 1990, given in Table 2, are certainly consistent with this view. The coefficient is strongly negative and statistically significant.

With this specification, the elasticity (between wages and the benefit ratio) corresponding to machinists in 1990 is -0.84 . This implies, for instance, for an average machinist, an additional dollar of weekly benefits corresponds to roughly a 3 cent decrease in real hourly wages²⁸. This estimate is exceptionally large since the benefit is only received if an injury occurs. Based on the average weekly hours, this suggests machinists' real weekly wages would fall by approximately \$1.25.

The 2SLS approaches, used by Viscusi and Moore [7] and Kaestner and Carroll [6], are designed to eliminate this bias. In fact, when (4) is estimated using their 2SLS approach, the magnitude of the negative effect is reduced.

The third row of Table 2 corresponds to two-stage least-squares (2SLS) model that uses the temporary benefit ratio. This produces an elasticity of -0.25 , so the implied impact on wages is significantly lower than that when OLS is used. Therefore, if the weekly benefit is increased by \$1, then the weekly wage falls by \$0.45. This is smaller in magnitude, yet still remains very large given the probability of a temporary injury. Moreover, the question remains whether or not this method fully purges the negative mechanical bias.

One way to examine the extent to which the previous studies succeeded in eliminating the bias is to compare the OLS and 2SLS estimates of (1). In (1), where the wage is a function of the level of benefits, I anticipate a positive mechanical bias in the coefficient. A large portion of the workers in the sample do not earn enough to hit the weekly maximum workers' compensation benefit. For those

TABLE 2: Estimates for machinists in 1990*.

Model specification	Dependent variable is natural logarithm of real hourly wage		
	Benefit coefficients	\$1 in benefit ^o	Elasticity
OLS with individual-specific temporary weekly benefit level	$B_i = 0.0037502$ (38.25)	+\$1.53	0.87*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	$R_i = -1.972772$ (-31.82)	-\$1.25	-0.84*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	$R_i = -0.4543988$ (-3.34)	-\$0.45	-0.25*
2SLS with individual-specific temporary weekly benefit level	$B_i = 0.0014911$ (7.05)	+\$0.56	0.30*
Modified Heckman for “-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	$R_i = -1.204623$ (-4.05)	-\$1.16	-0.81*
Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit level	$B_i = 0.0017827$ (10.26)	+\$0.90	0.52*
OLS with state-specific temporary weekly benefit index	$B_i = -0.0000485$ (-0.09)	-\$0.07	-0.04
OLS with state-specific comprehensive annualized (expected) benefit index ⁺	$B_i = 1.748117$ (1.99)	+\$1.75	0.06*

*All benefits are given in real US dollars, (*t*-statistics are in parentheses). Each coefficient comes from a separate regression that includes education, experience, regional and demographic variables. These full regression estimates are shown in Appendix D. Higher levels of education tend to correspond to higher wages; experience raises wages but at a decreasing rate. Greater overtime hours depress hourly wages, and race and residential/geographic location also impact wages. ^oThese are calculated by increasing the average weekly benefit by \$1. The value of the “benefit” is then recalculated, and this new value is multiplied by the estimated elasticity (located in Table 3) to obtain the change in the real hourly wage. To find the change in the weekly wage, the change in the real hourly wage is multiplied by the average weekly hours. For the final OLS model (state-specific comprehensive annualized expected benefit index), the extra benefit is the actual regression coefficient, so no manipulations are required. Moreover, the index includes the probability of injury and is therefore not directly comparable to the other estimates.

⁺This model uses the real annual wage as the dependent variable, and the benefit is an “expected” benefit.

workers, the wage and the workers’ compensation benefit would be strongly positively correlated.

Thus, I estimate the basic model in semilog form with the real US dollar benefit level as the workers’ compensation measure using OLS (1). This individual-specific, endogenous benefit variable produces a positive, statistically significant coefficient. The elasticity associated with machinists in 1990 is +0.87, suggesting that a one percent increase in the benefit level will correspond to a 0.87 percent *increase* in the average machinist’s real hourly wage. To get a sense of the magnitudes, consider the following example. If the average weekly benefit increased from \$244 per week to \$245, then this model suggests that real wage will rise 3.4 cents from \$9.51 to \$9.54 per hour. This means the real weekly wage increases by \$1.53, and since the probability of a temporary total occurring is not incorporated, this suggests these estimates are very unreasonable.

If the 2SLS technique used by Viscusi and Moore [7] and Kaestner and Carroll [6] effectively purges this bias and higher workers’ compensation benefits contribute to lower wages, then the 2SLS coefficient will be negative, while the OLS coefficient is positive. The OLS coefficient for machinists in 1990 in Table 2 is strongly positive and statistically significant. However, when the 2SLS approach is adopted, the coefficient remains positive and statistically significant.

The benefit level 2SLS model yields a positive elasticity of +0.30. Thus, raising weekly benefits by a dollar tends to *increase* the real weekly wage by \$0.56, on average. Relative to the benefit-level OLS model, the magnitude is about 60 percent smaller, but the direction of the impact is the opposite of the other 2SLS specification. These contrasting 2SLS results are disconcerting. Each model attempts to eliminate

the nonlinearity inherent in the benefits mechanism. The only difference between these two models is the manner in which benefits are measured. Economic theory provides no guidance regarding the proper specification. Moreover, it is unclear whether the difference in outcomes is due to the inability of the instruments to eliminate the bias, or if the result is driven by the specification.

These observed outcomes could occur under either of two scenarios. One, increases in workers’ compensation benefits do not lead to reductions in workers’ wages, or two, the 2SLS method does not eliminate the positive bias. To further examine the wage-benefit relationship, the OLS models are estimated using benefit indices. Benefits are calculated at the state level using the national average wage, so that benefits will generally be exogenous for individual workers. This benefit index is computed both using the temporary weekly benefits and, in a comprehensive fashion that incorporates the probability of different injury types (including permanent partial and fatal injuries), the duration of payments and discounts the stream of future payments to obtain an expected benefit.

The comprehensive benefits index method used by Fishback and Kantor [5] for eliminating the mechanical bias involves using the same wage to estimate workers’ compensation benefits for all workers in the sample. An advantage of this method is that the benefit measure changes only due to differences in policies across states. It does have the disadvantage that the index of benefits is different from the actual level of benefits that individual workers would receive. This OLS comprehensive *expected* benefit index model tends to result in positive coefficient estimates estimated using the comprehensive *expected* benefit index where the impact

TABLE 3: Elasticity estimates by occupation and year for each specification[♦].

	1940	1950	1960	1970	1980	1990
Cranemen						
OLS with individual-specific temporary weekly benefit level	1.09*	0.29	-0.24*	0.10	0.27*	0.62*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.98*	-0.71*	-0.46*	-0.37*	-0.74*	-0.66*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.78*	-0.33*	-0.32*	-0.12	-0.27*	-0.57*
2SLS with individual-specific temporary weekly benefit level	0.63*	0.26	-0.26*	0.00	-0.05	0.26
Modified Heckman for “middle-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	0.18	—	—	—	-4.54*	1.49
Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit level	0.77	—	0.13	0.11	0.14	0.11
OLS with state-specific temporary weekly benefit index	0.23	0.23	0.19	-0.14	-0.15	-0.12
Deliverymen						
OLS with individual-specific temporary weekly benefit level	—	0.41	0.11	0.23*	0.68*	0.69*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	—	-0.81*	-0.58*	-0.64*	-0.97*	-1.00*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	—	-0.46*	-0.44*	-0.17*	-0.29*	-0.42*
2SLS with individual-specific temporary weekly benefit level	—	0.37	0.04	0.13*	0.19*	0.38*
Modified Heckman for “middle-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	—	—	—	1.20*	-1.25*	-1.59
Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit level	—	0.07	0.53*	0.51*	0.49*	0.42*
OLS with state-specific temporary weekly benefit index	—	0.25	0.28	0.41*	0.02	0.33
Machinists						
OLS with individual-specific temporary weekly benefit level	1.00*	0.52*	0.11*	0.01	0.66*	0.87*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.13*	-0.64*	-0.44*	-0.54*	-1.09*	-0.84*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	0.07	-0.31*	-0.08*	-0.13*	-0.07	-0.25*
2SLS with individual-specific temporary weekly benefit level	0.42*	0.23	0.05	-0.05	0.17*	0.30*
OLS with state-specific temporary weekly benefit index	0.24	0.06	0.24*	0.18*	0.05	-0.04
Modified Heckman for “middle-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	0.17	-0.53	-0.77*	4.78*	-0.53	-0.81*
Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit level	0.58	0.14	0.28*	0.18*	0.44*	0.52*
OLS with state-specific temporary weekly benefit index	0.24	0.06	0.24*	0.18*	0.05	-0.04
Meat cutters						
OLS with individual-specific temporary weekly benefit level	0.81*	0.23	0.04	0.06	0.64*	0.93*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.16*	-0.68*	-0.55*	-0.60*	-1.10*	-0.96*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.02	-0.44*	-0.19*	-0.15*	-0.11	-0.25*
2SLS with individual-specific temporary weekly benefit level	0.25*	-0.02	-0.06	-0.06	0.13*	0.38*
Modified Heckman for “middle-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.03	-0.15	0.68	1.20*	-1.00*	-0.10
Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit level	0.47*	0.32	0.29*	0.31*	0.42*	0.50*
OLS with state-specific temporary weekly benefit index	0.13	0.24	0.08	0.21*	0.00	0.01

TABLE 3: Continued.

	1940	1950	1960	1970	1980	1990
Millwrights						
OLS with individual-specific temporary weekly benefit level	1.08*	-0.25	-0.02	0.21	0.14	-0.12
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.04*	-0.66*	-0.49*	-0.28*	-0.49*	-0.87*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.64*	-0.35	-0.23	0.03	-0.09	-0.26*
2SLS with individual-specific temporary weekly benefit level	0.96*	-0.25	-0.02	0.14	-0.03	-0.22
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	2.88	—	—	—	-6.36*	—
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	0.22	—	—	0.18	0.16*	-0.10
OLS with state-specific temporary weekly benefit index	1.09	-0.24	-0.20	0.14	-0.04	-0.46
Painters						
OLS with individual-specific temporary weekly benefit level	0.97*	0.39*	0.25*	0.28*	0.79*	1.06*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.20*	-0.85*	-0.65*	-0.82*	-1.53*	-1.71*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.47*	-0.30*	-0.25*	-0.14*	-0.38*	-0.38*
2SLS with individual-specific temporary weekly benefit level	0.28*	0.13	0.00	0.08	0.25*	0.36*
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.53*	-0.98*	1.47*	-0.19	-0.41	-0.97*
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	0.61*	0.25	0.25*	0.49*	0.51*	0.72*
OLS with state-specific temporary weekly benefit index	-0.32*	0.23	0.06	0.16	-0.24*	0.02
Rollers (metal workers)						
OLS with individual-specific temporary weekly benefit level	1.55*	-0.33	0.32	0.04	0.33*	0.31
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.18*	-0.87*	-0.52*	-0.36*	-0.56*	-1.39*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.14*	-0.82*	-0.32*	-0.26*	-0.32*	-0.23
2SLS with individual-specific temporary weekly benefit level	0.99*	-0.81	0.25	-0.03	0.11	0.14
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	—	—	—	—	—	—
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	0.72	-0.35	0.48	0.29	0.12	0.24
OLS with state-specific temporary weekly benefit index	0.24	-1.00	0.11	-0.20	-0.14	0.35
Roofers						
OLS with individual-specific temporary weekly benefit level	1.25*	0.61	0.19	0.21*	0.95*	1.08*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.42*	-0.85*	-0.73*	-0.97*	-1.47*	-0.55*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.37*	-0.82*	-0.59*	-0.40*	-0.84*	-0.79*
2SLS with individual-specific temporary weekly benefit level	1.13*	0.44	0.06	0.06	0.52*	0.68*
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.87	—	0.20	0.43	0.16	-0.39
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	0.67	1.39	0.08	0.24	0.66*	0.93*
OLS with state-specific temporary weekly benefit index	0.05	0.30	-0.08	0.05	-0.05	0.00

TABLE 3: Continued.

	1940	1950	1960	1970	1980	1990
Sawyers						
OLS with individual-specific temporary weekly benefit level	0.78*	0.34	0.25*	0.13	0.89*	1.11*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-1.34*	-0.63*	-0.77*	-0.84*	-1.14*	-1.37*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	0.06	-0.80*	-0.29*	-0.53*	-0.46*	-0.68*
2SLS with individual-specific temporary weekly benefit level	0.57*	0.18	0.09	0.03	0.56*	0.84*
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.06	-0.31	0.09	-0.01	0.44	0.23
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	1.47*	1.21	0.44	0.09	0.58*	1.11*
OLS with state-specific temporary weekly benefit index	0.19	-0.20	0.06	-0.47	0.15	-0.05
Welders						
OLS with individual-specific temporary weekly benefit level	1.18*	0.03	0.06	0.03	0.67*	0.86*
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.86*	-0.59*	-0.49*	-0.54*	-1.00*	-1.33*
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	-0.72*	-0.53*	-0.17*	-0.18*	-0.05	-0.32*
2SLS with individual-specific temporary weekly benefit level	0.70*	0.03	0.02	-0.06	0.35*	0.43*
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	0.27	—	—	5.49*	-0.07	-0.73*
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit level	0.71*	0.23	0.35*	0.34*	0.52*	0.58*
OLS with state-specific temporary weekly benefit index	0.15	0.07	0.33*	0.28*	0.21	0.09

♦ Missing estimates indicate too few observations to estimate with reasonable precision. * denotes that the elasticity is derived from a coefficient that is statistically different from zero at the 10 percent level.

TABLE 4: Regression estimates by occupation for the comprehensive benefit index model. Model: OLS with state-specific comprehensive annualized benefit index[†].

Occupation	Estimated impact of \$1 change in present value of expected benefits			
	Coefficient	<i>t</i> -statistic	<i>N</i>	<i>R</i> ²
Cranemen	-\$1.00	(-0.44)	878	0.56
Deliverymen	\$3.15	(1.34)	1406	0.16
Machinists	\$1.75**	(1.99)	5570	0.38
Meat cutters	\$0.20	(0.19)	4618	0.35
Millwrights	-\$2.66	(-0.76)	407	0.63
Painters	\$1.02	(0.98)	3991	0.19
Rollers	-\$1.66	(-0.36)	361	0.58
Roofers	\$5.13**	(2.22)	1089	0.20
Sawyers	\$4.34**	(1.97)	878	0.32
Welders	\$2.07	(1.62)	1940	0.26

[†] This model uses the real annual wage as the dependent variable. Each coefficient comes from a separate regression that pools all years for each occupation to form a pseudopanel. The model is estimated in levels (i.e., the dependent variable and the benefit regressor are both in real US dollars), so coefficients can be interpreted as the change in real annual wages due to a one dollar increase in the real net present value of annual *expected* benefit. Each regression includes control variables for education, experience, race, and demographics as well as year dummy variables and state-fixed effects. (*t*-statistics are in parentheses.)

is positive²⁹. As the real net present value of benefits increases by one dollar, it corresponds to a \$1.75 increase in real annual wages. The sign of this result is not expected; yet the magnitude suggests a fairly mild impact of benefits. This version of the model is estimated using pseudopanel design

where the observations are pooled and state-fixed effects are included. Table 4 compares the estimates of this specification for each of the ten hazardous occupations studied.

Next, there is the Modified Heckman approach. The goal here is to split the sample into distinct pieces. First, consider

TABLE 5: Replacement ratios*.

State	1940	1950	1960	1970	1980	1990
Temporary total disability replacement ratios: θ_s						
Alabama	0.55	0.65	0.65	0.65	0.67	0.67
Alaska	—	—	0.65	0.65	0.67	0.80
Arizona	0.65	0.65	0.65	0.65	0.67	0.67
Arkansas	—	0.65	0.65	0.65	0.67	0.67
California	0.65	0.65	0.6175	0.6175	0.67	0.67
Colorado	0.50	0.50	0.67	0.67	0.67	0.67
Connecticut	0.50	0.50	0.60	0.67	0.67	0.67
Delaware	0.50	0.60	0.67	0.67	0.67	0.67
District of Columbia	—	0.67	0.67	0.67	0.67	0.67
Florida	0.60	0.60	0.60	0.60	0.67	0.67
Georgia	0.50	0.50	0.60	0.60	0.67	0.67
Hawaii	—	—	0.67	0.67	0.67	0.67
Idaho	0.70	0.60	0.60	0.60	0.60	0.60
Illinois	0.60	0.65	—	—	0.67	0.67
Indiana	0.55	0.55	0.60	0.60	0.67	0.67
Iowa	0.60	0.60	0.67	0.67	0.80	0.80
Kansas	0.60	0.60	0.60	0.60	0.67	0.67
Kentucky	0.65	0.65	0.65	0.67	0.67	0.67
Louisiana	0.65	0.65	0.65	0.65	0.67	0.67
Maine	0.67	0.67	0.67	0.67	0.67	0.67
Maryland	0.67	0.67	0.67	0.67	0.67	0.67
Massachusetts	0.67	0.67	0.67	0.67	0.67	0.67
Michigan	0.67	0.67	0.67	0.67	0.67	0.80
Minnesota	0.67	0.67	0.67	0.67	0.67	0.67
Mississippi	—	0.67	0.67	0.67	0.67	0.67
Missouri	0.67	0.67	0.67	0.67	0.67	0.67
Montana	0.60	0.67	0.67	0.67	0.67	0.67
Value of θ_s for each year						
Nebraska	0.67	0.67	0.67	0.67	0.67	0.67
Nevada	0.60	0.70	0.90	0.90	0.67	0.67
New Hampshire	0.50	0.67	0.67	0.67	0.67	0.67
New Jersey	0.67	0.67	0.67	—	0.70	0.70
New Mexico	0.50	0.60	0.60	0.60	0.67	0.72
New York	0.67	0.67	0.67	0.67	0.67	0.67
North Carolina	0.60	0.60	0.60	0.60	0.67	0.67
North Dakota	0.67	0.67	0.80	0.80	0.67	0.67
Ohio	0.67	0.67	0.67	0.67	0.72	0.67
Oklahoma	0.67	0.67	0.67	0.67	0.67	0.67
Oregon	0.58	—	—	0.90	0.67	0.67
Pennsylvania	0.67	0.67	0.67	0.67	0.67	0.67
Rhode Island	0.50	0.60	0.60	0.60	0.67	0.67
South Carolina	0.60	0.60	0.60	0.60	0.67	0.67
South Dakota	0.55	0.55	0.55	0.55	0.67	0.67
Tennessee	0.50	0.60	0.65	0.65	0.67	0.67
Texas	0.60	0.60	0.60	0.60	0.67	0.67
Utah	0.60	0.60	0.60	0.60	0.67	0.67
Vermont	0.50	0.50	0.67	0.67	0.67	0.67
Virginia	0.55	0.55	0.60	0.60	0.67	0.67
Washington	0.60	—	—	—	0.60	0.60
West Virginia	0.67	0.67	0.67	0.67	0.70	0.70
Wisconsin	0.65	0.70	0.70	0.70	0.67	0.67
Wyoming	1.00	—	—	0.67	0.67	0.67

*— denote either state does not have workers' compensation benefits in that year or the replacement ratio is not made explicit within the law.

Proportions are the maximum allowed by state law for workers with dependents. In some cases workers will receive benefits based on a lower percentage if they are unmarried or have no dependent children.

TABLE 6: Number of workers sampled by year and percentage in each wage regime.

	Low wage	Middle wage	High wage	Total
1940				
Cranemen	0.9%	48.2%	50.9%	110
Deliverymen				0
Machinists	2.6%	55.7%	41.7%	736
Meat cutters	2.3%	62.6%	35.2%	657
Millwrights	0.0%	33.3%	66.7%	36
Painters	2.8%	60.5%	36.8%	468
Rollers	3.1%	20.0%	76.9%	65
Roofers	0.0%	67.8%	32.2%	59
Sawyers	0.0%	68.0%	32.0%	97
Welders	0.0%	52.7%	47.3%	74
1950				
Cranemen	0.0%	1.6%	98.4%	63
Deliverymen	6.9%	6.9%	86.2%	29
Machinists	1.4%	8.0%	90.6%	288
Meat cutters	3.0%	13.3%	83.7%	270
Millwrights	0.0%	0.0%	100.0%	30
Painters	3.1%	8.5%	88.5%	260
Rollers	0.0%	4.1%	95.9%	49
Roofers	5.9%	13.7%	80.4%	51
Sawyers	37.3%	31.4%	31.4%	51
Welders	3.6%	1.8%	94.5%	55
1960				
Cranemen	15.7%	0.7%	83.6%	134
Deliverymen	10.3%	7.6%	82.1%	145
Machinists	13.1%	3.6%	83.3%	1146
Meat cutters	10.5%	6.8%	82.7%	936
Millwrights	10.0%	0.0%	90.0%	40
Painters	8.6%	13.3%	78.1%	850
Rollers	15.3%	4.2%	80.6%	72
Roofers	7.4%	20.8%	71.8%	149
Sawyers	23.7%	25.8%	50.5%	194
Welders	15.4%	2.8%	81.8%	363
1970				
Cranemen	11.0%	3.8%	85.2%	210
Deliverymen	8.5%	8.8%	82.7%	457
Machinists	15.1%	5.9%	79.0%	680
Meat cutters	13.3%	9.8%	76.9%	987
Millwrights	11.2%	1.1%	87.6%	89
Painters	10.0%	12.8%	77.3%	642
Rollers	19.4%	4.5%	76.1%	67
Roofers	8.9%	11.7%	79.4%	180
Sawyers	14.5%	26.5%	59.0%	117
Welders	17.8%	7.5%	74.7%	387
1980				
Cranemen	0.0%	21.5%	78.5%	251
Deliverymen	1.3%	40.0%	58.7%	637
Machinists	1.4%	43.7%	54.9%	1238
Meat cutters	1.3%	38.7%	60.0%	1025
Millwrights	0.0%	11.9%	88.1%	151
Painters	1.0%	49.5%	49.5%	802

TABLE 6: Continued.

	Low wage	Middle wage	High wage	Total
Rollers	0.0%	11.3%	88.7%	71
Roofers	1.7%	50.4%	47.9%	234
Sawyers	1.7%	59.3%	39.0%	177
Welders	1.5%	49.6%	48.9%	587
1990				
Cranemen	0.9%	35.1%	64.0%	114
Deliverymen	1.1%	43.5%	55.4%	186
Machinists	1.5%	51.8%	46.7%	1616
Meat cutters	1.7%	56.2%	42.2%	908
Millwrights	0.0%	9.5%	90.5%	63
Painters	2.3%	60.3%	37.4%	1176
Rollers	0.0%	21.6%	78.4%	37
Roofers	3.8%	65.9%	30.3%	505
Sawyers	8.2%	70.3%	21.5%	279
Welders	2.1%	64.3%	33.7%	526

TABLE 7

Cranemen ^a	Cranemen, derrickmen, and hoistmen
Deliverymen ^b	Deliverymen
Machinists ^c	Machinists
Meat cutters ^d	Meat cutters, and meat packers
Millwrights ^a	Millwrights
Painters ^e	Painters-construction and maintenance
Rollers ^a	Rollers
Roofers ^e	Roofers-metal
Sawyers ^f	Sawyers
Welders ^c	Welders

^aManufacturing blast furnaces, steel workers, and rolling mills.

^bWholesale trade food and related products.

^cMiscellaneous machinery.

^dRetail trade food stores, except dairy.

^eConstruction.

^fManufacturing sawmills, planing mills, and mill work.

high-wage workers for whom the weekly maximums are binding. For these workers, the appropriate measure of their benefits is the weekly maximum in the state. This measure eliminates the mechanical negative bias of using the replacement ratio because the benefit is no longer divided by the wage. Recall that since the maximum is predetermined by the state it should be exogenous for individual wage earners. However, there remains the possibility of selection bias in the sample. Thus, this model is estimated with OLS and also with a Heckman selection correction.

The model for “high-” wage workers produces a statistically significant elasticity of +0.52. As the average weekly benefit rises by one dollar, the corresponding wage rises by roughly \$0.90. Thus, the regime-sensitive estimates exhibit more extreme magnitudes than those of the 2SLS, and less extreme than the biased (individual-specific) OLS models. This new approach yields remarkably high estimates despite the efforts taken to avoid the mechanical bias.

Finally, the sample of middle-wage workers is considered. These are workers for whom the weekly maximums are not binding. Now, to avoid the positive mechanical bias, the appropriate measure is the replacement ratio. Again the selection of the sample into the “middle-” group is a concern. Therefore, this model is also estimated with OLS and with a Heckman selection correction for selection bias. For workers in the “middle-” wage regime, estimated elasticity for middle-wage workers is -0.81 . This large negative effect implies that weekly wages fall by more than a dollar when the benefit increases by one dollar (due to an increase in the replacement ratio). This effect is more extreme than the corresponding 2SLS model.

7. Discussion and Conclusions

I have examined several different modeling approaches used to understand the impacts of workers' compensation benefits on the wages of workers in risky occupations. The actual mechanical procedure used to compute workers' compensation benefits causes complications for estimation. I highlight the circumstances in which the direct functional relationship between wages and postinjury benefits may lead to spurious conclusions.

Individual-specific census data spanning six decades are utilized to compare the influence of workers' compensation benefits for risky workers as inferred from various modeling strategies. I begin with a naïve OLS technique, followed by the two-stage least squares methods, and more complicated OLS models adopted by the existing literature, and I finally develop a novel strategy that acts to mitigate the mechanically induced biases inherent in the manner that benefits are determined.

The evidence suggests some important implications for modeling social insurance's impact on the wages of individuals. First, the variables used to measure benefits have a significant influence on the overall findings. This is especially relevant when economic theory does not dictate an

TABLE 8

(a) Regression estimates for machinists in 1990[♦]

Model	(1)	(2)	(3)	(4)
WC benefit				
OLS with individual-specific temporary weekly benefit	0.0038*** (38.25)			
OLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)		-1.9728*** (-31.82)		
2SLS with individual-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)			-0.4544*** (-3.34)	
2SLS with individual-specific temporary weekly benefit				0.0015*** (7.05)
NO HS	-0.0244 (-1.25)	-0.0623*** (-2.95)	-0.0760*** (-3.07)	-0.0580*** (-2.56)
Some college	0.0505*** (3.47)	0.0718*** (4.57)	0.1004*** (5.41)	0.0857*** (5.03)
College	-0.0488 (-1.16)	-0.0324 (-0.71)	-0.0486 (-0.91)	-0.0517 (-1.06)
Overtime	-0.1620*** (-13.03)	-0.1531*** (-11.37)	-0.1019*** (-6.27)	-0.1166*** (-7.88)
Experience	0.0123*** (6.01)	0.0220*** (10.12)	0.0298*** (11.41)	0.0242*** (9.53)
Experience ²	-0.0002*** (-3.89)	-0.0003*** (-6.90)	-0.0004*** (-7.81)	-0.0003*** (-6.65)
Farm	0.0111 (0.23)	0.0085 (0.16)	0.0337 (0.54)	0.0293 (0.52)
City	0.0298** (2.14)	0.0694*** (4.64)	0.0953*** (5.40)	0.0739*** (4.50)
Black	0.0279 (0.83)	-0.0917*** (-2.54)	-0.0696 (-1.64)	-0.0268 (-0.69)
Indian	-0.0048 (-0.06)	0.0002 (0.00)	-0.0150 (-0.14)	-0.0137 (-0.14)
North east	-0.1841*** (-8.84)	0.1744*** (7.64)	0.0287 (0.99)	-0.0822*** (-3.24)
North central	-0.2242*** (-11.11)	0.2226*** (10.11)	0.0525* (1.82)	-0.0882*** (-3.44)
South	-0.1223*** (-5.90)	-0.0501** (-2.21)	-0.1211*** (-4.48)	-0.1344*** (-5.62)
Constant	1.3132*** (41.74)	3.0077*** (60.29)	2.0595*** (22.26)	1.5918*** (37.48)
Adjusted-R ²	0.59	0.51	0.33	0.45

[♦] Dependent variable is natural logarithm of real hourly wage. Omitted dummy variables include WEST and HS.

(b) Regression estimates for machinists in 1990[♦]

Model	(5)	(6)	(7)	(8)
WC benefit				
OLS with state-specific temporary weekly benefit index	0.0000 (-0.09)			
Modified Heckman for "middle-" wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)		-0.8508** (-2.14)		
Modified Heckman for "high-" wage workers based upon state-specific temporary weekly benefit			0.0018*** (10.55)	
OLS with state-specific comprehensive annualized benefit index [°]				1.7481** (1.99)
NO HS	-0.0803*** (-3.00)	-0.0727** (-2.28)	-0.0027 (-0.09)	-1502.7170*** (-6.65)
Some college	0.1089*** (5.44)	0.0970*** (4.17)	0.0812*** (3.63)	1475.9650*** (5.23)
College	-0.0535 (-0.69)	-0.1805*** (-2.51)	-0.0181 (-0.30)	192.7681 (0.26)
Overtime	-0.0866*** (-5.08)	-0.1535*** (-6.74)	-0.1564*** (-7.03)	2794.0870*** (15.56)

(b) Continued.

Model	(5)	(6)	(7)	(8)
Experience	0.0321*** (12.25)	0.0194*** (5.48)	0.0161*** (3.77)	580.9895*** (21.57)
Experience ²	-0.0005*** (-8.38)	-0.0002*** (-3.41)	-0.0003*** (-3.45)	-9.0561*** (-16.92)
Farm	0.0413 (0.57)	0.0436 (0.62)	0.0826 (0.93)	94.8393 (0.16)
City	0.1031*** (5.35)	0.0864*** (3.97)	0.0129 (0.54)	1736.6110*** (7.39)
Black	-0.0632 (-1.39)	-0.1220** (-2.23)	0.0404 (0.83)	-2245.9350*** (-3.84)
Indian	-0.0199 (-0.25)	0.0205 (0.17)	-0.0038 (-0.03)	-598.5831 (-0.46)
North east	-0.0140 (-0.45)	0.2409*** (5.09)	-0.0408 (-1.07)	—
North central	0.0026 (0.08)	0.2518*** (5.58)	-0.0590 (-1.49)	—
South	-0.1428*** (-4.70)	0.0246 (0.60)	-0.1489*** (-5.28)	—
Constant	1.7864*** (14.70)	2.1251*** (7.94)	1.9162*** (21.26)	9197.6540*** (18.37)
Lambda		0.077 (1.18)	-0.057 (-1.04)	

♦ Dependent variable is natural logarithm of real hourly wage, except for (8) where the dependent variable is real annual wage. Omitted dummy variables include *WEST* and *HS*.

° Annualized comprehensive index model (8) includes state-fixed effects in lieu of all regional dummies and year dummies, and thus the coefficients are not directly comparable.

(c) First-stage probit estimates from modified Heckman for machinists in 1990♦

Model	(6)	(7)
	Modified Heckman for “middle-” wage workers based upon state-specific temporary weekly benefit ratio (i.e., benefit/weekly wage)	Modified Heckman for “high-” wage workers based upon state-specific temporary weekly benefit
Single	0.348*** (3.85)	-0.359*** (-3.95)
Family size	-0.037 (-1.15)	0.037 (1.15)
% union	-0.007* (-1.89)	0.187*** (4.89)
% mining	-0.188*** (-4.92)	0.008** (2.23)
Earnings	-5.860E - 05*** (-2.60)	5.760E - 05*** (2.55)
Accidents	-0.007 (-0.69)	0.007 (0.62)
No HS	0.242** (2.27)	-0.247** (-2.31)
Some college	-0.066 (-0.84)	0.079 (0.99)
College	-0.069 (-0.31)	0.077 (0.34)
Overtime	-0.326*** (-4.88)	0.323*** (4.80)
Experience	-0.046*** (-3.88)	0.049*** (4.03)
Experience ²	0.001** (2.19)	-0.001** (-2.27)
Farm	0.197 (0.71)	-0.172 (-0.62)
City	-0.178** (-2.32)	0.197*** (2.55)
Black	0.026 (0.15)	-0.026 (-0.15)
Indian	0.523 (1.10)	-0.516 (-1.09)
North east	0.897*** (6.83)	-0.920*** (-6.98)
North central	0.743*** (5.87)	-0.772*** (-6.05)
South	0.345*** (2.59)	-0.321*** (-2.40)
Constant	2.431*** (2.96)	-2.465*** (-2.99)

♦ Dependent variable is REGIME, the zero-one indicator that equals one if worker is “high-” wage and zero otherwise. Omitted dummy variables include *WEST* and *HS*.

appropriate specification. Using the wage replacement ratio instead of the actual dollar benefits may lead to substantially different conclusions. In the case of workers’ compensation, using the replacement ratio exclusively appears to overstate (both the magnitude and the significance of) the negative relationship between wages and mandated benefit levels.

This may indicate that the 2SLS procedures do not sufficiently purge the automatic negative correlation created by the division of the weekly maximums by larger and larger wages for workers beyond the state maximum. Second, when benefit mechanisms involve fixed maximums, the appropriate measure of benefits may vary. Since workers

TABLE 9: Membership in selected unions.

Organization	Thousands of members					
	1955	1965	1975	1979	1981	1989
Industrial Workers of America (International Union of)		71	93	92	78	60
Machinists and Aerospace Workers (International Association of)	627	663	780	664	680	517
Painters and Allied Trades (International Brotherhood of)	182	160	160	160	160	128
Sheet Metal Workers International (Association)	50	100	120	120	120	108
Roofers, Waterproofers and Allied Workers (United Union of)				28	31	23
United Steelworkers of America	980	876	1,062	964	913	481
AFL-CIO (overall)	12,622	12,919	14,070	13,621	13,602	13,556

will not really be concerned with both the state-determined replacement ratio and the benefit maximum, separating the sample enables estimation that avoids some biases specific to one group or “regime” of workers.

I began with the task of understanding how state-mandated benefits indirectly impact workers’ wages. The empirical investigation does not yield a simple answer. Instead the results suggest that “high-” wage earners do not receive lower wages as a result of higher levels of guaranteed benefits within their state. Moreover, there is conflicting evidence regarding the effects for “middle-” or moderate-wage earners. Estimates based upon the more comprehensive expected benefit index show considerably different wage-benefit relationships across occupations. The occurrence of positive coefficients which suggest a positive relationship between wages and workers’ compensation benefits is especially surprising. Such, nonintuitive results could suggest that labor markets are not operating efficiently, or certain critical factors are not being properly controlled for in the analysis. For instance, given the available data, the lobbying ability of unions cannot be taken into account. These ambiguous findings warrant additional work to understand more fully the dynamics of the benefits-wage relationship.

Appendices

A. State Replacement Ratios

For more details See Table 5.

B. Distribution of Workers by Wage Regime

For more details See Table 6.

C. Variable Definitions and Dataset Construction

C.1. Variable Definitions

Experience: Equals the individual’s age minus his highest-grade level attained minus 6.

AGE: Individual’s age in years.

NO HS: Equals one if the individual did not complete high school; zero otherwise.

HS: Equals one if the individual finished high school; zero otherwise.

Some College: Equals one if the individual had some college education; zero otherwise.

College: Equals one if the individual has a college degree; zero otherwise.

Family Size: Equals the number of family members (including the individual) in the household.

Children: Equals the number of children in the individual’s household.

Overtime: Equals one if the individual works more than 40 per week; zero otherwise.

Single: Equals one if the individual is single; zero otherwise.

Farm (Resident): Equals one if the individual resides on a farm; zero otherwise.

City: Equals one if the individual resides on a in a metropolitan area; zero otherwise.

Black: Equals one if the individual was black; zero otherwise.

Indian: Equals one if the individual was Native American; zero otherwise.

%Union: Percentage of union workers in non-agricultural employment in state S. (Except for 1990, where percentage is based on manufacturing employment.)

%Mining: Percentage of mine workers in non-agricultural employment in state S.

Earnings: Average weekly earnings in state S. (Except for 1940 and 1990, where earnings are annual averages.)

Accidents: Accidental death rate in state S.

Weekly Wage: This is the real weekly wage. It equals real annual total pretax salary and wage income in 1982–1984 US dollars divided by the reported number of weeks worked for the previous year. However, in 1960 and 1970 the reported number of weeks worked are only given in intervals, so the median value is used in the computation³⁰ (i.e., if reported weeks worked is 50–52, then 51 is used to calculate weekly wage).

TABLE 10

(a) State weekly WC benefit maximums for temporary total injuries*

State	1930	1940	1950	1960	1970	1980	1990
Alabama	\$12	\$18	\$21	\$31	\$47	\$136	\$344
Alaska	—	—	—	\$100	\$113	\$650	\$700
Arizona	—	—	\$150	\$150	\$150	\$192	\$253
Arkansas	—	\$20	\$25	\$35	\$49	\$88	\$209
California	\$25	\$25	\$30	\$65	\$88	\$154	\$224
Colorado	\$14	\$14	\$23	\$40	\$60	\$223	\$355
Connecticut	\$21	\$25	\$32	\$50	\$80	\$261	\$671
Delaware	\$15	\$15	\$25	\$50	\$50	\$165	\$265
District of Columbia	—	\$25	\$35	\$54	\$70	\$426	\$513
Florida	—	\$18	\$22	\$42	\$49	\$211	\$362
Georgia	\$15	\$20	\$24	\$30	\$50	\$110	\$175
Hawaii	—	—	—	\$75	\$113	\$215	\$358
Idaho	\$16	\$16	\$16	\$28	\$43	\$182	\$404
Illinois	\$18	\$20	\$30	\$51	\$91	\$353	\$581
Indiana	\$17	\$17	\$24	\$39	\$57	\$130	\$256
Iowa	\$15	\$15	\$24	\$44	\$56	\$352	\$660
Kansas	\$18	\$18	\$20	\$38	\$49	\$148	\$263
Kentucky	\$15	\$15	\$21	\$32	\$52	\$131	\$345
Louisiana	\$20	\$20	\$30	\$35	\$49	\$149	\$267
Maine	\$18	\$18	\$24	\$39	\$69	\$306	\$448
Maryland	\$18	\$20	\$28	\$40	\$76	\$241	\$407
Massachusetts	\$18	\$18	\$30	\$45	\$70	\$227	\$444
Michigan	\$18	\$18	\$34	\$57	\$69	\$200	\$409
Minnesota	\$20	\$20	\$30	\$45	\$70	\$226	\$391
Mississippi	—	—	\$25	\$35	\$40	\$98	\$198
Missouri	\$20	\$20	\$25	\$45	\$64	\$125	\$280
Montana	\$18	\$21	\$26	\$43	\$65	\$198	\$299
Nebraska	\$15	\$15	\$22	\$37	\$55	\$180	\$245
Nevada	\$17	\$17	\$32	\$57	\$80	\$229	\$369
New Hampshire	\$15	\$18	\$30	\$40	\$67	\$195	\$560
New Jersey	\$20	\$20	\$25	\$40	\$91	\$185	\$342
New Mexico	\$15	\$18	\$25	\$38	\$48	\$201	\$284
New York	\$25	\$25	\$32	\$45	\$85	\$215	\$300
North Carolina	\$18	\$18	\$24	\$35	\$50	\$194	\$376
North Dakota	\$20	\$20	\$20	\$53	\$88	\$196	\$326
Ohio	\$19	\$19	\$30	\$49	\$56	\$258	\$400
Oklahoma	\$18	\$18	\$25	\$35	\$45	\$141	\$231
Oregon	\$19	\$22	\$37	\$67	\$80	\$242	\$371
Pennsylvania	\$15	\$18	\$25	\$43	\$60	\$242	\$399
Rhode Island	\$16	\$20	\$28	\$32	\$70	\$199	\$378
South Carolina	—	\$25	\$25	\$35	\$50	\$197	\$335
South Dakota	\$15	\$15	\$20	\$35	\$44	\$175	\$281
Tennessee	\$16	\$16	\$25	\$34	\$47	\$107	\$231
Texas	\$20	\$20	\$25	\$35	\$49	\$119	\$238
Utah	\$16	\$16	\$25	\$37	\$47	\$210	\$344
Vermont	\$15	\$15	\$25	\$36	\$56	\$192	\$534
Virginia	\$14	\$16	\$20	\$33	\$51	\$199	\$362
Washington	\$14	\$14	\$38	\$57	\$81	\$187	\$384
West Virginia	\$16	\$16	\$25	\$35	\$54	\$237	\$359
Wisconsin	\$20	\$21	\$33	\$54	\$73	\$218	\$363
Wyoming	\$17	\$21	\$36	\$53	\$63	\$251	\$406

* In current US dollars. Dashed lines denote the lack of explicitly stated benefits in that year.

(b) State weekly WC benefit maximums for temporary total injuries[†]

State	1930	1940	1950	1960	1970	1980	1990
Alabama	\$24	\$43	\$29	\$35	\$40	\$55	\$88
Alaska	—	—	—	\$113	\$97	\$263	\$179
Arizona	—	—	\$208	\$169	\$129	\$78	\$65
Arkansas	—	\$48	\$35	\$39	\$42	\$35	\$53

(b) Continued.

State	1930	1940	1950	1960	1970	1980	1990
California	\$50	\$60	\$42	\$73	\$75	\$62	\$57
Colorado	\$28	\$33	\$32	\$45	\$51	\$90	\$91
Connecticut	\$42	\$60	\$44	\$56	\$69	\$106	\$171
Delaware	\$30	\$36	\$35	\$56	\$43	\$67	\$68
District of Columbia	—	\$60	\$49	\$61	\$60	\$173	\$131
Florida	—	\$43	\$30	\$47	\$42	\$86	\$93
Georgia	\$30	\$48	\$33	\$34	\$43	\$45	\$45
Hawaii	—	—	—	\$85	\$97	\$87	\$91
Idaho	\$32	\$38	\$22	\$32	\$37	\$74	\$103
Illinois	\$36	\$48	\$42	\$58	\$78	\$143	\$148
Indiana	\$33	\$39	\$33	\$44	\$49	\$53	\$65
Iowa	\$30	\$36	\$33	\$50	\$48	\$143	\$169
Kansas	\$36	\$43	\$28	\$43	\$42	\$60	\$67
Kentucky	\$30	\$36	\$29	\$36	\$45	\$53	\$88
Louisiana	\$40	\$48	\$42	\$39	\$42	\$60	\$68
Maine	\$36	\$43	\$33	\$44	\$59	\$124	\$114
Maryland	\$36	\$48	\$39	\$45	\$65	\$98	\$104
Massachusetts	\$36	\$43	\$42	\$51	\$60	\$92	\$114
Michigan	\$36	\$43	\$47	\$64	\$59	\$81	\$105
Minnesota	\$40	\$48	\$42	\$51	\$60	\$92	\$100
Mississippi	—	—	\$35	\$39	\$34	\$40	\$51
Missouri	\$40	\$48	\$35	\$51	\$55	\$51	\$71
Montana	\$36	\$50	\$36	\$48	\$56	\$80	\$76
Nebraska	\$30	\$36	\$30	\$42	\$47	\$73	\$63
Nevada	\$33	\$40	\$45	\$64	\$69	\$93	\$94
New Hampshire	\$30	\$43	\$42	\$45	\$58	\$79	\$143
New Jersey	\$40	\$48	\$35	\$45	\$78	\$75	\$87
New Mexico	\$30	\$43	\$35	\$43	\$41	\$81	\$72
New York	\$50	\$60	\$44	\$51	\$73	\$87	\$77
North Carolina	\$36	\$43	\$33	\$39	\$43	\$79	\$96
North Dakota	\$40	\$48	\$28	\$60	\$76	\$79	\$83
Ohio	\$38	\$45	\$42	\$55	\$48	\$105	\$102
Oklahoma	\$36	\$43	\$35	\$39	\$39	\$57	\$59
Oregon	\$37	\$53	\$51	\$76	\$69	\$98	\$95
Pennsylvania	\$30	\$43	\$35	\$48	\$52	\$98	\$102
Rhode Island	\$32	\$48	\$39	\$36	\$60	\$81	\$97
South Carolina	—	\$60	\$35	\$39	\$43	\$80	\$86
South Dakota	\$30	\$36	\$28	\$39	\$38	\$71	\$72
Tennessee	\$32	\$38	\$35	\$38	\$40	\$43	\$59
Texas	\$40	\$48	\$35	\$39	\$42	\$48	\$61
Utah	\$32	\$38	\$35	\$42	\$40	\$85	\$88
Vermont	\$30	\$36	\$35	\$41	\$48	\$78	\$136
Virginia	\$28	\$38	\$28	\$37	\$44	\$81	\$93
Washington	\$28	\$33	\$53	\$64	\$70	\$76	\$98
West Virginia	\$32	\$38	\$35	\$39	\$46	\$96	\$92
Wisconsin	\$39	\$50	\$45	\$61	\$63	\$88	\$93
Wyoming	\$35	\$50	\$49	\$60	\$55	\$102	\$104

* In real US dollars (1967 = 100). Dashed lines denote the lack of explicitly stated benefits in that year.

Wage: This is the real hourly wage. It is calculated by dividing the real weekly wage by the reported number of hours worked for the week³¹.

C.2. Income Replacement Ratio

This ratio is defined as in Kaestner and Carroll [6]. Essentially, it is the weekly benefit for temporary total disability for individual i divided by the average weekly wage of individual i .

For example, if an individual's weekly wage is \$400.00 and his state's temporary benefit payment is 60% of his average weekly wage (with a weekly maximum of \$425), then his replacement is $((0.60 \times 400)/400) = 0.6$.

For another worker who is otherwise identical but earns \$900 per week, the replacement ratio will be $(425/900) = 0.472$.

C.3. *Occupations.* Workers were randomly selected from the following 10 occupations; see Table 7.

C.4. *Data Sample Restrictions.* The sample observations were restricted to full-time male workers. They must be in the labor force and have reported working for 40 or more weeks in the previous year and 35 or more hours in the week prior to the survey. Workers' calculated hourly earnings must be above the minimum wage as mandated by the federal government. Workers cannot be self-employed, working for government agencies, or nonprofit companies. In addition, workers above the age of 65 or below the age of 18 were excluded from the sample. Workers must report wages and not be simultaneously in school. Finally, the workers must be employed in one of the ten selected occupations.

C.5. *Calculation of the Comprehensive Expected Benefit Index.* This variable was created to reflect the annualized net present value for the future stream of benefits that an average worker could expect to receive. This variable differs across states and years, but does not vary across workers within the same state and year. In each case, the national average wage is used to compute the relevant weekly payments for each category of injury: fatalities, temporary total, and permanent partial injuries. Permanent total injuries are treated the same as fatalities because they are similar and quite rare. Permanent partial injuries are represented by hand-loss injuries and then adjusted to reflect the relative severity of the typical permanent partial injury. In order to approximate the expected death benefits, each worker is assumed to have two dependent children (aged 8 and 10) and leave a widow who will live for an additional thirty years. This method allows the variable to represent the relative generosity of workers' compensation benefits in each state.

Future payments are discounted at an interest rate of five percent, and the payments for each type of injury are then weighted by their average probability of occurring. These probabilities are based on the overall workforce average as reported in the National Safety Council's Accident (Injury) Facts, an annual publication. As a result, the true

probabilities in these dangerous occupations are therefore understated by the "average" figures. Thus, the present values of benefits are adjusted such that benefits as a proportion of payroll are in line with historical trends.

This adjustment uses the scales of the expected benefits so they are proportional (based upon \$100 of payroll) to the premiums paid in the appropriate industry in the state of Ohio. Ohio requires all employers to purchase workers' compensation insurance through the state "fund." Its premiums are relatively stable and should be representative of the costs typical firms in dangerous firms actually pay. For example, in 2000 construction firms paid \$5.02 per \$100 of payroll; so if the estimated (annualized) net present value of benefits (divided by average annual earnings) was \$2.51, then the scale factor would be 2. The same scale factor was used to adjust the expected benefits in all years, but varied by industry to reflect, as accurately as possible, the true benefits (or premium costs) associated with each state.

D. Regression Estimates for Machinists in 1990

For more details see Table 8.

E. Membership in Selected Unions

For more details see Table 9.

F. State Weekly Workers' Compensation Benefit Maximums for Temporary Total Injuries

For more details see Table 10.

Endnotes

1. In other words, magnitude estimates of wage offsets reveal how much the marginal worker is willing to forgo in wages in order to have an additional dollar of insurance coverage.
2. The following is a partial list of studies in the literature that address workers' compensation and compensating wage differentials: Arnould and Nichols [10]; Balkan [11]; Butler [2]; Dorsey and Walzer [12]; Fishback and Kantor [4, 5]; Gruber and Krueger [15]; Kaestner and Carroll [6]; Krueger [16]; Moore and Viscusi [1]; Butler and Worrall [3]; Thaler and Rosen [17]; Thomason et al. [18]; Worrall [19]; Viscusi and Moore [7].
3. Essentially, wages and the level of benefits are jointly determined.
4. See Appendix A for a listing of these proportions by state and year.
5. For instance, if MIN= \$100 per week, MAX= \$220, and $\theta = 0.5$, then any eligible workers previously earning less than \$200 (= \$100/0.50) per week will receive the minimum \$100 per week in benefits upon injury. Thus, the "low-wage" workers are earning \$0–\$200, "middle-wage" workers are earning \$200–\$440, and all workers

earning more than \$440 per week will be classified as “high-wage” workers.

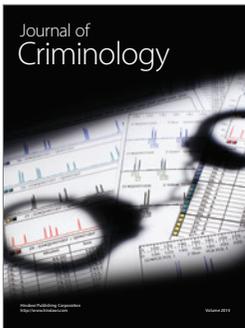
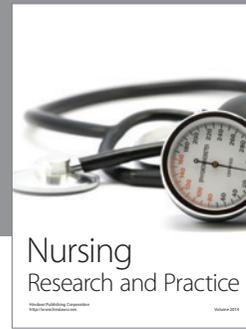
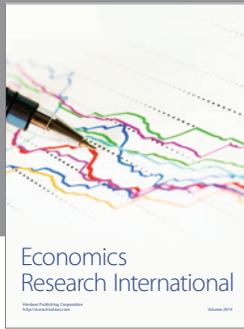
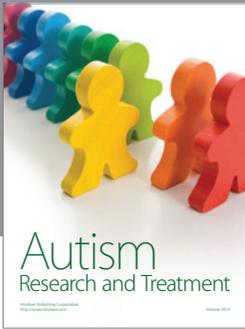
6. For example, in 1980, widows of fatally injured workers in South Dakota receive an additional \$50 per month per dependent child in the household.
7. “High-” wage workers choose their optimal wage and MAX_s combination, and “middle-” wage workers will select their preferred combination of wage and θ_s . In principle, “low-” wage workers would be concerned with wages and the states’ minimum benefit levels: MIN_s .
8. In addition, the replacement is based only on payments for temporary total disabilities. Therefore this method only provides a partial picture of the variation in benefits across states, which includes differences in waiting periods before cash benefits begin, differences in maximums for permanent disability and deaths, and differences in payout periods for deaths and long-term disabilities.
9. This suggests that workers (depending on their earnings) value an extra dollar of benefits differently. While this seems reasonable based on a marginal utility argument, it is less intuitive from an employer’s perspective. For instance, insurance premia will be based on the dollar value of benefits paid regardless of the preinjury earnings of the recipient(s).
10. Moreover, the effect of the “high-wage” group will be relatively milder than either the impact of the “low-wage” group here or the “middle-wage” group in the previous model design.
11. Kaestner and Carroll [6] do not adjust for taxes and claim that the effect would be minimal.
12. The same base model is adopted by Kaestner and Carroll [6]; however, they place the “married” dummy directly in the wage equation and add state monetary weekly maximums and minimums, medical benefits share of total benefits, and nonearned family income. The authors do not discuss the appropriateness of these instruments.
13. Fishback and Kantor [4, 5] do *not* restrict their benefit measure to actual weekly benefits for temporary total disability. Instead they calculate a present discounted value of all possible payment types. (Payments are discounted using a 5 percent interest rate.) Workers are assumed to have two children, ages 8 and 10, and (in the event of a fatal injury) leave a widow who would live for an additional 30 years. Payments for different injury types (temporary total, permanent partial, permanent total, and fatal) are weighted by their empirical probability of occurrence and then summed to obtain the benefit amount. Thus, this measure is more accurately described as an *expected* benefit.
14. However, note that one could alter this approach to use a replacement ratio index (based on the national average wage) in lieu of the benefit index if the proportion of replaced wages is more attractive on theoretical grounds.
15. Their estimation procedure follows the same intuition as instrumental variables. To see this consider the benefit for the i th worker in state s : $b_s(\bar{w}) = f_s(\bar{w}, \bar{Z}) = f_s(w_i + \nu_i, Z_i + \Gamma_i)$ which can be rewritten as $b_s(\bar{w}) = f_s(w_i, Z_i) + \varphi_s(\nu_i, \Gamma_i)$ or $b_s(\bar{w}) = b_i + \varphi_s(\nu_i, \Gamma_i)$. Therefore, the expected value of b_i is $b_s(\bar{w})$ minus the expected value of “error” term $\varphi_s(\nu_i, \Gamma_i)$. Consistent estimation requires that this “error” term is mean zero and is uncorrelated with the other regressors.
16. See Appendix A for the full table of replacement rates.
17. Based on the national average manufacturing wage, no one hits the minimum, and 32 percent hit the maximum, as the maximum benefit would be binding in 16 states.
18. I do not estimate the likelihood of being in the “low-wage” regime since this represents a negligible fraction of the sample.
19. In principle, this nonlinear system is identified; however, most economists consider identification tenuous without proper exclusion restrictions. For this reason I include several variables, K_s , exogenous to individual wages in the first (selection) equation.
20. Average earnings are weekly for 1950, 1960, 1970, and 1980; earnings are annual for 1940 and 1990.
21. Regressions of the state trait variables, K_s , on the state’s maximum weekly benefit show that these help explain up to 27 percent of the variation. All variables are statistically significant with the exception of percent union and percent mining in 1940.
22. Note that MAX_s equals b_i for all workers in the “high-wage” regime in state S . Similarly, θ_s is equal to R_i for all workers in the “middle-wage” regime in state S .
23. The comprehensive benefit index as well as other data restrictions are described in detail in Appendix C.
24. For the 10 selected occupations, only workers employed in the modal industry were used to ensure both comparability and larger sample sizes. See the appendix for description of variables and variable selection.
25. See Appendix E for a depiction of membership in unions that would likely have attracted workers from the 10 sampled occupations.
26. For 1940, 1950, and 1970, I am able to (separately for each year) pool all occupations to obtain a single estimate of the benefit’s impact on wage. These pooled impacts are reported, as elasticities, along with the occupation-specific results. However, for these pooled models, the occupation dummies were not statistically significantly different from the omitted group.
27. Those with less than a high school education tend to make less and those with some college earn more, relative to high school graduates. Wages are increasing in years of experience, but at a decreasing rate. Real

hourly wages tend to be lower among those who worked overtime hours in the week prior to the survey. Workers residing in metropolitan areas tend to earn more. Wages vary significantly across the four major census regions.

28. If a worker earns \$500 and his workers' compensation benefit is \$300, then the replacement ratio is 0.6. Raising the benefit maximum by a dollar to \$301 increases the replacement ratio by one-third percent which would decrease the wage by 0.28% ($= 0.85 \times 1/3$).
29. The temporary benefit index (not on based a net present value) yields estimates that are negative and not statistically different from zero. The elasticity of -0.04 suggests that increasing the weekly benefit for temporary total injuries by one dollar lowers the real weekly wage by a mere seven cents. This version of the model is estimated using cross-sectional data from each census year.
30. This systematic use of the median values may result in measurement error. However, this should be of little concern since wages appear as left-hand-side variables in the analysis and hence ought not lead to any biased results.
31. The census did ask for "usual hours worked per week" in 1980 and 1990; so in those years, this value is used. In the remaining years the census questions only inquired about the hours worked in the week prior to the study, so in these cases the hours worked in the previous week are assumed to be typical for each worker. In addition, the hours in 1960 and 1970 are only given in intervals; these cases are treated in a manner similar to those used in calculating the weekly wage.

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