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Workers' Compensation for Occupational Disease: Prorating Liability Versus Last Employer Liability

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ABSTRACT

Liability for occupational disease may be prorated among responsible employers or assigned to the last employer. In theory, it is shown that workers' compensation with a prorating liability rule may achieve optimal compensation and deterrence over time if two-part liability can be imposed to employers; such optimum is not expected under workers' compensation with the last employer liability rule. Empirical results indicate no significant difference between the two workers' compensation systems in their effects on the incidence of occupational disease.

Introduction

Occupational disability problems have been expanded to include not only safety concerns with job-related accidents but overall health concerns as well. These include work-related long-term exposure to hazardous substances that result in occupational diseases and emotional injuries such as depression.¹ Occupational disease is defined as any abnormal condition or disorder, other than one resulting from a traumatic occupational injury, alleged to be caused or aggravated by exposure to environmental factors associated with employment. It includes acute and chronic diseases and illnesses that may be caused by inhalation, absorption, ingestion, direct contact, or stress (U.S. Department of Labor, 1986). Occupational disease differs from occupational injury in that multiple parties may contribute to the disease, and the disease may not manifest itself until many years after the damaging exposure. This long period of latency

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¹Safety risks involving external physical dangers pose more immediate and visible threats to the worker's well-being, while health risks typically lead to deferred health effects for which the cause may be difficult to identify.

exacerbates the problems of determining the causes of a disease and allocating financial responsibility.

Today, each state has a workers' compensation law and recognizes the responsibility for occupational diseases that arise out of and in the course of employment. The workers' compensation law holds the employer absolutely liable for occupational diseases suffered by workers. In many cases, occupational disease is a result of a long period of exposure, and for a given occupational disease several different employers may be responsible. Although many workers' compensation laws set rules for assigning liability, doing so equitably and efficiently among the responsible employers is a continuing challenge. Several rules for assigning employer liability are used for occupational disease: apportionment of liability among responsible employers, limited apportionment of liability, the last injurious exposure liability, and the last exposure liability. If all previous employers and the last employer of a diseased worker are responsible for the exposure, these rules may be condensed into either prorating liability among the employers or the last employer liability. This article presents an empirical analysis of state workers' compensation systems to determine whether the prorated liability rule and the last employer rule have significantly different effects on the incidence of occupational disease.

Literature Review

Danzon (1987) examines alternative systems of liability and compensation for occupational disease. In considering liability systems that go beyond simply paying for claims that have already been made, she stresses the importance of the prevention of occupational disease. Optimal liability rules should consider incentives for precaution, uninsured risk, and costs of implementation. Danzon states that the optimal investment in safety involves weighing the marginal costs of prevention against the marginal benefit from reducing risk. She examines several liability assignments: employer liability under the workers' compensation system, tort liability of product manufacturers, employee liability with first-party insurance, and special government programs. Based on an evaluation of the effects of these alternatives on compensation and deterrence, Danzon concludes that the workers' compensation system with a pro rata division of liability among contributing employers appears to be superior to the alternatives.

Schlesinger and Venezian (1988) attempt to provide a framework for evaluating the effective policy of compensating victims of occupational diseases. They stress that a compensation mechanism for occupational disease must work well within the bounds placed upon it by imperfect information and limited resources. Compensation systems that are *ex ante* efficient—that is, those that provide proper incentives for all economic agents to take efficient actions—should be coordinated with *ex post* efficiency, minimizing the total social costs arising from injuries, injury prevention, risk bearing, overhead costs of litigation and administration, and inappropriate compensation.

Chang (1990) analyzes differences between workers' compensation with strict employer liability and first-party insurance with employee liability in their effects on compensation and deterrence. Chang shows, further, that, for occupational disease in a multiperiod analysis, workers' compensation systems with a prorating liability rule provide optimal compensation and deterrence over time if two-part liability is imposed on the employers.²

Many empirical studies, including Chelius (1982), Butler and Worrall (1983), Ruser (1985), and Moore and Viscusi (1989), have analyzed the effects of workers' compensation benefits on occupational injury or fatality. Despite the growing concern about workplace health risks and occupational disease problems, however, no study focuses specifically on occupational disease.

Empirical Model, Data, and Methodology

Assuming the use of two-part employer liability and no transactions costs, theoretical studies show that workers' compensation with pro rata division of liability among the employers concerned provides optimal compensation and deterrence. However, in practice, such a two-part liability may not be used and transaction costs cannot be ignored. Prorating liability among the employers may be difficult with transaction costs due to the uncertainty over the causes of a disease and with the manifestation lag.

How effectively are the current workers' compensation systems actually working to promote workplace health? To answer this question, I investigated the effects of workers' compensation systems with different liability rules on the risk of occupational disease, and I analyzed the effects of workers' compensation benefits and changes in occupational disease compensability rules on the risk of occupational disease.

I compared workers' compensation systems with prorating liability rules to systems with last employer liability rules in terms of their ability to deter occupational disease. Thirty-five states were included in the analysis (see Appendix). Two states use prorating liability rules, and 21 states use last employer rules in allocating the costs of occupational disease under workers' compensation. An additional 12 states were included in the analysis that do not specify an employer liability rule in their workers' compensation systems but clearly do not use a prorating liability rule.

It is hypothesized that the incidence rates of occupational disease (ODRATE), as the variable for occupational disease risk, is a function of workers' compensation benefits, unionization of workers, changes in occupational disease compensability rules, industry composition, and workers' characteristics. The incidence rate of occupational disease is the number of diseases related to a common exposure base of 100 full-time workers. The

²The analysis of "two-part liability" argues that, in addition to an employer's liability to the worker for optimal compensation, liability to the state (or payment of a fine) will be necessary to create optimal prevention incentives to employers (see Spence, 1977, and Danzon, 1987, for details).

common exposure base permits accurate interindustry comparisons, trend analysis, and comparisons among firms regardless of their size.³ The estimating equation is as follows:

$$\begin{aligned} \text{ODRATE}_{jt} = & \alpha_{jt} + \beta_1 \text{BENEFIT}_{jt} + \beta_2 \text{UNION}_{jt} + \beta_3 \text{STLIM}_{jt} + \beta_4 \text{TLIM}_{jt} \\ & + \beta_5 \text{MINEXP}_{jt} + \beta_6 \text{PRO}_{jt} + \beta_7 \text{LASTNO}_{jt} + \beta_8 \text{MINING}_{jt} \\ & + \beta_9 \text{CONST}_{jt} + \beta_{10} \text{MANUF}_{jt} + \beta_{11} \text{SERVICE}_{jt} + \beta_{12} \text{FEMALE}_{jt} \\ & + \beta_{13} \text{YOUNG}_{jt} + e_{jt}, \end{aligned}$$

where ODRATE_{jt} = incidence rate of occupational disease cases in state j in year t ,
 $j = 1, 2, \dots, 35$, and
 $t = 1, 2, \dots, 11$.

See Table 1 for definitions of the variables.

The data for incidence rates of occupational disease are available for 35 states over the period 1976 through 1986 from the Bureau of Labor Statistics' (BLS) *Annual Survey of Occupational Injuries and Illnesses*. The survey data are collected from employers' reports of occupational disability to the BLS, required under by the Occupational Safety and Health Act of 1970.⁴

The data on workers' compensation benefit levels by state are available from the National Council on Compensation Insurance, which collects statistics of job-related disabilities to establish a rate structure for member companies that write workers' compensation insurance. Workers' compensation income benefits for "total" disability (either temporary total or permanent total) are used here.

Unionization data are gathered from the *Statistical Abstract of the United States* and from the *Union Source Book* (1985). Details on the occupational disease provisions of workers' compensation laws are available from *Analysis of Workers' Compensation Laws* published by the U.S. Chamber of Commerce. Employment data for each industry group are retrieved from the Business Indicators (containing data from the Bureau of Economic Analysis, U.S. Department of Commerce), and data on workers' sex and age are collected from several different sources.

The effect of workers' compensation benefits on occupational disease incidence rates depends upon the relative responsiveness of employers and

³ This rate is calculated (by the U.S. Department of Labor, Bureau of Labor Statistics, 1987, p. 3) as

$$(N/EH) \times 200,000,$$

where N = number of illnesses,

EH = total hours worked by all employees during calendar year,

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

⁴ Obtaining reliable data on occupational disease risks is a real problem to the research in this area, and the BLS data used here are also subject to criticism. However, the BLS data seem to be the only consistent source of information on occupational diseases across different states over the study period.

Table 1
Sample Characteristics

Variable	Definition	Mean	Standard Deviation
ODRATE	The incidence rates of occupational disease	0.23	0.11
REPL	The replacement rate of the workers' compensation benefits for total disability	66.98	3.22
MAX	Maximum workers' compensation benefits for total disability in dollars	85.67	31.12
UNION	Percent of unionization of employed nonagricultural workers	21.08	8.09
STLIM	Statute of limitations period in years for occupational disease claims	1.49	0.78
TLIM	Time limitations rule dummy variable: 1 if it is applied, 0 otherwise	0.50	0.50
MINEXP	Minimum exposure rule dummy variable: 1 if it is applied, 0 otherwise	0.12	0.33
PRO	Prorating liability workers' compensation state dummy variable: 1 if it is applied, 0 otherwise	0.07	0.26
LASTNO	Last employer liability workers' compensation state (without second injury fund) dummy variable: 1 if it is applied, 0 otherwise	0.78	0.40
MININGR	Percent of employed nonfarm private workers in mining	1.87	3.02
CONSTR	Percent of employed nonfarm private workers in construction	7.22	1.97
MANUFR	Percent of employed nonfarm private workers in manufacturing	21.48	8.82
SERVICER	Percent of employed nonfarm private workers in service	27.43	4.93
FEMALE	Percent of female employed workers	42.58	2.18
YOUNGR	Percent of population age 18-44	43.05	5.29

employees; higher compensation raises the incentive for an employer to invest in safety, but it may reduce the employees' safety incentive. Chelius (1982), Butler and Worrall (1983), and Ruser (1985) found a positive relationship between workers' compensation benefits and the frequency of occupational injury or claims, while Moore and Viscusi (1989) found a negative relationship between workers' compensation benefits and the risk of occupational fatality.⁵ Because unionization may facilitate more and easier access to disease reports or because union members are more likely to be working in more hazardous workplaces (Worrall and Butler, 1983; Leigh, 1982), unionization of workers may be associated with a higher incidence of occupational disease. However,

⁵ See Ehrenberg (1988) and Moore and Viscusi (1990) for a good summary of these studies.

a higher incidence of disease may be offset if unions better inform workers of occupational disease risks.

One important principle of workers' compensation is that all employees must have reasonable and fair access to workers' compensation benefits. In practice, some states have imposed upon certain disease claims rather restrictive definitions of compensable occupational disease, several time limitation rules, and exposure rules. The major legal aspects of occupational disease compensability in workers' compensation statutes are the statute of limitations (STLIM), which sets a time limit for filing a claim either from the time of disease exposure or from the time of disease manifestation; time limitations (TLIM) rules, which require that a disease manifest itself within a certain period after the last injurious exposure or after the last day of work for the employer against whom the claim is filed in order for it to be compensable; and minimum exposure (MINEXP) rules, which bar occupational disease claims unless claimants can prove that their exposure to a workplace hazard occurred over a specified minimum period of time.

Over the period 1976 through 1986, the coverage of occupational disease was broadened either by changes in the state workers' compensation statutes or by a more liberal interpretation of compensable diseases by state workers' compensation commissions and courts. The statute of limitations slowly but steadily lengthened over the study period, and the time limitations rule was abolished in many states between 1980 and 1986. On the other hand, many states adopted a minimum exposure rule during the period 1983 through 1986. The effects of compensability law changes on the incidence rates of occupational disease are ambiguous a priori because the change in disease incidence depends on the relative responsiveness of the employers' incentive to invest in safety versus the employees' incentive to work more safely. Broadening compensability for occupational disease under workers' compensation may increase employers' incentive to invest in safety, while it may reduce employees' safety incentive. And, conversely, limiting compensability for occupational disease under workers' compensation may reduce employers' incentive to invest in safety, while it may increase employees' safety incentive.

Prorating liability rules and last employer rules may have different effects on occupational disease risk. If the employers have higher prevention incentives under prorated liability, then this system should be inversely associated with occupational disease incidence, assuming other things are equal. However, considering practical difficulties in prorating liability among the employers concerned, one might question the effectiveness of the existing prorating liability workers' compensation systems in reducing the incidence of occupational disease. Further, given the paucity of data on workers' compensation systems with prorating liability rules, the test may yield inconclusive results.⁶

⁶ Out of three states that use prorating liability workers' compensation systems, data on occupational disease incidence are available for only California and Rhode Island.

The last employer liability workers' compensation system is further classified into LASTNO and LASTYES depending upon the availability of a second injury fund for occupational disease in each state. Through the mechanism of a second injury fund, the liability for pre-existing disease conditions can be assumed by the fund, and the last employer would be charged only for the benefits associated with the subsequent disease. Employers' contributions to finance such a fund in LASTYES states may increase employers' incentives to invest in safety.⁷ Connecticut, Delaware, Florida, and Kentucky use the last employer liability workers' compensation system with a second injury fund available for occupational diseases.

The effects of the distribution of workers across industries on occupational disease incidence is ambiguous a priori because many different factors in an industry can affect occupational disease risk. The effect of a worker's sex on the incidence of occupational disease is also ambiguous a priori. Considering the cumulative effect of occupational disease over time, a worker's age may have a positive relationship on occupational disease incidence.

For the pooled cross-section and time-series data set (35 states over the period 1976 through 1986), the least squares dummy variables regression model is used in an attempt to adjust for missing explanatory variables in the model.

In the estimating equation $OD_{jt} = \alpha_{jt} + \sum_{k=1}^{13} \beta_k X_{kjt} + e_{jt}$, where X_k is the k^{th} explanatory variable, the intercept term α_{jt} can be rewritten as follows: $\alpha_{jt} = \bar{\alpha} + u_j + v_t$, where $\bar{\alpha}$ is the mean intercept, u_j represents the difference from $\bar{\alpha}$ for the j^{th} state (assumed to be fixed), and v_t represents the difference from $\bar{\alpha}$ for the t^{th} year (also assumed to be fixed). The error term e_{jt} is assumed to be an independent and identically distributed random variable with mean zero and constant variance.⁸

Dummy variables for each state and each year are inserted for the purpose of measuring shifts in the regression line arising from unknown variables. The influence of the dummy variables on the mean of the dependent variable is tested by using F-statistics, and the addition of the dummy variables is found to explain some of the variation in the incidence of occupational disease.

I also estimated the model without including state dummy variables, because they may obscure the effects of legal differences that affect a small number of states. Regression results with and without the state dummy variables are compared to see if any difference results.

⁷ Some states finance their second injury fund by assessing employers a charge for work-related deaths when the victim leaves no surviving dependent. And some states finance the fund by assessments against employers or their insurers in proportion to the benefits they pay.

⁸ That is, I adopt a fixed-effects model. If the given assumptions are held for u_j and v_t , the fixed-effects model would yield consistent regression estimates.

Results

Table 2 shows ordinary least squares estimates of the occupational disease incidence equation for the pooled data with and without state dummy variables. The values of workers' compensation benefits (REPL, MAX) are lagged one year. Similarly, the values for legal variables (STLIM, TLIM, MINEXP) are also lagged one year.⁹

The significant positive coefficient for workers' compensation maximum benefits (LMAX) indicates that workers' compensation benefits are positively associated with the incidence of occupational disease, consistent with the findings of many previous studies indicating that higher workers' compensation benefits are associated with higher traumatic or nonchronic occupational injury or claim rates. This positive relationship also reflects the possibility that the occupational disease data used in my test may be largely for nonchronic diseases. In the occupational disease incidence rate data set used for the analysis, many chronic and long latent diseases may be missed because the employers' report may not be complete. To this extent, chronic diseases such as cancer, asbestosis, or some respiratory diseases may be undercounted. The coefficient of the unionization variable is found to be positive and significant and may indicate the union's function of facilitating reports of workplace diseases and/or union members' working in more hazardous industries.

Although not conclusive, the results with the compensability law variables suggest that such laws do affect safety. The statute of limitations variable shows a strong negative coefficient in the equation without state dummy variables, perhaps implying that employers have stronger incentives to invest in safety when compensability for occupational disease is broadened by an increased statute of limitations period. The time limitations rule dummy variable has a strong positive coefficient in the estimation with state dummies, implying that employers' safety investment may be undermined through the imposition of the time limitation rule. The effect is not significant, however, when estimating the equation without state dummies. The minimum exposure rule dummy variable is not significant in either specification.

The insignificant coefficient of the prorating liability dummy variable suggests that there may be no significant difference between prorating liability and last employer liability in their effects on occupational disease incidence. For example, practical difficulties in prorating liability for a worker's disease among the responsible employers may lower the system's effectiveness. However, the test is not strong because the occupational disease incidence rate data are available only for two prorating liability states. The variable for a last employer liability workers' compensation state without second injury fund available for occupational disease shows a significant positive coefficient in the equation without state dummy variables, which may imply employers'

⁹One-year lagging may or may not be appropriate; knowing the exact lag structure is a challenge to this study as it is to many other empirical studies.

Table 2
Regression Results (t-statistics)

<i>Independent Variable</i>	<i>With State and Year Dummy Variables</i>		<i>With Year Dummy Variable Only</i>	
INTERCEPT	-0.5766	(1.907)**	0.8384	(3.251)*
LREPL	-0.0013	(1.282)	-0.0003	(0.319)
LMAX	0.0015	(6.049)*	0.0015	(7.439)*
UNION	0.0034	(1.766)**	0.0020	(2.000)*
LSTLIM	-0.0090	(0.761)	-0.0280	(3.515)*
LTLIM	0.0468	(3.573)*	0.0016	(0.137)
LMINEXP	-0.0049	(0.295)	0.0007	(0.041)
PRO	0.0372	(0.611)	0.0274	(0.960)
LASTNO	-0.0311	(0.713)	0.0381	(2.212)*
MININGR	0.0155	(2.355)*	-0.0070	(2.378)*
CONSTR	-0.0055	(0.870)	-0.0204	(3.332)*
MANUFR	0.0034	(1.358)	-0.0035	(2.549)*
SERVICER	0.0176	(2.525)*	-0.0084	(4.179)*
FEMALE	0.0007	(0.177)	0.0021	(0.500)
YOUNGR	-0.0003	(0.119)	-0.0079	(3.318)*
Adjusted R ²	0.6992		0.2781	
N	338		338	

Note: ODRATE = occupational disease incidence rate, LREPL = lagged workers' compensation benefits replacement rate, LMAX = lagged workers' compensation maximum benefits, LSTLIM = lagged statute of limitations period, LTLIM = lagged time limitation rule dummy variable, LMINEXP = lagged minimum exposure rule dummy variable.

* statistically significant at 5% level.

** statistically significant at 10% level.

relatively higher safety incentives in states with an employer-financed second injury fund.

Strong negative effects on the occupational disease incidence rate are found for all the industry variables when estimating without state dummy variables. The effect of a worker's sex is not significant, and the negative coefficient of the variable representing the proportion of young workers may indicate the cumulative effect of occupational disease over time.¹⁰

Conclusion

To compensate employees suffering an occupational disease that may involve many parties and a manifestation lag, workers' compensation systems use two employer liability rules: prorating liability among responsible

¹⁰ Considering a possible endogeneity problem in estimation, a simultaneous equations system was tried, but the two-stage least squares results were qualitatively and quantitatively same as the ordinary least squares results. For a possible heteroskedasticity problem in the error terms of the estimation, White correction was also tried, and the results were again qualitatively and quantitatively the same. The two-stage least squares or the White-corrected results are available from the author upon request.

employers and last employer liability. Theoretically, the prorating liability rule achieves optimal compensation and deterrence, assuming two-part employer liability and no transaction costs; such an optimum is not expected under the last employer liability system.

The evidence presented in this article suggests that the two workers' compensation systems may not differ significantly in their effects on the risk of occupational disease. This may be due to practical difficulties in prorating liability due to transaction costs. The results also show that higher workers' compensation benefits are associated with a higher incidence of occupational disease and that changes in occupational disease compensability rules influence employers' incentives to promote workplace safety and health.

Appendix

States That Use Prorating Liability Workers' Compensation

California

Rhode Island

States That Use Last Employer Liability Workers' Compensation

Alabama

Kentucky

New Mexico

Arizona

Maine

North Carolina

Arkansas

Maryland

Oregon

Florida

Michigan

Tennessee

Indiana

Minnesota

Utah

Iowa

Missouri

Vermont

Kansas

Montana

Virginia

States That Do Not Specify an Employer Liability Rule But Clearly Do Not Use a Prorating System—Included in the Analysis as Last Employer Liability States

Alaska

Louisiana

South Carolina

Connecticut

Mississippi

Washington

Delaware

Nebraska

West Virginia

Hawaii

Nevada

Wyoming

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