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WORKERS' COMPENSATION INSURANCE AND THE DURATION OF WORKPLACE INJURIES

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ABSTRACT

This paper uses a new administrative micro-data set to examine the effect of a legislated increase in the minimum and maximum workers' compensation benefit on the duration of workplace injuries in Minnesota. As a result of legislation, workers in some earnings groups received higher benefits if they were injured after the effective date of the benefit increase, while workers in other earnings groups received the same benefit regardless of when they were injured. The analysis compares the change in mean log injury duration for workers who were affected by the benefit increase to that of workers who were not affected by the benefit increase. The findings indicate that the duration of injuries increased by 8 percent more for the group of workers that experienced a 5 percent increase in benefits than for the group of workers that had no change in their benefit. Additional findings suggest that employees of self-insured firms who are injured on the job tend to return to work faster than employees of imperfectly experience rated firms who incur similar injuries.

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Work-related disabilities are an unfortunate and costly consequence of production. In a typical year, more than fifty times as many working days are lost to work injuries as are lost to labor strikes, and from one-half to one-third as many working days are lost to work injuries as are lost to unemployment.[1] The total amount of working time foregone because of work-related disabilities is the product of the incidence of work-related injuries and the average duration of time spent away from work once an injury has occurred.[2] This paper examines how workers' compensation insurance and other factors influence the duration of lost work time that results from work-related injuries and illnesses.

Workers' compensation insurance is the primary public program for workers who experience a work-related injury or illness. In recent years, nearly half of all workers who missed one or more days of work because of a work injury collected workers' compensation benefits.[3] Previous research has focused on the impact of providing more generous benefits on injured employees' incentives to return to work. This research is limited, however, by the difficulty of identifying separate benefit and wage effects because benefits are typically determined as a function of the worker's pre-disability wage. Moreover, workers' compensation insurance may also affect employers' incentives to encourage disabled workers to return to work. In particular, privately insured firms have little incentive to induce injured workers to return to work because insurance premiums are often imperfectly experience rated, while self-insured firms have a stronger incentive because they bear the full marginal cost of workers' compensation benefits. The effect of employers' incentives on the duration of workplace injuries has received little attention in the literature.

In this paper, I use longitudinal data on workers' compensation claims in

Minnesota to examine how both employees' and employers' incentives influence the duration of nonwork spells following workplace injuries. The analysis is based on an unusual natural experiment that was created by a legislated change in the benefit schedule which raised the minimum and maximum benefits during the sample period. As a result of this benefit change, identical workers who qualify for the maximum or minimum benefits would receive different benefit amounts depending on whether they were injured before or after the date of the benefit change. On the other hand, workers' who did not receive the maximum or minimum benefits form a control group because their benefits were the same regardless of when they were injured. Unlike previous studies, this natural experiment allows one to compare the duration of work injuries for workers in the same state who earn the exact same wage but received different workers' compensation benefits.

This quasi-experiment is used to address the following questions: How does the average duration and composition of temporary total workers' compensation claims respond to changes in benefits? Are short or long term injuries more responsive to a benefit increase? Do employees of self-insured firms who are injured on the job have shorter spells away from work than employees of firms that purchase insurance from private insurance companies or from the competitive state fund? Does the relationship between injury duration and benefits vary between self-insured and privately insured firms?

The findings indicate that the average duration of temporary total injuries is extremely responsive to the level of benefits paid. A comparison of changes in durations before and after a 5 percent increase in the maximum and minimum benefits shows that the average duration of claims increased by about 8 percent more for the group of workers that experienced a benefit

increase due to the schedule change than for the group of workers that was unaffected by the increase in the maximum and minimum benefits. Moreover, the estimated effect of benefits on the duration of work injuries is qualitatively different when the natural experiment is ignored and nonlinearities in the benefit schedule are used to estimate the benefit and wage effects.

In addition, employees of self-insured firms are found to have shorter spells on workers' compensation than employees of privately insured firms, and the average duration of injuries is found to be more responsive to the increase in benefits in imperfectly experience rated firms than in self-insured firms. These results suggest that employers' insurance incentives also have an effect on the duration of work injuries.

The remainder of the paper is organized as follows. Section I discusses relevant institutional features of the Minnesota workers' compensation system and briefly reviews the past literature. Section II presents several difference-in-differences estimators of the effect of benefits on injury duration based on the natural experiment created by the revision in the benefit schedule. Section III presents multivariate estimates of the effect of benefits on the duration of injuries based on the exogenous variation in benefits caused by the change in the benefit schedule. Section IV estimates the injury duration-benefit elasticity for a sample of workers with short-term injuries, and for separate samples of self-insured and nonself-insured firms. Section V contrasts estimates of the injury duration-benefit elasticity identified by the change in the benefit schedule to those identified by nonlinearities in the benefit schedule. Section VI contains a summary and conclusion.

I. A Description of Workers' Compensation Insurance

Temporary total injuries are the most common type of claim in the workers' compensation system. A temporary total injury is one that renders an employee completely unable to work for a finite period of time. Most injuries are initially classified as a temporary total claim. Cases involving injuries that result in some form of permanent impairment are reclassified as either a permanent partial or permanent total case upon attaining maximum medical improvement, depending on whether the worker is healthy enough to return to work and on the type of impairment. In well over 90% of cases, employees return to work upon attaining maximum medical improvement.[4]

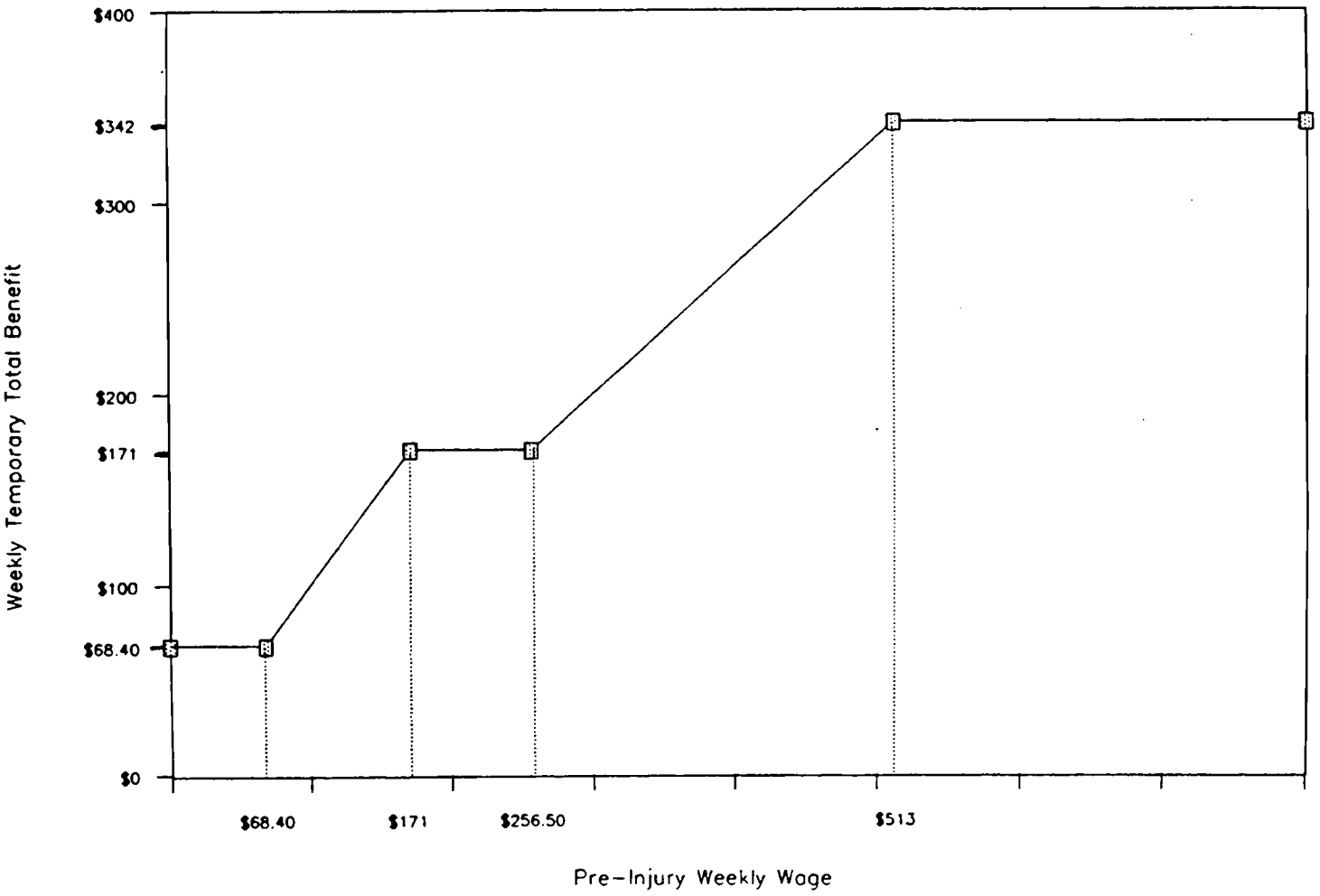
Figure 1 displays the schedule that was used to compute weekly benefits for temporary total cases in Minnesota in the beginning of 1986.[5] In essence, the workers' compensation benefit equals two-thirds of a workers' pre-disability weekly wage, subject to a maximum weekly benefit payment ($342), and a minimum weekly benefit payment ($171). There is a further stipulation, however, that workers' whose earnings make them subject to the minimum benefit be paid their weekly wage if their weekly wage is less than the minimum. Lastly, there is a second minimum ($68.40) that establishes a absolute floor for benefits, even for workers who earn less than the second minimum. It can be observed from Figure 1 that this benefit structure creates a "two-tier" minimum, in which workers earning less that $256.50 per week are paid the first minimum ($171) if their pre-disability wage exceeds the first minimum, exactly their wage if it is between the first minimum and the absolute minimum, or the absolute minimum if their wage is less than this absolute floor.

It should be noted that, for a number of reasons, Figure 1 is a slight

Figure 1

Minnesota Workers' Compensation

TEMPORARY TOTAL BENEFIT SCHEDULE (10/1/85–9/30/86)



simplification of the actual benefit computation formula. The value of certain fringe benefits, such as room and board, will be added to the weekly wage to compute benefits in cases where the provision of these fringes is curtailed as a result of the injury. Furthermore, minors and apprentices who experience an injury that is expected to result in any permanent impairment are paid the maximum benefit regardless of their pre-injury earnings. Finally, if an employee has a second job, his combined earnings from both jobs will be used to calculate the workers' compensation benefit.[6] In most temporary total cases, however, Figure 1 represents the relationship between past earnings and workers' compensation benefits.

Maximum and minimum benefits are revised each year on October 1 by the Minnesota legislature to keep pace with past statewide wage growth. The maximum and minimum benefits are specified as a certain percentage of the average weekly wage for the calendar year ending on December 31 of the preceding year. For example, the maximum benefit payable is 100 percent of the statewide average weekly wage. Injuries that occur on or after October 1 are subject to the new benefit schedule, while those that occurred prior to October 1 remain subject to the former benefit schedule. The next section demonstrates how legislated changes in the minimum and maximum benefits can be used to estimate the impact of benefits on the duration of claims.

Benefits are payable for the duration of the disability in temporary total cases. However, an employer or insurer may initiate administrative proceedings to discontinue benefits if it believes that an employee has recovered from his or her disability but continues to receive workers' compensation benefits. In Minnesota, an employer may not dismiss an employee for pursuing a workers' compensation claim. Most cases are concluded without

an administrative proceeding, and in the vast majority of temporary total cases, employees return to work for their former employer.[7]

Because workers' compensation insurance reduces the financial burden of work injuries, many observers have hypothesized that more generous workers' compensation benefits will lead workers to increase their reservation wage for returning to work (e.g., Richard Butler and John Worrall, 1985). A higher reservation wage, in turn, will lead injured workers to prolong their spell on workers' compensation insurance.

One problem with this argument is that most injured workers return to their former job at exactly their pre-disability wage.[8] As a consequence, their reservation wage must be no higher than it was before the injury occurred. A more plausible explanation for a positive relationship between benefits and work injuries is that workers experience greater disutility from work the more quickly they return to work after suffering an injury. For example, a back injury is likely to cause an employee more pain if he returns to work after resting one day than after resting one week. In this view, higher benefits increase average durations by raising workers' reservation health level, which explains why wages are typically unchanged after spells on workers' compensation insurance.

Past studies have typically found a positive relationship between the average duration of workers' compensation spells and the benefit level. For example, Butler and Worrall (1985) estimate that a 10 percent increase in benefits is associated with a 3.8 percent increase in the length of temporary total lower back injury claims using data for Illinois.[9] As Ehrenberg (1988) notes, however, the fact that benefits are a nondecreasing, nonlinear function of the predisability wage makes it impossible to disentangle the effect of

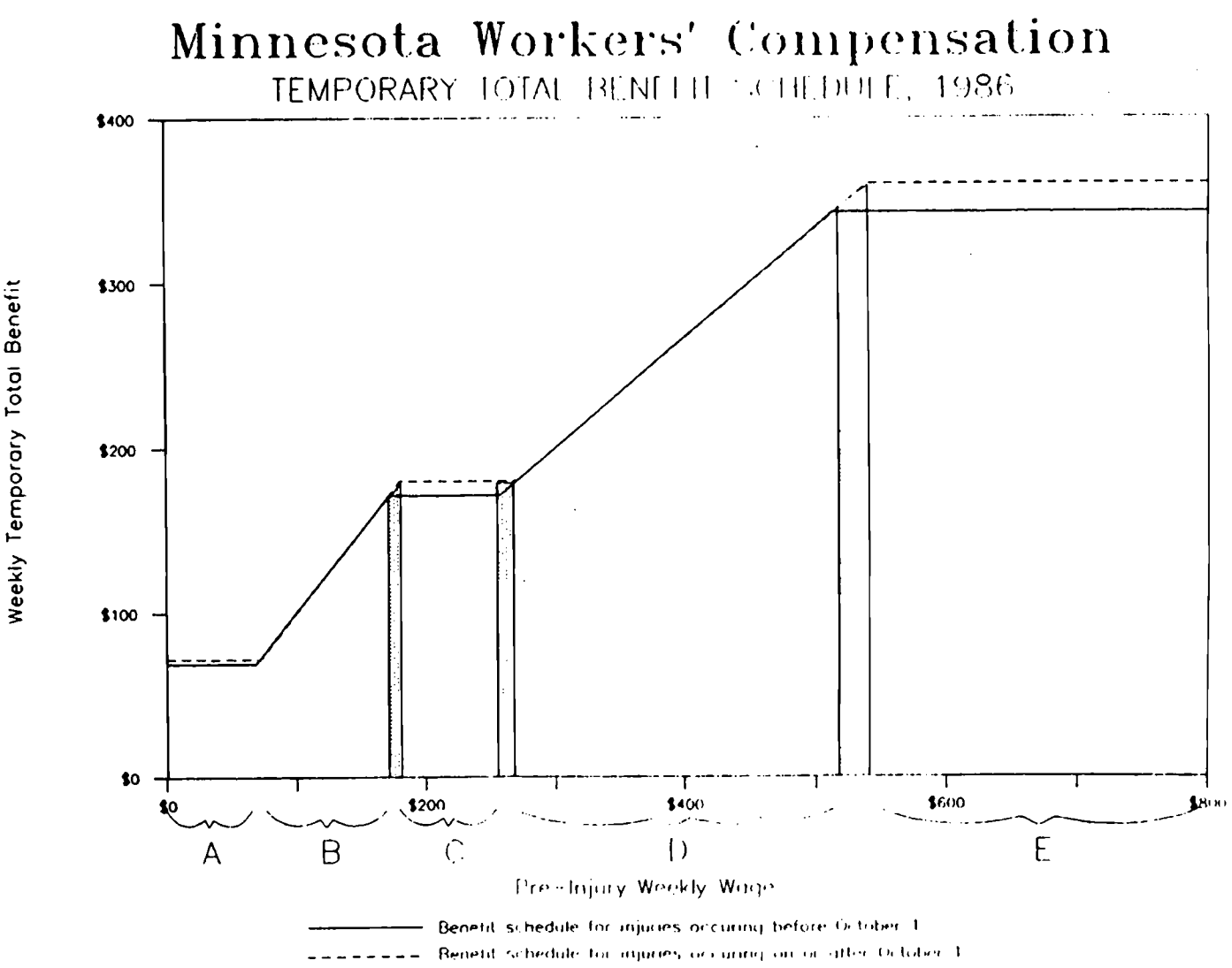
benefits from the effect of wages in a cross-sectional study of one state's workers' compensation program. Since workers of different earnings levels may have different motivation and attachment to work, the worker's pre-disability wage rate may directly influence the length of workers' compensation spells and thus confound estimates of the effect of benefits.

Furthermore, a cross-state analysis of the effect of benefits on duration is unavoidably hindered by the fact that many relevant institutional factors besides benefits differ across the states. For example, disabled workers are required to wait between three and seven days to become eligible for benefits, depending on the state. The waiting period will influence the measured average duration of claims in a state. Similarly, unobserved differences in the administration of workers' compensation laws are likely to affect the duration of injuries. Studies of injury duration based on inter-state variations in benefits, such as John Worrall, Richard Butler, Philip Borba and David Durbin (1989) and William Johnson and Jan Ondrich (1989), are unable to control for all the institutional features of workers' compensation insurance that vary across states.

II. Empirical Evidence on Benefits and Injury Duration: A Natural Experiment

Increases in the minimum and maximum benefits create a natural experiment that can be used to estimate the effect of increasing workers' compensation benefits on the duration of work injury claims.[10] Figure 2 illustrates how this experiment works. As a result of the legislated, nonretroactive increase in the maximum benefit and minimum benefits, individuals whose pre-disability earnings place them on segments A, C, and E of Figure 1 received a 5 percent greater weekly benefit if they were injured on or after October 1 than if they

Figure 2


Minnesota Workers' Compensation
TEMPORARY TOTAL BENEFIT SCHEDULE, 1986
Weekly Temporary Total Benefit
$400
$300
$200
$100
$0
$0
$200
$400
$600
A
B
C
D
E
Pre-Injury Weekly Wage
Benefit schedule for injuries occurring before October 1
Benefit schedule for injuries occurring on or after October 1

were injured before that date. For example, the weekly benefit increased from $342 to $360 for high-wage earners on October 1, 1986.[11] On the other hand, workers whose earnings fall into segments B and D form natural control groups because their benefit was the same regardless of when they were injured. Finally, the small sample of individuals with earnings in the gray areas between the distinct earnings segments are excluded from the analysis because their benefits increased by an amount between 0 and 5 percent.

If more generous benefits truly induce longer workers' compensation spells, we should observe longer spell durations for those in segments A, C and E who were injured after October 1 than for those with the same earnings but with injuries pre-dating the October 1 increase. Furthermore, the experience of individuals in segments B and D allow us to control for any other changes that might have occurred in this time period. Time-varying factors that affect the duration of claims (e.g., possible changes in administrative procedures) can be differenced out by computing the difference in the change in average duration between individuals on segments A, C and E, and those on segments B and D before and after the benefit change. Moreover, there are six possible pairings of "treatment" and "control" groups because of the two-tier structure of minimums.

Data and Empirical Results

The data analyzed here are taken from administrative records on temporary total claims filed by insurers and self-insured employers in Minnesota. This data set contains a rich collection of information on the duration of claims, injury characteristics, form of insurance, pre-disability wage, weekly benefit, and demographic characteristic of workers' compensation recipients. The original data set contains 33,015 temporary total workers' compensation

claims for injuries that occurred in 1986.[12] To eliminate gross errors in the benefit and wage data, the sample is restricted to individuals whose reported temporary total benefit is within $10 of the benefit that is calculated from the applicable benefit schedule and the reported weekly wage. Less than 5 percent of observations were deleted by this criterion.[13]

The data set includes all claims for temporary total injuries in Minnesota that originated in 1986 and closed by July 1989; incomplete spells are truncated. But because an estimated 99 percent of temporary total workers' compensation claims close in less than three years, the truncation of incomplete spells does not present a serious problem (Minnesota Department of Labor and Industry, 1988, p. 29). Furthermore, in a later specification I avoid the truncation issue entirely by restricting the sample to short-term injuries, such as broken fingers and sprained ankles; virtually all of these injuries would have closed in the sample period.[14]

Table 1 summarizes estimates of the change in duration of temporary total injuries that occurred before and after the benefit increases for each earnings category. The table shows a clear pattern. There is a statistically significant increase in the average duration of temporary total claims after October 1 for each of the three groups of workers (segment A,C,E of Figure 2) for which benefits were increased. For example, workers in group E, who qualified for the maximum benefit, had an average log duration of 1.101 weeks if they were injured before the benefit increase, and an average log duration of 1.233 if they were injured after the benefit increase. The difference between these two numbers, which is reported in Column 3, indicates that the average duration of claims increased by about 13.2 percent for workers who received the higher maximum benefit. The average duration of claims increased

Table 1

Duration and Benefit for Temporary Total Disabilities,
Average Before and After Changes in Minnesota Benefit Schedule[a]
(Standard Error of Estimates in Parentheses)

Earnings Segment	(1) Injured 1/1/86-9/30/86	(2) Injured 10/1/86-12/31/86	(3) Difference of (2) and (1)
Segment A - Treatment (Earnings ≤ $68.4)			
Log Weeks of Temporary total	.723 (.066)	.958 (.124)	.235* (.138)
Log Weekly Benefit	4.224 (.001)	4.279 (.002)	.055** (.002)
Segment B - Control ($72 ≤ Earnings ≤ $171)			
Log Weeks of Temporary Total	.801 (.028)	.815 (.050)	.014 (.058)
Log Weekly Benefit	4.846 (.005)	4.841 (.008)	-.005 (.009)
Segment C - Treatment ($180 ≤ Earnings ≤ $256.5)			
Log Weeks of Temporary Total	.893 (.024)	1.000 (.042)	.107** (.049)
Log Weekly Benefit	5.143 (.000)	5.193 (.000)	.050** (.001)
Segment D - Control ($270 ≤ Earnings ≤ $513)			
Log Weeks of Temporary Total	.887 (.016)	.932 (.028)	.045 (.032)
Log Weekly Benefit	5.514 (.002)	5.513 (.003)	-.001 (.004)
Segment E - Treatment (Earnings ≥ $540)			
Log Weeks of Temporary Total	1.101 (.025)	1.233 (.041)	.132** (.048)
Log Weekly Benefit	5.835 (.001)	5.886 (.000)	.051** (.000)

Notes:

a. New schedule was effective October 1, 1986. Earnings segments refer to Figure 2.

b. Sample sizes are: 582 for segment A; 3,590 for segment B; 5,405 for segment C; 12,297 for segment D; and 5,189 for segment E.

* One-tail t-test of difference is statistically significant at .05 level.

** One-tail t-test of difference is statistically significant at .01 level.

by a similar magnitude, 11 percent, for workers at the first minimum, and by 24 percent for the sample of workers at the absolute minimum.

In contrast, workers in the two earnings segments (B and D) that had no benefit change in spite of the higher maximum and minimums, exhibit no statistically significant change in their average duration of claims after October 1st.[15] This finding suggests that the observed longer durations for workers who received the higher benefits would not have occurred in the absence of the benefit increase.

The average log weekly benefit is reported in Table 1 to measure the benefit changes during the sample periods. As noted earlier, benefits increased by 5 percent for those who receive the maximum or one of the minimum benefits. However, because the weekly wage is inferred from the First Report Form and in some cases does not reflect the wage rate that was actually used to determine benefits (e.g., wages from secondary employment and fringe benefits are omitted), the benefit does not increase by exactly 5 percent for individuals in segments A, C, and E. Nonetheless, the measured benefit increases for the period after October 1 are extremely close to 5 percent for workers in segments A, C, and E. In addition, the change in the average log benefit is statistically insignificant and trivial for the groups of workers in segments B and D, which were not affected by the maximum or minimum benefit increase. Consequently, workers on segment B and D appear to form valid control groups.

A difference-in-differences estimate of the elasticity of the average temporary total duration with respect to benefits (η) can be calculated from the information reported in Table 1 as $\eta^{ij} = (\Delta T^i - \Delta T^j)/(\Delta B^i - \Delta B^j)$, where ΔT^k is the change in average log duration for workers in segment k and ΔB^k is

the change in the average log benefit for workers in segment k. Six possible elasticities can be calculated because there are three groups that experienced a benefit increase (i's), and two groups that had an insignificant change in their benefit (j's). The estimated elasticities are:

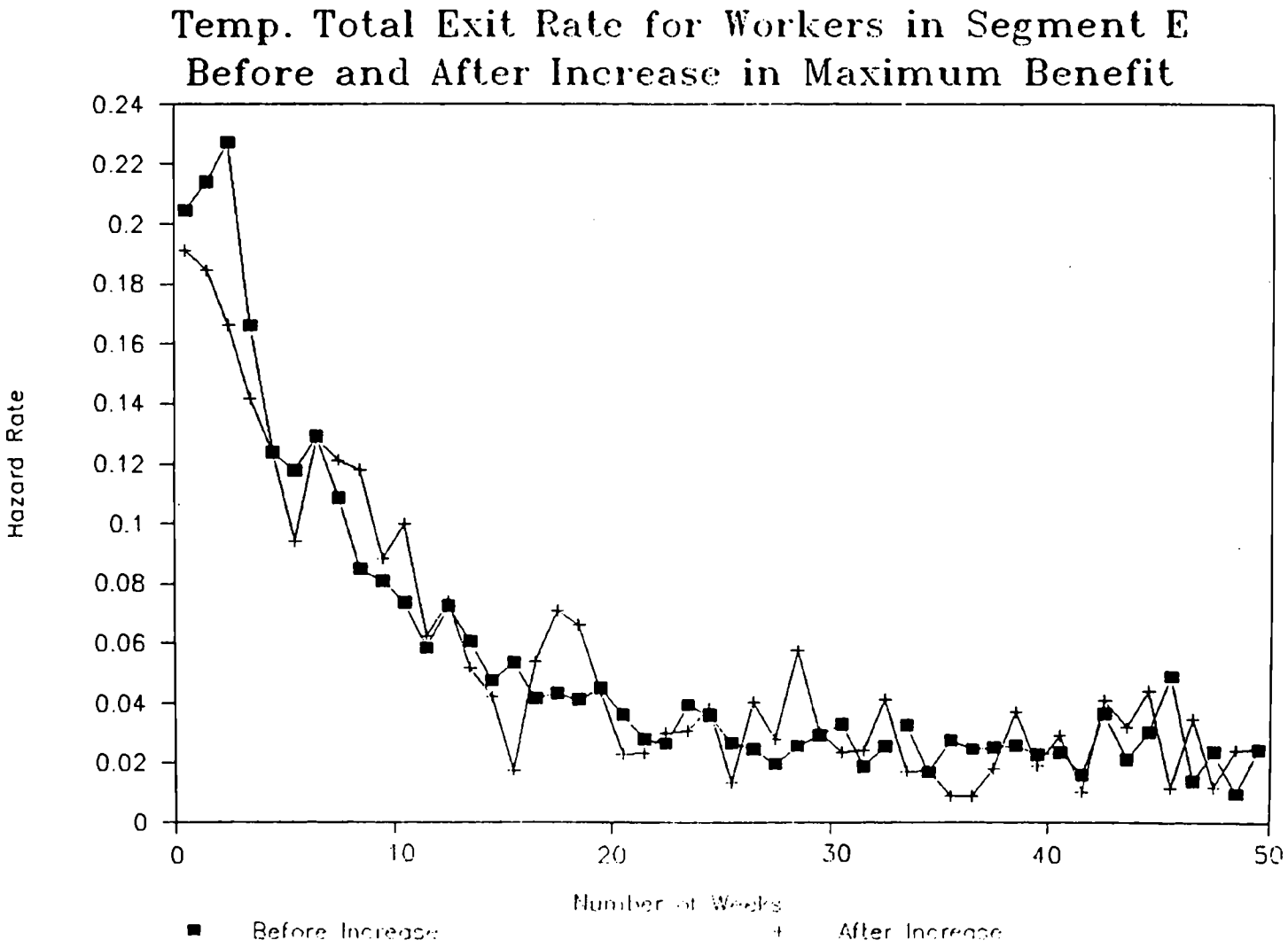
$$\eta^{AB} = 3.68 \qquad \eta^{AD} = 3.39$$
$$\eta^{CB} = 1.69 \qquad \eta^{CD} = 1.22$$
$$\eta^{EB} = 2.11 \qquad \eta^{ED} = 1.67 \ .$$

Even if we discount the two large elasticities derived from the imprecise estimate for segment A, the above elasticities are substantial. The unweighted average of the elasticities, excluding those based on segment A, is 1.67. This estimate is much larger than the elasticity that Butler and Worrall reported for temporary total back cases, and somewhat larger than Johnson and Ondrich's estimated elasticity for permanent partial cases.

Figure 3 contains plots of the weekly return-to-work hazard rate for workers in Segment E (the maximum benefit), depending on whether the injury occurred before or after the benefit increase. The figure depicts the proportion of ongoing injuries that close each week, through the fiftieth week. For both groups of workers, the plots show a sharply declining hazard rate. Overall, more than half of all cases end within the first month, and nearly three-quarters end within the first two months. The mean injury duration is 8 weeks.

In each of the first seven weeks, the exit rate is greater for workers who were injured before the benefit increase than for those who were injured prior to the benefit increase. Over the next four weeks, however, the hazard

Figure 3


Temp. Total Exit Rate for Workers in Segment E
Before and After Increase in Maximum Benefit
Hazard Rate
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
10
20
30
40
50
Number of Weeks
Before Increase
After Increase

rate of those with higher benefits exceeds the hazard rate of those with lower benefits. After three months, the hazard rates look about the same for both groups of workers. Plots of the hazard rate for workers in Segments A and C, which are not reported here, show a similar pattern to Figure 3. These results suggest that benefit increases have a somewhat greater effect on recipients with relatively short term injuries.

Finally, notice that Table 1 also shows that the average duration of workers' compensation spells increases with earnings in this sample. For example, workers with weekly earnings below $68.40 on average have substantially shorter injury spells than workers who earn in excess of $540 per week. This finding is surprising in view of past cross-sectional studies, which found that average duration increases with the proportion of lost wages replaced by workers' compensation benefits, because individuals with low earnings have a higher replacement rate than individuals with high earnings. As will be discussed below, the negative relationship between replacement rates and duration illustrates the difficulty of drawing inferences when there is not exogenous variation in benefits and wages.

Composition of Injuries

An increase in benefits may affect the incidence as well as the duration of workers' compensation claims. Therefore, the composition of temporary total injuries may be affected by an increase in the benefit level. A composition change would result if, for example, the availability of more generous benefits after a benefit increase encourages some workers with relatively minor injuries to pursue claims that they would otherwise have ignored in the absence of a benefit increase. On the other hand, higher benefits may induce some workers to take more risks on the job, which may

result in more serious injuries.

Table 2 explores the impact of changing benefits on the composition of workers' compensation claims by estimating the relative frequency of claims for various types of injuries for workers on the different segments of Figure 2, before and after the benefit increase. The results indicate that the relative frequency of injuries involving bone fractures increased slightly for workers who experienced a benefit increase, but was hardly changed for workers on the segments that were unaffected by the benefit increase. The relative frequency of fractures after October 1 increased by an average of 3 percent for workers on segments A, C, and E, while there was a slight decrease in the relative frequency of cases involving fractures for workers in segments B and D. On the other hand, there is no discernable difference in the pattern of changes in the share of cases involving sprains, back injuries, or multiple injuries for workers in the different benefit segments.

III. Controlling for Covariates

Because of potential compositional changes in workers' compensation recipients in response to a change in benefits, it is desirable to control for covariates in estimating the duration response to a benefit increase. In the absence of truncation and censoring, the log-linear multiple regression model corresponds to a class of duration models known as the accelerated failure time model. The accelerated failure time model encompasses a wide array of parametric duration models, including the Weibull model, the log-normal model, the generalized gamma model, and the log-logistic model (see John Kalbfleisch and Ross Prentice, 1980; Chapter 2). As noted previously, less than one percent of the temporary total claims are truncated in this data set, so the

Table 2
Relative Frequency of Selected Injuries, Before and After Benefit Change

Earnings Segment	(1) Injured 1/1/86-9/30/86	(2) Injured 10/1/86-12/31/86	(3) Difference of (2) and (1)
Segment A - Treatment			
Back Injury	.172	.126	-.046
	(.018)	(.029)	(.036)
Fracture	.098	.170	.072*
	(.014)	(.032)	(.031)
Sprain	.409	.326	-.083*
	(.023)	(.040)	(.048)
Multiple Injuries	.107	.089	-.018
	(.015)	(.025)	(.030)
Segment B - Control			
Back Injury	.283	.228	-.054**
	(.009)	(.014)	(.017)
Fracture	.059	.052	-.008
	(.005)	(.008)	(.009)
Sprain	.496	.450	-.046*
	(.010)	(.017)	(.020)
Multiple Injuries	.092	.114	.021*
	(.006)	(.011)	(.012)
Segment C - Treatment			
Back Injury	.286	.268	-.017
	(.007)	(.012)	(.014)
Fracture	.058	.065	.007
	(.004)	(.007)	(.007)
Sprain	.493	.491	-.002
	(.008)	(.014)	(.016)
Multiple Injuries	.090	.096	.006
	(.004)	(.008)	(.009)
Segment D - Control			
Back Injury	.275	.258	-.017*
	(.005)	(.008)	(.009)
Fracture	.070	.074	.004
	(.003)	(.005)	(.005)
Sprain	.484	.464	-.020*
	(.005)	(.009)	(.011)
Multiple Injuries	.098	.107	.009
	(.003)	(.006)	(.006)
Segment E - Treatment			
Back Injury	.272	.267	-.005
	(.007)	(.012)	(.014)
Fracture	.072	.087	.015*
	(.004)	(.008)	(.008)
Sprain	.503	.486	-.017
	(.008)	(.013)	(.016)
Multiple Injuries	.118	.119	.001
	(.005)	(.009)	(.010)

Notes: Standard errors in parentheses. See notes to Table 1 for details.

log-linear regression model seems a preferable alternative for estimating the duration of temporary total claims than making parametric distributional assumptions to handle truncation.

A fairly general model to explain the duration of injury spells as a function of benefits and other covariates is:

$$(1)\quad \ln T_i = \alpha_o + \alpha_1 A_i + \alpha_2 B_i + \alpha_3 C_i + \alpha_4 D_i + \beta_o \cdot \ln(\text{Wage}_i) + \beta_1 A_i \cdot \ln(\text{Wage}_i) + \beta_2 B_i \cdot \ln(\text{Wage}_i) + \beta_3 C_i \cdot \ln(\text{Wage}_i) + \beta_4 D_i \cdot \ln(\text{Wage}_i) + \eta \ln(\text{Benefit}_i) + X_i \Pi + \epsilon_i$$

where T_i is the completed spell duration for worker i. The variables denoted by a capital letter, A_i, B_i, C_i or D_i, are dummy variables that indicate the earnings segment along the horizontal axis of Figure 2 in which each worker is categorized. For example, if worker i earns less than $68.40 per week, dummy variable A_i will equal 1 and the other dummies (B_i, C_i, D_i) will equal zero. These dummy variables are interacted with the log of the weekly wage to allow for piecewise linear effects of past earnings on injury spells. Parameters are denoted by greek letters. The coefficient, η, is the elasticity of injury duration with respect to benefits, which is assumed constant across individuals. The vector X_i denotes covariates, including dummies for the type of injury and insurance arrangement, and ϵ_i is a random disturbance.

Furthermore, since the benefit level changed for workers in some earnings groups but not for workers in other groups, equation (1) could also include a dummy variable, z_i, which equals 1 if the worker was injured after the benefit increase went into effect, and 0 otherwise. Including z_i, as shown in equation (2), will net out additive period effects that might be correlated

with the change in benefits.

$$(2)\quad \ln T_i = \alpha_o + \alpha_1 A_i + \alpha_2 B_i + \alpha_3 C_i + \alpha_4 D_i + \beta_o \cdot \ln(Wage_i) + \beta_1 A_i \cdot \ln(Wage_i) + \beta_2 B_i \cdot \ln(Wage_i) + \beta_3 C_i \cdot \ln(Wage_i) + \beta_4 D_i \cdot \ln(Wage_i) + \eta \ln(Benefit_i) + X_i \Pi + \delta z_i + \epsilon_i$$

The wage terms in equation (2) are designed to absorb the benefit schedule at a point in time. Therefore, the variation in benefits due to the nonlinear benefit schedule has been partialled out. But in Minnesota there is also idiosyncratic variation in benefits for workers who earn the same wage because, in some cases, benefits are affected by the payment of fringe benefits, apprenticeship status, and other factors. Additionally, the observed wage variable is measured with some error because it is derived from the First Report. If equation (2) is estimated by Ordinary Least Squares (OLS) effect of the benefit is identified by both idiosyncratic variation in benefits (at the same wage) and by the change in the benefit schedule.[16]

Since the idiosyncratic variation in benefits is not necessarily a legitimate source of variation to use to identify the benefit elasticity, it is desirable to estimate the benefit elasticity from variations in benefits that are solely due to the intertemporal change in the benefit schedule. This is accomplished by estimating equation (2) by Two-Stage Least Squares (2SLS), using dummy variables indicating whether an individual is in segment A,B,C or D and injured after the benefit change, along with the included variables in (2), as instruments for the benefit variable. In other words, equation (2) is identified by the exclusion restriction of the vector of interactions, ($z_i \cdot A_i$, $z_i \cdot B_i$, $z_i \cdot C_i$, $z_i \cdot D_i$). It should be noted that if the legislated benefit

change was the only source of linearly independent variations in benefits, then estimation of equation (2) by 2SLS and by OLS would be identical.

Estimates

Columns 1 and 2 of Table 3 present OLS estimates of equation (2), and Columns 3 and 4 present 2SLS estimates. In both the OLS and 2SLS estimates, the first equation excludes covariates, and the second equation includes several covariates. Means and standard deviations of the variables are also provided in the table.[17]

The OLS estimates yield a larger benefit elasticity than the 2SLS estimates. Moreover, a Hausman test rejects the hypothesis that the OLS and 2SLS estimates of the benefit elasticity are equal at the .05 level, whether covariates are included or excluded from the equation. Since the benefit effect in the 2SLS equation is identified solely by variation created by a legislative act that could reasonably be taken as exogenous in this case, the idiosyncratic variation in benefits is not likely to be a legitimate source of variation to use to identify the benefit elasticity. For this reason, the 2SLS estimate, which relies solely on time-series variation in benefits, is probably more reliable.

The elasticity estimated by 2SLS without covariates is 1.83 (t=2.11), which is similar in magnitude to the difference-in-differences elasticities presented in Section 2. The addition of covariates slightly reduces the estimated benefit elasticity in both the OLS and 2SLS estimates, suggesting that compositional changes are not very significant. The estimated elasticity of 1.67 in Column 4 implies that a 10 percent increase in benefits would increase the average duration of temporary total work injuries by one week.

Chi-square over-identification tests are reported at the bottom of the

Table 3
Estimates of Workers' Compensation Spell Duration Based on Change in Benefit Schedule[a]
(Dependent Variable: Log Completed Duration)

Variable[b]	Mean [SD]	OLS (1)	OLS (2)	2SLS (3)	2SLS (4)
Intercept	1.00 [.00]	-17.364 (4.283)	-15.858 (4.143)	-11.717 (5.105)	-10.181 (4.934)
Log (Weekly Benefit)	5.40 [.38]	2.800 (.723)	2.646 (.699)	1.827 (.867)	1.668 (.838)
A	.02 [.14]	6.324 (1.543)	5.435 (1.501)	4.805 (1.714)	3.907 (1.665)
B	.13 [.33]	17.227 (4.329)	16.039 (4.192)	11.562 (5.148)	10.343 (4.980)
C	.20 [.40]	6.421 (1.478)	6.088 (1.441)	5.782 (1.511)	5.444 (1.473)
D	.46 [.50]	17.110 (4.598)	16.043 (4.448)	11.061 (5.477)	9.961 (5.294)
Log (Weekly Wage)	5.73 [.59]	.326 (.132)	.235 (.130)	.332 (.132)	.241 (.130)
A•Log (Weekly Wage)	.08 [.55]	-.343 (.206)	-.207 (.201)	-.352 (.206)	-.216 (.201)
B•Log (Weekly Wage)	.63 [1.63]	-2.935 (.741)	-2.724 (.718)	-1.965 (.881)	-1.749 (.853)
C•Log (Weekly Wage)	1.06 [2.14]	-.808 (.245)	-.761 (.239)	-.813 (.245)	-.766 (.239)
D•Log (Weekly Wage)	2.73 [2.95]	-2.742 (.735)	-2.567 (.711)	-1.774 (.876)	-1.594 (.846)
Injured after Oct. 1	.24 [.43]	.022 (.027)	-.007 (.026)	.042 (.029)	.014 (.028)
<u>Insurance Arrangement</u>					
Self Insured	.20 [.40]	—	-.090 (.028)	—	-.090 (.028)
Assigned Risk	.07 [.25]	—	.131 (.037)	—	.131 (.037)
State Fund	.03 [.17]	—	-.153 (.056)	—	-.153 (.056)
<u>Work Schedule</u>					
Full Time	.82 [.38]	—	-.124 (.035)	—	-.124 (.035)
Seasonal	.03 [.16]	—	.023 (.064)	—	.023 (.064)
Irregular Hrs.	.02 [.12]	—	.211 (.078)	—	.210 (.078)
<u>Employer Characteristics</u>					
Log (Avg. Estab. Size)[c]	3.57 [1.34]	—	-.042 (.008)	—	-.042 (.008)
Private Corporation	.65 [.48]	—	-.025 (.029)	—	-.025 (.029)
Public Administration	.03 [.12]	—	-.090 (.062)	—	-.090 (.062)

- Continued -

Table 3 (Continued)

Variable[b]	Mean [SD]	OLS (1)	OLS (2)	2SLS (3)	2SLS (4)
Professional	.05 [.21]	—	-.207 (.050)	—	-.206 (.050)
Manager	.04 [.19]	—	-.265 (.054)	—	-.265 (.054)
Clerical	.06 [.23]	—	-.185 (.045)	—	-.185 (.045)
Crafts	.19 [.40]	—	.043 (.031)	—	.043 (.031)
Operative	.27 [.44]	—	.091 (.028)	—	.091 (.028)
Service	.20 [.40]	—	-.144 (.032)	—	-.144 (.032)
Farm Worker	.01 [.07]	—	.308 (.128)	—	.308 (.128)
Demographics					
Male	.70 [.46]	—	-.101 (.032)	—	-.101 (.032)
Married	.60 [.49]	—	.072 (.034)	—	.072 (.034)
Male • Married	.40 [.49]	—	-.075 (.040)	—	-.075 (.040)
Age 25-34	.35 [.48]	—	.172 (.028)	—	.171 (.028)
Age 35-44	.22 [.42]	—	.325 (.032)	—	.325 (.032)
Age 45-54	.14 [.34]	—	.385 (.036)	—	.385 (.036)
Age 55+	.10 [.29]	—	.440 (.039)	—	.440 (.039)
Injury Characteristics[d]					
7 Part of Body Dummies	—	No	Yes	No	Yes
28 Nature of Injury Dummies	—	No	Yes	No	Yes
σ_ϵ^2		2.251	2.098	2.251	2.098
Chi-Square Over-ID Statistic (DF=3)		—	—	.606	.499

a. Sample size is 25,446. Standard errors of estimates are in parentheses. Mean [SD] of the dependent variable is .924 [1.506].

b. The omitted insurance arrangement is private insurance; the omitted work schedule is part time; the omitted ownership typeis unincorporated; the omitted occupation is laborer; the omitted age group is 16-24 year olds.

c. Estab. size is the average number of employees per establishment in the industry.

d. The 28 nature of injury dummies are: amputation, burn from heat, chemical burn, concussion, infective or parasitic disease, contusion, cut, dermatitis, dislocation, electric shock, fracture, hypothermic, hearing impairment, hernia, inflammation of joints, systemic poisoning, radiation exposure, scratch, hemorrhoids, hepatitis, multiple injuries, atmospheric pressure, circulatory system, eye disease, nervous system disorder, respiratory system disorder, hearing impairment, and miscellaneous injuries. The 7 body parts are: head or face, neck, upper extremities, lower extremities, multiple parts, body system, and nonclassifiable parts. The omitted body part is trunk, and the omitted nature of injury is sprain.

table to test whether the instruments are orthogonal to the residual in the 2SLS equations. Although these specification test results suggest that the model is correctly specified, the results are not compelling in view of the imprecision of the instrumented coefficient. On the other hand, the quasi-experimental nature of the instruments lends some additional support for the plausibility of the 2SLS estimation strategy.

The coefficients on the wage terms indicate that the pre-disability wage has a complicated, nonlinear effect on injury duration. Within most of the earnings brackets, the duration decreases with the wage rate, as evidenced by the negative coefficients on the wage-earnings segment interactions. It should also be noted that the dummy for injuries occurring after October 1 is statistically insignificant, suggesting that period effects are unimportant.

The estimated coefficients for the remaining covariates are very similar in the OLS and 2SLS models. The point estimates indicate that the duration of temporary total spells is about 10 percent shorter in self-insured firms than in privately insured firms (the omitted dummy variable), and that the duration of spells is about 15 percent shorter in firms insured by the Minnesota State Fund than by a private insurance carrier. Moreover, the difference in the duration between self-insured firms and the State Fund is not statistically significant. The spell length is longest at firms covered by the Minnesota Assigned Risk Pool, which only accepts firms with inferior safety records.

A discussed in more detail below, a possible explanation for the shorter injury duration at self-insured firms than privately insured firms is that self-insured employers bear the full marginal cost of benefits, while insurance premiums are only partially adjusted accident costs at privately insured firms. This financial arrangement provides self-insured firms with a

strong incentive relative to privately insured firms to encourage workers to return to work quickly after an injury. On the other hand, the group of firms that selects into self-insurance may have injuries that are less severe than privately insured firms, even after controlling for observable covariates.

The estimates also indicate that men have shorter injury spells than women, white collar workers have shorter injury spells than blue collar workers, and younger workers have shorter injury spells than older workers. Interestingly, being married tends to extend the length of time on workers' compensation insurance for women, but has no effect for men. Employees who work in larger establishments return to work after injuries faster than employees in smaller establishments, perhaps due to the fact that it is easier to facilitate injured workers in large establishments.[18] Larger establishments are also more likely to be experience rated.

Several injury characteristic dummy variables are included in the equations estimated in Columns 2 and 4 but not reported in the table. To summarize their effects, the results indicate that injuries involving an amputation, nervous disorder, hernia, or heart ailment, and injuries to the back and to multiple body parts have relatively long spell durations. On the other hand, scratches, cuts, contusions, and injuries to the lower extremities have relatively short spell durations.

IV. Estimates for Selected Subsamples

A. Short-Term Injuries

Table 4 presents 2SLS estimates of injury duration equations including covariates for several different samples. For convenience, Column 1 replicates the estimates for the full sample. Column 2 presents an estimate

of the same equation for the subset of workers with injuries that on average close in less than 10 weeks. The sample of short-term injuries includes such injuries as lacerations, scratches, and poison ivy infections.[19] The purpose of presenting results for the sample of workers with short-term injuries is twofold. First, it is likely that none of the spell durations for these types of injuries is truncated. Second, it is useful to know whether the duration of short-term injuries is relatively more responsive to changes in benefits.

The results for the sample of workers with short-term injuries are similar to those for the overall sample. The effect of benefits on injury duration is slightly greater in the sample of short-term injuries than in the full sample. The difference in the benefit elasticities, however, is not statistically significant. In addition, the effect of the covariates is similar in the sample of short-term injuries and in the full sample. These results suggest that, as expected, truncation of very long-term injuries in this sample has little effect on the estimates.

B. Form of Insurance

In Minnesota, employers can satisfy their workers' compensation insurance requirement by purchasing insurance from a private insurance carrier or from the competitive state insurance fund, or by self-insuring. Permission to self-insure is typically only granted to large, financially solvent firms.[20] Employers who are unable to provide insurance through other means may be eligible for coverage by the Minnesota State Assigned Risk Pool, which insures high-risk firms. Privately insured firms account for approximately 70 percent of injuries, and self-insured firms account for nearly 20 percent of injuries. The Minnesota Competitive State Fund is relatively new and quite small, handling just 3 percent of injuries that occur in the state. The alternative

Table 4
2SLS Estimates of Workers' Compensation Spell Durations for Selected Samples[a]

Variable	Full Sample (1)	Short-Term Injuries (2)	Self-Insured Employers (3)	Nonself-Insured Employers (4)
Intercept	-10.181	-10.700	5.705	-13.101
	(4.934)	(5.387)	(11.202)	(5.503)
Log (Weekly Benefit)	1.668	1.814	-1.214	2.270
	(.838)	(.915)	(1.907)	(.933)
A	3.907	3.724	3.124	4.034
	(1.665)	(1.810)	(4.143)	(1.851)
B	10.343	10.819	-2.994	13.134
	(4.980)	(5.436)	(11.379)	(5.550)
C	5.444	5.693	2.390	5.641
	(1.473)	(1.602)	(3.856)	(1.614)
D	9.961	10.326	-5.673	12.581
	(5.294)	(5.780)	(11.977)	(5.910)
Log (Weekly Wage)	.241	.181	.363	.163
	(.130)	(.143)	(.297)	(.148)
A•Log (Weekly Wage)	-.216	-.139	-1.054	-.062
	(.201)	(.216)	(.638)	(.217)
B•Log (Weekly Wage)	-1.749	-1.835	.501	-2.235
	(.853)	(.930)	(1.954)	(.950)
C•Log (Weekly Wage)	-.766	-.806	-.502	-.749
	(.239)	(.259)	(.645)	(.260)
D•Log (Weekly Wage)	-1.594	-1.653	.902	-2.010
	(.846)	(.924)	(1.915)	(.945)
Injured after Oct. 1	.014	-.018	.043	.011
	(.028)	(.030)	(.061)	(.031)
<u>Insurance Arrangement</u>				
Self Insured	-.090	-.100	—	—
	(.028)	(.030)		
Assigned Risk	.131	.134	—	.120
	(.037)	(.040)		(.037)
State Fund	-.153	-.174	—	-.156
	(.056)	(.059)		(.055)
<u>Work Schedule</u>				
Full Time	-.124	-.078	-.125	-.106
	(.035)	(.039)	(.084)	(.039)
Seasonal	.023	.128	-.130	.047
	(.064)	(.070)	(.181)	(.069)
Irregular Hrs.	.210	.242	-.074	.295
	(.078)	(.083)	(.170)	(.089)
<u>Employer Characteristics</u>				
Log (Avg. Estab. Size)	-.042	-.033	-.054	-.047
	(.008)	(.009)	(.016)	(.009)
Private Corporation	-.025	-.023	.185	-.143
	(.029)	(.032)	(.054)	(.036)
Public Administration	-.090	-.063	-.024	.269
	(.062)	(.070)	(.078)	(.142)

- Continued -

Table 4 (Continued)

Variable	Full Sample (1)	Short-Term Injuries (2)	Self-Insured Employers (3)	Nonself-Insured Employers (4)
Occupation				
Professional	-.206 (.050)	-.163 (.054)	-.101 (.093)	-.212 (.061)
Manager	-.265 (.054)	-.242 (.059)	-.303 (.160)	-.273 (.057)
Clerical	-.185 (.045)	-.194 (.049)	-.037 (.103)	-.223 (.050)
Crafts	.043 (.031)	.031 (.033)	.178 (.082)	.006 (.033)
Operative	.091 (.028)	.078 (.030)	.216 (.071)	.065 (.031)
Service	-.144 (.032)	-.142 (.035)	-.059 (.072)	-.142 (.037)
Farm Worker	.308 (.128)	.233 (.137)	—	.241 (.128)
Demographics				
Male	-.101 (.032)	-.120 (.035)	-.217 (.072)	-.072 (.036)
Married	.072 (.034)	.092 (.038)	.034 (.069)	.076 (.039)
Male • Married	-.075 (.040)	-.102 (.045)	-.005 (.088)	-.087 (.046)
Age 25-34	.171 (.028)	.147 (.030)	.245 (.083)	.156 (.030)
Age 35-44	.325 (.032)	.302 (.035)	.330 (.086)	.337 (.035)
Age 45-54	.385 (.036)	.367 (.039)	.373 (.092)	.402 (.040)
Age 55+	.440 (.039)	.417 (.043)	.516 (.096)	.425 (.044)
σ_ϵ^2	2.098	2.038	2.110	2.088
Chi-Square Over-ID Statistic (DF-3)	.499	.306	.512	.766
Sample Size	25,446	20,910	5,021	20,425

Notes:

a. All equations include 7 part of body dummies. Columns 1 and 4 include 28 nature of injury dummies; Column 2 includes 27 nature of injury dummies; and Column 3 includes 25 nature of injury dummies. See notes to Table 3 for other details.

insurance arrangements provide different incentives for firms to invest resources in accident prevention and to rehabilitate disabled employees.

In the event of a work-related injury, self-insured firms are required to provide the same level of workers' compensation benefits as firms that are insured through private carriers or the state. Self-insurers must maintain a security account with a balance of at least 110 percent of their expected annual workers' compensation costs. The firm's subsequent workers' compensation losses are drawn from this account. As a result, self-insurers bear the full marginal cost of injuries.

In contrast, insurance premiums for firms covered by the state fund, private carriers, or the Assigned Risk Pool are imperfectly modified to reflect an employer's past loss experience. Insurance premiums are typically determined by a weighted average of the firm's last three year's accident experience and the average accident experience in the firm's industry. Greater weight is placed on the firm's past insurance losses for larger firms. At one extreme, very small firms are "manual rated," which means they are charged the insurance rate for their industry listed in the state's rating manual regardless of their actual experience. For very large firms, most or all of the weight is placed on the firm's own experience. Louise Russel (1973) estimates that more than 80 percent of employees work in firms that are not fully experience rated for their workers' compensation costs.

Moreover, even in fully experience-rated firms, the typical experience-rating formula places greater emphasis on the incidence of past workers' compensation claims than on the severity (i.e., duration x average benefit) of injuries in determining experience-rating offset. This practice, known as "loss limitations," is accomplished by discounting the amount of losses

incurred for claims that cost more than $2,000, and by capping the maximum loss for a claim. The severity of injuries is given little weight in experience rating modifications because the conventional view in the insurance industry is that the duration of work injuries is beyond the employers' control (National Council on Compensation Insurance, 1982).

There are several ways, however, in which an employer might be able to affect the duration of an employee's workers' compensation claim. First, an employer could modify a disabled employee's work environment to accommodate his or her disability. Second, an employer could arrange for a temporarily disabled employee to perform alternate job tasks until he or she is fully recovered. Third, an employer could have an employee initially return to work on a part-time basis. Fourth, an employer could apply pressure on the employee to rapidly return to work. Finally, an employer might file for a discontinuance of benefits or challenge a claim if it is believed that a beneficiary is malingering.

A comparison of the duration of temporary total claims in self-insured and nonself-insured firms provides a test of whether firms' incentives influence the amount of work time their employees lose after a workplace injury. Because self-insured firms directly bear a greater share of the marginal cost of providing workers' compensation benefits to employees, these firms have a greater incentive to induce their workers to quickly return to work. The regression results in Table 3 indicate that self-insured firms have about a 10% shorter average injury duration than privately insured firms.[21] Moreover, in results not reported here, self-insured firms were found to have shorter injury durations than privately insured firms in a variety of homogeneous injuries, including hernias, broken fingers, and sprained ankles.

Columns 3 and 4 of Table 4 further explore differences in injury durations between self-insured and nonself-insured firms by estimating separate injury duration equations for these types of employers. The results are suggestive. The benefit elasticity is greater for nonself-insured firms than for the full sample, and the benefit elasticity is negative (but very imprecise) and statistically insignificant for self-insured firms. These results provide some support for the view that the effect of providing more generous benefits on employees' injury spells is tempered if employers' have a stronger incentive to have workers return to work.

V. Estimates Identified by Nonlinearities in the Benefit Schedule

In the absence of experimental data on benefit changes, it has been common for researchers to estimate the effect of social insurance benefits (which are a nonlinear function of wages) by restricting the functional form of wages. In the context of equation 2, this is equivalent to assuming that the piecewise log linear wage terms should be excluded from the equation. Although this restriction is overwhelmingly rejected by the estimates in Table 3, it is natural to question how sensitive the estimates would be to functional form restrictions of this type.

Table 5 presents several OLS injury duration regressions that are identified by restricting the functional form of the wage term.[22] Variations in the benefit variable in these specifications are primarily due to nonlinearities in the benefit formula. These estimates are meant to provide a comparison to the specifications previously estimated in the literature (e.g., Butler and Worrall, 1985). In general, this exercise shows that the benefit elasticity is remarkably sensitive to alternative identifying assumptions

Table 5

Determinants of Duration of Workers' Compensation Spells[a]
OLS Estimates

(Dependent Variable: Log Completed Duration)

Independent Variable[b]	Coefficient (Standard Error) (1)	(2)	(3)	(4)	(5)	(6)
Intercept	-.303 (.194)	-.108 (.214)	.043 (.211)	.819 (.016)	1.025 (.056)	.958 (.057)
Log (Weekly Benefit)	.319 (.100)	.280 (.100)	.279 (.098)	--	--	--
Log (Weekly Wage)	-.051 (.066)	-.041 (.066)	-.086 (.065)	--	--	--
Log (Benefit/Wage)	--	--	--	-.308 (.038)	-.196 (.050)	-.103 (.049)
Insurance Arrangement						
Self-Insured	--	-.098 (.027)	-.100 (.026)	--	-.077 (.026)	-.083 (.026)
Assigned Risk	--	.148 (.037)	.134 (.036)	--	.141 (.037)	.128 (.036)
State Fund	--	-.174 (.055)	-.145 (.054)	--	-.179 (.055)	-.148 (.054)
Work Schedule						
Full Time	--	-.164 (.032)	-.138 (.031)	--	-.118 (.031)	-.121 (.030)
Seasonal	--	-.005 (.062)	-.009 (.061)	--	.032 (.062)	.021 (.060)
Irregular Hrs.	--	.168 (.077)	.178 (.075)	--	.183 (.077)	.192 (.075)
Employer Characteristics						
Log (Avg. Establ. Size)[c]	--	-.055 (.008)	-.047 (.008)	--	-.053 (.008)	-.048 (.008)
Private Corporation	--	-.033 (.028)	-.018 (.028)	--	-.028 (.028)	-.012 (.028)
Public Administration	--	-.015 (.061)	-.038 (.060)	--	.001 (.061)	-.025 (.060)
Occupation						
Professional	--	-.244 (.048)	-.223 (.047)	--	-.238 (.048)	-.217 (.047)
Manager	--	-.237 (.053)	-.258 (.052)	--	-.241 (.053)	-.262 (.052)
Clerical	--	-.152 (.044)	-.184 (.043)	--	-.160 (.044)	-.191 (.043)
Crafts	--	.031 (.030)	.047 (.029)	--	.040 (.030)	.055 (.029)
Operative	--	.088 (.027)	.098 (.027)	--	.091 (.027)	.091 (.027)

Continued

Table 5 (Continued)

Independent Variable[b]	Coefficient (Standard Error) (1)	(2)	(3)	(4)	(5)	(6)
Service	--	-.161 (.032)	-.129 (.031)	--	-.179 (.031)	-.143 (.031)
Farm Worker	--	.344 (.125)	.314 (.122)	--	.317 (.124)	.293 (.122)
Demographics						
Male	--	-.171 (.031)	-.107 (.030)	--	-.156 (.031)	-.094 (.030)
Married	--	.074 (.033)	.065 (.032)	--	.070 (.033)	.061 (.032)
Male * Married	--	-.073 (.039)	-.066 (.039)	--	-.060 (.039)	-.056 (.039)
Age 25-34	--	.205 (.027)	.166 (.027)	--	.225 (.027)	-.182 (.027)
Age 35-44	--	.383 (.031)	.327 (.031)	--	.413 (.031)	.350 (.030)
Age 45-54	--	.455 (.035)	.382 (.034)	--	.484 (.035)	.405 (.034)
Age 55+	--	.536 (.038)	.443 (.037)	--	.561 (.038)	.463 (.037)
Season Injured						
Winter	--	.041 (.025)	.027 (.025)	--	.038 (.025)	.024 (.025)
Spring	--	-.047 (.025)	-.034 (.025)	--	-.054 (.025)	-.040 (.025)
Summer	--	-.036 (.025)	-.005 (.024)	--	-.041 (.025)	-.010 (.024)
Injury Characteristics[d]						
7 Part of Body Dummies	No	No	Yes	No	No	Yes
28 Nature of Injury Dummies	No	No	Yes	No	No	Yes
R^2	.004	.028	.074	.002	.027	.073

Notes:

a. Sample size is 27,825. The mean (SD) of the dependent variable is .824 (1.505).

b. The omitted insurance arrangement is private insurance; the omitted work schedule is part time; the omitted occupation is laborer; the omitted age group is 16-24 year-olds; and the omitted season is Fall. The equations also include a dummy variable for non-reported ownership status.

c. Establishment size is the average number of employees per establishment in the employer's 3 or 4 digit SIC industry, derived from the County Business Patterns survey for the state of Minnesota in 1986.

d. The 28 nature of injury dummies are: amputation, burn from heat, chemical burn, concussion, infective or parasitic disease, contusion, cut, dermatitis, dislocation, electric shock, fracture, hypothermia, hearing impairment, hernia, inflammation of joints, systemic poisoning, radiation exposure, scratch, hemorrhoids, hepatitis, multiple injuries, atmospheric pressure, circulatory system, eye disease, nervous system disorder, respiratory system disorder, hearing impairment, and miscellaneous injuries. The 7 body parts are: head or face, neck, upper extremities, lower extremities, multiple parts, body system, and nonclassifiable parts. The omitted body part is trunk, and the omitted nature of injury is sprain.

based on functional form.

The log of the benefit and the log of the wage are entered as separate regressors in the first three columns of Table 5. In these specifications, the benefit has a small but statistically significant, positive effect on the duration of claims, and the wage has a statistically insignificant, negative effect on claim duration. The magnitude of the benefit elasticity is close to Butler and Worrall's (1985) Weibull model estimate for Illinois, but substantially smaller than that implied by the natural experiment studied here.

Columns 4-6 of Table 5 enter the log of the replacement rate (weekly benefit divided by weekly wage) in place of the separate wage and benefit variables. This specification constrains the benefit and wage to have equal but opposite signed effects, which imposes a more restrictive functional form assumption than Columns 1-3. This modification in the specification yields a strikingly different result: A higher ratio of the benefit to the wage is associated with a shorter duration of time spent on workers' compensation insurance. Given that the benefit and wage have opposite signs in Columns 1-3, the negative effect of the replacement rate is counterintuitive.

The dramatic difference between the two different specifications in Table 5 can be traced to the strong multicolinearity between the benefit and wage variables. To see this, denote B as the benefit and W as the wage, and let b_1 equal the benefit coefficient and b_2 the wage coefficient in the specification in Columns 1-3. Using the omitted-variable formula, the coefficient on the log replacement rate, a_1, in the restrictive specification estimated in Columns 4-6 can be decomposed as:

$$(3) \quad a_1 = b_1 + (b_1 + b_2) \times \mathrm{Cov}(\ln W, \ln B/W) \; / \; \mathrm{Var}(\ln B/W) \; .$$

Substituting into equation (3), the coefficient on the log replacement rate in Column 4 is $-.308 = .319 + (.319 - .051) \times (-.124 \; / \; .053)$. The variance in the replacement rate (.053) is relatively low because benefits are nearly a linear transformation of wages. Moreover, the replacement rate declines sharply with wages, which leads to the large negative covariance between the two variables.

Lastly, it should be noted that the estimated negative effect of the replacement rate on spell durations is not entirely surprising in light of the cross-sectional relationship between wages and mean spell duration discussed in regards to Table 1. Higher paid workers tend to have a lower replacement rate and a longer injury duration, on average. Moreover, the fact that the effect of the replacement rate on nonwork spells is only one-third as large in magnitude in Column 6 as in Column 4 suggests that the variables measuring the workers' occupation, extent of injury, and demographic characteristics can account for a large portion of the negative effect of the replacement rate. This finding may result because, other things equal, high-pay workers have more dangerous jobs, or because high-pay workers are less likely to pursue claims for minor injuries.

The qualitatively different estimates of the effect of benefits on duration in the two specifications in Table 5 exemplify how incorrect inference can be drawn about the effect of social programs when nonlinearities in replacement rate formulas generate the main source of variations in benefits and wages.[23]

VI. Summary and Conclusion

This paper has explored the effect of the workers' compensation insurance system on the duration of workplace injuries. The analysis focuses on a natural experiment that increased benefits for some workers, but left benefits unchanged for other workers. This natural experiment is used to estimated the effect of providing more generous benefits on the duration of work injuries. In addition, incentive effects for employers' to facilitate and expedite their employees' return to work are also considered.

In a period when benefits were increased by 5 percent for workers who qualify for the minimum or maximum workers' compensation benefit, the average duration of an injury spell was found to have increased by 8 percent for the group of workers that received the higher minimum or maximum, but was virtually unchanged for workers who were unaffected by the benefit change. Moreover, the benefit response tends to be greater for workers who have short-term injuries. Although it is unlikely that these findings could have occurred by chance, one might be skeptical of the magnitude of the estimated impact of benefits on the duration of claims in this natural experiment because it is much larger than previously published estimates of the benefit-injury duration elasticity.

One explanation for the larger estimated effect of benefits in this study than in previous analyses of workers' compensation is that the variation in benefits is genuinely exogenous in the data considered here, whereas identification of independent benefit and wage effects is problematic in the past literature. Support for this interpretation comes from a recent paper by Bruce Meyer, Kip Viscusi and David Durbin (1989), which examines changes in the median injury duration associated with large changes in the maximum

benefit in two states. Although Meyer, Viscusi and Durbin's results are not directly comparable because they focus on the median spell length, the implied elasticities in their two states are also substantially larger than those found in the past literature. Together, these longitudinal analyses of benefit changes should move even a hardened skeptic in the direction of believing that the duration of work injuries is responsive to the amount of workers' compensation benefits that are paid.

Other estimates in the paper document that self-insurance is associated with shorter injury spells than (imperfectly experience rated) private insurance. Moreover, an increase in workers' compensation benefits has a positive effect on injury duration in the sample of firms that purchase insurance from private carriers or from the state fund, but has a statistically insignificant effect in the sample of self-insured firms. These results provide the first evidence that employers' incentives may have an important influence on the duration of employees' injuries. Clearly, additional evidence on this issue would be useful.

The empirical results presented here suggest that there are two effective levers available in workers' compensation insurance to influence the duration of working time lost due to workplace injuries. The first lever is by changing the amount of indemnity benefits provided to workers who are injured on the job; and the second lever is by strengthening the link between employer's insurance costs and the actual cost of providing injury benefits to their employees.

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Notes

1. In 1986, for example, 2.63 percent of working time was lost due to occupational injuries and illnesses, .05 percent of work days were idled due to work stoppages involving 1,000 or more employees, and 7.9 percent of labor force time was lost due to unemployment (see Tables 647, 679, and 681 of U.S. Bureau of the Census, 1989). For expediency, I will use the term work injury broadly throughout the paper, including both physical injuries and illnesses.

2. See Ronald Ehrenberg (1988) and Alan Krueger (1990) for recent surveys of the determinants of the incidence of work-related injuries.

3. This figure is based on the author's calculations of the nationwide workers' compensation recipiency rate using the March 1988 Current Population Survey and on the Occupational Safety Health Administration's survey of all lost-work time accidents.

4. See Minnesota Department of Labor and Industry (1988), Chapter 2 and 5. Because most workers return to work immediately when their temporary total spell ends, the terms duration of temporary total case and time away from work will be used interchangeably.

5. Only 13 percent of workers' compensation recipients in Minnesota receive disability compensation from their employer, and only 3 percent receive other government support, such as unemployment insurance, medicare, or foodstamps, during their disability, so little is lost by focusing solely on workers' compensation benefits (Minnesota Department of Labor and Industry, p. 74).

6. There are some additional, less common exceptions to the benefit-wage relationship in Figure 1. For example, benefits for volunteer workers are based on the prevailing wage for that type of job, and benefits for employees who work irregular hours are based on a five day work week if they work fewer

than five days per week.

7. See Minnesota Department of Labor and Industry (1988), Chapter 2 and 5.

8. See the survey results reported in Minnesota Department of Labor and Industry (1988, pp. 76-79) for evidence on the post-injury experience of workers' compensation recipients.

9. This estimate is taken from the Weibull specification model 2 in Table 2 of Butler and Worrall (1985).

10. Kathleen Classen (1979) and Bruce Meyer (1989) similarly examine increases in the maximum unemployment insurance benefit to estimate the effect of benefit changes on the duration of unemployment spells. In related work, Gary Solon (1985) uses a change in the tax status of unemployment insurance benefits to examine the effect of after-tax benefits on unemployment spells.

11. The inflation rate (CPI-Urban) was only 1.1% in 1986, so these benefit changes represent approximately real changes in transfer payments.

12. If a claim is initially classified as a temporary total case, but reclassified as a permanent partial case upon the date of maximum medical improvement, the length of time on temporary total is counted as the duration of the temporary total claim. Claims that are later reclassified as permanent total injuries are excluded from the data set. In results that are available on request, I have estimated Weibull duration models that treat the duration of permanent partial injuries as censored at the date of maximum medical improvement. These estimates lead to qualitatively similar conclusions.

13. The sample is also limited to individuals between age 16 and 70 with complete data who earned less than $5,000 per week.

14. Under the null hypothesis that benefits are unrelated to duration, the truncation of benefits does not lead to biased estimates. Furthermore, if higher benefits cause the distribution of spells to shift to the right, right-hand truncation will lead to an underestimate of the benefit elasticity.

15. The same pattern holds for the median injury duration.

16. Note, however, that the effect of measurement error and idiosyncratic variations in benefits should be limited because the sample was restricted to workers whose benefit was within $10 of the benefit based on the schedule.

17. To compare the age and marital status of the workers' compensation claimants to the overall workforce, I have estimated the age distribution and marital rate for the sample of Minnesota workers contained in the 1987 Current Population Survey Outgoing Rotation Group Sample. The sample of workers' compensation recipients is slightly younger than the general workforce, and about equally likely to be married.

18. The establishment size variable was merged to the data set by the author on the basis of the firm's Standard Industrial Classification (SIC) code. Specifically, the average number of employees per establishment in an industry was derived from the 1986 County Business Patterns survey of Minnesota (US Department of Commerce, 1987), and then matched to each claimant on the basis of its firm's four-digit SIC. If average firm size at the four-digit level was not available in County Business Patterns, the three-digit industry level was used, and so on. Because government employment is excluded from County Business patterns, it was assumed that the average establishment size is 1,000 for state government, 1,000 for the executive branch, and 50 for local governments

19. For this analysis, injuries are defined in terms of three-digit nature of injury-part of body cells. For example, a broken toe is considered separate from a broken arm. There are 357 injury-classes in the sample that have an average duration of less than 10 weeks. A complete listing of these injuries is available on request from the author.

20. A firm must receive permission from the Minnesota Department of Commerce to self-insure. Although the selection criteria the Department uses to determine eligibility are complicated, permission is typically only granted to financially solvent firms with a net worth of at least two million dollars. Examples of self-insured firms in Minnesota include US Steel, Amoco and Nabisco (see Minnesota Department of Labor and Industry, 1989). Self-insurance may also be granted to groups of employers.

21. Because the state fund utilizes the same experience rating formula as private insurance carriers, it is unclear why injuries covered by the state fund have a shorter duration than injuries covered by private insurance carriers. A possible explanation for this finding is that the state fund screens out firms with particularly severe injuries. Alternatively, the state fund may be more successful in providing rehabilitation for disabled workers.

22. The covariates in these specifications are the same as those in Table 3, except dummies indicating the season of the year the worker was injured have been added to these specifications. Note also that the sample for these regressions includes individuals with earnings in the grey area of Figure 2.

23. See John Bound (1989), Orley Ashenfelter (1985), and Krueger and Joern-Steffen Pischke (1989) for econometric solutions to this problem in analyses of Disability Insurance, the Negative Income Tax, and Social Security.