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WORKERS' COMPENSATION AND INJURY DURATION: EVIDENCE FROM A NATURAL EXPERIMENT

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ABSTRACT

This paper examines the effect of workers' compensation on the time until an injured worker returns to work. Two large increases in the maximum weekly benefit amount in Kentucky and Michigan are examined. The increases raised the benefit amount for high earnings individuals by over sixty percent, while low earnings individuals, who did not earn enough to be eligible for the old maximum, did not experience a change in their incentives. A comparison of the behavior of people injured the year before the benefit increases to those injured the year after provides an estimate of the effect of higher benefits on injury duration. This use of a "natural experiment" allows us to separate the effect of the level of the benefits from the effect of previous earnings, which is a common difficulty in the analysis of social insurance programs. The analysis uses individual records from a large number of insurance companies. Time out of work increases dramatically for those groups eligible for the higher benefits, while those whose benefits do not change do not experience a change in duration. The estimates suggest large moral hazard effects of higher benefits, with the estimated elasticity of spell duration with respect to benefits of approximately .3 to .4.

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1. Introduction

Workers' compensation has several different types of moral hazard effects. Higher benefit rates may affect workers' incentives to avoid injuries, may increase the incentive to file for compensation for any given job injury, may foster more claims for non-work injuries, and may increase the duration of claims. Most of the previous work on incentive effects of workers' compensation has focused on injury rates or the number of claims rather than the duration of claims.[1]

This emphasis may have led to underestimates of the extent of the influence of moral hazard. In particular, it seems likely that the duration of claims is more responsive to the level of benefits than is the incidence of claims. Once a person has filed a claim, the level of benefits is clearly known, while this may not be the case prior to an injury. Many people might be willing to stay out of work longer and have more leisure time when benefits rise, but few may be sufficiently less careful to cause a work injury because of the substantial nonmonetary losses involved. In this paper, we will address one aspect of the moral hazard problem using data from a natural experiment provided by two large increases in state benefit levels.[2] Because of this natural experiment, a comparison of the behavior of people who are injured after the benefit increases to those injured before the increases will provide a test of the effect of benefit changes on duration.

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[1]See Ehrenberg (1988), Krueger (1989) and Chapter 2 of Moore and Viscusi (1990) for surveys of previous studies.

[2]See Meyer (1989) for the use of this approach to estimate the effects of unemployment benefits on the length of unemployment spells.

Workers' compensation is an increasingly expensive program. Between 1970 and 1987, benefit payments rose at over a 7 percent annual rate after accounting for inflation.[3] In 1987, total benefit payments reached an estimated $27.4 billion, with the insurance cost to employers at over $38.0 billion. Despite the size and importance of workers' compensation, research on the program is not extensive.

One aspect of the program that has received scrutiny is the effect of benefit levels on claim duration. Studies by Butler, Worrall and their coauthors[4] on the relationship between the level of benefits and the duration of benefit receipt have yielded mixed results. Their examination of low-back injuries in Illinois indicated that a 10 percent increase in benefits was associated with a two to four percent increase in mean spell length, depending on the statistical technique used. When they examined data pooled from 13 states, however, they did not find a consistent relationship between the level of benefits and the length of spells.

Even if Butler et al.'s findings were more conclusive, the implications of the Illinois analysis would be clouded by the confounding of the effects of previous earnings and the effects of workers' compensation. Ehrenberg (1988) observes that it is difficult to distinguish effects of workers' compensation from effects of previous earnings since the level of benefits is a simple

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[3]Nelson (1990) provides a good overview of workers' compensation costs. There is a lag in the availability of cost data because the full expense of a claim may not be known until several years after the injury.

[4] See for example, Butler and Worrall (1985), Worrall, Butler, Borba and Durbin (1988).

nonlinear function of previous earnings.[5] Within a given state at a point in time, the weekly benefit for temporary total disability is a constant fraction of previous earnings except when an individual receives the minimum or maximum weekly benefit. Since previous earnings strongly influence the payoff from returning to work, the economic benefits of returning to work and the economic gains from receiving benefits are each largely influenced by a common variable, previous earnings. Regressions of spell length on weekly benefits and previous earnings consequently cannot easily distinguish the effects of workers' compensation from the highly correlated influence of previous earnings.

The main idea for this study can be seen in Figure 1. Figure 1 displays a typical state schedule relating the weekly benefit for temporary total disability[6] to previous earnings. The solid line is the schedule prior to a change in the state law that raises the maximum weekly benefit amount. The dashed line is the schedule after the benefit increase. Between the minimum and the maximum, the weekly benefit amount is a constant fraction of previous earnings.[7]

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[5]Ehrenberg's criticism has been frequently made about studies that examine the level of unemployment insurance benefits on the length of unemployment spells. The structure of unemployment benefits is similar to that of temporary total workers' compensation benefits. An early statement of the criticism as applied to unemployment insurance studies can be found in Welch (1977).

[6]Temporary total disabilities are those where the employee is unable to work but is expected to recover fully and return to work. The types of benefits are discussed in more detail in Section 2.

[7]The period over which previous earnings are measured varies across the two states.

For people with previous earnings of at least E_3 (the High Earnings group), we compare the mean and median weeks of benefits received for people injured during the year before and the year after the change in the benefit schedule. Those whose claims began before the increase receive B^o_{max} while those injured afterwards receive B^n_{max}. This group of workers consequently experiences the full effect of the benefit increase. An individual's injury date determines his temporary total disability benefit amount for the entire period of the disability.[8] For example, two individuals with previous earnings greater than E_3 will receive different weekly benefits for up to several years, if one was injured a few days before and the other a few days after the effective date of the benefit increase. The effect of this difference is the basis of the empirical test used in the paper. Most of the remaining methodological problems involve correcting for possible differences between the individuals who are injured before and after the benefit increase. In much of what follows, we will use as a comparison group those with earnings between E_1 and E_2 (the Low Earnings group) who are injured during the year before and after the benefit increase. The benefits these individuals receive are unaffected by the increase in the maximum weekly benefit.

Section 2 briefly outlines the structure of workers' compensation and describes the benefit changes in Kentucky and Michigan that provide the basis for this paper. In Section 3 we outline the empirical procedure used to relate the policy shifts to the incentive effects. The two modes of analysis, assessment of mean effects resulting from the policy shifts and regression

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[8]Some states have cost of living adjustments which index the benefit for inflation. The two states examined below, Kentucky and Michigan, did not have such adjustments during the period examined.

analysis of durations, appear in Sections 4 and 5. By comparing changes in duration and changes in medical expenditures we are also able to distinguish the duration moral hazard effect from changes in injury severity that may have accounted for a legitimate increase in duration. In Section 6, the change in the incidence of claims after the benefit increases is briefly examined. As we indicate in the concluding Section 7, the incentive effect of the benefit shifts is quite substantial. In particular, a 10 percent increase in the benefit level is associated with an increase in spell duration of approximately 3 percent.

2. Workers' Compensation Laws and the Benefit Increases

Workers' compensation provides benefits to workers disabled from work-related injury or illness, and to dependents of workers who have died from such injury or illness. Regardless of who is at fault in an injury, the employer is responsible for medical costs and must compensate the worker for lost wages. It would be incorrect to say that there is one workers' compensation program; there is a program in each state and several federal programs for specific occupations. The states have large differences in coverage, types of benefits, levels of benefits, and the methods of insurance underwriting that are available.

Workers' compensation benefits are divided into medical payments and indemnity (cash) benefits. By far the most common type of indemnity payments are those for temporary total disabilities. This paper concentrates on temporary total disability claims, as do the earlier papers in the workers' compensation duration literature. A person with a temporary total disability

is unable to work but is expected to recover fully and return to work. These claims accounted for more than 80 percent of the recent claims in the two states analyzed below.[9] However, temporary total claims account for a smaller fraction of total costs.[10] Figure 1 characterizes a typical schedule relating the permanent partial weekly benefit amount to previous earnings. Most importantly for this study, temporary total claims have no fixed duration; their length is determined by the injured worker, his or her doctor, the employer, and its insurer. While not the case in the two states analyzed below, some states have a maximum duration or maximum amount of total benefits.

The vast majority of other indemnity claims are for permanent partial injuries. These claims typically constitute a majority of total costs. A person with a permanent partial injury is permanently impaired but not completely disabled. Permanent partial injuries are commonly divided into scheduled and non-scheduled injuries. Scheduled injuries are listed in the state law where a specific amount of compensation is specified. These injuries involve loss of an arm, leg, hand, finger, or other member of the

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[9]See Table 1 for a breakdown of benefit types in Kentucky and Michigan. We include a larger fraction of claims in the temporary total classification than other sources because we use benefit type as of 42 months rather than classifying as permanent all claims longer than 1 year as is done in the commonly cited National Council on Compensation Insurance figures.

[10]Over the two year period examined below, claims with only temporary total benefits accounted for 41 percent of all indemnity and medical payments in Kentucky and 68 percent in Michigan. These numbers are based on tabulations from the DCI data described below. The percentages are much larger than the fraction of costs typically attributed to temporary total claims, since the commonly cited data classifies as permanent all claims longer than 1 year.

body. Benefits for non-scheduled injuries are determined by multiplying an impairment percentage by a weekly benefit amount.

The selection of the state benefit increases used in this study was relatively straightforward. There were only three large increases in the temporary total maximum benefit levels in the states and time periods included in the National Council on Compensation Insurance (NCCI) data base used in this study. These increases occurred in Florida, Kentucky, and Michigan. The Florida increase coincided with a major overhaul of the workers' compensation law, so that the before versus after comparisons reflect multiple aspects of the change in benefit structure.[11] Because of this complication, we analyze only Kentucky and Michigan.

The Kentucky increase of July 15, 1980, raised the maximum benefit from $131 to $217 a week, a 66 percent increase. The replacement rate of 66 2/3 percent did not change. The minimum weekly benefit fell by 60 cents from $44.00 to $43.40. Permanent partial scheduled injuries were replaced by payments determined by multiplying the weekly benefit for permanent partial disability by the percentage of disability or the loss in wage earning

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[11]Florida raised its maximum benefit amount from $130 per week to $195 on August 1, 1979, but this coincided with a complete reform of the Florida workers' compensation law. A wage-loss system was adopted which eliminated benefits if an individual made more after reaching maximum medical improvement than he or she had previously. Initial interpretations of the new law made it difficult for workers to demonstrate they had certain impairments, particularly those not listed in AMA guides. Many minor permanent partial cases were eliminated from the program. The reform also sought to reduce the frequency of lump sum settlements, by not allowing them to be considered until 6 months after the worker had reached maximum medical improvement. For descriptions of the Florida reform see Berkowitz and Burton (1987) and Tinsley (1980).

capacity, whichever was greater.[12] Only a small fraction of claims was affected by this change as indicated by the distribution of benefit types in Table 1. There were some much smaller changes in temporary total benefits on January 1, 1980 and January 1, 1981.[13]

The Michigan increase on January 1, 1982 raised the maximum benefit from $181 to $307 per week, a 70 percent increase. The minimum benefit of $144 was eliminated and the replacement rate was changed from 66 2/3 percent of pre-tax wages to 80 percent of after-tax wages. The change in the benefit schedule was not quite as simple as Figure 1 suggests, since benefits depended partly on tax filing status and the number of dependents[14], as well as previous earnings. Fortunately, the benefit levels for those with earnings in the relevant region (below those needed for the old maximum) remained remarkable close to the old schedule. Furthermore, the new law stipulated that if an employee was eligible for a larger benefit under the old law, the employee was entitled to that benefit.[15] In practice, this rule meant that the old replacement rate was applicable for most people with earnings less than those required for the old maximum benefit. The barely noticeable change in the

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[12]See Tinsley (1981), p.54.

[13]On January 1, 1980 the maximum rose from $121 to $131 and the minimum from $40 to $44. On January 1, 1981 the maximum rose from $217 to $233.26 and the minimum from $43.40 to $46.65.

[14]There were dependents' allowances under both the old and new law which caused some very slight changes in benefits. Under the old law, dependents' allowances raised the benefit for an individual at the minimum benefit amount by $3 per dependent, up to a maximum of five dependents. Someone at the maximum benefit received $5 for the first dependent and $6 for each of the next four dependents. Under the new law, each dependent raised benefits by about $7 at the maximum, and by about $4 at the old minimum.

[15]See Michigan Department of Labor (1989), p.28.

mean replacement rate for low earnings individuals reported in Table 2 corroborates this constancy.

In Kentucky, Michigan, and most other states, insurance is provided by private insurers and self-insurers. If a firm meets certain requirements, it can choose to self-insure, i.e. pay the costs of all medical and indemnity benefits. In Kentucky about one-fourth and in Michigan about one-half of all benefits are paid by self-insurers.[16] In Michigan there is also a competitive state fund that offers insurance. Our data described in Section 3 include the Michigan state fund, but not self-insurers.

Other characteristics of state workers' compensation laws include the waiting period, retroactive period, and the rules on choice of physician. The waiting period was 7 days in both states, which meant that no compensation for lost work time was paid for injuries lasting less than 7 days. There was a 2 week retroactive period in both states that provided compensation for those first 7 days if an injury lasted more than 2 weeks. In Kentucky the employee had the right to choose the attending physician, while in Michigan the employer had the initial choice. After the first ten days of treatment the employee could choose his or her own physician by giving notice to the employer.

The states also had different administrative procedures to resolve disputes. In Kentucky, if the employer and employee were unable to reach an agreement on the nature of compensation, the parties could apply for a hearing. A workers' compensation board member rendered an opinion, subject to the approval of the full board. Appeals could be brought to the Circuit

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[16]See Price (1984) and Nelson (1988).

Court, and then the Court of Appeals. Michigan had a two-tier structure for decision making in contested cases. Initial hearings were conducted by an Administrative Law Judge. Either party could appeal the Judge's decision to the Workers' Compensation Appeal Board, and during this period most did appeal.

3. Data and Methods

The data source for this study is the Detailed Claim Information (DCI) data base collected by NCCI. Data from ten states beginning in 1979 are available, with data from six additional states available over a more limited time period. The data set contains a random sample of indemnity claims from a group of insurance companies which account for over 99.5 percent of the insurance sold in the states. The sampling rates from this population of claims are .4 for Kentucky, and .2 for Michigan.

The key variables in the data set that we use are date injured, duration of temporary total benefits, total medical costs, previous wage, weekly benefit amount, benefit type (i.e., temporary total or permanent partial), type of injury (body part affected and the type of damage), if the claim was settled by a lump sum, age, sex, marital status, and an industry code. A report containing these and additional variables is made 6 months after the claim is filed, then at 18 months, 30 months, and 42 months after filing, and periodically thereafter. We have used the information available after 42 months. The measure of duration is weeks of temporary total benefits paid plus anticipated future weeks paid if the claim is still open. Since less

than one-half of 1 percent of cases are open, duration is estimated rarely.[17] Nevertheless, we set the duration of cases still ongoing at 42 months equal to 42 months to eliminate any estimated durations. We restricted the sample to exclude claims with lump sum payments since it is difficult to calculate a duration and a weekly benefit amount in these cases. Claims involving payments besides temporary total benefits and those where previous earnings were unknown were also excluded.[18]

To make the before group and after groups shown in Figure 1 as comparable as possible, the upper and lower limits (E_1 and E_2) on previous earnings for the Low Earnings group, and the lower earnings limit (E_3) for the High Earnings group, were indexed using state level average weekly earnings.[19] During the year surrounding the benefit increase in Kentucky, average wages rose 8.94 percent. The analogous figure for Michigan was 7.76 percent.

Table 2 reports some summary measures of the change in benefit structure in Kentucky and Michigan. In both states, the fraction of previous earnings replaced by workers' compensation rose dramatically for the High Earnings

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[17]By 42 months, more than 99.5 percent of claims are recorded as closed in Kentucky in Michigan. However, these numbers seem to conflict with the claims distribution which indicates that .85 percent of the Kentucky claims and 3.15 percent of the Michigan claims are at least 42 months long.

[18]The frequency of other types of claims can be seen in Table 1. The frequency of claims with unknown previous earnings was .41 percent in Kentucky and 1.84 percent in Michigan.

[19]These numbers were used because they are at the state level, have broad coverage, and are available on a quarterly basis so they match the qualifying periods well. The average wage data are unpublished, but were provided by Cindy Ambler of the Department of Labor. As an example of the indexing procedure, in Kentucky the values of E1, E2 and E3 were $66, 196.50, and $298.79, respectively before the increase, and $71.90, $214.07, and $325.50, respectively after the increase.

group which received the benefit increase, but remained constant for Low Earnings individuals who were unaffected by the increase. Previous earnings and the fraction of claims filed by males are very similar before and after the benefit increases in both states and earnings groups. There are some changes in the composition of claims by previous industry, but they go in different directions for the two states. The changes in composition did not bias the results discussed in Section 4 below, because the empirical results are very similar when done separately for the three industry groups. Moreover, the regression analysis in Section 5 will explicitly account for any changes in the industry mix.

Table 3 reports the composition of the sample by injury type. The large injury categories are a fairly stable fraction of the total in Kentucky. Michigan is less stable, with a notable decline in injuries to upper extremities for High Earnings individuals. Again, the regression analysis below will control for injury type.

As the data in Table 1 indicate, the relative frequency of the different benefit types did change somewhat, but the changes are in opposite directions for the two states. A similar pattern is also evident for the frequency of lump sum payments. Since both of these changes affect a very small percentage of the sample, they are unlikely to appreciably affect statistics like the median or 75th percentile of the claim distribution.

One should remember though, that the comparisons below will be valid as long as any changes in Kentucky and Michigan, other than the increase in the benefit maximum, affected the High and Low Earnings groups similarly. In most of the comparisons, we examine the durations and medical costs of Low Earnings

individuals before and after the benefit increases in case the changes we observe for High Earnings individuals were occurring for all groups.

4. Means and Percentiles of the Duration Distribution

The results for both Kentucky and Michigan, reported in Tables 4 and 5, show large and statistically significant increases in the duration of temporary total claims after the benefit increases for the High Earnings group. On the other hand, the Low Earnings group, which was not subject to the benefit increase, did not experience any change in their duration. The median[20] and the mean of the natural logarithm of duration are used to summarize the central tendency of the duration distribution. These statistics are likely to be fairly robust, which is important since the distribution of claim lengths has a few large values, but most values are small. The mean of the untransformed data is susceptible to large changes due to a few observations. In Kentucky, median durations rise by 25 percent and in Michigan by 40 percent. The mean of the logarithm of duration indicates a 12 percent increase in High Earnings durations in Kentucky and 26 percent increase in Michigan. All of these increases are significant at the .05 percent level. On the other hand, there is no change in the duration of Low Earnings claims in either state using either measure. Changes similar to those for the median are found in the 75th percentile of the distribution.

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[20]The standard errors of the medians and 75th percentiles were calculated using the formula reported on page 400 of Bickel and Doksum (1977). The density of the claims distribution was estimated using a histogram approach.

Figures 2 and 3 provide a graphical display of the entire distribution of claim durations for High Earnings individuals before and after the benefit increases. Figure 2 is the cumulative distribution of claim durations in Kentucky, while Figure 3 is the distribution in Michigan. Both states show an increase in all percentiles of the injury distribution.

The elasticity of the duration of claims with respect to the temporary total benefit can be calculated by dividing the change in duration by the percentage change in the benefit maximum after accounting for inflation. The percentage changes in the benefit maximum for the two states is reported in line 1 of Table 2, while the inflation rates were given in Section 3. Using the median as the measure of duration one obtains an elasticity of .44 for Kentucky and .65 for Michigan, while the mean of the logarithm implies an elasticity of .32 for Kentucky and .42 for Michigan.[21] These estimates suggest large effects of the benefit amount on the length of time people take to return to work after an injury.

The comparability of the claims from the year before the increase to those the year after the benefit increases is generally supported by the numbers on total medical costs associated with the claims. These numbers, also reported in Tables 4 and 5, show that the High and Low Earnings groups experience similar increases in median costs, probably due to a general rise

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[21]The median elasticities are calculated as 25/(65.65-8.94) and 40/69.61-7.76) for Kentucky and Michigan respectively. For the mean of logarithm of duration one has 18/(65.65-8.94) and 26/(69.61-7.76) for Kentucky and Michigan respectively, since the change in the logarithm is already a percentage change.

in medical costs.[22] The mean of the logarithm and 75th percentile of total medical costs provide less clear evidence. Kentucky shows a relative increase in costs for the High Earnings group, while Michigan shows a relative decrease in costs. Overall, the medical cost numbers do not suggest that the above comparisons of duration were caused by changes in severity of the injuries.[23] While the duration of claims subject to the benefit increases rose dramatically, their severity as indicated by the medical cost statistics in Tables 4 and 5 does not on average go up. The regressions reported in Section 5 also control for measures of severity including total medical costs, hospital days, and type of injury. The regression estimates conform quite closely with the simple duration comparisons above.

The results on changes in the median, 75th percentile, and mean of the logarithm are nearly identical when we exclude individuals with injury dates between two weeks before and two weeks after the increases. We checked this slightly different sample of claims in case there was some ability to delay reporting injuries to receive a higher weekly benefit. The ability to delay reporting might be possible in the case of some cumulative injuries.

A possible confounding factor in any analysis of the effects of benefits is that higher benefits might induce changes in the composition of the

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[22]While the medical cost figures are indexed using the medical care component of the Consumer Price Index, there may be local variation in medical cost inflation for which we have not adequately controlled.

[23]If there is any bias in the comparisons of medical costs, it would likely go in the direction of finding increases in medical costs for the High Earnings group if a longer duration mechanically mean more doctor visits independent of severity. It is possible however, but unlikely, that greater medical costs might mean better rehabilitation and thus a speedier return to work. The regression estimates below suggest that this effect is not the dominant one.

population examined. If higher benefits induce more people to make indemnity claims, then our estimates are likely to understate the effects of higher benefits on claim durations. The additional people who file claims when benefits rise are likely to have sufferd minor injuries with short durations, since they had not planned to claim previously. On the other hand, the structure of benefits might affect transitions from temporary total to permanent disability as suggested by Worrall, Durbin, Appel and Butler (1987), and Thomason (1988). It is not clear in what direction our results would be biased by such an effect, as we exclude permanent disabilities from the sample we analyze. Since this effect is likely to apply to a small number of claims relative to the total number of permanent partial claims, there is unlikely to be an appreciable effect on the medians emphasized above. While a few large observations can greatly affect a mean, they will likely have little effect on a median. One should also note that there is very little evidence of an increase in the severity of the claims as measured by medical costs. Therefore, we think these criticisms are unlikely to be very important.

5. Regression Estimates of the Duration Effect

To account for possible changes in the composition of the sample after the benefit increases, log duration regression equations[24] are also estimated. The estimates in Table 6 control for attributes of the individual, the job, and the injury. The variables include worker age, marital status, sex,

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[24]Hazard models are not used because of the infrequency of censoring, and the lack of time-varying explanatory variables.

industry, and the severity of the injury as measured by medical costs and hospital days. The equations include all of the available demographic variables, and indicator variables for the major injury classifications. In all of the equations the dependent variable is the logarithm of duration measured in weeks. The sample sizes are slightly smaller than those earlier because of missing variables. In almost all cases the missing variable is marital status.

Two sets of specifications were estimated: specifications (1) through (4) which pool High and Low Earnings individuals, and specifications (5) through (8) with only High Earnings workers. The variables in the pooled estimates explicitly take into account two possibly confounding determinants of spell lengths in the sample. An indicator variable for whether the observed behavior is after the benefit increase (after increase variable) removes any effect of being after the increase that is common to both the High Earnings and Low Earnings groups. The high earnings variable and the ln(previous wage)*high earnings group interaction variable net out any time-invariant differences between the High Earnings and Low Earnings groups. The key variable to interpret in these pooled estimates is the first variable appearing in Table 6--the interaction of being after the increase and in the High Earnings group. This dummy variable is an indicator for the group which experienced the increase in benefits, and it measures the percentage change in duration associated with the benefit increase. The coefficient has the expected positive sign in both states and is significant at conventional levels in Kentucky.

One should note that these estimates are extremely similar in size and significance to the difference of the differences in mean log duration reported in Tables 4 and 5. The similarity is not surprising since the After increase*High earnings group coefficient is the regression analog of the difference in column (5) minus the difference in column (6) in those tables. If only the first three dummy variables were included, the regressions would exactly reproduce this second difference.

The second set of estimates, reported in columns (5) through (8) of Table 6, use only the High Earnings observations. These estimates correspond to a single difference in the mean of log duration as reported in column (6) of Tables 4 and 5. Since the After increase coefficient is small and insignificant in the first four equations, it does not appear to be necessary to control for any effect of just being injured one year later. The ability to directly compare the High Earnings groups before and after the increase is also supported by the earlier comparisons of means which shows little change in Low Earnings durations. The key coefficient in these High Earnings only equations is on the After increase variable. Since these regressions with only High Earnings individuals correspond to a single difference, the standard errors are smaller than those for the key variable in the first four equations. Again, these estimates are very close to the analogous differences in means of log duration reported in Tables 4 and 5. Both the Kentucky and Michigan coefficients are significant at conventional levels, and they suggest large increases in duration after the benefit increases.

Among the other variables in the equations, medical costs, the hospital stay indicator variable, and age are particularly important. Higher medical

costs, a hospital stay, and being older all lead to a longer time until an injured worker returns to work. There is also some evidence that women have longer injury durations. The estimates of the key coefficient are extremely similar when an indicator for the presence of an attorney, and the interaction of marital status and male are added to the equations. Overall, the regression estimates are strikingly similar to the earlier comparisons of means, and strongly indicate that the earlier results were not due to changes in sample composition. Using the extremes of the estimates from the four Kentucky regression equations one obtains duration elasticities of .24 to .36. Similarly, for Michigan one obtain the range of .23 to .38.

To provide a comparison with alternative methodologies, we also present a series of equations estimated using more conventional specifications and including all individuals, regardless of previous earnings. These specifications are reported in Table 7 and are similar to those estimated by Butler et al. The specifications in columns (1) through (4) use the replacement rate, which is the weekly benefit divided by previous earnings, as the measure of benefit generosity. The coefficient on the replacement rate, which can be interpreted as an elasticity, is always less than .1 and not significantly different from zero. These equations imply that level of benefits has little effect on the duration of claims.

If, however, we separately account for the two components of the replacement rate, the results are more similar to those examined in Table 6. The specifications in columns (5) through (8) measure the generosity of benefits using the natural logarithm of benefits and the natural logarithm of the previous wage. The coefficient on ln(weekly benefit), which can be

interpreted as an elasticity, is always similar to elasticities estimated earlier using the natural experiment methodology. It is tempting to conclude that this variant of the conventional methodology produces reasonable estimates. While true for this sample, one should remember that the states and sample period were selected specifically so that much of the variation in benefits would be due to the benefit increases.

6. Some Evidence on Incidence

The benefit increases also provide some suggestive evidence on the effect of higher benefits on the incidence of claims. One might expect that benefit increases will have a smaller effect on the incidence of claims than on their duration, as suggested earlier. We measure incidence by dividing the number of claims after the increase by the number before the increase, and then subtracting this ratio for the Low Earnings group from that for the High Earnings group. This statistic, which is reported in the last column of Table 8, measures the change in incidence of High Earnings claims relative to Low Earnings claims. The relative comparison is appropriate if there is a trend over time in the total number of claims. If the benefit increase caused an increase in incidence, we should see a relatively larger increase for the High Earnings group. Here, the effect of the increases on incidence is not statistically significant in both cases, but weakly suggests an increase in the relative number of High Earnings claims after the increases.

7. Conclusions

The results of this study indicate a strong effect of the level of temporary total benefits on the duration of workers' compensation claims. There is some variation in the estimated effect depending on whether one examines the median duration or the mean of the logarithm of duration, and whether one looks at Kentucky or Michigan. The elasticities range from .23 to .65, with most clustering between .3 and .4. These results suggest large labor supply effects of workers' compensation benefits. The elasticities are larger than those found by Butler et al., but much smaller than those found by Krueger (1990) in a paper that adopts our methodology.

The longer durations that we find after benefit increases may not be a pure moral hazard effect, as longer recovery times may improve subsequent health. Higher benefits may enable injured workers to complete their recovery before returning to work. To examine this question, we would like to be able to examine health status after an individual returns to work. Unfortunately, such an analysis is not possible with available data.

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Figure 1

Temporary Total Benefit Schedule
Before and After an Increase in the Maximum Weekly Benefit

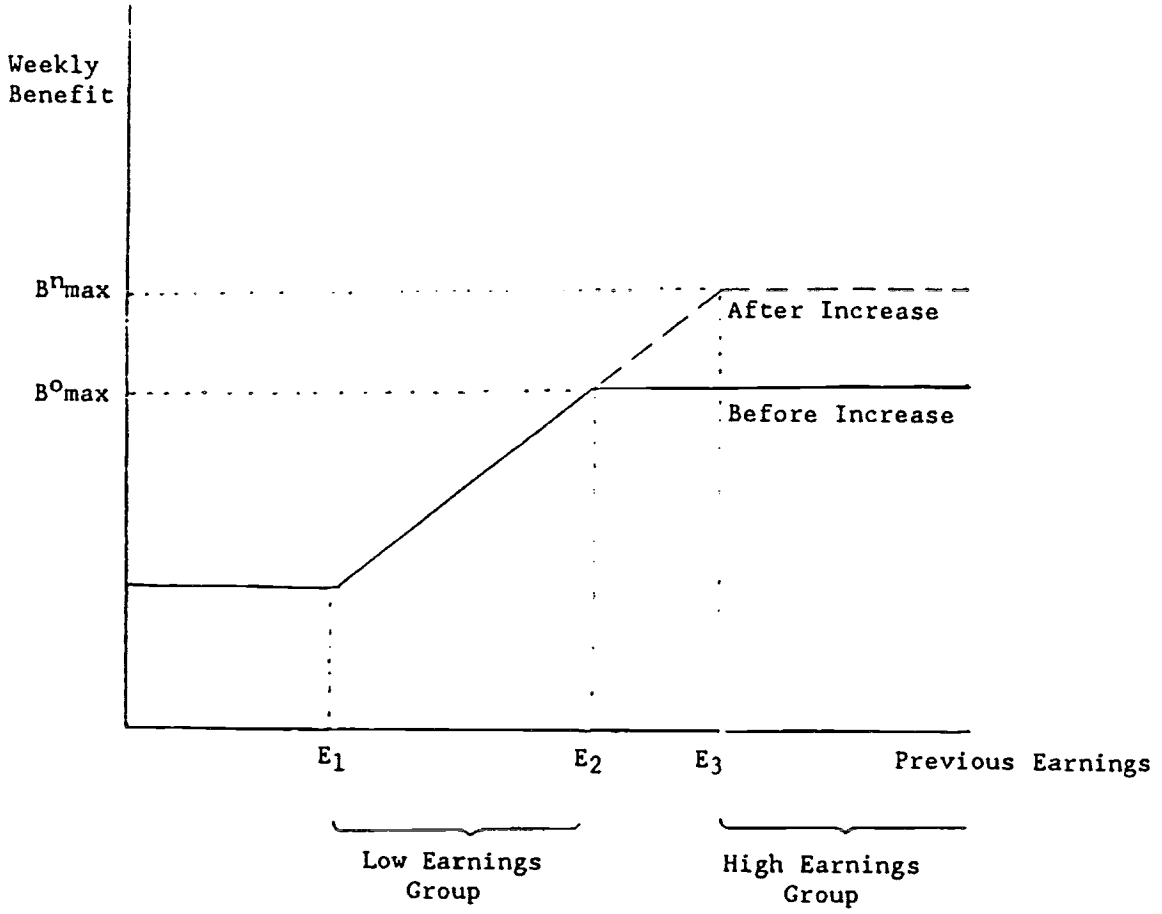

Figure 2

Kentucky Cumulative Distribution of Injury Duration
for High Earnings Individuals, Before and After Benefit Increase

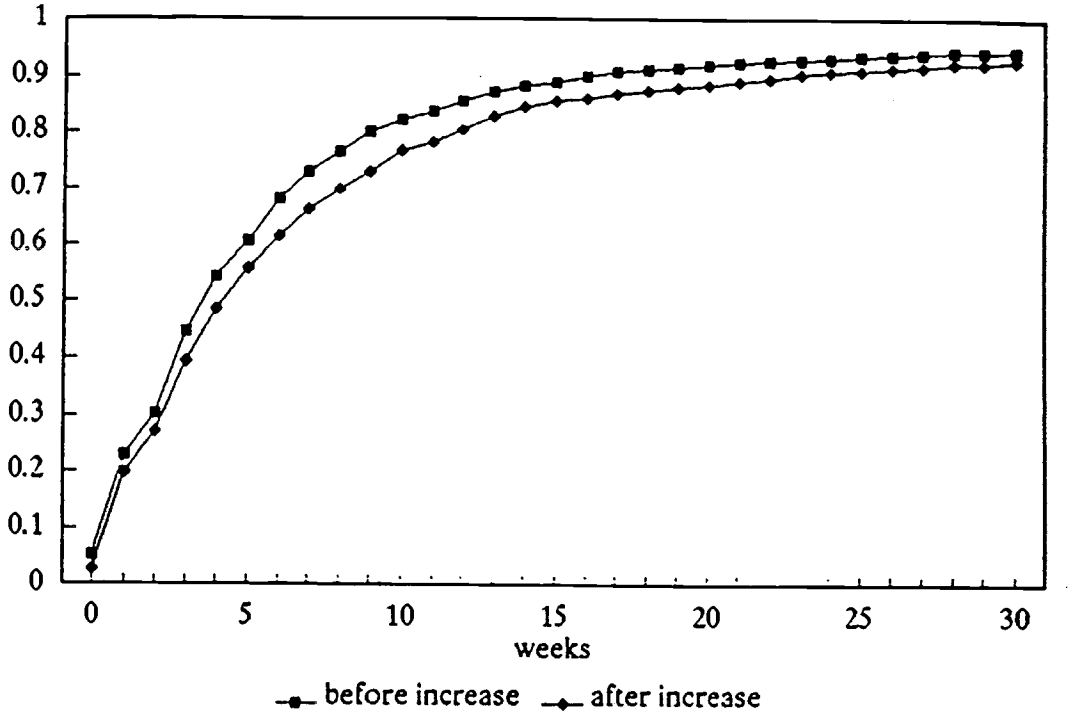

Figure 3

Michigan Cumulative Distribution of Injury Duration
for High Earnings Individuals, Before and After Benefit Increase

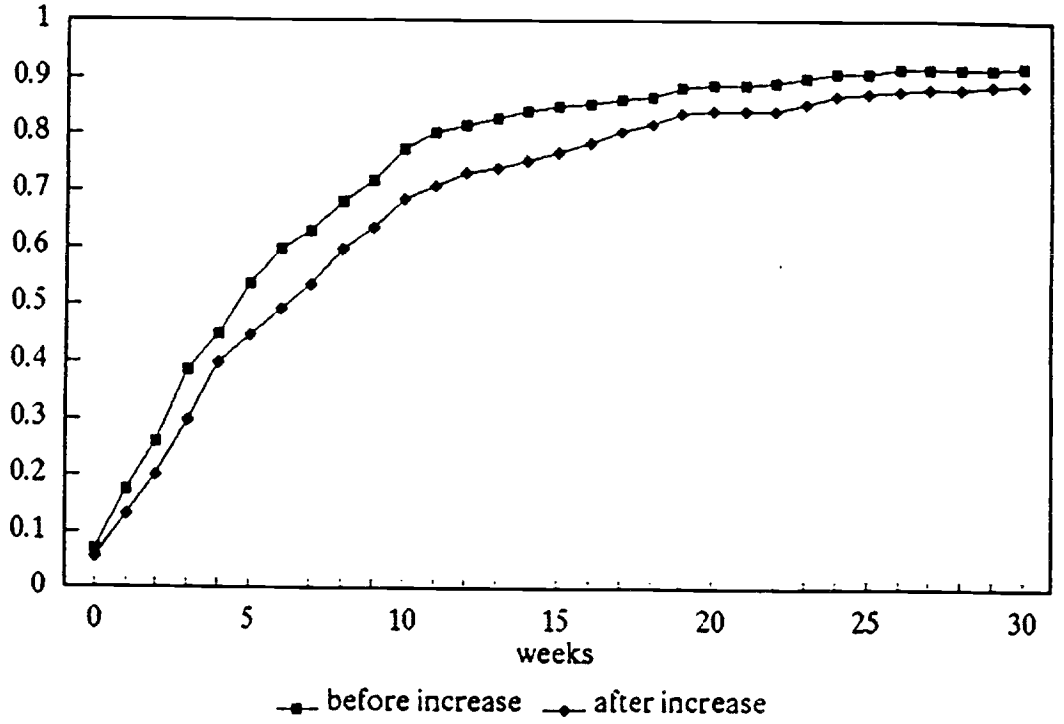

Table 1

Frequency of Benefit Types and Lump Sum Payments

	Kentucky			Michigan		
	Before	After	Percentage Change	Before	After	Percentage Change
	(1)	(2)	(3)	(4)	(5)	(6)
Benefit Type Frequency (%)						
Temporary total						
high earnings	83.63	87.13	4.19	88.26	88.69	0.49
	(0.93)	(0.89)	(1.57)	(1.87)	(1.91)	(3.03)
low earnings	85.74	85.97	0.27	87.63	90.10	2.82
	(0.76)	(0.80)	(1.28)	(1.19)	(1.23)	(1.99)
Permanent partial						
high earnings	12.06	8.18	-32.17	0.67	0.73	8.76
	(0.81)	(0.72)	(7.55)	(0.47)	(0.51)	(108.38)
low earnings	10.04	9.39	-6.47	1.05	1.54	45.90
	(0.65)	(0.67)	(9.02)	(0.37)	(0.51)	(70.44)
Other benefits						
high earnings	4.31	4.69	8.64	11.07	10.58	-4.42
	(0.51)	(0.56)	(18.21)	(1.82)	(1.86)	(22.97)
low earnings	4.22	4.64	9.95	11.32	8.36	-26.11
	(0.44)	(0.48)	(16.11)	(1.15)	(1.14)	(12.59)
Sample sizes						
high earnings	1600	1430		298	274	
low earnings	2132	1896		760	586	
Temporary Total Lump Sums (%)						
high earnings	7.85	6.82	-13.07	9.13	9.88	8.23
	(0.74)	(0.71)	(12.21)	(1.78)	(1.91)	(29.72)
low earnings	6.73	6.32	-6.09	11.56	9.66	-16.46
	(0.59)	(0.60)	(12.13)	(1.24)	(1.29)	(14.28)
Sample sizes						
high earnings	1338	1246		263	243	
low earnings	1828	1630		666	528	

Notes: (1) Standard errors are in parentheses. (2) The benefit types require some explanation. Other includes combinations of benefit types, permanent total, temporary partial, and death.

Table 2

Kentucky and Michigan
Replacement Rates, Earnings and Demographic Characteristics
Before and After Benefit Increases

	Kentucky			Michigan		
	Before	After	Percentage Change	Before	After	Percentage Change
	(1)	(2)	(3)	(4)	(5)	(6)
Maximum benefit ($)	131.00	217.00	65.65	181.00	307.00	69.61
Replacement rate, high earnings (%)	32.70 (0.25)	51.02 (0.37)	56.02 (1.65)	30.01 (0.35)	44.15 (0.48)	47.14 (2.33)
Replacement rate, low earnings (%)	66.42 (0.20)	66.66 (0.22)	0.36 (0.44)	66.64 (0.24)	66.35 (0.30)	-0.45 (0.58)
Average real wage, high earnings ($)	475.31 (2.45)	482.41 (2.73)	1.49 (0.78)	749.72 (7.25)	739.01 (7.49)	-1.43 (1.38)
Average real wage, low earnings ($)	179.09 (0.89)	177.54 (0.97)	-0.86 (0.73)	275.83 (0.75)	275.654 (0.83)	-0.07 (0.40)
Percentage male, high earnings	94.39 (0.66)	95.78 (0.59)	1.47 (0.94)	100.00 ---	97.25 (1.11)	-2.75 ---
Percentage male, low earnings	64.36 (1.16)	62.88 (1.24)	-2.30 (2.61)	73.94 (1.81)	75.58 (1.97)	2.22 (3.50)
Percentage manufacturing, high earnings	15.69 (1.04)	18.80 (1.15)	19.84 (10.79)	36.82 (3.12)	19.72 (2.70)	-46.43 (30.01)
Percentage manufacturing, low earnings	30.71 (1.12)	31.52 (1.19)	2.65 (5.38)	44.69 (2.06)	41.35 (2.26)	-7.48 (7.73)
Percentage construction, high earnings	20.65 (1.15)	16.55 (1.09)	-19.85 (6.94)	34.73 (3.08)	35.78 (3.25)	3.03 (12.31)
Percentage construction, low earnings	9.29 (0.70)	10.48 (0.78)	12.81 (12.01)	12.33 (1.36)	9.07 (1.32)	-26.42 (24.81)
Sample Sizes:						
High earnings	1233	1161		239	219	
Low earnings	1705	1527		589	477	

Notes: (1) Standard errors are in parentheses. The standard errors for the fraction male, high earnings cannot be calculated in the usual way. (2) Wages are in 1982 dollars, indexed using state level average weekly earnings from the Unemployment Insurance Service.

Table 3

Kentucky and Michigan
Injury Types, Before and After Benefit Increases

	Kentucky			Michigan		
	Before	After	Percentage Change	Before	After	Percentage Change
	(1)	(2)	(3)	(4)	(5)	(6)
Head, high earnings (%)	4.38 (0.58)	3.36 (0.53)	-23.30 (15.81)	4.18 (1.30)	2.74 (1.10)	-34.52 (33.25)
Head, low earnings (%)	3.40 (0.44)	4.32 (0.52)	27.06 (22.43)	2.72 (0.67)	2.31 (0.69)	-15.11 (32.84)
Neck, high earnings (%)	2.27 (0.42)	3.19 (0.52)	40.34 (34.68)	2.51 (1.01)	1.37 (0.79)	-45.43 (38.25)
Neck, low earnings (%)	0.88 (0.23)	1.31 (0.29)	48.88 (50.58)	1.19 (0.45)	1.26 (0.51)	5.84 (58.52)
Upper extremities, high earnings (%)	23.76 (1.21)	23.51 (1.24)	-1.05 (7.27)	30.96 (2.99)	18.26 (2.61)	-41.01 (10.18)
Upper extremities, low earnings (%)	34.13 (1.15)	33.01 (1.20)	-3.31 (4.80)	33.11 (1.94)	31.45 (2.13)	-5.02 (8.50)
Trunk, high earnings (%)	12.41 (0.94)	12.23 (0.96)	-1.43 (10.75)	14.23 (2.26)	19.63 (2.68)	38.02 (28.92)
Trunk, low earnings (%)	10.26 (0.73)	9.36 (0.75)	-8.76 (9.77)	11.38 (1.31)	12.37 (1.51)	8.74 (18.22)
Low back, high earnings (%)	28.71 (1.29)	28.34 (1.32)	-1.30 (6.39)	21.34 (2.65)	26.03 (2.97)	21.97 (20.56)
Low back, low earnings (%)	24.69 (1.04)	26.20 (1.13)	6.09 (6.40)	25.64 (1.80)	22.85 (1.92)	-10.87 (9.77)
Lower extremities, high earnings (%)	24.98 (1.23)	24.12 (1.26)	-3.45 (6.93)	22.59 (2.71)	27.85 (3.03)	23.28 (19.94)
Lower extremities, low earnings (%)	22.99 (1.02)	21.87 (1.06)	-4.86 (6.24)	19.35 (1.63)	23.69 (1.95)	22.40 (14.39)
Other injuries, high earnings (%)	2.51 (0.45)	4.05 (0.58)	61.02 (36.67)	4.18 (1.30)	2.74 (1.10)	-34.52 (33.25)
Other injuries, low earnings (%)	3.05 (0.42)	3.01 (0.44)	-1.23 (19.69)	3.74 (0.78)	4.61 (0.96)	23.48 (36.45)

(continued)

Table 3--continued

	Kentucky			Michigan		
	Before	After	Percentage Change	Before	After	Percentage Change
	(1)	(2)	(3)	(4)	(5)	(6)
Occupational diseases, high earnings (%)	0.97	1.21	23.90	0.00	1.37	---
	(0.28)	(0.32)	(48.48)	---	(0.79)	---
Occupational diseases, low earnings (%)	0.59	0.92	56.32	2.89	1.47	-49.16
	(0.18)	(0.24)	(64.49)	(0.69)	(0.55)	(22.62)
Sample Sizes:						
High earnings	1233	1161		239	219	
Low earnings	1705	1527		589	477	

Notes: (1) Standard errors are in parentheses. The standard errors for the percentage of occupational diseases in Michigan, high earnings cannot be calculated in the usual way.

Table 4

Kentucky
Duration and Medical Costs of Temporary Total Disabilities, Year Before and After July 15, 1980 Benefit Increase for High Earnings Individuals

	High Earnings		Low Earnings		Differences		Percentage Differences	
	Before	After	Before	After	(2)-(1)	(4)-(3)	(2)-(1)	(4)-(3)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Duration (weeks)								
Median	4.00	5.00	3.00	3.00	1.00	0.00	25.00	0.00
	(0.14)	(0.20)	(0.11)	(0.12)	(0.25)	(0.16)		
75th Percentile	8.00	10.00	7.00	7.00	2.00	0.00	25.00	0.00
	(0.28)	(0.45)	(0.21)	(0.24)	(0.53)	(0.32)		
Mean of natural log	1.57	1.74	1.34	1.35	0.18	0.01		
	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.04)		
Medical costs (dollars)								
Median	393.51	411.49	238.96	254.40	17.98	15.44	4.57	6.07
	(19.29)	(22.72)	(8.48)	(9.11)	(29.80)	(12.44)		
75th Percentile	1335.71	1686.40	864.94	867.53	350.69	2.59	26.25	0.30
	(103.08)	(122.95)	(72.24)	(69.78)	(160.45)	(100.44)		
Mean of natural log	6.08	6.24	5.59	5.68	0.16	0.09		
	(0.05)	(0.05)	(0.04)	(0.04)	(0.07)	(0.06)		
Sample Size	1233	1161	1705	1527				

Notes: (1) Standard errors are in parentheses. (2) Medical costs are in 1982 dollars, indexed using the medical care component of the CPI.

Table 5

Michigan
Duration and Medical Costs of Temporary Total Disabilities, Year Before and After January 1, 1982 Benefit Increase for High Earnings Individuals

	High Earnings		Low Earnings		Differences		Percentage Differences	
	Before	After	Before	After	(2)-(1)	(4)-(3)	(2)-(1)	(4)-(3)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Duration (weeks)								
Median	5.00	7.00	4.00	4.00	2.00	0.00	40.00	0.00
	(0.45)	(0.67)	(0.22)	(0.28)	(0.81)	(0.35)		
75th Percentile	10.00	14.00	8.50	9.00	4.00	0.50	40.00	5.88
	(0.74)	(1.88)	(0.54)	(0.57)	(2.03)	(0.79)		
Mean of natural log	1.75	2.01	1.59	1.68	0.26	0.09		
	(0.08)	(0.09)	(0.05)	(0.06)	(0.12)	(0.07)		
Medical costs (dollars)								
Median	689.73	765.00	390.63	435.00	75.27	44.38	10.91	10.20
	(77.30)	(134.53)	(32.80)	(33.09)	(155.16)	(46.59)		
75th Percentile	2284.60	2379.00	1383.93	1822.00	94.40	438.07	4.13	31.65
	(178.51)	(284.80)	(155.69)	(145.49)	(336.12)	(213.09)		
Mean of natural log	6.55	6.56	5.81	6.07	0.02	0.26		
	(0.11)	(0.13)	(0.09)	(0.09)	(0.17)	(0.13)		
Sample Size	239	219	589	477				

Notes: (1) Standard errors are in parentheses. (2) Medical costs are in 1982 dollars, indexed using the medical care component of the CPI.

Table 6

Regression Equations for Log of Duration, Kentucky and Michigan, High and Low Earnings Groups Pooled, and High Separately

Variable	Specification							
	High and Low Pooled				High Only			
	Kentucky		Michigan		Kentucky		Michigan	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
After increase	.193	.145	.142	.180				
*High earnings group	(.060)	(.051)	(.136)	(.118)				
After increase	.014	.000	.074	.009	.205	.136	.220	.236
	(.039)	(.033)	(.075)	(.065)	(.048)	(.039)	(.122)	(.103)
High earnings group	-1.517	-.696	4.973	3.267				
	(0.952)	(.808)	(4.269)	(3.715)				
Ln(previous wage)	.212	.171	.813	.141	.442	.210	.063	-.296
	(.090)	(.076)	(.375)	(.502)	(.144)	(.118)	(.444)	(.375)
Ln(previous wage)	.235	.088	-.868	-.532				
*High earnings group	(.162)	(.137)	(.713)	(.620)				
Male	-.062	-.058	-.264	-.293	-.081	-.003	-.959	-.474
	(.040)	(.034)	(.088)	(.076)	(.118)	(.096)	(.565)	(.477)
Married	.050	.052	-.021	-.061	.169	.110	-.085	-.254
	(.035)	(.030)	(.072)	(.063)	(.070)	(.058)	(.165)	(.140)
Ln(age)	.211	.211	.410	.429	.053	.055	.707	.755
	(.045)	(.038)	(.101)	(.088)	(.081)	(.066)	(.210)	(.177)
Ln(total medical costs)		.284		.253		.343		.396
		(.009)		(.016)		(.015)		(.032)
Hospital stay indicator variable		.300		.284		.246		-.200
		(.037)		(.074)		(.057)		(.133)
Industry Indicators:								
Manufacturing	-.150	.136	-.068	-.109	-.185	-.189	-.040	.016
	(.036)	(.031)	(.069)	(.060)	(.066)	(.054)	(.151)	(.128)
Construction	.055	.026	.395	.312	.025	.020	.554	.427
	(.045)	(.038)	(.090)	(.078)	(.063)	(.052)	(.140)	(.119)

(continued)

Table 6--Continued

Variable	Specification							
	High and Low Pooled				High Only			
	Kentucky		Michigan		Kentucky		Michigan	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Injury Type Indicators:								
Head	-.431	-.384	-.851	-.758	-.371	-.281	-1.703	-1.048
	(.112)	(.095)	(.241)	(.210)	(.177)	(.145)	(.436)	(.371)
Neck	.241	.327	-.200	-.270	.306	.444	-.861	-.594
	(.139)	(.119)	(.303)	(.264)	(.195)	(.160)	(.512)	(.432)
Upper Extremities	-.154	.107	-.187	-.238	-.274	.122	-.719	-.248
	(.087)	(.075)	(.167)	(.146)	(.139)	(.115)	(.328)	(.278)
Trunk	.088	.105	.046	-.168	.047	.130	-.509	-.222
	(.094)	(.080)	(.179)	(.157)	(.146)	(.119)	(.339)	(.287)
Low Back	-.005	.166	-.367	-.322	-.059	.244	-.809	-.349
	(.088)	(.075)	(.170)	(.148)	(.138)	(.113)	(.330)	(.280)
Lower Extremities	-.113	.146	-.306	-.314	-.133	.219	-.839	-.439
	(.088)	(.075)	(.171)	(.149)	(.138)	(.114)	(.328)	(.278)
Occupational Diseases	.250	.478	.354	.328	.448	.694	-2.291	-1.965
	(.182)	(.155)	(.290)	(.253)	(.263)	(.215)	(.926)	(.785)
Sample size	5349	5349	1475	1475	2232	2232	447	447
R-square	.050	.316	.068	.295	.040	.358	.128	.386

Notes: (1) The dependent variable is ln(.5+duration). (2) A constant is included in each equation. (3) Standard errors are in parentheses. (4) The omitted industry is other industries, and the omitted injury is other injuries. (5) The sample sizes are slightly smaller them those in the earlier tables because of missing marital status. (6) Previous wage and medical costs are in 1982 dollars.

Table 7

Regression Equations for Log of Duration, All Earnings Groups, Kentucky and Michigan

Variable	Specification							
	With Replacement Rate				With Previous Wage and Weekly Benefit			
	Kentucky		Michigan		Kentucky		Michigan	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Replacement Rate	.072	.087	-.004	.066				
	(.061)	(.052)	(.075)	(.065)				
Ln(weekly benefit)					.469	.317	.265	.206
					(.045)	(.039)	(.059)	(.051)
Ln(previous wage)					-.033	-.057	-.108	-.141
					(.037)	(.032)	(.048)	(.043)
Male	.000	-.076	-.093	-.157	-.104	-.134	-.120	-.158
	(.031)	(.027)	(.037)	(.032)	(.032)	(.028)	(.038)	(.034)
Married	.097	.066	.054	.017	.049	.040	.034	.011
	(.029)	(.024)	(.033)	(.029)	(.029)	(.025)	(.033)	(.029)
Ln(age)	.260	.214	.451	.386	.202	.181	.437	.390
	(.037)	(.032)	(.045)	(.039)	(.037)	(.032)	(.046)	(.040)
Ln(total medical costs)		.290		.232		.283		.232
		(.008)		(.007)		(.008)		(.007)
Hospital stay indicator variable		.251		.425		.253		.423
		(.031)		(.035)		(.031)		(.035)
Industry Indicators:								
Manufacturing	-.143	-.117	-.008	-.013	-.198	-.152	-.028	-.019
	(.027)	(.023)	(.032)	(.028)	(.027)	(.023)	(.033)	(.028)
Construction	.075	.033	.305	.245	.023	.003	.290	.246
	(.037)	(.032)	(.047)	(.041)	(.037)	(.032)	(.048)	(.041)

(continued)

Table 7--Continued

Variable	Specification							
	With Replacement Rate				With Previous Wage and Weekly Benefit			
	Kentucky		Michigan		Kentucky		Michigan	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Injury Type Indicators:								
Head	-.474	-.376	-.517	-.538	-.463	-.369	-.514	-.536
	(.094)	(.080)	(.112)	(.097)	(.093)	(.080)	(.112)	(.097)
Neck	.197	.251	-.187	-.141	.150	.224	-.193	-.142
	(.117)	(.100)	(.145)	(.126)	(.116)	(.100)	(.145)	(.125)
Upper Extremities	-.205	.062	-.268	-.202	-.187	.070	-.274	-.207
	(.074)	(.063)	(.078)	(.067)	(.073)	(.063)	(.078)	(.067)
Trunk	.066	.082	-.062	-.169	.054	.075	-.075	-.176
	(.079)	(.067)	(.086)	(.074)	(.078)	(.067)	(.085)	(.074)
Low Back	-.082	.113	-.229	-.135	-.090	.107	-.244	-.142
	(.074)	(.063)	(.079)	(.068)	(.073)	(.063)	(.079)	(.068)
Lower Extremities	-.142	.134	-.222	-.144	-.143	.130	-.235	-.151
	(.075)	(.064)	(.079)	(.069)	(.074)	(.063)	(.079)	(.069)
Occupational Diseases	.342	.489	.313	.507	.265	.442	.304	.501
	(.130)	(.111)	(.125)	(.108)	(.129)	(.111)	(.125)	(.108)
Sample size	7809	7809	6766	6766	7809	7809	6766	6766
R-square	.031	.297	.040	.281	.052	.305	.044	.283

Notes: (1) The dependent variable is ln(.5+duration). (2) A constant is included in each equation. (3) Standard errors are in parentheses. (4) The omitted industry is other industries, and the omitted injury is other injuries. (5) The sample includes all observations regardless of previous earnings. (6) The weekly benefit, previous wage, and medical costs are in 1982 dollars.

Table 8

Kentucky and Michigan
Incidence of Temporary Total Claims Before and After Increase

	High Earnings		Low Earnings		Number After Divided By Number Before	
	Before	After	Before	After	(2)/(1)	(2)/(1)-(4)/(3)
	(1)	(2)	(3)	(4)	(5)	(6)
Kentucky sample size	1233	1161	1705	1527	0.942 (0.039)	0.046 (0.050)
Michigan sample size	239	219	589	477	0.916 (0.086)	0.106 (0.099)

Note: Standard errors are in parentheses.