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Workers' Compensation Benefits and the Duration of Disabilities

by

Chang Gun Kim

A dissertation is submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

1997

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Abstract

Workers' Compensation Benefits and the Duration of Disabilities

by

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The main purpose of this paper is to investigate the role time an injured worker spent on the workers' compensation program. A theoretical model is developed to explain the behavior of an injured worker who has suffered disability at work and analyze how an injured worker allocate his time between for the recuperation and for the life time consumption. A main assumption on the theoretical model is that claimants in the workers' compensation program may respond to differences in price of medical cares. Even though an injured worker faces no monetary costs of medical care under the current system, employers attempt to limit medical cares since workers' compensation premiums are experience rated and their attempts indirectly influence employees' incentive to return to work.

I estimate the number of days that an injured worker spends on the workers' compensation program after being injured on the job depends on the wage the worker received before being injured and the ratio of weekly workers' compensation benefits to the weekly wage. An increase in this ratio increases the period of disability since it lowers the opportunity cost of a longer recuperation period. An increase in pre-injury

wage raises this cost but may prolong recuperation via an income effect. The data for this study is based on a random sample of over 5,000 total temporary disability claims filed by injured workers during the period of 1988 to 1991. Empirical estimation is based on hazard models which correct right censored problems and empirical results find considerable support for the above hypothesis.

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I. Introduction

A total of 6.8 million injuries and illness was reported in private industry workplaces and more than 60 million lost workdays occur each year¹. Workers' compensation programs provide cash benefits which are intended as partial replacement for lost wages during recuperation and all necessary medical care including rehabilitation services to workers who have suffered from job related injuries or illness.

Workers' compensation is the first social insurance program in the United States² and it is also one of the nation's largest social program. During 1992-1993 workers' compensation benefits totaled about \$43 billions. As regards to benefits paid, workers' compensation is larger than both the Social Security Disability Income program and the unemployment insurance program. The former covered 5.3 million beneficiaries and paid out approximately \$25 billions in 1994; and the latter covered 2 million unemployed workers per week and the annual cost was about \$25 billion in the same year.

Over the past decades, the workers' compensation program has experienced a considerable growth, in particular since mid-1970's. Table I shows that the size of total payment in 1993 is as high as 26 times that of total payment in 1960. During 1970-

¹ Occupational Injuries and Illness in the United States by Industry, 1994, Bureau of Labor Statistics, United States Department of Labor.

² In 1910, New York passed two laws. The compulsory law was declared unconstitutional, but the elective law was validated. Most states enacted laws between 1910 and 1920.

1980, the workers' compensation program experienced the most rapid increase. The amount of total indemnity payments increased by more than 380 percent between 1970 and 1980. Also, the amount of medical payments increased by more than 270 percent between 1970 and 1980. Accordingly, employers' costs as a percent of total payroll costs have more than doubled since 1960. The rapid increases in benefit level in this period have been followed by the 1972 report of National Commission of State Workmen's Compensation Laws, which criticized the inadequacy of benefit levels.³ After the commission's report, most states increased the cash benefit levels and reduced the waiting periods prior to benefit eligibility. This increased benefit levels may also reflect increases in wage levels during that periods since cash benefits are usually calculated as a fraction of weekly earnings at the time of injury.

Other possible source that have contributed to the increase in the cost of workers' compensation program includes rapidly rising medical costs component of total benefits and the broadened coverage of illness not previously covered by the workers' compensation laws, such as, stress-related disease. Since 1980, the growth rate of medical benefits increased more rapidly than that of indemnity benefits. Medical benefits increased more than 10 percent a year from 1980 to 1991. Currently, medical costs account for 40 percent of the total benefits, compared to 30 percent in 1980.

³ The commission was established by the Occupational Safety and Health Act (OSHA). The commission concluded:

In general, workmen's compensation programs provide cash benefits are inadequate. The majority of disabled beneficiaries receive less than two-thirds of the lost wages. In most States, the most a beneficiary may receive, "the maximum weekly benefits", is less than the poverty level of income for a family of four.

The commission's report was followed by the higher industrial accident rates occurred during the 1960s. The commission recommended that federal legislation be enacted if states did not substantially improve their benefit levels by 1975. Under threat of federalization after the commission's report, most states have increased the benefit levels substantially.

Furthermore, the growth rate of medical expenditure in workers' compensation is faster than that of total health expenditure in the United States. Between 1980 and 1987, medical benefits in workers' compensation increased by 151 percent, while 102 percent for medical expenditure in general (Baker and Krueger, 1993).

This steady growth in the amount and importance of workers' compensation has generated the interest of both policy makers and academic researchers. There have been extensive empirical findings of incentive effects of increases in the level of workers' compensation benefits on injury rates or on the number of claims. Most of past research has typically used state level aggregate data to estimate the effects of increases in benefit levels on injury rates or the number of claims rather than on the duration of claims. Most of these studies find that an increase in benefits is associated with an increase in the injury rate (or frequency of claims), and that an increase in the average wage is associated with a fall in the injury rate. Such approaches may have led to an underestimation of the extent of the effect of workers' compensation on incentives. Higher benefits might induce workers to stay out of work longer either to complete medical recovery or to have more leisure. (Meyer, Viscusi, and Durbin, 1995). Also, uses of state-level aggregate data to investigate the incentive effects poses another bias since these studies analyzed nonlinear relationships with group average for groups composed of heterogeneous individuals, they are viewed as descriptive equations rather than as models based on disaggregated behavioral assumptions (Krueger, 1990a).

The main aim of this paper is twofold. First, I present a theoretical model to analyze how an injured worker allocates his or her time to the recuperation and to life

time consumption. Previously, theoretical models in the workers' compensation literature have concentrated on whether or not filing a claim, given a variety of incentive effects for the employers and employees. The worker compares the expected utility of the injured state with the expected utility of the non-injured state. As the expected utility of injured state increases, workers may report injuries that otherwise would have gone unreported or they may take more risky activities on the job.⁴ However, how an injured worker allocates his or her time to recuperation and to consumption has not examined yet. Since the ultimate purpose of workers' compensation system is to return the injured workers' stock of health to the point of being able to return to work and being productive remainder of their working life, it is necessary to investigate the allocation of time during recuperation.

This paper, in particular, makes a contribution in analyzing the effects of both pre-injury wages and weekly indemnity benefits on the duration of claims. Previous empirical studies usually used the duration of non-working spells as a dependent variable and used weekly indemnity benefits and pre-injury wages as explanatory variables. These estimations cannot easily disentangle the effects of benefits and pre-injury wages since the weekly benefits are piecewise linear function of pre-injury weekly earnings (Ehrenberg, 1988). In this paper, I propose a new variable, the proportion of economic loss during the recuperation which will account for tax status of individual claimants.

⁴ Krueger (1990a) provide representative example of this model.

Second, a main assumption of my theoretical model is that claimants in the workers' compensation system may respond to differences in the price of medical care. Even though injured workers face no monetary costs of medical care under the current system, employers attempt to limit medical care since workers' compensation premiums are experience-rated and employers' attempts indirectly affect employees' incentives to return to work. A recent proposal that called for 'twenty-four-hour coverage' suggests that the medical component in workers' compensation would merge into the traditional employer-provided health insurance for off-work injuries. This proposal also allows employers to use coinsurance and deductibles for work-related injuries (Baker and Krueger, 1993). The effectiveness of this proposal will be tested, based on the assumption that duration of recovery period is influenced by the price of medical care.

For the above purposes, I examine the determinants of the length of time spent on the workers' compensation program with explicit recognition of the possibility that claimants respond to differences in the price of medical care. An important contribution to of this paper is to test whether higher costs of treating workers' compensation claimants can be justified by faster return to work. If differences in the price of medical services is found to have a significant impact on the duration of disabilities, then this information may help explain the possible consequences surrounding workers' compensation reform proposal - whether to incorporate the medical component of the workers' compensation system into the traditional health care plan. The effects of an injured worker's pre-injury wage, the price of medical services, and the proportion of economic loss during recovery, along with other socio-demographic variables, on the

duration of disability are estimated using statistical models for the analysis of duration data.

This paper consists of five sections as follows. Section II describes the workers' compensation system. Section III reviews previous studies on the topics of workers' compensation program. Section IV develops a theoretical model and establishes hypotheses to be tested in my empirical study and section V describes the data and the methodology used in the estimation. Finally, section VI and section VII discusses the empirical results and conclusions.

II. Description of the Workers' Compensation Program.

Workers' compensation programs cover any injury or illness arising out of and in the course of employment.¹ These programs require employers to carry 'no fault' coverage to protect their employees against job-related injuries or illness. That is, employees do not need to prove that the employer did something to cause an accident. In turn, employees forgo their rights to sue their employers when such injuries occur. Employers are liable for all occupational injuries and illness. However, they have the right to contest whether the claim is actually work-related and they may dispute the determination concerning the severity of the injury. In most states, workers' compensation programs are mandatory for all employees covered by the law except New Jersey, South Carolina, and Texas.²

According to Schmulowitz (1993), an estimated 96.1 million persons were covered under workers' compensation programs, or 82 percent of the nation's employed wage and salary labor force in the United States during 1992-1993. About \$17.5 billion (41 percent) and \$25.4 billion were paid for medical and hospitalization benefits; and for cash benefits, respectively as a result of claims filed for injured workers during the same period. The cost of workers' compensation as a percent of covered payroll is

¹ Many state programs exclude the coverage of employees of nonprofit, charitable, or religious institutions, and some programs restrict coverage to employees in hazardous jobs. The most common exemptions are domestic services, agricultural employment, casual labor, and State and local government. Also, not all workers employed in smaller firms (usually less than five) are covered.

² In these three states, the coverage of workers' compensation program is optional. But if employers reject such coverage, they lose their protection from suits filed by the employees. They also forfeit their right to the three common law defense: contributory negligence, fellow-servant rule, and the assumption of the risk. As a result, the most of employers elect coverage in these three states.

currently approximately 2.6 percent of total covered payroll compared to 1.96 percent of total covered payroll in 1980. According to the National Council on Compensation Insurance (1990), the temporary total disability indemnity benefits per week range from \$300 to \$400 in average, while total medical costs per lost time claim are about \$1,500 on average in nationwide.

Like other social insurance program, the workers' compensation program is designed to protect employees' economic security against adverse events (i.e., unemployment), however, it is distinguished from other programs in two ways. First, workers' compensation laws operate at the state levels rather than at the federal level. State workers' compensation programs generally are administered by industrial commissions or special units within each state's department of labor. Each of fifty states has its own rules for setting the coverage requirement, the level of benefits, and insurance methods. While state laws regulate the administration of the program, most claims are resolved between the claimant and the insurer without the involvement of state regulators.

Second, the workers' compensation program is the only social insurance program in the United States that allows the participation of private insurance carriers. Benefits are paid by private carriers, by Federal funds, by State funds, or by self-insuring companies as determined by laws among states. Except for a few largest companies, most firms purchase their insurance from private insurance companies. In 1993, \$21.8 billion (50.7 percent) of benefits were paid by private insurers; \$8.1 billion (18.9 percent) by State funds; \$3.2 billion (7.4 percent) by Federal programs; and \$9.9

billion (23 percent) by self-insurers. Small employers are charged a premium based on the historical safety experience of their industry, while larger firms' premiums are 'experience-rated' on the basis of the firms' own past safety record or they have the option to self-insure.

There are four types of benefits³: 1) temporary total disability; 2) temporary partial disability; 3) permanent total disability; and 4) permanent partial disability benefits. Initially, any worker who is injured on the job will receive temporary partial or temporary total disability benefits. Temporary partial disability benefits are paid to those claimants who have some wage earning capacity, whereas temporary total benefits are paid to those workers who are not able to work at all during their recuperation, but are expected to return to work completely. The payments of temporary benefits do not usually start immediately following the injury. There is a waiting period of three to seven days (which depends on the jurisdiction) before an injured worker began to receive the benefits. But workers will receive the benefits retroactively for the waiting period if their disability persists beyond a specified time period. The length of the retroactive period varies from five days to six weeks.

Permanent total disability benefits are paid to the worker if an individual is found to be permanently and totally disabled for any type of gainful employment. Most state laws provide weekly benefits either for life or for the duration of disability. Permanent partial disability benefits were paid to those workers whose permanent

³ There is also death benefits. In the case of a worker is killed on the job, dependents of workers are paid survivor's benefits. Such benefits are paid in a lump sum.

disability was partial and thus may or may not have affected their ability to work.

Usually, permanent benefits are paid in addition to temporary benefits.

Benefits for permanent partial disability depend on whether the claim is classified as 'scheduled' or 'non-scheduled' injury or a combination of both. Scheduled (or specific) injuries are subject to the body part injured (such as, the loss of arm, leg, eye, or other part of the body) and the severity of injury. Non-scheduled injuries refer to a disability caused by injury to the head, back, or nervous system. Benefits for scheduled injuries are usually made at the same rate as for temporary total disability benefits, while compensation for non-scheduled injuries are determined, based on the percent of wage loss or reduction in earning capacity. Some states may specify the minimum length for permanent partial claims. Again, each individual state establishes its own rules to determine the benefits.

While temporary disability claims (including total and partial) account for three-fourths of all compensable claims, nearly three-fourths of all indemnity payments made to permanent disability claims (including total and partial). From 1978 to 1988, the average benefit per compensable claim involving permanent total disability nearly tripled, from \$73,408 to \$201,102. Many claims are classified as temporary total disability claims initially but which have longer duration will eventually be classified as permanent partial or total claims.

Temporary benefits are paid until the injured worker reaches to the point of maximum medical improvement, or to the point where any further medical treatment is not expected to improve an injured worker's physical condition. The payment of

benefits will stop once a person returns to work. In general, during the recuperation, an injured worker is under the care of a physician who is designated by the insurance company carrying the employer's workers' compensation policy. Given the fact that an injured worker may return to work at any time while under a physician's care, there is some latitude for an injured worker to control the duration of non-working spells. A worker can stay on the workers' compensation program until a physician determines the 'maximum medical improvement' has been achieved. While the worker's degree of recuperation is a medical judgment of a medical provider, a physician will heavily rely on subjective information provided by a worker. Therefore, an increase in these benefits will create an incentive to increase the duration of non-working spells. If insurance companies suspect abuse, they can contest legitimacy of the claims. Once they find the claim is fraud, they can cease the payment at any time during the recuperation. At the same time, if an injured worker believes he or she received unfair judgment, he or she has the right to litigate against their judgment in a hearing before workers' compensation board. In fact, many of claims are contested in a court. The litigation rate is higher for more severe injuries.

The indemnity benefits for temporary total disability, permanent partial disability, and permanent total disability are usually calculated as a percent of weekly earnings at the time of accident - mostly two thirds of weekly earnings. These benefits are subject to maximum and minimum weekly benefit levels, which varies across states. Interstate variations for the minimum and maximum benefit level are rather substantial.

As of January 1992, for example, state maximum weekly benefits for temporary total disability ranges from \$225 in Georgia to \$737 in Connecticut.⁴

The maximum benefit levels have increased significantly after the recommendations by the National Commission on State Workmen's Compensation Laws in 1972. During 1970- 1980, automatic increases in the maximum weekly benefit amounts became law in many states. This legislation resulted in higher benefits because the maximum level of benefits generally were adjusted based on the level of wages covered by the unemployment insurance. Many states have temporary total disability benefit maximum of 100 percent of the statewide average weekly wage (SAWW). The median state maximum benefit in January 1992 was \$409.

Also, note that cash benefits are exempted from income taxation. Given the minimum and maximum weekly benefit levels and tax exemption laws, some low-wage employees may receive weekly indemnity benefits more than their after tax earnings and some high-wage workers may collect their benefits short of two-thirds of their previous wages. Some state's laws also specify indemnity payment only up to a maximum number of weeks and a maximum total payment. Besides four benefit types, lump sum settlements are permitted in most states. These settlements are more common for serious cases. Injured workers who have applied for workers compensation benefits may be also entitled to receive other forms of government transfer programs.

All state laws require unlimited coverage of medical expenses associated with the treatment of injuries. This medical care includes first-aid treatment, physician

⁴ Chamber of Commerce, Analysis of Workers' Compensation Laws (Washington D.C.: 1993)

services, surgical and hospital services, nursing, medical drug and supplies, appliances, and prosthetic devices. Also, medical care is provided without a limit on time or amount for injuries. As mentioned before, rising medical cost have become an important issue in many states' workers' compensation program. In order to refrain the growth of medical costs, many states enacted cost containment strategies to control the costs. There are basically six types of medical cost containment policies in workers' compensation program. These are limited employee choice, limited employee change, fee schedule, hospital rate regulation, bill review, and utilization review.

The medical fee schedule is the most widely used methods to control medical costs in workers' compensation programs. The fee schedule specifies the maximum reimbursement rates for services supplied by health care providers. Fee schedule vary considerably across states. There are differences in how fees are set, reimbursement levels, the frequency of fee updates, and the types of coverage and provider covered, and enforcement mechanisms. Fee schedule is designed to control medical prices paid for medical services, not medical utilization - the frequency of treatments, the type and duration of medical episode. According to the Workers Compensation Research Institute (WCRI) , fee schedules were in effect in forty states as of 1995. There are wide interstate variations in fees for the same procedures across states.

The choice of treating provider is another source of controlling costs in workers' compensation system. The basic underlying concept is that if employers or insurers have the initial choice of treating provider, then they may opt to choose those physicians who offer discounts or practicing conservative treatments. Contrary to

medical fee schedule, the choice of treating provider is to control utilization of medical services.

Some of the states mandated the implementation of bill and utilization review of recipients of the workers' compensation benefits. These are the formal process of monitoring a physician's treatments and discharge decisions; and, in particular, of reviewing a patient's needs for continuing treatment.

III. Literature Reviews

Researches on impacts of workers' compensation benefits on the labor market have focused on following issues: effects of changes in benefits on the incidence of injury or illness; benefit levels and the duration of claims; and the moral hazard problems.

Many studies focused on the investigation of the effects of benefits on wages and on incidences of injury or illness on the job. This section reviews literature on the previous issues. The recent studies focus on the extremely high medical costs associated with treating occupational injuries after experiencing rapidly increasing medical costs in 1980's.

1. Compensating wage differentials - Wages and Benefits Tradeoff

A number of previous studies ascertained that wage differentials exist to compensate workers for the exposure to job risks, or, wage rates are positively associated with the risk of injury on the job.¹ Recently, a number of researchers studied the role of workers' compensation benefits on compensating wage differentials. These studies included the workers' compensation benefits and measures of risk variables in the wage equation and estimated the effect of workers' compensation benefits on the tradeoff between wages and job risks. Arnould and Nichols (1983) and Dorsey and Walzer (1983) discussed that compensating wage differentials may be understated unless differences in the level of workers' compensation benefits are considered.

¹ See Smith (1979) for a review of the earlier empirical studies.

Arnould and Nichols (1983) used the average weekly wage of individuals from the U.S. Census of 1970 as the dependent variable. As the major explanatory variables, they used as the measure of risk as the actuarial risks of death by occupational class provided by the Society of Actuaries and they included the wage replacement rate for the amount of benefits. They reported that there is a positive relation between the weekly wages and risks, suggesting that the wage-risk differentials would be much higher in the absence of workers' compensation benefits.

Dorsey and Walzer (1983) found similar results. Their dependent variable was the weekly earnings based on the Current Population Survey for May 1978. The probability of a nonfatal accident involving lost workdays and the average number of lost workdays per lost-workday accident were used as measures of risk. They also included the actual workers' compensation costs per \$100 of payroll as a measure of employer liability. Like Arnould and Nichols, they found that the wage rate is negatively related to the workers' compensation benefits and it is positively related to measures of risk variables. In sum, their empirical results based on wage equations showed two principal findings. First, compensating wage differentials would be much higher in the absence of workers' compensation benefits. Second, increases in workers' benefits decrease wages since workers' presumably require smaller risks on hazardous jobs. This implies that workers' compensation benefits have an indirect effect on the wages..

The studies mentioned above imply that workers' compensation benefits play a significant role to a worker. Another important policy implication relates to at the adequacy of benefit levels and costs to an employer. Viscusi and Moore (1987)

confirmed above previous findings; the higher levels of workers' compensation benefits decrease wage levels and raises estimates of compensating differentials for risk after controlling the workers' compensation. Furthermore, they investigated properties of the trade-off between wages and workers' compensation benefits and suggested that benefit levels provided sub-optimal levels of income insurance. They concluded that

“the observed rate at which workers are willing to trade off base wage rates for higher levels of compensation greatly exceeds the actuarial rate of trade-off, even taking into account the administrative costs. These results suggest that benefit levels in 1976 were sub-optimal, provided that one abstracts from moral hazard considerations.” (1987, p.260)

Moore and Viscusi (1990) presented the net cost (workers' compensation premium less wage reduction) of the workers' compensation program to the employer after taking into account the wage offset effects. They presented a wide range of estimates for net cost under the different wage reduction rates. In every instance the annual net cost of the workers' compensation system was negative; the highest annual costs was -\$2.3 billion, and the lowest was -\$26.7 billion. Wages decline by more than the firm's cost of workers' compensation program for a given level of benefits. They concluded that the workers' compensation system has more than paid for itself through associated reductions in wages.

2. Benefit Levels and Injury Rates

Many early studies used aggregated state-level data or state-by-manufacturing-industry-level data to investigate the relation between variations in the benefit levels and the frequency of either a claim or an injury. Chelius (1982) examined the relation

between the workers' compensation indemnity benefits and frequency rates of injury using injury rates of manufacturing industries in 36 states. The data used by Chelius were collected by the Occupational Safety and Health Administration (OSHA) from 1972 to 1975. He used three versions of the dependent variables: the total lost workdays per 100 full time employees, the frequency rate of lost workday cases, and the average number of days lost per case (severity rate). He used the of income replacement rate and waiting periods which varies from state to state as independent variables. He found a positive and significant relation between the income replacement rates and the frequency rates, suggesting that higher benefits induce employees to spend fewer resources on preventing injuries. However, he found the negative relation between days per case and income replacement rate, implying that greater employer liability is associated with greater expenditures on the prevention of more serious injuries. There no significant relation between the average number of days per case and the level of income replacement.

Butler (1983)² used the data on 15 industries from South Carolina in more than 32 years. He limited the analysis to a single state to eliminate unobservable variations in the administration of state laws and regulations. He used the annual injuries per employee as results of the temporary total disability, the permanent partial disability, the permanent total disability, and death as dependent variables; and average real annual benefit payments for each category of above injury types, after-tax weekly earnings which were adjusted for state, federal, and social security taxes, the size of employees per

² This study also includes the wage-benefit tradeoff based on the wage equations. He reached the similar conclusions as Dorsey and Walzer (1983) and Arnould and Nichols (1983) presented.

establishment, and the time trend which may reflect changes in industrial safety changes over time, as main explanatory variables. He used the levels of benefits as exogenous and weekly wages were predicted to consider the simultaneous relation between injury rates and wage rates.

His main finding was that the frequency rates for each types of injuries are positively associated with the level of benefits for each types of injuries and the frequency rates negatively related to the wage rates. He reported that the elasticity of the claim rates with respect to benefits at the sample means and it ranged from 1.13 to 0.13. The death rate is most responsive to changes in the benefits and temporary total benefits were the least responsive.

Butler and Worrall (1983) used temporary total disability and permanent partial disability claims to estimate the relation between benefit levels and injury rates of 35 states from 1972 to 1978. Their dependent variable was the log of claim rates which adjusted for both labor supply and labor demand adjustments in wages and hours of work using two-stage least squares. The major findings from their empirical results are as follows: injury claims increases as wages fall and as benefits increase, the lower the injury claims the longer the waiting periods holding benefits constant, and the degree of unionism has a significant impact in increasing the number of claims filed. The average elasticity of claim rates with respect to benefits was around 0.4. This elasticity was a little less than 0.4 for temporary total disability and was slightly over 1.0 for major permanent partial disability claims. Like Butler (1983), the elasticity of claims rates with respect to benefits increased with the severity of an injury.

Worrall and Appel (1982) examined the relation between the injury severity and the level of benefits. Their data was based on claims filed by National Council on Compensation Insurance in Texas from 1958 to 1977. In their estimation, claims severity were proxied by the ratio of temporary total claims to medical only claims and the ratio of all indemnity claims to medical only claims. They found that increases in the relative frequency of indemnity claims as the replacement increases. They reported the elasticity of claims severity with respect to the replacement rate was 0.5 for the ratio of all indemnity claims to medical only claims and was 0.6 for the ratio of temporary total claims to medical only claims.

There are two additional analyses of claim frequency using individual data sets to study the probability of participation in workers' compensation program. These studies have the advantages of allowing for more demographic information about a claimant or a claim.

Leigh (1985) used disaggregated data from Panel Study of Income Dynamics (PSID) from 1977 to 1979 to estimate the probability of receiving the workers' compensation benefits. The expected probabilities that particular individuals will receive workers' compensation benefits are estimated from information on the worker's pre-injury wage, years of schooling and of work experiences, and other demographic variables. Using a logit estimation, he found the elasticity at the mean values of receiving workers' compensation benefits with respect to the potential benefit level was 0.3 for temporary total disability claims after controlled for year and state effects. His finding

was similar to Butler and Worrall (1985)'s benefit elasticity of 0.4 using aggregate industry level data.

Krueger (1990a) also used micro-level data from Current Population Survey (CPS) in the two periods: 1983-1984 and 1984-1985 to estimate the determinants of participation in the workers' compensation program. Using a probit estimation, he found a positive relation between benefits and claims for men but not for women. Overall, a 10 percent increase in benefits would lead to about 7 percent increase in recipiency. His elasticity of participation of workers' compensation programs with respect to benefits was 0.535 for the entire sample, slightly higher for manufacturing employees (0.569) than for non-manufacturing employees (0.505) when they are estimated separately. He provided two alternative explanations for positive relation between the participation of program and the level of benefits. Higher benefits may induce workers to take more *ex ante* job risks given a higher level of *ex post* compensation and thereby increase the frequency of injury occurred (called 'risk-bearing moral hazard effect'). On the other hand, higher benefits may not affect the frequency of 'true' on-the-job injuries, but may instead induce workers to file fraudulent claims, or to file claims for injuries that otherwise would have occurred but would not have been reported without a sufficient financial incentive. Thus, increases in benefits have no effects on actual injuries or risks, but does induce the filing of fraudulent claims (called 'reporting moral effect'). I will explain these moral hazard problems in later more detail.

The above mentioned studies suggest that the employee's response to benefits dominates the employer's response, however, employer incentives will also affect the use

and costs of the workers' compensation program. A major point to the employer incentives is that workers' compensation benefits alter firm's financial incentive to expand resources to reduce workplace injuries. A number of studies have found that 'experience-rating' does matter; experience-rated employers respond to higher benefits by making a workplace safer and reduce injuries.

Ruser (1983) estimated how indemnity benefits affect injury rates after controlling for the size of a firm establishment. His study was based on a theoretical model that shows an increase in indemnity benefits has a smaller influence on injury rates in larger firms with respect to the number of employees. The cost of a workplace injury to a firm in terms of increased premiums is based on firm's own safety records. This is especially true for large firms, which tend to be self-insured. As for large firms, a given increase in benefits will result in more safer investments due to high premiums. He discussed that the magnitude of the benefit-injury relation will decrease with an increase in firm size since the full impact of accidents reflects firms' insurance premiums. His sample consisted of 25 three-digit U.S. manufacturing industries in 41 states from the Bureau of labor Statistics (BLS) during 1972-1979. The dependent variables used in his study were the frequency of all injuries per 100 workers and of lost workday injuries per 100 workers in those periods. His independent variables were average real weekly benefits and average number of employees per establishment. After allowing the interaction of the benefits and firm sizes, he found that the relation between benefits and injury rates is smaller in larger firms when the frequency of all injuries was used as the dependent variable.

Later Ruser (1991) confirmed his finding using a longitudinal microdata on nearly 2,800 manufacturing firms for the years 1979-1984. He included four dummy variables for the firm establishments as to the size of a firm: 1-99, 100-249, 250-499, and 500 plus employees. His dependent variables were same as his previous study. Using both ordinary least square and count data models, again, he found an evidence that a more experience-rated firm tends to internalize the costs of benefits paid to their injured employees since a firm has more incentive to improve its safety record in the workplace. That leads to a smaller relation between the injury rates and the benefit levels for large firms. After allowing interaction of workers' compensation benefits with firm sizes, the effect of raising weekly benefits by \$50 in 1989 would increase the lost workday rate by 1.20 (1.26 cases per 100 workers). However, in establishments with 500 or more workers, the resulting increases were only between 0.27 and 0.31 cases.

All studies mentioned above found that an increase in benefits raises the frequency of either claims or injuries. Yet, there is one study which found that an increase in benefits actually *decreases* the frequency of injuries. Moore and Viscusi (1990) found that an increase in benefits leads to a small but significant decrease in the frequency of fatal injuries. Their studies are distinguished from others: they imputed not only various measures of benefits available to injured workers but also risk variables which are different among industries. Their dependent variable is an industry death risk which is the most severe accidents, and they found workers' compensation benefits have a significant negative effect on the fatality rates. They suggested that employers' responses are dominating the employees' responses in the workers' compensation program since a

higher level of benefits leads to the greater accident prevention efforts by employers. Therefore, higher levels of workers' compensation benefits actually save money since it promotes the safety in the workplace. Albeit the current criticism of the workers' compensation program, they suggested that the workers' compensation program is by far the most influential governmental program for reducing workplace fatalities (Moore and Viscusi, 1990 pp. 135).

3. Benefit Levels and Duration of Disability

Another way workers' compensation programs can influence employees' behavior is by affecting incentives to recuperate and return to work. Because injured workers' foregone earnings are partially replaced by benefits, an injured worker who can receive indemnity benefit close to his or her pre-injury earnings may have an incentive to delay his or her return to work and that leads to an increase in the duration of disability. Therefore, workers' compensation benefits may affect not only the frequency of either claims or injuries, but also affect employees' incentive to return to work. The following studies analyzed the effects of benefits on the duration of non-working spells.

1) Hazard rate approach

The first study on benefit levels and the duration of non-working spells has been done by Butler and Worrall (1985). They used a cross sectional sample data of a single state (Illinois) and their sample exclusively contained male with temporary total lower-back injuries. The data were drawn from National Council of Workers' Compensation

Insurance (NCCI). Since April in 1979 where the data collection started, claimants who have not returned to work by the end of observation period are considered as right censored. They used a duration model to correct right censored problems and to predict the length of stay on the workers' compensation program. Their theoretical foundation was based on a search model, which suggests that the duration of a claim decreases as the wage offer or the probability of a wage offer increase, and increases with increases in the reservation wage. The actual wage received before an injury and the weekly benefits under workers' compensation program were used as proxy variables for the wage offer and the reservation wage.

Their principal finding was that the duration of a claim increases with benefit levels and decreases with the employee's pre-injury wage rate. Since pre-injury wages are opportunity costs of staying on the program, the higher the pre-injury wages, the sooner injured workers return to work and, hence, the shorter duration of non-working spells. Also, workers' compensation benefits will lead workers to increase their reservation wages for returning to work and a higher reservation wage will increase the length of time spent on the workers' compensation program. They reported that the elasticity of the duration of claims with respect to the temporary total benefits were ranges from 0.18 to 0.35, depends on the specifications, which implies that a 10 percent increase in benefits yields about a 2 to 4 percent increase in the duration of claims. The elasticity of the duration of claims with respect to pre-injury earnings was -0.04.

Krueger (1990a and 1990b) and Ehrenberg (1988) criticized previous findings, saying that identification of independent benefit and wage effects in a single state cross-

sectional study does not yield enough variations since linearly independent variations in benefits and wages are generated solely by non-linearity's in the benefit formula. Like Butler (1983), by limiting their sample to a single state may eliminate some of unobservable effects of the variations in administration of programs, but the identification of two major variables - the benefit and the wage variables become problematic. Since benefits are function of the pre-injury wage for all claimants subject to the minimum and maximum benefit levels, benefits are a negative, monotonic function of wages within a state. Therefore, it is difficult to disentangle the effect of benefits from the effect of wages. Furthermore, Krueger suggested an alternative explanation for a positive relation between the benefit and the duration of disability, saying that injured workers will take longer time to recuperate in response to higher benefit levels so that they will be less likely to have a recurrence of the same or another injury and be productive remainder of their working life.

Johnson and Ondrich (1990) used a cross-sectional sample from states (Florida, New York and Wisconsin) of injured workers who had suffered from the permanent partial disabilities. Their data contained better demographic variables, such as education, job experience, race, and union membership. They also included the various types of physical impairments and the index of severity of impairments. Like Butler and Worrall (1985), they found that increases in benefit levels associated with the longer spells and the higher the pre-injury wage, the shorter the duration of work absence. They reported a larger elasticity of the duration with respect to the permanent partial benefits (range from 1.11 to 1.13) compared to that of temporary total disability, suggesting that for more

serious injuries there is more disincentive effects of returning to work. The estimates for the wage elasticity were between -0.64 and -0.46.

This paper focuses on injured workers, including males and females who suffered from the temporary total disability and the data were collected in four states during 1988 and 1991 to control inter-state variations. Also, the data includes all injured body types compared to a single injury type.

(2) Natural Experiments Approach

Krueger (1990b) employed a natural experiment approach to investigate the effect of a legislated increase in the minimum and maximum workers' compensation benefits on the length of non-working spells in Minnesota that originated in 1986 and closed by July 1989. Using the method called 'difference in difference', he compares the control group whose mean injury duration was unaffected by increases in benefit levels to the treatment group whose mean injury duration was affected by 5 percent increases in the minimum and maximum benefits. The differences in mean injury duration between the control and the treatment groups provide a measure of percent changes in duration of work absences due to changes in benefit levels. These differences divided by the differences in weekly benefit levels show a measure of benefit elasticity. His finding suggest that the duration of disability increase 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 benefits. His estimate of the elasticity of duration of non-working with respect to the temporary total disability was 1.67. He reported much larger estimates than the benefit

elasticity estimated by Butler and Worrall (1985) and somewhat larger than Johnson and Ondrich (1990)'s estimated elasticity for permanent partial claims. His explanation for a much larger estimate was that the variation in the benefits in his data was genuinely exogenous in his data, whereas identification of independent benefit and wage effects was problematic in the previous two studies.

Curington (1994) also used a natural experiment method to examine the benefit levels and the duration of disability, using permanent partial disability claims filed before and after four benefit changes in New York states during 1964 and 1983. He found that benefit elasticity of the duration of disabilities for minor permanent disability ranges from 0.13 to 0.24. This finding is similar to estimates results from analyses based on the temporary total disability (Butler and Worrall, 1985). However, he found much larger elasticity for more severe permanent disability, which ranges from 0.75 to 1.34.

Recently, Meyer, Viscusi, and Durbin (1995) used same the natural experiment approach to examine the effects of workers' compensation on time out of work. They compared time out of work for injured workers before and after increases in the benefit levels in Kentucky and Michigan. They used a control group as low earning injured workers who were unaffected by the increase in the maximum weekly benefits, while a treatment group those who experienced approximately 50 percent increases in the maximum weekly benefits, held the replacement rate constant. They reported the elasticity of duration of claims with respect to benefits ranges from 0.3 to 0.4.

4. Moral Hazards Associated with Benefit Levels

Like other social insurance program, the workers' compensation program poses moral hazard problem. In workers' compensation programs, the potential moral hazard is particularly acute, because, by providing the income protection to workers in the event of workplace injuries, the public policy may inadvertently encourage workers to take greater risks on the job and thus incur even more injuries. Also, workers have incentives to 'make up' injuries or to report for injury claims that occurred off the job (Krueger, 1990).

The statutory provision of unlimited medical care for injured workers may induce them to take less care on the job and thus resulting in more accidents or in an increase in the severity of injuries. This is called a 'risk-bearing' moral hazard. Any changes in the benefit levels may alter employees' incentives to file claims without changing actual safety on the workplace.³ Or, workers may also decide to file a claim for disability that otherwise would have occurred but would not have been reported in the absence of moral hazard. This is called a 'claim reporting' moral hazard.

Butler and Worrall (1991) tried to disentangle 'claim reporting' from 'risk bearing' moral hazard effects by estimating separately indemnity and medical costs as a function of the level of expected indemnity benefits. If medical costs are properly deflated by medical price index, the impact of expected indemnity benefits should be the same on indemnity and medical costs in the absence of a 'claim reporting' moral hazard effect, since the workers' compensation program pays for unlimited medical care. The

³ The 1987 *Economic Report of the President* notes that

A growing body of research has found that the workers' compensation benefits have unfavorable effects on safety. Higher benefits appear to increase both the frequency of work injuries and the number of compensation claims filed. One explanation for the positive connection is the claim effect. Even if actual injuries remain constant, workers are more likely to file claims when benefits are higher, thereby producing more reported injuries.

real medical costs should reflect for the 'true' compensable injuries (a 'risk bearing' effect) and the indemnity costs reflect a 'claim reporting' effect. They found that indemnity costs are positively related to expected benefits, while medical costs are negatively related to expected benefits. These results suggest that the higher level of benefits may induce more 'claim reporting' effects and thus higher indemnity costs. On the other hand, higher benefits led employers to increase the workplace safety by reducing the injury rates, and, therefore, thus medical costs will be lower.

A study by Dionne and St-Michel (1991) examined the variation of recovery time due to moral hazard and their main finding was that a moral hazard increases with the degree of relative difficulty in diagnoses for injuries. They classified injuries into two dimensions based on the severity of injury, which is measured by the average length of absence from work and whether injury is easy or more difficult to diagnose. Then they examined the variations of recovery time on workers' compensation claims and the degree of relative difficulty in diagnoses for injuries. For instance, they grouped low back pains (minor injuries) and spinal disorders (major injuries) as difficult conditions to be diagnoses, and contusion, amputation, and burn (minor injuries) and fracture (major injuries) as easy conditions to be diagnosed. The data for their study were collected from workers' compensation claims in Quebec from 1978 and 1982. They found that variations of recovery time are greater for difficult diagnose injuries (lower back pains and spinal discords) than other injuries. Furthermore, they estimated the total variation in recovery time with respect to changes in insurance coverage. They found that the recovery

time is significantly longer for difficult diagnose injuries when insurance coverage increased in 1979 for lower income bracket recipients.

Unusually high claims reporting on Monday have led to the possibility that some workers are filing fraudulent claims for off-the-job injuries occurred during the weekend as having occurred on-the-job (for example, strains and sprains), which are relatively easy to be concealed but difficult to be diagnosed. Smith (1990) analyzed pattern of workers' compensation claims filing by injury type and by the day of week and time of day that an injury was first reported. To test a hypothesis that workers are filing off-the-job injury claims on Monday (or on Tuesday after long weekends) as having occurred at work so that they can obtain medical and indemnity benefits, he partitioned a sample of claims into two groups: (1) injuries that are easy to be concealed as on-the-job injuries even though it occurred off-the-job, such as sprains and strains; and (2) injuries that are difficult to be falsely reported as on-the-job, such as fractures and lacerations. His data are drawn from Supplement Data System (SDS), which is a part of the Bureau of labor Statistics (BLS) and which is collected in seven states between 1978 and 1979. He compared the frequency of injuries that may be easily concealed to the frequency of injuries that are difficult to be concealed between on Monday and other days of the week. He suggested that there is a circumstantial evidence that workers' compensation benefits are paying for some off-the-job injuries. He estimated that as much as 9 percent of injuries reported on a Monday were falsely reported.

Card and McCall (1995) also tested the 'Monday effect' in workers' compensation claims. Recent increases in medical costs, along with a rise in the fraction

of workers who do not have medical care insurance, have raised the concern that workers' compensation programs may be paying for some off-the-job injuries. They combined information on medical insurance coverage from the March Current Population Survey with the claim data from the Minnesota workers' compensation program. Unlike Smith, they found neither the evidence of Monday effect nor the evidence of a bigger Monday effect for workers who do not have medical insurance coverage for their off-the-job injuries. They suggested an alternative explanation for Monday effect, such that sprains and strains injuries are more likely to occur on Monday after a weekend hiatus. As a result, the Monday effect in injury claims is rather a physiological-based explanation than an explanation based on fraudulent claim filings.

Butler, Durbin, and Helavacian (1996) investigated the marked shift towards soft tissue injuries such as sprains, strains, and low back pains during the last decades. The soft tissue injuries are defined as hard-to-monitor and more subjective injuries. For instance, low back pains are more easy-to-conceal than laceration and fracture injuries which are directly visible and difficult-to-conceal. They used a fifteen state sample of workers' compensation claims from 1980 to 1989 and found that the proportion of soft tissue injuries has risen from 44.7 percent of all claims in 1980 to 50.6 percent in 1989. As a result, the relative share of costs attributable to soft tissue injuries has also risen from 41 percent to 48.8 percent. They also found that, at the same time, there have been modest decreases in laceration and fracture injuries and the relative share of costs for fracture injuries is the only category that declined between 1980 and 1989.

They suggested that one of the reasons for increases in the soft tissue injuries is that the moral hazard behavior on the part of workers and health care providers. Not only workers are sensitive to financial incentives (e.g., indemnity benefits) but also health care providers respond to the economic incentives generated by the workers' compensation program. In particular, physicians in HMOs (Health Maintenance organization) may have incentives to misclassify claims as compensable in the workers' compensation in order to maximize their income. They found evidence that moral hazard response explains most of the 30 percent increase in the proportion of soft tissue injuries during the 1980s.

5. Medical Benefits Utilization

As mentioned in the previous section, the growth of medical expenditure under the workers' compensation program is faster than that of medical costs under traditional health insurance plans. Although the medical costs of workers' compensations have been a small portion of the total medical expenditure (about 2 to 3 percent) in the United States, rapid increases in medical benefit costs under the workers' compensation program have led policy makers and insurers to pay attentions on cost containment policies. A number of studies on the effectiveness of various costs containment policies in workers' compensation program have been conducted. Pozzebon (1994) examined the effectiveness of cost containment policies; limits on the employee's choice of the treating practitioner and use of fee schedules. The dependent variable in her study was the natural logarithm of the medical costs per claim during 1979 and 1987, which were adjusted for inflation. She found no evidence that the imposition of limits on choice of providers and

uses of fee schedule would effectively contain the medical costs in workers' compensation systems. However, Durbin and Appel (1991) found a negative relation between the use of fee schedules and medical care costs. They found that the use of fee schedules reduces medical costs between 3.5 and 5.4 percents. Their data set included 33 states over the period of 1964-1984 and their estimation was based on multivariate regression methods. Likewise, Levy and Miller (1996) found that fee schedules and state hospital rate-settings reduce the medical expenditure per claim. They used lost workday claims from Detailed Claims Information (DCI) database of National Council of Workers' Compensation. The samples were collected for four major injuries in 17 states between 1979 and 1988.

Baker and Krueger (1995) analyzed, for similar injuries, the differences between the charges in medical treatments incurred by injured workers under the workers' compensation program and the charges by patients under the traditional health insurance plan. Workers' compensation claims were drawn from Liberty Mutual Insurance Company and insurance claims were drawn from Blue Cross/Blue Shield for their fee-for-service health plan. Both samples were based on workers whose ages are 16-65 and who are living in Minnesota.

They used the amount of billed medical treatments as a dependent variable because the billed data were only available for the control group. They found a larger difference in the amount charged for medical services between two groups, and the differences attributed to the disparity of price discriminations and lack of extensive oversights in workers' compensation. Since the medical care is unlimited for treating

injured workers at zero price and there are no copayments and deductibles in workers' compensation systems, injured workers have little incentives to search for low-cost health care providers. As a consequence, a health care provider may price discriminated against recipients of workers' compensation systems.

Recently, Durbin, Corro, and Helvacian (1996) also compared the medical costs between two groups and they found significant differences in total medical costs between two groups. Contrary to Baker and Krueger, they attributed the differences to the greater utilization of medical services and a different mix of medical services rendered after controlling for demographic and claimant characteristics. They used the subsample of claims from four states (Florida, Illinois, Oregon, and Pennsylvania) from the NCCI Detailed Claim Information database and the group health data were drawn from MEDSTAT, Inc., for the same four states and the same time periods as the workers' compensation claim data. They used both actual amounts of medical care charged and actual amounts paid as dependent variables in their regression. They used unit price of a specific service rendered by the current procedural terminology (CPT) codes which are used by physicians to categorize medical services provided. They found no systematic differences in medical expenditures between two groups using the average amount billed per CPT. To examine utilization of medical services, they compared the performance of average number of days each procedure per case between two groups. They concluded that the more extensive utilization of medical services for workers' compensation claimants attributed the differences in medical expenditures between two groups.

Durbin, Helvacian, and Worrall (1995) examined the linkage and potential substitutability between indemnity and medical components of workers' compensation costs. They developed a theoretical model to analyze the relation between the demand for and the provision of medical care with the duration of disability for injured workers. They suggested that national health proposals which disconnect the medical and indemnity components of the workers' compensation program (such as twenty-four-hour coverage) may not yield the savings in both duration of disability and indemnity benefits. Their sample are workers compensation claims filed in four states (Florida, Illinois, Oregon, and Pennsylvania) from 1988 through 1991 that resulted in time loss from work and exclusively contains closed claims. The data for this paper is same as theirs but it includes both closed and open claims.

Their empirical evidence showed that a decrease in medical services leads to an increase in temporary total disability spells. Based on their estimates, a 10 percent increase in the relative price of medical care in the post-acute phase, reduces demand for medical services in the acute and post-acute phases by 1.9 percent and 3.4 percent, respectively. At the same time, a 10 percent increase in the price of medical care in the acute period, decrease demand for medical services in the acute and post-acute periods by 0.9 percent and 1.1 percent, respectively. Consequently, a 10 percent increase in the price of medical care in both acute and post-acute periods increases the duration of temporary total disability by 1.6 percent and 0.9 percent, respectively.

IV. Theoretical Consideration

IV-1. Demand for time input of health production function

The following model is to explain the behavior of a worker who has suffered from a temporary total disability at work and it is deciding for an individual how much time and medical care to be allocated during recuperation. Suppose that a life time utility function of an injured worker after he or she got injured is defined as follow:

$$U = U(H, X) \quad \text{Eq (1)}$$

where H is health after returning to work and X is the lifetime consumption.

An individual will try to maximize the utility function subject to a health production function; and income and time constraints. First, the health production function of an injured worker is defined as:

$$H = H(M, D) \quad \text{Eq (2)}$$

where M is medical care received during the recuperation and D is the time spent away from work because of an injury. Health (H) is positively related to medical care (M) and to the duration (D). More medical care and longer to recover presumably for a given injury increase the health status. Durbin et. al. (1995) treated D as an output of the health production function, which depends on M. They assume that the utilization of more medical services may lower the duration of an individual's non-working time and it may result in savings of indemnity benefits. Thus, their health production function depends only on the amounts of medical care.

In contrast, I consider of D as an input of the health production function (Eq (2)). In order to be cured from an injury and return to work, an injured worker needs not only medical care, but also non-working time to improve his or her health status. Although the sample is restricted to those who receive temporary total disability benefits, I cannot rule out the possibility that some injured workers are permanently disabled and never return to work because of the severity of an injury. If one assumes that D as output of health production function and a negative relationship between D and M (because the more medical care use will lower D , and increasing H), the model cannot explain an individual who need more medical care, but who suffers from a longer duration of disability). In other words, as to those who were injured seriously and who require significant amount of time to recover, ignoring a time input in a health production function would cause a negative marginal product of medical care, which means that the more medical care input leads less health (H) because of a positive relationship between D and H . Thus, I cannot simply assume that the more medical care, the shorter duration of disability.¹ In this framework, therefore, an injured worker invests both medical care and his or her non-working time in order to produce “*the stock of good health*”.

Second, an individual’s lifetime income and time constraints are expressed as follows:

$$X + P_m M = W(1 - t)T_w + WDb \quad \text{Eq (3)}$$

$$N = T_w + D \quad \text{Eq (4)}$$

¹ However, Durbin et. al (1996) specification allows the estimation of production function.

where W , t , and T_w are termed as the weekly gross pre-injury wage rate, the tax rate, and an individual remaining actual working hours, respectively. Assumed that the price of consumption goods (P_x) is assumed to be 1. In Eq (3), the left side represents an individual's total expenditures on consumption goods and medical care, where X and M are the amounts of consumption goods and medical care, respectively; and P_m shows the price of medical care. The right side of Eq (3) indicates an injured worker's total income, which can be described as the sum of earned income after he or she returns to work ($W(1-t)T_w$) and he or she receives workers' compensation benefits of bW per week², where b is termed the replacement rate³ while an individual is recuperating and not working.

There is also time constraint (Eq (4)). An individual's total working hours available (N) is the sum of actual working hours (T_w) and time lost due to injury (D). Eq (4) implies that time not spent for working would be an input into the production of good health. Substituting Eq (4) to Eq (3), the combining income and time constraint can be rewritten as follow:

$$X = W(1-t)N - WD(1-t-b) - P_m M \quad \text{Eq (5)}$$

This suggests that an individual's total spending on consumption goods and medical care equal his/her full income that is shown by the subtraction of forgone earned income

² As mentioned before, workers' compensation benefits are not taxed.

³ The replacement rate is determined by the total weekly indemnity benefits divided by the weekly pre-injury wage. If weekly indemnity benefit exceeds the maximum benefits, in which case the injured worker will receive the maximum benefits. Or if weekly indemnity benefit is less than the minimum benefit, in which case the injured worker will receive the minimum benefits.

for producing improved health from the income if he or she works in all available working hours.

In order to maximize an individual's utility subject to health production function; and time and income constraints, the following Lagrangian multiplier is introduced:

$$\text{maximize } L = U(H(M, D), X) + \lambda[X - W(1-t)N + WD(1-t-b) + P_m M] \quad \text{Eq (6)}$$

where λ is the shadow price of the time and income constraints. Solving Eq (6), the first order condition for a maximum is given by:

$$\frac{U_H}{U_X} = \frac{P_m}{H_M} = \frac{W(1-t-b)}{H_D} \quad \text{Eq (7)}$$

Eq (7) says that, in equilibrium, the marginal utility rate of substitution of health stocks for consumption goods equals the rate of the price of medical care input to the marginal product of health with respect to medical care input, as well as it equals the rate of the price of time input to the marginal product of health with respect to time input, or, the duration of disability.

If one solves an individual's utility maximizing problem, an individual's optimal level of health demanded which should meet Eq (7) will be attained. Suppose that the optimal health demanded by an individual is $\bar{H}$, which can be described as a linear homogeneous function of medical care input (M) and time input (D) as follow:

$$\bar{H} = D^\alpha M^{1-\alpha} \quad \text{Eq (8)}$$

where $0 < \alpha < 1$.

And, the total cost of gross investment in health is defined by:

$$\bar{H} \pi = P_m M + WD(1-t-b) \quad \text{Eq (9)}$$

where π is the shadow price of health stocks. The demand for each input, M and D, can be derived by minimizing the total cost function (Eq (9)) subject to the optimal health production function given (Eq (8)). Therefore, the Lagrangian is:

$$\text{minimize } L = P_m M + WD(1-t-b) + \pi [\bar{H} - D^\alpha M^{1-\alpha}] \quad \text{Eq (10)}$$

The first order condition for the cost minimization with respect to M and D is shown by:

$$\pi = \frac{P_m}{\bar{H}_M} = \frac{W(1-t-b)}{\bar{H}_D} \quad \text{Eq (11)}$$

where $\bar{H}_M = (1-\alpha) D^\alpha M^{-\alpha}$ and $\bar{H}_D = \alpha D^{\alpha-1} M^{1-\alpha}$, based on the linear homogenous assumption of the health production function. Then, solving Eq (11), the shadow price of an individual's health stocks can be expressed by:

$$\pi = \gamma W^\alpha (1-t-b)^\alpha P_m^{1-\alpha} \quad \text{Eq (12)}$$

where γ is a constant term, which is $\left[\frac{1-\alpha}{\alpha} \right]^\alpha$. Since I defined that $0 < \alpha < 1$, Eq (12)

shows that increases in the weekly pre-injury wage (W), the real benefit rate (1-t-b), and price of medical care will raise the shadow price of health stock (π). Substituting Eq (11) into the optimal health production function, Eq (8), each demand function for medical care and time inputs conditional on the optimal health demanded were obtained as follows:

$$\begin{aligned} M &= \gamma_1 \left(\frac{P_m}{W(1-t-b)} \right)^{-\alpha} \bar{H} \\ D &= \gamma_2 \left(\frac{W(1-t-b)}{P_m} \right)^{1-\alpha} \bar{H} \end{aligned} \quad \text{Eq (13)}$$

In the empirical work of this paper, I will focus on the second equation, the demand for time input of health production function. Taking the natural logarithm of the demand function for time input, D ,

$$\log D = \beta_0 + \beta_1 \log(W(1-t-b)) + \beta_2 \log P_m + \beta_3 \log \bar{H} \quad \text{Eq (14)}$$

This equation will be a function to be estimated in my empirical analysis. In Eq (14), however, the effects of the weekly pre-injury wage rate (W) and of the real benefits rate ($1-t-b$) on the demand for time input should be distinguished.

First, let's consider the effect of an increase in an individual weekly pre-injury wage rate on the budget constraint, shown by Figure 1. Figure 1 shows the income constraints on purchasing both an individual life time consumption goods (X) and health inputs to improve an individual's health stock (H), if one ignores the effect of $(1-t-b)$ on the budget constraint. In Figure 1, the vertical and horizontal intercepts represent how many X and H can be purchased by an individual if one works in whole available time (N) and he spends all pre-tax income for buying X and H , respectively. An increase in W causes bigger increase in a vertical intercept than in a horizontal intercept, since the shadow price of health, π , rises as well as W (Eq (12)). An increase in π discounts the effect of an increase in W on the income constraint, because, with respect to health inputs, the real income is expressed by the ratio of total pre-tax income to the shadow price of health stock, $\frac{WN}{\pi}$. Therefore, an increase in W shifts the budget

line to the right from $WN - \frac{WN}{\pi}$ to $W'N - \frac{W'N}{\pi'}$, but the shift may not be in proportion.

Second, let's discuss both effects of W and $(1-t-b)$ on the budget constraint, shown by Figure 2. Suppose that the real full income can be defined as:

$$S = \frac{WN}{Z} \quad \text{Eq (15)}$$

where Z is a geometric price levels of both an individual life time consumption goods and health inputs and it is defined as $Z = \pi^k P_X^{1-k}$. The k is the share of income spent on health inputs and thus, $k = \frac{H\pi}{WN}$, where $0 < k < 1$. Now, if one assumes that $P_X = \$1$, taking the natural logarithm of Eq (15),

$$\log S = \log W + \log N - k \log \pi \quad \text{Eq (16)}$$

Substituting Eq (12) to Eq (16), the following equation can be obtained:

$$\log S = k \log \gamma + (1 - k\alpha) \log W - k\alpha \log(1-t-b) - k(1-\alpha) \log P_m \quad \text{Eq (17)}$$

Since as regards two parameters, k and α , I assume that $0 < k < 1$ and $0 < \alpha < 1$, taking partial derivatives of Eq (17), with respect to W and $(1-t-b)$, we can obtain:

$$\begin{aligned} \frac{\partial \ln S}{\partial \ln W} &= 1 - k\alpha > 0, \\ \frac{\partial \ln S}{\partial \ln(1-t-b)} &= -k\alpha < 0 \end{aligned} \quad \text{Eq (18)}$$

Eq (18) shows that, while the effect of a change in W on real income is positive, held $(1-t-b)$ and P_m constant, the effect of a change in $(1-t-b)$ on real income are negative, held W and P_m constant. Thus, as Figure 2 shows, an increase in $(1-t-b)$ causes a horizontal intercept of budget line to shift to the left from $\frac{WN}{\pi}$ to $\frac{WN}{\pi'}$, remained a vertical intercept unchanged if one holds W and P_m constant. If $(1-t-b)$ increases,

holding W constant, the shadow price of health stock will rise and therefore real income with respect to health inputs will decrease.

The effects of W and $(1-t-b)$ on the demand for time input should be distinguished in Eq (14), because the effects of changes in W and $(1-t-b)$ on real income as well as an individual's budget constraint differ. Increases in both W and $(1-t-b)$ raises the shadow price of health stock, π , however, an increase in W raises the real full income and an increase in $(1-t-b)$ lowers it. Therefore, now, the regression model to be estimated is defined as follow:

$$\log D = \phi_0 + \phi_1 \log W + \phi_2 \log(1-t-b) + \phi_3 \log P_m + \phi_4 \log Z + \varepsilon \quad \text{Eq (19)}$$

where the dependent variable is the number of weeks of an injured worker spent on the workers' compensation program after filing a claim. The explanatory variables are: the weekly pre-injury wage, the proportion of economic loss $(1-t-b)$, the price of medical care (or the number of medical treatments) for both acute and post acute period, and Z is a vector of exogenous determinants of D . These are measures of severity of injury, demographic variables, types of injury, medical cost containment policies, types of industry, and involvement of a lawyer.

IV-2. Hypothesis

In this section, I abstract hypotheses to be examined in my empirical analysis. The econometric model to be tested is based on Eq. (19), which represents the demand for time input of the health production function. It allows to estimate the determinants of the length of the temporary total disability.

(1) Effects of real benefit rate and weekly pre-injury wage

First, the variable, $[1 - \text{tax rate}^4 - \text{replacement rate}]$, measures the proportion of gross wages not replaced by indemnity benefits (called the proportion of economic loss during recovery). This variable is an individual specific variable rather than the state benefit average and it is incorporated with an individual's tax status. As mentioned before, the replacement rate itself cannot easily disentangle the effects of indemnity benefits and pre-injury weekly earnings on the length of disability, since the weekly total temporary total disability indemnity benefits are rather deterministic functions of pre-injury wages subject to the minimum and maximum state benefit levels. This additional variation introduced by the individual tax status would mitigate an estimation problem.

The sign on $(1 - t - b)$ is expected to be positive in the hazard estimation, which means that is the higher the proportion of economic loss during the recovery, the more likely to return to work, because an increase in $(1 - t - b)$ raises the shadow price of health and lowers the real full income (see Eq.18). An increase in the shadow price of health lower the optimal stock of health and lower the consumption of medical care. An

⁴ The calculation of tax rate is as follows;

First, the appropriate tax bracket is determined based solely on claimants' gross annual earnings since that data do not have any information on claimants deduction. The effective federal tax rate is 15% and state tax rates ranges from 0% in Florida to 9% in Oregon. Social Security tax were excluded from the calculation. Then, the after-tax weekly wage rate is calculated as;

$(1 - \text{FTAX} - \text{STAX} + \text{FTAX} * \text{STAX}) * \text{pre-injury gross weekly earnings}$

where, FTX = Federal Income Tax Rate

STAX = State Income Tax Rate

increase in the consumption of medical care decreases the duration of non-working (substitution effect in the production). Also, the consumption of lifetime goods will increase as the stock of health decreases (substitution effect in the consumption). On the other hand, an increase in $(1-t-b)$ lowers the real full income and the stock of health as the shadow price of health increases, and therefore, the duration of disability is expected to decrease (income effect). However, only if the substitution effect in the production dominates both the substitution effect in consumption and the income effect, the length of non-working will decrease because of an increase in medical care consumption. Therefore, those who have the higher proportion of economic loss are more likely to return to work, and consequently, the duration of disability will decrease via both income and substitution in production and substitution in consumption effect.

However, the sign on the pre-injury wage⁵ cannot be determined *a priori*. Like $(1-t-b)$, an increase in the pre-injury earnings raises the shadow price of health. But an increase in pre-injury wages will also raise the real full income (see Eq. 18). An increase in the shadow price of health raises the consumption of medical care as the stock of health decreases. Thus, an increase in the consumption of medical care decreases the duration of non-working spells (substitution effect in the production). Also, the consumption of life time goods will increase as the stock of health decreases (substitution effect in the consumption). Yet, an increase in pre-injury earnings will

⁵ I assumed that pre-injury wages are exogenous into the model. In section III, a number of studies showed that pre-injury wages compensate for the risks associated with a work-place injury since pre-injury wages ex-ante compensate risks. However, in this study, pre-injury wages are not likely to be endogenous into the model because this study is based on only a sample of injured workers rather than a sample of all workers.

raise the real full income and, therefore, the stock of health (income effect). Claimants who had high pre-injury earnings may stay out of work longer to recover completely from the injury than those who had low previous earnings. Therefore, the duration of non-working spells rises with the higher pre-injury earnings if the income effect dominates both substitution in production and in consumption effects. On the other hand, the duration of non-working spells decreases with the higher pre-injury wages if substitution effect in production dominates both the substitution effect in consumption and the income effect.

2) Two Alternative Sets of Medical Variables

As mentioned in the introduction, currently claimants face no monetary costs for obtaining medical care under the current workers' compensation system. However, an injured worker may not demand an infinite amount of medical care or the amount that drives its marginal product to zero. One possible explanation is that there are nonpecuniary costs associated with obtaining medical care, such as time costs for traveling and waiting, and other inconvenience costs. These costs may influence a claimant's decision to seek the level and the mix of medical services which they can obtain.

Another explanation is that employers' responses may enter into the model. While many previous empirical results support that employees' responses to benefits dominate employers' responses, a number of previous studies support employers' responses dominate employees' responses by making the workplace safer and reducing

injuries⁶. As Ehrenberg (1988, pp76) has pointed out, "As long as workers' compensation benefits are partially experienced-rated, the higher benefits will increase the employer's incentive both to challenge claims and to encourage injured workers to speed their recovery and return to work. Even if increasing benefits do not alter employer resources devoted to injury prevention, it may affect the number and the duration of claims". Employers or insurers do not have the full control of the consumption of medical care since they cannot fully monitor the behavior of the injured workers. Yet, they make every attempts to limit the consumption of medical care since workers' compensation premiums are experienced-rated and most states enacted various measures of cost containment policies to curtail rapid increases in the medical costs.

Unlike previous literature, this paper assumes that an injured worker's time spent on temporary total disability is influenced by the price of or an unit cost of medical services. The price of medical treatments is decomposed into acute and post-acute phase. The explanation on the construction of the price of medical services will be explained in section V.

Recently, Durbin et.al (1996) observed large differences in medical costs between claimants covered by the workers' compensation program and patients covered by the traditional health plans. They suggested that the large differences of medical costs between these two groups is due to the utilization of medical services rather than the price or an unit cost of medical services. They found no evidence of the price discrimination for recipients of workers' compensation benefits. I also used the number

⁶ For example, see Ruser (1983 and 1991) and Moore and Viscusi (1990).

of medical treatments received in both acute and post-acute periods to the estimate the effect on the duration of disabilities.

(3) The severity of injuries

Differences in the severity of injury may play an important role. Perhaps one of the most difficult part in empirical estimation is to control for the initial severity of injury. I used the two following variables to control the severity of injury: one is the length of hospital stays. It is plausible that the longer the hospital stay, the more serious the injury. The other is a surgery dummy variable. Claimants who had a surgery were assumed to have more serious injuries than those who did not. The length of hospital stay may be endogenous because it is determined by the insurance arrangement and state's cost containment policies.

(4) Demographic Variables

In general, a person's capability to recover from an injury declines with age. I predict that age is negatively related to the probability of returning to work. Also, for older workers, they may find other alternatives (for example, social security benefits). Thus, older claimants, especially lower wage earners, tend to stay longer in the workers' compensation program or they may not return to work at all. I expect that male claimants will stay longer than female claimants. Traditionally, male workers tend to have more physically demanding jobs than female workers. Since their jobs are

more dangerous, not only male workers will be injured more often but also they will have more serious injuries, which leads to the longer spells of non-working.

(5) Injury type

I used a set of dummy variables to control for the type of injury. They are back, burn, dislocation, joint, nerve, hernia, fracture, strain, laceration, and others. Some types of injury are difficult to monitor and slow to develop (for instance, back or strain injuries), while other types of injury is more acute and requires immediate medical attentions (for example, burn, or laceration). I predict that the coefficient on the duration of disabilities for the first type will be greater than for the latter since there will be more moral hazard problems associated with difficult-to-monitor types of injuries, in particular, for low wage earning groups.

V. Empirical Considerations

1. Data

The data used by empirical analyses in my study are randomly selected sample of temporary total disability claims filed by injured workers from 1988 to 1991. The source for the data is drawn from the Detailed Claim Information (DCI) file maintained by the National Council on Compensation Insurance (NCCI). The DCI file contains more than 450,000 claims and has been collecting claim reports since April in 1979. It is based on longitudinal and nationally representative samples of injured workers, which is probably one of the most widely used database for the study of workers' compensation.

For each claim in the DCI sample, the insurers post first reports at six months after the initial injury and, thereafter, they report at eighteen, thirty, forty-two, and fifty-four months.¹ Insurers are recorded payments in the DCI when claims are paid, not when costs are incurred. The DCI database includes only claims that satisfy a minimum number of lost work days. The DCI database thus excludes claims for minor injuries only which requires medical treatment without lost work days from work.²

¹ After the initial six month report, the next report is 18-month report which represents the total payments for the first year charges; the 30-month report represents the total payments for the second year charges; and so on. Not all sampled claims will have all five reports. For instance, if a claim is closed in three months, the DCI file would have only one report. If a claim is closed in eight months, the file would have two reports, a first report at six months, and a second one at 18-months.

² This is because of a waiting period (varies from three to seven days depend on state's jurisdiction) for disability benefits, injuries that result in no more than three days of lost work time (including the day of injury) do not qualify for an indemnity benefits and do not require the first report for an injury.

A sample of 5,051 claims was extracted from four states: Florida, Illinois, Oregon, and Pennsylvania. These claims were chosen from the 15 largest insurers in each state as to the sampling proportional to insurer market share. Among 5,051 claims, 4,045 claims were closed claims and 1,006 were open claims. The closed claims are defined as claims which were settled at the latest report, while open claims are defined as claims filed by individuals continuing to receive the workers' compensation benefits until at the end of 1991. These open claims have high indemnity costs as well as medical costs. Also, these open claims have the high probability of being eventually classified as permanent disability claims or being settled as lump sum payment cases.

The detailed description of each state involved is presented at Table II. In Table II, each state has a different level of state minimum and maximum weekly benefit levels. Florida is the only state that restricts the maximum duration of temporary total disability in the sample (the maximum duration of temporary total disability is 360 weeks). The rate of replacement is same for all four states. In terms of medical cost containment policies, Illinois is the only state which does not have any cost containment policies in the sample period. Florida has the most aggressive cost containment policy.

The data includes detailed information on indemnity benefits as well as a wealth of information on medical benefits, such as the number of medical treatments received, the length of a medical episode, the types of medical providers, the total amounts billed, the total amounts paid by insurers eventually, whether a claimant was hospitalized or had a surgery, the body part injured, and the nature of injuries. It also contains

information on demographic and socio-economic variables such as, age, gender, pre-injury wages, injury date, claimant's employment status at the time of claim filed, whether a claimant is represented by a lawyer, and whether a claim is contested by an employer.

The samples are restricted to claimants between 16 and 65 years old who were employed at the time of claim filed, and earned at least the minimum wages. After deleting inaccurate observations and observations which miss key information, the size of the sample were reduced to 2,649 closed and 744 open claims.

(1) Acute and Post-acute Periods

The time of receiving medical treatments following an injury are divided into acute and post-acute periods. The acute period is defined as the first fourteen days after starting of care and the post-acute period after the initial two weeks periods. Therefore, medical costs and the number of medical treatments can be classified by acute and post-acute periods. This decomposition of medical episodes into two phases has advantages for my analysis as follows. Injured workers, in general, may need continuous medical treatments even after they returned to work. Indeed, the span of medical treatments well exceeds the period of non-working spells. Although defining the first two weeks of medical treatments as acute period seems to be arbitrary, it will provide allows better measurements and estimations for those who need more aggressive medical treatments at the earlier stage of their recuperation periods. There is no incentives for injured workers to delay looking for medical treatments because there is no out-of-pocket costs

for them. More importantly, most medical services are rendered during the period when temporary total disability benefits are paid. This is especially true for more serious injuries or for major injuries which require more immediate medical attentions compared to minor injuries.

(2) Price or unit costs of medical care³

What makes this study distinguish from previous studies is the use of the price of medical care or an unit price per specific service rendered. Here, the construction of the price of medical services is same as the descriptions given by Durbin et al. (1995). The price per specific medical treatment charged can be obtained from the current procedural terminology (CPT) codes used by physicians to identify the type of services provided. Using CPT codes, the unit prices were constructed as follows: the mean and median unit charges, by state and year, were calculated for each CPT code with greater than twenty observations. Similarly, the mean and median unit charges were calculated for a hospital room and a board. All other charge that were not identified by the CPT code and were not for hospital services were totaled into a category called “other services”. This total was divided by the number of treatment days excluding hospital treatment days to make an average cost per day for “other services” by state and year. The rest of all other related to hospital charges, except for rooms and boards, were summed into a category called “other hospital service”. Then, this total was divided by the number of hospital treatment days to construct an average cost per hospital day by

³ Following description heavily rely on Durbin et al (1995).

state and year. As results, the median price for physician services, the mean price for a hospital room and a board, the mean cost per day for ‘other services’ and the mean cost per day for ‘other hospital services’ were combined to make a claim specific weighted average unit prices for each acute and post-acute medical services. Both of acute and post-acute prices are deflated by the medical price index which developed by NCCI. This index is based on expenditure weights associated with workers’ compensation claims.

2. Censoring problem

Estimating a model that describes the length of non-working spells seems to be a straight forward application of simple regression techniques (e.g., ordinary least squares). However, the estimation is complicated by the censoring problem. An important aspect of a duration data is that some observed spells are typically incomplete. Data including observations whose spells are not complete are called censored data. For instance, as mentioned previously, some claims remain active even after the second and third year reports. A right censoring problem occurs when these claims have not been closed at the end of observation period. Therefore, those claims which are not closed at the end of 1991 are called “right censored”, and, for such observations, we can know only that how long they have been on the workers’ compensation program and cannot tell when their non-working spells will end. The exact lifetime remains to be unknown and, in most of duration models, the right

censoring problem is inevitable since the measurement is taken while the process is ongoing⁴.

Duration data typically consist of a measured length and the information on whether the spell was censored. Let T^* , a random variable, be a length for an individual in the absence of censoring, and let c be a censoring indicator measured from the time origin to the end of a spell. Then, the random variable that will be observed is the smaller than T^* and c , or $T = \min\{T^*, c\}$. It is also known whether the observation is censored ($T = c$) or uncensored ($T = T^*$).

These right censored observations cannot be excluded. If we exclude these observations and, thereby, reduce the sample size, we will have a sample selection bias that results from selecting only settled claims because the duration of claims among samples of closed claims will be shorter than of all claims. Thus, we might have a non-representative sample. Moreover, these right censored claims may characterize the incentive effects of employees whose duration of disability are typically longer than those of workers who have returned to work, holding the severity of an injury constant. Exclusion of censored data can produce large biases (Tuma and Hannan, 1978). Using ordinary least square estimation after including right censored observations, will result in biased results since we assume the same distribution function for both closed and open claims. An alternative method might be to assign the maximum length of time

⁴ Usually the panel data set covers a period from calendar time 0 to calendar time T . Some spells are already ongoing at the time the panel begins, and hence they begin before calendar time zero. Other spells are new spells in the sense that they begin after calendar time zero. If one uses only the sample of ongoing spells, it is called a "stock sample". On the other hand, if one select the sample of new spells, it is called this sample as a "flow sample", following Lancaster (1990). In this case, the sample is mixed sample that including both some spells already ongoing and new spells occurred 1988.

observed as the value of the dependent variable for the right censored data. But this undoubtedly underestimates the true value and, again, result in a substantial bias. Tobit model may be appropriate for the censored data. However, it does not take into account the fact that all injured workers eventually return to work (note that temporary total disability claims refer to an injured worker who is unable to work in finite time but who is expected to recover fully and to return to work). A hazard model (or a survival model) is suitable for duration data including some claimants who are still receiving benefits payments and have not returned to work at the end of observation period.

In sum, the hazard function approach is appropriate for the regression approach for duration data for two reasons: it allows more flexibility to specify the duration distribution and it deals with censoring problem easily through an appropriate specification of the sample likelihood.

3. Methodology⁵

I briefly outline the statistical problems involved in analyzing the length of time until some specified event occurs. The hazard function has been widely used in industrial the engineering, where it is used to estimate the length of time for a machine until its failure. For example, the model discussed below was applied to estimate the lives of machines or electronic components. Likewise, in the medical sciences and biostatistics, the hazard model has been used to describe the survival rates of patients after the diagnosis of a disease and after an operation such as a heart transplant.

⁵ Kiefer (1988) and Lancaster (1990) provide an excellent introductory survey. Additional references include Cox and Oakes (1984), Kalbfleish and Prentice (1980), Lawless (1982), and Miller (1981).

Econometric methods for the analysis of duration data are rapidly being used and imported from engineering and biometrics. Recently, duration models play an important role in several areas of economics, including the analysis of strike length (Kennan, 1985), the timing and spacing of births (Newman and McCullough, 1984), the study of spells of unemployment (e.g., Moffit, 1985) and the spells of AFDC reciprocity (e.g., O'Neil, Bassi, and Wolf, 1987 and Blank, 1989). Most applications have been concentrated on the field of search models in the labor economics.

3.1 Basics

Let a survival distribution function be $S(t) = \text{Prob}(T > t)$, where $S(t)$ is the actual length of survival time (T) to be observed is greater than an observed time (t), but the precise length remains to be known. The cumulative distribution function can be described as $F(t) = \text{Prob}(T < t)$. Then, the relationship between $S(.)$ and $F(.)$ is: $1 - F(t) = 1 - \text{Prob}(T < t) = \text{Prob}(T > t) = S(t)$.

Suppose the underlying failure process is continuous. The hazard rates at time t among individuals are defined as:

$$\lambda(t) = \lim_{dt \rightarrow 0} \frac{\text{Prob}[t < T < t + dt | T > t]}{dt}$$

This is the conditional probability that a person who has been in a state at time t leaves it in the short interval of length dt after t , given that this person has not left the state before then. The hazard rate in this study is the probability that an injured person leaves workers' compensation program at time t , conditional on he or she being on the workers'

compensation program at time $t-1$. Note that the hazard rate emphasizes the conditional probability, whereas the probability distribution function, $F(T)$, emphasizes the unconditional probability. The hazard rate can be expressed in terms of both probability density and survival distribution functions. By the mechanism of conditional probability,

$$\begin{aligned}\lambda(t) &= \lim_{dt \rightarrow 0} \frac{\text{Prob}(t < T < t + dt)}{\text{Prob}(T > t)} \frac{1}{dt} \\ &= \lim_{dt \rightarrow 0} \frac{\text{Prob}[t < t < t + dt]}{dt} \frac{1}{\text{Prob}(T > t)} \\ &= \frac{f(t)}{\text{Prob}(T > t)} = \frac{f(t)}{S(t)} = \frac{f(t)}{1 - F(t)} = \frac{-d \log S(t)}{dt}\end{aligned}$$

$$\lambda(t) = \frac{-d \log S(t)}{dt} \text{ is differential equation in } t, \text{ subject to initial condition } S(0) = 1.$$

$$\text{Then } S(t) = \exp - \int_0^t \lambda(x) dx$$

Finally the probability density function is defined as follow:

$$f(t) = \lambda(t) \exp - \int_0^t \lambda(x) dx$$

3.2 Estimation

We can estimate the hazard function, using nonparametric or parametric methods. Nonparametric estimates of the hazard function are useful for displaying data on duration. This analysis is known as the life tables method in the social science. The parameters of nonparametric hazard function are consistent only if the underlying population is homogeneous. However, such a restriction may not be realistic in this context since the characteristics of individuals may well influence the length of spells. According to Heckman and Singer (1984) the failure to control for individual characteristics biases the parameters of hazard function downward. Parametric estimates of the hazard function allow the duration of non-working spells to fit a particular form of the density function and, in parametric analyses, we can use maximum likelihood function to estimate the parameters. . Also, there is a semiparametric analysis. A widely known example of this analysis is the Cox proportional hazard model.

3.2.a Building a Likelihood Function

The estimation of the hazard function starts with building a likelihood function. Consider n individuals with covariates values $x_1, \dots, x_n$. These covariates are either time constant or time varying covariates. Time-invariant covariates include variables which do not change over the course of an episode such as sex and race of a person, whereas time-varying covariates are variables which change over time, such as age, income, and health status of an individual. These variables can change as the duration of an event changes. But they can be regarded as time-invariant since they change by a rate

enough to be ignored rate relative to the spells of an event. We will consider only time-invariant variables in the following framework.

Suppose that $T_1, \dots, T_n$ is the observed failure times which may or may not be right censored. Let $\delta_1, \dots, \delta_n$ represent the corresponding censoring indicators, which are defined as $\delta_i = 0$ if T_i is censored at time t_i ($T_i > t_i$) and $\delta_i = 1$ if T_i is uncensored at time t_i ($T_i = t_i$). The censoring scheme is assumed to be independent, that is, an individual's spell is independent of the other, then the likelihood function is the joint probability distribution of a duration t as $f(t, x, \beta)$.

$$L(\beta) = \prod_{i=1}^n [f(t_i, x_i, \beta)^{\delta_i}]$$

where β is a vector of parameters.

As mentioned above, often times it is not possible to observe all spells of an event until it ends. When a spell is censored at t_i , however, only available information is the density function of T . As a result, the likelihood function for the entire population is as follow:

$$L(\beta) = \prod_{i=1}^{n_1} [f(t_i, x_i, \beta)^{\delta_i}] \prod_{j=1}^{n_2} [S(t_j; x_j, \beta)^{1-\delta_j}]$$

where n_1 is the set of all observations where complete spells are observed and n_2 is the set of all observations where the spells are assumed to be ongoing, and, hence they are right censored. Clearly n_1 and n_2 are disjoint sets whose union is exactly the set of observations.

Defining the hazard function as $\lambda(t, x, \beta) = \frac{f(t, x, \beta)}{S(t, x, \beta)}$ and applying the definition of

the hazard function, we may rewrite the likelihood function as follows:

$$L(\beta) = \prod_{i=1}^{n_1} [\lambda(t_i, x_i, \beta)]^{\delta_i} \prod_{j=1}^{n_2} [S(t_j, x_j, \beta)]^{1-\delta_j}$$

which is the standard likelihood function for a parametric duration model with the right censoring scheme.

VI. Empirical Results

Empirical results are consist of three subsections. Section I presents the descriptive statistics of the data used for my empirical study. First, Table III shows the average indemnity and medical costs by the type of injury. Second, the frequency distribution of the length of non-working spells by the type of injury is shown in Table IV. Third, Table V and Table VI shows the basic statistics and definitions of the explanatory variables used in the estimation. Section II discusses the excess fraction of Monday injuries. The distribution of types of injury by the day of week is presented in Table VII. Section III discusses the empirical results. Table VIII shows the regression results from a semi-parametric baseline hazard model for the estimating the conditional probability of returning to work. The results of various parametric hazard models were shown in Table IX-a and Table IX-b. Table X shows the results from a parametric hazard model with Weibull-Gamma distribution. Finally, Table XI shows the summary of expected duration as result of different distributions.

Section I. Descriptive Statistics

(1) Average Indemnity and Medical Costs by the type of Injury

Table III shows the mean indemnity and medical costs by the type of injury. Strain injuries are, by far, the most common type of injuries, followed by back and fracture injuries. Strain injuries which may be caused by a slip or fall account for

nearly one-thirds of the total sample. Those who suffered from back injuries have the longest spells of non-working, while those who had hernia spent the shortest time on temporary total disability program. In average, they spent 26 and 8 weeks for recovering from back injuries and hernia, respectively. Furthermore, injured workers who had back problems have the longest medical episode. A medical episode can be defined as the period between the first day and the last day of receiving medical services. A typical medical episode includes visits to the physicians, physical rehabilitation, and in-patient hospitalization. Workers with back injuries spent, in average, more than a year for their medical episodes. On the other hand, those who had hernia or burn injuries spent less than 3 and 6 months, respectively. Perhaps, back injuries include spinal code types of injury which are slow to develop, difficult to be recovered in a short period, and require continuous medical treatments for quite a long time. Consequently, back injuries have the most expensive medical costs, while hernia costed the lowest as to total medical costs. Also, the largest amount of other indemnity costs are payment paid for back injuries. The other indemnity costs are paid in a lump sum settlement which is paid for serious injuries.

The average weekly indemnity benefits for all types of injuries is in the range of \$223 to \$297. Among claims, those who with hernia have the highest average weekly indemnity benefits (\$297), while those with joint injuries received the lowest weekly average indemnity benefits. There is a possible explanation for this: most of those with hernia tend to be office workers who are required to sit down for a long time and they tend to be white collar jobs. A conventional wisdom is that earnings for white collar job

are higher than earnings for blue collar jobs. Therefore, earnings of those with hernia tend to be higher than other types of injuries. The average amount of rehabilitation payments are not significant here because the many rehabilitation payments are usually awarded to permanent partial or total disabilities which are more serious injuries.

For the total number of medical treatments, those who had back injuries received the most number of medical treatments, while those with hernia received the fewest. They received, in average, 178 and 32 medical treatments, respectively. The medical treatments include chest X-ray, office visits to physicians, therapeutic treatments, and other treatments. Burn injuries received the most treatments in the acute phase which is defined as initial two weeks. Because burn injuries are more acute and require immediate medical attentions, it is probable that they will receive the most medical treatments in early phase.

(2) Dependent and Explanatory Variables

The number of observations used for the estimation is 3,376, out of which 2,642 were closed claims (78.3 percent) and 734 were open claims (21.7 percent). Table IV shows the frequency distribution of the length of non-working by the type of injury. More than half of injured workers return to work in less than three months. Especially, more than 90 percent of those with hernia returned to work in less than three months. In general, the proportion of returning to work in less than three months for those who have hard core injuries like burn, fracture, and laceration, is higher than those with soft tissue injuries like back, strain, and nerve.

The sample was divided into closed and open claims. As I expected there are some apparent differences between closed and open claims. The mean number of weeks of the temporary total disability (TTDUR) for closed claim is 10 weeks, whereas it is 40 weeks for open claims. Accordingly, the average total indemnity benefits (TTINC) for open claims is larger than the average total indemnity benefits for closed claims by about four times. The mean weekly indemnity benefits (WBEN) are \$248 and \$267 for closed and open claims, respectively. Also, note that the mean benefits of the other indemnity benefits (OTINC) for open claims is significantly larger than the mean benefits for closed claims. The average amount of other indemnity benefits for the open claims is by 11 times larger than the average for closed claims. This reflects that, for a very long claims, there is more lump sum settlements. The mean rehabilitation income is almost zero for closed claims but it is about \$133 per open claim. The rehabilitation income includes such services as counseling, guidance, vocational education, and job training. As to the temporary total disability claims, I expect the amount of rehabilitation income is significantly lower than that of permanent partial (or total) claim.

The average of weekly pre-injury weekly earnings for those who did not returned to work is slightly higher than that of those who returned to work. The average weekly pre-injury wages are \$398 for closed claims and \$417 for open claims. These weekly pre-injury wages are properly deflated by the state consumer price index. Injured worker who have returned work, in average, received 84.4 percent which can be calculated as $1 - \text{RATIO}$, of their after-tax wages as indemnity benefits, while injured

workers who have not returned to work received, in average, 86.3 percent of their after-tax wages as indemnity benefits.

The average price of medical treatments for open claims (\$149) is almost twice as large as for closed claims (\$85) in the acute phase; and three times as large as for closed claims in the post-acute period. A plausible explanation for these large discrepancies are as follow: in general, open claims reflect more serious injuries and, therefore, they are required more expensive medical treatments. Since the mean or median charges are significantly higher for open claims, the price or an unit cost of medical treatment for open claims is significantly higher for closed claims. For the utilization of medical services, claimants received, in average, 9 medical treatments in the acute period (T_ACUTE) and 60 medical treatments in the post-acute phase (T_POST).

For the comparison of the severity of injury, the following two variables are used; the number of days in hospital and an indicator whether or not a claimant had a surgery. About a half of claimants is required a surgery in closed claims and, in average, a claimant spent about 1 day in the hospital, whereas more than a 75 percent of claimants is required a surgery in open claims and the average number of days in the hospital is approximately 4 day. Though the amount of payment for rehabilitation is the one of component in the total benefits, it may also measure the severity of injury since the more serious injuries require more rehabilitation. As mentioned previously, the average amount of rehabilitation payment is much higher for open claims compared to closed claims.

I would like to discuss socio-demographic and legal variables used for my empirical analysis. The average age of claimant is young (37 years old). The mean age of claimants in open claims is slightly older than that of claimants in closed claims. About a three fourth of injured workers is a male for closed claims, while a sixty-nine percent of injured workers is a male for open claims. For a marital status, about a thirty-five percent of claimants are married in closed claims and a thirty percent of claimants are married in open claims. Significantly, higher rates of attorney involvement (ATT) are observed for open claims compared to closed claims. Considering that the sample is restricted to the temporary total disability, it is a high rate of attorney involvement. In general, attorney involvement is higher for permanent partial or total claims which are more serious injuries. More than a thirty percent of open claims is represented by lawyers. This suggests that longer claims require attorney involvement because they need a proof for the legitimacy of claims. Or, attorneys may be able to extend the out-of-time for claimants for reasons unrelated to true medical conditions. At the same time, open claims are more likely to be contested by employers than closed claims. More than a 12 percent of open claims are contested by employers, whereas only a 7 percent of closed claims are contested. Employers try to verify the degree of compensability and reasonableness of their claims. For industry types, there is no apparent differences between closed and open claims.

Finally, as for the medical providers, most claimants in the open claims received some kinds of physician care (97 percent) and radiology treatments (90 percent). Surprisingly, a percent of receiving emergency care to the total is the same for closed

and open claims. Since open claims suggest more severe injuries, I expect that more emergency care is received by open claims, but the descriptive result does not support that. More than a 80 percent and a half of open claims require the attention of acute care providers and orthopedic surgery, compared to a 64 percent and a 32 percent for closed claims, respectively. Those claimants in open claims received twice as much as chiropractic care than those in closed claims.

Section II. Distribution of Type of Injury by the Day of Week

Smith (1992) provided a circumstantial evidence that some claimants falsely filed workers' compensation claims rising out of off-the-job related injuries as having occurred at work so that they are qualified for medical and indemnity benefits. Unusually, the high rate of Monday injuries can be explained as this phenomenon. Table VII shows the distribution of injury types by the day of week. Across all types of injuries, a 19.9 percent of injuries occurred on a Monday. If work hours were equally distributed across weekdays then we would expect exactly a 20 percent of weekday injuries to occur on Monday. Based on this assumption, the data do not support the 'excess fraction' of Monday injuries. However, Table VII suggests that there is the excess fraction of Monday injuries for easy-to-conceal and non-life threatening injuries such as back, nerve, and strains. For instance, the excess fraction of Monday injuries for nerve injuries is approximately 6 percent. On the other hand, the excess fraction of Monday injuries is lower for difficult-to-conceal or directly visible injuries like fracture, dislocation, and burn. In particular, the excess fraction of Friday injuries is

nearly 6 percent for burn injuries. This suggests that some employees become lax on Friday waiting for the weekend hiatus. Note that this distribution is based on the first day of service or the day of occurrence, not the first day of being reported.

Section III. Hazard Function Estimates

Section III-a. Estimates of Cox proportional hazard function¹

A semiparametric analysis of duration data is based on Cox (1972)'s proportional hazard function which relates hazards rates to individual characteristics without imposing a particular form of density function. A proportional hazard model measures a relative risk of an event in a small time interval under the assumption that the relative risk is constant over the follow-up period. The Cox parameterisation of the hazard rate is defined as follow:

$$\lambda(t, X, \beta) = \lambda_0(t) \exp(X\beta)$$

where X is the vector of time invariant covariates, β is the corresponding vector of parameters, and $\lambda_0(t)$ is an arbitrary and unspecified baseline hazard function. By restricting the interaction of t and X to be multiplicative through the baseline hazard rate,

$\lambda_0(t)$, the covariates are embodied in the link function, $\exp(X\beta)$.² The likelihood function contains unknown baseline hazard rates $\lambda_0(t)$. Thus a maximum likelihood

¹ The detailed explanation of the proportional hazard model is given in Kalbfleisch and Prentice (1980, Chapter 4 and 5) or Lawless (1982, Chapter 7).

² No condition requires for the link function to be $\exp(X\beta)$. It merely ensures that the non-negativity of the hazard function.

method is inappropriate. Cox (1972 and 1975) that suggested there are basically distribution free method for estimating β using a partial likelihood function.

In order to estimate β , suppose that we have a sample of N individuals, n of whom fail before the end of their follow-up periods. After ordering the observations such that the first individual has the shortest observed time until event occurs, the second individual has the second shortest time, and so forth. Thus, for individuals $i, i = 1, 2, \dots, n$, we observe failure time t_i , such as:

$$t_1 < t_2 < \dots < t_n.$$

Define R as the set of all $j = 1, \dots, N$ such that j was still at risk just prior to time t_i .

The partial likelihood function of the proportionality for any two individuals means that

$$L(\beta) = \frac{\lambda(t, X_i, \beta)}{\sum_{j \in R} \lambda(t, X_j, \beta)}$$

which follows that after canceling the $\lambda_0(t)$,

$$L(\beta) = \prod_{i=1}^n \frac{\exp(X_i \beta)}{\sum_{j \in R} \exp(X_j \beta)}$$

The factor, $\exp(X\beta)$, describes the ratio of hazard for those who completed individuals a spell at time t_j to the sum of the hazards for individuals whose spells were in progress just prior to t_j . To accommodate the censoring problem in a spell between duration t_j and t_{j+1} , censored data appear in the summation of the denominator but not in

the numerator. In this way, we use an individual who is still in progress, and who can fail (or exit) up to a certain time. In sum, it is the ratio of the hazard for the individual whose spell was completed at duration t divided by the sum of the hazards for individuals whose spells were still in progress just prior to time t .

The survival function can be expressed as follow:

$$S(t, X, \beta) = S_0(t) \exp(X\beta)$$

where $S_0(t) = \exp(-\int_0^t \lambda_0(u) du)$ is the baseline survival function. Then, the likelihood function is as follow:

$$L(t, X, \beta) = \prod_{i=1}^{n_1} [\lambda_0(t) \exp(x\beta)] \prod_{j=1}^{n_2} \left[\exp(-\int_0^t \lambda_0(u) \exp(x\beta) du) \right]$$

where n_1 is the completed non-working spells observed (injured workers who have already returned to work or who have reached at 'maximum medical improvement') and n_2 is the right censored spells (injured workers who are still receiving benefit payments).

Table VIII shows regression results of the Cox's proportional hazard estimates for the transition probability from non-working to return to work. In general, the coefficients do not have a clear interpretation as much as a partial derivative analogous to the interpretation of coefficient based on a linear regression model. The signs of the coefficients indicate the directions of the effects of explanatory variables on the conditional probability of completing a spell. Unlike the ordinary least square regression estimation, a positive (or negative) coefficient indicates the likelihood of events occurring.

In this case the event is returning to work. Therefore, the positive (negative) coefficients show more (less) likelihood of returning to work and, consequently, less (more) time spent on the workers' compensation program. Also, an important aspect of a Cox proportional hazard model is that it does not have an intercept. This is due to fact that there is no parametric assumption about the baseline hazard rate as mentioned before.

Two versions of the estimation are presented in Table VIII as follows: one is an estimation using the price or an unit cost of medical care, and the other is an estimation using the number of medical treatments. Both of them are entered separately into acute and post-acute phases. The sample size of two models is different because 379 observations in model I do not have the price of medical care in the post-acute phase. The third column of each model estimated gives the percentage effects of an unit changes in each covariate on the conditional probability of returning to work. The percent effects can be obtained as $[\exp(\text{covariates})-1] * 100\%$. The results show that a substantial number of variables have significant effects on transition probability from non-working to return to work.

First, I obtained the following results for the income variables. The sign of $1-t-b$ (the proportion of economic loss) is positive and it is statistically significant, suggesting that the negative relation between the proportion of economic loss and the duration of disabilities. An unit increase in LN_RATIO increases the probability of returning to work by 16 and 13 percents in model I and model II, respectively. These results support the hypothesis that the conditional probability of returning to work increases since an increase in $(1-t-b)$ lowers the real full income and raises the shadow price of health. This increase

in the shadow price of health raise the consumption of medical care as it lowers the stock of health (substitution in production effect). As a result, those with the higher proportion of economic loss will spent less time in non-working spells.

An unit increase in LN_WAGE increases the likelihood of returning to work by 11 and 18 percents in model I and model II, respectively. An increase in the consumption of medical care as the stock of health decreases and, thus, decreases the length of time spent on the program. These positive signs on pre-injury wage show the dominant substitution effect; the substitution in production and substitution in consumption effects dominate the income effect. There are two additional economic variables which are considered in model I and II. An unit increase in LN_OTHER and LN_REH decrease the conditional probability of returning to work by 16 and 39 percents, respectively in model I. Results are similar for model II. Those who receive other indemnity benefits or rehabilitation income take longer time to recuperate than those who did not. These variables are in the form of income benefits but also they reflect severity of their injuries, since a lump sum settlements and rehabilitation incomes are awarded to more serious injuries.

Second, the results support the hypothesis that claimants respond to the differences in the price of medical care. An increase in the price of medical care for both acute and post-acute periods will decrease the likelihood of returning to work and, hence, increase the duration of disabilities. The sign on the price of medical care in the post-acute period, P_POST, is statistically significant and negative, while the sign on the price of medical care in the acute period, P_ACUTE is negative but it is not statistically significant. This

implies that the impact of the price of medical care more important in the later period compared to the initial two weeks.

The elasticity of the duration of claims with respect to the price of medical care in the post-acute phase (the direct coefficient estimates) is -0.27. Thus, a 10 percent increase in the price of medical care would decrease the probability of returning to work by 2.7 percent in post-acute period. This finding is consistent with Durbin et. al (1996). Their estimates suggest that a 10 percent increase in the price of medical care in the post-acute care will decrease the duration of disabilities by 0.9 percent. This result has an important policy implication: any proposals (such as twenty-four-hour coverage) designed to save medical costs by merging the medical costs component of the workers' compensation into the traditional employer-provided health plan and the introduction of coinsurance and deductibles in medical costs would result in prolonging the duration of disabilities and in increasing indemnity costs associated with the longer spells.

In model II, I used the utilization of medical services for the medical variables. The transition probability from non-working to return to work is positively related to the number of medical treatments in the acute period and negatively related to the number of medical services in the post-acute period. Both coefficients are statistically significant at 5 percent level. An increase in T_ACUTE raises the likelihood of returning to work by almost 26 percent, while an increase in T_POST lowers the probability of returning to work by 31 percent.

These results suggest that providing more aggressive and timely manner of treatment in early phase of recovery may shorten the duration of disabilities, yet,

providing unnecessary medical care which has little or no values in the post-acute phase will result in the longer spells of non-working. Many employees with work-related injuries are known to continue with some types of medical treatments for quite a long time after returning to work. However, medical providers may provide extra services for injured workers that are of little or no significant medical values since claimants face no out-of-pocket costs for medical services and the oversight of medical providers in workers' compensation programs has been relatively lax compared to other traditional health plan. Furthermore, there are usually neither dollar limits on the total amount of medical care, nor any restrictions on the types of medical care covered.³

My results suggest that a decrease in the utilization of medical services in the post-acute period will not result in longer duration of temporary total disability claims. This has an important policy implication with respect to the movement toward a more general managed care programs. Recently, many states are considering providing medical care under a part of more general managed care programs, such as HMO (Health Maintenance Organization) and PPO (Preferred Provider Organization). A managed health care program which is designed to specify the number of treatments or impose restrictions on the number of treatment⁴ for certain type of injuries may shortening the length of disabilities, especially in the later phase of recovery.

³ Roberts and Zonia (1994) find the evidence that under a medical fee schedule for cost containment policy may induce medical providers rendering additional services otherwise rendered.

⁴ For instance, Oregon initiated a new policy which limiting treatments provided by chiropractors.

Third, results show that, in general, the more serious injuries the longer time spent on the workers' compensation program. The proxy variables for measures of the severity of injury length of hospital stays and a categorical variable for a surgery. The coefficients have right signs and significant. Those workers who had a surgery, for instance, are less likely returned to work than those who did not by 18 and 20 percents in model I and II, respectively. The sign on L_IN DAYS suggest that the longer hospital stays, the probability of returning to work decreased thus, the longer stay on the workers' compensation program. An unit increase in hospital stay would result in 11 and 13 percents decrease in the duration of temporary total disabilities. The L_IN DAYS may be considered endogenous since the utilization of hospital services affected by the insurance arrangement or it is restricted by the states' cost containment policies. I tried separated estimation excluding this variable but found there is no significant differences in the results.

Fourth, I included the types of injury in the estimation. The categorical variables are; BACK, BURN, DISLOCAT, JOINT, NERVE, HERNIA, STRAIN, LACERATN, and OTHERS. The omitted variable is fracture injuries.⁵ Dionne and St-Michel (1991) found evidences that the moral hazard is greater for claims involving injuries that are difficult to diagnose. To the extent that there is a greater moral hazard for difficult-to-diagnose injuries, it is anticipated that the probability of returning to work will have greater coefficients for the sample of back or strain injuries than for that of other injuries.

⁵ I chose the omitted categorical variable as whether the injury is a fracture since it is likely to be easiest type of injury to diagnose and the least ambiguous to treat (see Dionne and St.-Michael, 1991)

The signs on both BACK and STRAIN are negative and significant in model I, and the coefficients on BACK, NERVE, and HERNIA are negative and significant in Model II, suggesting that the probability of returning to work is lower for such types of injuries compared fracture injuries. However, the estimates of the other injury type are not significant. The empirical results do not support the hypothesis that the duration of disability for difficult-to-conceal or directly visible injuries (such as, burn, fracture, and laceration) will have greater coefficient than that of disability for difficult-to-diagnose injuries (such as, back and strain). Perhaps, the failure to control the initial severity of injuries may cause this problem.

Fifth, the results on the cost containment policy control variables (FEE, HCR, and LIPC) shows that states adopted fee schedules cost containment policy have positive effect on the probability of returning to work. The coefficient on FEE shows that state has fee schedule cost containment policy increases the probability of returning to work by more than 50 percent and 74 percent in model I and model II, respectively. This finding is consistent with earlier work done by Durbin and Appel (1991), but it is different from work done by Pozzebon (1993). The signs on HCR (hospital charge regulation) and LIPC (limited initial provider choice) are negative but not statistically significant. However, this interpretation requires a caution since it may also capture other differences in the structure of workers' compensation system.

Seven, the legal variables have influences on the probability of returning to work. The signs on attorney involvement is statistically significant and negative in model II. The sign on ATT shows that claimants represented by lawyers are less likely returned to work

by 18.6 percent compared to claimants are not represented by lawyers. This result is consistent with previous finding (Butler and Worrall, 1985). Attorneys are more likely to be retained by injured workers with more serious injuries than less serious injuries. On the other hand, because of financial incentives, involvement of lawyers may increase the length of spells for reasons unrelated to true state of medical condition. Employers may contest overly long claims to justify the reasonableness of the claims. The estimate on *CONTEST* are statistically significant and negative, suggesting that claimants whose case were contested by the employer decrease the probability of return to work.

Eight, as to the demographic variables, the age of a claimant has effect on the likelihood of transition from non-working to return to work. The sign on *LN_AGE* is negative and statistically significant; confirming above hypothesis. Because injuries have more serious consequences for older workers, claimant's age should be negatively related to the risk of returning to work. An unit increase in *LN_AGE* decreases the probability of returning to work by 25.3 percent and 19.4 percent in model I and model II, respectively. For other demographic variable, the estimates on marital status and gender of claimants is not significant.

Finally, for the above estimation, industry (manufacturing, construction, clerical, producer, and others) and the mix of medical providers (acute, physician care, emergency care, orthopedic surgery, therapy, radiology, surgeon, and chiropractic care) categorical variables were entered to control for working conditions and characteristics of medical provider. Those results are not presented in the table.

A disadvantage of this analysis is that part of the regression model is unspecified. For instance, we cannot investigate the duration dependence. Duration dependence shows the relationship between the hazard rate and the survival rate. The hazard rate shows the instantaneous probability that a person (or a subject) will leave a certain event over a time $t + \Delta t$, for a very small t , assuming a person has not left the event. Analogously, the survivor function at time t represents the probability that a person will survive until time t . If the hypothesis to be tested is concerning about the duration dependence (e.g., the longer time an injured worker spent on the program, the less likely return to work, and hence prolong the duration of non-working spells), we need to make some parametric assumptions about the distribution of baseline hazard. Duration dependence exists when $(d / dt)\lambda(t, x, \beta) \neq 0$, suggesting that the probability of returning to work is influence by the length of time spent on the program. The next section deals with parametric analysis.

Section III-b. Alternative distribution assumptions for the parametric hazard

In this section, I use parametric hazard models to estimate the probability of exiting from spells of temporary total disability. The parametric hazard estimations allow the examination of possible duration dependence. Table IX-a and IX-b show the results based on various parametric assumptions. The parametric regression model assumes the log of the duration as a dependent variable.

$$y = \ln T = \beta_0 + X' \beta + \sigma w$$

where σ is a scale parameter and w is a probability density function, which may be specified as Weibull, log-logistic, or other. The above regression model shows that the duration of disability is related to the explanatory variables after imposing a specific functional form for the baseline hazard functions. In general, a specific functional form imposed on the hazard function is based on the mathematical convenience and results are very sensitive to the assumptions on the hazard function. One of the feature for the workers' compensation duration data is that observations are highly skewed to the right because most claimants will return to work in the early phase and a few stay on the program for an extremely long time (see Table IV). Given this feature, the normal distribution is clearly not suitable to fit the duration data, although the log normal distribution is.

(1) Exponential distribution

The hazard function with exponential distribution is as follow:

$$\lambda(t;X) = \exp(X' \beta) \lambda$$

The distribution of the hazard is characterized by a constant hazard rate λ .

(2) Weibull distribution

The hazard function with Weibull distribution is as follow:

$$\lambda(t, X) = \gamma \alpha t^{\alpha-1}$$

where the scale parameter γ is usually taken as $\exp(X\beta)$ to ensure the non-negativity of the hazard function. The shape parameter (α) of the hazard function determines that

how the instantaneous probability that a person will be returned to work changes over the duration of non-working spells. The scale parameter, influenced by the covariates, indicates how this probability different across individuals at any given point in time. If the $\alpha > 1$, the hazard is increasing over time, or it has the positive duration dependence; when $0 < \alpha < 1$, the hazard is decreasing over time, or it has the negative duration dependence; if $\alpha = 1$ we have an exponential distribution with a constant hazard. The Weibull distribution, however, may be restrictive because it only allows the shape parameter of the hazard function to be either monotonically increase or decrease over time, but not both. For example, this rules out the possibility that the probability of returning to work increases with time initially but decreases thereafter.

(3) Log - logistic distribution

Another widely used functional form is log - logistic distribution. This distribution has an advantage of not constraining the hazard to be either monotonically increasing or decreasing. The hazard function is as follow:

$$\lambda(t, X) = \frac{\gamma \alpha (t)^{\alpha-1}}{[1 + (\gamma t)^\alpha]}$$

If $\alpha > 1$, then the hazard rate is increasing from zero up to $t = \frac{(\alpha - 1)^{1/\alpha}}{\lambda}$ and decrease thereafter, while duration dependence is negative if $\alpha < 1$.

Section III-c. Empirical results of parametric hazard models

Tables IX-a and IX-b show the results based on fitting various different distributions to the data by the maximum likelihood.⁶ Table IX-a is based on an estimation using the price of medical care for medical variable and Table IX-b is based on an estimation using the utilization of medical services for medical variables. The basic structure of the model is, however, unchanged. The distribution parameters from Tables IX-a and IX-b are $\alpha = \frac{1}{scale}$ and $\gamma = \exp(\frac{-intercept}{scale})$. The signs of the coefficients of the covariates are fairly consistent across parametric distributions which are exponential, Weibull, log-normal, and log-logistic. The expected duration under a various parametric distributions given in Table XI. These expected spells are calculated from multiplying the survival probabilities by the number of temporary total disability for all observations. Overall, the expected spells is about 8-9 weeks.

Even though both exponential and Weibull distributions are commonly found in the hazard model, but these distribution forms are probably inappropriate in this study, since they cannot generate non-monotonic hazard rates. For instance, the estimate of α the Weibull distribution in Table IX-a is model is 1.18 (or 1.28 in Table IX-b), which implies a hazard function that continuously increases over time. This implication is inappropriate in this study, because the probability of returning to work ought to decline after a certain time. As mentioned earlier, most injured workers spent a relatively short

⁶ Given the parameterization in SAS LIFEREG estimation, the estimated coefficients and the scale parameter must be transformed as follows in order to obtain the estimates in Table IV-a and IV-b.

$$\hat{\beta} = -\frac{1}{ScaleParameter} \hat{\beta}^*$$

length of time (recall that a more than half of injured workers spent less than three months) and a few workers spent a very long time on the workers' compensation program (see Table IV). Some injured workers eventually will not return to work completely either due to the severity of their injuries or, after a significant time, their cases will be re-classified as permanent total (or partial) claims. Therefore, it is reasonable to expect that estimated hazard rate rises sharply in the early phase of a non-working period and it declines steadily.

The log-normal and log-logistic distributions will fit the data better since using these distributions, hazard rates rise and then to fall. For example, the estimates of α with log-logistic are 1.95 and 2.18 in Tables IX-a and Table IX-b, respectively. which suggest that the probability of returning to work increases initially and falls thereafter. Likelihood ratio test confirms the superiority of log-logistic distribution over other distributions. The likelihood ratio test is computed by taking twice the difference between the maximized log-likelihood values of the null and the alternative models (see Table IX-c).

The results on the Tables IX-a and IX-b can be interpreted similarly to the Cox proportional hazard estimates. Again, the sign of LN_RATIO is positive and statistically significant; confirming that those with the higher proportion of economic loss will spent less time in the non-working spells. Also, the positive coefficient on LN_WAGE shows the dominant substitution effect in the production over the income effect - an increase in medical care decrease the duration of non-working spells. In Table IX-a, like results from Cox proportional estimates, the price of medical care in the acute phase significantly influences the probability of returning to work. An increase in the price of medical care

decreases the probability of returning to work and thus, it will raise time spent on the workers' compensation system. The similarity of these results reinforces conclusions drawn from Table VIII.

Section III-d. Unobservable heterogeneity

Above parametric models assumed that all of the relevant influences are captured by explanatory variables. The difference in the hazard rate is the result of variations in these independent characteristics and functional forms of baseline hazards. However, such an assumption is unrealistic, since unmeasured and omitted sources of heterogeneity are unavoidable. In addition to explanatory variables in the model, there might be further characteristics that were not available influence the hazard rate. Compare to linear regression model, ignoring such unobserved variables in the duration model lead to more serious problems even if the omitted variables are uncorrelated with explanatory variables. Estimation of the hazard rate, which ignores these unobservable differences result in an apparent duration dependency. Heckman and Singer (1984) pointed out that the presence of unobservable heterogeneity create a negative bias in the estimation, providing a decreasing hazard rate when the true underlying hazard rate is flat or increasing. Failure to correct these heterogeneity can lead to an estimated hazard rate that decline more steeply than the true hazard rates as well as to biases in the parameter estimates for the included repressors.

Suppose all injured workers entered the workers' compensation benefit program initially. If some workers are more motivated to returned to work than others (motivations

are certainly unobservable), then they are more likely to exit the program sooner than less motivated workers. As time goes on, therefore, less motivated workers as a percent of those who have been on the workers' program for a long time are increasing, which leads to decreasing hazard rates. Thus, it is no longer possible to differentiate whether the hazard rate falls with increasing duration for each individual or this is simply a misspecification problem due to neglected differences between individuals.

Suppose there is an unobserved heterogeneity in the Weibull distribution. The following specification is modified to include a random variable, v , which is unobservable or omitted regressors varying from individuals to individuals, to capture heterogeneity. The hazard function becomes

$$\lambda(t; X, v) = v \gamma t^{\alpha-1}$$

where the scale parameter is the product of $v\gamma$.

The density and survivor functions are as follows:

$$f(t; X, v) = v \gamma t^{\alpha-1} \exp(-v\gamma t^\alpha),$$

$$S(t; X, v) = \exp(-v\gamma t^\alpha)$$

where γ is $\exp(X\beta)$ to ensure the non-negativity of the hazard function and v is a non-negative random variable which has a multiplicative effect on the hazard rate.

Assuming v is distributed as gamma with $E(v) = \frac{r}{\kappa}$, so that the density function is as follow;

$$f(v) = \frac{\kappa^r}{\Gamma(r)} \exp^{-\kappa v} v^{r-1}$$

where $\Gamma(\gamma)$ represents a gamma function.

The hazard and survival functions become

$$\lambda(t; X) = \frac{\gamma \alpha (t)^{\alpha-1}}{[1 + \theta (\gamma t)^\alpha]}$$

$$S(t; X) = [1 + \theta (\gamma t)^\alpha]^{-1/\theta}$$

where θ is the shape parameter, and the greater the deviation of from zero, the greater effect of heterogeneity exists in the estimation. The results of this estimation controlling for unobserved heterogeneity are presented In Table X. It shows that an increasing hazard ($\alpha = 1.18$) in model I and there is unobserved heterogeneity left in the estimation (shape parameter is 0.063 and it is statistically significant, which is significantly different from zero). The same can be drawn for model II.

VII. Conclusion and Future Research

This study estimated the impact of workers' compensation benefits on the duration of disability. A theoretical model was developed to explain how much time and medical care to be allocated during the recuperation for an individual who has suffered from a temporary total disability at work. The empirical results demonstrated that the conditional probability of returning to work is influenced by not only direct physical effects of injury but also many other influences.

As for income variables, my empirical results showed dominant substitution effect; an increase in the proportion of economics loss and an increase in the pre-injury wages will lead to increase in the probability of exiting from the temporary total disability. Therefore, the duration of disability will decrease. This paper introduced an assumption that claimants may respond to differences in the price of medical care. In particular, an increase in the price of medical care in the post acute period may prolong the time spent on the workers' compensation system. This result, coupled with the finding of Durbin, Helavacian, and Worrall (1995) suggests that an increase in the price of medical care will decrease the demand for medical care service and thus, the longer time spent on the workers' compensation system.

The empirical results show important policy implications. Any program designed to save on medical costs that would raise employee share of both acute and post-acute medical prices would result in prolonging the time spent on the workers' compensation program. Consequently, increase the costs associated with temporary total disability.

However, the my empirical results support that the effects of programs which may limit the utilization of medical services, especially for the post-acute period, would not likely result in much longer the duration of temporary total disability. In general, many injured workers continue to receive some types of medical treatment for quite sometime after returning to work. The costs of these medical treatments account for a major component of total costs in workers' compensation. Empirical results supports that state can lower medical costs by encouraging employers or insurers to participate in HMOs (Health Maintenance Organizations) or PPRs (Preferred Provider Organizations) types of arrangements for delivering health care services under workers' compensation program. Indeed, a number of states are considering some restrictions on utilization of medical services for specific treatment. For instance, Oregon began to limit the number of treatments provided by chiropractors. The general managed health care programs which specific treatments are designed to curtail the rapid increase in medical costs.

The directions of future research can be summarized by two ways. One way is to adopt 'split population model' of Schmidt and Witte (1989). Using temporary total disability claims, so far we assumed that all right censored claimants will return to work. However, this assumption may be unrealistic since censored observations have much longer spells than settled claims. This suggests that those injured workers who has not returned to work at the end of observation period might qualify for permanent partial disability or might not return to work at all. They suggested that the model be modified by allowing for the possibility that some censored claimants who might never return to work. Their estimation technique allows to parameterize both the probability of returning to work and

the timing of return, so that we can estimate separate effects of explanatory variables on the duration of disability.

Another area for improvement is to use 'competing risk' model to estimate the probability of transition from temporary total disability to permanent total disability. The competing risk model allows multiple ways for a non working spells after injury to end and characterized by a different hazard functions.

Table I: Workers' Compensation Benefits Payments, Selected Years.

	Total Payment (millions)	Types of Benefits			Workers Covered in Average Month		Cost of Program as Percent of Covered Payroll
		Indemnity	Medical	Percent of Medical Benefits	Number (millions)	Percent of Employed Workers	
1940	\$256	\$161	\$95	37%	24.6	71%	1.19
1950	\$615	\$415	\$200	33%	36.8	77%	0.89
1960	\$1,295	\$860	\$435	34%	44.9	80%	0.91
1970	\$3,031	\$1,981	\$1,050	35%	59.2	84%	1.11
1980	\$13,562	\$9,632	\$3,930	29%	78.8	87%	1.96
1985	\$22,472	\$14,987	\$7,485	33%	84.3	87%	1.81
1986	\$24,613	\$15,971	\$8,642	35%	86.0	87%	1.99
1987	\$27,318	\$17,406	\$9,912	36%	88.4	87%	2.07
1988	\$30,733	\$19,215	\$11,518	37%	91.3	87%	2.16
1989	\$34,316	\$20,892	\$13,424	39%	93.7	88%	2.27
1990	\$38,238	\$23,051	\$15,187	40%	95.1	88%	2.36
1991	\$42,169	\$25,337	\$16,832	40%	93.6	89%	2.40
1992	\$44,169	\$26,408	\$18,252	41%	94.6	89%	2.31
1993	\$42,925	\$25,403	\$17,521	41%	96.1	90%	2.30

SOURCE: Various Issues of Social Security Bulletin

Table II: Comparison of Four States Workers' Compensation Policy

		Florida	Illinois	Oregon	Pennsylvania
Rate of Maximum Weekly Benefits	a/				
1988		100% SAWW	133% SAWW	100% SAWW	100% SAWW
1989		100% SAWW	133% SAWW	100% SAWW	100% SAWW
1990		100% SAWW	133% SAWW	100% SAWW	100% SAWW
1991		100% SAWW	133% SAWW	100% SAWW	100% SAWW
Maximum Weekly Benefits					
1988		\$334	\$554	\$355	\$377
1989		\$362	\$581	\$371	\$399
1990		\$382	\$605	\$390	\$419
1991		\$392	\$631	\$407	\$436
Minimum Weekly Benefits					
1988		\$20	\$101	\$50	\$189
1989		\$20	\$101	\$50	\$200
1990		\$20	\$101	\$50	\$140
1991		\$20	\$101	\$50	\$145
Maximum of Temporary Total Disability Duration (Weeks)					
1988		360	None	None	None
1989		360	None	None	None
1990		360	None	None	None
1991		360	None	None	None
Rate of Replacement					
1988-91		66.7%	66.7%	66.7%	66.7%
Waiting Periods (Days)					
1988-91		7	3	3	7
Retroactive Periods (Days)					
1988-91		14	14	13	14
Medical Cost Containment Policy	b/	LIPC LPC FS HCR UR BR	None	LPC HCR	LIPC LPC HCR
Medical Costs Trend	c/	11.1%	7.4%	4.7%	13.1%

Notes:

a/: SAWW is State Average Weekly Wage

b/: Various cost containment policies are as follows:

LIPC: Limited Initial Provider Choice

LPC: Limited Provider Change

FS: Fee Schedule

HCR: Hospital Charge Regulation

BR: Bill Review

UR: Utilization Review

c/: Medical cost trend is the growth rate of medical costs during 1988-1991.

Table III: Average Indemnity and Medical Costs by Injury Types

		Back	Burn	Dislocation	Fracture
Total Indemnity Benefits					
Temporary Total Disability Payments		\$6,663	\$2,251	\$3,577	\$3,782
Rehabilitation Payments		\$95	\$5	\$1	\$20
Other payments		<u>\$12,404</u>	<u>\$4,305</u>	<u>\$6,046</u>	<u>\$5,440</u>
Total Indemnity Costs		\$19,161	\$6,562	\$9,624	\$9,242
Temporary Total Duration (in weeks)		26	9	15	14
Total Medical Benefits					
Number of Treatments	Acute Period	10	11	7	9
	Post Acute Period	<u>168</u>	<u>78</u>	<u>76</u>	<u>80</u>
	Total	178	90	83	89
Medical Costs	Acute Period	\$1,266	\$3,349	\$1,839	\$2,202
	Post Acute Period	<u>\$11,540</u>	<u>\$3,992</u>	<u>\$4,787</u>	<u>\$3,736</u>
	Total	\$12,805	\$7,341	\$6,626	\$5,938
Hospital stays (Days)		3	3	1	2
Medical Episode (weeks)		56	24	38	34
Total Benefits		\$31,966	\$13,903	\$16,250	\$15,180
Number of Obs		368	50	73	312

Table III: Average Indemnity and Medical Costs by Injury Types (Continued)

		Hernia	Joint	Laceration	Nerve	Strain
Total Indemnity Benefits						
Temporary Total Disability Payments		\$2,383	\$4,925	\$2,997	\$4,343	\$4,870
Rehabilitation Payments		\$0	\$13	\$2	\$31	\$27
Other payments		<u>\$746</u>	<u>\$6,268</u>	<u>\$4,320</u>	<u>\$5,018</u>	<u>\$7,656</u>
Total Indemnity Costs		\$3,129	\$11,206	\$7,319	\$9,392	\$12,553
Temporary Total Duration (in weeks)		8	22	11	19	20
Total Medical Benefits						
Number of Treatments	Acute Period	5	7	9	5	11
	Post Acute Period	<u>27</u>	<u>137</u>	<u>55</u>	<u>74</u>	<u>140</u>
	Total	32	144	64	79	151
Medical Costs	Acute Period	\$1,827	\$644	\$3,361	\$439	\$661
	Post Acute Period	<u>\$1,793</u>	<u>\$6,602</u>	<u>\$2,833</u>	<u>\$5,095</u>	<u>\$5,219</u>
	Total	\$3,620	\$7,246	\$6,193	\$5,534	\$5,880
Hospital stays (Days)		1	2	2	1	2
Medical Episode (weeks)		12	58	27	52	49
Total Benefits		\$6,750	\$18,451	\$13,512	\$14,926	\$18,433
Number of Obs		98	110	231	129	958

Table IV: Frequency of Percent of Length of Stay by the Type of Injury

Length of Stay (Weeks)	Back	Burn	Dislocation	Fracture	Hernia
Less than 12	49.18%	82.00%	61.64%	68.91%	93.88%
Less than 24	68.20%	88.00%	87.67%	85.90%	97.96%
Less than 36	80.43%	94.00%	94.52%	92.63%	98.98%
Less than 48	83.15%	96.00%	95.89%	95.51%	98.98%
Less than 96	95.11%	100.00%	100.00%	99.04%	100.00%
Less than 144	98.91%	100.00%	100.00%	100.00%	100.00%
Less than 192	99.73%	100.00%	100.00%	100.00%	100.00%
Less than 208	100.00%	100.00%	100.00%	100.00%	100.00%

(Continued)

Length of Stay (weeks)	Joint	Laceration	Nerve	Strains	Others	Total
Less than 12	54.55%	76.19%	55.03%	62.10%	78.81%	68.16%
Less than 24	70.91%	88.31%	79.84%	76.09%	87.21%	81.46%
Less than 36	83.64%	95.24%	87.59%	85.38%	92.27%	89.07%
Less than 48	90.00%	95.67%	93.02%	89.87%	94.56%	92.12%
Less than 96	98.18%	99.57%	99.22%	96.97%	98.19%	97.84%
Less than 144	98.18%	100.00%	100.00%	99.16%	99.43%	99.41%
Less than 192	100.00%	100.00%	100.00%	99.79%	100.00%	99.91%
Less than 208	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table V: Definition of Variables

<i>Variables</i>	<i>Descriptions</i>
<u><i>Dependent Variable</i></u>	
TTDUR	Number of weeks a claimnant spent on the temporary total disability
<u><i>Income Variables</i></u>	
WBEN	Weekly tempoary total disability payment
PREWAGE	Weekly pre-injury wage before tax
REPLACE	Weekly indemnity payment divided by pre-injury wage before tax
RATIO	Proportion of economic loss (1 - REPLACE - TTR)
TTR	Average tax rate
MTR	Marginal tax rate
TTINC	Temporary total disability payment
OTINC	Other indemnity payment
REHINC	Rehabilitation payment
TOTINC	Total indemnity payment
<u><i>Medical Variables</i></u>	
P_ACUTE	Price or unit cost of medical care in initial two weeks
P_POST	Price or unit cost of medical care in after two weeks
T_ACUTE	Number of medical reatments received in initial two weeks
T_POST	Number of medical treatments received in after two weeks
<u><i>Severity Control Variables</i></u>	
IN_DAYS	Number of days spent in the hospital
SURGERY	If a claimnant had surgery then 1, otherwise 0
<u><i>Demographic Variables</i></u>	
AGE	Age of a claimnant
MALE	If a claimnant is male then 1, otherwise 0
MARRIED	If Claimnant is married then 1, otherwise 0
<u><i>Legal Variables</i></u>	
CON	If an employer or insurer contested the claim then 1, otherwise 0
ATT	If a claimnant is represented by a lawyer then 1, otherwise 0
<u><i>Types of Injuries</i></u>	
BACK	If back injury then 1, otherwise 0
BURN	If burn injury then 1, otherwise 0
DISLOCAT	If dislocation injury then 1, otherwise 0
JOINT	If joint injury then 1, otherwise 0
NERVE	If nerve injury then 1, otherwise 0
HERNIA	If hernia injury then 1, otherwise 0
FRACTURE	If fracture injury then 1, otherwise 0
STRAIN	If strain injury then 1, otherwise 0
LACERATN	If laceration injury then 1, otherwise 0
OTHER	If other injury then 1, otherwise 0

Table V: Definition of Variables (Continued)

<i>Variables</i>	<i>Descriptions</i>
<u>Cost Containment Policy Variables</u>	
LIPC	If state has Limited Initial Provider Choice cost containment policy then 1, otherwise 0
LPC	If state has Limited Provider Choice cost containment policy then 1, otherwise 0
FS	If state has Fee Schedule cost containment policy then 1, otherwise 0
HCR	If state has Hospital Charge Regulation cost containment policy then 1, otherwise 0
UR	If state has Utilization Review cost containment policy then 1, otherwise 0
<u>State Control Variables</u>	
WAIT (Days)	Waiting period before the start of temporary total disability
RETRO (Days)	Retroactive period after the start of temporary total disability
STUNEMP	State unemployment rate
Florida	If state is Florida then 1, otherwise 0
Illinois	If state is Illinois then 1, otherwise 0
Oregon	If state is Oregon then 1, otherwise 0
Pennsylvania	If state is Pennsylvania then 1, otherwise 0
<u>Industry Control Variables</u>	
IND1	If manufacturing job then 1, otherwise 0
IND2	If construction job then 1, otherwise 0
IND3	If office or clerical job then 1, otherwise 0
IND4	If producer or dealer job then 1, otherwise 0
IND5	Other job category
<u>Provider Control Variables</u>	
Acute	If provider type is acute care then 1, otherwise 0
Physician	If provider type is physician then 1, otherwise 0
Emergency	If provider type is emergency care then 1, otherwise 0
Orthopaedic Surgery	If provider type is orthopaedic surgery then 1, otherwise 0
Physical Therapy	If provider type is physical therapy then 1, otherwise 0
Radiology	If provider type is radiology then 1, otherwise 0
Surgeon	If provider type is surgeon then 1, otherwise 0
Chiropractic Care	If provider type is chiropractic care then 1, otherwise 0

Table VI: Descriptive Statistics of Variables used in the Regression

Variables	Full Sample (N=3,376)		Return to Work (N=2,642)		Not Return to Work (N=734)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
<u>Dependent Variable</u>						
TTDUR	16.531	24.767	9.912	14.424	40.352	36.723
<u>Income Variables</u>						
WBEN	251.930	113.149	247.676	112.284	267.244	114.938
PREWAGE	401.898	256.960	397.843	270.715	416.493	199.238
REPLACE	0.648	0.088	0.645	0.092	0.657	0.073
RATIO	0.152	0.087	0.156	0.089	0.137	0.078
TTR	0.201	0.051	0.199	0.050	0.206	0.053
MTR	0.312	0.028	0.310	0.026	0.319	0.032
TTINC	4,109.098	6,641.229	2,497.818	3,873.728	9,908.826	10,294.345
OTINC	6,402.472	17,473.333	1,997.628	7,355.201	22,257.510	29,819.704
REHINC	29.854	367.369	0.783	26.569	134.495	777.721
TOTINC	10,611.103	21,590.869	4,486.871	9,580.204	32,655.003	34,553.290
<u>Medical Variables</u>						
P_ACUTE	98.565	214.083	84.507	179.594	149.163	302.553
P_POST	122.383	239.609	85.939	170.936	238.273	359.934
T_ACUTE	9.048	8.480	8.576	8.241	10.744	9.094
T_POST	100.618	234.882	59.938	142.429	247.044	391.785
<u>Severity Control Variables</u>						
IN_DAYS	1.723	6.815	1.055	5.265	4.124	10.323
SURGERY	0.536	0.499	0.473	0.499	0.763	0.426
<u>Demographic Variables</u>						
AGE	36.967	11.386	36.463	11.423	38.783	11.074
MALE	0.752	0.432	0.768	0.422	0.698	0.460
MARRIED	0.343	0.475	0.353	0.478	0.307	0.461
<u>Legal Variables</u>						
CON	0.078	0.269	0.066	0.248	0.123	0.328
ATT	0.152	0.359	0.111	0.314	0.303	0.460
<u>Types of Injuries</u>						
BACK	0.109	0.312	0.086	0.280	0.194	0.395
BURN	0.015	0.121	0.017	0.128	0.008	0.090
DISLOCAT	0.022	0.146	0.022	0.145	0.022	0.146
JOINT	0.033	0.178	0.028	0.166	0.048	0.213
NERVE	0.038	0.192	0.030	0.171	0.067	0.250
HERNIA	0.029	0.168	0.036	0.186	0.004	0.064
FRACTURE	0.092	0.290	0.096	0.294	0.080	0.272
STRAIN	0.284	0.451	0.264	0.441	0.354	0.479
LACERATN	0.068	0.253	0.075	0.263	0.046	0.210
OTHER	0.310	0.463	0.347	0.476	0.177	0.382

TABLE VI: Descriptive Statistics of Variables used in the Regression (Continued)

Variables	Full Sample (N=3,376)		Return to Work (N=2,642)		Not Return to Work (N=734)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
<i><u>Cost Containment Policy Variables</u></i>						
LPC	0.487	0.500	0.499	0.500	0.447	0.498
LPC	0.776	0.417	0.770	0.421	0.798	0.402
FS	0.512	0.500	0.492	0.500	0.587	0.493
HCR	0.776	0.417	0.770	0.421	0.798	0.402
UR	0.512	0.500	0.492	0.500	0.587	0.493
<i><u>State Control Variables</u></i>						
WAIT	4.949	2.000	4.994	2.000	4.788	1.990
RETRO	13.711	0.453	13.729	0.445	13.649	0.478
STUNEMP	5.745	0.605	5.707	0.579	5.883	0.673
FLORIDA	0.224	0.417	0.220	0.415	0.236	0.425
ILLINOIS	0.224	0.417	0.230	0.421	0.202	0.402
OREGON	0.289	0.453	0.271	0.445	0.352	0.478
PENNSYLVANIA	0.264	0.441	0.278	0.448	0.211	0.408
<i><u>Year Control Variables</u></i>						
1988	0.090	0.286	0.083	0.276	0.116	0.320
1989	0.309	0.462	0.329	0.470	0.237	0.426
1990	0.466	0.499	0.498	0.500	0.350	0.477
1991	0.135	0.342	0.091	0.287	0.297	0.457
<i><u>Industry Control Variables</u></i>						
IND1	0.171	0.377	0.178	0.382	0.147	0.355
IND2	0.129	0.335	0.125	0.331	0.144	0.352
IND3	0.063	0.244	0.063	0.243	0.064	0.245
IND4	0.253	0.435	0.247	0.431	0.274	0.446
IND5	0.134	0.341	0.120	0.325	0.185	0.389
<i><u>Provider Control Variables</u></i>						
Acute	0.680	0.467	0.639	0.480	0.828	0.377
Physician	0.888	0.316	0.865	0.342	0.969	0.174
Emergency	0.128	0.334	0.126	0.332	0.135	0.342
Orthopaedic Surgery	0.370	0.483	0.321	0.467	0.548	0.498
Physical Therapy	0.295	0.456	0.237	0.425	0.504	0.500
Radiology	0.748	0.434	0.705	0.456	0.902	0.298
Surgeon	0.302	0.459	0.249	0.433	0.491	0.500
Chiropractic Care	0.106	0.308	0.087	0.282	0.173	0.379

Table VII: Distribution of Injury Types by the Day of Week

	Obs	Mon	Tues	Wed	Thr	Fri	Sat	Sun
Back	368	21.20%	18.21%	18.21%	19.02%	15.76%	4.89%	2.71%
Burn	50	20.00%	16.00%	20.00%	6.00%	26.00%	6.00%	6.00%
Dislocation	73	24.66%	21.92%	12.33%	19.18%	6.85%	9.59%	5.47%
Fracture	312	18.91%	17.63%	16.03%	20.19%	18.27%	4.81%	4.16%
Hernia	98	20.41%	18.37%	17.35%	14.29%	23.47%	4.80%	2.03%
Joint	110	21.82%	26.36%	8.18%	15.45%	20.00%	3.64%	4.55%
Laceration	231	20.78%	16.45%	15.15%	18.61%	19.05%	6.93%	3.03%
Nerve	129	25.58%	13.95%	13.95%	23.26%	15.50%	5.43%	2.33%
Strain	958	20.25%	20.35%	16.28%	16.28%	16.18%	5.32%	5.34%
Other	1,047	17.77%	20.73%	19.39%	17.29%	16.71%	4.30%	3.81%
Total	3,376	19.85%	19.58%	17.00%	17.51%	16.94%	5.04%	4.08%

Table VIII: Semi-Parametric Hazard Estimates (Cox Proportional Hazard Model)
(Estimated By PHREG in SAS)

Variables	Model I			Model II		
	Estimates	Std Err	% effect	Estimates	Std Err	% effect
<u>Income Variables</u>						
LN_RATIO	0.162 *	0.042	17.6%	0.126 *	0.038	13.4%
LN_WAGE	0.107 *	0.049	11.2%	0.184 *	0.046	20.166%
LN_REH	-0.394 *	0.092	-32.6%	-0.418 *	0.092	-34.2%
LN_OTHER	-0.163 *	0.007	-15.0%	-0.154 *	0.007	-14.3%
<u>Medical Variables a/</u>						
P_ACUTE	-0.031	0.035	-3.1%	N/A	N/A	N/A
P_POST	-0.270 *	0.033	-23.7%	N/A	N/A	N/A
T_ACUTE	N/A	N/A	N/A	0.232 *	0.030	26.1%
T_POST	N/A	N/A	N/A	-0.372 *	0.017	-31.1%
<u>Measures of Severity</u>						
SURGERY	-0.199 *	0.068	-18.0%	-0.220 *	0.066	-19.8%
L_IN DAYS	-0.113 *	0.041	-10.7%	-0.140 *	0.037	-13.0%
<u>Types of Injury b/</u>						
BACK	-0.297 *	0.081	-25.7%	-0.316 *	0.078	-27.1%
BURN	-0.071	0.174	-6.9%	-0.057	0.160	-5.5%
DISLOCAT	-0.070	0.147	-6.8%	-0.052	0.141	-5.1%
JOINT	-0.133	0.127	-12.5%	0.018	0.124	1.8%
NERVE	-0.349	0.130	-29.5%	-0.423 *	0.124	-34.5%
HERNIA	0.047	0.138	4.8%	-0.380 *	0.118	-31.6%
STRAIN	-0.269 *	0.057	-23.6%	-0.062	0.054	-6.0%
LACERATN	0.110	0.092	11.7%	0.029	0.083	2.9%
OTHER	-0.029	0.079	-2.8%	-0.024	0.076	-2.3%
<u>Cost Containment Policy Variables</u>						
FEE	0.503 *	0.136	65.4%	0.639 *	0.132	89.5%
HCR	-0.347 *	0.169	-29.3%	-0.463 *	0.162	-37.1%
LIPC	-0.386	0.072	-32.1%	-0.303 *	0.068	-26.1%
<u>Legal Variables</u>						
ATT	-0.234	0.072	-20.9%	-0.206 *	0.071	-18.6%
CON	-0.145 **	0.091	-13.5%	-0.143 *	0.084	-13.3%
<u>Demographic Variables</u>						
MT	-0.055	0.051	-5.3%	0.012	0.048	1.2%
MALE	0.047	0.056	4.8%	-0.081	0.052	-7.8%
LN_AGE	-0.291 *	0.075	-25.3%	-0.216 *	0.069	-19.4%
Observations	2,997			3,376		
Uncensored	2,280			2,642		
Censored	717			734		
% Censored	23.92%			21.74%		

Notes:

- 1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%
- 2) Controlled industry types and provider types but not presented in the table.
- 3) % effect of coefficient is calculated as $(\exp(\text{estimates}) - 1) * 100\%$
- 4) -2 LOG L (w/o covariates) = 39207.59 and -2 LOG L (w/ covariates) = 35876.9.
- 5) a/: Entered as log form.
- 6) b/: The omitted variable is fracture injuries.

Table IX-a: Parametric Hazard Regression Results

Variable	Log-Logistic		Log-Normal	
	Estimates	Std Err	Estimates	Std Err
INTERCEPT	-0.703	0.498	-0.391	0.502
<i>Income Variables</i>				
LN_RATIO	0.296 *	0.035	0.167 *	0.032
LN_WAGE	0.160 *	0.041	0.095 *	0.041
LN_REH	-0.561 *	0.051	-0.302 *	0.041
LN_OTHER	-0.313 *	0.006	-0.172 *	0.006
<i>Medical Variables a/</i>				
P_ACUTE	0.026	0.026	0.005	0.025
P_POST	-0.429 *	0.028	-0.229 *	0.027
<i>Measures of Severity</i>				
SURGERY	-0.180 **	0.057	-0.132 **	0.058
L_IN DAYS	-0.254 *	0.032	-0.156 *	0.031
<i>Types of Injury b/</i>				
BACK	-0.404 *	0.066	-0.238 *	0.067
BURN	-0.091	0.150	-0.037	0.152
DISLOCAT	-0.065	0.124	-0.007	0.125
JOINT	-0.292	0.105	-0.158	0.106
NERVE	-0.434	0.106	-0.233 **	0.106
HERNIA	-0.168	0.113	-0.038	0.123
STRAIN	-0.377 *	0.047	-0.229	0.048
LACERATN	0.435 *	0.079	0.249	0.079
OTHER	0.008	0.065	0.008	0.067
<i>Cost Containment Policy</i>				
FEE	0.898 *	0.107	0.553	0.110
HCR	-0.609 *	0.137	-0.375	0.139
LIPC	-0.863 *	0.061	-0.475	0.060
<i>Legal Variables</i>				
ATT	-0.074	0.064	-0.092	0.061
CON	-0.308 *	0.075	-0.158	0.075
<i>Demographic Variables</i>				
MARRIED	0.054	0.042	0.030	0.043
MALE	0.034	0.046	0.033	0.046
LN_AGE	-0.382 *	0.061	-0.219	0.062
<i>Distributional Parameters</i>				
SCALE	0.512 *	0.009	0.908 *	0.014
γ	1.953		1.101	
α	0.499		0.682	
Log Likelihood	-3364.45		-3371.34	

Notes:

- 1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%
 2) Controlled industry types and provider types but not presented in the table.

	Size	Percent
3) Uncensored observations	2,280	76.08%
Censored observations	717	23.92%
4) a/: Entered as log form.		
5) b/: The omitted variable is fracture injuries.		

(Continued)

Table IX-a: Parametric Hazard Regression Results

Variable	Exponential		Weibull	
	Estimates	Std Err	Estimates	Std Err
INTERCEPT	-0.640	0.632	-0.923	0.539
<i>Income Variables</i>				
LN_RATIO	0.153 *	0.041	0.164 *	0.034
LN_RWAG	0.104 *	0.049	0.139 *	0.042
LN_REH	-0.399 *	0.092	-0.405 *	0.077
LN_OTHER	-0.164 *	0.007	-0.176 *	0.006
<i>Medical Variables a/</i>				
P_ACUTE	-0.004	0.035	-0.006	0.028
P_POST	-0.243 *	0.033	-0.277 *	0.029
<i>Measures of Severity</i>				
SURGERY	-0.166 *	0.068	-0.212 *	0.058
L_INDDAYS	-0.148 *	0.041	-0.171 *	0.035
<i>Types of Injury b/</i>				
BACK	-0.263 *	0.081	-0.312 *	0.069
BURN	-0.084	0.174	-0.081	0.147
DISLOCAT	0.030	0.147	0.036	0.124
JOINT	-0.122	0.127	-0.147	0.107
NERVE	-0.297 *	0.130	-0.352 *	0.110
HERNIA	0.076	0.138	0.107	0.116
STRAIN	-0.253 *	0.057	-0.293	0.049
LACERATN	0.126	0.092	0.124	0.078
OTHER	0.009	0.079	0.003	0.066
<i>Cost Containment Policy</i>				
FS	0.486 *	0.134	0.583	0.114
HCR	-0.331 **	0.168	-0.389	0.142
LIPC	-0.359 *	0.071	-0.401	0.060
<i>Legal Variables</i>				
ATT	-0.256 *	0.072	-0.364	0.060
CON	-0.104	0.090	-0.119	0.077
<i>Demographic Variables</i>				
MARRIED	-0.039	0.051	-0.060	0.043
MALE	0.057	0.056	0.062	0.047
LN_AGE	-0.259 *	0.075	-0.315 *	0.063
			0.000	0.000
<i>Distributional Parameters</i>				
SCALE	1.000	0.000	0.845 *	0.013
γ	1.000		1.183	
α	0.532		0.399	
Log Likelihood	-3589.14		-3534.19	

Notes:

1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%

2) Controlled industry types and provider types but not presented in the table.

	Size	Percent
3) Uncensored observations	2,280	76.08%
Censored observations	717	23.92%

4) a/: Entered as log form.

5) b/: The omitted variable is fracture injuries.

Table IX-b: Parametric Hazard Regression Results

Variable	<i>Log-Logistic</i>		<i>Log-Normal</i>	
	<i>Estimates</i>	<i>Std Err</i>	<i>Estimates</i>	<i>Std Err</i>
INTERCPT	-3.161 *	0.393	-1.783 *	0.402
<i>Income Variables</i>				
LN_RATIO	0.292 *	0.029	0.170 *	0.027
LN_WAGE	0.204 *	0.034	0.134 *	0.035
LN_REH	-0.603 *	0.046	-0.323 *	0.037
LN_OTHER	-0.298 *	0.005	-0.163 *	0.005
<i>Medical Variables a/</i>				
T_ACUTE	0.328 *	0.021	0.168 *	0.021
T_POST	-0.629 *	0.012	-0.338 *	0.012
<i>Measures of Severity</i>				
SURGERY	-0.279 *	0.049	-0.164 *	0.050
L_IN DAYS	-0.281 *	0.025	-0.178 *	0.025
<i>Types of Injury b/</i>				
BACK	-0.373 *	0.057	-0.229 *	0.058
BURN	-0.140	0.123	-0.068	0.127
DISLOCAT	-0.037	0.104	-0.024	0.109
JOINT	-0.111	0.090	-0.089	0.093
NERVE	-0.639 *	0.091	-0.341 *	0.091
HERNIA	-0.815 *	0.090	-0.383 *	0.095
STRAIN	-0.128	0.039	-0.083 **	0.041
LACERATN	0.303 *	0.063	0.178 *	0.065
OTHER	-0.024	0.056	-0.008	0.058
<i>Cost Containment Policy</i>				
FEE	0.942 *	0.089	0.587 *	0.093
HCR	-0.524 *	0.114	-0.336 *	0.118
LIPC	-0.792 *	0.051	-0.429 *	0.052
<i>Legal Variables</i>				
ATT	0.057	0.057	-0.035	0.054
CON	-0.355 *	0.063	-0.178 *	0.063
<i>Demographic Variables</i>				
MARRIED	0.128 **	0.035	0.077 **	0.036
MALE	-0.073	0.038	-0.042	0.039
LN_AGE	-0.231 *	0.051	-0.146 *	0.053
<i>Distributional Parameters</i>				
SCALE	0.458 *	0.007	0.822 *	0.011
γ	2.183		1.220	
α	0.041		0.166	
Log Likelihood	-3568.74		-3596.36	

Notes:

1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%

2) Controlled industry types and provider types but not presented in the table.

	Size	Percent
3) Uncensored observations	2642	78.26%
Censored observations	734	21.74%

4) a/: Entered as log form.

5) b/: The omitted variable is fracture injuries.

Continued

Table IX-b: Parametric Hazard Regression Results

Variable	Exponential		Weibull	
	Estimates	Std Err	Estimates	Std Err
INTERCPT	-1.695 *	0.538	-2.287 *	0.423
<i>Income Variables</i>				
LN_RATIO	0.120 *	0.037	0.126 *	0.028
LN_WAGE	0.155 *	0.046	0.233 *	0.036
LN_REH	-0.418 *	0.092	-0.429 *	0.072
LN_OTHER	-0.152 *	0.007	-0.168 *	0.005
<i>Medical Variables a/</i>				
T_ACUTE	0.188 *	0.029	0.251 *	0.023
T_POST	-0.309 *	0.016	-0.389 *	0.012
<i>Measures of Severity</i>				
SURGERY	-0.157 *	0.066	-0.211 *	0.051
L_INDDAYS	-0.157 *	0.037	-0.193 *	0.029
<i>Types of Injury b/</i>				
BACK	-0.271 *	0.078	-0.356 *	0.061
BURN	-0.057	0.159	-0.044 ***	0.125
DISLOCAT	0.047	0.141	0.052 ***	0.110
JOINT	0.008	0.124	0.035 ***	0.097
NERVE	-0.342 *	0.124	-0.420 *	0.097
HERNIA	-0.263 *	0.118	-0.307 *	0.092
STRAIN	-0.073	0.054	-0.078 ***	0.042
LACERATN	0.058	0.083	0.023 ***	0.065
OTHER	0.016	0.075	0.021 ***	0.059
<i>Cost Containment Policy</i>				
FEE	0.538 *	0.128	0.722 *	0.102
HCR	-0.369 *	0.159	-0.512 *	0.126
LIPC	-0.277 *	0.067	-0.312 *	0.053
<i>Legal Variables</i>				
ATT	-0.182 *	0.071	-0.342 *	0.055
CON	-0.122	0.084	-0.141 **	0.066
<i>Demographic Variables</i>				
MARRIED	0.020	0.048	0.008 ***	0.037
MALE	-0.043	0.052	-0.074 ***	0.041
LN_AGE	-0.175 *	0.069	-0.247 *	0.054
<i>Distributional Parameters</i>				
SCALE	1.000		0.781 *	0.011
γ	1.000		1.282	
α	0.187		0.104	
Log Likelihood	-3937.91		-3803.94	

Notes:

1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%

2) Controlled industry types and provider types but not presented in the table.

	Size	Percent
3) Uncensored observations	2642	78.26%
Censored observations	734	21.74%

4) a/: Entered as log form.

5) b/: The omitted variable is fracture injuries.

Table IX-c: Test Statistics Under Alternative Model Specifications

Null	Alternative	Test Statistics	<i>p value</i>
<u>Model I</u>			
Exponential	Log-logistic	449.38	(p = 0.00)
Weibull	Log-logistic	339.48	(p = 0.00)
Log-normal	Log-logistic	13.78	(p = 0.01)
<u>Model II</u>			
Exponential	Log-logistic	738.34	(p = 0.00)
Weibull	Log-logistic	470.4	(p = 0.00)
Log-normal	Log-logistic	55.24	(p = 0.01)

Table X: Parametric Hazard Regression Results:
Heterogeneity with Weibull Distribution

Variable	Model I		Model II	
	Estimates	Std Err	Estimates	Std Err
INTERCPT	-0.409	0.504	-1.806 *	0.403
<i>Income Variables</i>				
LN_RATIO	0.168 *	0.032	0.170 *	0.027
LN_RWAG	0.095 *	0.041	0.136 *	0.035
LN_REH	-0.305 *	0.043	-0.325 *	0.038
LN_OTHER	-0.172 *	0.006	-0.164 *	0.005
<i>Medical Variables a/</i>				
P_ACUTE	0.005	0.028	N/A	N/A
P_POST	-0.232 *	0.026	N/A	N/A
T_ACUTE	N/A	N/A	0.173 *	0.022
T_POST	N/A	N/A	-0.342 *	0.012
<i>Measures of Severity</i>				
SURGERY	-0.136 *	0.058	-0.167 *	0.050
L_IN DAYS	-0.155 *	0.031	-0.176 *	0.026
<i>Types of Injury b/</i>				
BACK	-0.240 *	0.067	-0.234 *	0.058
BURN	-0.043	0.151	-0.069	0.127
DISLOCAT	-0.006	0.125	-0.019	0.109
JOINT	-0.157	0.106	-0.082	0.093
NERVE	-0.238 *	0.106	-0.346 *	0.091
HERNIA	-0.032	0.123	-0.383 *	0.095
STRAIN	-0.232 *	0.048	-0.084 **	0.041
LACERATN	0.243 *	0.079	0.172 *	0.065
OTHER	0.010	0.067	-0.007	0.058
<i>Cost Containment Policy</i>				
FEE	0.555 *	0.110	0.592 *	0.093
HCR	-0.378 *	0.139	-0.344 *	0.118
LIPC	-0.472 *	0.061	-0.423 *	0.052
<i>Legal Variables</i>				
ATT	-0.103	0.061	-0.045	0.055
CON	-0.155 *	0.075	-0.178 *	0.063
<i>Demographic Variables</i>				
MARRIED	0.025	0.043	0.074 **	0.036
MALE	0.036	0.046	-0.041	0.039
LN_AGE	-0.223 *	0.063	-0.148 *	0.053
<i>Distributional Parameters</i>				
SCALE	0.904 *	0.014	0.819 *	0.012
γ	1.106		1.221	
α	0.063		0.057 *	
Log-Likelihood	-3370.61		-3595.62	
Observations	2280		2642	
Uncensored	717		734	
Censored	1563		1908	

Notes:

- 1) * indicates p-value < 5% and ** indicates 5% < p-value < 10%
- 2) Controlled industry types and provider types but not presented in the table.
- 3) a/: Entered as log form.
- 4) b/: The omitted variable is fracture injuries.

Table XI: Summary of Expected Duration as Results of Different Distribution

Distributions	Model I (Medical price)		Model II (Medical treatments)	
	Expected Duration (weeks)	Std. Dev	Expected Duration (weeks)	Std. Dev
Weibull	9.28	14.31	8.67	14.26
Exponential	9.24	14.35	8.56	14.20
Log-logistic	8.74	13.46	8.10	13.36
Log-normal	8.66	13.16	8.02	13.04
Gamma	8.66	13.26	8.06	13.13

Notes: These results are calculated by the author, based on the survival probabilities for all observations as results from the regressions with different distributions.

FIGURE 1: EFFECT OF A CHANGE IN AN INDIVIDUAL'S WEEKLY PRE-INJURY WAGE RATE ON INCOME CONSTRAINT

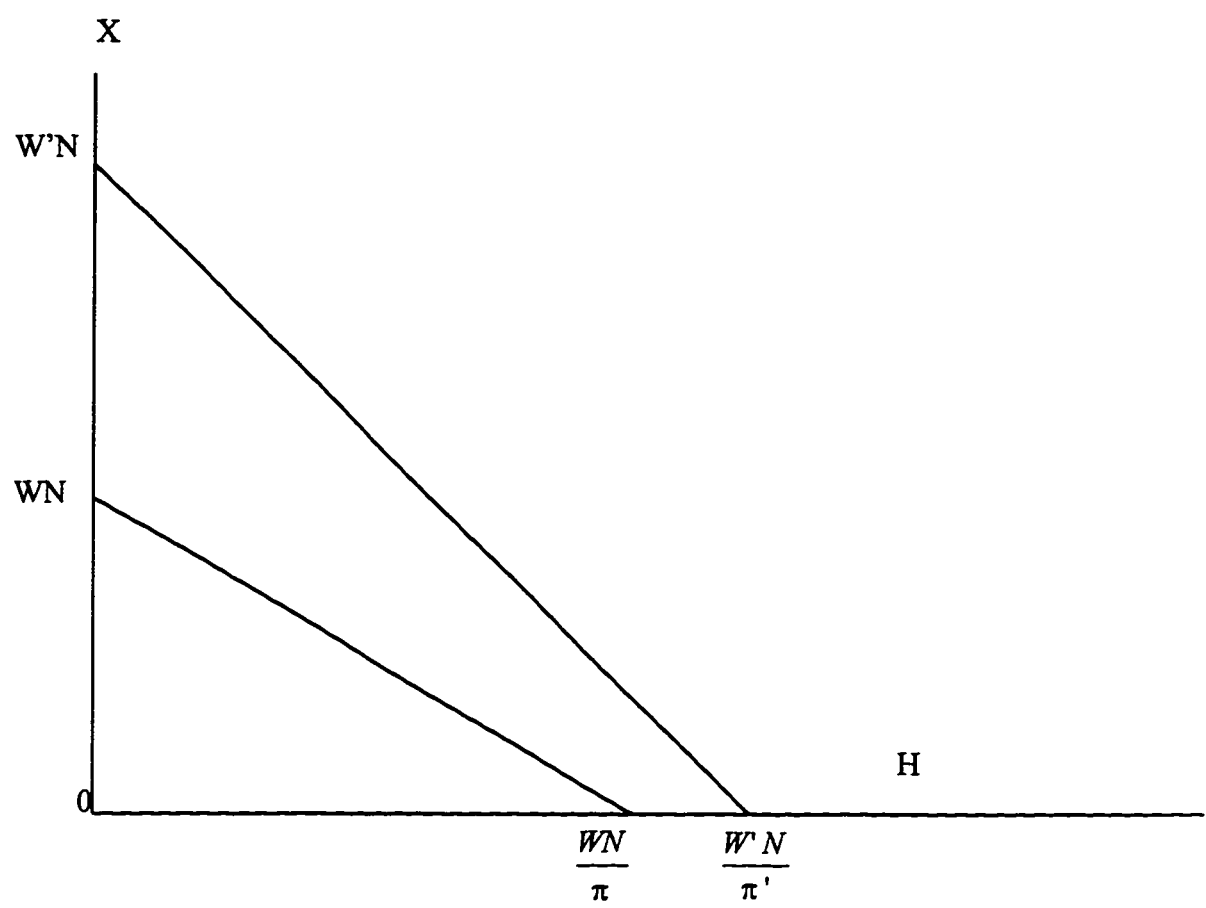
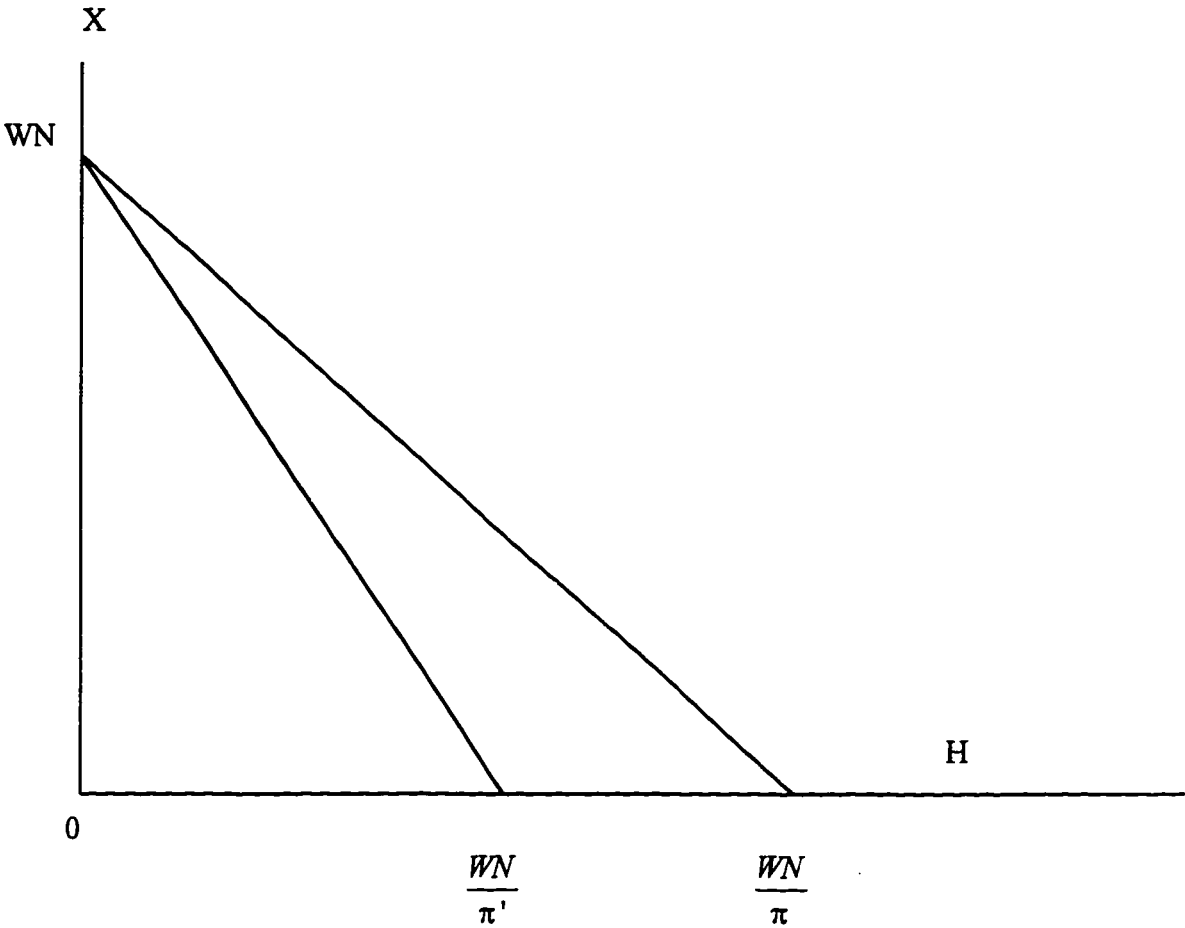


FIGURE 2: EFFECT OF A CHANGE IN AN INDIVIDUAL'S REAL BENEFITS RATE ON INCOME CONSTRAINT



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