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Permanent Partial Disability in Workers' Compensation: Probability and Costs

Terry Thomason

ABSTRACT

Two samples of administrative records from state workers' compensation programs are used to investigate factors explaining the probability of a permanent partial disability conditional on a compensation claim and the size of the award conditional on a permanent partial disability. The probability of a permanent disability is found to be positively related to the level of weekly permanent partial disability benefits as well as the potential duration of benefits. In addition, the process determining whether compensation claimants receive a permanent partial award is independent of and different from the process determining the size of the award.

Introduction

Workers' compensation costs, as a percentage of covered payroll, have more than doubled since 1960, rising from 0.93 percent in that year to 2.15 percent in 1988. These increased costs have been attributed to changes in workers' compensation programs following the 1972 report of the National Commission of State Workmen's Compensation Laws, which criticized program benefits as inadequate.[1] Among other things, states responded to this report by increasing indemnity benefits and reducing the waiting period prior to benefit eligibility. In addition to the direct effect of such changes, a number of studies have found that liberalization of benefits increased program utilization. Specifically, several studies have found that higher compensation benefits are associated with higher claims incidence and longer durations of temporary total disability—the period

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[1] Other factors that have contributed to the increase in the cost of workers' compensation benefits include coverage of occupational illness not previously covered by workers' compensation programs, including stress-related disease, an aging workforce, and inflation in medical care costs.

of disability occurring prior to the point of maximum medical improvement (see Krueger, 1990a, and Ehrenberg, 1988, for recent reviews of the literature).

A substantial portion of the increased cost of workers' compensation may be due to higher permanent partial disability costs. Permanent partial disability benefits represent approximately two-thirds of the total cost of workers' compensation benefits. In addition, while the incidence of permanent partial disability claims as a portion of total claims declined from a high of 26 percent in 1958 to 24 percent in 1982, the portion of total benefits attributable to permanent partial disability claims rose from 60 percent to 65 percent during that same period (Berkowitz and Burton, 1987). Krueger and Burton (1990) have shown that permanent partial disability benefits are an important determinant of overall program cost; that is, employer premiums are positively related to the proportion of total benefits accounted for by permanent partial compensation.

Policy-makers have become increasingly concerned with permanent partial disability as overall costs have risen. Berkowitz and Burton (1987) have argued that increasing costs since the National Commission report have triggered a "second wave" of reform, centering on the compensation of permanent partial disability.[2] A number of jurisdictions have reassessed or changed their criteria or procedures for permanent partial benefits, including Florida, which implemented fundamental reform in 1979.

Despite their importance as an element of compensation costs, there is little research examining the factors that influence the probability and costs of a permanent partial disability claim. This article explores three issues related to permanent partial disabilities. First, the process determining whether a claim becomes a permanent partial disability is modeled, as is the process determining the size of the permanent partial disability award. In particular, I estimate the extent to which each of these processes is affected by claimant moral hazard. Second, alternative empirical specifications of these processes are compared, one which assumes that the process determining the probability of permanent partial disability is identical to the process determining the size of the permanent partial disability award, and another which assumes that these two processes are different. (In this article, the probability of a permanent partial disability is estimated using a sample of injured workers rather than a sample of all workers. Therefore, the probabilities estimated in this study are not unconditional probabilities, but are conditional on a compensation claim having been initiated.) Finally, based on these results, estimates of the elasticities of permanent partial disability claims and costs with respect to changes in benefits are obtained.

The next section of this article describes relevant aspects of workers' compensation programs; it is followed by a discussion of the potential effect of claimant moral hazard on the probability and size of a permanent partial award and a review of the empirical literature. Then, two sections describe two

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[2] The "first wave" involved the liberalization of benefits.

data sets that are used to explore the factors that influence the probability and costs of a permanent partial disability claim as well as the methods used to analyze these data and the results of those analyses. The final section presents conclusions.

Characteristics of Workers' Compensation Programs

Workers' compensation programs provide cash benefits, medical care, and rehabilitative services to workers disabled by work-related injuries or diseases. A variety of cash benefits are paid, including survivor benefits, which are paid to immediate family members if the worker suffers a fatal injury, and indemnity benefits, which are paid to disabled workers. Indemnity or disability benefits may be categorized by permanency and degree of disability according to a four-fold classification scheme: temporary total, temporary partial, permanent total, and permanent partial.

Generally, any worker who becomes disabled as the result of an injury will receive temporary partial or total disability benefits. Partial benefits are paid to those claimants who retain some wage-earning capacity, while temporary total benefits are paid to workers who are completely disabled and unable to work. Temporary total benefits are a fraction of the claimant's pre-injury weekly wage (usually two-thirds), subject to minimum and maximum benefits. Once begun, temporary benefits are paid until the worker reaches the point of maximum medical improvement, or that point where further medical treatment is not expected to result in any substantial improvement in the claimant's physical condition. In most cases, the worker is no longer disabled once he or she reaches this point, and temporary disability benefits cease. If, however, the worker continues to suffer some permanent consequence as a result of the injury, he or she will be eligible for permanent disability benefits. These benefits may be total or partial, depending on the degree of disability.

In most jurisdictions, compensation for permanent partial disability depends upon whether the claim involves a "scheduled" or "nonscheduled" injury. Scheduled injuries are compensated according to body part injured and injury severity. For example, in New York, a worker who suffers a 50 percent loss of the arm is entitled to 50 percent x 312 = 156 weeks of permanent partial disability compensation.[3] Scheduled body parts are typically limited to the extremities, one eye, and the ears. Injuries to internal organs, the trunk, the neck, and head are nonscheduled injuries and are compensated by a variety of means.[4] Table 1 contains the schedules for the five states examined here as

[3] As with temporary total benefits, weekly permanent partial disability payments are typically two-thirds the claimant's pre-injury weekly wage, subject to minimums and maximums.

[4] For a more complete description of permanent partial disability compensation, see Berkowitz and Burton (1987).

Table 1
Maximum Scheduled Permanent Partial Disability Awards, Maximum and Minimum Weekly Benefit Payments, 1979

Variable	*Delaware*	*Montana*	New York		*North Carolina*	*Wisconsin*[a]
			Sched	*HP*		
Arm	250	280	312	32	240	500
Hand	220	200	244	32	200	400
Thumb	75	75	75	24	75	160
Index Finger	50	40	46	18	45	60
Middle Finger	40	37	30	12	40	45
Ring Finger	30	25	25	8	25	26
Little Finger	20	15	15	8	20	28
Leg	250	300	288	40	200	500/425[b]
Foot	160	180	205	32	144	250
Great Toe	40	37	38	12	35	83.33
Lesser Toe	15	16	16	8	10	25
Eye	200	165/140[c]	160	20	120	275/250[c]
One Ear	75	40	50	25	70	55
Two Ears	175	200	150	25	150	330
PPD Maximum	$154.35	$94	$105	--	$178	$65
PPD Minimum	$51.49[d]	No Minimum Benefit	20[d]	--	$20	$30
TTD Maximum	$154.35	$188	$215	--	$178	$218
TTD Minimum	$51.49[d]	No Minimum Benefit	30[d]	--	$20	$30

Source: U.S. Chamber of Commerce (1979).
Note: Duration data are in weeks. Sched = the maximum duration of permanent partial disability benefits, and HP = the scheduled healing period (see footnote 4). PPD = permanent partial disability benefits, and TTD = temporary total disability benefits.
[a] In addition to payments for temporary total disability. Periods during which payments are made for scheduled injuries are based upon an employee who is 52 years or less. Where the employee is over 52, the benefit period is reduced by 2½ percent for each year over 52.
[b] The first figure represents maximum duration for the loss of a leg where such loss precludes the use of an artificial limb.
[c] The first figure represents maximum duration where the loss of sight is by enucleation.
[d] Benefits are equal to wages if less than minimum.

well as minimum and maximum temporary total and permanent partial weekly benefits for the year 1979.[5]

Theoretical Considerations

Workers' compensation claims are affected by two types of moral hazard (Dionne and St-Michel, 1991). The first involves incentives that affect the worker's willingness to engage in activities that prevent accidents or to falsely

[5] Typically, permanent partial disability benefits are paid in addition to temporary benefits. However, in New York, temporary total benefits are subtracted from the scheduled award up to a maximum "scheduled healing period." The scheduled healing periods for New York are reported in Table 1. For example, if the claimant has suffered a 10 percent permanent disability of the arm and has received five weeks of temporary total disability benefits, the claimant would receive a permanent partial disability award equal to 10 percent x 312 weeks - 5 weeks = 26.2 weeks.

report accidents that either did not occur or occurred off the job. In this regard, a number of studies have shown that the probability of an occupational accident or compensation claim is positively related to compensation benefits; as benefits increase, the claimant is less likely to engage in accident prevention activities (Chelius, 1982; Butler and Worrall, 1983; Krueger, 1990a). The second type of moral hazard involves the worker's behavior following the accident. Since the worker has better information regarding his or her health than the insurer, the worker is able to influence benefits that are contingent on post-accident health. In particular, several studies have shown that the duration of temporary total disability is positively related to benefit levels (Butler and Worrall, 1985; Dionne and St-Michel, 1991; Krueger, 1990b). Similar reasoning suggests that this second moral hazard would affect losses resulting from the determination that the claimant has suffered a permanent partial disability.

The extent to which a compensation claimant is permanently disabled is ultimately determined by a neutral third party—the state workers' compensation agency or the courts. This determination is primarily based on the presence or absence of specific medical symptoms. However, for a subset of claims that are marginal with respect to objective medical evidence, the claimant may influence the agency's determination of the permanent partial award in two ways. First, claimants suffering a temporary total disability decide whether to apply for permanent partial disability benefits; obviously, claimants who do not pursue a permanent partial award will not receive a permanent partial award.[6] Second, claimants influence the permanent partial award by investing in resources designed to influence the compensation board's decision. Claimants may retain legal counsel or physicians to give expert medical testimony. More talented and better prepared (and more costly) legal counsel could affect the compensation agency's decision, as could additional or more credible medical evidence. Claimant incentives to pursue a permanent partial disability claim or to invest in medico-legal resources should increase with the level of permanent partial disability benefits.

Prior Research

Few empirical studies have examined the phenomenon of permanent partial disability. Worrall et al. (1993) used longitudinal, individual claim data from Massachusetts and Illinois to estimate the probability that a claimant would migrate from temporary to permanent partial disability status. Their sample was drawn from the National Council of Compensation Insurers Detailed Claim Call, a series of private insurance carrier reports on a sample of unresolved compensation claims. Information is collected at intervals of 6, 18, 30, 42, and 54 months after the claim is made as long as the claim remains open. Worrall et al. estimated logit regressions predicting the probability that a claim would

[6] For example, in New York the claimant or his or her representative must attend at least one hearing in order to obtain permanent partial benefits.

be closed as a permanent partial disability by the fifth report. Although their results indicated that the claimant's pre-injury wage was negatively and compensation benefits were positively related to the transition from temporary disability, these results, with one exception, were not statistically significant. The lack of significance may be attributed to collinearity between wages and benefits.

Using a sample of New York compensation claims resulting from injuries that occurred during the period 1972 through 1977, Thomason (1993) found evidence that the probability of a permanent partial disability claim was positively related to permanent partial disability benefits. However, this relationship was significant only for nonscheduled claims, which are primarily back injuries and are compensated on a wage-loss basis in New York.[7] Once again, the lack of a robust relationship could be due to a low degree of independent variation in the wage and benefit variables.

Statistical Methodology

As indicated, the size of the award for a scheduled permanent partial disability is determined at a single point in time (the date of maximum medical improvement). The distribution of permanent partial disability awards is censored at zero—claimants cannot receive negative awards. As such, the process determining the permanent partial disability award may be modeled as follows:

$$\begin{aligned} A_i^* &= \beta' X_i + u_i \\ A_i &= 0 \qquad \text{if } A_i < 0 \\ A_i &= A_i^* \qquad \text{if } A_i > 0 \end{aligned} \tag{1}$$

where $u_i \sim N[0,\sigma^2]$,

A_i = size of the permanent partial disability award,

β = vector of model parameters, and

X_i = vector of variables influencing award size.

This model may be estimated as a tobit or censored regression model.

Alternatively, as Lin and Schmidt (1987) indicate, the tobit is a special case of a more general model proposed by Cragg (1971). Cragg's model allows the parameters determining the probability of a nonlimit observation (a nonzero permanent partial disability award) to differ from the parameters that determine the value of the nonlimit observation (the size of the award). In contrast, these parameters are constrained to be identical in the tobit. The probability that the claimant does not receive a permanent partial award in Cragg's model is given

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[7] In New York, weekly compensation benefits for nonscheduled work injuries is equal to two-thirds of the difference between the claimant's pre- and post-injury weekly wage rate, if the claimant is earning wages. If the claimant is unemployed, benefits are equal to two-thirds of the claimant's pre-injury wage and the claimant's post-injury earning capacity as determined by the New York Workers' Compensation Board. Unlike scheduled injuries, the duration of benefits is unlimited.

by a probit with parameter vector β_1 or $\text{Prob}(A_i = 0) = \Phi(-\beta_1' X_i)$. The density of permanent partial disability awards, conditional on the claimant receiving an award, is given by

$$f(A_i|A_i>0) = \frac{1}{\phi(\beta_2' X_i/\sigma)} \frac{1}{\sqrt{2\pi\sigma}} \exp\left\{\frac{-1}{2\sigma^2}(A_i - \beta_2' X_i)^2\right\}, \quad (2)$$

where Φ = cumulative standard normal probability function, and
σ^2 = error variance.

Cragg's model may be estimated by maximizing the following log-likelihood function:

$$\ln L = \sum_{t=1}^{T} \left\{(1-I_i)\ln\Phi(-\beta_1' X_i) + I_i\left[\ln\Phi(\beta_1' X_i) - \ln\Phi(\beta_2' X_i/\sigma) - \tfrac{1}{2}\ln(2\pi\sigma^2) - \frac{1}{2\sigma^2}(A_i - \beta_2' X_i)^2\right]\right\} \quad (3)$$

where I_i = an indicator function, such that $I_i = 0$ where $A_i = 0$, and $I_i = 1$ where $A_i > 0$.

As indicated, if $\beta_1 = \beta_2/\sigma$, this model reduces to the tobit, so that if we substitute β_2/σ for β_1 in equation (3), the log-likelihood function for the tobit is obtained.

Cragg's model can be estimated in two parts; the β_1 vector may be estimated using a probit, and the β_2 vector can be estimated using truncated regression. Unlike the tobit, truncated estimation does not utilize limit observations (details on truncated regression estimation may be found in Greene, 1990, chap. 21, or Madalla, 1983, chap. 6). Furthermore, Greene (1990) has developed a simple likelihood ratio test of the tobit restriction (i.e., the hypothesis that $\beta_1 = \beta_2/\sigma$):

$$\Lambda = -2[\ln L_T - (\ln L_P + \ln L_{TR})], \quad (4)$$

where $\ln L_T$ = the log-likelihood from estimating the tobit model,
$\ln L_P$ = the log-likelihood from estimating the β_1 vector with a probit, and
$\ln L_{TR}$ = the log-likelihood from estimating the β_2 vector with a truncated regression.

In this study, both Cragg's model and the tobit model are estimated, as is a probit equation for the probability of a permanent partial disability. All models are estimated using maximum likelihood. The X vector includes variables measuring compensation benefits; claimant wages; claimant age, occupation, and sex; and the nature of injury and body part injured.

The SDS Sample

Data and Model Specification

Two data sources were used in this study. The first was the Supplementary Data System Microdata Files for the years 1979 to 1981. These data were collected by the U.S. Bureau of Labor Statistics from records of state workers'

compensation agencies. Data vary widely from state to state with respect to variables and claims included.[8] Because the analysis required data on the claimant's wage and extent of disability, the sample was limited to claims from Delaware, Montana, New York, North Carolina, and Wisconsin.

Three data sets were constructed from the SDS files. In each case, the universe was limited to claims that: (1) involved injury to the arm, ear, hand, finger, thumb, foot, leg, or eye; (2) resulted from an accident occurring in 1979; and (3) resulted in a temporary total or permanent partial disability. Three random samples were drawn from this universe. The first sample includes all injuries, regardless of their nature, the second is restricted to sprains and strains, and the third is limited to fractures. Since the data were limited to claims closed between 1979 and 1981, the sample is truncated; that is, claims that did not close within three years of the date of injury were not included in the sample. This could result in sample selection bias. However, an analysis of the SDS data indicates that over 93 percent of all claims closed in the sample states between 1979 and 1981 were closed within the first three years following the injury. While regression estimates using these data may be biased, it is unlikely that this bias substantially alters the results.

The dependent variable of interest was the probability that the claim was classified as a permanent partial disability. A probit equation was estimated using a dummy variable (PPD) that assumed the value 1 if the claim was classified as a permanent partial disability and 0 if it was not. Regressors included the claimant's age (AGE), sex (FEMALE), pre-injury weekly wage (WAGE), the weekly permanent partial (PERMBEN) and temporary total (TEMPBEN) benefit payment, and the maximum duration of permanent partial benefits (MAXWEEKS) given the nature of the claimant's injury.[9] The two benefit variables were constructed according to the state's benefit formula using the claimant's weekly wage.[10] Analyses also included dummy variables for the claimant's pre-injury occupation, the nature of injury, the body part injured,

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[8] For example, certain states include claims where only medical care was provided, while others limit claims to those paying indemnity benefits.

[9] Recall that the duration of permanent partial benefits depends on the body part injured. Table 1 contains a list of maximum durations for scheduled injuries for states included in the SDS sample. Values for MAXWEEKS were assigned by identifying body part injured for each claim and assigning the corresponding value from Table 1. Because the SDS data did not distinguish between injuries to the thumb and injuries to other fingers, all finger injuries were assigned the maximum benefit duration for thumbs. For similar reasons, all toe injuries were assigned the duration for a great toe, and ear injuries assumed the duration for one ear.

[10] Weekly permanent partial and temporary total disability benefit payments in all five states are equal to two-thirds of the claimant's weekly wage subject to minimums and maximums, which are reported in Table 1. The simple correlation between temporary total and permanent partial weekly benefit payments is 0.315, the correlation between weekly temporary total benefits and the maximum duration of permanent partial benefits is -0.085, and the correlation between the weekly permanent partial payment and the maximum permanent partial duration is -0.259. Observations with missing wage data were eliminated from the sample. Comparatively, for the New York Closed Case Data (see below) the simple correlation between temporary total and permanent partial benefits is 0.806.

Table 2
Sample Means and Standard Deviations

	SDS Sample			All Claims			Permanent Disability Claims		
Variable	*All Injuries*	*Fractures*	*Sprains*	*All Injuries*	*Fractures*	*Sprains*	*All Injuries*	*Fractures*	*Sprains*
WAGE	227.1	230.7	237.4	209.7	217.5	219.6	223.4	225.7	235.2
	(98.3)	(102.7)	(98.9)	(99.7)	(102.9)	(98.3)	(102.2)	(103.7)	(100.2)
AGE	34.9	37.4	35.1	36.4	38.5	36.5	38.4	39.8	39.4
	(13.8)	(14.2)	(13.1)	(14.5)	(14.8)	(13.9)	(14.4)	(14.6)	(13.7)
PERMBEN	93.0	97.4	92.2	94.3	95.5	96.3	96.6	96.8	98.7
	(27.9)	(27.8)	(27.2)	(19.4)	(18.7)	(17.5)	(17.5)	(17.5)	(15.1)
TEMPBEN	143.3	144.2	149.1	117.8	120.1	121.5	122.6	123.0	126.7
	(50.6)	(50.7)	(49.9)	(39.6)	(39.0)	(38.0)	(38.3)	(38.2)	(36.1)
MAXWEEKS	195.6	158.1	265.4	---	---	---	---	---	---
	(135.8)	(117.2)	(117.5)						
POTDUR	---	---	---	172.6	147.5	229.5	151.7	143.9	224.6
				(105.7)	(106.3)	(68.2)	(109.5)	(107.5)	(79.6)
FEMALE	---	---	---	0.244	0.231	0.297	0.236	0.237	0.294
				(0.429)	(0.422)	(0.457)	(0.424)	(0.425)	(0.455)
WKSLOST	---	---	---	4.987	6.475	5.239	6.048	6.592	6.962
				(7.981)	(9.437)	(8.198)	(9.559)	(9.964)	(10.910)
STATE	---	---	---	0.266	0.269	0.255	0.269	0.268	0.268
				(0.442)	(0.444)	(0.436)	(0.444)	(0.443)	(0.443)
PUBSELF	---	---	---	0.059	0.059	0.083	0.060	0.061	0.097
				(0.236)	(0.236)	(0.276)	(0.237)	(0.240)	(0.296)
PRSELF	---	---	---	0.113	0.108	0.124	0.117	0.113	0.125
				(0.317)	(0.310)	(0.329)	(0.321)	(0.317)	(0.331)
PPD	0.362	0.565	0.249	0.528	0.768	0.406	---	---	---
	(0.481)	(0.496)	(0.432)	(0.499)	(0.422)	(0.491)	---	---	---
AWDWKS	---	---	---	11.303	16.831	10.675	20.670	21.484	20.364
				(20.53)	(24.64)	(19.81)	(24.12)	(26.06)	(23.58)
Sample N	16,524	20,672	17,473	15,350	12,444	9,593	8,105	9,524	3,894

Note: Standard deviations are in parentheses. WAGE = pre-injury weekly wage, AGE = claimant's age, PERMBEN = weekly permanent partial benefit payment, TEMPBEN = temporary total benefit payment, MAXWEEKS = maximum duration of permanent partial benefits given the nature of the claimant's injury, POTDUR = potential duration of permanent partial benefits, FEMALE = claimant's sex, WKSLOST = number of weeks the claimant was temporarily and totally disabled, STATE = State Insurance Fund is liable for the claim, PUBSELF = public-sector, self-insured employer is liable for the claim, PRSELF = private-sector, self-insured employer is liable for the claim, PPD = permanent partial disability, and AWDWKS = size of the permanent partial award in weeks.

and the jurisdiction in which the claim was initiated.[11] Means and standard deviations of variables used in the analyses are presented in Table 2. Observations with missing data were eliminated from the sample.

Because similar injuries have more serious consequences for older workers, claimant age should be positively related to the probability of permanent partial disability. Prior results suggest that weekly permanent disability benefit payments are positively related to permanent partial disability status, indicating that claimants respond to increased benefits by exerting a greater effort to be classified as permanently disabled. For similar reasons, the potential duration of permanent partial disability benefits (MAXWEEKS) should be positively related to the probability of permanent partial disability. If post-injury wages are a function of pre-injury wages, claimants who receive high wages will be less likely to become permanently disabled since they incur higher opportunity costs in pursuit of their claims. Therefore, claimant pre-injury wages should be negatively related to the likelihood of permanent partial disability.

Dionne and St-Michel (1991) demonstrate 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 expected that both the weekly permanent disability benefit payment and the potential duration of permanent partial benefits will have greater coefficients for the sample of sprains than for the sample of fractures.

Results

Table 3 presents results for the SDS analyses. The first column contains coefficients from a model estimated with the all-injury sample, and the second and third columns contain coefficients from models estimated with samples of sprains and fractures, respectively. These results generally support the model described above. In particular, both the potential duration of permanent partial disability benefits and the weekly permanent partial benefit payment are positively related to the probability of permanent partial disability, indicating that claimant behavior is influenced by the size of the permanent partial award and that the claimant is, in turn, able to affect the disposition of his or her claim. Additionally, claimant age is positively related to the likelihood of a permanent partial disability, as would be expected if the consequences of injury are more severe for older workers. On the other hand, the pre-injury wage exhibits a positive relationship to permanent partial disability probability, contrary to expectations.

A comparison of the coefficients in columns 2 and 3 indicates differences between the processes by which fractures and sprains become permanent disabilities. The most significant difference is for weekly temporary total

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[11] Occupation dummy variables included professional and managerial employees, sales and clerical workers, craftsmen, operatives except transport, transport equipment operatives, laborers, and service workers. The injury nature variable included amputations, contusions, cuts, dislocations, inflammations, scratches, sprains, multiple injuries, miscellaneous injuries, and fractures. Body parts were arm, hand, finger, leg, foot, toe, ear, and eye.

Table 3
Probability of Permanent Partial Disability, SDS Data

Variable	All Injuries	Sprains	Fractures
WAGE	0.00470	0.02483*	0.00953
	(0.426)	(3.205)	(0.967)
AGE	0.44942*	0.34301*	0.61555*
	(14.388)	(13.784)	(52.14)
TEMPBEN	0.01420	-0.04276**	0.00462
	(0.611)	(2.550)	(0.215)
PERMBEN	0.14214*	0.09455*	0.18332*
	(5.534)	(4.281)	(7.664)
FEMALE	0.09191	-2.3888*	1.4621
	(0.082)	(2.822)	(1.309)
MAXWEEKS	0.07136*	0.08655*	0.09078*
	(6.043)	(8.491)	(6.916)
Log-Likelihood Ratio	-7,740.1	-10,278.9	-8,276.7
Sample N	16,524	17,541	20,650

Note: Absolute t-ratios are in parentheses. WAGE = pre-injury weekly wage, AGE = claimant's age, TEMPBEN = temporary total benefit payment, PERMBEN = weekly permanent partial benefit payment, FEMALE = claimant's sex, and MAXWEEKS = maximum duration of permanent partial benefits given the nature of the claimant's injury.
* $p < 0.01$ ** $p < 0.05$

benefit payments, which are negatively related to permanent partial disability for sprains but positively related for fractures, although the latter relationship is not statistically significant. One possible explanation is that higher temporary benefits increase the pool of workers' compensation claims by inducing workers with marginal injuries to initiate claims. If claims that pay high temporary total benefits include a greater proportion of marginal injuries than low temporary benefit claims, it is less likely that any one of these high benefit claims will become classified as a permanent partial disability. Since sprains are more likely than fractures to be marginal claims, they are more susceptible to this effect. Similar reasoning could explain the results for the pre-injury wage. High-wage workers may be less likely to initiate compensation claims than low-wage workers. If marginal claims from high-wage workers are selected out, high-wage claimants will be more severely injured than low-wage claimants, *ceteris paribus*. Once again, this effect should be more evident for sprains than for fractures.

If higher temporary disability benefits and lower wages induce the initiation of claims for marginal injuries such as sprains, the proportion of these marginal claims should increase as the level of temporary total benefits increases and as the pre-injury wage decreases. Therefore, the probability of a marginal claim, conditional on a sample of compensation claims, should be positively related to temporary total disability benefits and negatively related to the pre-injury wage. To test these hypotheses, a data set that combined the fracture and sprain samples was created, and the probability of a sprain was regressed on temporary total benefits, pre-injury wages, and a variety of control variables,

including claimant age and sex, body part injured, jurisdiction, and occupational dummies. Regression results showed that temporary total disability benefits were positively related to the probability of a sprain and that this relationship was significant at the 0.01 level (t = 6.965). However, the relationship between pre-injury wages and the conditional probability of a sprain, while negative, was not statistically significant (t = -0.259). When control variables were eliminated, the relationships between sprain probability and both temporary benefits (t = 8.651) and the pre-injury wage (t = -5.179) were statistically significant and in the expected direction. These results provide partial evidence that the negative relationship for temporary total disability benefits and the positive relationship for pre-injury wages reported in Table 3 are due to differences in claim mix, owing to an increased proportion of marginal claims.

New York Closed Case Data

The multijurisdictional character of the SDS data allows independent variation between wage and benefit measures, on one hand, and between potential duration and body part, on the other. However, the SDS data are problematic for two reasons. First, there is no independent measure of injury severity, and, second, the data include only those injuries that had been closed within two to three years of the date of injury. It does not include claims with "long tails," that is, claims where the worker has experienced a long period of temporary disability or claims where a dispute has delayed closing. In addition, most states in the SDS sample do not include data on the size of the permanent partial award.

Data and Model Specification

For these reasons, a sample of New York compensation claims resulting from 1978 injuries was constructed. The data source was the New York Workers' Compensation Board's Closed Case Tapes. These tapes are created each year by the New York Workers' Compensation Board and are the source of the New York SDS data. Originally organized by year of closing, these data were re-sorted by year of injury and contain all compensation claims resulting from injuries occurring in 1978 and closed before 1984.[12]

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[12] An analysis of 1964 injury claims from New York reveals that 98.6 percent of temporary disability claims and 99.6 percent of the scheduled permanent partial disability claims were closed by the end of 1969. Of course, the distribution of durations between injury and closing may have changed between 1964 and 1978. However, since the data only include claims that closed before 1984, information on 1978 injuries is limited to developments that occurred within six years of the injury. To compare the 1964 and 1978 claim distributions, 1964 injuries that closed after 1969 were eliminated. A frequency distribution for both injury-years by year of closing was then constructed. While only 0.76 percent of these 1964 claims (i.e., claims resulting from injuries that occurred in 1964 and that closed before 1970) were open five years following the injury, 1.16 percent of the 1978 claims were still open five years after the injury. Similarly, only 2.03 percent of 1964 claims were open after four years compared to 3.59 percent for 1978. These data indicate that, while the duration distribution has increased during this period, it has done so only slightly.

The primary dependent variable of interest in the New York data is the size of the permanent partial award, which is measured in weeks (AWDWKS). If the claimant is classified as temporarily disabled, then he or she receives no permanent partial award. As indicated above, this variable was estimated in two ways, as a tobit or in two stages—as a probit and a truncated regression. The tobit and truncated regression specifications were estimated as two-limit models, with zero as the lower limit and the maximum duration of permanent partial benefits (MAXWEEKS) as the upper limit. The regressions include many of the same variables described above. However, POTDUR, the potential duration of permanent partial benefits, is constructed differently than MAXWEEKS.[13] In addition, the New York data include a measure of injury severity—WKSLOST, the number of weeks the claimant was temporarily and totally disabled—as well as dummy variables for the party liable for the claim, including STATE, PUBSELF, and PRSELF, which indicate that the State Insurance Fund; a public-sector, self-insured employer; or a private-sector, self-insured employer was liable for the claim, respectively. The omitted category includes claims where a private insurance carrier was liable. Finally, dummy variables indicating the nature of injury, the district office of the New York Workers' Compensation Board in which the claim was initiated, and the claimant's pre-injury occupation were included as well.[14] Sample means and standard deviations of variables used in the analyses are found in Table 2. Observations with missing data were excluded.

Because the State Insurance Fund and public-sector self-insurers are insulated from market forces, both should be less aggressive in their claims adjustment activity. On the other hand, the costs of monitoring claimant disability should be lower for self-insured employers than for third-party carriers; self-insured employers are better equipped to gain information concerning the state of the claimant's health. Together, these two considerations suggest that the probability of permanent partial disability will be higher for state fund claims and lower for private-sector, self-insured claims than for private carrier claims. Similarly, award size should be higher for the state fund and higher for private-sector, self-insured employers than for private insurers. No prediction is made for public-sector self-insureds.

Effectively, then, this sample is representative of the universe of 1978 injuries resulting in temporary total or scheduled permanent partial disability.

[13] Recall that in New York, the permanent partial award is also a function of the number of weeks the claimant received temporary total benefits or the scheduled healing period, whichever is shorter (see footnote 5). POTDUR, the potential duration of permanent partial benefits, is the scheduled maximum minus the maximand of the scheduled healing period and the number of weeks the claimant was temporarily and totally disabled (WKSLOST).

[14] Dummy variables for the nature of the injury included contusions, burns, cuts and scratches, dislocations, fractures, sprains and strains, and miscellaneous injuries. Occupation variables included professional and managerial employees, sales and clerical workers, craftsmen, operatives except transport, transport equipment operatives, laborers, service workers, and protective services workers.

Results

Table 4 contains the results of analyses conducted with the New York Closed Case data. The first two columns contain tobit regressions estimating the number of weeks of permanent partial benefits received by the claimant (AWDWKS) using both limit and nonlimit observations. The third and fourth columns contain the results of probit regressions estimating the likelihood that the claim is classified as a permanent partial disability, while the two right-hand columns contain coefficient estimates from truncated regressions predicting the number of weeks the claimant collected permanent partial disability benefits using nonlimit observations only. In each case, two specifications were estimated, one that included the potential duration of permanent partial benefits (POTDUR) and one that did not.

Log-likelihood ratio tests (see equation [4]), comparing the tobit with the combined probit and truncated regression models, rejected the null hypothesis, indicating that the process determining permanent partial disability status differs from the process determining the size of the permanent partial award. A comparison of coefficients reveals the major differences. The weekly permanent partial benefit payment is positively related to the probability of a permanent partial disability, but negatively related to award size. Tests of the restriction that the coefficient for weekly permanent partial benefits (PERMBEN) from the probit regression is equal to its counterpart from the truncated regression reject the null hypothesis at the 0.01 level of significance ($t = 2.90$ from the specification that includes POTDUR and $t = 2.75$ from the specification that does not include POTDUR). These results indicate that, although the claimant is able to influence the probability of receiving permanent partial disability compensation, he or she is unable to affect the size of the award.

Unlike the results for the SDS sample, the potential duration of permanent partial disability benefits is negatively related to the probability of permanent partial disability in the New York Closed Case sample. These contradictory results are probably due to the confounding of body part and benefit duration in the New York sample. Because the SDS sample contained data from several states, variation in the maximum duration of benefits in that sample was independent of body part, as long as the regressions controlled for state or body part. When regressions using SDS data did not control for these variables, similar results were obtained; maximum permanent partial disability benefit duration was negatively associated with the probability of permanent partial disability.[15] These results suggest that injury to body parts with long maximum durations—such as arms, legs, hands, feet, and eyes—is less likely to result in permanent partial disability than injury to body parts with relatively short durations, such as fingers or toes. The reasons for this are not entirely clear. However, these results support the long-held conventional wisdom that

[15] These regression results are available from the author upon request.

Table 4
Tobit, Probit, and Truncated Regression Results, New York Closed Case Data

Variable	*Tobit*		*Probit*		*Truncated Regression*	
WAGE	0.25942E-1*	0.25751E-1*	0.04353*	0.048371*	0.41784E-1*	0.23794E-1*
	(6.476)	(6.438)	(5.381)	(5.916)	(3.329)	(2.835)
AGE	0.30295*	0.30093*	0.45306*	0.50945*	0.71866*	0.39433*
	(17.848)	(17.726)	(14.105)	(15.604)	(10.996)	(9.509)
PERMBEN	0.30921E-1	0.31269E-1	0.10847*	0.10568**	-0.17728**	-0.12260**
	(1.487)	(1.507)	(2.792)	(2.683)	(2.297)	(2.394)
TEMPBEN	-0.85200E-2	-0.85158E-2	0.01309	0.01335	-0.43574E-1	-0.41257E-1
	(0.709)	(1.315)	(0.555)	(0.559)	(1.072)	(1.527)
POTDUR	---	-0.43107E-2***	---	-0.11760*	---	0.30429*
		(1.730)		(24.392)		(27.364)
FEMALE	-0.56931	-0.56050	0.35629	-0.00849	-2.0984	-0.58705
	(0.915)	(0.903)	(0.307)	(0.007)	(0.908)	(0.381)
WKSLOST	1.5786*	1.5690*	0.69484*	0.94700*	2.8813*	2.1956*
	(56.836)	(55.514)	(10.933)	(14.399)	(33.519)	(43.025)
STATE	0.96665***	0.95766***	1.9086***	0.21883**	2.6150	1.3047
	(1.771)	(1.759)	(1.855)	(2.097)	(1.337)	(1.004)
PUBSELF	-1.9915***	-2.0137**	-0.50659	0.17259	-13.472*	-8.5244*
	(1.941)	(1.967)	(0.263)	(0.088)	(3.596)	(3.452)
PRSELF	-0.79402	-0.76564	0.25731	-0.31224	-5.2034***	-2.8504
	(1.028)	(0.993)	(0.176)	(0.210)	(1.728)	(1.442)
SIGMA	25.208*	25.162*	---	---	35.115*	27.667*
	(118.172)	(117.386)			(39.507)	(52.203)
Log-Likelihood Ratio	-41,951.6	-41,950.7	-9,042.7	-8,737.8	-30,808.6	-30,088.7

Note: Absolute t-ratios are in parentheses. WAGE = pre-injury weekly wage, AGE = claimant's age, PERMBEN = weekly permanent partial benefit payment, TEMPBEN = temporary total benefit payment, POTDUR = potential duration of permanent partial benefits, FEMALE = claimant's sex, WKSLOST = number of weeks the claimant was temporarily and totally disabled, STATE = State Insurance Fund is liable for the claim, PUBSELF = public-sector, self-insured employer is liable for the claim, PRSELF = private-sector, self-insured employer is liable for the claim, SIGMA = an estimate of σ.
* $p < 0.01$ ** $p < 0.05$ *** $p < 0.10$

workers' compensation programs overcompensate minor injuries and undercompensate major injuries.

Otherwise, the New York results support the model advanced above. Claimant age and the number of weeks the claimant received temporary total benefits are both positively related to the probability of permanent partial disability and the size of the award. Consistent with the results reported above, the pre-injury wage is positively related to the size and probability of a permanent partial disability award. Weekly temporary total benefit payments are positively related to permanent partial disability probability and negatively related to award size. As expected, State Insurance Fund claims were more likely to become permanent disabilities and receive greater awards than claims covered by private insurers, consistent with the notion that the State Fund is insulated from market forces. While the probit coefficients for the self-insured employer dummy variables were not statistically different from zero, coefficients from the truncated regressions were significant and negative. These results suggest that self-insured employers monitor claimants more effectively than private carriers. Finally, SIGMA, an estimate of σ—the standard deviation of the error—was positive, as expected.

Table 5 presents the results of the combined probit-truncated regression model described above and estimated with the fracture and sprain samples. Probit regression coefficients are contained in the two left-hand columns of that table, while coefficients from the truncated regression estimating award size are in the right-hand columns. Similar to the results from the all-injury sample, log-likelihood ratio tests for the sprain and fracture samples rejected the tobit specification in favor of the combined probit and truncated regression model presented in Table 5.

The SDS probit regression results reported above suggest that the sample of sprains includes a greater proportion of marginal injuries than the fracture sample. Results from the New York probits do not support this; coefficients for the pre-injury wage are approximately equal. Although the result is not statistically significant, the level of temporary disability benefit payments bears a positive relationship to the probability of permanent partial disability. Differences may be due to a number of factors, including collinearity between wage and benefit measures in the New York sample, institutional differences among programs in the SDS sample, or differences between the samples with respect to claims included, namely the inclusion or exclusion of "long-tail" claims.

Once again, to test the hypothesis that temporary total disability benefits and the pre-injury wage affect the proportion of marginal claims in the sample, the fracture and sprain samples were combined into a single data set. Sprain probability was regressed on the pre-injury wage, temporary total benefits, and a variety of controls (claimant age, sex, and occupation; regional office; and insurance dummies). Once again, temporary disability benefits were negatively related to sprain probability ($t = 3.361$). However, unlike the results for the SDS data, pre-injury wages were positively and significantly related to sprain probability ($t = 3.936$). A regression that eliminated control variables found that

Table 5
Probit and Truncated Regression Results, New York Closed Case Data, Fracture and Sprain Samples

	Probit		Truncated Regression	
Variable	*Fractures*	*Sprains*	*Fractures*	*Sprains*
WAGE	0.04047*	0.03498*	0.3293*	0.00153
	(5.888)	(3.802)	(4.004)	(0.173)
AGE	0.38211*	0.54808*	0.46710*	0.21300*
	(13.889)	(13.640)	(11.582)	(5.025)
PERMBEN	0.07403**	0.09466***	-0.15709*	0.03036
	(2.246)	(1.859)	(3.328)	(0.540)
TEMPBEN	0.02234	0.00293	-0.04006	-0.02447
	(1.081)	(0.108)	(1.459)	(0.915)
POTDUR	-0.03905*	-0.07131*	0.36092*	0.19078*
	(10.110)	(9.293)	(24.392)	(45.746)
FEMALE	-2.7937*	-0.47225	-0.96772	2.6364***
	(2.661)	(0.344)	(0.659)	(1.769)
WSKLOST	0.21305*	1.3543*	2.3168*	1.7987*
	(4.664)	(17.533)	(47.260)	(39.748)
STATE	1.4851***	3.9810*	4.5963*	-2.2417***
	(1.668)	(3.043)	(3.685)	(1.660)
PUBSELF	1.2013	5.7332*	-6.6758*	-8.7699*
	(0.699)	(2.799)	(2.790)	(4.058)
PRSELF	0.14429	3.0981***	-4.8022**	-3.7703***
	(1.075)	(1.780)	(2.259)	(1.872)
SIGMA	—	—	28.989*	23.807*
			(57.864)	(45.746)
Log-Likelihood Ratio	-6,296.9	-5,566.1	-35,047.6	-15,601.4

Note: Absolute t-ratios are in parentheses. WAGE = pre-injury weekly wage, AGE = claimant's age, PERMBEN = weekly permanent partial benefit payment, TEMPBEN = temporary total benefit payment, POTDUR = potential duration of permanent partial benefits, FEMALE = claimant's sex, WKSLOST = number of weeks the claimant was temporarily and totally disabled, STATE = State Insurance Fund is liable for the claim, PUBSELF = public-sector, self-insured employer is liable for the claim, PRSELF = private-sector, self-insured employer is liable for the claim, and SIGMA = an estimate of σ.
* $p < 0.01$ ** $p < 0.05$ *** $p < 0.10$

temporary benefits were positively related (t = 2.449) and pre-injury wages were negatively related (t = -0.963) to sprain probability, although the coefficient for pre-injury wages was not significantly different from zero. These results suggest that, while higher temporary total disability benefits may induce injured workers to initiate marginal claims, lower wages do not result in a greater proportion of marginal claims, as they did in the SDS sample.

The results from regressions estimating the size of the permanent partial disability award suggest that economic incentives have a smaller impact on award size for sprain and strain claims than for fractures: the coefficients of the weekly permanent partial disability payment, the level of temporary total disability benefits, and pre-injury wages are all insignificant. Claimants suffering from sprains are able to influence the probability of being classified

as permanently disabled. However, they are unable to influence the size of the permanent partial disability award.

Elasticity Estimates

Panels A, B, and C of Table 6 present elasticity estimates for the probability of permanent partial disability and award size based on the results of regressions from the SDS and New York samples. Elasticity estimates using the New York data were based on specifications that included the potential duration of permanent partial benefits. Panel D of Table 6 reports elasticity estimates for the expected value of the permanent partial disability award. The expected value of this award is equal to

$$E[A] = p_i A_i, \tag{5}$$

where p_i = the probability of permanent partial disability, and
A_i = the size of the award for the ith individual in the sample.
Totally differentiating equation (3) with respect to benefits,

$$\frac{\partial E[A]}{\partial B} = \frac{\partial p_i}{\partial B} A_i + \frac{\partial A_i}{\partial B} p_i. \tag{6}$$

The first term on the right-hand side of equation (6) is the change in award probability weighted by the size of the award, and the second is the change in award size, conditional upon receiving an award, weighted by award probability. Expected value elasticities are equal to

$$\eta = \frac{\partial E[A]}{\partial B} \cdot \frac{B}{E[A]}. \tag{7}$$

Sample means for award size, probability, and benefits were used for the values of A_i, p, and B. The probit coefficients reported in Tables 4 and 5 were used for estimates of $\partial p_i/\partial B$, and coefficients from the truncated regression models in Tables 4 and 5 supplied estimates of $\partial A_i/\partial B$.

As shown in Panels A and B, the elasticity of the probability of permanent partial disability with respect to a change in permanent partial benefit ranges from 0.092 to 0.365; a 10 percent increase in benefit levels increases the probability of permanent partial disability by about 1 to 4 percent. (On the other hand, temporary disability benefit elasticities, except for sprains from the SDS sample, are negligible. They range from approximately 0.009 to 0.056.)[16]

[16] This simple measure of the effect of temporary disability benefits on the probability or size of a permanent partial disability award is somewhat misleading. A number of studies have shown that the duration of temporary disability is positively related to temporary disability benefits levels, with an elasticity from around 0.4 to as much as 2.0. The coefficient for the number of weeks the claimant received temporary total disability benefits indicates a strong relationship between the length of temporary disability and the probability and size of a permanent partial disability award. Temporary disability benefits may have an effect on the permanent disability award through their effect on temporary disability duration.

Table 6
Elasticity Estimates

Variable	*All Injuries*	*Fractures*	*Sprains*
Panel A: SDS Sample, Probability			
TEMPBEN	0.056	0.012	-0.256**
	(0.61)	(0.22)	(2.55)
PERMBEN	0.365*	0.316*	0.351*
	(5.53)	(7.66)	(4.28)
MAXWEEKS	0.385*	0.254*	0.924*
	(6.04)	(6.92)	(8.49)
Panel B: New York Sample, Probability			
TEMPBEN	0.030	0.035	0.009
	(0.56)	(1.08)	(0.11)
PERMBEN	0.188*	0.092**	0.225***
	(2.68)	(2.25)	(1.86)
Panel C: New York Sample, Award Size			
TEMPBEN	-0.237	-0.225	0.146
	(1.53)	(1.46)	(0.92)
PERMBEN	-0.555**	-0.695*	0.144
	(2.39)	(3.33)	(0.54)
Panel D: New York Sample, Expected Value			
TEMPBEN	-0.211	-0.199	0.110
	(1.40)	(1.27)	(0.86)
PERMBEN	-0.440***	-0.633*	-0.202
	(1.93)	(2.96)	(0.96)

Note: Absolute t-ratios are in parentheses. TEMPBEN = temporary total benefit payment, PERMBEN = weekly permanent partial benefit payment, and MAXWEEKS = maximum duration of permanent partial benefits given the nature of the claimant's injury.
* $p < 0.01$ ** $p < 0.05$ *** $p < 0.10$

Elasticities from the SDS regressions are somewhat larger than the New York elasticities—about 0.35 compared to around 0.15. Interestingly, award size elasticities for the potential duration of permanent partial disability benefits from the SDS regressions are nearly identical (with the exception of the sprain sample) to the elasticities for the weekly permanent partial disability payment.

Finally, award size elasticities are negative and approximately two to three times larger (with the exception of the fracture sample) than corresponding elasticities for award probability. Changes in award size overwhelm changes in the probability of an award; consequently, the expected value elasticities are negative and around -0.2 to -0.6, indicating that a 10 percent increase in permanent partial disability benefits will be associated with a 2 to 6 percent decrease in the expected award.

Conclusions

Compensation claimants are able to influence the probability of permanent partial disability.[17] The probability of a permanent partial disability is positively associated with two dimensions of the permanent partial disability award: the size of the weekly payment and the potential duration of benefits. The results further suggest that the process determining whether a claimant is permanently disabled is fundamentally different from the process determining the size of the award. While higher permanent partial disability benefits increase the probability of a permanent partial disability award, award size is negatively related to permanent partial disability benefits. These results suggest that the claimant is able influence the probability of a permanent partial disability award but not the award size. Due to this offsetting reduction in the size of the permanent partial disability award, increasing the level of weekly permanent partial disability compensation benefits by one dollar raises benefit costs by only 40 cents. However, these results must be treated with caution, as they may not generalize beyond New York.

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[17] As indicated above, the results refer to conditional, and not unconditional, probabilities. See footnote 4.

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