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Hospital Rate Regulations, Fee Schedules, and Workers' Compensation Medical Payments

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ABSTRACT

This article examines the effect of workers' compensation fee schedules and state hospital rate-setting upon workers' compensation payments. We examine four types of injuries and payments involving hospitalization and nonhospitalized claims. The sample contains about 217,000 randomly-selected workers' compensation lost workday claims from 17 states filed between 1979 and 1988. We find that workers' compensation fee schedules and state hospital rate-setting reduce medical payments per claim.

INTRODUCTION

While the increase in U.S. health care costs receives much national attention, medical care expenditures for workers' compensation insurance programs have increased even more rapidly. Indeed, workers' compensation medical payments, which were about $17 billion in 1991, increased about 70 percent more rapidly than national health care expenditures between 1980 and 1990 (Nelson, 1992, 1993; Burton, 1993). Medical costs also comprise an increasing share of total workers' compensation costs relative to indemnities (Burton, 1990). The high growth rate in workers' compensation costs is generally explained by the heavy emphasis on injuries (which involve no pediatric, prenatal, geriatric, or preventive care) and the way that workers' compensation insurance is administered (Boden, DeFinis, and Fleischman, 1990; Durbin and Appel, 1991).

Workers in all states generally have an automatic right to full compensation for the medical costs of job-related injuries; unlike other forms of insurance, states are unable to control costs through coinsurance and deductibles.[1] In addition,

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[1] In addition, the health care provider may be called upon to determine whether the injured party should return to work. Thus, workers may seek more medical attention or engage in other

workers' compensation is primary coverage for work-related injuries, that is, it is paid before other types of insurance coverage. As a consequence, injured workers have little incentive to search for low-cost health care providers, and hospitals and other health care providers may price discriminate against medical claims covered by workers' compensation (see Foster, 1985; Dranove, 1988; Baker and Krueger, 1993b).[2]

Because the demand for medical services is difficult to regulate, some states have attempted to control workers' compensation medical care costs on the supply side. Fee-setting schemes are used to limit payments to hospitals and/or physicians. Durbin and Appel (1991) find that medical fee schedules and employer choice are associated with lower costs. Durbin, Corro, and Helvacian (1996) also find that medical fee schedules and employer choice are associated with lower costs, but that workers' compensation hospital regulations are associated with higher hospital costs. On the other hand, Boden and Fleischman (1989) and Pozzebon (1994) find no effects of workers' compensation fee schedules.

Previous rate-setting studies do not consider the effect of other types of rate regulation such as state hospital rate setting, which began in the 1960s and 1970s. Gold et al. (1993) conclude that hospital costs in states with mandatory regulations have fallen relative to other states. The present article extends the existing research by examining the effects of both hospital rate regulations and fee schedules on workers' compensation medical payments.

We also consider the role of Medicare. In 1983, Medicare replaced cost-based payments to hospitals with a much stricter prospective payment scheme (PPS). Under this system, hospitals are paid specified amounts for diagnosis-related groups. Although the growth rate in Medicare costs fell in the early years of PPS (see Coulam and Gaumer, 1991; and Gold et al., 1993), their effect on other populations is less clear. In particular, Coddington, Keen, and Moore (1991) and Altman and Young (1993) claim that the reduced revenues in the regulated health sectors may lead to cost-shifting, that is, raising the prices to some third-party payers to cover shortfalls from Medicare. Similarly, hospital rate regulation may lead to higher nonhospital medical costs. Because our data include different states and the years 1979 to 1988, we are able to examine the effect of rate regulations and whether workers' compensation medical costs increased following implementation of Medicare's prospective payment system.

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activities in order to qualify for increased indemnity benefits (see Butler and Worrall, 1983, 1985; Dionne and St-Michel, 1991; Thomason, 1993).

[2] Several studies examine the costs of providing medical services. A study by the Minnesota Department of Labor and Industry (see also Baker and Krueger, 1993a, 1993b) finds that workers' compensation medical costs per treatment are twice those for similar injuries treated outside the workers' compensation system. Durbin, Corro, and Helvacian (1996), however, find that the difference in medical care costs may be explained by differences in treatment intensity and the mix of health care providers. Worrall, Appel, and Butler (1987) also find that any gender and marital differences in workers' compensation medical utilization were small or nonexistent after controlling for type of care.

Data Source and Sample

Our analysis relies upon the Detailed Claims Information (DCI) data base of the National Council on Compensation Insurance (NCCI). DCI records claims payments by year for a simple random sample of workers' compensation lost workday claims. The DCI file includes data from 17 states chosen to be nationally representative during the years 1979 through 1988. To keep the sample representative (e.g., following population shifts discovered from the 1980 census), the states included in the file have been revised.

The DCI data include only claims that satisfy a minimum number of lost work days. The number of lost days required to qualify as a lost workday claim varies by state, with a range from two to seven and an incidence weighted mean of four. The states, years included, and number of days required to qualify are presented in Table 1.

Table 1
Characteristics of Workers' Compensation Claim Sample

State	Years	Number of Lost Days to Qualify for Claim	Rate-Setting	Hospital	Medical
Connecticut	1979-1983	3	Yes	No	No
Florida	1979-1988	7	No	1965	1965
Georgia	1979-1984 1987-1988	7	No	No	1987
Hawaii	1983-1988	2[a]	No	1962	1962
Illinois	1979-1988	3	Yes[b]	No	No
Kentucky	1979-1988	7	No	No	No
Louisiana	1984-1988	7	No	No	No
Maine	1980-1988	3	No	No	No
Massachusetts	1979-1988	5	Yes	1972	1972
Michigan	1979-1988	7	No	No	No
Minnesota	1979-1988	3	No	1984	1984
New Mexico	1986-1988	7	No	No	No
New York	1979-1983	7	Yes	No	No
Oregon	1983-1988	3	No	No	1982
Pennsylvania	1979-1988	7	No	No	No
Virginia	1979-1984	7	No	No	No
Wisconsin	1979-1983	7	Yes	No	No

Source: Years: NCCI (1987). Number of days lost to qualify for inclusion in the DCI file: U.S. Chamber of Commerce (various years). State hospital rate regulations: Esposito, Hupfer, and Mason (1983); Gold et al. (1993); Schramm, Renn, and Biles (1986); Sloan (1983); and telephone calls to state regulatory agencies. Fee schedules: Boden, DeFinis, and Fleischman (1990). Dates that fee schedules were in effect were obtained and existence of schedules was verified through telephone calls to the state workers' compensation programs.

[a] Changed to three days in 1986.
[b] Discontinued in 1983.

For each claim in the DCI sample, the insurer reports data six months after the injury and annually thereafter until the claim is closed (i.e., until no more payments are anticipated, or a reserve was set aside—and reported to DCI—to cover predictable future payments). DCI claims are reopened if unanticipated payments arise after closure. DCI data are extracted from claims forms by insurer clerks who select the injury codes.

The DCI record includes hospital payments (medical payments covering professional services, prescriptions, equipment, long-term medical care, and vocational rehabilitation); length of stay if hospitalized; disability compensation; and classification as total temporary, partial permanent, or total permanent disability. The record also includes the person's most severe injury by body part and nature (e.g., finger fracture) using the American National Standards Institute's Z-16.2 injury coding system.

The DCI data for the period of our study contain 452,000 injury claims, of which 138,000 (about 30 percent) involve hospitalization. In deriving our sample, we narrow the overall DCI sample in two ways. First, we limit the cases to four major types of injuries: upper extremity fractures, dislocations, and ruptures; other upper extremity injuries; lower extremity fractures, dislocations, and ruptures; and back sprains and strains.[3] These four types of injuries comprise about half of the DCI file.

Second, we exclude cases that are not closed within 18 months in order to reduce truncation problems in the latter years of our sample (i.e., claims opened in 1988 but not closed by the end of the year would not be included in the sample).[4] Approximately two percent of nonhospitalized injuries and 16 percent of hospitalized injuries for the four injury types are excluded as claims not closed within 18 months.[5]

Our final sample includes about 217,000 claims. Besides separately examin-

[3] We aggregate two-digit injury codes for a particular body type and general injury type (fractures vs. nonfractures). We also estimate regressions for the most frequent injuries within category–back sprain, upper extremity fracture, upper extremity laceration, and finger nonfractures–to see if explanatory power or variable significance changes. These regressions yield similar results to the more inclusive regressions. We do not analyze brain injuries or internal injuries, because DCI data do not describe these injuries well. For example, all internal organs except the heart are coded as body part 48. Availability of adequate sample cases for other types of injury further constrain the choice of injuries.

[4] Claims closed within 18 months may include injuries with treatment lasting more than 18 months, but where a reserve has been set aside to cover anticipated future claims. Exclusion of claims open more than 18 months and of certain types of injuries may cause sample selection bias. Preliminary investigation indicates that the percent of open claims in states did not vary systematically with the existence of rate regulations.

[5] Using Nelson's (1988) finding that 1,346,700 new workers' compensation claims were processed in 1982 in the United States and adjusting for the increase in the number of covered workers (assuming that claims per thousand covered workers were stable through 1986), we estimate that 1.47 million claims were processed annually in the period 1984 through 1986. Since 30 percent of DCI lost workday claimants for traumatic injury are hospitalized, approximately 440,000 claims per year involve hospitalization. Using hospitalization data from the 1984 through 1986 National Hospital Discharge Survey compiled by Rice et al. (1989) with a supplemental back injury count (as discussed above), we find that the DCI data sample comprises 16 percent of total injury hospitalizations and 24 percent of injury hospitalizations to civilians aged 15 to 64.

ing the four injury groups, we distinguish claims that do and do not involve hospitalization. Of the 217,000 claims, 35,200 involve hospitalization.

MODEL

Our analysis focuses upon total medical and ancillary payments per injury episode. To control for general inflation in medical costs, the measures of medical payments are inflated to 1988 dollars using the medical care component of the consumer price index. Because the distribution of medical payments begins at $0 and has a long upper tail, the payments variable is converted to the natural logarithm form.

We estimate eight separate equations: for each injury group and by hospitalization status. For episode i, state s, region r, and year t, our basic model for each injury group is

$$\begin{aligned} LPAYMENT_{i,s,t} = \alpha + \Sigma\beta'_k PERSON_{i,s,t} + ß_1 DAYS_{s,t} + ß_2 FXMSA_{s,t} + ß_3 TRAUMA_{s,t} \\ + ß_4 HSPADJ_{s,t} + ß_5 RATE_{s,t} + ß_6 WCRATE_{s,t} + u_r + v_t + e_{i,s,t}, \end{aligned}$$

where LPAYMENT = the logarithm of total medical payments per episode divided by the medical cost index,
PERSON = a set of person-specific variables,
DAYS = days lost required by the state to qualify as a workers' compensation lost workday injury,
FXMSA = the fraction of population living in metropolitan areas,
TRAUMA = the presence of a regional trauma care system,
HSPADJ = the average real Medicare-covered charge per covered day in short-stay hospitals,
RATE = state hospital rate setting,
WCRATE = workers' compensation fee schemes,
u_r = a set of region-specific fixed effects, and
v_t = a set of year-specific fixed effects.

The person-specific variables control for personal characteristics, case mix, and injury severity. Personal characteristics include the worker's age, age squared, and a dummy variable for sex. To control for case mix, we include separate indicator variables for the specific body part injured and the nature of the injury, as well as estimate separate regressions by major body part.[6] Injury severity is measured by the amount of time before the claim is closed, the duration of total temporary disabilities, and a dummy variable indicating whether the claimant is permanently disabled. A variable denoting the length of hospital stay is included in the equations for hospitalized claims.

A number of variables are included to control for differences across states and time in the medical environment. Because the number of days lost required to

[6] Because regulations (especially prospective payment schemes, which pay the same amount regardless of length of stay) may affect the length of hospital stay or the amount of time that the case is opened, we also estimate equations without those variables. The omission of the length of hospital stay variable does not substantially affect the results. The coefficient on the hospital rate setting variable fell but was still significant with the omission of the length of case indicator variable.

qualify for workers' compensation varies across states, average claims are expected to be greater in states that have higher requirements. The FXMSA variable controls for differences in medical care between urban and rural areas (Dor and Holahan, 1990). Miller and Levy (1995) find that the presence of a regional trauma care system reduces injury costs. The coefficient on the variable TRAUMA is, therefore, expected to be negative. The average Medicare-covered charge per covered day of short-stay hospital care (HSPADJ) is based on the costs of providing medical care in an area. As a control for health care provider costs, it is expected to be positive.

States vary in the manner in which their workers' compensation program regulates medical costs. Some states regulate hospital payments; others regulate physician fees. Some states allow the employer rather than the employee to determine the choice of health care provider. The method of setting the maximum payment also varies. For simplicity, we limit our analysis to two dimensions of workers' compensation: the use of hospital charge controls and the use of medical fee schedules.

Four states had hospital and medical fee schedules for workers' compensation throughout the data collection period; one had only a medical fee schedule. One state implemented a hospital fee schedule and two states implemented medical fee schedules part way through the period (see Table 1). We include a dummy variable for hospital fee schedules (WCHSRATE) in the equations for hospitalized claims and a dummy variable for medical fee schedules (WCMEDRATE) in the equations for nonhospitalized claims. A negative coefficient for the workers' compensation fee schedule variables would be consistent with the hypothesis that the relevant fee schedules reduce medical costs for worker injuries.[7]

Hospital rate-setting schemes in different states also vary along a number of dimensions, including the breadth of coverage (i.e., which patients are covered); whether mandatory or voluntary; and whether rates are calculated based on total revenue or per case, per diem, or per service. Previous studies generally find that the key determinant of effectiveness is whether rate regulations are mandatory (see Hadley and Swartz, 1989; Gold et al., 1993). Therefore, the rate regulations variable (RATE) is set equal to one if state s had mandatory rate regulations in year t. A negative coefficient on the state rate-setting variable would indicate that rate regulations are associated with lower medical costs for those covered by workers' compensation.

Five states in our sample—Connecticut, Illinois, Massachusetts, New York, and Wisconsin—had mandatory rate regulations during the sample period. Of these states, Wisconsin and Illinois implemented rate regulations in the late-1970s, and Illinois dropped its regulations in 1984 (see Table 1). Since previous studies (see Sloan, 1983) find that state rate regulations are less effective in their first three

[7] Because part of the hospitalized claim includes medical fees, we also include the medical fee setting variable in that equation, but found that it did not improve the explanatory value of any of the equations (based upon F-tests). All states in our sample with workers' compensation hospital fee schedules also regulate medical fees, thus creating a high degree of collinearity between the variables. Thus, we are unable to distinguish whether it is hospital or fee schedules that affect costs.

years and Wisconsin had less inclusive regulations, we assigned Illinois and Wisconsin a separate dummy variable. The coefficient on this variable was never negative and even close to significant. Consequently, we do not consider these two states to be regulated.

To incorporate other omitted area-specific cost effects, we include dummy variables for three of the four regions.[8] We also include time-specific fixed effects for each year except 1979 (the first year of the sample). Since the dependent variable is the logarithm of medical payments divided by the medical price index, the year variables are used to track the relative growth in workers' compensation medical costs. Specifically, the coefficient of each year dummy variable indicates the rate of growth in workers' compensation medical costs since 1979 relative to the growth in all medical costs. We are particularly concerned with the growth since 1983, when Medicare's prospective payment scheme was first implemented. The explanatory variables are defined in Table 2.[9]

RESULTS

The empirical results are reported in Table 3. We present separate equations for hospitalized and nonhospitalized claims of each of the four injury types. We do not report the coefficients of the person-specific variables (which vary from equation to equation) or the regional indicator variables, but the coefficients for these variables are of the expected sign (where there is one to be had) and often are statistically significant at the five percent level.[10] Correcting for heteroscedasticity using the White method did not materially affect the results.[11]

The nonregulatory state-level variables generally reflect our expectations. Higher hospital costs (HSPADJ) are associated with higher workers' compensation payments, and trauma care systems are associated with lower payments. These effects are significant or nearly significant in all of the equations. The days lost variable is positive in six of the eight equations and is significant in four of the six equations where its effect is positive. The urbanization variable (FXMSA) is associated with higher payments (except for upper body hospitalized fractures) and is often significant.

Consistent with the hypothesis that rate regulations are effective, state hospital rate-setting is associated with lower medical payments in each of the equations for hospitalized claims. The effect is also statistically significant. In the equations

[8] State fixed effects are highly collinear with the regulation variables and consequently are not included.

[9] Means and standard deviations for each of the variables in each injury category and by hospitalization status are available from the authors upon request.

[10] In particular, women had between 3 and 15 percent lower costs than men. This finding is consistent with earlier work by Worrall, Appel, and Butler (1987), who found that mean levels of costs per claim were generally greater for men than for women in most injury groups and for most states. See, however, other studies cited therein. We also found that workers' compensation costs peaked for injured workers between 45 and 65 years of age. The coefficients on the age and sex variables were generally significant.

[11] We were unable to obtain the covariance matrix for the leg injury nonhospitalized claim equations, and the leg, upper fracture, and upper other injuries nonhospitalized claim equations. However, the results are not substantially affected when the White correction is computed, that is, the level of significance is roughly the same for each coefficient as without the correction.

Table 2
Definitions of Regression Variables for Workers' Compensation Claim Sample

Person-Level Variables	
SEX	Sex; 0 = Man, 1 = Woman
AGE	Age in Years
AGE2	Age Squared
HSP	Length of Hospital Stay
IPERM	Disability Severity; 0 = Temporary, 1 = Permanent
DURTEMP	Duration of Total Temporary Disability
RPT	Date of Report Closing Case; 0 = 6 Months, 1 = 18 Months
SPRAIN, STRAIN, SEVERANCE, CONTUSION, CONCUSSION, AMPUTATION, LACERATION	Nature of Injury for Other Upper Extremity Injury Regressions
SPRAIN, STRAIN, DISLOC	Nature of Injury for Back Injury Regressions
RUPTURE, FRACT	Nature of Injury for Fracture Regressions
THUMB, HAND, WRIST, LOWARM, ELBOW, SHOULDER/UPARM, MULTUP, FINGER	Body Part for Upper Extremity Injury Regressions
HIP, THIGH, KNEE, LEG, ANKLE, TOE, MULTLOW, FOOT	Body Part for Lower Extremity Injury Regressions
State and Year Variables	
DAYS	Days Lost Required to Qualify as a Workers' Compensation Lost Workday Injury, from NCCI
FXMSA	Fraction of Population Living in Metropolitan Area, from *U.S. Statistical Abstract*
HSPADJ	Average Medicare-Covered Charge per Covered Day of Care in Short-Stay Hospitals, from *Social Security Bulletin Annual Supplement,* Inflated to 1988 Dollars Using the Medical Care Component of the Consumer Price Index
TRAUMA	Trauma Care System; 0 = No System, 1 = System
RATE	Mandatory State Rate Regulations; 1 = Yes Except Wisconsin and Illinois, 0 = No
WCHSRATE	In Hospitalized Claim Equations, Workers' Compensation Hospital Fee Schedule; 1 = Yes, 0 = No
WCMEDRATE	In Nonhospitalized Claim Equations, Workers' Compensation Medical Fee Schedule; 1 = Yes, 0 = No
SOUTH, MIDWEST, NORTHEAST	Geographic Region
Y80, Y81,..., Y88	Year Dummy Variables; in 1980, Y80 = 1 and 0 Otherwise; in 1981, Y81 = 1 and 0 Otherwise; in 1988, Y88 = 1 and 0 Otherwise

for nonhospitalized claims, the effect is smaller in magnitude (as expected) but negative and statistically significant. This result is inconsistent with cost-shifting

from the hospital to the nonhospitalized sectors. Workers' compensation hospital and medical fee schedules are also associated with lower costs of medical care. This effect is statistically significant in all cases. The magnitude of the regulatory variable coefficients suggests substantial regulatory effects.[12]

Table 3
Regression Analysis of Workers' Compensation
Medical Payments Per Injury Episode

	Upper Body Fracture		Upper Body Injury, Other		Leg Injury		Back Injury	
	Hospital	Nonhospital	Hospital	Nonhospital	Hospital	Nonhospital	Hospital	Nonhospital
DAYS	0.030	-0.0010	0.033	0.062	-0.015	0.0072	0.020	0.0007
	(2.19)*	(0.20)	(3.64)*	(19.2)*	(1.31)	(1.26)	(2.39)*	(0.23)
FXMSA	-0.25	0.50	0.038	0.032	0.43	0.64	0.56	0.74
	(1.16)	(6.30)*	(0.27)	(0.69)	(2.49)*	(7.66)*	(4.77)*	(15.7)*
TRAUMA	-0.076	-0.039	-0.097	-0.054	-0.16	-0.052	-0.12	-0.14
	(1.88)	(2.45)*	(3.53)*	(5.23)*	(4.68)*	(3.04)*	(5.21)*	(13.8)*
HSPADJ	0.0016	0.00083	0.0012	0.0009	0.00075	0.00039	0.0003	0.0008
	(3.96)*	(5.34)*	(4.39)*	(9.99)*	(2.27)*	(2.35)*	(1.33)	(9.03)*
RATE	-0.25	-0.21	-0.48	-0.10	-0.33	-0.22	-0.58	-0.26
	(3.30)*	(7.79)*	(9.26)*	(5.63)*	(4.90)*	(7.23)*	(12.6)*	(14.1)*
WCHSRATE	-0.18		-0.13		-0.14		-0.16	
	(3.40)*		(3.87)*		(3.22)*		(5.25)*	
WCMEDRATE		-0.17		-0.13		-0.16		-0.092
		(8.36)*		(10.5)*		(7.26)*		(7.60)*
Y80	0.023	0.016	0.061	0.0094	0.075	0.011	0.032	0.024
	(0.47)	(0.80)	(1.82)	(0.75)	(1.88)	(0.52)	(1.19)	(1.85)
Y81	0.036	0.022	0.059	0.020	0.087	0.078	0.95	0.045
	(0.67)	(1.01)	(1.58)	(1.49)	(1.93)	(3.28)*	(3.18)*	(3.15)*
Y82	0.10	0.013	0.15	0.020	0.13	0.048	0.90	0.052
	(0.16)	(0.52)	(3.36)*	(1.28)	(2.51)*	(1.75)	(2.51)*	(3.24)*
Y83	-0.016	-0.043	0.078	-0.0052	0.044	0.043	0.10	0.043
	(0.19)	(1.35)	(1.41)	(0.26)	(0.65)	(1.24)	(2.26)*	(2.17)*
Y84	-0.22	-0.094	-0.029	-0.049	0.071	0.018	0.041	0.035
	(2.27)*	(2.49)*	(0.45)	(2.18)*	(0.88)	(0.44)	(0.77)	(1.54)
Y85	-0.29	-0.082	-0.15	-0.065	0.072	0.027	-0.042	0.053
	(2.41)*	(1.74)	(1.94)	(2.37)*	(0.72)	(0.54)	(0.62)	(1.93)
Y86	-0.52	-0.055	-0.33	-0.041	-0.088	0.031	-0.28	0.093
	(4.00)*	(1.12)	(4.0)*	(1.44)	(0.84)	(0.58)	(3.78)*	(3.25)*
Y87	-0.34	-0.029	-0.45	-0.073	-0.25	-0.00001	-0.45	0.10
	(2.42)*	(0.055)	(4.97)*	(2.38)*	(2.08)*	(0.002)	(5.66)*	(3.34)*
Y88	-1.00	0.072	-0.45	0.21	-0.52	0.38	-0.45	0.22
	(1.52)	(0.52)	(1.67)	(2.23)*	(1.27)	(2.37)*	(1.93)	(2.40)*
R-squared	0.33	0.26	0.34	0.22	0.53	0.34	0.36	0.21
F-stat	62.9*	199.9*	153.5*	514.6*	156.7*	230.8*	321.5*	874.3*
DF	4354	18653	11110	65205	4780	14904	14942	82851

Note: The dependent variable is the logarithm of medical claims per episode divided by the 1988 medical price index. Person-specific variables have been included in the equations but are not reported. Absolute values of the t-statistics are in parentheses. See Table 2 for variable definitions.

* Statistically significant at the 0.05 level using a two-tailed test.

[12] For the dummy variables, the coefficient ß must be transformed by the formula 100[exp(ß)-1] to get the percentage effect on medical payments. For example, a coefficient of -0.50 translates to a 39 percent reduction in costs, and a coefficient of -0.25 translates to a 22 percent reduction (see Halvorsen and Palmquist, 1980).

The pattern on the year fixed effects indicates a mixed pattern of growth in workers' compensation costs per episode relative to the growth in all medical costs. The coefficients of the year dummy variables are positive for all years before 1983. However, they are only larger than 0.03 in magnitude and significant in the other upper body injury and hospitalized leg injury equations and in both back injury equations. Thus, even in the early years of the sample period, relative growth was rather modest, generally less than three percent (relative to the medical price index) since 1979. The coefficients generally become smaller in magnitude after 1983. In all but the nonhospitalized leg injury and the nonhospitalized back injury equations, growth since 1979 is negative and often significant.[13] Even for back and leg injury claims, the growth in costs per episode is on the order of less than ten percent since 1979.[14] The general fall in real growth occurs around the time that Medicare's prospective payment scheme began (late 1983), indicating that the implementation of PPS is associated with lower payments for injury claims. This result is inconsistent with the notion of cost-shifting from the Medicare to the workers' compensation population.

Because rate regulations may affect the rate of growth as well as the level of workers' compensation costs, we estimate equations in which we add variables interacting the rate measures with a time trend. In cases where the coefficient is negative, it is in some cases statistically significant and in the range of -0.01 to -0.04. Specifically, workers' compensation is associated with lower (and significant) growth in medical costs in each of the nonhospital equations except for leg injury claims. Hospital rate regulations are associated with lower (and significant) growth for hospitalized back injury claims. The other coefficients are not substantially affected in these equations, except that the nontrended workers' compensation rate variables are smaller in absolute magnitude.

CONCLUSION

States with workers' compensation hospital and medical fee schedules and states with state hospital rate-setting have lower costs of workers' compensation medical claims. These results are obtained for all four main injury types considered and for both hospitalized and nonhospitalized claims. Another interesting finding is that states with regional trauma care systems have lower payments for injury claims.

The growth in workers' compensation medical costs relative to the growth in all medical costs has generally been negative since the implementation of Medicare's prospective payment scheme. This finding is contrary to claims that stricter regulations under Medicare have shifted costs to other populations.[15] The reduced

[13] Estimating equations with separate time trends for 1979 through 1983 and 1984 through 1988, we find negative and significant growth in the latter period in all the equations for hospitalized claims. Estimating the equations excluding the hospital costs variable, we find that the coefficient on year dummy variables increased, but the same general pattern emerged.

[14] For nonhospitalized leg injury claims, the coefficient is large for 1988 but not for any other years. This may be explained as an aberration, since the number of observations for 1988 in that equation is small.

[15] Hadley and Zuckerman (1990) and others also find no evidence of cost-shifting. For a review of the empirical literature, see Coulam and Gaumer (1991, p. 62) and Gold et al. (1993, p. 197).

growth in workers' compensation costs coinciding with the implementation of Medicare PPS may be due to a demonstration effect that lower payments could be obtained or to increased vigilance from other forms of insurance. Others (see Dranove, Shanley, and White, 1993; Zwanziger and Melnick, 1989) find that competition in hospital markets increased and prices fell during the mid- to late-1980s. Our findings generally indicate smaller increases in total workers' compensation medical payments per episode than for total medical payments for the United States as a whole during the 1980s. This finding merits further attention.[16]

Our results are consistent with salutary effects of state hospital rate-setting, workers' compensation fee schedules, and Medicare PPS. Our analysis, however, is subject to a number of limitations. Our use of a dummy variable to capture the effects of each of the various types of schemes for regulating workers' compensation as well as state hospital rate-setting may be an oversimplification. Regulations are implemented many different ways across states. In addition, we do not consider the availability or quality of care. One might expect that increased rate regulations would lead to reductions in the quality or quantity of health care. Although our equations control for length of treatment, this possibility cannot be excluded.[17] Finally, the omission of cases over 18 months long and of cases not involving upper body, back, or leg injuries may cause selectivity bias. We leave these issues for future research. Nevertheless, the data cover a large number of observations, four of the main types of injuries, and a representative sample.

[16] The total growth in medical payments can be decomposed into price changes and quantity changes in the different injury categories. The higher growth in total workers' compensation medical expenditures compared to the growth in costs per episode may be due to changes in the case mix of workers' compensation claims relative to other health care expenditures. Although the pattern of growth was not systematically affected when the injury characteristic variables, date of case closing, or length of hospital stay were excluded from our estimation equation, changes in injury types between broader injury categories may explain the relative growth in workers' compensation medical payments. This explanation is consistent with findings by Durbin, Corro, and Helvacian (1996), who examine claims of four states between the years 1988 to 1992 and conclude that cost differences between workers' compensation and other medical costs is due to treatment intensity and the mix of health care providers. The percentage of variation explained by their equations appears to be higher than ours due to the more recent time period of the sample and to a more extensive list of health care provider controls.

[17] With regard to health care quality and quantity reactions to workers' compensation fee schedules, see Roberts and Zonia (1994). It should be noted that the medical cost index does not control for quality changes; indeed, there are well known biases (see Newhouse, 1992). Examining average length of acute care stay, we found that the average length of stay for live DCI injury discharges is 6.2 days compared to 6.4 days from National Hospital Discharge Survey data for 1984 through 1986.

REFERENCES

Altman, S. and D. Young, 1993, A Decade of Medicare's Prospective Payment System—Success or Failure, *Journal of American Health Policy,* 3: 219–223.

Baker, L. C. and A. B. Krueger, 1993a, Twenty-Four-Hour Coverage and Workers' Compensation Insurance, *Health Affairs,* 9: 271–281.

Baker, L. C. and A. B. Krueger, 1993b, Evidence on Price Discrimination in Workers' Compensation Medical Care, Working Paper, Princeton University, Princeton, New Jersey.

Boden, L. I., J. M. DeFinis, and C. A. Fleischman, 1990, Medical Cost Containment in Workers' Compensation: A National Inventory (Cambridge, Mass.: Workers Compensation Research Institute).

Boden, L. I. and C. A. Fleischman, 1989, Medical Care Costs in Workers' Compensation—Trends and Interstate Comparisons (Cambridge, Mass.: Workers Compensation Research Institute).

Burton, J. F., 1990, *Workers' Compensation Monitor,* 3(2): 1–21.

Burton, J. F., 1993, *Workers' Compensation Monitor,* 6(2): 1–23.

Butler, R. J. and J. D. Worrall, 1983, Workers Compensation: Benefit and Injury Claims Rates in the Seventies, *Review of Economics and Statistics,* 65: 580–591.

Butler, R. J. and J. D. Worrall, 1985, Work Injury Compensation and Duration of Nonwork Spells, *Economic Journal,* 5: 714–724.

Coddington, D. C., D. J. Keen, and K. D. Moore, 1991, Cost Shifting Overshadows Employers' Cost-containment Efforts, *Business and Health,* 12: 51–54.

Coulam, R. and G. Gaumer, 1991, Medicare's Prospective Payment System: A Critical Appraisal, *Health Care Financing Review,* Annual Supplement, 12: 45–77.

Dionne G. and P. St-Michel, 1991, Workers Compensation and Moral Hazard, *Review of Economics and Statistics,* 73: 236–244.

Dor, A. and J. Holahan, 1990, Urban-Rural Differences in Medicare Physician Expenditures, *Inquiry,* 27: 307–318.

Dranove, D., 1988, Pricing by Non-profit Institutions: The Case of Hospital Cost-shifting, *Journal of Health Economics,* 7: 47–57.

Dranove, D., M. Shanley, and W. D. White, 1993, Price and Concentration in Hospital Markets: The Switch from Patient to Payer-Driven Competition, *Journal of Law and Economics,* 36: 179–203.

Durbin, D. L. and D. Appel, 1991, The Impact of Fee Schedules and Employer Choice of Physician, *NCCI Digest,* 6: 39–59.

Durbin, D. L., D. Corro, and N. H. Helvacian, 1996, Workers' Compensation Medical Expenditures: Price vs. Quantity, *Journal of Risk and Insurance,* 63: 13–33.

Esposito, A., M. Hupfer, and C. Mason, 1982, Abstracts of State Legislated Hospital Cost Containment Programs, *Health Care Financing Review,* 4: 129–183.

Foster, R. W., 1985, Cost-shifting under Cost Reimbursement and Prospective Payment, *Journal of Health Economics,* 4: 261–271.

Gold, M., K. Chu, M. Felt, M. Harrington, and T. Lake, 1993, Effects of Selected Cost-Containment Efforts: 1971–1993, *Health Care Financing Review,* 14: 183–226.

Hadley, J. and K. Swartz, 1989, The Impacts on Hospital Costs between 1980 and 1984 of Hospital Rate Regulation, Competition, and Changes in Health Coverage, *Inquiry,* 26: 35–47.

Hadley, J. and S. Zuckerman, 1990, Changes in Hospitals' Charges to Privately Insured Patients During PPS, Project Report 3429-07 (Washington, D.C.: Urban Institute).

Halvorsen, R. and R. Palmquist, 1980, The Interpretation of Dummy Variables in Semilogarithmic Equations, *American Economic Review,* 70: 474–475.

Holahan, J., A. Dor, and S. Zuckerman, 1991, Has PPS Increased Medicare Expenditures on Physicians? *Journal of Health Politics, Policy, and Law,* 16: 335–362.

Miller, T. M. and D. T. Levy, 1995, The Effects of Regional Trauma Care Systems on Medical Costs, *Archives of Surgery,* 130: 188–193.

National Council on Compensation Insurance, 1987, *Detailed Claims Information Codebook* (New York: NCCI).

Nelson, W. J., Jr., 1988, Workers' Compensation: Coverage, Benefits, and Costs, 1988, *Social Security Bulletin,* 54: 12–20.

Nelson, W. J., Jr., 1992, Workers Compensation: 1984–88 Benchmark Revisions, *Social Security Bulletin,* 55: 41–58.

Nelson, W. J., Jr., 1993, Workers Compensation: Coverage, Benefits and Costs, 1990-1, *Social Security Bulletin,* 56: 68–74.

Newhouse, J. P., 1992, Medical Care Costs: How Much Welfare Loss? *Journal of Economic Perspectives,* 6: 2–22.

Pozzebon, S., 1994, Medical Cost Containment Under Workers' Compensation, *Industrial and Labor Relations Review,* 48: 153–165.

Roberts, K. and S. Zonia, 1994, Workers' Compensation Cost Containment and Health Care Provider Income Maintenance Strategies, *Journal of Risk and Insurance,* 61: 117–131.

Schramm, C. J., S. C. Renn, and B. Biles, 1986, Controlling Hospital Cost Inflation: New Perspectives on State Rate Setting, *Health Affairs,* 5: 22–33.

Sloan, F. A., 1983, Rate Regulation as a Strategy for Hospital Cost Control: Evidence from the Last Decade, *Millibank Memorial Fund Quarterly,* 61: 195–220.

Thomason, T., 1993, Permanent Partial Disability in Workers' Compensation: Probability and Costs, *Journal of Risk and Insurance,* 60: 574–590.

U.S. Chamber of Commerce, various years, *Analysis of Workers' Compensation Laws* (Washington, D.C.: U.S. Chamber of Commerce).

Worrall, J. D., D. Appel, and R. J. Butler, 1987, Sex, Marital Status, and Medical Utilization by Injured Workers, *Journal of Risk and Insurance,* 54: 27–39.

Zwanziger, J. and G. Melnick, 1989, The Effects of Hospital Competition and the Medicare PPS Program on Hospital Cost Behavior in California, *Journal of Health Economics,* 7: 301–320.