National Trends in Occupational Injuries Before and After 1992 and Predictors of Workers' Compensation Costs

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ABSTRACT

Objective. Numbers and costs of occupational injuries and illnesses are significant in terms of morbidity and dollars, yet our understanding of time trends is minimal. We investigated trends and addressed some common hypotheses regarding causes of fluctuations.

Methods. We pulled data on incidence rates (per 100 full-time employed workers) for injuries and illnesses from the U.S. Bureau of Labor Statistics and on costs and benefits from the National Academy of Social Insurance for 1973 through 2007. Rates reflected all injury and illness cases, lost work-time cases, and cases resulting in at least 31 days away from work. We adjusted dollar costs (premiums) and benefits for inflation and measured them per employed worker. We plotted data in time-trend charts and ran linear regressions.

Results. From 1973 to 1991, there was a weak to nonexistent downward trend for injury and illness rates, and rates were strongly and negatively correlated with the unemployment rate. From 1992 to 2007, there were strong, consistent downward trends, but no longer were there statistically significant correlations with unemployment. Significant predictors (and signs) of workers' compensation premiums for 1973–2007 included medical price inflation (positive), number of lost-time injuries (positive), the Dow Jones Industrial Average (negative), and inflation-adjusted interest rate on U.S. Treasury bonds (negative). Dollars of benefits were positively and significantly predicted by medical inflation and number of lost-time cases. For 1992–2007, the Dow Jones variable was the only robust predictor of premiums; the number of injuries was not a significant positive predictor.

Conclusion. We had two major conclusions. First, the year 1992 marked a sharp contrast in trends and correlations between unemployment and incidence rates for occupational injuries and illnesses. Second, for the entire time period (1973–2007), insurance carriers' premiums were strongly associated with returns on investments.

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Roughly four to five million new job-related injury and illness cases are recorded each year by the U.S. Bureau of Labor Statistics (BLS) in the Survey of Occupational Injuries and Illnesses (BLS-SOII).[1] The annual cost for workers' compensation in 2007 was $85 billion.[2] In recent years, only a few studies have addressed national trends of numbers of cases or incidence rates; however, none of these studies addressed whether trends differed before and after 1992. Moreover, each of the studies has limitations for our purposes because they focus on either short time frames, only specific types of injuries, or only specific geographic areas.[3–9] Finally, no studies addressed predictors of workers' compensation costs or paid benefits. We used national time-series data from 1973–2007 to test for a change in patterns before and after 1992 for injuries and illnesses and to investigate predictors of workers' compensation costs and paid benefits.

Understanding trends and exploring possible predictors are important for health policy and planning. Some researchers suggest that there has been a downward trend in the number and rate of injuries and illnesses since the inception of the Occupational Safety and Health Administration (OSHA) in 1970.[8,10] However, this decline may only be apparent for the 1990s and 2000s. Fluctuations in national unemployment rates and the business cycle are alleged to be strongly associated with injury rates,[3,7,11,12] but this association may have ended in 1992. The apparent steady decline in injury rates since the early 1990s has led some observers to wonder why workers' compensation costs have not also demonstrated a steady decline. Some researchers have suggested that severe injuries are rapidly increasing and can partially explain why workers' compensation costs have not declined.[13] We investigated an additional cause of fluctuations in costs: fluctuating returns on investment (ROIs) by workers' compensation carriers.

METHODS

Previous literature and hypotheses

In recent years, the BLS-SOII has been reporting declines in the numbers of cases as well as incidence rates virtually every year. These continual declines are frequently touted in print media,[12,14,15] and a number of studies have documented and investigated the steady decline.[4,9,16] An impression one might glean from these reports and scientific studies is that injury and illness cases and rates have been dropping for a long time, perhaps since the 1970 Occupational Safety and Health Act.[17] However, media reports typically only mention the last few years, and studies and newspaper articles do not include data prior to 1992. One reason that the studies chose 1992 was because that was the year that the BLS instituted significant changes in its techniques for collecting and presenting data. But there are other reasons. State workers' compensation laws and enforcement procedures have changed; outsourcing, employment of undocumented workers, and globalization have increased;[8,16] and there were additional BLS changes in recordkeeping in 1995 and 2001.[9] But none of these authors tested whether there was, in fact, a break in the time-series pattern in the early 1990s.

One factor that has received considerable attention in the literature as a potential predictor of numbers of cases and rates is the unemployment rate, or some other measure of the business cycle.[3,8,11,12] However, there are conflicting theories. On the one hand, adding new workers results in declining unemployment. New hires are generally unfamiliar with hazards at the new job and tend to have higher injury rates than more experienced workers. In addition, the expansion of output accompanying falling unemployment could lead to more injuries as firms ramp up production and work intensifies.[18] In the same vein, as recessions deepen and firms cut workforces, firms are more likely to lay off the new hires, workers with less experience, and workers whom firm managers believe are accident-prone. On the other hand, some researchers assert that workers who anticipate unemployment quickly file for workers' compensation claims because they are thought to be more generous than unemployment compensation claims.[19]

Our hypothesis, derived from Krueger,[12] was that there was a break in the time series in 1992 and that the break contained two parts. First, there was either a slight or no secular long-term downward trend in reported rates prior to 1992, but there was a sharp downward trend after 1992. Second, injury incidence rates were responsive to the unemployment rate and the business cycle prior to 1992, but cases and rates were no longer responsive after 1992.

A test of this two-part hypothesis required that we also control for other covariates thought to be important in explaining fluctuations in incidence rates. Ideally, we would like to have added as many covariates as mentioned in the literature. However, we had a limiting factor: sample size. We had only 19 observations before and 17 observations after 1992. The control variables we added were percent of total employment accounted for by manufacturing, percent of employed who were younger than 25 years of age, and percent who were female. Morse et al.[6] suggested that percentage in manufacturing was an important predictor, but Conway and Svenson[4] disagreed. Shuford and Wolf[8] drew attention to the increasing numbers of baby boomers and females in the workforce. Baby boomers in the 1970s and women had less average work experience than those with tenure; therefore, they may have contributed to fluctuations. We simply wanted to test whether our two-part hypothesis could be explained away by other covariates that are popular in the literature.

The literature on trends in workers' compensation costs and paid benefits is sparse.[2] We measured costs as premiums that workers' compensation carriers charged business customers. Benefits were measured as the dollars these carriers paid to physicians and hospitals to care for injured workers, as well as indemnity benefits paid to injured workers to (partially) replace their lost wages. Sengupta et al.[2] showed a slight downward trend from 1989 to 2007, but with two clear waves: one wave peaking in 1990 and the second wave peaking in 2004.

We are not aware of any studies that attempted to explain fluctuations in national costs and benefits using time-series data. Therefore, we did not focus on any break in time series in 1992; rather, we focused on separate hypotheses in the literature regarding predictors of costs and benefits. We first considered costs. The most obvious hypothesis would be that increasing numbers of cases or increasing rates should lead to increasing costs per employed worker, and that the converse would also be true (i.e., more injuries should correspond to more total costs). A related hypothesis is that increasing severity of injuries should lead to increasing costs, and vice versa.[13] We therefore included covariates measuring numbers of injury and illness cases ("all cases") as well as numbers of cases resulting in lost time from work ("lost-time cases").

We derived a separate hypothesis from Sengupta et al.,[2] who pointed out that private workers' compensation carriers do not simply hold cash; they invest it, and their ROIs may influence how much they charge in premiums. We considered the Dow Jones Industrial Average (DJIA) and the real interest rate on U.S. Treasury bonds as measures of rates of financial ROIs. Finally, Sengupta et al. pointed to the rising share of medical benefits in the total amount of workers' compensation benefits paid. Even though benefits are not the same as costs (premiums), it seems logical that costs should be influenced by this trend toward increasingly higher payments to medical providers. We therefore added medical cost inflation as a covariate. Our dependent variable was inflation-adjusted costs per employed worker, but our inflation adjustment was the Consumer Price Index (CPI) covering all products and services. Medical inflation exceeded the general CPI inflation for all years, 1973–2007.

Our benefits regressions were similar to the cost regressions except that the benefits regressions excluded the DJIA and the Treasury bill rate. There was no theoretical rationale to include the latter two as covariates, explaining the amount of money carriers paid to medical providers or injured workers.

We did not include manufacturing, unemployment, or percentage female or younger than 25 years of age as covariates for either costs or benefits. These covariates were intended to predict injuries and illnesses, but direct measures of injuries and illnesses were already included in our regression analyses for costs and benefits.

Data

We drew numbers of injury and illness cases and incidence rates (cases per 100 full-time employed workers) for the private sector from the BLS-SOII for 1973–2007.[1] In recent years, the annual survey collected data from roughly 190,900 private firms, establishments, and governments. In 2007, for example, data represented roughly 296,082 nonfatal injury and illness cases involving days away from work, as well as more than an equal number of cases not involving days away from work.[1] BLS uses these data to extrapolate the annual numbers of cases nationwide.

Data collection efforts were modified in 1992. First, deaths were no longer recorded in the BLS-SOII; BLS began collecting deaths with the Census of Fatal Occupational Injuries program in 1992. However, this change did not affect our trends analysis, as deaths typically comprise less than one-tenth of 1% of the total. Second, BLS began asking businesses for more information on cases with days away from work. For example, beginning in 1992, data became available on cases involving at least 31 days away from work. These cases are the only information BLS has on whether an injury was very severe.

Data on workers' compensation costs to employers and benefits for workers and medical providers were drawn from the National Academy of Social Insurance.[2] For employers that insured with insurance carriers, employer costs were simply the premiums carriers charged. For employers that were self-insured, employer costs corresponded to benefits plus administrative expenses.

Analyses

For injuries, our strategy was to first present data on incidence rates during 1973–2007 in time-trend figures to show the pattern both before and after 1992. We used incidence rates for cases for the years 1973–2007 and plotted time trends. Because BLS sample sizes were large (e.g., >700,000 in 2007), these means have very small standard errors.[1] We also plotted numbers of cases over time.

Second, we ran linear regressions with indicator variables for 1992 to determine if there was a statistically significant break in the intercept and slope in 1992. Third, we divided samples into the early years (1973–1991) and the later years (1992–2007) and ran separate linear regressions on each time period that included a time trend, the unemployment rate, the percent of total employment attributed to manufacturing, the percent of employed who were younger than 25 years of age, and the percent female.

For workers' compensation costs and benefits, our strategy differed somewhat. We adjusted costs and benefits by first dividing by the CPI to account for inflation, and then dividing by the total number of people employed in the economy so that dollars would be expressed in a per-capita amount. Our dependent variables were per employed worker in the U.S., not per injury or per case.

We began by presenting means on costs and benefits in a time chart. Most of our analyses focused on all years, 1973–2007. Some analyses, however, were directed at the later years, 1992–2007. We wanted to test what role very severe injuries might have played in explaining fluctuations. The best measure of very severe injuries was the variable for at least 31 days of work lost, but BLS provided information on this variable only beginning in 1992.

For the years 1973–2007, and for the dependent variable for workers' compensation costs per employed worker, covariates (and hypothesized sign) included medical inflation (positive), the DJIA (negative), interest rate on Treasury bills (negative), numbers of all cases (positive), and numbers of cases with lost work time (positive). For 1992–2007, we included these variables as well as the variable for at least 31 days of work lost (positive).

For the years 1973–2007 and for the dependent variable for workers' compensation benefits per employed worker, covariates included medical inflation (positive), numbers of all cases (positive), and numbers of cases with lost work time (positive).

Sources for covariates included the following: numbers of employed people, nationwide, and percent of employment in manufacturing;[20] unemployment rate;[21] medical inflation;[22] the DJIA; and the interest rate on Treasury bonds.[23] We preferred to use Yahoo! Finance[23] because it provided the annual average for the DJIA and Treasury bond interest values; we believe annual averages are more representative than the year-end values available from the Statistical Abstract of the United States.[20]

Because covariates were measured in dissimilar units (e.g., dollars and percents), and because their variances differed, we took two approaches to account for these varied covariates. In the first, we estimated elasticity. Elasticity is a measure of the strength of an association in linear regression, similar to an odds ratio in logistic regression. To estimate elasticity, continuous variables were converted to logs prior to running regressions. This technique resulted in coefficients that were elasticities. However, because elasticities do not account for the range of variability in the covariates or what different values of covariates are possible, we estimated standardized regression coefficients. The standardized coefficient measures the amount of the change in the dependent variable associated with a one standard deviation (SD) change in the covariate.[24] To standardize all continuous variables, we subtracted the sample mean from all values of the variable and divided the difference by the SD of that variable. Whereas the standardized coefficient has the advantage of accounting for variances, the elasticity has the advantage of intuition (i.e., percentages are easier to understand than changes in SDs).

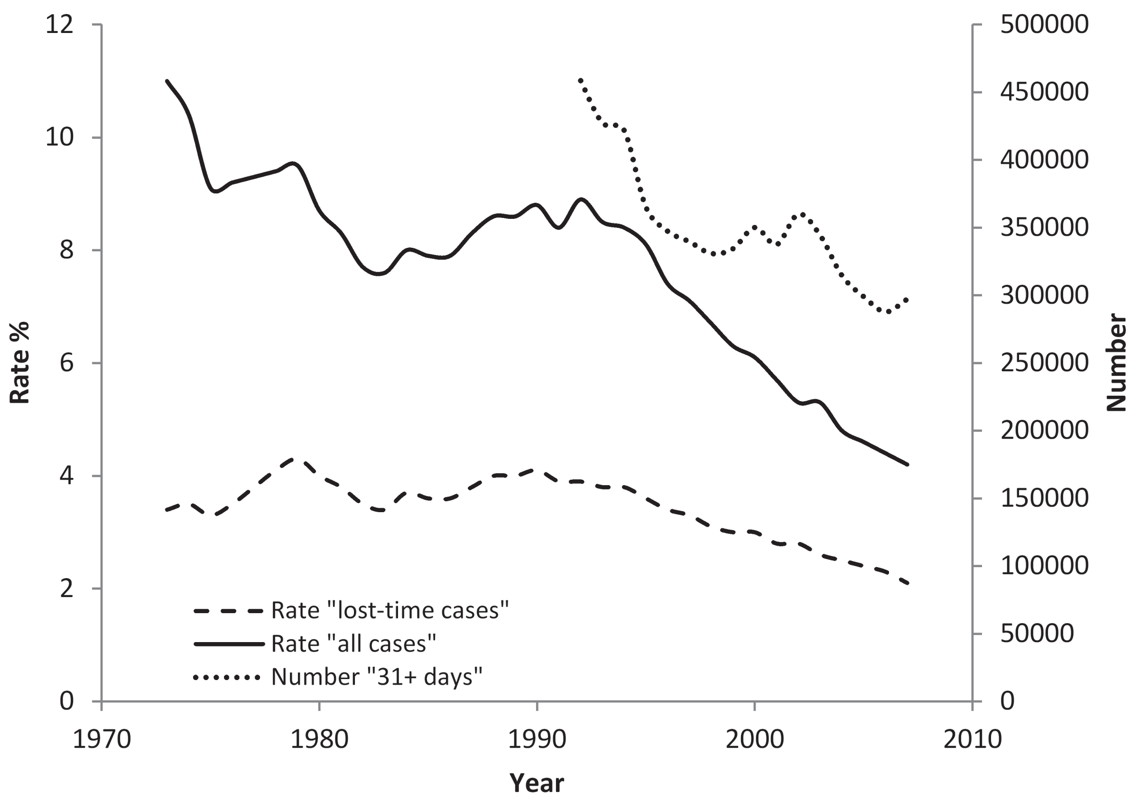
RESULTS

We had several dependent variables: incidence rates for all cases, incidence rates for lost-time cases, costs (premiums) per employed worker, and paid benefits per employed worker. In addition, the dependent variables were sometimes treated as logs and sometimes as standardized variables.

Figure 1 presents incidence rates for three different variables: all private-sector BLS cases (1973–2007), lost-time cases (1973–2007), and numbers of only those cases with at least 31 days away from work (1992–2007). Considering the 1973–2007 incidence rate data, there were waves prior to 1992 and a consistent downward trend from 1992 to 2007. Local maximums for the late 1980s and early 1990s, occurring in 1992, were 8.9 for all cases and 4.1 for lost-time cases. The 1992 break was even more apparent for time-trend charts of numbers of all cases and lost-time cases: waves were apparent from 1973 to 1991, but there was a pronounced steady drop from 1992 to 2007. The trend for the ≥31 days away from work category was downward from 1992 to 1997, flat from 1998 to 2003, and downward again from 2004 to 2007.

Table 1 presents linear regression results with incidence rates for all cases between 1973 and 2007 (regression #1), between 1973 and 1991 (regression #2), and between 1992 and 2007 (regression #3). Regression #1 tested for differences in time trends

Figure 1. Trends in lost-time cases, all cases, and ≥31 lost days of work cases,[a] U.S., 1973–2007



[a]Data available only for 1992–2007 for ≥31 lost days of work cases

between 1973–1991 and 1992–2007. A slight downward trend was apparent from 1973 to 1991 for all cases ($p<0.0001$) (Table 1) and an upward trend was apparent for lost-time cases ($p<0.0001$) (data not shown). We calculated the trend beginning in 1992 by adding the two time-trend coefficients (−0.0116 minus 0.0405

Table 1. Linear regression results for log of injuries and illnesses in the U.S., 1973–2007

Covariates	*Regression #1: 1973–2007 Coefficient (p-value)[a]*	*Regression #2: 1973–1991 Coefficient (p-value)[a]*	*Regression #3: 1992–2007 Coefficient (p-value)[a]*
Time trend 1,…, 35 for 1973–2007; 1,…, 19 for 1973–1991; and 1,…, 17 for 1992–2007	−0.0116 (<0.0001)	−0.0119 (0.2020)	−0.0650 (0.0129)
Time shift 0,…, 0 through 1991 and 1,…, 1 for 1992–2007	0.9727 (<0.0001)	NA[b]	NA[b]
Time trend × time shift	−0.0405 (<0.0001)	NA[b]	NA[b]
Sum of two time-trend coefficients	−0.0521	NA[b]	NA[b]
Log unemployment rate	NA[b]	−0.3148 (0.0009)	−0.0737 (0.5991)
Log percent manufacturing	NA[b]	−0.0514 (0.9175)	−0.1308 (0.7747)
Log percent employed who were <25 years of age	NA[b]	−0.2454 (0.4143)	−0.6366 (0.3152)
Log percent employed who were female	NA[b]	−0.7598 (0.1565)	1.8560 (0.3179)
Intercept	2.2835 (<0.0001)	6.4087 (0.0095)	−3.1330 (0.6235)
Adjusted R-squared	0.9475	0.9223	0.9942

[a]Statistical significance of entire regression (F-statistic) for all regressions was $p<0.0001$.

[b]Covariate did not enter regression.

NA = not applicable

= −0.0521 for all cases, and 0.0255 minus 0.0531 = −0.0276 for lost-time cases; data not shown). A one-time shift upward was apparent in 1992 for both all cases and lost-time cases. The statistical significance on the 1992 time-shift indicator variable and the interaction between the time-shift variable with the time-trend variable suggested that there was a break in the time series in 1992.

Regressions #2 and #3 tested for correlations between unemployment and injury rates in the two time periods while simultaneously accounting for control variables, including percent manufacturing, percent younger than 25 years of age, and percent female. For the 1973–1991 data (regression #2), the unemployment rate was strongly statistically significant with a negative sign (p=0.0009). For the 1992–2007 data (regression #3), unemployment was not statistically significant (p=0.5591). Moreover, the time-trend coefficient for the 1973–1991 period was smaller (in absolute value) than the one for the 1992–2007 period. Similar patterns were observed for the lost-time cases (data not shown).

Additional analyses involved placing covariates into diagrams to test for trends over time. The percent of employment in manufacturing gradually decreased virtually every year. Unemployment fluctuated with the business cycle (e.g., high in 1981–1985 and low in 1996–2000). No apparent break for these control variables was observed for 1992.

In Figure 2, the top two lines present data on inflation-adjusted, per-employed-worker workers' compensation costs (premiums) and dollar benefits from 1973 to 2007. These costs and benefits rose and fell (somewhat) in tandem except for roughly 1978–1983 and 2001–2006. The ratio of costs to benefits might be relatively stable in the long run, assuming that ratios of reserves to benefits, administrative costs to benefits, and profits are stable over time. This ratio highlights the larger disparities between costs and benefits that occurred roughly during 1978–1983 and 2001–2006.

We found a striking similarity in incidence rates: the years 1992–1994 were local maximums for all cases and lost-time cases, and absolute maximums for costs and benefits. We also found a striking dissimilarity. From roughly 1992 to 2007, incidence rates steadily declined (Figure 1); however, costs and benefits continued to fluctuate from 1992 to 2007 (Figure 2).

Table 2 presents results from three multiple linear regressions, all using national data for which the dependent variable was premiums (workers' compensation costs) adjusted for inflation and divided by the number of people employed (real costs per employed worker). All three linear regressions contained the critical

Figure 2. Time trend for real costs, real benefits per employed worker, and costs-to-benefits ratio: U.S., 1973–2007

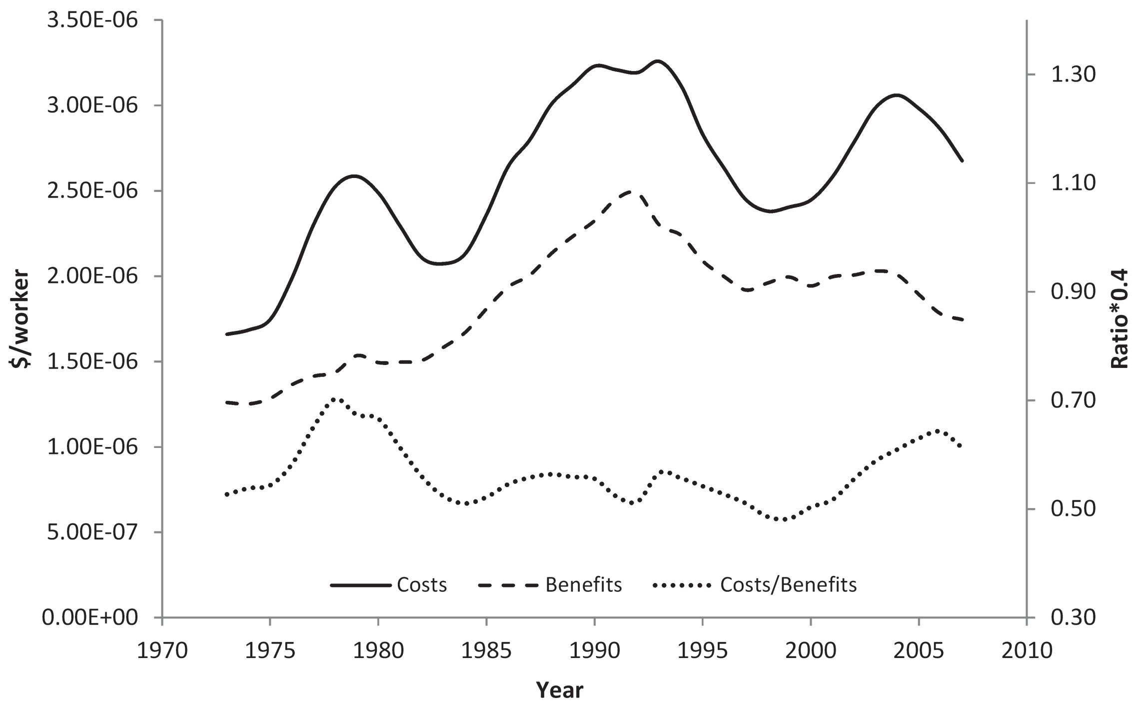


Table 2. Linear regression results for log of real cost (premiums) per employed worker: U.S., 1973–2007

Covariates	Regression #1: 1973–2007[a] Coefficient (p-value)[b]	Regression #2: 1973–2007[a] Coefficient (p-value)[b]	Regression #3: 1973–2007[a] Coefficient (p-value)[b]
Log medical price index	0.7274 (<0.0001)	0.5801 (<0.0001)	0.4261 (0.0003)
Log Dow Jones Industrial Average	−0.4495 (<0.0001)	−0.4103 (<0.0001)	−0.3700 (<0.0001)
Log Treasury bill interest rate	−0.4147 (0.0004)	−0.4732 (<0.0001)	−0.5125 (<0.0001)
Log number of all cases	0.3646 (0.0012)	NA[c]	−0.5240 (0.0317)
Log number of lost-time cases	NA[c]	0.5523 (<0.0001)	1.1391 (<0.0001)
Intercept	−17.7567 (<0.0001)	−19.7016 (<0.0001)	−19.6898 (<0.0001)
Adjusted R-squared	0.7893	0.8430	0.8619

[a]Regression #1 omitted the lost-time-cases covariate, regression #2 omitted the all-cases covariate, and regression #3 included all covariates.

[b]The sample size was 35 for each regression. The statistical significance of the entire regression (F-statistic) for all regressions was $p<0.0001$.

[c]The covariate did not enter regression.

NA = not applicable

variables for medical price inflation, DJIA, and Treasury bill interest rate. We treated inclusion and exclusion of covariates for all cases and for only lost-time cases differently due to collinearity. In regression #1, the all-cases covariate was included, but the lost-time covariate was omitted. In regression #2, the all-cases covariate was omitted, but the lost-time covariate was included. In regression #3, both covariates were included. The medical inflation index always entered with a positive and statistically significant coefficient. Elasticities on medical inflation ranged from 0.43 to 0.73, suggesting that, for example, a 10% increase in the medical price index (i.e., a 10% rate of medical inflation) was associated with a 4.3% to 7.3% increase in the real, per-worker cost of workers' compensation. This finding was reasonable given that medical inflation exceeded general inflation for all years, 1973–2007. Both the DJIA and the interest rate were statistically significant.

In regression #1, the all-cases covariate entered significantly and was positive. However, in regression #3, which included both covariates, the all-cases covariate entered with a negative sign and was statistically significant. The lost-time cases variable entered positively and statistically significantly in both regressions in which it was entered.

We also ran regressions identical to those in Table 2 with standardized variables that generated standardized coefficients. The rank order of statistically significant covariates (and corresponding coefficients) was medical inflation (2.1504), DJIA (−1.6697), and all cases (0.2115) for regression #1; medical inflation (1.7213), DJIA (−1.4331), and lost-time cases (0.3484) for regression #2; and DJIA (−1.5171), medical inflation (1.2562), lost-time cases (0.9945), all cases (−0.6715), and Treasury bill interest rate (−0.4795) for regression #3 (data not shown).

Table 3 presents linear regression results for the dollar benefits dependent variable. This variable was real, per-employed-worker workers' compensation dollar benefits. All regressions always included the medical inflation index. Regressions #1 and #2 alternately included and excluded the all-cases covariate and the lost-time covariate due again to collinearity. The medical price index always entered with a positive sign and

Table 3. Linear regression results for log of real benefits per employed worker: U.S., 1973–2007

Covariates	Regression #1: 1973–2007[a] Coefficient (p-value)[b]	Regression #2: 1973–2007[a] Coefficient (p-value)[b]	Regression #3: 1973–2007[a] Coefficient (p-value)[b]
Log medical price index	0.2626 (<0.0001)	0.1617 (0.0001)	0.1986 (<0.0001)
Log number of all cases	0.6556 (<0.0001)	NA[c]	0.2588 (0.1982)
Log number of lost-time cases	NA[c]	0.7120 (<0.0001)	0.4622 (0.0343)
Intercept	−24.7050 (<0.0001)	−24.5162 (<0.0001)	−25.0360 (<0.0001)
Adjusted R-squared	0.8501	0.8633	0.8664

[a]Regression #1 omitted the lost-time-cases covariate, regression #2 omitted the all-cases covariate, and regression #3 included all covariates.

[b]The sample size was 35 for each regression. The statistical significance of the entire regression (F-statistic) for all regressions was $p<0.0001$.

[c]The covariate did not enter regression.

NA = not applicable

was statistically significant. Elasticities were somewhat smaller than those in the cost regressions in Table 2. In Table 3, elasticities on medical inflation ranged from 0.16 to 0.26. Statistically significant *p*-values were found for the all-cases and lost-time-cases covariates in regressions #1 and #2. Only the lost-time-cases covariate was statistically significant in regression #3, however.

We also ran regressions identical to those in Table 3 with standardized variables that generated standardized coefficients. The rank order of statistically significant covariates (and corresponding coefficients) was medical inflation (0.8193) and all cases (0.6864) for regression #1; lost-time cases (0.7096) and medical inflation (0.4591) for regression #2; and lost-time cases (0.6188) and medical inflation (0.5118) for regression #3 (data not shown).

Table 4 presents results only for the years 1992–2007 with real cost per worker as the dependent variable. We again considered medical price index, DJIA, interest rate on the Treasury bill, and all cases as covariates. The new covariate (only available beginning in 1992) was number of cases with ≥31 days of work loss. Because there were so few observations (n=16), we also ran some regressions with limited numbers of independent variables. Despite the limited number of observations, our standard covariates (medical price index, DJIA, and interest rate) always entered with the hypothesized signs (positive, negative, and negative, respectively), while the variable that achieved statistical significance in all regressions in Table 4 was the DJIA. We also found that the all-cases covariate entered with a negative sign and was statistically significant in both regressions #2 and #3. The ≥31 days covariate entered with a positive sign but never achieved statistical significance when it was expressed as a log; when it was expressed as a standardized variable, statistical significance was achieved with a positive correlation in three of four regressions. We concluded that the evidence on the ≥31 days variable is suggestive rather than definitive; more severe injuries may be associated with greater total cost.

DISCUSSION

The national annual incidence rates of reported job-related injuries and illnesses, as well as the costs to employers and benefits to workers and medical providers from workers' compensation systems, fluctuate over time. However, few studies have addressed these fluctuations in recent years. In part, this lack of knowledge is the result of the few datasets available. We are aware of only one dataset for incidence rates[1] and one for costs and benefits.[2] (The National Council on Compensation Insurance[25] collects data from the majority of states, but does not regularly publish national annual estimates for all 50 states combined.)

Considerable attention has been focused on the secular decline in reported cases after 1992.[4,12,16,18] Less has been written combining all years since OSHA statistics became available. The zigzagging waves and slight downward trend for rates from 1972 to 1991 were replaced by a consistently strong downward trend from 1992 until 2007 for all cases and for lost-time cases. In addition, we found like others that incidence rates were procyclical: as the economy expanded and unemployment fell, incidence rates increased; however, as the economy contracted and unemployment increased, incidence rates decreased. For 1992–2007, correlations between unemployment and injury rates were not statistically significant. Finally, we found that the 1992 break may even have been apparent in the workers' compensation cost and benefits data.

Krueger may have been the first to notice the

Table 4. Linear regression results for log of real cost (premiums) per employed worker: U.S., 1992–2007

Covariates	*Regression #1: 1992–2007[a] Coefficient (p-value)[b]*	*Regression #2: 1992–2007[a] Coefficient (p-value)[b]*	*Regression #3: 1992–2007[a] Coefficient (p-value)[b]*	*Regression #4: 1992–2007[a] Coefficient (p-value)[b]*
Log medical price index	0.8315 (0.0005)	0.0573 (0.8922)	−1.3804 (0.1237)	0.1345 (0.7821)
Log Dow Jones Industrial Average	−0.3802 (<0.0001)	−0.3319 (<0.0001)	NA[c]	−0.3394 (0.0001)
Log Treasury bill interest rate	−0.1808 (0.1176)	NA[c]	0.2189 (0.4034)	−0.0508 (0.7045)
Log number of all cases	NA[c]	−0.7210 (0.0320)	−1.7446 (0.0348)	−0.6219 (0.1489)
Log number of cases ≥31 days of work lost	0.3847 (0.0620)	0.2534 (0.1964)	0.5050 (0.2183)	0.2577 (0.2094)
Intercept	−18.6255 (0.0001)	−2.2111 (0.7922)	15.0974 (0.4449)	−4.0794 (0.6853)
Adjusted R-squared	0.8777	0.9002	0.5413	0.8919

[a]Regression #1 omitted the all-cases covariate, regression #2 omitted the interest rate covariate, regression #3 omitted the Dow Jones Industrial Average covariate, and regression #4 included all covariates.

[b]The sample size was 16 for each regression. The statistical significance of the entire regression (F-statistic) for all regressions was $p<0.0001$.

[c]The covariate did not enter regression.

NA = not applicable

1992 break.[12] He used the term "mystery" to describe a reason for the break, and we tend to concur. It is beyond the scope of this article to definitively determine the reasons. We nevertheless can suggest some explanations. It could be that outsourcing from larger to smaller firms and an increasing reliance on independent contractors in the 1990s and 2000s were partially responsible for underreporting of injuries to the BLS.[16] It could also be that changes in OSHA policy and enforcement were a factor. In the late 1980s, OSHA fines for recordkeeping violations and press coverage may have led to a reaction by firms in the 1990s.[26] For example, firms may have responded by simultaneously improving their recordkeeping and providing safer workplaces. In addition, OSHA changed its reporting form from Form 200 to Form 300 in 2002. OSHA requires most employers with 10 or more full-time employees to keep a yearly log—the OSHA Form 300—for all work-related injuries and illnesses. There were many changes between Form 200 and Form 300, the most noteworthy of which were (*1*) in Form 200, all significant injuries and illnesses were recorded; in Form 300, this requirement was dropped; and (*2*) Form 300 required recording days away from work based upon calendar days rather than scheduled workdays as in Form 200. Another possible explanation for the 1992 break is that state legislatures may have tightened eligibility rules for receiving workers' compensation benefits during the 1990s.[27] Finally, this break is consistent with the hypothesis advanced by Friedman and Forst[9] that changes in BLS data-collection efforts in the 1990s and 2000s may be partially to blame.

Our results on costs (premiums) suggest that medical inflation and ROI as measured by either the DJIA or interest on Treasury bills were the important predictors. The number of all cases was negatively associated with costs when the number of time-lost cases was also entered as a covariate. On face value, this result was unexpected. Presumably, the greater the number of cases, the greater the overall costs. But it could be that over time, increasing costs were being generated by more severe injuries, and these would more likely be reflected in time lost rather than all cases. Workers' compensation injuries have a long tail (i.e., insurance companies must pay for the injuries for the claimant's lifetime). Premiums, therefore, may be especially responsive to rising and forecasted increases in severe injuries.

We attempted to test this hypothesis about the most serious injuries creating the greatest increase in costs in recent years with the ≥31 days away from work variable. We first noticed that this variable did not follow the pattern of the all-cases or lost-time-cases variables after 1992. The ≥31 days away from work variable only dropped modestly during 1992–2007 and the percent of cases that were in the ≥31 days category actually rose. The ≥31 days away from work variable was never statistically significant in our results. However, it was significant for three of four regressions based upon the standardized coefficients. We believe the hypothesis is reasonable and perhaps was statistically insignificant due to a small sample size.

Results on the DJIA and all-cases variables were noteworthy. Of all covariates we considered in predicting costs in this 1992–2007 time range, the DJIA variable was the most robust, consistently generating the lowest *p*-values ($p<0.0001$) and the highest elasticities (-0.33 to -0.38) and standardized coefficients (-1.355 to -1.359). Insurance carriers may have lost considerable revenue on their financial investments, independent of their underwriting activities. The all-cases covariate was the second most robust in our results. The negative coefficient on all cases suggests that the falling number of cases predicted a rising level of costs. These two findings—for DJIA and all cases—are important. First, they are consistent with the notion that carriers profit more from investments than from underwriting. The converse is likely also true: carriers lose profits on investments and, when they do, must raise premiums to compensate. Second, these results demonstrate that a public perception[28] is incorrect: in recent years, rising workers' compensation costs have not been driven by increasing numbers of workers filing claims; rather, the costs are more likely the result of falling investment income for insurance carriers.

Limitations

The BLS-SOII does not sample employees on farms with fewer than 11 employees, the self-employed, or other out-of-scope workers (e.g., domestic workers). However, most of these same workers (e.g., self-employed) would not qualify for workers' compensation.[2] Secondly, the BLS likely underestimates the number of workers' compensation cases.[29] However, numbers of BLS-SOII cases and numbers of workers' compensation cases are likely to be strongly correlated, thereby bearing little effect on the results.

It is also difficult to collect data on, or define, serious or severe occupational injury and illness cases.[14] One definition for these cases might be those injuries and illnesses that fall into the workers' compensation category of "permanent partial disability." But there are no national, publicly available data on annual averages for permanent partial disabilities. The BLS, for example, does not have information on workers' compensation categories. The next best available alternatives for serious cases were the variables we analyzed: lost-time cases and cases that resulted in ≥31 days of work loss. The BLS-SOII has also been criticized for not counting days lost beyond 365. However, the number of cases with ≥31 days of work loss will include those with more than 365 days. Nevertheless, a measure that includes all days lost would have been more accurate.

CONCLUSION

This study demonstrated that published annual national data from the BLS-SOII and the National Academy of Social Insurance could be used to generate time plots and linear regressions that provide insights into trends and fluctuations in injury and illness incidence rates, as well as dollars of workers' compensation premiums and benefits. The strong downward trend in incidence rates, which have been frequently commented upon,[12] originated in 1992; there was only a weak or nonexistent downward trend prior to 1992. Whereas incidence rates were procyclical prior to 1992, there was no correlation between rates and the business cycle as measured by the unemployment rate after 1992. Medical inflation, the Dow Jones average, interest on Treasury bonds, and number of lost-time cases were predictive of costs (premiums), while medical inflation and lost-time cases were predictive of dollar benefits. Finally, recent increases in workers' compensation costs were likely the result of declines in the value of financial investments by insurance carriers rather than increases in the numbers of new injuries and illnesses.

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