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Excess Healthcare Costs Associated With Prior Workers' Compensation Activity

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Background *Workers compensation (WC) does not fully compensate workplace injuries and illnesses. This work examines whether cost shifting occurs to group health insurance for work-related injuries and illnesses.*

Methods *Thomson Reuters MarketScan databases of medical insurance claims were used. WC and other benefit system data, employee status and types of medical insurance coverage were also available. Medical cost was analyzed using two-part models: the first part modeled the monthly probability of a worker having any group health medical claims, and the second part modeled the total monthly cost of those medical claims. Models included an estimate of a worker's annual medical costs prior to a WC claim. The predicted monthly medical costs were derived by retransformation using Duan's smearing factor.*

Results *Individuals with prior WC claims were more likely to file a group health medical claim compared to those with no prior WC claims (OR = 1.25) and incurred a higher average monthly medical costs (among nonunion hourly men aged 18–34 years with prior WC claims: $203.72 vs. $160.29 with no prior claim, an increase of $43). These increases were observed in all industrial sectors with the service sector having the highest monthly increase ($66).*

Discussion *The results reveal that individuals with prior WC claims had higher probability of filing a group health medical claim and higher average monthly medical costs in all sectors. This suggests that a part of employer liability costs related to WC gets shifted to the group health medical insurance system.* Am. J. Ind. Med. 55:1018–1027, 2012. © *2012 Wiley Periodicals, Inc.*

KEY WORDS: workers compensation; health insurance; occupational disease two-part models

INTRODUCTION

Workers' compensation (WC) is a social insurance program providing cash benefits, medical care, and rehabilitation services to workers disabled by work-related injuries or illnesses. It is also the oldest social insurance program in the United States [Thomason and Burton, 1993]. In 2008, $57.6 billion were paid out in WC benefits (including medical costs), and employer costs for WC amounted to $78.9 billion [Sengupta et al., 2010]. WC programs have undergone considerable growth, particularly since the mid-1970s [U.S. Department of Health and Human Services, 1989]. Correspondingly, employers' costs as a percentage of total payroll costs have also increased. According to LaDou [2005], the WC systems administered by each state poorly serve the needs of many injured workers, and are unpopular with many employers and health care providers as well. While most states have similar approaches to providing WC benefits, they differ,

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often dramatically, on the level and scope of permanent disability benefits, coverage of mental health conditions resulting from work, and insurance and claims administration regulation [Clayton, 2003/2004]. Workers' Compensation, on average, covers <25% of the $250 billion (for 2007) estimated annual cost of occupational injuries, illnesses and fatalities [Leigh, 2011]. Mistrust, denial of claims, stigmatization, payment delays, and refusals to pay benefits are common experiences for many workers who must deal with the system [Strunin and Boden, 2004]. WC fails to fully compensate many occupational injuries and fails to cover most illnesses, including fatalities [Boden, 2005; Jenkins, 2009]. Even when workers' applications are successful, WC payments often replace only a small portion of their lost earnings [Burton, 2006]. Numerous studies have also demonstrated that occupational injuries and illnesses are under-compensated by WC systems because there are conditions and incentives that discourage the submission of a WC claim [Ducatman, 1986; Biddle et al., 1998; Boden and Galizzi, 1999; Rosenman et al., 2000; Leigh et al., 2001; Leigh and Robbins, 2004]. After WC wage payments expire, injured workers on average never achieve the earning potential that they had before injury [Boden and Galizzi, 1999]. Experts estimate that only one out of 20 occupational disease victims receive WC benefits [U.S. Department of Labor, 1980]. There are ten times as many severely disabled occupational disease victims who receive Social Security Disability Insurance (SSDI) or early retirement benefits compared to those who receive WC benefits [Reville and Schoeni, 2003/2004]. This situation is perpetuated by systematic employer, physician, and even employee underreporting of occupational injuries and illnesses to the Occupational Safety and Health Administration (OSHA) and the Bureau of Labor Statistics (BLS) [Leigh et al., 1997; Morse et al., 2000; Rosenman et al., 2006; Boden and Ozonoff, 2008]. Many workers choose not to report for fear of employer retaliation.

Workers Compensation: The Problem of Cost Shifting

Health events that may precipitate entrance into the disability system need to be viewed in the larger context of the workplace environment. If workers, managers and doctors are maximizing their utility, then whether a health event becomes compensable under WC depends in part on the level of wages and benefits the worker receives, where the workers are in their training, how satisfied they are with their working conditions, how the work manager deals with productivity failure among the employees, how health care providers are reimbursed, etc. [Butler et al., 1997]. The disability system becomes not just a rehabilitation experience when health conditions are serious enough, but it can become an alternative that depends on more than just the ''objective'' nature of the health event. Both employer-offered group health and WC plans provide medical insurance to reimburse medical expenses. There are several financial incentives that can act to discourage the submission of a WC claim. Workers may avoid repeat WC claim submissions to protect themselves from a bad reputation in the firm by using their group health insurance to cover work related injuries and illnesses. This is the problem of cost shifting from WC to group health insurance. Furthermore there are gaps in WC coverage such that cost shifting is expected to be high in firms with inadequate WC policies, firms employing temporary daily workers or firms in the states where mandatory WC policies are not required, like Texas [Peele and Tollerud, 2001]. Also there are states where the WC policy allows employees to choose the medical provider for WC-related medical care. If the employee chooses to visit his or her personal care physician rather than an employer-designated occupational medicine provider, the costs of the medical care can be covered by the group health insurance rather than the WC system. Given these conditions and others, there is likely to be cost shifting to the group health medical care from the WC. There is also some evidence of cost shifting in the opposite direction in situations where employer incentives may favor that choice [Zwerling et al., 1991; Butler et al., 1997].

Some etiologic studies based on medical insurance records [Park et al., 1992; Lipscomb et al., 2009], OSHA logs [Nelson et al., 1992], or medical disability records [Park et al., 1996] imply that costs have been shifted from WC to other benefit systems such as medical insurance or short-term disability. Several investigators have proposed that since 1990 the SSDI has been absorbing an increasing burden of work-related conditions [Guo and Burton, 2008]. Another impediment to full compensation for work-related adverse health conditions is the subsequent occurrence of problems not easily identified as related to the original condition such that, as for illnesses, causation is difficult to prove or even suspect.

Our objective in this study is to investigate whether utilization of medical insurance, as manifest in claims frequency and costs, are predicted by prior WC experience.

DATA AND METHODOLOGY

Medical Cost Database

The data used here are from Thomson Reuters MarketScan databases on Health and Productivity Management (HPM) for the years 2001 through 2005. Some of the WC claims relate to injuries from earlier years. The data released by Thomson Reuters MarketScan to external clients is certified as de-identified according to HIPAA

rules and do not disclose individual identity, therefore IRB approval was not required. This database emphasizes healthcare costs and contains information on employees of participating employers (approximately 45 large employers) including utilization of medical care, short-term disability, and WC claims (a description of the MarketScan databases is available on request, Hansen and Chang, 2010, white paper). The number of employees at a particular facility or employer is unavailable in this dataset. The data comprise inpatient, outpatient and pharmacy services covered by a group health insurance system for individuals aged 18–64. For each month in which an employee is enrolled for medical insurance, MarketScan data specifies the employee age, gender, type of health insurance coverage, region of the U.S., industrial sector, and employee status (hourly/salaried; union/non-union). Seven types of medical insurance coverages were available: Health Maintenance Organization (HMO), Preferred Provider Organization (PPO), Exclusive Provider Organization (EPO), Point of Service (POS), Point of Service with capitation (POS CAP), Consumer Driven Health Plans (CDHP) and comprehensive. Seven industrial sectors were represented: retail trade; transportation, communication and utilities (TCU); manufacturing durables; manufacturing non-durables; services; finance, insurance and real estate (finance); and oil and gas extraction/mining. The regions included South, Northeast, North Central, West, and "unknown."

Two of the seven industrial sectors (retail trade and oil/gas) had no WC information available and were excluded and there was very sparse reporting for manufacturing non-durable, so it was dropped from the study as well. Also, there were not enough individuals covered by the CDHP and EPO health care plans, so these coverage types were dropped from the study. Additionally, there was an indicator for whether WC utilization information was available for each enrollee in each year. Based on WC claim dates, it appeared that when WC reporting was available in a given year, WC claim records were available for the previous years, in some cases going back many years to as far as 1979. Exactly which WC claims were reported is not known but likely were limited to "active" claims (claims that could still generate costs). WC information included dates of injury and return to work, days away from work, medical and indemnity (wage replacement) costs, and type of injury (free text). Two dummy variables related to WC claims were utilized in this study: (1) whether a worker in a specific month over the 4 year period had a prior WC claim and (2) whether a worker was known ever to have had a WC claim regardless of claim date. The latter WC variable was introduced as a proxy for non-time-dependent personal risk factors for WC, for example, obesity or depression, conditions not available in the databases that could contribute to medical costs. Another variable included was average annual medical expenses prior to the first WC claim in the years 2001 and 2002 to provide within-individual comparison of costs. This average prior cost was based on a minimum of 6 months of observation.

Methodology

The costs analyzed in this study consist of monthly group health medical expenses classified by prior WC claim status for the years 2003 through 2005. These expenses are *total costs* including out-of-pocket expenses not covered by the insurance benefits. Monthly medical expenditure can run from zero for individuals with no medical expenses to very large numbers for those with high medical costs. The distribution, therefore, has a spike at zero and then is approximately log–log-normally distributed as the medical expenses are continuous (Fig. 1). This mixture of zeroes and continuously distributed positive values cannot be readily described with a simple parametric form. Instead, the analysis followed a two-part process [Duan et al., 1983]. In a two-part model, charges for a health service are represented by a binary variable, y, which equals 1 if the service was used and 0 if it was not used, and a continuous variable, W, that represents charges if $y = 1$. Effects of covariates on y are estimated using logistic regression, and those on $W|y = 1$ are estimated using a linear regression model with log(W) as response (a "logged linear model (LM)") [Blough et al., 1999; Buntin and Zaslavsky, 2004]. This model actually takes advantage of the basic rule of probability, $E(W|x) = \Pr(W > 0) \times E(W|W > 0)$ and splits medical care

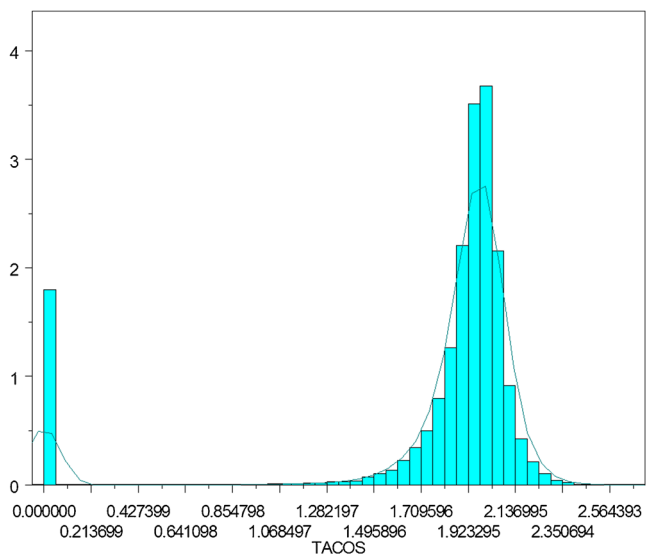

FIGURE 1. Distribution of average monthly total medical expenditures (transformed: TACOS = log(log(costs + 1) + 1); 1.923295 corresponds to $344/month).

consumption into two parts. The first part estimates Pr (any use or expenditures) using the full sample with a logit. The second part models expenditures conditional on $W > 0$ (that is, it uses the subsample with $W > 0$) using ln(W).

For the first part, each month of enrollment during 2003 through 2005 (n = 4,659,212) was classified based on prior WC claims. The predicted probability of non-zero monthly expenditures was obtained from models using logistic (binomial) regression, which estimates odds ratios in the form of $e^{x'a}$. Probability of any use was then derived from the odds ratios: $\text{Prob}(y^i > 0) = e^{x'a}/(1 + e^{x'a})$, for covariate vector x'. For the second part, ordinary least squares regression of log-transformed W (total healthcare expenditure > 0) was used which predicts average monthly medical costs conditional on nonzero costs. When dependent variables are transformed, predictions must be retransformed back to the original scale of W to draw useful conclusions about the original variables [Manning, 1998]. But if the log-scale errors are heteroscedastic (non-uniform variance), then retransformation can yield biased predictions (termed ''retransformation bias''), unless the variance of ln(W) can be sufficiently adjusted or a ''smearing'' function used with conditioning on covariates [Manning and Mullahy, 2001; Zhou et al., 2001]. If the error term is not normally distributed then the smearing estimator developed by Duan [1983] consistently estimates the expectation provided the errors are independent and identically distributed. The smearing factor is the average exponentiated residual from the ordinary least squares (OLS) procedure, a simple linear regression. The exponentiated predictions are then multiplied by the smearing factor to predict expected values on the original (unlogged) scale. The predicted values are then given by, $\widehat{W} = \Phi(X\widehat{\alpha}) \times \exp\left(X\widehat{\beta}\right) \times \widehat{D}$ (where $\widehat{D}$ is Duan's [1983] smearing estimator, and Φ = probability of nonzero charge).

Estimated monthly average medical expenses are obtained from the first and second part of the model grouped by gender, industries, and employee classification. These values are illustrated in the Tables II–IV. The outputs from the second part of the model (represented in Table III) are converted to dollar figures for a particular variable, using the expression, exp(estimated constant + estimate of binary covariate effects + estimate of the variable prior medical costs × (ln(average of prior medical cost of the group))). This is because the model uses ln(prior medical cost) as a variable. The costs shifted to the group health medical system from the WC system reported in Table IV are the difference in the average monthly medical costs between individuals with prior WC claims and those with no prior WC claims. This assumes that if there was no cost shifting, an individual with prior WC claim would have experienced the same medical expenses in the absence of any prior WC claim. For Tables II–IV the reference groups in the models comprise hourly, non-unionized males, aged 18–34, with no prior WC claims in the last 4 years residing in the northeast region, employed in manufacturing durables, and covered by PPO plans. Almost all estimated effects in this rich dataset are highly statistically significant.

RESULTS

For the four industry sectors reporting WC utilization, there were 4,659,212 person-months of observation for the years 2003 through 2005 and 186,919 WC claims. Table I presents the numbers and percentages of months of observation by industry sectors and coverage types. The most common coverage in finance was provided by HMOs (49%). Overall, PPOs covered 53% of enrolled employees followed by HMOs covering 20% of all claims.

Part-One Outputs: The Logistic Regression Model

Table II displays the odds ratios obtained from the (part one) logistic regression model for the entire sample and by the different industries. The complete sample, represented by the ''All Industries'' column reveals that females were more likely to file a medical claim than males (OR = 1.7). Individuals with prior WC claims have 1.25× the odds of filing a group health medical claim compared to those without any prior WC claim. The population residing in North Central (OR = 1.2) or South (OR = 1.1) were more likely to file for a medical claim compared to those residing in the Northeast region. The salaried workers (both unionized and non-unionized) and the hourly unionized workers were more likely to file for medical claims compared to hourly non-unionized workers. Individuals aged 35–64 years were increasingly more likely to file for medical claims than the 18- to 34-year-old workers. Workers in the age group 55–64 had 2.1× the odds of filing medical claims compared to 18- to 34-year-old workers. The results also show that individuals covered by POS plans were more likely to file for medical claims compared to other workers and those with HMO coverage were the least likely to have claims, however, not all coverages were available in each sector (Table I) so that the design is unbalanced and coverage differences may be difficult to interpret.

Part Two Outputs: Log Linear Model

Table III presents the results obtained from the part-two, linear regression model for the whole population and also by the different industries. From the results in the first set of columns ''All Industries,'' the estimate of average

TABLE I. Study Population: Numbers and Percentages* of Months of Observations by Industry Sector, Coverage Type, Gender, and Employee Classification

	Finance	Manufacturing Durable	Services	TCU	All
Type of group health insurance					
Comp.	19,518	62,604	18,863	2,178	103,163
	3.64	2.5	5.21	0.17	2.21%
HMO	261,766	73,701	6,408	606,954	948,829
	48.84	2.94	1.77	48.3	20.36%
POS	2,337	NA	106,229	640,929	749,495
	0.44	NA	29.34	51	16.09%
POS CAP	243,398	120,950	NA	NA	364,348
	45.41	4.83	NA	NA	7.82%
PPO	8,968	2,247,254	230,539	6,616	2,493,377
	1.67	89.73	63.68	0.53	53.51%
Sociodemographic variables					
Female	281,331	617,512	187,330	565,592	1,651,765
	52.49	24.66	51.74	45.01	35.45%
Male	254,656	1,886,997	174,709	691,085	3,007,447
	47.51	75.34	48.26	54.99	64.55%
Hourly nonunion	49,447	638,982	57,019	551,357	1,296,805
	9.23	25.51	15.75	43.87	27.83%
Hourly union	14,465	646,745	75,885	6,195	743,290
	2.7	25.82	20.96	0.49	15.95%
Salaried nonunion	450,921	1,184,246	177,536	476,175	2,288,878
	84.13	47.28	49.04	37.89	49.13%
Salaried union	21,154	34,536	51,599	222,950	330,239
	3.95	1.38	14.25	17.74	7.09%
Total	535,987	2,504,509	362,039	1,256,677	4,659,212
	11.5	53.75	7.77	26.97	100%
	100%	100%	100%	100%	100%

Comprehensive, one policy, with a deductible, and coinsurance; HMO, health maintenance organization, fee per person, in-network only; POS, point of service, larger regional networks; PPO, preferred provider organization, yearly deductible, can use out-of-network; POS CAP w/capitation, same as POS but w/fee per person; TCU, transportation, communication, and utilities; NA, not sufficient records to include in the study.

*Each column adds up to 100% at the bottom.

non-zero monthly cost in the reference group was: exp $(4.13 + 0.131 \times (\ln(841.16))) = \$150.24$ (where, constant = 4.13; estimated coefficient for prior medical costs = 0.131; average monthly medical costs for the reference group = \$841.16). Females had average monthly costs of $(\exp(4.13 - 0.07 + 0.131 \times (\ln(3381.94))) = \$168.10$ (where, estimated coefficient for females = −0.07 and average of prior monthly medical costs of all females = \$3381.94) and males had average monthly costs of $(\exp(4.13 + 0.131 \times (\ln(2288.51))) = \$171.29$. The estimate of the effect of a prior WC claim was a cost increase by a factor of $\exp(0.113) = 1.12$.

The outputs are similar for the models run separately by industries, except for a few. For example, individuals employed in manufacturing durable had the lowest average monthly costs for the reference group: \$175.86 ($\exp(4.185 + 0.126 \times \ln(2637.554))$) and those employed in finance had the highest monthly average costs for the reference group $\$267.90 = \exp((4.28 + 0.165 \times \ln(2815.81)))$. The westerners (\$158.91), southerners (\$174.31) and those residing in the north central region (\$165.42) and employed in manufacturing durables had lower monthly average costs compared to the ''all'' group. Westerners employed in finance sector had the highest monthly average medical costs (\$310.51). Individuals employed in manufacturing durable and covered by HMO and POS capitation had the lowest monthly average non-zero costs of \$159.52 and \$160.78, respectively. Employees in the finance sector covered by POS had the highest monthly average medical costs of \$605.22. Individuals in finance and TCU had higher personal risk factor effects yielding higher monthly average medical costs of

TABLE II. Odds Ratios for Filing Group Medical Claims in a Month: Part 1 (Binomial Logistic Regression) Model by Industries

	All Industries	95% CI		Manufacturing durables	Services	Finance	TCU
WC	1.254	1.233	1.277	1.233	1.156	1.520	1.254
Female	1.733	1.725	1.740	1.643	1.643	1.665	1.930
Personal risk factors	1.025	1.010	1.040	1.062	1.045	1.082	0.934
North Central	1.183	1.175	1.190	1.255	0.997	1.019	1.080
South	1.118	1.112	1.124	1.171	1.172	1.217	1.059
West	1.103	1.094	1.112	1.104	1.049	1.103	1.092
Unknown	0.590	0.570	0.610	0.598	0.607	0.306	0.934
35–44 years	1.090	1.084	1.096	1.184	0.985	0.958	1.064
45–54 years	1.512	1.503	1.520	1.656	1.283	1.327	1.414
55–64 years	2.091	2.076	2.106	2.277	1.627	1.787	1.962
Comprehensive	1.067	1.051	1.083	0.960	1.015	0.894	0.972
HMO	0.966	0.957	0.976	1.114	1.024	0.518	0.983
POS	1.104	1.092	1.116		0.935	1.606	1.090
POS CAP	0.983	0.973	0.993	0.980		0.552	
Sal. unionized	1.112	1.102	1.122	1.313	0.892	1.050	1.105
Sal. nonunion	1.072	1.066	1.077	1.069	0.881	1.123	1.126
Hourly unionized	1.096	1.088	1.104	1.074	0.918	1.490	1.053
Prior group medical costs	1.390	1.389	1.392	1.392	1.455	1.428	1.355
TCU	1.182	1.170	1.194				
Finance	1.181	1.169	1.194				
Services	0.962	0.954	0.970				

TCU, transportation communications, and utilities.
The reference groups are hourly, non-unionized males, aged 18–34, with no prior WC claims in the last 4 years or ever, residing in the northeast region, employed in manufacturing durables, and covered by PPO plans.
Personal risk factor: It is a dummy variable that shows whether a worker had any known prior claim. It a proxy for personal risk factors for WC, for example, obesity or depression, conditions not available in the databases that could contribute to medical costs.

$299.18 and $212.62 compared to $174.84 for the ''All Industries'' group.

Retransformed Results: Average Monthly Expenses

Table IV summarizes the retransformed group means derived from the predicted probability estimated from the first part (logistic regressions) of the model and the average monthly medical costs predicted from the second part for individuals with and without prior WC claims. The results show that individuals with prior WC claims had higher average monthly medical costs and predicted probability of filing a claim compared to those with no prior WC costs. The predicted probability of individuals with prior WC claims was 0.56 compare to 0.49 for those with no prior WC claims and average monthly medical expenses for all individuals with prior WC claims was $204 compared to $160 for those without prior claims.

The next-to-last column with the results for ''All Industries'' population shows that among the different employee classifications, hourly unionized employees had the largest average monthly medical expenses ($192 for those with no prior WC claims and $231 for those with prior WC claims). The second-to-last row illustrates that the services sector experienced the highest monthly medical costs for those with prior WC claims ($248).

Table IV reports the estimated cost shifting to the group health care medical system from the WC system in the last column and last row. The average cost shifting for the population was $43/month. This shifting was observed in all industrial sectors, with the services sector having the highest estimate $66, followed by finance ($61) and the TCU sector having the lowest shift of $14. Among the different employee classifications salaried non-union population had the highest shifting ($53).

DISCUSSION AND LIMITATIONS

This study estimated the association between group health medical care expenditure and prior WC claims and its variation across different industries. Not surprisingly, we found that employees with prior WC claim were medically more expensive compared to those with no prior WC

TABLE III. Average Monthly Expenditure (Log) When Medical Claims Were filed: Part 2 (Cost Linear Regression) by Industry

	All Industries		Manufacturing Durable		Services		Finance		TCU	
Variables	**Coefficient**	***P*-value**	**Coefficient**	***P*-value**	**Coefficient**	***P*-value**	**Coefficient**	***P*-value**	**Coefficient**	***P*-value**
WC	0.113	0.000	0.124	0.000	0.092	0.000	0.148	0.000	0.092	0.000
Female	−0.072	0.000	−0.024	0.000	−0.033	0.000	−0.135	0.000	−0.138	0.000
Personal risk factors	−0.015	0.001	−0.036	0.000	−0.002	0.893	0.101	0.005	0.057	0.000
North Central	−0.036	0.005	−0.075	0.000	0.104	0.000	−0.036	0.000	−0.043	0.000
South	0.004	0.000	−0.011	0.007	0.294	0.000	0.059	0.000	−0.026	0.000
West	0.084	0.000	−0.104	0.000	0.044	0.425	0.140	0.000	0.147	0.000
Unknown	0.063	0.020	0.002	0.938	0.278	0.019	−0.368	0.006	0.317	0.000
35–44 years	0.115	0.000	0.088	0.000	0.124	0.000	0.075	0.000	0.134	0.000
45–54 years	0.231	0.000	0.200	0.000	0.228	0.000	0.219	0.000	0.248	0.000
55–64 years	0.379	0.000	0.356	0.000	0.353	0.000	0.301	0.000	0.387	0.000
Comp.	0.230	0.000	0.173	0.000	0.172	0.000	0.152	0.000	0.251	0.000
HMO	−0.201	0.000	−0.089	0.000	0.030	0.187	−0.302	0.000	−0.099	0.000
POS	−0.101	0.000			−0.025	0.026	0.502	0.000	−0.021	0.365
POS CAP	−0.044	0.000	−0.058	0.000			−0.091	0.000		
Salaried unionized	−0.025	0.212	−0.005	0.646	−0.062	0.000	−0.228	0.000	0.090	0.000
Salaried nonunion	−0.035	0.000	−0.010	0.002	−0.066	0.000	−0.215	0.000	−0.016	0.003
Hourly unionized	0.028	0.000	0.058	0.000	−0.095	0.000	0.004	0.822	0.007	0.105
Prior group medical costs	0.131	0.000	0.126	0.000	0.145	0.000	0.165	0.000	0.124	0.000
TCU	0.235	0.000								
Finance	0.126	0.000								
Services	0.107	0.000								
Constant	4.129	0.000	4.185	0.000	4.062	0.000	4.281	0.000	4.333	0.000

TCU, transportation, communication, and utilities.
The reference groups are hourly, non-unionized males, aged 18–34, with no prior WC claims in the last 4 years or ever residing in the northeast region, employed in manufacturing durables, and covered by PPO plans.
Personal risk factor: It is a dummy variable that shows whether a worker had any known prior claim. It a proxy for personal risk factors for WC, for example, obesity or depression, conditions not available in the databases that could contribute to medical costs.

claims after controlling for prior medical cost experience. This implies cost shifting from WC to group health medical care. The group health medical care database does not classify medical claims on work-relatedness. It is in fact difficult for physicians to distinguish some work-related medical conditions, and even if identifiable, this dataset does not capture that information.

Regressions similar to those reported here were also run retaining the WC variable representing whether there was a prior WC claim but with no proxy for personal risk factors (any known WC claim during 2001–2005) and no measure of individuals' medical expenses prior to 2003 (results can be obtained from the authors). Using the proxy for personal risk factors resulted in a decrease in the estimated odds of filing group health claims (part one) associated with a prior WC claim for all industries and coverages but an increase in the estimated coefficients for the WC effect on monthly costs (part two). Although the proxy for personal risk factors variable did not drastically change the retransformed outcomes it was a significant effect in both models. This suggests that personal health determinants captured by the proxy variable affect WC claim rates and impact the group health medical costs. Overall, the prior medical expenses variable (from 2001 to 2002) was a highly significant predictor of monthly medical costs during 2003–2005. Addition of the prior medical expenses variable slightly further reduced the odds ratios and the estimated coefficient values associated with prior WC claims in the first and second part models respectively, and thus reduced the retransformed monthly average medical costs (the ones displayed in Tables III and IV), but the percentage increases in the retransformed monthly average medical costs with prior WC claims were larger.

The results show that the female working population had a higher probability of filing a medical claim as well as higher predicted (retransformed, not shown here) average monthly medical expenses. This may be due to poor health or propensity to higher utilization among females compared to their male counterparts, which not only raises

TABLE IV. Excess Group Health Care Costs: Claim Probabilities and Costs, by Industry and Employee Classification

	WC claim		Finance	Manufacturing durable	Services	TCU	All Industries	Cost shifting
Hourly non-unionized	No prior claim	Probability	0.60	0.44	0.54	0.45	0.45	29.59
		Mean cost	227.92	144.61	189.98	127.21	142.51	
	Prior claim	Probability	0.68	0.52	0.66	0.47	0.51	
		Mean cost	251.36	181.20	258.01	146.70	172.10	
Hourly unionized	No prior claim	Probability	0.70	0.51	0.55	0.50	0.51	39.44
		Mean cost	385.15	187.46	187.20	166.78	191.53	
	Prior claim	Probability	0.72	0.58	0.62	0.52	0.58	
		Mean cost	273.29	230.06	244.52	187.36	230.97	
Salaried non-unionized	No prior claim	Probability	0.50	0.49	0.52	0.50	0.50	53.03
		Mean cost	148.35	160.41	175.79	152.49	157.58	
	Prior claim	Probability	0.64	0.58	0.63	0.57	0.59	
		Mean cost	223.77	208.03	247.17	197.20	210.61	
Salaried unionized	No prior claim	Probability	0.60	0.54	0.60	0.56	0.57	48.40
		Mean cost	198.36	187.65	184.38	178.61	181.56	
	Prior claim	Probability	0.62	0.61	0.71	0.67	0.62	
		Mean cost	207.73	224.57	255.61	254.23	229.96	
All	No prior claim	Probability	0.52	0.49	0.54	0.49	0.49	43.43
		Mean cost	164.14	163.45	181.50	146.41	160.29	
	Prior claim	Probability	0.65	0.56	0.64	0.50	0.56	
		Mean cost	225.10	209.45	247.86	160.80	203.72	
Cost shifting			60.96	46.00	66.36	14.39	43.43	

TCU, transportation, communication, and utilities; cost shifting, difference in mean cost for "prior claim" and "no prior claim."
The reference groups are hourly, non-unionized males, aged 18–34, with no prior WC claims in the last 4 years or ever residing in the northeast region, employed in manufacturing durables, and covered by PPO plans.

the number of claims but also the average costs of medical care. The results also show the well-known increase in medical expenses with age; the literature widely documents age-associated increases in prevalence of illness, and reduced cognitive capacity, physical strength and endurance [Benjamin and Wilson, 2005]. Overall the odds ratios are not very large so relative risks were not calculated [Zhang and Yu, 1998].

Limitations

A major limitation of this study is that the MarketScan databases are not publicly available. Public availability of these databases would have helped science to progress further with more use of the data. The databases have WC claims running for many years prior to 2001 but it is not clear whether all such claims were included from some earlier starting date. It is likely that the reporting criteria and definition of what constitutes an ''active'' claim may have varied across employers and time.

As in any analysis of occupational injury or illness, knowledge of exposures is paramount. Of course, in this database assembled primarily for healthcare costs analyses, no such information was available although industrial sector can be a very crude surrogate. If specific employers were classifiable (but not identifiable) using, for example, NAICS codes, some further exposure specificity would be possible but to comply with confidentiality assurances, a coded employer identity is not provided in the MarketScan databases. Therefore, interpretations of predicted probabilities of filing medical claims and the average monthly medical costs across the industrial sectors, medical insurance categories, gender, age groups, and regions are all potentially confounded by unknown workplace exposure, particularly if there are work-related injuries and illnesses that are not being compensated by WC. Because there could be small numbers of firms in some sectors or regions, the specific features of employment, including their medical benefit packages or work environment could strongly influence the estimated.

Given there is no information on personal risk factors, a proxy was generated but appropriate personal risk factor measures would have produced better analyses. It can be reasonably assumed that these host factors are largely unassociated with sector and actual workplace exposures, but they could be somewhat associated with healthcare coverage choices. Because there exists the problem of moral hazard and self-selection bias of selecting health care

plans [Pauly, 1968, 1974; Cutler and Zeckhauser, 2000; Bajari et al., 2006; Farnsworth, 2006], individuals with high health risk are prone to choose plans, which have optimum coverage.

Employer contribution of WC claims data to MarketScan is optional, which could lead to skewed data and biased results. In the present study workers for whom WC utilization data was not available were excluded. Another limitation is that the population in this study is employed by large corporations; therefore the results may not be nationally representative. Large corporations may provide better health care and WC coverage, which might raise the frequency of doctors' office visits and influence the probability of filing medical claims and monthly average costs. At the national level, average medical costs and probabilities of filing medical claims are probably lower but the implication for cost shifting to group health insurance from WC is unknown.

This study is limited to information on medical costs and prior WC claims in any past few years. Information on socioeconomic status, health behavior, past health history, family health history, workplace exposures, or other risk factors affecting the current health condition of the individuals are not available. Availability and control of all these factors would have provided stronger outcomes. Also methodologically, two-part modeling was found to best suit the data used in this study, but retransformation of interaction variables was not possible using this methodology so was not included in the study. Therefore, the two part models will benefit from further methodological advances.

Cost shifting from employers' liability to employee health plans needs to be addressed. It inflates the cost of health care generally and diminishes incentives for employers to reduce work-related injury and illness in the same way that workers with inadequate WC or group health insurance end up in emergency rooms raising the aggregate medical costs and the overall burden to the society. Future research should focus on precise quantification of cost shifting including shifts in both directions. A clearer picture of the cost shifting and its impacts on workers and to society will help policy makers target research and prevention activities to improve workplace safety and health and performance of the WC system.

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