

# Increasing Experience Rating for Small Employers

## Would Lowering the Threshold for Experience Rating Improve Safety?

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Center for Health and Safety in the Workplace

RAND Safety and Justice Program

WR-955-CHSWC

July 2013

Prepared for the California Commission on Health and Safety and Workers' Compensation

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Center for Health and Safety in the Workplace

## Preface

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Workers' compensation (WC) insurers typically adjust the premium they charge employers to reflect the loss experience of the firm, a practice referred to as experience rating. The practice should enhance the financial incentives for firms to prevent injuries and illnesses. However, small firms whose premiums fall below a threshold are not experience-rated because the predictive value of their experience is viewed as too low. This paper examines what happens to injury and illness losses when small firms do become subject to experience rating. If their injury experience improves, more consideration might be given to lowering the threshold premium in order to subject more firms to experience rating.

This work was funded by the California Commission on Health and Safety and Workers' Compensation (CHSWC). The audience for the study should include not only California, but also other jurisdictions which use experience rating, as well as scholars interested in the role of incentives on work injuries.

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The center's work is supported by funds from federal, state, and private sources.

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## Summary

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Experience-rating (ER) is the common practice in insurance markets of adjusting premiums to take into account the actual losses of the insured. Insurers apply experience rating as a means of underwriting heterogeneity among policyholders that may be hard or costly to otherwise observe. In workers' compensation experience rating is also advanced as a method to re-introduce a stronger financial incentive for firms to prevent losses, an incentive that the loss-spreading effect of insurance tends to weaken. The use of experience rating in workers' compensation is controversial. Some argue that the financial incentives provided by experience rating are an essential incentive for improving workplace safety. Others argue that experience rating has little impact on safety but causes some employers to suppress legitimate claims, depriving workers of benefits. What is lacking is sufficient evidence on the causal impact of experience rating on outcomes.

The current California threshold for mandatory application of experience rating by insurers excludes 80% of employers. Excluded employers are smaller firms whose experience insurers consider too limited to be credibly predictive of future losses. This paper explores, in the California context, what happens to the loss experience of small firms when they become just large enough to be experience-rated for the first time. By doing so, the paper provides insight about the impact that lowering the threshold to subject more employers to experience rating would have on safety outcomes for workers at these smaller firms.

We obtained data on workers' compensation losses from the Workers' Compensation Insurance Rating Bureau of California (WCIRB) for every insured employer from 1993-2006. We selected employers who were in the WCIRB file for 5 consecutive years during the study sample; were not experience-rated in the first two years; had a premium the next year that was within 30% of the threshold needed for experience-rating in that year; if experience rated in year 3, continued to be experience rated in years 4 and 5; if not experience-rated in year 3, then were not experience-rated in years 4 and 5. This gave us a representative sample of the set of firms that are most likely to be affected by a change in the threshold for experience rating.

Using these data we compared the change in losses for the firms that did not become experience-rated with the change in losses for those firms that became experience-rated. We

found that those firms which became experience-rated had a decline in losses relative to those whose status did not change. Specifically, the workers' compensation losses at firms that became experience-rated declined 6% to 9% compared to those that did not. We found that virtually all of the reduction in losses is due to the reduction in claim frequency; and not due to a decline in the average cost per claim. As we discuss in detail in the report, this finding suggests that the changes are a real safety improvement and not artifacts of increased efforts to suppress claims. Expanding experience rating to more employers would reduce occupational injuries without substantially increasing claim under-reporting.

We also examine whether, absent regulatory or statutory intervention, insurers would, *de facto*, experience rate more or fewer firms than currently required. We found that insurers do not adjust premiums for employers below the current threshold, suggesting that increasing the fraction of employers subject to experience rating would require state intervention.

We also analyzed any extra cost that a newly experience-rated employer could incur by reporting a claim under the current rules and found a surprisingly big effect. In many cases the increase in a small employer's premiums triggered by a claim can be substantially greater than the actual cost of the claim. Thus, any extension of experience rating to impact more firms should be mindful of the potential cost that large variance in year-to-year premiums could impose on some employers. Future research should focus on the design of experience rating for smaller employers that retains incentives for safety while limiting large swings in premium costs.

## Acknowledgements

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We would like to acknowledge the support of the Commission for Health, Safety and Workers' Compensation, which provided the financial support for this study. The commission staff graciously helped with all the arrangements for the study.

David Bellusci at the California Workers' Compensation Rating Board helped us to obtain data from his agency and to interpret it. Gayle Stephenson helped to prepare the manuscript. We benefited from the comments of Susan Gates and Paul Heaton at RAND and from an outside reviewer.

## Abbreviations

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ER	experience-rating
LAE	loss adjustment expense
WCIRB	Workers' Compensation Rating Bureau of California

## Introduction

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Workers in the United States or Canada that are injured on the job are usually eligible for medical and indemnity benefits through the workers' compensation system. Employers are responsible for paying workers' compensation benefits, and they typically are required to purchase insurance coverage to guarantee their liabilities. Experience rating is the practice of modifying employers' workers' compensation premium rates to reflect past occupational injury and illness experience, and it is common in most North American jurisdictions. Experience rating was widely adopted in the United States when workers' compensation was introduced in the early 20th century (Fishback and Kantor, 1998) and more recently by Canadian provinces in the 1980s – 1990s (Bruce and Atkins, 1993; Hyatt and Thomason, 1996; Deland, 1995).

Experience rating serves two primary purposes. First, insurers use experience rating information to help underwriters profitably price heterogeneous risks (WCIRB, 2008). Second, the public policy motivation is the contention that varying the price firms pay for insurance based on past experience will motivate employers to maintain safe work places and protect workers from the consequences of occupational injury and illness. However, it is typically believed that insurers pay little attention to the safety justification of experience rating and rely on it almost exclusively as an underwriting tool. Thus, it falls to policymakers to design and implement experience rating if it is to be used as an effective tool for improving safety.

While experience rating has been a fixture of workers' compensation insurance, there are several open questions about how best to design an experience rating program to motivate employers to improve safety. The key implementation issues are two: First, should the fraction of employers that is subject to experience rating be expanded by lowering the minimum premium threshold that excludes most employers? And, second, should the sensitivity of the rating process to an employer's experience be increased? Both questions involve the potential to increase the variance employers face in their year-to-year premiums. A related question is whether, in the absence of regulatory intervention, insurers will implement a system that advances occupational safety at least as effectively as a solution imposed on insurers by regulation.

In this paper we answer the question about small employers and insurer behavior in the absence of regulation. We do this using employer-level administrative data on experience rating and workers' compensation claims from California. We find that the practice of experience rating is, indeed, associated with a decline in the number of workplace injuries at a firm. Moreover, we find evidence that suggests this is due to actual improvements in safety as opposed to just claims suppression by employers. This has important implications for the extension of experience modification to smaller employers and its potential impact on workplace safety.

## Premiums and Experience Rating in California

California's rate setting mirrors the approach used in virtually all other states and is similar to that in Canadian provinces. The Workers' Compensation Insurance Rating Bureau of California (WCIRB) collects data on all policies written by insurers in California. Class codes are used to segregate industries and occupations into groups of workers with similar risk of injury and, consequently, with similar expected workers' compensation costs relative to payroll during a policy period. The WCIRB uses these data to calculate "pure premium" rates for each of approximately 500 class codes. Pure premium rates are set for each class code to reflect expected losses plus an allowance for loss adjustment expense (LAE). LAE is calculated as a percent of expected losses and is a constant across all classes in a policy year. Because class codes are usually built around separating occupations as well as industries, the rates vary much more across class codes than they would if they were based only on industry. Rates vary by a factor of more than 100 across class codes for a policy year.<sup>1</sup>

Employers often have workers covered under multiple class codes. For example, a construction firm can have several codes for building trades as well as for clerical and sales occupations. Total pure premium for an employer for a policy year is calculated as:

$$Pure\_Premium_{i,y} = \sum_{j=1}^n Pure\_Premium\_rate_{j,y} * Payroll_{i,j,y}$$

Where,  $Pure\_Premium\_rate_{i,j}$  is the pure premium rate for the "jth" class code in year "y,"  $Payroll_{i,j,y}$  is the payroll reported in the "jth" class code by the "ith" employer in year "y."  $Pure\_Premium_{i,y}$  can be interpreted as the expected losses plus LAE of the "ith" employer in year "y." Because pure premium translates occupational injury risk into a single dimension, it can be used as a standardized measure for comparing the expected accident frequency and expected losses across employers in different industries and/or with different distributions of employees among occupations within the same industry.

Actual premiums charged by insurers vary from pure premium rates for several reasons. These reasons can be general to the rate setting process or specific to the underwriting of specific policy holders. For rate making in general, while insurers are required to adopt the WCIRB pure premium rates as the initial basis for their rates, individual insurers may differ relative to the WCIRB in their expectations for the level and trend of losses for the next policy year. Insurers can differ in their companies' estimation of claims handling and underwriting expenses as well as investment returns. These differences are reflected in the filing of "deviations" from the pure premium rate.

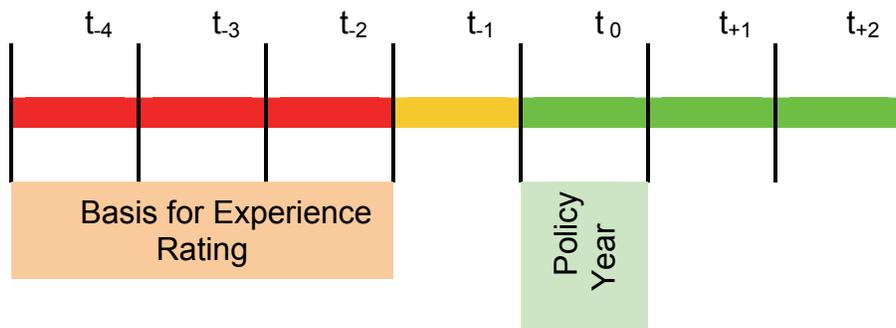
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<sup>1</sup> For example, for the current policy year, 2012, the lowest class rate is \$0.18/\$100 payroll (class 8859, Computer programming and software development) and the highest is \$42.31/\$100 payroll (9185, Carnival and circus workers). The 10th and 90th percentiles are at \$2.24/\$100 and \$11.17/\$100.

At the policyholder level, insurers frequently apply debits and credits to individual employers, reflecting employer specific conditions observed in the underwriting process, such as past experience, site specific risk assessments, and competitive market forces. When employers are large enough, an experience rating factor is applied as a multiplier to premium. The experience rating factor is calculated by the WCIRB for all employers above a minimum threshold of pure premium. Insurers are required to include the experience modification in the premium calculation, but the impact can be modified by the filed debits and credits. We explain the experience rating factor next.

If we think of  $t_0$  as the policy year for which an employer's policy is written, then the experience used to calculate an employer's experience rating (X-mod) is all reported payroll, injuries, and incurred costs related to those injuries for policy years  $t_4$ ,  $t_3$ , and  $t_2$  (see Figure 1.1). For example, the experience of the employer in policy years 2001, 2002, and 2003 is used to calculate the experience modification that applies to premium in the 2005 policy year. Also, because the base period is three years, an injury in  $t_2$  will continue to impact the experience modification through policy year  $t_{+2}$  (2007 in the example). The calculation of experience modification is complex and depends on an employer's size, the number of claims in the periods and the size and distribution of losses across the reported claims.<sup>2</sup> The precise calculation is not important to the methodology used here.

Figure 1.1 Years Used in Experience Rating



Not all employers are experience-rated. Each policy year the WCIRB calculates a threshold that applies experience modifications to approximately 20 percent of employers, those with the highest pure premium based on pure premium rates in  $t_0$  and reported payroll in  $t_4$ ,  $t_3$  and  $t_2$ . The threshold varies from year-to-year, mostly driven by variation in the level of pure premium

<sup>2</sup> For a complete description of experience modification calculations refer to California Workers' Compensation Experience Rating Plan - 1995, 2011 Edition available at [https://wcirbonline.org/wcirb/product\\_services/publications.aspx](https://wcirbonline.org/wcirb/product_services/publications.aspx)

rates. Because the pure premium rates are used in this calculation, whether an employer is experience-rated is not affected by insurers' deviations from the published rates or any debit or credits assigned to an employer. Also, whether or not an employer is experience-rated is only a function of premium and not the employer's past safety experience.

In our empirical work we use whether or not an employer is experience rated as our key variable of interest. One concern might be that employers manipulate their own manual premium in order to stay below the threshold and avoid experience rating. However, this is extremely difficult based on the formula that is used. The payroll by class code that is summed up to determine whether an employer is experience rated is based on the time from  $t_1$  to  $t_2$ , even though the actual threshold level changes on a year-to-year basis. Thus, there is nothing that employers can do once they are closer to the application of experience rating in the current year and the threshold is known. In essence, for employers to systematically manipulate premium to stay below the threshold they would have to be consistently and regularly depressing their payroll over a period of years due to the chance they might become experience rated, a strategy that would likely prove more costly than the actual change in premium if they became experience rated.

## The Impact of Experience Rating

Experience rating is not without critics, especially when applied to smaller employers. Experience modifiers (X-mods) tend to be weak predictors of future experience even for medium size employers. For smaller employers, experience modifications (and consequently premium rates) can vary considerably from year-to-year, at least in part, because of the random character of industrial injuries (Hyatt and Thomason, 1998; Cantor and Long, 1995). The smallest, experience-rated employers are expected to have a lost-time claim only once every 11 years (WCIRB, 2008). But that claim, if the only claim on an employer's record, could result in a change in the experience modification factor under California's system from 0.90 to 1.28. In addition, that experience rating will track that employer for the three years that the experience from the policy year of injury is included in the base period used to calculate experience modifiers, even though the expectation is that the employer is unlikely to have another lost-time claim during the three-year period. Consequently, there is a lot of concern and political pressure from small employers against what seems a highly arbitrary, low predictive value modifier of premium.

There is also a line of criticism that experience rating causes employers to emphasize claim suppression instead of or as well as safety (Thomason and Pozzebon, 2002). Proponents of this critique argue that employers pressure workers to not report occupational injuries in order to avoid triggering an increase in premiums (Kralj, 1994; Hyatt and Kralj, 1995). Another criticism is that employers may encourage employees to stay at work, when contra-indicated medically, to avoid filing a lost-time claim (Weiler, 1983; Tompa, 2007).

There have been three surveys of the literature on experience rating including, Boden (1989) and Thomason (2005). The most recent review by Tompa, et al., 2007 identified 10 studies that merited inclusion. Several studies (Ruser, 1985; Ruser, 1991; Lanoie and Streliski, 1996) have the limitation that they measure the degree of experience rating with the proxy measure of employer size as measured by employment. However, this measure has very important limitations. Most important, experience rating in the United States is almost always based on premium size and not employment. Because premium rates, as a fraction of payroll, vary by a factor of 100 across different occupational categories, firms in high risk occupations (for example construction trades) will be experience-rated to a much higher degree than firms, with the same employment, dominated by very low risk jobs like programmers, clerical, and professional staff. This can lead to substantial estimation errors when a study relies on employment as a proxy for the degree of experience rating. Since Tompa's review in 2007, another study by Tompa et al. (2012) has corrected for the methods of the earlier papers by using the firm's premium to calculate the degree of experience rating.

Several past studies rely on indirect effects to suggest that experience rating has an impact on safety. These proxy measures include the fraction of claims that transition from medical only to indemnity (Ruser, 1985 and 1991), duration of disability (Krueger, 1990; Cheadle et al., 1994), the frequency of disputes (Hyatt and Kralj 1995), and the fraction of disputes resulting in appeals of workers' compensation board decision (Kraj, 1994). These studies generally find effects on the proxy measures and argue this is at least partly attributable to the greater financial incentive from experience rating. Because the studies measure proxies, the direction of the impact on safety has to be inferred and the absolute size cannot be measured.

The studies most comparable in purpose to this paper are a group of studies that attempt to evaluate the impact of the introduction of experience rating rather than variation in the degree of experience rating among employers already rated. The main weakness in the earlier studies (Bruce and Atkins, 1993; Kotz and Schafer, 1993; Cheadle et al., 1994; Deland, 1995) was the use of single-difference approaches to examine the introduction of experience modification in different systems (Ontario, Canada and the German Sugar industry, respectively). While they find substantial effects, it is difficult to rule out other trends affecting occupational injury frequency that could differentially impact the pre and post-introduction periods.

## Methods and Data

The key to our analysis approach is that most employers are below the threshold and not subject to experience rating. But there are many employers just below the threshold in  $t_1$  that can become experience-rated for the first time in year  $t_0$  because they were somewhat larger in the period  $t_4$  through  $t_2$  than they were in  $t_5$  through  $t_3$  or the pure premium rate(s) for their class code(s) increased more (declined less) relative to other class codes. We compare the losses

of employers experience-rated for the first time in  $t_0$  against employers that remained just below the threshold for experience rating in  $t_0$ .

Our methodology uses a double-difference approach to control for heterogeneity between firms and the differences in time periods that could be driven by secular trends outside experience rating. We explicitly outline the analysis as follows. Define the sample of employers' pre-treatment experience as the period, up to two policy years prior to the policy year in which we identify if an employer is experience-rated. The post-experience rating period is the policy year in which the employer becomes experience-rated and up to two policy years after that policy year. Define the affected or "treated" employers as those that were first experience-rated in  $t_0$ , continued to be experience-rated in  $t_1$  and  $t_2$ , and not experience-rated in the two policy years,  $t_{-1}$  and  $t_{-2}$ , prior to  $t_0$ .

Define  $z^*$  as the average value of a measure of interest. Then the pre-post change in  $z^*$  is given by the equation

$$Diff_{exp\_rated} = z_{experience\_rated}^{*post\_rating} - z_{experience\_rated}^{*pre\_rating}$$

Where  $z^*_j$  is the average of the measure  $z$  for employers  $j$  (experience-rated, not experience rate) in the time period  $i$  (post-experience rating, pre-experience rating).

The difference in the above equation will be driven by the incentive effects of experience rating and whatever other changes (in the economy, regulatory or statutory rules, etc.) affect the mean of measure  $z$ . Assuming that all other factors affecting measure  $z$  affect non-experience-rated and experience-rated employers in a similar manner, the experience of the non-experience-rated employers can be used to net out all other unobservable factors. Defining a similar pre-post change for non-experience-rated employers, the difference-in-difference (DD) estimator is given by the equation

$$DD = Diff_{exp\_experience\_rated} - Diff_{not\_exp\_experience\_rated}$$

To regression-adjust these estimates for observable covariates, define the dummy variable  $treat_i$  as equal to 1 if the employer is experience-rated in  $t_0$ , and the dummy variable  $after_i$  as equal to 1 if the employers experience is in  $t_0$  or later. The adjusted DD estimates come from the equation

$$z_i^* = \beta_0 + \beta_1 After_i + \beta_2 Treat_i + \beta_3 Treat_i x After_i + \delta X_i + \epsilon_i$$

Where  $\beta_0$  through  $\beta_3$  and the vector  $\delta$  are regression coefficients, and  $\epsilon_i$  is an error term. The coefficient  $\beta_3$  gives the extent to which the pre-post change in the measure  $z$  for employers subject to experience rating for the first time in  $t_0$  exceeds the change for employers that were not experience rating, holding constant the variables in  $X$ .

We evaluate the equation separately for each post period year,  $t_0$ ,  $t_1$  and  $t_2$  relative to the pre-period year  $t_{-1}$ .

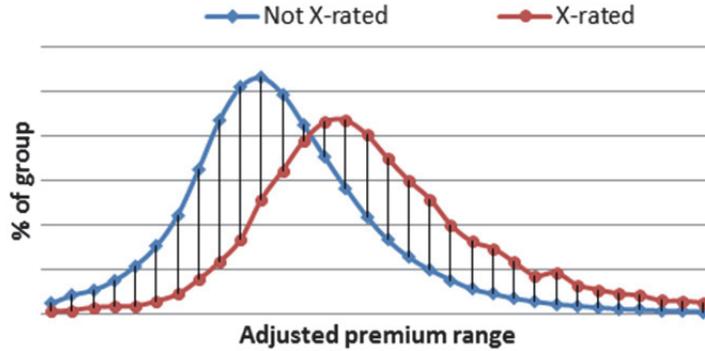
### *Description of the Data*

We use administrative data provided by the Workers' Compensation Insurance Rating Bureau of California (WCIRB). The WCIRB data covered every insured employer for every policy year from 1993 through 2006. The total number of employer-years was 8.4 million. The administrative data were in three files: (1) a file containing the classcode, the payroll, number of claims (if any), incurred cost (if any) for each class code under which an employer reported payroll for the policy year, whether the employer was experience rated, and, if experience rated, the experience modification factor for the employer; (2) a file identifying the actual premium charged for the policy year after consideration of insurer specific rates and all credits and debits; and (3) a file with pure premium rates for each policy year for each class-code.

Unique employers were identified by an ID number created by the WCIRB. The ID number was created by scrambling the internal Bureau Numbers used by the WCIRB to link employers' experience across years and sometimes across multiple policies in a single year. The Bureau puts substantial effort into ensuring that all of an employer's experience is linked, even when an employer changes a business name or other identifying information.

From this census of employers, we identified a subset of employers to use for analysis. Specifically, we restricted the sample to employers who (1) had payroll reported in all five consecutive years ( $t_{-2}$  through  $t_2$ ); (2) were not experience rated in either  $t_{-2}$  or  $t_{-1}$ ; (3) had pure premium in  $t_0$  that was within +/-30% of the experience rating threshold for that year; (4) had combined pure premium within +/-30% of the average threshold over the period  $t_{-2}$  through  $t_0$ ; (5) if experience-rated in  $t_0$ , the employer continued to be experience-rated in  $t_1$  and  $t_2$ ; and (6) if not experience-rated in  $t_0$ , then not experience-rated in  $t_1$  and  $t_2$  as well. This selection process results in a good but not perfect match between the experience-rated employers and the controls. The distribution of employers by premium level is shown in Figure 1.2. The experience-rated employers are on average slightly larger, which is consistent with their being subject to experience rating. We add control variables in the regression to adjust for observable differences. An alternative would be to select from the large pool of potential controls, those more similar to the experience-rated employers. The challenge is that one cannot match on size in  $t_0$  without identifying as controls firms with a faster growth profile in between  $t_{-2}$  and  $t_0$ . The controls had to be somewhat smaller in terms of premium in order to fall below the experience rating threshold. The trade-off is between the potential impact of small differences in size vs. the impact of substantial differences in the rate of growth. Research on business cycles and injury rates generally find that business expansions are associated with increasing injury rates as newer and less experienced workers are added to firms (Robinson, 1988; Frank et al., 1997). Consequently, we chose to emphasize controlling for employment growth over absolute size within the small range of employer size allowed.

Figure 1.2 Distribution Adjusted Pure Premium, Year t-1



When we evaluate the impact of experience rating on the average cost per claim, we add an additional restriction on the sample. We include only employers that reported at least one claim in the pre-period as well as the post-period. While this substantially reduces the sample size, we avoid any unobserved heterogeneity that could characterize the minority of small employers that report claims in any policy year relative those that do not. The additional criteria did not substantially change the characteristics of the two samples. Table 1.1 gives the mean values for the treatments and controls in each sample.

Table 1.1 Comparison of Treatments and Controls at  $t_0$

Comparison of Treatments and Controls at $t_0$				
	All Cases		Cases with Claims in both $t_1$ and $t_0$	
	Not Experience-rated	Experienced rated	Not Experience-rated	Experienced-rated
Pure premium	\$6,510.12 (4.64)	\$7,515.23 (19.49)	\$6,336.19 (16.19)	\$7,287.42 (60.00)
Pure premium rate	4.77 (0.006)	5.06 (0.025)	4.98 (0.021)	5.13 (0.076)
Multi-class	0.505 (0.001)	0.580 (0.004)	0.567 (0.004)	0.647 (0.011)
Average number of claims	0.298 (0.001)	0.327 (0.005)	1.586 (0.008)	1.547 (0.023)
Portion with at least one claim	0.215 (0.001)	0.236 (0.003)	n/a	n/a
Average incurred cost	\$2,860.06 (86.79)	\$3,389.95 (277.66)	\$11,937.12 (558.58)	14,782.96 (2491.76)
n =	250,298	18,097	19,220	1,806

Standard errors in parentheses

The importance of the double-differencing approach is indicated by the differences in the mean values for most variables in both sets of comparisons. The differences are expected

because the employers that are experienced rated are expected to be somewhat larger, a factor that increases premiums and makes experience rating more likely. These differences persist, even though the time period for determination of experience rating is  $t_4$  to  $t_2$  and we are calculating the means in  $t_0$ .

Two differences are notable, the portion that report premium under more than one class code (Multi-class) and the average pure premium rate. First, a significantly larger fraction of experience-rated employers report payroll in multiple classes. This is at least partially driven by their larger size leading to more diverse employment. Given that multiple classes may offer more opportunity to misreport payroll, we acknowledge the importance of conditioning on this variable in the analysis.

Second, the average pure premium rate is significantly higher for experience-rated employers in both sets of samples. This may just be a product of the experience rating process, where given the same payroll, the employer with the higher average pure premium rate is more likely to exceed the threshold premium for being experience-rated. Again, we will include this variable and its squared term in the regressions given that frequency and severity may vary with the risk of an occupation, even controlling for risk through the inclusion of the total pure premium. For example, the types of injuries common to construction (high premium rate) may be more costly, on average, than the typical claim reported by an office worker. If so, given the same pure premium (overall expected losses), the construction firm may report fewer, but more serious injuries.

We evaluate three measures of change in safety:

- $ANY\_CLAIMS_i$ — whether any claims were reported in the policy period by the ‘*ith*’ employer.
- $NUMBER\_OF\_CLAIMS_i$ — the number of claims reported in the policy period by the ‘*ith*’ employer, conditional on reporting any claims.
- $LN\_INCURRED\_COST/CLAIM_i$ — the natural log of average incurred cost per claim in the policy period for the ‘*ith*’ employer, by employers reporting any claims.

On the right-hand side, we include year dummies to control for the changes in expected losses and injury frequency that characterized this period. We include pure premium to control for the variation in expected employer risk on the probability of any reported injury, number of injuries and incurred losses. While pure premium anticipates a linear relationship between premium and losses, we also include the square of pure premium. The quadratic allows the relationship of pure premium and injuries and losses to vary with the total size of an employer’s expected risk.

We include a dummy variable that equals one when an employer reports payroll in more than one class code and zero otherwise. Research has found substantial misclassification, that is, employers misreport payroll for a higher-risk class in a lower-risk class (Neuhauser and Donovan, 2009). Employers may misreport all payroll into a different single class, but we expect employers are more likely to shift some payroll when reporting multiple classes rather than

misclassifying the entire operation. We expect the sign on the dummy for Multi-class to be positive for the ANY\_CLAIM and NUMBER\_OF\_CLAIMS, but have no intuition on the sign for LN\_INCURRED\_COST/CLAIM.

We also include the relative value of the pure premium rate for the employer. For those employers with more than one class code, we use the pure premium rate for the class with the greatest reported pure premium. For the pure premium rate we used the 2006 manual rates or, when class codes were not in existence in 2006, the most recent rate relative to 2006. We reference these as relative rates because we use only one year's pure premium rates. The level of rates changes year-to-year, more than doubling between 1999 and 2004, and then declining 60 percent by 2006. However, the relative rates between classes tend to be much more consistent. Using a single year's rates maintains the relative values across classes without confusing the issue with the changing rate levels. Again, we include the square of the primary pure premium rate to allow the relationship to be other than linear. The use of the relative pure premium rate variable allows for the severity (incurred cost/claim) to vary with the riskiness of the class. That is, the severity of injuries (as measured by the cost/claim) may increase or decrease more as the risk of injuries across classes increases, leading to higher (lower) average incurred losses per claim. The addition of this variable was suggested by the WCIRB, but no testing of this hypothesis has been done outside this paper.

## Results

We are interested in whether the introduction of experience rating to smaller employers has an impact on the frequency and/or severity of occupational injuries. We define severity using the insurance term, the incurred cost of the claim, rather than the medical sense. Consequently, if there is an effect we would expect it to exhibit as either a reduction in injuries, in the average cost of injuries, or in both.

We chose the Tobit regression as the first stage to analyze simultaneously the impact on the probability of having a claim and the number of claims conditional on having any claims.<sup>3</sup> The Tobit is appropriate in this situation where the values are “censored” at 0. Additionally, occupational injury data tend to clump heavily on the value of zero, because for small firms, the subject of this analysis, occupational injury claims are infrequent events. Conventional regression could result in bias in the measure of the coefficients. We also deconstruct the Tobit coefficients to measure separately the impact of the probability of having any claim and the number of claims. The results are presented in Table 1.2.

The results indicate a substantial and significant impact of experience rating in the first year. The second and third year effects are larger, suggesting that while the effects are only partially realized in the short-term, they are sustained at least in the medium-term.

**Table 1.2 Impact of Experience-Rating in First Years in that Status**

	<b>1<sup>st</sup> year Experience-rated</b>	<b>2<sup>nd</sup> year Experience-rated</b>	<b>3<sup>rd</sup> year Experience-rated</b>
Constant	-3.615*** (0.110)	-3.424*** (0.095)	-3.476*** (0.094)
Experience-rated * After	-0.081** (0.033)	-0.123*** (0.035)	-0.120*** (0.035)
Experience-rated	0.054* (0.026)	0.055* (0.027)	0.049 (0.027)
After	0.033*** (0.006)	0.053*** (0.008)	0.042*** (0.010)
\$1000_Premium	0.293*** (0.014)	0.232*** (0.007)	0.236*** (0.006)
\$1000_Premium_sq	-0.009*** (0.001)	-0.005*** (0.0003)	-0.004*** (0.0002)
Multi_class	0.218*** (0.016)	0.215*** (0.016)	0.198*** (0.016)
Primary_manual_rate	0.085*** (0.006)	0.088*** (0.006)	0.089*** (0.006)
Primary_manual_rate_sq	-0.005*** (0.0003)	-0.005*** (0.0003)	-0.005*** (0.0003)

<sup>3</sup> Alternatively, we could have chosen a zero-inflated negative binomial regression model to account for the excess number of firms with zero claims. In either case, the negative binomial is preferred here because the mean and standard deviation were too dissimilar to allow a Poisson model.

Pseudo R <sup>2</sup>	0.010	0.015	0.020
sigma	2.2595	2.2723	2.2855
n =	380,246	380,284	380,246

Notes: Tobit: dependent variable, Number of claims  
 Year dummies included but not reported.  
 Robust std. errors corrected for clustering by firm  
 p values \* = 0.05; \*\* = 0.01; \*\*\* = 0.001

Following the analysis of Roncek (1992) and McDonald and Moffit (1980) we disaggregate the marginal impacts from Tobit coefficients (Table 1.3). The probability of a firm having a claim is reduced by 4.8 percent in the first year and just over 7 percent in years 2 and 3. Conditional on having a claim, the number of claims is reduced by 1.3 percent (first and third years) and 1.7% in the second year.

**Table 1.3 Disaggregating the Marginal Effects of Experience Rating**

	<b>1<sup>st</sup>Year Experience-rated</b>	<b>2<sup>nd</sup>Year Experience-rated</b>	<b>3<sup>rd</sup>Year Experience-rated</b>
P(any claim)	-4.8%	-7.3%	-7.2%
Number of claims, conditional on any claims	-1.3%	-1.7%	-1.3%
Total effect	-6.0%	-8.9%	-8.4%

From the marginal effects, we can identify the total effect on claim frequency of -6.0 percent in the first year and approximately -8.9 percent and -8.4 percent in the second and third years.

The decline in claim frequency can be driven by either an improvement in safety or less complete reporting of claims in response to the incentives of experience rating. We answer this question by estimating the impact of experience rating on the cost per claim. Generally, it is argued that experience rating is likely to affect the number of claims, but not to have a substantial effect on the cost per claim (Tompa et al., 2007). The argument is that employers have control over safety in the workplace, but very limited control over the cost of claims once they pass to the insurer for handling. This theory is built into the experience rating formula which weights the frequency of claims much more heavily than the average cost in calculating the X-mod.

If experience rating affects the number of claims but not the cost per claim, then the average cost of claims should remain unchanged. This requires an assumption that the safety effect is evenly applied across all types of injuries and/or the cost of a claim is nearly random given the accident occurs.

If firms attempt to repress claim reporting in response to being newly experience-rated, we expect the average cost per claim to increase for experience-rated firms for three reasons. First, claim frequency is the most important component of the experience modification calculation.

Second, it is almost surely easier to avoid reporting minor claims than serious claims. Third, if employers have to pay for a worker's cost of medical treatment and wage loss if they choose to not report a claim, then it becomes an increasingly worse proposition to not report a claim as severity increases.<sup>4</sup>

We analyze the impact of experience rating on average claim cost in Table 1.4. For this analysis we select a subset of the original sample. Specifically, we analyze the cost per claim only on the subset of firms that had at least one claim in the two years prior to experience rating, because firms more likely to have a claim (in either period) may be different in unobserved ways that also affect the average cost per claim. We also require that the firm have at least one claim in the specific year after initiation of experience rating. Consequently, for each year  $t_0$  to  $t_2$ , separately, we are comparing an identical set of firms pre and post. The sample of firms being compared will vary across the three years of comparison.

**Table 1.4 Dependent Variable: In(incurred losses/claim) Conditional on Having Any Incurred Cost**

	1 <sup>st</sup> Year Experience-rated	2 <sup>nd</sup> Year Experience-rated	3 <sup>rd</sup> Year Experience-rated
Constant	7.208*** (0.078)	7.127*** (0.042)	7.137*** (0.040)
Experience-rated *After	0.000 (0.049)	0.111* (0.052)	-0.023 (0.053)
Experience-rated	0.101*** (0.031)	-0.019 (0.033)	-0.030 (0.034)
After	0.031 (0.016)	0.057*** (0.018)	0.104*** (0.020)
\$1000_Premium	-0.028* (0.014)	-0.020*** (0.006)	-0.019*** (0.005)
\$1000_Premium_sq	0.002** (0.001)	0.002*** (0.0003)	0.001*** (0.0002)
Multi_class	0.132*** (0.013)	0.145*** (0.014)	0.126*** (0.014)
Primary_premium_rate	-0.058*** (0.005)	-0.039*** (0.005)	-0.051*** (0.005)
Primary_premium_rate_sq	0.005*** (0.0005)	0.004*** (0.0004)	0.005*** (0.0004)
Adj. R <sup>2</sup>	0.020	0.021	0.022
n =	54,849	51,456	48,183

Notes: Year dummies included but not reported  
Robust std. errors corrected for clustering by firm  
p values \* = 0.05; \*\* = 0.01; \*\*\* = 0.001

<sup>4</sup>One might think that under insurance, it is almost always a better proposition to report a claim and have it paid by the insurer than to pay it directly. We conducted a survey of small employers near the range of premium size studied here. They universally responded that a \$5,000 claim would increase their premiums, but the increase would be less than \$5,000. While this argues for limited impact of experience rating on reporting, employers were actually incorrect in this specific case. As we will discuss later in the paper, the experience rating calculation over-weights small claims (under \$7,000), and most often will raise future premiums more, often several times more, than the actual cost of the claim.

Table 1.4 presents the results of this part of the analysis. The coefficient on the interaction term, Experience-rated \*After, is near zero and not significant for years  $t_0$  and  $t_2$ , consistent with the interpretation that the reduction in claims is a real safety improvement. The average cost per claim remains similar to the controls despite the decrease in claims reported. The coefficient on the interaction term in year  $t_1$  is significant and substantial. We believe that this is most likely a statistical anomaly, for several reasons. First, two of the years have coefficients near or below zero. Second, the samples differ for each of the years, because we are specifically including only treatments and controls that had claims in the specific post-period year as well as the pre-period. Most important, we evaluated specific sub-periods and identified that except for post-period years 2004-2006, the coefficient on the interaction term is very near zero and not significant. The period 2004-06 was characterized by historically rapid declines in both premium rates and average claim costs. This may have resulted in some more extreme value changes, pre and post.

Table 1.5 gives the total impact of experience rating as observed for the third year of experience rating ( $t_2$ ). In this table we include the effect on claim frequency and the average cost of claims. We also present two other models' results as a check on the robustness of results under the preferred model. The results are comparable across all three specifications. The preferred models, Tobit for the claim counts and OLS for log cost per claim, indicate an approximately 10.5 percent reduction in cost of occupational claims in year  $t_2$  for firms that become experience-rated for the first time in year  $t_0$ .

The impact of experience rating under the other two specifications is larger. In the second column, we present the results for the model using Logit to measure the impact on the probability of a firm filing any claims and a negative binomial regression for the number of claims, conditional on reporting any claims. The negative binomial regression is well suited for these data where the distribution is heavily skewed towards firms reporting only one claim (approximately 74 percent of firms reporting any claims, report only one claim). The final stage of this specification uses the same OLS with the dependent variable the  $\ln(\text{cost}/\text{claim})$  used in the preferred specification. The results for this model are very similar to the preferred model, experience rating results in approximately a 10 percent reduction in claims and an 11.8 percent reduction in total claim costs.

The final specification is a simple OLS model with the dependent variable equal to the log of incurred cost across all claims for the firm in the policy year. The estimated impact of experience rating is larger under this specification, -15.7 percent on total incurred cost. However these data have a majority of policies with no incurred costs for which we have to substitute small values in the log transformation. We note that the dominance of zero values and highly variant costs when present are likely not well modeled with a one-stage OLS approach. However, the effects are comparable to the effects with the conceptually superior approaches, so we include these results because the estimates are easier to interpret.

**Table 1.5 Comparison of Estimates for Third Year of Experience Rating**

	Tobit +OLS	Two-stage (Logit/ Negative Binomial) + OLS	1-stage (OLS)
P(any claims)	-7.2%***	-6.0%***	
Number of claims, conditional on any	-1.3%***	-3.9%***	
ln(cost/claim)	-2.3%	-2.3%	
ln(incurred cost)			-15.7%***
Total impact	-10.5%	-11.8%	-15.7%

Notes: Year dummies included but not reported  
 Robust std. errors corrected for clustering by firm  
 p values \* = 0.05; \*\* = 0.01; \*\*\* = 0.001

***How Would Insurers Act in the Absence of Statutory Requirements to Experience Rate?***

We find experience rating has significant and substantial impacts on small employers’ safety experience. The next question is whether insurers will act in a socially optimal way in the absence of regulatory intervention. To accurately answer this question we would have to reach a conclusion on the social value we put on reducing occupational injuries relative to the cost of the safety interventions that accomplish the improvement. While we cannot answer that trade-off in this paper, we can ask a simpler question that is informative: “Do insurers differentiate premium rates for small employers as though they are experience-rated, even when they are not?” That is, in the current market, does the safety effect we observe lead insurers to apply debits, credits and other tools near the margin to, in effect, *de facto* experience rate employers? If not, then absent the currently imposed requirements, insurer would not apply the equivalent of experience rating to more employers and most likely would apply them to even a smaller fraction of employers than current regulation requires.

Experience rating is only one tool that insurers have to vary premiums across employers. At one extreme, insurers can simply refuse to underwrite a firm with poor previous experience, limiting choice of available insurers for the firm and, all else equal, increasing premiums. Alternatively, an insurance group that includes several insurance companies under the same umbrella can shift the policy to a company with a higher premium rate. This higher rate exists because each company files a different “deviation” from the pure premium rate approved by the Department of Insurance. Even among companies under the same group umbrella these deviations can range from well below 1.0 to in excess of 2.0 depending upon the market segment being targeted by that specific company. Finally, insurers often apply debits and credits to

premium rates to reflect different underwriting criteria that the insurer expects will affect the policyholder's expected losses.<sup>5</sup>

These pricing options are frequently applied to larger employers, but there has been no research on how this type of underwriting might affect small employers who are not subject to experience rating. We did such an analysis. Using the sample of all employers within +/-30 percent of the threshold for experience rating, we split the file by whether they were experience-rated or not experience-rated and ran regressions separately. The explanatory variables included whether the firm reported any claims in any of the three years equivalent to the experience rating base period (ANY\_CLAIMS\_X, where X could be t<sub>2</sub>, t<sub>3</sub>, or t<sub>4</sub>), the incurred cost of any claims in each of the previous three years (INCURRED\_X, where X could be t<sub>2</sub>, t<sub>3</sub>, or t<sub>4</sub>) and dummies for each policy year. Similar to the modeling of the safety impact of experience rating, we include a dummy for Multi\_class, and continuous variables for total pure premium and pure premium rate. The dependent variable is the actual premium divided by the pure premium. This ratio is a measure of the margin above the pure premium rate that the insurer required to underwrite the risk. A higher ratio indicates the insurer attributed higher expected cost to that policy and imposed a higher actual premium to reflect the risk. The results are presented in the Table 1.6.

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<sup>5</sup> For a detailed discussion of insurance pricing and analysis of filed deviation in the California market, see Neuhauser, et al., 2009.

**Table 1.6 Impact of Claim Experience on Actual Premium by Experience Rating Status**

	Not Experience-rated	Experience-rated
Constant	1.621 (0.032)	1.827 (0.141)
ANY_CLAIMS_t-4	0.002 (0.002)	0.099*** (0.007)
ANY_CLAIMS_t-3	0.007*** (0.002)	0.129*** (0.007)
ANY_CLAIMS_t-2	0.012*** (0.002)	0.103*** (0.006)
\$1000 INCURRED_t-4	0.0001*** (0.00002)	0.0039*** (0.0002)
\$1000 INCURRED_t-3	0.0004*** (0.00003)	0.0036*** (0.0001)
\$1000 INCURRED_t-2	0.0005*** (0.00003)	0.0050*** (0.0001)
Multi_class	0.061*** (0.001)	0.069*** (0.005)
ln_pure_premium	-0.068*** (0.004)	-0.112*** (0.016)
Primary_manual_rate	0.0008** (0.0004)	-0.0013 (0.0018)
Primary_manual_rate_sq	0.0005*** (0.000)	0.0005*** (0.0001)
Adj. R <sup>2</sup>	.302	.420
n =	157,897	13,790

Notes: Year Dummies not reported here.

p values \* = 0.05; \*\* = 0.01; \*\*\* = 0.001

Dependent variable: ratio of actual premium to pure premium

One moderate sized claim (\$10,000 incurred) in one of the three years used in calculating experience rating factors would have a very minor impact on non-experience-rated employers, adding, on average, 0.010 to the ratio of the actual premium to the pure premium, equivalent to the impact of an experience rating factor of 1.010. However, for an experience-rated employer a single claim of the same size would increase the ratio substantially, +0.152, or an experience rating factor of 1.152.

The calculation of experience rating results in the average experience modification of less than 1.0.<sup>6</sup> For the small, experience-rated employers in this analysis, the average experience modification is 0.971. Consequently, a related issue is whether the newly experience-rated employers enjoy the impact of the average experience modification being less than 1.0, or whether insurers compensate by reducing credits, increasing debits, or using other pricing options, removing the savings of a, on average, lower X-mod. We evaluated this question in the following manner. We started from the results in Table 6 where we identified that premiums were essentially unaffected by losses for employers who were just below the experience rating threshold. Consequently, we can reasonably model the actual premium paid by employers, when

<sup>6</sup> Over all experience rated employers, the average X-mod, weighted by premium, usually is between .91 and .94.

not experience-rated as a function of the manual premium rate and other factors we have available and identified as impacting non-experience-rated employers’ actual premium. We then estimated the following equation:

$$\ln\_finalpremium = a + b1*manualpremium + b2*primary\_manual\_rate + b3*multi\_class + bi*year\_dummies$$

We estimated this equation for the non-experience-rated employers and applied the coefficients to estimate the counterfactual premium for the experience-rated employers in the absence of being experience rated. We compared this premium estimate to the premium actually charged experience-rated employers and measured the difference, if any.

As a check, we also estimated the same equation for the combined set of employers, adding a dummy for experience rating. The estimates were calculated separately for  $t_0$ ,  $t_{+1}$ , and  $t_{+2}$ . We also estimate the same equations for  $t_{-1}$ , where, if our treatments and controls are well matched, should have resulted in a very small or no difference. These two approaches give virtually identical results. We report the results on the second approach in Table 1.7 because it is simpler to apply corrections for clustered standard errors in this estimate.

**Table 1.7 Estimating the Impact of Becoming Experience-Rated on Actual Premium**

<b>Difference Between Expected and Actual Premium for Newly Experience Rated Employers</b>				
	<b>t<sub>-1</sub></b>	<b>t<sub>0</sub></b>	<b>t<sub>1</sub></b>	<b>t<sub>2</sub></b>
Difference (Actual – expected premium)	-0.002	-0.073***	-0.061***	-0.040***
	(0.002)	(0.002)	(0.003)	(0.004)
adj. R <sup>2</sup>	0.842	0.843	0.793	0.611

Note: p values \* = 0.05; \*\* = 0.01; \*\*\* = 0.001

Since we are using the logged final premium as the dependent variable, the results in Table 1.7 can be interpreted as percent reduction in the actual premium as a consequence of being experience-rated. A key finding is the match in the year prior to the experience rating year when we identify the treatment and controls. In  $t_{-1}$ , there is no difference in the final premium for the two samples. Insurers priced the employers that eventually became experience rating identically to those that did not. Consequently, we are comfortable interpreting the differences after becoming experience rating as the result of the experience rating process.

## Discussion

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The key public policy question addressed here is whether jurisdictions should lower their thresholds for experience rating, thus including a substantially larger number of employers. These employers would theoretically respond to experience rating in the same manner as the slightly larger firms just above the current threshold. The evidence that lowering the threshold has a preventive impact on injury rates is strong. Employers who are included in the expanded experience rating would reduce claims by 7-11 percent and total losses by 10-15 percent. The safety improvements are stable and continuing, at least in the medium-term.

This impact represents a substantial improvement in workplace safety unless claim suppression is contributing to or is even the dominant source of any reduction. Based on that explanation, Boden has argued that, “Increasing the responsiveness of workers’ compensation premiums to injury incidence is a policy whose risks outweigh its potential benefits” (Boden, 1995, p. 287). However, the finding that the reduction in claim frequency is found across the range of claim severities rather than, on average, only among less serious claims, should allay this concern. The reduction in claims appears to represent a real change in the workplace safety environment.

The next important policy question is whether the insurance market would achieve socially efficient pricing in the absence of extensive regulatory intervention. The answer to this depends on how policymakers interpret socially efficient pricing. What we do conclude is (1) experience rating leads to substantial and significant reductions in claims and related costs; and (2) in the absence of experience rating requirements, insurers will not apply experience rating, *de facto*, to employers at the margin. Both of these findings from our study argue for regulatory intervention, even expanding the reach of the intervention to a greater portion of employers.

On the other side of the cost-benefit equation is the additional variation experienced by employers in their workers’ compensation premium if experience-rated. There is a substantial increase in variance. The coefficient of variation on the actual premium charged increases about ten percentage points for experienced rated employers. But this is probably not the key problem perceived by employers and the main political issue that concerns regulators.

The main issue is that aggregate measures of experience rating obscure situations that trigger complaints, particularly by smaller employers. Certain types of claims result in unexpected and probably inequitable changes in employers premiums. These claims are not uncommon. For example, take an employer with just twice the minimum size to be experience-rated (about \$25,000 in annual charged premium, 2012), who has two \$3,700 claims in one of the three policy years used for experience rating. The \$7,400 loss represents about 40 percent of the employer’s “expected loss” over the period. The impact of the two claims is to raise the employers experience modifier from 0.79 (if zero claims) to 1.19 and increase premium over the three years

the experience modifier is affected by about \$31,000. The employer pays about four times the loss in additional premium and has an experience modifier greater than 1.0, even though actual losses were lower than expected losses. An employer just at the threshold for experience rating (about \$12,500 in actual premium, 2012) and one \$3,700 claim, would have an experience modification of 1.10 instead of 0.90 and pay an additional \$7,600 in premium over three years, about two times actual losses. The current design of the experience modifier is such that claims around the median value result in increases in premium in excess of the actual losses. When claims are smaller, the experience modification formula is much more responsive to losses. A single, \$1 million claim would have increased the modifier to only about 1.30. The situations where premiums go up substantially more than losses raise serious equity issues and call into question the role of insurance in smoothing risk. For smaller employers, any claims with total cost below the threshold of \$7,000 will increase future premiums by substantially more (two to four times) than the actual losses. And, over 70 percent of claims have costs below \$7,000.

Off-setting the increased variance, experience-rated employers, on average, pay lower premiums. The impact ranges from -4.0 percent to -7.3 percent. Experience rating alone would reduce premiums by 2.9 percent for these employers. The greater percent reduction in premium is consistent with the experience rating triggering access to other premium adjustments in recognition by insurers of the safety incentive built into experience rating.

One should not necessarily interpret the effects found here as a full measure of the impact of introducing experience rating into system where it was not previously implemented. We would underestimate the effect of experience rating if employers think they are experience-rated when they are not or think experience affects their premiums even when they are not experience-rated. When we undertook this study, we began by surveying smaller employers about experience rating. The survey was done on a convenience sample of business owners participating in small business association meetings. The majority of these employers thought that injuries affected their future premiums, even when we could determine from other answers to the survey that they were very unlikely to be experience-rated. Even when they knew they were not formally experience-rated, many employers thought claims would affect insurers' calculation of premium. This would suggest that our estimates be treated as a lower bound on the impact of experience rating.

One area of future research should be a focus on designing experience rating for smaller employers that avoids unnecessary variance while maintaining the incentive for safety. This research may even focus on solutions that differ in important ways from the design for larger employers. Until now, insurers have not focused on experience rating alternatives for smaller employers because small employers have not been experience rated.

An important question if jurisdictions change experience rating approaches is whether an approach that reduces the variance experienced by smaller employers would maintain the incentive effects we observed? The formula for calculating X-mods is very complex and it is likely that a minority of employers understand a great deal more than that they are experience

rated, that the experience modification is greater or less than 1.0, and whether it changed between policy years. Whether the degree of variance introduced by experience ratings affects the strength of incentives for safety is the focus of future work we will be doing under this research grant from CHSWC.

If the safety impacts on workplaces and the possible savings for employers outweigh the increased variance in pricing the employers would experience, then regulatory intervention to expand experience rating would be efficient. Because insurers do not currently adjust premiums for claims experience on employers very near, but below, the threshold, we conclude that lowering the experience rating threshold to include more employers and workers would reduce occupational injuries and illnesses.

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