WORKING
PAPER

The Pennsylvania Certified Safety Committee Program

An Evaluation of Participation and Effects on Work Injury Rates

HANGSHENG LIU, RACHEL M. BURNS,
AGNES GEREBEN SCHAEFER, TEAGUE RUDER,
CHRISTOPHER NELSON, AMELIA M. HAVILAND,
JOHN MENDELOFF

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ABSTRACT

The Pennsylvania Certified Safety Program: An Evaluation of Participation and Effects on Work Injury Rates

Since 1994, the Pennsylvania Certified Safety Committee program has granted a 5% discount on workers' compensation premiums to firms which established a joint labor-management safety committee that meets certain criteria. This study evaluated the effect of that program on injury prevention in 2 ways: 1) by comparing changes in injury rates for participants and non-participants; and 2) by comparing, for an audited sample of participants, changes in injury rates for those with good compliance and those with poor compliance. For the first, we constructed a control group of non-participants by propensity score matching, allowing us to compare firms in each group which had a similar estimated probability of joining the program. We found that the injury rates of participants did not decline more than the rates for non-participants; however, we did find that rates at participant firms with good compliance dropped more than the rates at participant firms with poor compliance. It is likely implementing the program does prevent injuries, but that not enough firms complied to achieve an overall impact.

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EXECUTIVE SUMMARY

The Department of Labor and Industry in Pennsylvania requested that RAND conduct a study that would assess: 1) how effective the Certified Safety Committee (CSC) program had been in improving safety and health outcomes; and 2) how to increase the participation of firms in the program. To address these objectives, we answer the following questions in this report:

a) Program Impact

- Do CSC participants experience greater reductions in injuries compared to non-participants?
- Does the extent to which CSC participants comply with program requirements affect the changes in their injury rates?

b) Program Participation and Dropout

- Are firms with more employees more likely to join the CSC program?
- Are firms in high risk industries more likely to join the program?
- Are firms with higher injury rates within their industries more likely to join the program? Are firms whose injury rates just went up more likely to join the program?
- Are firms with labor unions more likely to join the program?
- Are firms with certain workers' compensation insurers more likely to join the program than firms with other insurers?

We asked the same questions about the determinants of dropping out of the program. In addition, we asked whether, among the audited firms, those which had poorer compliance with program requirements were more likely to drop out.

Our final sample consisted of 364,840 firms and 1,901,768 firm years and our analysis revealed the following findings.

Program Impact on Injury Rates

We found that firms that joined the CSC program did not, on average, experience reductions in injury rates compared to similar firms that did not join. In fact, there was evidence that injury rates actually decreased less for CSC participants. The injury rates for participants declined by an average of 0.06 per 100 employees, while the rate for the matched non-participants decreased by 1.01 per 100 employees. This unexpected finding

was strongest in the construction industry, where rates at non-participants declined by 1.5 per 100 workers more than rates at participants. The unexpected finding was found in other industries as well, although it was not statistically significant.

We also examined whether the variation in program implementation had any effect on injury rate change after program participation in about 500 audited firms. When a deficiency was cited for the requirements that an agenda be prepared for each safety committee meeting or that all committee members receive annual training in 3 specified areas, the unadjusted post-participation injury rate was significantly higher. After controlling for other factors, the injury rate of the 51 percent of firms that failed to train committee members increased 1.79 per 100 employees compared to the firms that complied with all the requirements or firms that were cited for other (apparently less important) requirements.

We should be clear that we do not doubt that, because of the CSC, some firms made considerable strides in injury prevention by establishing safety committees and carrying out the activities required by the CSC. Because over 80 percent of the audited firms had deficiencies, and an additional 5 percent had no operating committee at all, our findings suggest that the absence of an overall benefit was largely, although not entirely, due to non-compliance with effective program elements.

Program Participation

Firms with injury rates less than half of their industry average were about half as likely join the certified safety committee program compared to those with injury ratios above that level. Firms with over 100 employees were almost 100 times as likely to join as firms with fewer than 25 employees. Participating firms were much larger than non-participants, with an average size of 167 versus 17. Firms with 2 to5 workplace sites were 15 percent less likely to join than firms with a single site. Firms in western Pennsylvania were 20% more likely to participate than similar firms in eastern Pennsylvania. Most non-participating establishments had zero injuries during the observed time period. The mean injury rate of participants was 2.6 per 100 workers versus 0.9 for non-participants.

Compared to the firms in agriculture or mining industries, construction firms and manufacturing firms were more likely to join the program while those in the service industries were less likely to join the program. Firms with unionized workforces were

about 20 percent less likely to join. Holding firm characteristics constant, there were major differences among large workers' compensation insurers in the percentage of their clients who participated.

Overall participation in the program increased over time, growing from less than 0.5 percent in 1996 to nearly 2 percent in 2006. Rates of participation increased steadily, with relatively larger increases between 2001 and 2006. One factor that played a role in these increases were the statutory changes that allowed the premium discounts to be received in up to 5 years (in 1996) and indefinitely (in 2002). On average, participating firms in our sample participated in the program 6.5 out of the 13 possible years.

Program Dropout

For the most part, the features that made firms less likely to participate in the first places also made them more likely to drop out. This applied to small employment size and lower injury rates compared to the industry average. Firms with headquarters located outside of Pennsylvania were twice as likely to drop out. With the exception of manufacturing firms (which were 2.2 times more likely to drop out), industry did not have a significant impact on whether a firm remained in the program.

Firms with unionized workforces were about 50 percent more likely to drop out than non-unionized firms, which is consistent with what we found about the effect unionization on participation. Not surprisingly, firms which had one or more deficiencies cited in their state CSC program audits were about 40 percent more likely to drop out by the end of 2007. Firms with no deficiencies were 86 percent less likely to drop out.

Policy Options

To Improve Program Effectiveness

- One option is to continue the status quo. However, it seems improper that so many firms appear to be getting a discount without fulfilling their share of the bargain in terms of implementing the Safety Committee program.
- Program compliance could be better enforced, especially on some key program requirements such as that all committee members receive annual training in 3 specified areas. The downside is that a more extensive audit program would reduce participation, and more audits would require more staff, increasing public costs.
    - Given that the great majority of participants were cited for some audit deficiency and given the absence of knowledge about whether all of the requirements are important for safety, it seems

unwise to sanction participants simply because they have any deficiency. But to sanction firms that have no program at all or that fail to train their committee members is more reasonable.

- The State could require that firms that meet either of the two criteria above pay back any discount that they received that year from CSC program participation. This policy can be criticized for being too lenient; after all, a firm that never intended to comply is no worse off joining and being caught than it would have been if it had not joined. However, being forced to return the discount would provide more incentive for compliance than currently exists.
- Some of the funds received from non-compliant firms could go the Bureau of Workers' Compensation to compensate it for audit activities. However, this might be viewed as providing an incentive for the Bureau to cite deficiencies too often. Otherwise funds would be returned to the WC insurer.

To Increase Program Participation

Given our findings on effectiveness, it is not evident that increasing participation deserves a high priority until issues of compliance are addressed. However, the following could be employed:

- Raising the discount in WC premiums for participants would very likely increase participation, but it would shift some costs to insurers. It is possible to estimate what the increase in participation would be for a given increase in the discount. However, good estimates require using actual premium data, which we did not have for this study. The PCRB, however has this data and could carry out this study.
- Program requirements could be relaxed. A method to identify what provisions, if any, could be usefully dropped would require finding deficiencies which are not related to injury prevention, especially those that also increase drop-outs. The analyses that we conducted here could provide a first step, but a larger sample of audits is needed in order to make those judgments with more confidence.
- The BWC could consider adopting measures that would better assure that insurers did not unduly discourage firms from participating. Our results suggest that participation were associated with having different WC insurers.

1 INTRODUCTION

The idea that safety committees, especially joint labor-management safety committees, can promote workplace safety has influenced policy in many advanced industrial countries. In the United States, however, safety committees have not played as prominent a role in national policy, although a number of states have either mandated safety committees for some or all employers or offered financial incentives to firms that establish them.

Pennsylvania (PA) is one of the states that adopted legislation that provides a financial incentive for firms to certify that they have joint labor management safety committees. In PA, firms that do so are eligible for a 5 percent discount on their workers' compensation (WC) insurance premium. The original 1993 statute Act 44 allowed firms to get this benefit for only 1 year (PADLI, 2004). Thus none of the firms receiving it in 1995 had received it in the first year, 1994. Act 57 of 1996 allowed firms to receive the benefit for 5 policy years (PADLI, 2004). Then, in December 2002, the cap was removed and firms could obtain the discount indefinitely as long as they submitted a satisfactory re-application.

1.1 The Charge

The Department of Labor and Industry in PA requested that RAND conduct a study that would examine two issues. The first was how to increase the participation of firms in the certified safety committee (CSC) program. The second was to assess how effective the program had been in improving safety and health outcomes.

In PA, a safety committee is supposed to regularly bring workers and management together to improve safety and health in the workplace by carrying out three main functions: detect hazards, analyze and solve problems, and assist in the management of safety (PADLI, 2003). The safety program requires that firms set up a safety committee that consists of equal numbers of management and employee representatives. The safety committee is responsible for conducting periodic workplace inspections, including walking through the workplace, detecting hazardous conditions and unsafe work practices, and discussing with workers. The safety committee also needs to investigate accidents and identify causes of accidents. Finally, the committee members should adopt measures to prevent future work injuries such as disseminating work safety policies,

promoting safe work practices, and resolving other occupational safety and health issues in the workplace. To become certified, a firm must have had a safety committee for 6 months that meets the criteria set by the PA Department of Labor and Industry. Once the firm's written application is approved, the state of Pennsylvania sends the firm a written notification that can be provided to its WC insurer to obtain the 5 percent discount on its next annual workers' compensation insurance policy. Since 1999, the PA Bureau of Workers Compensation (BWC) has randomly selected and audited some participating firms each year. The purpose is to make sure participating firms comply with the program requirements. (For a list of the requirements, see Table 4.)

We evaluated the program participation and effect on injury rates, and answered the following questions in this report:

a) Program Participation and Dropout

- Are firms with more employees more likely to join the CSC program?
- Are firms in high risk industries more likely to join the program?
- Are firms with higher injury rates within their industries more likely to join the program? Are firms whose injury rates just went up more likely to join the program?
- Are firms with labor unions more likely to join the program?
- Are firms with certain workers' compensation insurers more likely to join the program than firms with other insurers?

We asked the same questions about the determinants of dropping out of the program. In addition, we asked whether, among the audited firms, those which had poorer compliance with program requirements were more likely to drop out.

b) Program Impact

- Do CSC participants experience greater reductions in injuries compared to non-participants?
- Does the extent to which CSC participants comply with program requirements affect the changes in their injury rates?

1.2 Our General Approach

1.2.1 Program Participation

We developed a simple model of the expected benefits and costs to a firm of joining the CSC program: the larger the expected savings and the lower the costs of participating, the greater the participation would be. Savings are based on the size of premiums. Premiums are higher when there are more employees; their average wages are higher; the riskiness of their work is higher; and, for firms large enough to be experience-rated,[1] the firm's losses are unusually high among firms doing similar work. The costs of participating include costs related to the application process; costs related to setting up an eligible committee if none exists or adjusting an existing one; and costs associated with regular committee activities. Larger firms or firms with multiple facilities may have higher associated costs, but some of the costs are probably fixed; therefore, net benefits would probably tend to increase with the level of employment.

In practice, there are other reasons to expect larger firms to participate more. They are more likely to already have safety committees and more likely to have personnel who specialize in safety and who, therefore, might tend to champion initiatives that promise to give more attention to safety.

It is unclear whether the presence of a labor union would tend to increase or decrease participation. Firms with labor unions are more likely to already have safety committees.[2] These firms might like to take advantage of them, but unions might be wary of conflicts between the provisions they have negotiated in contracts and what the state would require for a safety committee.

In addition, workers' compensation insurers may play an important role in participation because the PA state program relies on insurers to notify their customers about the existence of the discount. PA specifies the general terms of the notices, but it is possible that insurers vary in their presentation of the program, depending in part upon whether they believe that a safety committee would lead to savings that were large enough to offset the discounts they have to provide.

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[1] Experience rating is the process by which insurers adjust the premiums of firms based upon their losses in the last few years. The extent of the adjustments depends upon how credible the experience is as a predictive tool. Thus experience rating generally affects premiums more in firms with larger payrolls in higher risk industries. The effect of the experience rating, of course, can either raise or lower the premiums.

[2] By the 1980s most workplaces with union representation had a joint labor management committee stipulated by their contract (Robinson, 1988).

1.2.2 **Program Impact**

As described in more detail below, we evaluated the impact of CSC participation on the change in the rate of lost time injuries and illnesses per 100 workers.[3] The lost time injuries and illnesses are those reported via First Report of Injury forms to the PA BWC. . We compared the changes in lost time rates for CSC participating firms with the changes at comparable non-participating firms.

The Pennsylvania Compensation Rating Board (PCRB) (2006) undertook its own study of the CSC program from 1994 through 2004, focusing on whether participant's injury losses had declined enough to match the 5% credit they had received from the insurers.[4] PCRB calculated the reduction in losses by comparing the actual loss ratio for participants to the actual loss ratio for non-participants. The loss ratio basically compares the losses to the "standard premium," an amount which takes account of any experience rating for the firms. We can view the standard premium as the expected losses for the firm on the basis of their recent experience. Thus a lower loss ratio for participant firms means that, relative to other firms, their actual losses were lower than their expected losses.

In fact, in 7 of the 11 years (1994-98, 2002 and 2003) the difference between actual and expected WC losses (i.e., the cost reduction) at CSC firms was larger than the credit they received. In 1999 and 2004, the difference between the actual and expected losses was positive, but less than the credits; and in 2000 and 2001, the loss ratios were higher than at non-participating firms. For the entire period, the average credit for participating employers was 4.88 percent while their experience could have justified a credit of 6.63 percent. However, for the last 6 years through 2004, the average credit was 4.93 percent, while the justified credit was only 2.51 percent.

From the perspective of WC insurers, the program appears to have saved them money over the entire 11 years that the PCRB study reviewed, although since 1999 their premium reductions exceeded the reduction in losses. From a societal perspective, the $132 million in premium savings (the sum of the 5 percent credits over the 11 years) for participants is a transfer, not a real cost or benefit. Customers pay less and the insurers receive less. However, the reduction in WC losses, if it reflects actual reductions in

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[3] This measure is equivalent to the "days away from work" cases in the OSHA recordkeeping system.

[4] Unlike the Bureau of WC, PCRB has data on the dollar value of WC benefits paid on behalf of each employer and the amounts spent for medical expenses and for indemnity benefits for lost work time.

injuries and illnesses, is a real benefit to society regardless of whether it exceeds the amount of the credits.

How does our study of the CSC's impact differ from what PCRB did? One difference is that we are looking at changes in lost-time injuries, not changes in dollar losses. More importantly, the PCRB study did not compare changes at participant firms with changes at similar non-participant firms. As we describe below, CSC participants were much larger and more concentrated in high risk sectors than the typical firm. Thus, if different types of firms were experiencing different trends, the PCRB study might not provide a valid comparison of participants and non-participants.

1.3 Organization of this Report

This report is organized into six chapters. Chapter Two examines the literature to date on safety committees. Chapter Three presents the data and methods used in our analysis. Chapter Four presents the results of our analysis. Chapter Five presents the discussion of the results of our analysis. Finally, Chapter Six presents our policy recommendations based on the findings of our study.

2 PREVIOUS LITERATURE

2.1 Effect of Safety Committee on Work Injuries

Although a number of studies have tried to identify the impact of safety committees on workplace safety, we still lack quantitative estimates about the impact on injuries that can stand up to serious scrutiny. Despite this gap, earlier studies do suggest a number of potentially interesting lessons. Kochan et al. (1977) examined 51 unionized plants in New York State with joint labor-management committees, concluding that their effectiveness was determined largely by labor and management commitment and less from observable safety committee activities.

Prior studies have identified factors such as training, commitment by senior management, and strong communication that may contribute to the effectiveness of safety committees (Yassi et al., 2005; O'Toole, 1999; Shannon et al., 1996;; Reilly et al, 1995). However, the empirical evidence in the literature about the effectiveness or impact that safety committees have on safety in the workplace is mixed. Several studies of safety committees conclude that sometimes they will be effective and sometimes not.

Two studies that did have data on injury rates looked at mandates for joint safety and health committees in the province of Ontario. A study by Lewchuck, Robb, and Walters (1996) is noteworthy for its survey of 206 manufacturing and retail firms in Ontario to determine when their safety committees were established. They looked separately at firms whose safety committees had been created prior to the 1979 mandate and at firms which had created them after they were required to. They found that "workplaces where the first committee was formed after 1980 did not enjoy a drop in injury and illness frequency once the committees were formed." They concluded that "Simply mandating committees is unlikely to have much effect at workplaces where the Internal Responsibility System and co-management of health and safety matters is not embraced by management and/or labour." They also argued that the finding that rates in manufacturing, which had been covered by the mandate, declined more than rates in retail trade, which had not been, constituted good evidence of the mandate's impact. In the absence of any exam of whether rates in the two sectors had tracked each other in the past or whether the two sectors in other jurisdictions showed similar patterns, we don't find this argument compelling.

Tuohy and Simard (1993), who looked at mandates in both Ontario and Quebec, also concluded that, at least in Ontario, rates had declined because of the mandates and that "the most important result...is the finding the committees with bipartite structures, broad scope of activities, and institutionalized procedures reduce injury rates and improve problem-solving capabilities at the workplace level..." Other studies have usually focused either on how well firms complied with mandated program elements or on what characteristics of the safety committees made them more effective, but these studies relied upon surveys of safety committee members for assessments of safety committee effectiveness. In a review of this literature on factors influencing safety committee effectiveness, O'Grady (2000) states that "two clearly stand out". The first is access to information. The second is training for members of the joint committees, especially the chairs." A 1994 survey in Ontario (SPR, Inc. 1994) found a large difference in committee activity between those firms where core certification training had been completed by committee members and those where it had not been.

2.2 Methodological Issues in Prior Studies

Studies of *voluntary* programs are bedeviled by the threat posed by potential selection bias; firms that volunteer probably have a greater commitment to do something about workplace risks. Therefore, it seems very plausible that they would have done something to try to reduce injuries even in the absence of a safety committee. Thus the problem becomes how much of any safety gains can be attributed to the safety committee itself and how much to a firm's greater commitment to safety, which may have taken other forms as well. One step to try to address this issue is by getting information on exactly what firms did. If we found, for example, that firms did carry out each of the elements of the voluntary program and that they did not launch any other initiatives, we would gain confidence that any drop in injuries that followed was the result of these activities. We have found several analyses of voluntary programs with workers' compensation premium discounts, but they all involve safety programs, not joint labor-management safety committees, and clearly do not require committees.[5] While these analyses suggest that firms that volunteered reduced their injuries more than those that did not, these studies do not provide very credible evidence of program impact.

[5] For a review of these studies, see LaTourette and Mendeloff (2008).

The vast majority of studies that examine the impact of safety committees suffer from major methodological shortcomings. In addition to potential selection bias, the studies to date face other problems as well. Case study or cross-sectional designs, such as in Walters and Nichols (2006) and Reilly et al. (1995), are correlational studies not designed to discern causality. Studies with short observation windows must contend with noisy data that make it difficult to draw conclusions, as in Eaton and Nocerino (2000). Because injury rate data and safety committee participation data can be hard to obtain, studies can suffer from small sample sizes or low survey response rates that make it difficult to discern an effect (O'Toole, 1999; Boden et. al, 1984). There is also a subset of U.S. studies that examine an indirect outcome measure – the federal Occupational Safety and Health Administration inspection records -- rather than injury rates. (Weil, 1999; Boden et al., 1984). However, with these data it is not clear what effect a safety committee should have: should the number of violations be higher because the safety committee is identifying hazards (Weil, 1999) or should the number be lower because the safety committee serves as an effective intermediary for solving problems (Boden et. al., 1984)?

2.3 **Contribution of Our Study**

Our study addressed the need for more rigorously designed empirical studies of programs using financial incentives to attract firms into voluntary safety programs. According to one study, in the late 1990s, 10 states had voluntary programs for either safety committees or safety programs under their workers' compensation systems (Conway and Svenson 1998). Although not able to fully overcome the self-selection problems that arise, we do have several methodological advantages: We have a relatively large set of observations; we can look at changes in injury rates over time; we have relatively valid measures of whether firms complied with program requirements and of which ones. Perhaps most importantly, we have two different data sets and analyses, which allow us to raise some interesting questions.

3 DATA AND METHODS

3.1 Data Sources

Several data sources were used for this study. Employment data came from the Pennsylvania Unemployment Insurance system (UI) spanning the years 1996-2006, including the average number of employees each quarter, the 1987 standard industrial classification (SIC), the number of workplaces, and their location. The UI data were used to define the universe for the analysis, that is, all the firms operating in Pennsylvania. The injury data came from the Pennsylvania Workers' compensation system for the years 1998-2005. State law requires employers to submit a First Report of Injury form to the Bureau of Workers' Compensation for all cases with one or more days away from work. The WC data also contains each firm's insurer information at the time of the injury.

The PA Bureau of Workers' Compensation (BWC) provided a file listing all of the firms that had ever participated in the CSC program from 1994 through 2007. The file included information about the year the firm first joined the CSC, the number of employees covered, whether the firm had a union, the name of the WC insurer, whether the firm was still participating in the program at the end of 2007 and the number of applications to the CSC that the firm had submitted. State BWC officials told us that the number of applications did not always correspond to the number of years that the firm had been in the program. Therefore, for firms that had dropped out of the program by the end of 2007, we did not necessarily know when they had dropped out.

In addition, two additional datasets were used for the sensitivity analysis, including inspection data (1993-2007) from the federal Occupational Safety and Health Administration Integrated Management Information System (IMIS), and the BWC's file with the findings from its audits of almost 500 CSC participants. The inspection data included information on the presence of unions, so it allowed us to identify the union status of some firms outside of the CSC and examine the effect of union status on both participations and changes in injury rates.

According to the BWC, firms were randomly selected for audits. Therefore, it is reasonable to view the findings as representative of all of the CSC firms. The audits provide compliance information on 22 separate areas of possible deficiencies. The audit records provided detailed information about compliance for each specific program requirement.

3.1.1 **Data linkage**

These datasets were linked together at the firm level, based on unique firm numeric identifiers and matching based on a firm's name-address information (using matching techniques developed in Fellegi and Sunter (1969) and described in Gray (1996)). If a firm had multiple establishments, the information was aggregated to the firm level. Both the UI data and the WC data files included the Federal Employer Identification Number (EIN), although for many WC records the EIN was missing. We initially linked together those UI and WC records with the same EIN, rejecting a few cases with very different name-address information in the two datasets. We then took the non-linked WC records and used name-address matching to link them to the UI data. The inspections in the IMIS data were then linked to the UI data, using name-address matching. Some firms in the UI data appeared to change their EIN over time, so we also used name-address matching within the UI data to ensure that our analysis included the full history of firms and injuries at each firm.

3.1.2 **Key variable definitions**

Throughout the analysis, the injury rate was defined as the number of cases with lost work days per 100 workers. The injury rate ratio is the ratio of a firm's injury rate to the average injury rate of its 4-digit SIC category for that year. Region was based on the mailing address since some firms had multiple establishments. The state was divided into three areas according to the Federal District Court system: eastern, central, and western Pennsylvania.[6] We included the region variable because we thought that awareness of the program might vary in different parts of the State. Program compliance measures for audited firms were derived from audit deficiencies, such as presence of a safety committee, composition of the committee, safety and injury records, minimum training of committee members, and frequency of the committee meeting (see Footnote 1 for a complete list).

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[6] Eastern District: Berks, Bucks, Chester, Delaware, Lancaster, Lehigh, Montgomery, Northampton and Philadelphia; Central District: Adams, Bradford, Cameron, Carbon, Centre, Clinton, Columbia, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lackawanna, Lebanon, Luzerne, Lycoming, Mifflin, Monroe, Montour, Northumberland, Perry, Pike, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming and York; Western District: Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Clarion, Clearfield, Crawford, Elk, Erie, Fayette, Forest, Greene, Indiana, Jefferson, Lawrence, McKean, Mercer, Somerset, Venango, Warren, Washington and Westmoreland.

3.2 Methods

3.2.1 Program participation and dropout

Based on the general approach proposed in the introduction, program participation was modeled as a function of firm size, number of workplaces, the prior injury rate[7], industry, region, presence of a union, and insurer. In addition to the factors influencing participation, we also added a compliance measure (from audit records) to the model on program dropouts. Multiple regression models were used to explore the factors that affect program participation and dropping out. We used generalized estimating equations to adjust for within firm clustering.

3.2.1.1 Model program participation

3.2.1.1.1 Initial participation

During the period we examined, the percentage of PA firms participating in the CSC program never exceeded 2%, although the percentage of workers was well over 5%. Our main analysis focuses on explaining initial participation in the program. This approach allows us to look at the firm's characteristics the year prior to joining, especially its injury rate. This method is more informative than a model that simply examines whether a firm ever joined.[8] We focused first on firms that joined the program in 1999 and later since we have injury rate data beginning only in 1998. For non-participating firms, all the firm years with prior year data were used as a control group. In addition, we also used the firm years of participants prior to their joining the program as controls.

For each firm, we had data for multiple years. Since a firm generally behaves consistently in its decision to join the program based on its calculation of expected savings and costs of participation, its participation status in one year was assumed to be correlated with the status in other years. We estimated a logistic model using the generalized estimating equations method to take account of the correlation between years since we are interested in the population-level effects;[9] and the correlation structure

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[7] Comparison firms are included in the data set for the same years as the participant firms and we use the year prior to the participant firm's joining as the prior year for the comparison firm.

[8] We also tested a model to predict whether a firm ever participated in the program between 1998 and 2006, by aggregating the information across years. The results were similar to those from the analysis the initial participation in the program.

[9] An alternative is to fit a model using a firm-level random effect, and this model could be interpreted as the individual-level effects rather than the population-average effects.

within firms was tested using quasi-likelihood information criteria (Pan 2001; Hardin and Hilbe, 2003). We reported the estimates based on a model with the best correlation structure according to the information criteria (see Appendix A for model specifications

Further, we added the change in the level of the injury rate in the prior 2 years as one of the independent variables in the model. The purpose was to examine whether the *change* in the injury rate matters in the firm's decision to participate in the program in addition to the possible effect of the absolute level of prior injury rate.

3.2.1.1.2 **Effects of union and insurer**

For CSC participants, we had data on the presence of a union. In order to assess the effect of the presence of a union on program participation, additional analyses were performed with a dataset limited to the firms which were ever inspected by the federal Occupational Safety and Health Administration. These inspection records identify whether a firm has a union. We also explored the possible effect of individual workers' compensation insurers on participation. The top 10 insurers in the state were identified and entered into the regression models. These insurers were identified based on average total premiums in 2002 and 2006.[10] Again, we had data on the insurer for all participants. For non-participants, we had this information only for those which had filed a WC claim from 1998 to 2005.

3.2.1.2 **Explaining program dropouts**

3.2.1.2.1 **Program dropout by the end of 2007**

We then conducted analysis on firms which had ever participated in the CSC program and tried to identify the factors that predicted whether they were still in the program at the end of 2007. We would have preferred to use one year of pre-dropout data to predict dropping out in the current year as we did for the initial participation model. However, since the actual date of dropping out is not clear in the data, we only examined whether a firm was in the program by the end of 2007. To explain drop out behavior, we limited the analysis to the firm-years after participation using the data from 1998 to 2005. Program dropout was modeled as a function of firm size, number of workplaces, the prior injury rate, industry, region, presence of a union, insurer, and compliance to the program requirements. We used a simple logistic model and the variables in the model were

[10] This was based on the published premium writings of workers' compensation insurers in PA, available at http://www.dli.state.pa.us/ Accessed on 05/29/2008.

aggregated at the firm level across multiple years (see Appendix A for model specifications).

3.2.1.2.2 Effects of union, insurer, and program compliance

As in the analysis of program participation we explored the roles of unionization, and the particular individual workers' compensation insurer in explaining dropping out. Lastly, an analysis limited to the firms that were audited was conducted to assess the association between audit deficiencies and dropping out. It seems plausible that firms cited for more audit deficiencies would be more likely to drop out of the program, because correcting the deficiencies involves additional costs and firms might not be willing to make the investment.

3.2.2 Model program impact

3.2.2.1 Regression model

To assess the program's effects on injuries, we compared the change in the injury rate for participating firms with the change in the rate for non-participants.[11] In order to control for the effects of other factors that might affect injury rate changes, the regression model included program participation, firm size, the number of workplaces, the presence of a union, industry, and program compliance. However, because participation in the program is voluntary, the main obstacle to evaluating its effect is self-selection, that is, firms that participated in the program are potentially different from non-participants, either in observed or unobserved dimensions. We included only firms that had at least one year of injury data prior to participation in the program in order to have a more valid comparison of injuries before and after participation. We used a population-average regression model that may not sufficiently address the possible selection bias (see Appendix A for model specifications). The same analysis was also done separately for manufacturing, construction, and other industries.

3.2.2.2 Propensity score matching analysis

The use of control variables in a multiple regression analysis can help to isolate the impact of participation in the CSC program. However, if the participants are very different than the non-participants, a further step is often helpful. That step is to compare the injury rate changes for the participants to the changes for a group of non-participating

[11] This type of comparison is sometimes referred to as a "difference in difference" analysis since we are comparing the difference in the changes for each group.

firms whose probability of participation was the same. Thus the control group becomes very similar firms who, for an unknown reason, decided not to participate. We identified these control firms by using the results of our analysis of participation to predict, for each firm, its probability (or propensity) of participating given its characteristics.

We employed propensity score matching as the method to assess the impact of program participation on injury rates. Since firms joined the program at different time points, it was critical to match the firms by year to make sure that both the participants and non-participants experienced the same time period. Propensity score was generated for each calendar year. Non-participating firms that were matched in earlier years were excluded in the matching process for later years. Again, the propensity for participation was assumed to be a function of firm size, number of workplaces, industry, the prior injury rate, and region. Nearest one-to-one matching was used, which achieved good balance between the two groups and was relatively easy to implement.[12] After matching, the firm level characteristics were not significantly different between participants and matched non-participants, including firm size, number of workplaces, industry, the prior injury rate, and region. We then pooled together all the participants and their matched controls, and conducted a paired "t" test of the difference in difference in injury rate. Propensity score matching analyses were also performed separately for manufacturing, construction, and other industries.

3.2.2.3 **Effect of program implementation on work injuries**

Since 1999, about 500 firms were randomly selected and audited by the BWC. Based on these audit records, we were able to assess their program implementation. This analysis answered the question whether the variation in program implementation affects work injuries. The analysis was limited to the audited firms only. We used a regression model similar to the one in Section 3.2.3.1 to assess the change in injury rates pre- and post-participation and estimate the difference in difference (see Appendix A for model

[12] A STATA module "PSMATCH2" was used for propensity score matching (http://ideas.repec.org/c/boc/bocode/s432001.html, accessed as of 05/15/2008). We also tried other matching algorithms, including Mahalanobis matching, k-nearest neighbors matching, kernel matching and local linear regression matching. Only nearest one-to-one matching and Mahalanobis matching allowed us to store the matched controls so that we could pool the participants and matched controls together. Though Mahalanobis matching achieved better balance between two groups, it did not support no-replacement matching. Therefore, we decided to use the nearest one-to-one matching. In addition, only one out of 1,861 program participants did not achieve common support.

specifications). It should be noted that the selection issue is not important here because all the audited firms were participants.

3.2.3 **Phone Interviews**

In addition to the injury rate data discussed above, we carried out a small number of interviews with a set of participant and non-participant firms. Our plan was to contact 20 participant firms and 10 non-participant firms to find out why they had or had not decided to participate in the CSC. The firms all had over 100 employees and were in the manufacturing or construction sectors, so they were in a group that had relatively high participation. We randomly chose firms in this category located in the Pittsburgh area. The Bureau of Workers' Compensation sent an email to the CSC participant firms which had been chosen, letting them know that we would be contacting them.

Despite 3 or 4 calls to each firm, we were able to complete interviews with only 10 of the 20 participant firms and 1 of the 10 non-participant firms. Therefore, we report below only on the participant firms.

4 RESULTS

4.1 Descriptive Statistics

The final sample consisted of 364,840 firms and 1,901,768 firm years. We compared characteristics of participants with non-participants (see Table 1). Firms in manufacturing were heavily overrepresented in the CSC, while other "blue collar" industries were also well represented compared to "white collar" industries. Participating firms were much larger than non-participants, with an average size of 167 versus 17. Most non-participating establishments had zero injuries during the observed time period. The mean injury rate of participants was 2.6 per 100 workers versus 0.9 for non-participants.

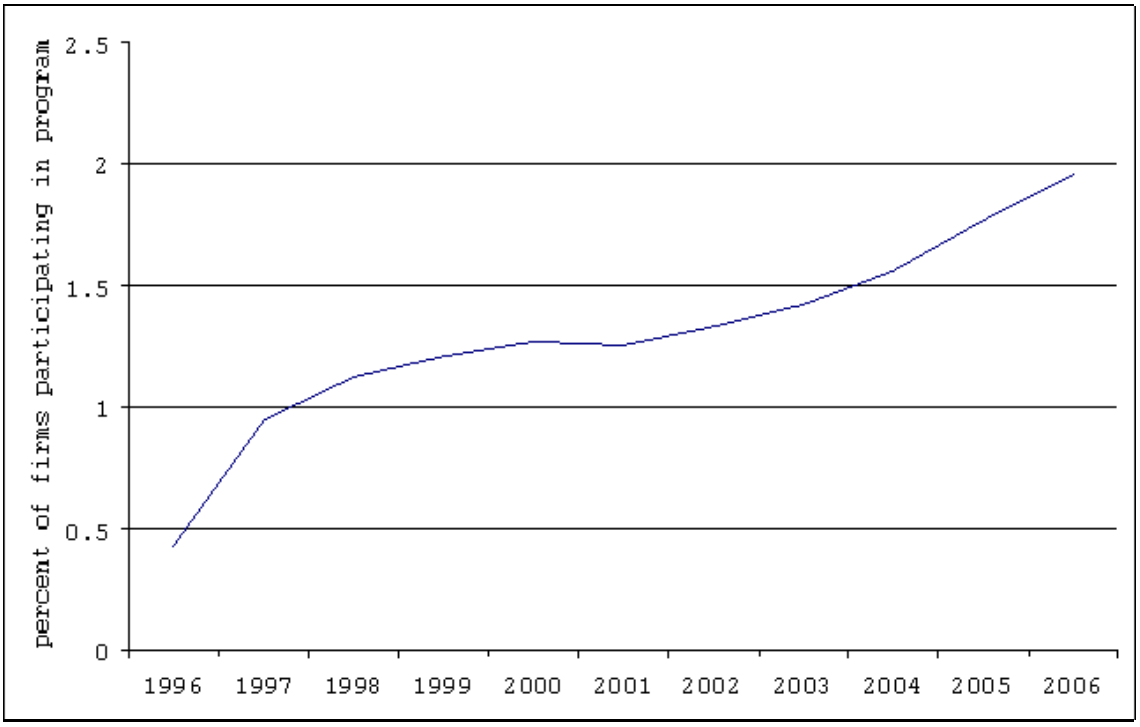
Figure 1 shows the time trend in participation rates. Overall participation in the program increased over time, growing from less than 0.5 percent in 1996 to nearly 2 percent in 2006. One factor that played a role in these increases were the statutory changes that allowed the premium discounts to be received for up to 5 years (in 1996) and indefinitely (in 2002). On average, participating firms in our sample participated in the program 6.5 out of the 13 possible years.

Table 1: Comparison of CSC Participants and Non-participants

Characteristics	Participants (%)	Non-participants (%)	Total (%)
SIC Division			
Agriculture, Forestry, Fishing	1.5	2.2	2.2
Mining	0.8	0.3	0.3
Construction	15.1	12.0	12.2
Manufacturing	32.0	4.7	5.2
Transportation, Communications, Electric, Gas, and Sanitary Services	5.1	3.3	3.4
Wholesale Trade	7.1	5.9	6.0
Retail Trade	8.9	17.9	17.9
Finance, Insurance, and Real Estate	1.4	5.5	5.5
Services	23.0	32.8	33.0
Public Administration	5.1	14.4	14.4
Firm Size			
10-24 employees	11.1	58.5	55.9
25-49 employees	20.1	21.6	21.4
50-99 employees	26.7	10.2	11.1
100-249 employees	27.0	5.4	7.0
250-499 employees	9.2	2.1	2.5
500 or more employees	6.0	1.8	1.4
Average Injury Rate (1998-2005)[13]			
0 No injuries	27.8	74.1	71.4
0-1 injuries per 100 workers	9.4	2.6	3.0
1-3 injuries per 100 workers	26.6	6.7	7.9
3-5 injuries per 100 workers	15.2	5.2	5.8
5+ injuries per 100 workers	21.1	11.3	11.6

[13] The injury rate was calculated as the number of lost-time injuries and illnesses (as determined by First Reports of Injury Reports filed with the State BWC) divided by the number of employees (as determined by UI records) per year. The numbers reflect average injury rates between 1998 and 2005.

Figure 1: Participation in the Certified Safety Committee Program,
by year



4.2 Program Participation

4.2.1 Initial participation

Table 2 presents the estimates on the probability that firms join the CSC program in a given year, based on the prior year's data (including the prior injury rate) before participation.[14] We calculated injury rate ratios, a firm's injury rate divided by the average injury rate for that firm's particular industry, based on 4-digit SIC codes. Firms with injury rate ratios greater than 0.5 were about 2 times more likely to join the certified safety committee program compared to those with injury ratios less than 0.5. Firms with over 100 employees were almost 100 times as likely to join as firms with fewer than 25 employees. Firms with 2-5 workplace sites were 15 percent less likely to join after controlling for other factors. Compared to the firms in agriculture or mining industries, construction firms and manufacturing firms were more likely to join the program while those in the service industries were less likely to join the program. Compared to year 1999, firms were less likely to join the program before and during 2002 and more likely to join the program after 2003. Relative to those in the eastern part of the state, firms in the western part of the state were 20 percent more likely to participate.

[14] We also examined whether a firm ever participated in the safety committee program during 1998 through 2006 and found similar results to those in Table 2. The probability of participation was higher among larger firms and firms with higher injury rate ratios (see Appendix Table 2).

Table 2: Initial Participation in the Certified Safety Committee Program

(N=1,901,768 firm years; 362,165 firms)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
1-24 employees (reference)						
25-49 employees	24.70	1.66	47.84	0.00	21.66	28.17
50-99 employees	72.33	5.11	60.55	0.00	62.97	83.08
100-249 employees	106.78	8.13	61.32	0.00	91.97	123.97
250-499 employees	116.63	11.43	48.54	0.00	96.24	141.34
500 or more employees	85.75	10.29	37.09	0.00	67.78	108.49
injury ratio <0.5 (ref)						
injury ratio 0.5-1	2.12	0.13	12.21	0.00	1.88	2.40
injury ratio 1-1.5	2.39	0.15	13.59	0.00	2.11	2.71
injury ratio 1.5-2	2.79	0.19	14.85	0.00	2.43	3.19
injury ratio greater than 2	2.58	0.13	19.34	0.00	2.34	2.84
1 workplace (ref)						
2-5 workplaces	0.85	0.06	-2.34	0.02	0.75	0.97
more than 5 workplaces	1.00	0.09	-0.02	0.98	0.84	1.19
Agriculture and Mining (ref)						
General Contractors	2.10	0.30	5.19	0.00	1.59	2.78
Heavy Construction	1.61	0.30	2.57	0.01	1.12	2.31
Special Trade	2.01	0.26	5.48	0.00	1.57	2.59
Manufacturing	1.48	0.18	3.21	0.00	1.16	1.87
Transportation	0.88	0.12	-0.91	0.37	0.67	1.16
Wholesale Trade	0.99	0.13	-0.07	0.94	0.76	1.28
Retail Trade	0.33	0.04	-8.5	0.00	0.25	0.43
Hotel, Personal, Business, Repair, Entertainment Services	0.52	0.07	-4.96	0.00	0.40	0.67
Health Services	0.69	0.10	-2.63	0.01	0.53	0.91
Legal, Educational, Social Services	0.56	0.07	-4.48	0.00	0.43	0.72
Public Administration	0.99	0.15	-0.09	0.93	0.73	1.33
Non-classifiable Industry	0.60	0.11	-2.88	0.00	0.42	0.85
Year 1999 (ref)						
Year 2000	0.93	0.08	-0.84	0.40	0.80	1.10
Year 2001	0.86	0.07	-1.87	0.06	0.73	1.01
Year 2002	0.75	0.06	-3.3	0.00	0.64	0.89
Year 2003	1.04	0.08	0.5	0.62	0.89	1.22
Year 2004	1.53	0.11	5.72	0.00	1.32	1.77
Year 2005	2.00	0.14	9.78	0.00	1.74	2.30
Year 2006	1.75	0.13	7.64	0.00	1.51	2.02
Eastern PA (ref)						
Western PA	1.19	0.05	4.06	0.00	1.10	1.30
Central PA	0.98	0.05	-0.37	0.71	0.89	1.08
Outside PA	0.23	0.02	-14.69	0.00	0.19	0.28

4.2.2 Effects of union and insurer on participation

Several sensitivity analyses were also performed. We added a variable for the change in the injury rate in the 2 years prior to participation in order to see whether a jump in the injury rate made firms more likely to join the CSC. However, the injury rate change in the prior two years had no effect on participation (Appendix Table 1). Firms with unionized workforces were about 20 percent less likely to join (Appendix Tables 3). When the top 10 workers' compensation insurers entered the model, it was clear that firms insured by some top insurers were more likely (odds ratios ranging from 1.3 to 1.7) or less likely (odd ratios down to 0.3) to join than firms insured by other top insurers (data not shown).

4.2.3 Interview Results

Our contacts at the 10 firms that were CSC participants all expressed satisfaction with the program. Since several of the firms had joined the program 9 or 10 years earlier, several of our contacts were too new to know about the decision process that had occurred then or the status of the firm's safety program at that time. Among the other 5, one reported that their pre-existing program already met the CSC requirement. One said that the firm had formerly used a centralized safety committee dominated by managers, but changed to a more decentralized and balanced committee when it joined the CSC. The others said that they had had safety programs in place, but not safety committees. Thus most reported that CSC participation had involved changes in practices.

4.3 Program Dropouts

Among those firms that ever participated in the program between 1998 and 2005, 17 percent were not in the program at the end of 2007.

4.3.1 Program dropout by the end of 2007

Table 3 shows the regression on the probability that CSC participants were no longer in the program at the end of 2007. For the most part, the features that made firms less likely to participate in the first places also made them more likely to drop out. This applied to small employment size and lower injury rate compared to the industry average. (These 2 variables use the pre-participation levels.) But the effects were much smaller compared to those on participation, and less likely to be statistically significant at the 5 percent level. Compared to firms that were not audited, firms identified as fully "compliant" with safety committee program audit requirements were 86 percent less

likely to drop out of the program, while audited firms with deficiencies were 39 percent more likely to drop out. Firms with headquarters located outside of Pennsylvania were twice as likely to drop out. With the exception of manufacturing firms (which were 2.2 times more likely to drop out), industry did not have a significant impact on whether a firm remained in the program.

Table 3: Program Dropout among Participating Firms

(N=5,221 firms)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
1-24 employees (ref)						
25-49 employees	0.64	0.09	-3.26	0.00	0.49	0.84
50-99 employees	0.66	0.09	-3.04	0.00	0.50	0.86
100-249 employees	0.60	0.09	-3.53	0.00	0.45	0.79
250-499 employees	0.73	0.14	-1.63	0.10	0.50	1.06
500 or more employees	0.68	0.16	-1.66	0.10	0.43	1.07
Injury Ratio Less Than 0.5 (Ref)						
Injury Ratio 0.5-1	0.56	0.06	-5.32	0.00	0.45	0.69
Injury Ratio 1-1.5	0.48	0.06	-6.15	0.00	0.38	0.61
Injury Ratio 1.5-2	0.49	0.07	-5.07	0.00	0.37	0.65
Injury Ratio Greater Than 2	0.63	0.07	-4.36	0.00	0.51	0.77
1 Workplace (Ref)						
2-5 Workplaces	0.68	0.08	-3.11	0.00	0.53	0.87
More Than 5 Workplaces	0.89	0.17	-0.59	0.55	0.61	1.30
Not Audited (Ref)						
Full Compliance	0.14	0.10	-2.73	0.01	0.03	0.57
1 or more Deficiencies	1.39	0.19	2.38	0.02	1.06	1.83
Agriculture And Mining (Ref)						
General Contractors	0.98	0.37	-0.05	0.96	0.47	2.05
Heavy Construction	1.23	0.52	0.50	0.62	0.54	2.80
Special Trade	0.95	0.32	-0.15	0.88	0.50	1.82
Manufacturing	2.21	0.67	2.58	0.01	1.21	4.02
Transportation	1.48	0.51	1.14	0.26	0.75	2.92
Wholesale Trade	1.53	0.50	1.29	0.20	0.80	2.91
Retail Trade	1.48	0.48	1.19	0.23	0.78	2.80
Hotel, Personal, Business, Repair, Entertainment Services	1.44	0.48	1.08	0.28	0.75	2.77
Health Services	1.55	0.52	1.31	0.19	0.80	2.98
Legal, Educational, Social Services	0.89	0.30	-0.35	0.73	0.45	1.74
Public Administration	0.68	0.29	-0.89	0.37	0.30	1.58
Non-Classifiable Industry	0.61	0.34	-0.88	0.38	0.20	1.84
Eastern PA (Ref)						
Western PA	1.00	0.09	-0.05	0.96	0.83	1.19
Central PA	1.21	0.12	1.88	0.06	0.99	1.47
Outside PA	2.39	0.38	5.40	0.00	1.74	3.27

4.3.2 **Effects of union, insurer, and program compliance on dropout**

Firms with unionized workforces were about 50 percent more likely to drop out than non-unionized firms (Appendix Table 5), which is consistent with what we found about the effect of unionization on participation. Firms insured by some top 10 workers' compensation insurers were less likely (odds ratios varying from 0.24 to 0.65) to drop out than firms in other top insurers (data not shown).

Furthermore, we explored the impact of compliance on dropping out. First, we used participant firms that had never been audited as the reference group (Table 3). Compared to them, firms which had one or more deficiencies cited in their audits were about 40 percent more likely to drop out by the end of 2007. Firms with no deficiencies were 86 percent less likely to drop out.

Second, in order to gain more insight, we looked at the relationship of a deficiency on each audit requirement to the probability that a firm dropped out. This analysis had to be limited to only those firms which had been audited. About 10 percent of the firms participating in the program during 1998 through 2005 were audited. Of these 491 audited firms, only 99 (20 percent) had no deficiencies. Of the other 80 percent, 5 were found to have no sign of a safety committee program, 47 complied with none of the CSC requirements and the others had, on average, 2 deficiencies. Some of these deficiencies may be quite minor, but fully 222 firms were cited for failing to have their safety committee members go through the 3 training courses that the CSC required.

Not too surprisingly, the regression model showed that firms which did not comply with any requirements were over 16 times as likely to drop out as firms with at least some compliance (Table 4). Of the 7 deficiencies with "p" values less than 0.10, all were associated, as we would expect, with increased rates of dropping out. Three of the 8, documenting causes of accidents, hazard detection, and training can involve a substantial investment of resources, although the others appear to deal with more procedural issues.

Table 4: Program Dropout among Audited Firms

(N=457 firms)

Variables	Odds Ratio	Std. Err.	P Value
Workplace Safety Committee Requirements	16.31	0.43	0.00
Workplace Safety Committee Composition 2 Mgmt & 2 Employees Required	1.73	0.44	0.21
1 more than half of the Workplace Safety Committee Quorum	5.75	1.47	0.23
Workplace Safety Committee Membership List is required to be maintained	0.88	0.66	0.85
An Agenda, prepared prior to Workplace Safety Committee meetings, is required	2.73	0.33	0.00
Workplace Safety Committee Membership is on a rotational basis which is established by the employer and to be recorded in the Committee By-Laws	1.20	0.58	0.76
Actual Committee Member Rotation documented	0.67	0.56	0.47
Workplace Safety Committee must be held monthly	1.95	0.29	0.02
Quorum: 1/2 of the Committee members plus 1	1.06	0.31	0.86
Meeting Attendance must be recorded & filed	0.37	0.95	0.29
Meeting Minutes are to be recorded & filed	0.92	0.82	0.92
Members are required to take 3 specific courses annually	2.40	0.31	0.01
Trainers must meet the Division of Health & Safety requirements	0.74	0.51	0.56
These are the 3 required training courses	0.47	1.12	0.50
Document cause of accidents, illnesses, etc. and methods of prevention	4.14	0.72	0.05
Hazard Detection	6.24	1.00	0.07
Hazard Inspection	0.46	1.25	0.54
Workplace Safety Committee Meeting minutes	1.71	0.49	0.28
An actual 'joint' committee comprised of the same # of members from mgmt as from employees	8.03	0.95	0.03

4.4 Program Impact

As explained before, our analysis of program impact proceeded in two steps. First, we compared the change in lost time injury rates for participants with the change for non-participants with controls for variables like industry and firm size that might also have affected changes in rates. So, for example, this test compared the changes in the two groups of firms, but it did so within each industry sector and size group. In the next step,

we introduced the results of propensity score matching and the effect that had on our estimates of CSC effectiveness. The first analysis may address selection bias if the linear model reasonably approximates the relationships. However, the propensity score analysis is a more robust method for assessing the relationship that is less sensitive to model specification.

4.4.1 **Regression model**

Table 5 shows the first analysis. The "post-program" variable shows that, for all firms, the injury rates went up, on average, over this period, although only by 0.22 injuries per 100 workers. The "Participation" variable shows that, on average, the injury rates of participants were 1.89 per 100 higher than the rates for non-participants. We expect this kind of difference because we know that the firms that join the program tend to be more risky firms in more risky industries. The key variable here is the interaction between "post-program" and "participation." What the coefficient for this variable measures is whether, holding constant the general changes over time in injury rates and holding constant the higher rates that participants have to begin with, the injury rates for the participants declined more than the injury rates for non-participants.

The negative coefficient on this interaction term (-0.33) means that the injury rates of participants did decrease relative to the rates of non-participants. However, the 'p" value of 0.37 means that there is greater than a 1 in 3 probability that this result could have occurred simply due to chance. The basic problem is that these injury rates are subject to a good deal of seemingly random fluctuations, which make it more difficult to conclude that the effect we find is unlikely to be due to chance. The other variable that might be related to program effectiveness is the "Years in Program," but we see that it had no effect on changes in injury rates. We repeated this analysis (not shown) separately for construction firms and for manufacturing firms and found similar results.

Table 5: Naive Regression Model Estimating Change in Injury Rate
(N=642,070; 321,035 firms)

Variables	Coefficient	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Pre-program (ref)						
Post-program	0.22	0.06	3.60	0.00	0.10	0.34
Participation	1.89	0.42	4.54	0.00	1.07	2.70
Interaction between post-program and participation	-0.33	0.37	-0.90	0.37	-1.06	0.39
1-24 employees (ref)						
25-49 employees	0.22	0.07	2.96	0.00	0.07	0.36
50-99 employees	0.26	0.13	2.01	0.04	0.01	0.51
100-249 employees	0.14	0.18	0.77	0.44	-0.21	0.48
250-499 employees	0.03	0.29	0.10	0.92	-0.54	0.60
500 or more employees	-0.25	0.34	-0.73	0.47	-0.92	0.42
1 workplace (ref)						
2-5 workplaces	0.16	0.18	0.85	0.39	-0.20	0.51
More than 5 workplaces	0.40	0.27	1.49	0.14	-0.13	0.93
Years in program	0.01	0.09	0.08	0.94	-0.18	0.19
Agriculture and mining (ref)						
General Contractors	0.09	0.13	0.68	0.50	-0.17	0.35
Heavy Construction	-0.53	0.32	-1.65	0.10	-1.16	0.10
Special Trade	0.10	0.12	0.84	0.40	-0.14	0.34
Manufacturing	-0.87	0.13	-6.77	0.00	-1.12	-0.62
Transportation	-1.07	0.14	-7.76	0.00	-1.34	-0.80
Wholesale Trade	-1.73	0.12	-14.16	0.00	-1.97	-1.49
Retail Trade	-2.07	0.11	-18.75	0.00	-2.28	-1.85
Hotel, Personal, Business, Repair, Entertainment Services	-1.89	0.11	-16.71	0.00	-2.11	-1.67
Health Services	-2.21	0.12	-17.75	0.00	-2.45	-1.97
Legal, Educational, Social Services	-2.19	0.11	-19.21	0.00	-2.41	-1.97
Public Administration	0.33	0.22	1.52	0.13	-0.10	0.75
Non Classifiable Industries	-1.83	0.12	-14.72	0.00	-2.07	-1.59
Year 1998 (ref)						
Year 1999	-0.05	0.08	-0.61	0.54	-0.21	0.11
Year 2000	0.16	0.09	1.68	0.09	-0.03	0.34
Year 2001	0.05	0.08	0.61	0.54	-0.11	0.22
Year 2002	0.06	0.08	0.72	0.47	-0.10	0.22
Year 2003	0.09	0.08	1.05	0.29	-0.08	0.25
Year 2004	-0.02	0.09	-0.22	0.83	-0.19	0.15
Year 2005	0.04	0.08	0.55	0.58	-0.11	0.19

4.4.2 **Propensity score matching analysis**

We next carried out the analysis after matching non-participating firms to participants based on the factors that predicted participation in the program. Results from this propensity score analysis are shown in Table 6. If we look at the top row first (the analysis for all industries together), we see that the injury rates for participants declined by an average of 0.06 per 100 employees, while the rate for the matched non-participants decreased by 1.01 per 100 employees. The "p" value in the upper left indicates that the probability that a difference this large was due to chance was less than 0.01. Thus it appears here that, on average, rates for non-participants improved more than rates for participants.

We get somewhat different pictures when we look separately at different sectors. For both manufacturing and "other industries," the injury rates for CSC participants still decline less than the rates at matched non-participants, but the differences are no longer statistically significant. In the construction sector, by contrast, the difference are very large; rates at matched non-participants declined by 1.5 per 100 workers more than rates at participants.

Table 6: The Impact of CSC Participation on Lost Time Injury Rates: Results from the Propensity Score Analysis, by Industry

Groups	Sample Size	Mean Difference	Std. Err.	95% Conf. Interval	
All Industries (p<0.01)					
Participants	1861	-0.06	0.24	-0.53	0.41
Matched Controls	1861	-1.01	0.21	-1.42	-0.61
Manufacturing (p=0.24)					
Participants	564	-0.11	0.25	-0.61	0.38
Matched Controls	564	-0.47	0.22	-0.91	-0.03
Construction (p=0.03)					
Participants	318	0.09	0.38	-0.66	0.83
Matched Controls	318	-1.59	0.78	-3.12	-0.06
Other Industries (p=0.30)					
Participants	973	-0.06	0.42	-0.89	0.76
Matched Controls	973	-0.64	0.43	-1.49	0.20

Note: Only those CSC participants in the program for at least 2 years were included. The controls were matched with participants based on all of the variables described in the methods section.

4.4.3 **Effect of program implementation on work injuries**

We also examined whether the variation in program implementation had any effect on injury rate change after program participation. There were 433 audited firms that could be matched to the injury data (WC). Among the audited firms, 79 had a safety committee that met all the requirements at the time of audit (compliant group), 18 had no committee at all (non-compliant group), and 336 firms had some violations with an average of 2.6 audit deficiencies out of 20 possible deficiencies (deficiency group). Table 7 presents the unadjusted work injury rates both for pre- and post-participation. On average, compliant firms had a higher injury rate (4.1) before participation than the other two groups (non-compliant firms 0.90, deficiency firms 2.8). After program participation, however, the compliant group had a rate of 2.8, lower than the deficiency group (3.4), higher than the non-compliant group (1.16). In other words, the compliant group had a decrease in injury rate, while the rates of the other groups increased.

Table 7: Comparison of Unadjusted Injury Rates before and After CSCP Participation by Audit Compliance Category

Audit Results	Pre Injury Rate	Post Injury Rate
Totally Non-compliant group	0.90	1.16
Deficiency group (with audit deficiencies)	2.80	3.44
Compliant Group (without deficiencies)	4.10	2.80

Note: the differences between pre- and post-participation injury rates were not statistically significant for any of the 3 groups.

In Appendix Table 6, we compare the unadjusted before and after injury rates for each of the deficiency categories used in the audit. There we found that there were statistically significant effects for 3 of them: the requirement that an agenda be prepared for each safety committee meeting, the requirements that meeting attendance must be recorded and filed, and the requirement that all committee members receive annual training in 3 specified areas. For all of these, when the deficiency was cited, the post-participation injury rate was significantly higher. BWC officials had earlier indicated that they believed that the training provisions were crucial for effectiveness, so the finding for this deficiency may indicate a true relation to injury prevention. We had not developed clear predictions regarding the other deficiencies, other than that non-compliance should increase the rates, so it is difficult to interpret the findings for the other two.

We examined the effects of the deficiencies on the change in injury rates at audited firms. Because it was cited at only 11 firms, we dropped the deficiency dealing with recording attendance. Table 8 shows the results. First, we see that the overall post-

program rates were lower than pre-program rates, but that the difference was not very statistically significant. The next 3 coefficients indicate that firms with these deficiencies tended to have lower than average injury rates prior to entering the program. The next 3 interaction variables show the association between citations of these deficiencies and the post-program injury rate. For all 3, the post-program rates are higher when these deficiencies were cited; however, the only effect that meets the usual test of statistical significance is the citation for absence of training for committee members. On average, the 222 firms (out of 433) that failed to train committee members did no better than firms that had no program. Other deficiencies did not have clear negative effects.

Table 8: Impacts of Deficiencies in CSC Programs on Changes in Lost Time Injury Rates

Variables	Coefficient	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Compliant firms and firms with other audit deficiencies (ref)						
Post-program	-0.83	0.65	-1.27	0.20	-2.10	0.45
No SC meeting agenda	-1.10	0.85	-1.29	0.20	-2.76	0.57
Not completing required member training	-1.47	0.64	-2.29	0.02	-2.73	-0.21
Firms without committees	-3.88	1.58	-2.46	0.01	-6.97	-0.78
Interaction between no SC meeting agenda and post-program	0.80	1.18	0.68	0.50	-1.51	3.11
Interaction between not completing required member training and post-program	1.79	0.89	2.00	0.05	0.04	3.53
Interaction between firms without committees and post-program	1.05	2.19	0.48	0.63	-3.24	5.34
1-24 employees (ref)						
25-49 employees	-0.15	0.93	-0.16	0.87	-1.97	1.67
50-99 employees	-0.86	0.91	-0.94	0.35	-2.64	0.93
100-249 employees	-1.04	0.95	-1.10	0.27	-2.89	0.81
250-499 employees	-1.81	1.13	-1.60	0.11	-4.02	0.41
500 or more employees	-2.46	1.36	-1.80	0.07	-5.13	0.21
1 workplace (ref)						
2-5 workplaces	0.54	0.71	0.75	0.45	-0.86	1.93
More than 5 workplaces	1.10	1.00	1.09	0.28	-0.87	3.06
Years in program	-0.11	0.11	-1.02	0.31	-0.33	0.10
Agriculture and mining (ref)						
General contractors	-0.73	1.87	-0.39	0.70	-4.40	2.94
Heavy construction	2.83	2.09	1.36	0.18	-1.26	6.92
Special trade	1.35	1.65	0.82	0.42	-1.89	4.58
Manufacturing	0.11	1.49	0.07	0.94	-2.82	3.04
Transportation	-0.79	1.73	-0.46	0.65	-4.19	2.61
Wholesale trade	-0.10	1.62	-0.06	0.95	-3.27	3.07
Retail trade	-1.21	1.61	-0.75	0.46	-4.37	1.96
Hotel, personal, business, repair, entertainment services	1.36	1.66	0.82	0.41	-1.89	4.60
Health services	-0.45	1.60	-0.28	0.78	-3.59	2.68
Legal, educational, social services	-1.16	1.63	-0.71	0.48	-4.35	2.03
Public administration	1.17	2.02	0.58	0.56	-2.80	5.13

5 DISCUSSION

5.1 Program Impact

Our findings here appear, at least at first, to be contradictory. On the one hand, we found that firms that joined the CSC program did not, on average, experience reductions in injury rates compared to similar firms that did not join. In fact, there was evidence that injury rates for CSC participants actually increased relative to those for non-participants. That unexpected finding was driven by results in the construction industry; in other sectors, the non-participants also did better, but the differences were not very close to statistical significance.

We should note that if we had found that CSC participants had larger injury rate decreases than non-participants had, we still might have wondered whether we could attribute the gain to participation in the program. As we noted, firms that joined the CSC may have been more motivated to reduce their injury rates and might have taken steps to do so even in the absence of the CSC. Our finding that CSC participants did somewhat worse is especially striking given this potential selection effect.

On the other hand, when we looked only at the subset of about 450 firms subjected to random audits by the BWC, we found evidence that better compliance with at least some of the program requirements was linked to larger decreases in injury rates after firms joined the CSC. So, if firms with better compliance with CSC requirements showed improvements relative to participants with poor compliance, why don't we find that CSC participants, as a whole, do better?

One consideration here, of course, is that either or both analyses could be flawed and the findings invalid. Below, we discuss the limitations of the study, but since we don't find that those limitations are necessarily very damaging, we continue here on the assumption that the findings are valid.

As a matter of logic, one possible explanation is that, despite CSC membership, participating firms did not actually make greater steps to improve the activities that the JLMSC carried out. We know that 80% of the audited firms had deficiencies, and an additional 5% had no operating program at all. We do not, of course, know what changes occurred at non-participant firms during this period. Some of them must certainly have made improvements of their own, while others may have deteriorated. Still, even if the

net change for non-participants was toward improvement, it seems unlikely that they would have made as many changes as participants did.

However, we need to consider that some program requirements are very likely to be more important than others. As noted, we did ask the BWC officials who run the program whether they believed that any particular deficiencies were more important than others. The only one they clearly identified was the requirement that all members of the committee receive annual training.[15] As we described above, we found evidence supporting this view: the average injury rate changes for firms with this deficiency were indistinguishable from those firms found to have no program at all, while firms with no deficiencies or only "other deficiencies" saw sizable decreases in their injury rates. Here, it is important that almost half of all audited firms were cited for this training deficiency. We assume that, since they were randomly chosen, the audited firms represent the population of CSC participants. Thus, about half of all participants might be expected to have seen no decrease in injury rates for this reason alone. This is an average effect; some might have had rates go up, while others had rates go down.

Even if were to accept that half of the participating firms would not, on average, see any benefits because of this failure of program implementation, we still have to take account of the other 50%. If they did implement the program with some faithfulness, shouldn't we still find some evidence that, as a group, participants did better?

Of course, that statement assumes that implementing these activities does indeed help to prevent injuries. Although strong quantitative evidence supporting that conclusion is surprisingly hard to find, we find it difficult to question the argument that conscientious implementation of these activities will help to prevent injuries. However, the expected magnitude of the effect that would follow full implementation is not clear.

Along with the factor of firms that did not implement the CSC program, we have to consider that some firms must have had similar programs to begin with and joined to get the 5% discount without having to make any changes. The program rules did not place any bar on including firms that already had committees. In fact, firms had to show

[15] How to interpret the coefficients on the deficiencies is an important issue because it has implications for whether and how changes in compliance would have a causal effect on injuries. Do the coefficients really show the independent effect of a deficiency on the change in injury rates; or are they mainly just indicators of underlying lack of commitment to the safety program? Some, like failing to train committee members, may partake more of the former, while others, like lack of a written agenda for committee meetings may be more symptomatic than causal

that a committee had been operating for at least 6 months in order to formally apply. To the extent that participating firms already had committees similar to what the CSC required, we would not expect to see any larger reductions there than at non-participating firms. Still, it seems implausible to us that more than a sizable minority of participating firms already had safety committees. The evidence for this assessment is rather skimpy. As we noted, only about 10% of participant firms had unions, which would be likely to have required joint labor management safety committees. Second, among the 5 firms from whom we obtained information about their pre-CSC status, only 1 said that there had been little change.

Nevertheless, if even 10-15% of participants fell in this category, then along with the 50% with serious implementation problems, we see more potential that the overall effects of the program might be small. That still doesn't explain why the findings suggest that rates for participants *increased* relative to similar non-participant firms. We also do not understand why participants in the construction industry fared so poorly compared to non-participants there.

Another issue is possible changes in reporting practices. Unfortunately, it is not clear how this issue might play out. On the one hand, joint labor-management committees might make it more likely that worker injuries would be reported. On the other, CSC participants are high injury rate firms that want to cut their losses due to injuries. Therefore, they might also be adopting practices like increased use of restricted work activity and more aggressive return to work programs that may reduce injury reporting by workers. Obtaining more information about severe injuries, where reporting practices are harder to alter, might provide more insights about reporting, but we did not have it for our study.

Is it possible to reconcile our conclusions with those of the Pennsylvania Compensation Rating Board study (PCRB 2006) described in the introduction? Our study found that, despite declines when requirements were scrupulously adhered to, the lost time injury rates of CSC participants did not, as a whole, improve compared to non-participants. The PCRB study found that the actual losses of the CSC participants were lower than their predicted losses and that this difference was greater than it was for non-participants. Several factors should be considered:

1) CSC participants in the PCRB money saw the greatest loss reduction in the first years of the program, before 1998. For the later years that cover the same period as our analysis, the savings were considerably smaller. Thus the disparity in findings is not as large as a comparison with all 11 years of the PCRB study suggests

2) The PCRB looked at losses, not at lost-time injuries. Their study clearly shows that the big factor in reducing losses for participants was the greater decline there in the average cost per claim, not a decline in the number of claims. We find it surprising that the CSC program's main effect would be to reduce the average cost of claims, rather than to reduce their frequency. One response might be that the Casks would focus on preventing the highest cost injuries. However, workers' compensation insurers have generally found that the best predictor of total losses is the frequency of claims, which would argue against this response.

3) As we explained, the PCRB analysis did not take direct account of the possibility that losses or injury rates for different types of firms (e.g., in different industries) would change at different speeds. The CSC participants were disproportionately in manufacturing, where the rate of injuries with days away from work (and probably WC losses as well) was declining more steeply.[16]

5.2 Program Participation

Our findings regarding the factors that affect participation in the CSC were largely consistent with our conceptual model. Firms which have more employees and thus higher payrolls, which are in industries that are risky and have to pay higher premiums, and which are not unusually safe within their industry are more likely to join. All of these factors lead to increased premiums, which increase the benefit of a 5% discount. Firms with multiple workplaces, which probably raise the cost of implementing the CSC, are less likely to join. In addition, the program participation rate has been increasing over the years as shown in the descriptive analysis, and this could be due to increasing awareness of the program.

A few finer points are worth making. The greater than 100-fold increase in the probability of participation for firms with more than 100 employees, compared to firms with fewer than 25, is perhaps not surprising when we consider the great number of very small firms. However, it does suggest the possibility that among some groups of firms, participation in the CSC program is already high. We did check the percentage of all manufacturing establishments with more than 100 workers that were CSC participants in 2006 and found that it was about 40%. If we excluded establishments that are part of

[16] From 1998 to 2005, the national rate for days away from work injuries in manufacturing fell 35% while the same rate for all other industries fell 28%.

self-insured firms, which generally don't participate in the CSC because they don't get a discount, this percentage would be higher.

We expected to find that firms with higher injury rates within their industries would participate more at least in part because they were likely to have higher WC premiums. We did find that firms with lost time rates that were quite low (less than ½ of the industry average) were less likely to participate than all other firms. However, above that level of injury rates, we did not find further distinctions.

The presence of labor unions made it less likely that firms would join and more likely that they would drop out if they did join. As we noted above, we were unsure what effect we would find here because there seemed to be factors that could lead to either higher or lower participation. The fact that firms with labor unions were more likely to have existing safety committees and thus might save on their premiums without having to do anything different appears not to have been the dominant factor. We suspect, although we have no evidence, that unions with existing committees mandated by contract were often not interested in accepting a different set of State requirements.

Workers' compensation insurers could have played a role in program participation because they have the role of notifying firms about the safety committee program. But obviously, they may not have incentives to do so since participation means reduced premiums. The analysis did show that the average participation rates for firms using different large insurers varied substantially, even when holding employment size and industry constant. We think it would be worthwhile to investigate further. If our findings are borne out and insurers did differ in encouraging or discouraging participation in the CSC, then changing their behavior might foster greater participation.

Compliance with the CSC program requirements was shown to have a strong relationship with program dropout among those firms that were audited. Apparently, when some firms realized that they would really have to make some changes to stay in the program, they decided that it wasn't worth it. In Table 4, the deficiencies which had clear relationships to dropping out were: a) not meeting any requirements, b) not preparing an agenda, c) not holding monthly meetings, d) not training safety committee members, e) not documenting causes of accidents, f) not carrying out hazard detection, and g) not making sure that labor and management both participated.

It is not clear whether each of these deficiencies is really an independent cause of dropping out or whether they are simply indicators of an underlying lack of commitment to the safety program.

5.3 Possible Measures to Improve Effectiveness

The failure to find overall preventive effects of the CSC program seems largely attributable to lack of compliance among participants. A common response to lack of compliance is increased enforcement. However, the CSC is a voluntary program and penalties for failure to comply would surely reduce participation. We have seen that the existing auditing program increases the drop out rate. A more extensive audit program would probably improve compliance, but would further reduce participation. In addition, more audits would require more staff, increasing public costs.

One option is to continue the status quo. However, it seems improper that so many firms appear to be getting a discount without fulfilling their share of the bargain in terms of implementing the Safety Committee program. Given that the vast majority of participants were cited for some audit deficiency and the lack of a strong knowledge base for determining which requirements really matter in improving safety, it seems unwise to sanction participants simply because they have a deficiency.

However, firms that have no program at all or which failed to implement training for the committee members present a more reasonable target. Possible sanctions range from civil penalties to the current practice of requiring them to correct the deficiencies or be dropped from the program. Civil penalties seem like a dubious practice for a voluntary program, but the current policy does not provide much of a deterrent. One intermediate practice could be to require that firms that meet either of the two criteria above pay back any discount that they received that year from CSC program participation. This policy can be criticized for being too lenient; after all, a firm that never intended to comply is no worse off joining and being caught than it would have been if it had not joined. However, being forced to return the discount would provide more incentive for compliance than currently exists.

It may be desirable to provide that some of the funds received from non-compliant firms go the Bureau of Workers' Compensation to compensate it for audit activities. However, this might be viewed as providing an incentive for the Bureau to cite deficiencies too often. Otherwise funds would be returned to the WC insurer.

5.4 Insights about Increasing Participation

What options could be considered to increase participation in the CSC and what are the potential trade-offs? In particular, as we have seen, increasing participation is only worthwhile from a societal view if it does lead to reductions in injuries and illnesses.

Raising the discount in WC premiums for participants would very likely increase participation, but it would shift some costs to insurers. It is possible to estimate what the increase in participation would be for a given increase in the discount.[17] However, good estimates require using actual premium data, which we did not have for this study. The PCRB, however has this data and could carry out this study.

Program requirements could be relaxed. The only relevant empirical evidence that we have is the analysis of the relationship between audit deficiencies and dropping out. Since many of these requirements seem like central elements of a safety committee program, it is not evident that dropping them in the hopes of reducing drop-outs would make sense. training of safety committee members and getting firms to carry out reviews of injury causation are the central features of a safety program, relaxing these requirements does not seem like an attractive option. A method to identify what provisions, if any, could be usefully dropped would require finding deficiencies which are not related to injury prevention, but which do encourage drop-outs. The analyses that we conducted here could potentially find if any of the requirements fit these criteria, but a larger sample of audits is needed in order to make those judgments with more confidence.

In addition, as we noted above, if the differences in participation that were associated with having different WC insurers can not be explained by other factors, the BWC could consider adopting measures that would better assure that insurers did not unduly discourage firms from participating.

These findings emerged from our analyses that used propensity score matching to make the control group of non-participants as similar to the participants as we could. When we used a method without matching, the CSC participants did do better, although not to the extent that the differences were statistically significant. However, in both cases,

[17] Using premium data for each firm, one would calculate participation as a function of the dollar level of the premium savings and of other factors. Suppose, hypothetically, that, on average, each thousand dollars in savings for a firm increased participation by 2%. (It would also be possible to see if that relationship differs for different subgroups of firms.) Then for each group of firms, one could estimate the increased likelihood of participating if their discount rate increased by a given percentage. (For example, if the current 5% saves you $3,000 per year, then an 8% discount would save you $4,800. The extra premiums would increase participation for firms in that situation by 3.6% (1.8 times 2%).

it is possible that we omitted some unobserved factors that influence injury rates. Only a large experiment where firms were randomly assigned to participate in the CSC could totally rule out such a threat. Second, only 97 of 491 audited firms had no deficiencies. The others had, on average, about 3 deficiencies. It is not obvious how important each deficiency is in undermining the safety goal of the program, although we did make an effort to find out. However, one deficiency that seems relatively important is the requirement that safety committee members obtain training in key areas like hazard detection and accident investigation. Of the 491 audited firms, 222 had deficiencies for failing to adequately train the safety committee members.

Third, we don't know how many firms that joined the CSC program already had safety committees at the time that they joined.

5.5 Limitations to the Study

There are several limitations of this study. First, our matching of the firm's employment data with its work injury data, based on firm names and addresses, involved some uncertainty because we lacked a unique identifier. The difficulties were greatest among firms with multiple workplaces (and multiple addresses) and firms that changed addresses over time (and therefore changed the federal employer identification number). Misclassification of two groups of firms may have led to an underestimation of the program effect on work injuries. Second, we may not have completely addressed selection bias because propensity score matching can only match firms on the variables we can observe, not on those (like motivation) which we can not observe directly. Although propensity score matching is a more robust method than a regression model, it only balances two groups based on observed factors. The fact that we observed a relative increase in the injury rates of CSC participants compared to matched controls may imply that selection bias was removed.

Third, except for the audited firms, no information about program implementation was available. Although the random selection of firms for auditing helps ensure that the findings are representative of all CSC firms, a larger sample would have provided more precise estimates. Fourth, no workers' compensation insurance premium data were available for this analysis, and we were not able to explore the direct impact of the 5 percent discount of premium on program participation, e.g., calculating the percentage change in participation for a given change in premium savings, which could have direct policy implication in terms of setting the size of the discount. Fifth, we were not able to

assess possible changes in the reporting of injuries that may have accompanied implementation of the CSC.

5.6 Conclusions

In conclusion, we found that the injury rates at CSC participants did not decline relative to similar non-participants. In fact, in construction, rates at non-participants declined more. We also found that compliance with the requirement to train safety committee members was strongly related to decreases in injury rates among CSC participants. However, more than 50% of participants did not comply with that provision.

Larger firms, firms with higher injury rates, firms in high risk industries, and firms without labor unions were more likely to join the safety committee program and less likely to drop out of the program. Firms insured by certain WC insurers had a lower rate of participation than those insured by other insurers, and firms with audit deficiencies were more likely to leave the program.

Improving compliance seems like a necessary step to make the CSC program fairer to all parties and more effective.

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APPENDIX A – MODELS

Initial Participation

Program participation was modeled as a function of firm size, number of workplaces, the prior injury rate, industry, region, presence of a union, and insurer, and the functional form is logit. All the variables were from the prior year data. In addition, the correlation among the observations within each individual was incorporated by using a Generalized Estimating Equations (GEE) model with a log link and the binomial family. Consequently, the logit of the probability of participation in year t can be modeled as a linear function of the firm-level characteristics. Model specifications were assessed using the information criteria (Pan 2001; Hardin and Hilbe, 2003), including interactions. Only top 10 insurance carriers were entered into the model, and other carriers were used as the reference group.

$$\text{Logit}\{\text{Prob}(\text{Participation}_t)\} = \beta_0 + \beta_1 * \text{Firm Size}_{t-1} + \beta_2 * \text{Number of Workplaces}_{t-1} + \beta_3 * \text{Injury Rate}_{t-1} + \beta_4 * \text{Industry} + \beta_5 * \text{Region} + \beta_6 * \text{Presence of Union} + \beta_7 * \text{Insurance Carrier}_{t-1} + \beta_8 * \text{Year}_t$$

Program Dropout

We used a simple logistic model for program dropout, and program dropout was modeled as a function of firm size, number of workplaces, the prior injury rate, industry, region, presence of a union, insurer, and compliance to the program requirements. Firm size, number of workplaces, injury rate are averages across years based on firm years before dropout. Program compliance was from the audit records, grouped into 3 categories: being compliant, with audit deficiencies, and non-compliant (no safety committee).

Logit {Prob(dropout)} = β_0 + β_1 * Average Firm Size + β_2 * Average Number of Workplaces + β_3 * Average Injury Rate + β_4 * Industry + β_5 *Region + β_6 * Presence of Union + β_7 * Insurance Carrier + β_8 *Program Compliance

Regression Model to Assess Program Impact

Each firm has 2 lines of data, one for pre- injury rate before program participation, and the other for post- injury rate at the end of program participation. The correlation between pre- and post- injury rate were incorporated using Generalized Estimating Equations method. The coefficient of the interaction between Post and Program Participation can be interpreted as difference in injury rate change.

Injury Rate$_t$ = β_0 + β_1 *Post + β_2 *Program Participation + β_3 *Post*Program Participation + β_4 *Firm Size$_t$ + β_5 * Number of Workplaces$_t$ + β_6 * Industry + β_7 * Presence of Union + β_8 * Number of Years in Program + β_9 * Year

Regression Model to Predict the Propensity of Participation

We ran a simple logistic model and predicted propensity of participation for each calendar year. The propensity for participation was assumed to be a function of firm size, number of workplaces, industry, the prior injury rate, and region. All variables were from the prior year data.

Logit {Prob(Participation$_t$)} = β_0 + β_1 * Firm Size$_{t-1}$ + β_2 * Number of Workplaces$_{t-1}$ + β_3 * Injury Rate$_{t-1}$ + β_4 * Industry + β_5 *Region

Effect of program implementation on work injuries

Each firm has 2 lines of data, one for pre- injury rate before program participation, and the other for post- injury rate at the end of program participation. The correlation between pre- and post- injury rate were incorporated using Generalized Estimating Equations method. The coefficients of the interaction between post and

program compliance measures can be interpreted as difference in injury rate change. The reference group was those without a safety committee.

Injury Rate$_t$ = β_0 + β_1*Post + β_2*Firms with Deficiencies + β_3*Firms without Deficiencies + β_4*Post*Firms with Deficiencies + β_5*Post*Firms without Deficiencies + β_6*Firm Size$_t$ + β_7* Number of Workplaces$_t$ + β_8* Industry + β_9* Number of Years in Program

APPENDIX B – TABLES

Appendix Table 1: Initial Participation in the Certified Safety Committee Program – including the Change in the Prior Injury Rate

(N=1,539,603; 321,877 firms)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
10-24 Employees (Ref)						
25-49 Employees	23.55	1.68	44.15	0.00	20.47	27.09
50-99 Employees	67.73	5.13	55.68	0.00	58.39	78.56
100-249 Employees	101.18	8.25	56.61	0.00	86.23	118.72
250-499 Employees	100.97	10.82	43.06	0.00	81.84	124.57
500 Or More Employees	80.45	10.33	34.16	0.00	62.55	103.48
Injury Ratio Less Than 0.5 (Ref)						
Injury Ratio 0.5-1	2.19	0.14	11.96	0.00	1.93	2.49
Injury Ratio 1-1.5	2.47	0.17	13.36	0.00	2.16	2.82
Injury Ratio 1.5-2	2.87	0.21	14.36	0.00	2.48	3.31
Injury Ratio Greater Than 2	2.62	0.14	18.36	0.00	2.37	2.91
Change In Injury Ratio	1.00	0.00	-1.08	0.28	1.00	1.00
1 Workplace						
2-5 Workplaces	0.88	0.06	-1.80	0.07	0.77	1.01
More Than 5 Workplaces	0.99	0.09	-0.15	0.88	0.82	1.19
Agriculture And Mining (Ref)						
General Contractors	2.09	0.31	4.90	0.00	1.56	2.81
Heavy Construction	1.46	0.29	1.90	0.06	0.99	2.16
Special Trade	1.99	0.27	5.16	0.00	1.53	2.58
Manufacturing	1.44	0.18	2.87	0.00	1.12	1.85
Transportation	0.88	0.13	-0.85	0.39	0.66	1.18
Wholesale Trade	0.99	0.14	-0.07	0.95	0.76	1.30
Retail Trade	0.32	0.04	-8.26	0.00	0.25	0.42
Hotel, Personal, Business, Repair, Entertainment Services	0.48	0.07	-5.20	0.00	0.37	0.63
Health Services	0.63	0.09	-3.11	0.00	0.47	0.84
Legal, Educational, Social Services	0.55	0.07	-4.47	0.00	0.42	0.71
Public Administration	0.95	0.15	-0.33	0.74	0.69	1.30
Non-Classifiable Industry	0.57	0.12	-2.69	0.01	0.37	0.86
Year 2000 (Ref)						
Year 2001	0.91	0.08	-1.16	0.25	0.77	1.07
Year 2002	0.79	0.07	-2.63	0.01	0.67	0.94
Year 2003	1.10	0.09	1.17	0.24	0.94	1.29
Year 2004	1.63	0.12	6.46	0.00	1.41	1.89

Year 2005	2.12	0.15	10.36	0.00	1.84	2.45
Year 2006	1.83	0.14	8.04	0.00	1.58	2.11
Eastern PA (Ref)						
Western PA	1.15	0.05	3.02	0.00	1.05	1.26
Central PA	0.95	0.05	-1.05	0.295	0.86	1.05
Outside PA	0.23	0.02	-13.81	0	0.18	0.28

Appendix Table 2: Ever Participation in the Certified Safety Committee Program during 1998-2006

(N=364, 840)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
24-49 employees	23.43	1.23	59.98	0.00	21.14	25.97
50-99 employees	78.77	4.44	77.48	0.00	70.54	87.97
100-249 employees	150.83	9.14	82.76	0.00	133.93	169.85
250-499 employees	159.62	13.15	61.59	0.00	135.82	187.58
500 or more employees	151.87	14.59	52.28	0.00	125.80	183.34
injury ratio less than 1	3.18	0.15	24.89	0.00	2.90	3.48
injury ratio 1-1.5	4.19	0.21	29.18	0.00	3.80	4.61
injury ratio 1.5-2	4.11	0.23	24.82	0.00	3.67	4.59
injury ratio greater than 2	4.22	0.20	30.03	0.00	3.84	4.63
2-5 workplaces	0.88	0.05	-2.12	0.03	0.79	0.99
more than 5 workplaces	1.04	0.08	0.50	0.62	0.89	1.21
General Contractors	1.82	0.23	4.75	0.00	1.42	2.33
Heavy Construction	2.39	0.39	5.33	0.00	1.73	3.29
Special Trade	2.14	0.24	6.80	0.00	1.72	2.67
Manufacturing	2.09	0.22	7.01	0.00	1.70	2.56
Transportation	0.96	0.12	-0.31	0.76	0.76	1.22
Wholesale Trade	1.17	0.13	1.35	0.18	0.93	1.46
Retail Trade	0.35	0.04	-9.43	0.00	0.28	0.44
Hotel, Personal, Business, Repair, Entertainment Services	0.47	0.05	-6.52	0.00	0.38	0.59
Health Services	0.89	0.10	-0.99	0.32	0.71	1.12
Legal, Educational, Social Services	0.56	0.06	-5.21	0.00	0.45	0.69
Public Administration	1.26	0.17	1.69	0.09	0.96	1.65
Non-classifiable Industry	0.30	0.04	-8.07	0.00	0.22	0.40
Western PA	1.31	0.05	7.26	0.00	1.22	1.41
Central PA	1.05	0.04	1.22	0.22	0.97	1.14
Outside PA	0.23	0.02	-20.08	0.00	0.20	0.26

Appendix Table 3: Initial Participation in the Certified Safety Committee Program among Inspected Firms

(N=44,290)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
10-24 Employees (Ref)						
25-49 Employees	6.22	1.10	10.35	0.00	4.40	8.79
50-99 Employees	13.96	2.51	14.65	0.00	9.81	19.87
100-249 Employees	17.04	3.17	15.26	0.00	11.84	24.53
250-499 Employees	14.79	3.21	12.40	0.00	9.66	22.64
500 Or More Employees	9.81	2.45	9.14	0.00	6.01	16.02
Injury Ratio Less Than 0.5 (Ref)						
Injury Ratio 0.5-1	1.85	0.22	5.10	0.00	1.46	2.33
Injury Ratio 1-1.5	2.26	0.28	6.69	0.00	1.78	2.87
Injury Ratio 1.5-2	2.06	0.28	5.24	0.00	1.57	2.70
Injury Ratio Greater Than 2	2.13	0.22	7.46	0.00	1.75	2.59
1 Workplace (Ref)						
2-5 Workplaces	0.77	0.10	-2.13	0.03	0.60	0.98
More Than 5 Workplaces	0.77	0.15	-1.34	0.18	0.53	1.13
No Union Presence (Ref)						
Union Presence	0.79	0.08	-2.34	0.02	0.65	0.96
Agriculture And Mining (Ref)						
Construction	3.84	4.11	1.26	0.21	0.47	31.27
Manufacturing	1.68	1.70	0.51	0.61	0.23	12.20
Transportation	1.20	1.23	0.18	0.86	0.16	8.97
Wholesale Trade	1.33	1.36	0.28	0.78	0.18	9.82
Retail Trade	0.89	0.91	-0.11	0.91	0.12	6.61
Hotel, Personal, Business, Repair, Entertainment Services	0.94	0.97	-0.06	0.95	0.12	7.11
Health Services	1.26	1.29	0.23	0.82	0.17	9.33
Legal, Educational, Social Services	1.32	1.37	0.27	0.79	0.17	10.10
Public Administration And Non-Classifiable	0.97	1.04	-0.03	0.98	0.12	7.97
Year 1999 (Ref)						
Year 2000	1.00	0.15	0.02	0.99	0.75	1.33
Year 2001	0.83	0.13	-1.24	0.22	0.61	1.12
Year 2002	0.80	0.13	-1.41	0.16	0.59	1.09
Year 2003	0.83	0.13	-1.15	0.25	0.61	1.14
Year 2004	1.34	0.19	2.04	0.04	1.01	1.76
Year 2005	1.48	0.21	2.76	0.01	1.12	1.95
Year 2006	1.24	0.18	1.45	0.15	0.93	1.66

Eastern PA (Ref)						
Western PA	1.22	0.11	2.22	0.03	1.02	1.46
Central PA	1.07	0.11	0.70	0.49	0.88	1.30
Outside PA	0.27	0.05	-7.70	0.00	0.20	0.38

Appendix Table 4: Ever Participation in the Certified Safety Committee Program during 1998-2006 among Inspected Firms

(N=5,716)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
10-25 Employees (Ref)						
24-49 Employees	6.30	1.03	11.24	0.00	4.57	8.68
50-99 Employees	20.32	3.36	18.21	0.00	14.69	28.10
100-249 Employees	28.50	4.85	19.70	0.00	20.42	39.77
250-499 Employees	23.86	4.76	15.91	0.00	16.14	35.27
500 Or More Employees	18.08	3.99	13.12	0.00	11.73	27.87
Injury Ratio Less Than 0.5 (Ref)						
Injury Ratio 0.5-1	2.06	0.25	6.01	0.00	1.63	2.60
Injury Ratio 1-1.5	2.85	0.35	8.59	0.00	2.25	3.62
Injury Ratio 1.5-2	2.70	0.36	7.40	0.00	2.08	3.51
Injury Ratio Greater Than 2	2.85	0.35	8.47	0.00	2.24	3.63
No Union (Ref)						
Union Presence	1.01	0.09	0.12	0.91	0.85	1.20
1 Workplace (Ref)						
2-5 Workplaces	0.94	0.09	-0.68	0.50	0.77	1.13
More Than 5 Workplaces	0.69	0.13	-2.03	0.04	0.48	0.99
Agriculture And Mining (Ref)						
Construction	1.83	1.89	0.59	0.56	0.24	13.86
Manufacturing	1.55	1.43	0.48	0.63	0.26	9.39
Transportation	0.77	0.72	-0.28	0.78	0.12	4.79
Wholesale Trade	1.00	0.93	0.00	1.00	0.16	6.16
Retail Trade	0.56	0.52	-0.63	0.53	0.09	3.46
Hotel, Personal, Business, Repair, Entertainment Services	0.60	0.56	-0.55	0.58	0.10	3.76
Health Services	1.41	1.30	0.37	0.71	0.23	8.62
Legal, Educational, Social Services	0.82	0.78	-0.21	0.83	0.13	5.29
Public Administration And Non-Classifiable Industry	0.24	0.24	-1.42	0.16	0.03	1.72
Eastern PA (Ref)						
Western PA	1.16	0.10	1.62	0.11	0.97	1.38
Central PA	1.10	0.11	0.99	0.32	0.91	1.33
Outside PA	0.26	0.03	-10.15	0.00	0.20	0.33

Appendix Table 5: Program Dropout among Inspected Participating Firms
(N=1,325)

Variables	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
10-24 Employees (Ref)						
25-49 Employees	0.71	0.29	-0.83	0.41	0.32	1.58
50-99 Employees	0.77	0.30	-0.68	0.50	0.35	1.66
100-249 Employees	0.58	0.23	-1.38	0.17	0.26	1.26
250-499 Employees	1.00	0.44	0.00	1.00	0.43	2.35
500 Or More Employees	1.28	0.62	0.50	0.61	0.49	3.33
Injury Ratio Less Than 0.5 (Ref)						
Injury Ratio 0.5-1	0.46	0.11	-3.28	0.00	0.29	0.73
Injury Ratio 1-1.5	0.41	0.10	-3.71	0.00	0.25	0.65
Injury Ratio 1.5-2	0.37	0.11	-3.50	0.00	0.21	0.64
Injury Ratio Greater Than 2	0.70	0.16	-1.56	0.12	0.45	1.09
No Union (Ref)						
Presence Of Union	1.57	0.26	2.70	0.01	1.13	2.17
1 Workplace						
2-5 Workplaces	0.70	0.15	-1.64	0.10	0.46	1.07
More Than 5 Workplaces	0.96	0.43	-0.09	0.93	0.40	2.33
No Information About Compliance (Ref)						
Compliance	0.55	0.43	-0.76	0.45	0.12	2.59
Noncompliance	1.53	0.40	1.63	0.10	0.92	2.54
Agriculture And Mining (Ref)						
Transportation	0.99	0.36	-0.04	0.97	0.48	2.03
Wholesale Trade	0.55	0.20	-1.64	0.10	0.26	1.13
Retail Trade	0.07	0.07	-2.53	0.01	0.01	0.55
Hotel, Personal, Business, Repair, Entertainment Services	0.64	0.32	-0.90	0.37	0.24	1.71
Health Services	0.88	0.23	-0.50	0.62	0.52	1.47
Legal, Educational, Social Services, Public Administration And Non Classifiable	0.80	0.41	-0.44	0.66	0.29	2.19
Eastern PA (Ref)						
Western PA	0.73	0.14	-1.64	0.10	0.50	1.06
Central PA	1.16	0.23	0.75	0.46	0.79	1.70
Outside PA	1.80	0.50	2.13	0.03	1.05	3.09

Appendix Table 6: Pre- and Post- Injury Rates among Audited Firms, by Cited Deficiencies

Audit Deficiencies	Sample Size	Pre-Injury Rate	Post-Injury Rate	P Value
Non-compliant group (no committee)	18	0.91	1.16	0.57
Deficiency group (with audit deficiencies)				
Health and Safety Improvements and Safety Injury Records	0	-	-	-
Workplace Safety Committee Composition 2 Mgmt & 2 Employees Required	32	5.44	3.36	0.63
Workplace Safety Committee By-Laws & Operating Procedures are Required	27	2.48	2.27	0.72
1 more than half of the Workplace Safety Committee Quorum	2	2.29	18.08	0.39
Workplace Safety Committee Membership List is required to be maintained	19	2.81	4.23	0.10
An Agenda, prepared prior to Workplace Safety Committee meetings, is required	71	2.00	3.32	0.00
Workplace Safety Committee Membership is on a rotational basis which is established by the employer and to be recorded in the Committee By-Laws	22	3.55	2.43	0.54
Actual Committee Member Rotation documented	27	2.65	2.96	0.77
Workplace Safety Committee must be held monthly	210	2.96	3.38	0.58
Quorum: 1/2 of the Committee members plus 1	99	3.77	3.63	0.92
Meeting Attendance must be recorded & filed	11	1.78	4.56	0.03
Meeting Minutes are to be recorded & filed	11	4.91	4.19	0.72
Members are required to take 3 specific courses annually	222	2.29	3.47	0.00
Trainers must meet the Division of Health & Safety requirements	40	2.42	3.07	0.30
These are the 3 required training courses	8	1.86	2.99	0.48
Document cause of accidents, illnesses, etc. and methods of prevention	10	4.98	4.31	0.72
Hazard Detection	8	3.69	3.61	0.97
Hazard Inspection	4	1.36	2.56	0.63
Workplace Safety Committee Meeting minutes	28	7.45	4.75	0.59
An actual 'joint' committee comprised of the same # of members from mgmt as from employees	6	1.66	2.43	0.42
Compliant Group (without deficiencies)	79	4.09	2.80	0.18

Note: p values are based on paired t tests.