HEALTH CARE REFORM AND WORKERS' COMPENSATION: EVIDENCE FROM MASSACHUSETTS

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The authors provide evidence of important spillover effects of comprehensive health care reform on workers' compensation (WC) that are likely to reduce WC costs. Using data on more than 20 million emergency room (ER) discharges in Massachusetts and three comparison states, they find that Massachusetts health care reform caused a 6.2 to 8.2% decrease in the per capita number of ER discharges billed to WC. The authors document heterogeneity in the impacts of the reform, shedding light on the mechanisms generating the overall decline in ER discharges billed to WC. Results indicate a larger decrease in WC claiming for weekday admissions than for weekend admissions and for harder-to-verify musculoskeletal discharges than for wounds. The decline in WC discharges is driven both by injured workers increasingly seeking care outside of the ER and by changes in the propensity to bill WC for a given ER discharge.

The extent to which the Affordable Care Act (ACA) affected participation and program costs for other forms of social insurance is an important and timely policy question. State workers' compensation (WC) programs, which provide near-universal insurance for workers who become injured or ill on the job, may be especially affected by changes in access to health insurance. This article provides evidence of important spillover effects of health care reform on WC—effects that are likely to reduce WC costs.

We study the 2006 Massachusetts health care reform, shedding light on the likely impacts of the ACA on WC and providing new evidence on the relationship between health insurance and WC claiming. The key features of the Massachusetts reform are now well known. Like the Affordable Care Act (ACA), the reform included an individual mandate, requiring individuals to purchase health insurance or face a tax penalty; an employer mandate, requiring all but the smallest firms to offer insurance plans to

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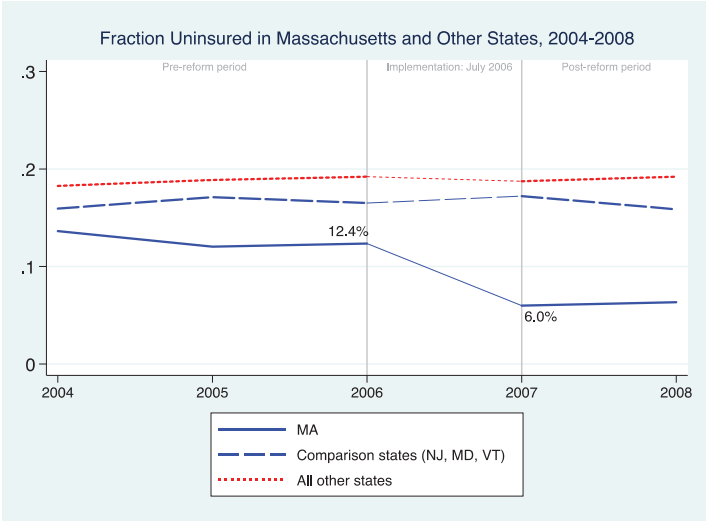
Figure 1. Percentage Uninsured in Massachusetts and Other States, 2004 to 2008



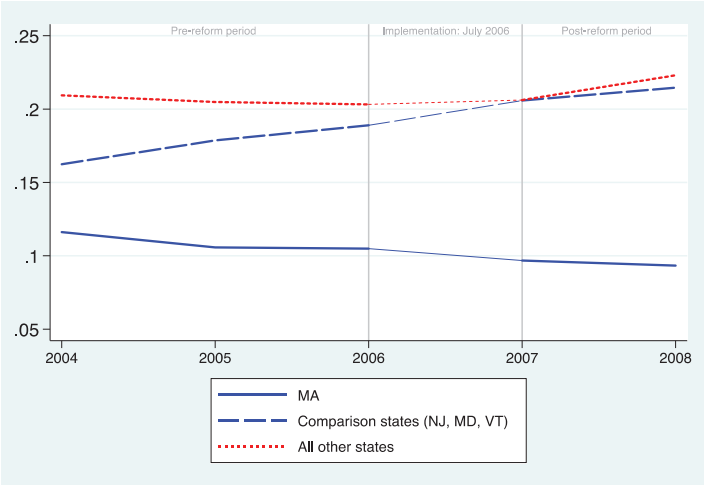
Source: Authors' calculations from March Current Population Survey.

their employees; a state-run health insurance exchange; a state-subsidized low-cost insurance plan (for those with incomes too high to qualify for Medicaid); and an expansion of Medicaid through increases in the income thresholds that determine eligibility.

In Massachusetts, the years immediately following the reform witnessed a dramatic increase in insurance coverage and a marked decrease in WC costs. Between 2006 and 2008, the rate of uninsurance in Massachusetts fell by approximately 50%, while the uninsurance rate in other states remained flat (see Figure 1). Coinciding with this increase in insurance coverage was a fall in WC medical costs in Massachusetts, relative to other states (see Figure 2). Whereas WC medical benefit payouts were rising at the national level, WC medical benefits fell from 10.6 cents per covered worker in 2005 to 9.3 cents per covered worker in 2008 in Massachusetts (a decrease of 12%). Moreover, this decrease in WC medical payments in Massachusetts occurred despite the fact that injury rates were falling less quickly in Massachusetts than in other states (see Figure 3). Although these trends do not necessarily reflect causal relationships, they are consistent with the increase in health insurance coverage causing a decrease in the average medical cost of a WC claim and/or a decline in the number of WC claims.

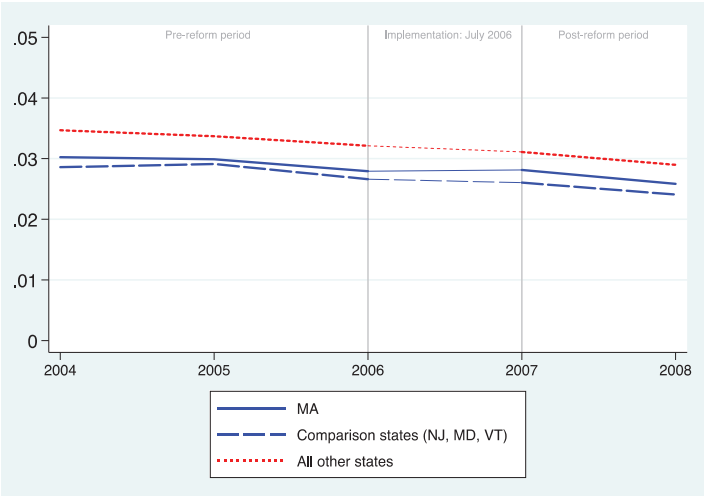
We study the impact of the 2006 reform using data on more than 20 million emergency room (ER) discharges in Massachusetts and three comparison states (New Jersey, Maryland, and Vermont). Estimating the impact of the reform on the county-level per capita number of discharges billed to WC, we find that the 2006 reform decreased WC emergency department

Figure 2. WC Medical Benefits Paid per Covered Worker, 2004 to 2008



Source: National Academy of Social Insurance.
Notes: WC, workers' compensation.

Figure 3. Rate of Private Industry Injury or Illness, 2004 to 2008



Source: Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses.

discharges in Massachusetts relative to comparison states by 6.2% in the implementation period (Q3 2006 through Q4 2007) and by 8.2% in the post period (2008).

This decline in the number of ER discharges billed to WC may reflect health care reform influencing workers' choices of where to seek medical

care (as the price of an ER visit rose relative to care at other locations for those gaining insurance), or reducing the likelihood of billing WC for a *given* ER visit (if some newly insured injured workers chose to bill their health insurance rather than file WC claims). Our results suggest that both mechanisms are at play.

First, the estimated decreases in per capita WC discharges are very similar to the proportional reductions in overall ER usage, with total ER discharges per capita falling by 6.5% and 8.3% in the implementation and post periods, respectively. One interpretation is that the entire decrease in WC discharges was attributable to injured workers shifting their care from the ER to non-ER settings. But given that injured workers face zero cost sharing in either location if they file for WC, they have less incentive to seek care outside of the ER than do those with non-work injuries, for whom the reform unambiguously lowered the price of a visit in a physician's office or urgent care center. Thus, we conclude that the reform must have also caused a decline in the propensity to claim WC for a given injury.

If such substitution between payers occurs, it will be more pronounced for discharges of injuries that are more difficult to verify—such as strains and sprains—relative to discharges of more easily verifiable injuries, such as lacerations or burns (e.g., Card and McCall 1996; Hansen 2014). We compare the effects among musculoskeletal injuries and wounds and find evidence of significantly larger reductions for musculoskeletal injuries. Back-of-the-envelope calculations based on our estimates for musculoskeletal injuries suggest that among these harder-to-verify conditions, changes in the propensity to bill WC are likely to account for more than one-third of the decline in discharges billed to WC.

Taken together, our findings provide some of the first evidence of spillover effects of comprehensive health care reform on the WC program. We conclude that the increase in health insurance coverage brought on by the Massachusetts reform likely reduced WC costs, both by causing workers to shift care away from the more costly hospital/ER setting to lower-cost locations and by affecting the number of claims for WC. Our study expands upon existing research in Dillender (2014) by analyzing the overall impacts of comprehensive health care reform on WC claims among all working-age adults (as opposed to studying the effects of losing insurance coverage at age 26, the ACA's cut-off for dependent coverage) and by studying a sample of injuries and illnesses that may have occurred at work without conditioning on WC receipt. Unlike the approach in Heaton (2012), who also studied the Massachusetts reform, our difference-in-differences methodology uses three comparison states to disentangle the impact of health care reform from any concurrent effect of the Great Recession on WC claims.

Our results also contribute directly to the literature on the relationship between health insurance coverage and WC claiming. Empirical evidence on this topic is mixed and yields no consensus on how insurance status

affects workers' decisions to file WC claims.[1] In recent work on this issue, Dillender (2014) studied young adults who lose insurance coverage at age 26, when they age out of their parents' insurance. He demonstrated that losing health insurance increases the number of bills per WC claim, suggesting that access to insurance may affect WC costs by changing the pattern of treatment for injured workers. Although the overall number of WC claims is not affected, losing health insurance at age 26 significantly raises the number of WC claims for non-emergent occupational diseases and sprains and strains. Similarly, we find that health insurance affects the pattern of treatment for injured workers by causing some injured workers to seek care outside of the ER, and also decreases the likelihood of claiming WC, particularly among those with harder-to-verify musculoskeletal conditions.

A third contribution of our article is to harness a data set not often used to study WC. As is well known in the literature on work-related injuries, data limitations present many challenges to researchers interested in studying workplace safety and WC claiming. In part because WC programs are administered at the state level, no national administrative data set tracks WC claims that would allow a difference-in-differences study of Massachusetts health care reform (or the ACA) using all other non-treated states as a comparison group. WC claims are instead tracked at the state level, but obtaining state administrative data on WC is difficult, particularly for a study of more than one or two states. Those nationally representative surveys that do contain information on WC filing are based on self-reports of WC benefit receipt and are unlikely to include claims for which WC covers only medical costs. The Healthcare Cost and Utilization Project (HCUP) and State Emergency Department Databases (SEDD) data make it possible to study Massachusetts health care reform using several other states as a comparison group and using a measure of WC claiming that is not based on self-reporting or on cash benefit receipt. Our choice of comparison states is influenced, in part, by the availability of HCUP SEDD data. Many states do not participate in the HCUP, or did not participate during 2004 to 2008, and some participating states' data sets fail to track key variables. We discuss this issue further in the Results section. In addition, approximately 40% of WC claims involve some ER care (Heaton 2012). Although the costs of this care represent a relatively small fraction of overall WC medical costs (Lipton, Cooper, and Robertson 2009), the high rate of ER utilization among injured workers makes the SEDD a useful data set for studying the relationship between health insurance and WC claiming.

[1]See Heaton (2012) for evidence that increases in health insurance led to a decrease in the number of WC claims. By contrast, Lakdawalla, Reville, and Seabury (2007) found that injured workers with health insurance are more likely to file WC claims; they concluded that the result reflects employer differences between firms who offer medical insurance and those who do not. Card and McCall (1996) and Campolieti and Hyatt (2006) showed that the share of injuries reported on Mondays is unrelated to health insurance status, casting doubt on whether workers fraudulently report non-work-related injuries as occurring at work in order to claim WC (as in Smith 1990).

Background

Health Care Reform and Incentives to Bill WC as the Payer

Our analysis examines the effect of Massachusetts health care reform on the per capita number of ER discharges that are billed to WC. Health care reform may influence the number of ER discharges billed to WC by affecting the propensity to bill one's health care costs to WC (versus new private health insurance or Medicaid), or by affecting the likelihood of seeking care in the ER (versus an urgent care center or physician's office).

In every state, WC is expected to cover all medical costs associated with injuries (or illnesses) caused by work but none of the medical costs of injuries that occurred outside of work. WC also provides partial wage replacement when a worker is unable to work as a result of the injury. Yet the extant literature suggests that workers may substitute, to some degree, between WC and health insurance to cover the medical costs of injuries. For example, uninsured workers or those who are covered by plans that involve high cost sharing have an incentive to report injuries that happened outside of work as work-related (Smith 1990; Card and McCall 1996; and Campolieti and Hyatt 2006).[2] By contrast, workers with insurance coverage may choose to bill health insurance for work-related injuries to avoid filing a WC claim (Biddle and Roberts 2003). In particular, if workers or medical providers incur additional administrative costs when billing to WC rather than health insurance, insured workers may decide not to take the time to file a WC claim for their injuries (Lakdawalla et al. 2007). Injured workers may be discouraged from filing a WC claim by employers if treating workplace injuries is costlier under WC than health insurance (see Baker and Krueger 1995; Johnson, Baldwin, and Burton 1996) or by health care providers if WC involves more paperwork and administrative costs or provides a lower reimbursement rate (Leigh and Ward 1997). In any case, we expect an increase in insurance coverage such as that brought on by comprehensive health care reform to lead to a decrease in WC claiming. Such an effect would be particularly strong for injuries that are difficult to verify or to attribute to work (e.g., sprains and strains).

An injured worker's choice of where to seek medical care will be affected by the relative price of care in different settings. As we describe below, Massachusetts health care reform lowered the price of a physician's visit for those gaining insurance, while either leaving unchanged, or marginally raising, the price of an ER visit. Miller (2012) demonstrated that ER discharges, overall, declined in Massachusetts in response to health care reform. Thus,

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[2]Smith (1990) documented the well-known "Monday Effect" result that a disproportionate share of workplace injuries (especially injuries that are difficult to verify) are reported on Mondays, which may reflect workers fraudulently reporting injuries that occurred outside of work in order to claim WC. Card and McCall (1996) and Campolieti and Hyatt (2006) recognized that uninsured workers have a stronger incentive to report non-work-related injuries as work-related in order to have medical costs covered by WC; however, both articles found health insurance status to be unrelated to the share of WC claims filed on Mondays.

any decline in the number of ER discharges billed to WC may be explained, in part, by a decrease in ER utilization overall, including among injured workers.[3]

However, the mechanisms whereby the reform would induce a worker who has been injured on the job to seek care in a non-ER setting are more nuanced than for someone whose injury is unrelated to work. After all, if a worker is billing his costs to WC, he faces no cost sharing in either setting. Nonetheless, there are a number of reasons injured workers may increasingly turn to physicians' offices and urgent care centers after the reform. Health care reform may have raised the transaction costs associated with an ER visit, perhaps by increasing expected wait times,[4] or may have caused more workers to have a personal doctor (Kolstad and Kowalski 2012), to whom they would then turn if injured on the job.[5] Newly insured injured workers might use non-ER care if they are risk-averse and perceive there to be a risk their WC claims could be denied, in which case their out-of-pocket costs under health insurance would be lower in a non-ER setting than in the ER.[6] Regardless, because WC involves no patient cost sharing, we expect less (or at least, no greater) shifting away from the ER for work-related injuries or illnesses than for other, non-work-related conditions.

WC and Health Insurance in Massachusetts and Comparison States

Our difference-in-differences approach relies on the assumption that ER discharges in our comparison states (New Jersey, Maryland, and Vermont) represent a reasonable counterfactual for what would have occurred in Massachusetts in absence of the reform. We selected these three comparison states because they are located on the East Coast, are available in the HCUP in the years 2004 through 2008, and also separately identify WC as a payer. These states are also similar to Massachusetts in their distributions of industry and education (Table 1) and with respect to employment trends over the 2004 to 2008 period, including at the onset of the Great Recession (Figure 4).

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[3]Related to this decrease in ER utilization, County Business Patterns data reveal that the supply of substitutes (urgent care centers and physician's offices), as measured by employment in these locations, grew more rapidly in Massachusetts over the 2004 to 2008 period (by 10%) than in our three comparison states (5.6%), or in the set of all other states (3.1%). This 10% increase in urgent care center and physician's office employment in Massachusetts also exceeded the growth in hospital employment (6.6%) in the state over the same time period.

[4]"In Massachusetts, universal coverage strains care," *New York Times*, published April 5, 2008.

[5]Similarly, Miller (2012/2013: 324) found that Massachusetts health care reform reduced the likelihood that individuals listed the ER as their usual place for care and documented a negative but not statistically significant impact of reform on the likelihood of having "no regular place to get preventive care."

[6]Although WC claims denial rates are quite low, workers may perceive them to be higher. Without additional information on worker characteristics (e.g., unionization), we are unable to test whether this is an important determinant of shifting care to non-ER settings.

Table 1. Means for Massachusetts and Comparison States in Pre-Reform Period

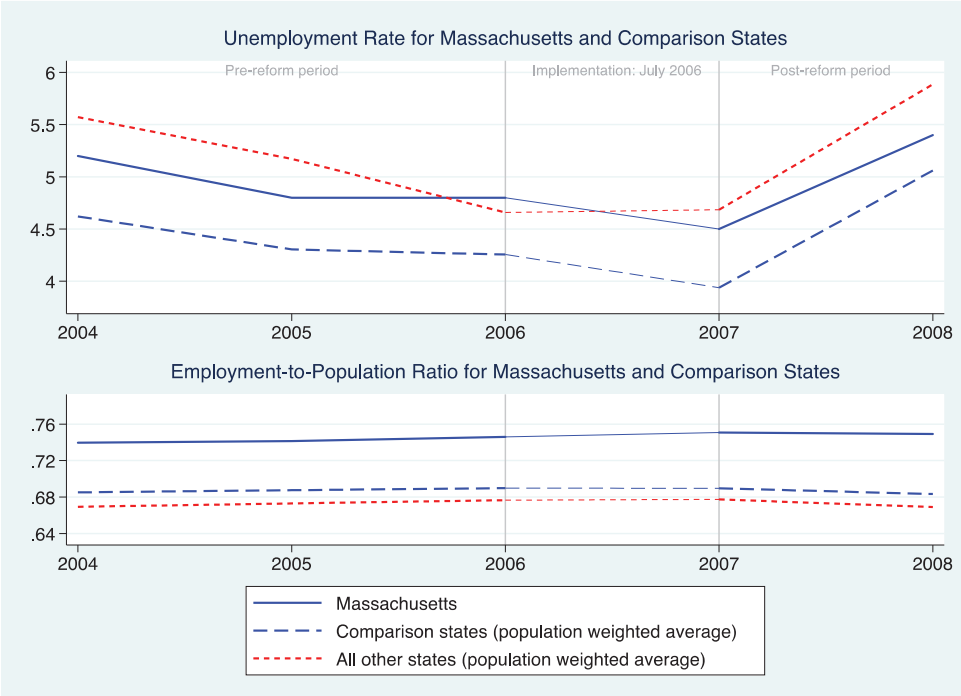
	Massachusetts	*Comparison states*
Discharges per 100 county residents[a]		
Total ER discharges	8.65	7.26
WC	0.49	0.26
Share discharges billed to WC	0.06	0.04
Uninsured	1.00	2.14
Privately insured	3.84	3.54
Medicaid	1.74	0.77
Medicare	0.71	0.41
N (counties)	14	59
Demographic characteristics[b]		
Age	42.70	42.90
Male	0.48	0.48
Education		
Less than high school	0.08	0.09
High school degree	0.24	0.27
Some college	0.26	0.27
College or more	0.42	0.38
Employed	0.76	0.76
Industry		
Agriculture	0.00	0.01
Mining	0.00	0.00
Construction	0.06	0.06
Manufacturing	0.10	0.08
Wholesale	0.03	0.03
Retail	0.09	0.09
Transportation	0.03	0.04
Utilities	0.01	0.01
Information	0.03	0.03
Finance, insurance, and real estate	0.08	0.08
Services	0.45	0.42
Public Administration	0.04	0.06
Armed forces	0.00	0.00
No industry	0.09	0.09
Occupation		
Manager	0.07	0.07
Professional	0.30	0.28
Service worker	0.13	0.13
Sales	0.10	0.10
Support	0.13	0.14
Farm	0.00	0.00
Construction	0.05	0.05
Maintenance	0.02	0.03
Production	0.04	0.03
Transportation	0.04	0.04
Military	0.00	0.01
No occupation	0.09	0.09
N	90,539	212,333

Notes: ER, emergency room; WC, workers' compensation.

[a]County-quarter observations from the Healthcare Cost and Utilization Project (HCUP) State Emergency Department Database (SEDD) data for the years 2004 and 2005. Observations are weighted by county population estimates for 20- to 64-year-olds from the Small Area Health Insurance Estimates (SAHIE) files from the U.S. Census Bureau.

[b]Unweighted means for American Community Survey (ACS) respondents ages 20 to 64 between 2004 and 2006.

Figure 4. Employment Trends in Massachusetts and Comparison States, 2004 to 2008



Sources: Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics and Current Employment Statistics.

Workers' Compensation in Massachusetts and Comparison States

In all states except Texas, firms are required by law to obtain WC insurance to provide immediate coverage of medical and rehabilitation costs to workers who are injured or become ill on the job.[7] Workers may also file for WC indemnity benefits, which begin after a waiting period and are paid according to a state-mandated benefit schedule. The waiting period is five days in Massachusetts, three days in Vermont and Maryland, and seven days in New Jersey. This difference is less important for our analysis because we focus on coverage of medical costs rather than indemnity payments. At the national level, medical costs have represented an increasing share of the benefits paid out through state WC programs since the late 1980s. WC medical payments to providers amounted to $31.1 billion in 2016 and now account for approximately half of all WC benefits paid out (McLaren, Baldwin, and Boden 2018). If increased access to health insurance

[7]All but the smallest firms face experience-rated premiums, whereby their insurance premiums increase in relation to their past losses. Since employers pay higher WC premiums when workers receive medical or cash benefits, experience-rated employers may discourage injured workers from filing WC claims or dispute their claims, giving injured workers added incentive to use health insurance to pay for the medical costs of an injury.

negatively impacts WC claiming, we expect health care reform to lower WC program costs. Indeed, WC medical benefit payments per covered worker decreased in Massachusetts after the 2006 reform, despite the fact that they were rising at the national level (Figure 2), and that injury rates fell by less in Massachusetts than in other states (Figure 3).

Provider incentives to bill health insurance rather than WC may be linked to the reimbursement the provider receives from WC. Compared to many states, Massachusetts WC provides a lower rate of reimbursement to providers for medical services (Coomer and Liu 2010). Massachusetts sets its fee schedule according to its Medicare reimbursement schedule, with some modifications, as does Maryland. Vermont bases its WC provider fee schedule on various Blue Cross/Blue Shield plans, and New Jersey does not have a provider fee schedule for WC. To assess the relative generosity of WC reimbursements in differing states, Fomenko and Liu (2012) compared WC provider reimbursement amounts to Medicare provider reimbursements in the 43 states that have fee schedules. For ER services, the authors found that Massachusetts is the least generous state, Maryland is among the bottom four states, and Vermont is more generous but also falls below the median state. We check the sensitivity of our results to the inclusion of any particular state and find the main results to be robust to separately dropping each state from the analysis.

Finally, injured workers in Massachusetts are free to choose their own doctors (seeking initial treatment within a preferred provider network if their employer has such an arrangement), but some doctors refuse to accept the WC rate of reimbursement. Injured workers in Vermont and Maryland are also free to choose their physicians, whereas under New Jersey WC law, the employer and/or the insurance carrier can select the physician(s) to treat injured workers for work-related injuries. Generally speaking, the extent of physician choice may affect insured workers' incentives to use health insurance rather than WC to pay for medical costs; however, this difference between states is not a great concern for our study because we observe injuries and illnesses treated in emergency rooms.

Massachusetts Health Care Reform

In April 2006, Massachusetts enacted major legislation designed to provide universal health insurance, expanding coverage to nearly all residents. A model for the national reform legislation (ACA) several years later, the Massachusetts reform combined an individual mandate to obtain health insurance coverage (or pay a tax penalty) with a substantial expansion of the state's Medicaid program (*MassHealth*); a state-run online health insurance exchange (the *Connector);* and subsidies for individuals in households with incomes up to 300% of the federal poverty line (FPL) to purchase insurance. Gruber (2008) provided a detailed account of the reform's features, and the details of its implementation are documented elsewhere (see Lischko, Bachman, and Vangeli 2009).

The expansion of Massachusetts' Medicaid program, *MassHealth*, raised income eligibility cutoffs for children, restored coverage to groups who had lost it during the 2002 to 2003 fiscal crisis, including the long-term unemployed, and removed caseload caps for low-income people with disabilities (Kolstad and Kowalski 2012; Miller 2012). The Medicaid changes were among the first reform efforts to take hold, while other parts of the reform were implemented more slowly. We document a large and immediate uptick in the share of ER discharges being billed to Medicaid, beginning in the third quarter of 2006, when implementation of the reform first began.

The reform also increased coverage among those who would not qualify for expanded Medicaid. For those with low to moderate incomes, new Commonwealth Care (*CommCare*) plans were sold through the state-run health insurance exchange; coverage was free for those below 150% FPL and subsidized for individuals up to 300% FPL. Individuals above 300% FPL could purchase health insurance coverage at regulated levels (i.e., bronze, silver, gold, platinum, and catastrophic plans for young adults) through an online marketplace, the *Connector*. And of course, individuals could continue purchasing employer-provided health insurance if it was available to them, or could continue purchasing plans directly from insurers through the non-group market.

The reform either lowered or left unchanged the relative price of care in physician's offices compared to ER care. For uninsured individuals below 100% FPL, the reform did not meaningfully change the price of an ER visit. Prior to the reform, their care would have been financed through the Uncompensated Care Pool, whereas after the reform they were eligible for either fully subsidized Commonwealth Care plans or MassHealth (Raymond 2007), both of which require ER co-pays of only $3. Those between 100% and 200% FPL, if ineligible for *MassHealth*, would face a higher ER co-pay of $50 after the reform, through partially subsidized Commonwealth Care plans (Miller 2012). By contrast, the reform unambiguously lowered the price of a visit in a physician's office for *all* individuals below 200% FPL.

Changes in Health Insurance in Comparison States

Although none of the comparison states experienced the discrete drop in uninsurance brought about in Massachusetts by the 2006 reform (see Figure 1), all three states expanded access to health insurance for adults to some degree during our study period. We note that using these three states as a control group would tend to bias us toward underestimating the impacts of Massachusetts health care reform, as expansions in access to insurance in the comparison group will mute the treatment contrast between Massachusetts and the comparison states.

Although Maryland did not enact comprehensive health care reform during our study period, in July 2008, the state expanded Medicaid to parents

and childless adults with family income up to 116% of the FPL through the Primary Adult Care (PAC) Program (under a section 1115 waiver).[8] At the same time, the state also began subsidizing health insurance premiums for employees working in small businesses. Although this popular insurance expansion began enrolling adults during Massachusetts's post-reform period, it only affects the last two quarters of our study period.

New Jersey's large public insurance expansions preceded our study period of 2004 through 2008. After the introduction of the Children's Health Insurance Program (CHIP) in 1998 (NJ KidCare), New Jersey expanded CHIP to parents (up to 200% FPL) and childless adults (up to 100% FPL) through the NJ FamilyCare program in 2001. Response to the program was overwhelming, and when combined with a large state budget shortfall, enrollment closed in September 2001 (Silow-Carroll et al. 2002). During our study period of 2004 through 2008, enrollment re-opened for parents. In 2005, parents with income up to 100% FPL were eligible for coverage, and this income threshold for parents increased gradually to 133% FPL during the implementation and post periods (2006 through 2008).[9]

Most notably, Vermont enacted comprehensive health care legislation in May 2006.[10] Prior to the legislation, Vermont had generous eligibility criteria for Medicaid (i.e., childless adults with income up to 150% FPL were eligible, and parents with income up to 192% FPL were eligible throughout the entire study period of 2004 to 2008). But the reform in Vermont also introduced the Catamount Health Plan, with subsidized premiums for individuals up to 300% FPL. Similar to Massachusetts, Vermont introduced a penalty to employers who do not offer affordable health care coverage. We include Vermont in our main analysis because it is a neighboring state with comparable information in the HCUP database; however, we recognize that including Vermont poses an especially stringent test on our estimates of the impacts of Massachusetts reform because of the concurrent reform.

Data and Empirical Methods

Data: HCUP State Emergency Department Databases

Our analysis relies on data from the Agency for Healthcare Research and Quality's HCUP and SEDD, from 2004 through 2008. The SEDD comprise data from hospital-based emergency departments and include all patients, regardless of payer (e.g., Medicare, Medicaid, private insurance, the uninsured, and other government programs, such as the Civilian Health and Medical

[8]See http://www.commonwealthfund.org/publications/newsletters/states-in-action/2009/august/august-september-2009/snapshots/maryland-increasing-adult-eligibility-while-cutting-the-budget (accessed May 31, 2016).

[9]See http://kff.org/medicaid/state-indicator/medicaid-income-eligibility-limits-for-parents/ and http://www.state.nj.us/humanservices/dmahs/info/resources/medicaid/2005/05-08_NJ_FamilyCare_Expansion.pdf (both accessed May 31, 2016).

[10]See https://kaiserfamilyfoundation.files.wordpress.com/2013/01/7723.pdf (accessed May 27, 2016).

Program of the Uniformed Services [CHAMPUS]). They include discharge information for emergency department visits that do not result in admission to the inpatient hospital or an outpatient observation stay. Although not every hospital in Massachusetts contributes data, 99% of patient charges in the state (coming from 65 of the state's 68 hospitals) are included during our study period. In all cases, we restrict our samples to discharges for working-age adults, ages 20 through 64, who reside in state. That is, we exclude those patients who were discharged from a hospital in a state other than the one in which they live.

We first classify discharges according to the primary payer listed; if WC is listed as the first payer, we treat that discharge as billed to WC. We code those discharges for which the patient is listed as the primary payer ("self-pay") as uninsured. Discharges billed to Medicaid are clearly delineated in the SEDD data. We include as privately insured those for which the primary payer is a private insurance plan.

We then aggregate total discharges (overall, and by payer) to the county-quarter level, for the patient's county of residence. As our primary dependent variables, we construct per capita measures of total ER discharges (per 100 residents) and discharges billed to WC and other payers, using county population estimates for 20- to 64-year-olds from intercensal estimates from the U.S. Census Bureau.

The SEDD also provide some information on the nature of the discharge, including whether the admission occurred on a weekend[11] and the International Classification of Diseases, Ninth Revision (ICD-9) diagnosis code. We use this information to examine heterogeneity in the impacts of health insurance on WC discharges for admissions occurring during weekdays versus weekends, as well as to compare WC discharges for musculoskeletal injuries versus more easily verifiable wounds. In these regressions, we use per capita county totals for the distinct categories of discharges as the dependent variable.

We control for county-level traits that may affect the number of discharges billed to WC, including the share of total discharges that arise from various types of injuries (cuts, falls, drowning, fires, firearm accidents, machinery, motor vehicle accidents, environmental causes, poisonings, being struck, suffocations, and overexertion), and the county-quarter unemployment rate, median income, and percentage of population that is black in the individual's county, similar to Miller (2012). We find that the pre period trends in the outcome of interest—WC discharges—are quite similar for Massachusetts and the control group states, as discussed later in the article.

Methods

To estimate the causal impact of Massachusetts's 2006 health care reform on WC claims, we use a difference-in-differences (DD) approach,

[11]Unfortunately, although the SEDD indicate whether the admission occurred on a weekday or weekend, they do not include the day of week or date of the admission. Thus, we are unable to test whether health care reform affected the share of discharges billed to WC on Mondays.

comparing changes in ER discharges billed to WC for counties in Massachusetts to changes in counties in three comparison states (Maryland, New Jersey, and Vermont) over the years 2004 to 2008. This approach controls for confounding factors that may also have been changing over this time period. For instance, the economic downturn that began in the fall of 2007 had an impact on WC coverage[12] and may have affected the health of the working-age population, insurance coverage, and ER utilization, as well. The internal validity of our DD estimator depends on the assumption that ER discharges in Massachusetts would have evolved similarly to discharges in the group of comparison states in the absence of health care reform (*parallel trends).* We consider the plausibility of this assumption in the Results section.

We examine the impacts of the reform on the overall number of ER discharges per capita (per 100 residents), and the number of per capita discharges billed to WC and other payers. Our regression models take the following form:

$$D_{ct} = \beta_0 + \beta_1 imp_t + \beta_2 post_t + \beta_3 imp_t \times MA_c + \beta_4 post_t \times MA_c + \beta_5 X_{ct} + \gamma_c + \delta_t + \varepsilon_{ct} \quad (1)$$

where the unit of observation is the county-quarter, D_{ct} is the per capita number of discharges, MA_c is an indicator for a county in Massachusetts, imp_t equals 1 for the quarters in the implementation period (from July 2006 to December 2007), $post_t$ indicates post-reform quarters in 2008, X_{ct} is a vector of county characteristics (the unemployment rate, the share of the population that is black, and the median income), γ_c is a set of county fixed effects, and δ_t is a set of year-by-quarter fixed effects.[13] The key DD estimators are β_3 and β_4. We estimate this model for the overall (per capita) number of discharges from the ER, as well as for the per capita number of discharges billed to WC, private insurers, and Medicaid, and the number uninsured. These payer types are not exhaustive; discharges billed to Medicare or to "other" payers are not included here. In Massachusetts, discharges billed to one of the CommCare insurance plans purchased on the exchange are coded as "other." This is not problematic for our key dependent variable of interest (WC discharges).

We expect the regressions described by Equation (1) to confirm that Massachusetts health care reform caused a decrease in the overall

[12]The Great Recession was associated with substantial changes in WC coverage and workplace injury rates and WC costs. Annual reports from the National Academy of Social Insurance (NASI) show that the number of workers covered by WC declined steadily from 2007 through 2010. Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses (SOII) data indicate a marked 18% decline in both the total number of all work injuries and illnesses and the number of injuries or illnesses with days away from work or job transfer or restriction.

[13]Although the coefficient on $post_t$ is only identified if the fixed effect for 2008 is omitted, we have left $post_t$ in Equation (1) for clarity. Similarly, the indicator for MA is replaced by the full set of county fixed effects.

number of (per capita) ER discharges. If we also find that the reform decreased the per capita number of discharges billed to WC, such a result could be explained by shifting of the site of care for work-related injuries and illnesses away from the ER, and/or by a change in the propensity to bill WC for a particular ER visit. In our Conclusion, we discuss how the relative magnitude of the reform's effect on WC discharges, compared to total ER discharges, provides evidence on the importance of these two mechanisms.

Estimated effects should be larger for conditions for which there is more scope for seeking care outside of the ER or changing payers. We first test for heterogeneous treatment effects by separately examining discharges by weekday versus weekend admission. Second, we split the sample by whether the diagnosis was for a musculoskeletal injury or illness or a wound (here we include ICD-9 codes for head wounds, open wounds, contusions, burns, spinal cord injuries, and poisoning or reaction to a toxic substance).

In all cases, we report robust standard errors. In Online Appendix Tables A.1 and A.2, we show that the qualitative conclusions are similar, but the standard errors are smaller, when we cluster on state[14] or on county. We also demonstrate that our results are robust to performing the analysis at the state level, to using a synthetic control group, and to randomization inference methods, as in Kaestner (2016).

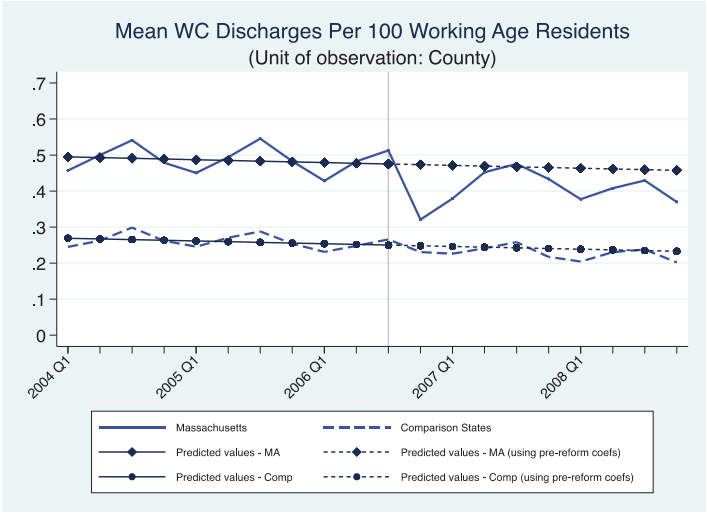
ER Discharges in Massachusetts and Comparison States in the Pre-Reform Period

Table 1 presents differences between Massachusetts and the comparison states in the total number of per capita ER discharges, as well as the numbers of discharges billed to different payers. Massachusetts counties have a somewhat higher number of quarterly ER discharges overall in the pre-reform period (8.65 ER discharges per 100 residents versus 7.26 ER discharges in comparison states), and a larger per capita number of discharges billed to WC (0.49 versus 0.26). Massachusetts also entered the reform period with a much lower uninsurance rate than other states, which is reflected in the lower number of uninsured discharges and the higher number of discharges billed to private and public insurance in Massachusetts, relative to comparison states.

While it is worth noting these treatment-control differences in the levels of mean outcomes during the pre-reform period, our DD estimates will be biased if WC discharges were trending differently in Massachusetts than in the comparison states prior to the reform. In other words, the identifying assumption that allows us to draw a causal link between increased insurance coverage resulting from Massachusetts health care reform and any change

[14]Although the policy variation occurs at the state level, clustering on state, with too few clusters, could lead us to over-reject the null hypothesis (Bertrand, Duflo, and Mullainathan 2004).

Figure 5. ER Discharges Billed to WC per 100 County Residents, 2004 to 2008



Notes: ER, emergency room; WC, workers' compensation.

in WC-claiming behavior is that no other trend differentially impacted WC discharges in Massachusetts relative to comparison states.

Figure 5 documents that the trend in the number of ER discharges billed to WC per capita is similar during the pre period for Massachusetts and the comparison states, with WC discharges per capita decreasing slightly in both Massachusetts and the comparison group. We also note that the series appear to converge slightly in the implementation and post periods, as Massachusetts WC discharges decrease more rapidly than would have been projected based on pre-period trends.[15] In Figure 6, we repeat this exercise for the county-level share of ER discharges billed to WC in Massachusetts and the group of comparison states. The share of discharges billed to WC is consistently higher in Massachusetts than in the comparison states, yet the trend lines track in a parallel fashion through the pre period. Nonetheless, we assess the robustness of our results to relaxing the parallel trends assumption and present the findings later in Table 3.

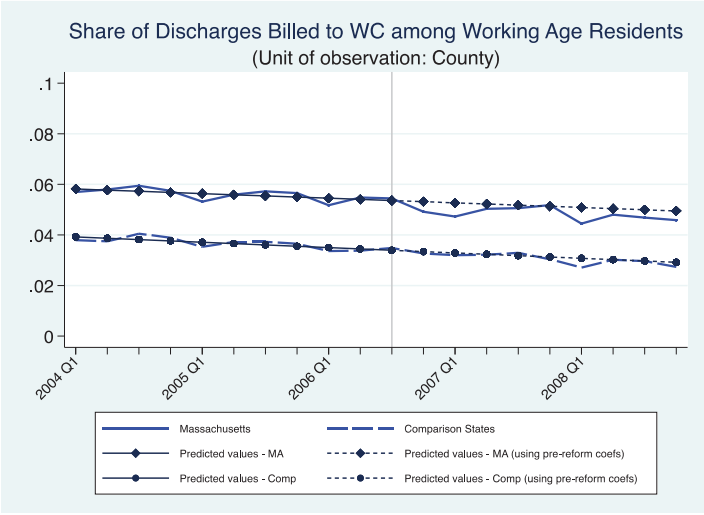
Results

Effects of Health Care Reform on ER Discharges Billed to WC

The results in panel A of Table 2 (column (1)) document significant decreases in the number of ER discharges in Massachusetts, relative to comparison states, following health care reform. Discharges from the ER decrease by 6.5% in the implementation period and 8.3% in the post

[15]Note the large change in WC discharges per capita in Q4 2006; our results are robust to excluding discharges from this quarter.

Figure 6. Share of ER Discharges Billed to WC, 2004 to 2008



Notes: ER, emergency room; WC, workers' compensation.

period (relative to a pre-period mean of 8.7 quarterly discharges per 100 residents).[16] These reductions are consistent with increased access to health insurance lowering the relative price of care outside of the emergency room.

The primary outcome of interest, however, is the number of per capita discharges billed to WC (column (2)). The DD estimates indicate that Massachusetts health care reform caused a significant reduction in the number of WC discharges in both the implementation and post periods. The negative sign on these coefficients should be expected, given that overall ER usage declined as a result of the reform. Comparing the magnitudes of these coefficients to the DD estimates for total ER discharges, we note that the reductions in WC discharges (6.2% and 8.2% in the implementation and post periods, respectively) are very similar in magnitude to the reductions in ER discharges overall. Because of this, we estimate no change in the share of discharges billed to WC (panel B of Table 2).

In Table 3, we examine the robustness of our main results (repeated in column (1) for comparison) to several specification checks. First, in column (2), we probe the parallel trends assumption by including interaction terms between Massachusetts and each of the two pre-period years, 2004 and 2005. If our main estimates merely reflected a pre-existing trend that differed between Massachusetts and comparison states, then including these lead terms may reduce our estimated impacts in the implementation and

[16]Our estimates are similar in magnitude to those of Miller (2012), who found a reduction in ER discharges of approximately 5%. However, she included discharges for patients of all ages, and her data set was not limited to outpatient-only ER discharges.

Table 2. Effects of Massachusetts (MA) Health Care Reform on ER Discharges Billed to WC and Other Payers

Panel A: Per-capita results

	Total discharges (1)	*WC* (2)	*Uninsured* (3)	*Private* (4)	*Medicaid* (5)
DD coefficients					
Implementation period × MA	–0.559***	–0.030***	–0.329***	–0.161***	0.166***
	(0.131)	(0.008)	(0.027)	(0.063)	(0.043)
Post period × MA	–0.721***	–0.040***	–0.534***	–0.105*	0.350***
	(0.127)	(0.006)	(0.029)	(0.061)	(0.049)
Pre-reform MA mean	8.649	0.486	0.997	3.836	1.742
Effect sizes (DD coefficient as a % of pre-reform mean)					
Implementation period	**–6.5%**	**–6.2%**	**–33.0%**	**–4.2%**	**9.5%**
Post period	**–8.3%**	**–8.2%**	**–53.6%**	**–2.7%**	**20.1%**
County-quarter observations	1,460	1,460	1,460	1,460	1,460
R^2	0.964	0.946	0.982	0.877	0.970

Panel B: Share of discharges billed to different payers

	Total discharges (1)	*WC* (2)	*Uninsured* (3)	*Private* (4)	*Medicaid* (5)
DD coefficients					
Implementation period × MA	—	–0.000	–0.028***	0.019***	0.028***
	—	(0.001)	(0.002)	(0.004)	(0.002)
Post period × MA	—	–0.001	–0.042***	0.038***	0.046***
	—	(0.001)	(0.002)	(0.004)	(0.002)
Pre-reform MA mean	—	0.056	0.115	0.453	0.194
Effect sizes (DD coefficient as a % of pre-reform mean)					
Imp. period	—	0.0%	**–24.3%**	**4.2%**	**14.4%**
Post period	—	−1.8%	**−36.5%**	**8.4%**	**23.7%**
County-quarter observations	—	1,460	1,460	1,460	1,460
R^2	—	0.942	0.986	0.967	0.980

Notes: Regressions include 1,460 county-quarter observations from 2004 through 2008. Regressions include controls for the implementation period and post period; year-by-quarter fixed effects; county-level unemployment, median income, and percentage black; and share of discharges represented by the following types of injury: cuts, drownings, falls, fires, firearms, motor vehicles, nature/environment, poisoning, strikes, suffocation, and overexertion. Robust standard errors are presented in parentheses. Regressions are weighted by the county population. Boldface type indicates that the corresponding coefficient estimate used to construct the effect size is statistically significantly different from 0 at the 10% level. DD, difference-in-differences; ER, emergency room; WC, workers' compensation.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

post periods. Our DD results are robust to this change; we continue to estimate significant decreases in WC discharges per capita for both the implementation and post periods, and the estimates are of similar magnitude to those in column (1). We also confirm that the coefficient estimates on the two pre-period interaction terms are close to zero and not statistically significant, suggesting that WC discharges were not changing differently in

Table 3. Effects of Massachusetts (MA) Health Care Reform on ER Discharges Billed to WC, Robustness Checks

	Main results (1)	*Add lead terms* (2)	*Add state time trends* (3)	*Drop MD* (4)	*Drop NJ* (5)	*Drop VT* (6)	*State level* (7)	*Synthetic control* (8)	*Triple difference* (9)	*p value from Randomization inference* (10)
Panel A: WC discharges (per capita)										
DD coefficients										
Imp. period × MA	−0.030***	−0.028***	−0.044***	−0.038***	−0.018**	−0.030***	−0.026*	−0.042**	−0.022***	p=0.005
	(0.008)	(0.010)	(0.015)	(0.008)	(0.008)	(0.008)	(0.014)	(0.015)	(0.008)	
Post period × MA	−0.040***	−0.038***	−0.062***	−0.046***	−0.031***	−0.041***	−0.026***	−0.043**	−0.031***	p=0.006
	(0.006)	(0.009)	(0.017)	(0.006)	(0.006)	(0.006)	(0.008)	(0.019)	(0.006)	
DDD Coefficients										
Imp. × MA × 2005 Unins.									−0.006	
									(0.016)	
Post × MA × 2005 Unins.									0.003	
									(0.010)	
Effect sizes (DD coefficient as a % of pre-reform mean, 0.486)										
Imp. period	**−6.2%**	**−5.7%**	**−9.0%**	**−7.8%**	**−3.7%**	**−6.1%**	**−5.3%**	**−8.6%**		
Post period	**−8.2%**	**−7.8%**	**−12.7%**	**−9.4%**	**−6.3%**	**−8.4%**	**−5.3%**	**−8.8%**		
Panel B: All ER discharges (per capita)										
DD coefficients										
Imp. period × MA	−0.559***	−0.357**	−0.528**	−0.650***	−0.410***	−0.586***	−0.370**	−0.532**	−0.596***	p=0.007
	(0.131)	(0.174)	(0.246)	(0.134)	(0.126)	(0.134)	(0.176)	(0.249)	(0.132)	
Post period × MA	−0.721***	−0.517***	−0.648**	−0.827***	−0.545***	−0.757***	−0.412***	−0.690**	−0.798***	p=0.036
	(0.127)	(0.167)	(0.275)	(0.140)	(0.129)	(0.129)	(0.091)	(0.289)	(0.132)	
DDD coefficients										
Imp. × MA × 2005 Unins.									−0.293	
									(0.249)	
Post × MA × 2005 Unins.									−0.411**	
									(0.195)	
Effect sizes (DD coefficient as a % of pre-reform mean, 8.649)										
Imp. period	**−6.5%**	**−4.1%**	**−6.1%**	**−7.5%**	**−4.7%**	**−6.8%**	**−4.3%**	**−6.2%**		
Post period	**−8.3%**	**−6.0%**	**−7.5%**	**−9.6%**	**−6.3%**	**−8.8%**	**−4.8%**	**−8.0%**		

(continued)

Table 3. Continued

	Main results (1)	*Add lead terms* (2)	*Add state time trends* (3)	*Drop MD* (4)	*Drop NJ* (5)	*Drop VT* (6)	*State level* (7)	*Synthetic control* (8)	*Triple difference* (9)	*p value from Randomization inference* (10)
Panel C: Share of discharges billed to WC										
DD Coefficients										
Imp. period × MA	−0.000	−0.002*	−0.002**	−0.000	0.000	−0.000	−0.001	−0.002***	0.001*	p=0.799
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
Post period × MA	−0.001	−0.002**	−0.003**	0.000	−0.001	−0.001	−0.000	−0.000	0.001	p=0.712
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
DDD coefficients										
Imp. × MA × High Unins.									−0.001	
									(0.001)	
Post × MA × High Unins.									0.001	
									(0.001)	
County-quarter observations	1,460	1,460	1,460	980	1,040	1,180	80	80	1,460	

Notes: Regressions include same controls as in Table 2. In columns (1) through (6) and (9) and (10), county-quarter-level observations are weighted by the county population. Columns (7) and (8) present results at the state-quarter level. In column (7), state-level regressions include state fixed effects; state unemployment, median income, and percentage black; and state share of discharges consisting of external cause of injury and are weighted by state population. Column (8) presents results from constructing a synthetic control group and cells are weighted by their contribution to the synthetic control state; in panels A and B Maryland contributes 10.1%, New Jersey contributes 0%, and Vermont contributes 89.9% and in panel C Maryland contributes 8.9%, New Jersey contributes 26%, and Vermont contributes 65.1%. (Massachusetts contributes 100% of the treatment group.) We construct the synthetic control group using the following covariates: state population ages 20 to 64, share of population residing in a metro area, mean household income, share black, share uninsured, state unemployment rate, distribution of employment by 1-digit industry, distribution of population ages 18 to 64 by age category, distribution of educational attainment, and WC discharges per capita in 2004 Q1 and 2004 Q2 (for panels A and B) and share of discharges billed to WC in 2004 Q1 and 2004 Q2 (in panel C). Column (9) includes interactions between the indicators for the implementation and post periods, the indicator for Massachusetts, and the county's 2005 uninsurance rate. Column (10) presents randomization inference p values that reflect the share of 1,000 iterations for which the absolute value of the "placebo" state consisting of 14 random counties exceeds the absolute value of the effect for the 14 counties that make up Massachusetts. Boldface type indicates that the corresponding coefficient estimate used to construct the effect size is statistically significantly different from 0 at the 10% level. DD, difference-in-differences; DDD, triple difference; ER, emergency room; WC, workers' compensation; Imp., implementation; Unins., uninsured.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Massachusetts relative to the comparison states in the pre period.[17] Column (3) presents the results of a related check, wherein we relax the parallel trends assumption by including a set of state-specific (linear) time trends. The estimated effects of health care reform on WC discharges are larger in magnitude when we do so, suggesting that, if anything, failing to control for any differential pre-period trends was biasing our main estimates toward zero. Because we do not have a particularly long pre period with which to estimate these trends, we take these estimates with a grain of salt, recognizing that the state linear time trends may confound pre-existing trends with the dynamic effects of the policy shock (see Wolfers 2003). Nonetheless, it is reassuring that our estimates are larger in absolute value under this specification.

In the remaining columns we test the appropriateness of our comparison group in several ways. In columns (4) through (6), we demonstrate the robustness of our estimates to dropping each comparison state individually. The magnitudes of the effects drop somewhat when we eliminate New Jersey from the comparison sample, perhaps because Maryland and Vermont enacted more substantial health insurance expansions during this time period. In column (7) we estimate our DD model at the state level instead of the county level, and in column (8) we create a synthetic control group that weights each comparison state according to the extent to which it matches Massachusetts on pre-reform characteristics (Abadie, Diamond, and Hainmueller 2010; see Hansen and DeAngelo 2014 for a similar application).[18] In both cases, we estimate significant decreases in per capita ER discharges billed to WC, which are similar in magnitude to our primary results. Again we find the percentage reduction in per capita discharges billed to WC to be similar to the percentage reduction in total ER discharges.

In column (9) we use variation across counties in the pre-reform level of uninsurance as an additional source of identifying variation in a triple-difference framework. Here the $imp \times MA$ and $post \times MA$ indicators are interacted with an indicator for whether the county's 2005 uninsurance rate is in the top quartile for its state (12.6 in Massachusetts), following Miller (2012). Our results for overall ER discharges are very similar to those in Miller (2012). Massachusetts counties with the highest uninsurance rates

[17]The coefficient estimate on $MA \times 2004$ is 0.001 (standard error 0.010) and the coefficient estimate on $MA \times 2005$ is 0.004 (standard error 0.009).

[18]We construct the synthetic control group using the following covariates: state population age 20 to 64, share of population residing in a metro area, mean household income, share black, share uninsured, state unemployment rate, distribution of employment by 1-digit industry, distribution of population age 18 to 64 by age category, distribution of educational attainment, and WC discharges per capita in 2004 Q1 and 2004 Q2 (or share of discharges billed to WC in 2004 Q1 and 2004 Q2 in panel C of Table 3). In the Online Appendix we present graphs that compare trends in the outcomes of interest for Massachusetts and the synthetic control. We note that the synthetic control approach more closely approximates the level for Massachusetts, especially for the outcomes of discharges per 100 working-age residents.

experienced an additional decline of 0.411 ER discharges per 100 working-age residents in the post period (the coefficient in the implementation period is negative but not significant). Counties with high 2005 uninsurance rates do not appear to experience larger declines in WC discharges, however. While our estimated coefficients on $imp \times MA$ and $post \times MA$ are similar to the other columns, the coefficients on the triple interactions are close to zero and not statistically significant. One possible explanation is that some of the counties with the highest uninsurance rates were experiencing increases in employment (which would lead to more workplace injuries), offsetting any decline in WC attributable to falling rates of uninsurance. Indeed, the employment-to-population ratio in the most populated of the high-uninsurance counties, Suffolk County (which contains Boston), rose by 4.4 percentage points between 2004 and 2008 and the employment-to-population ratio fell in the balance of the state. (Recall that our regressions are weighted by county populations, leading to greater influence for Suffolk County.) Nonetheless, the fact that we do not find significant differences in the impact of health care reform on WC discharges across areas with higher versus lower pre-reform rates of uninsurance is in contrast to other articles evaluating the reform's impacts on non-WC outcomes, such as ER utilization (Miller 2012), financial distress (Mazumder and Miller 2016), and spillover effects to Medicare enrollees (Bond and White 2013).

Finally, in column (10) we present p values from a randomization inference approach. There are 14 counties in Massachusetts and 59 counties in Maryland, New Jersey, and Vermont. Over 1,000 iterations, we randomly select 14 counties out of the 73 potential counties, assign them to a placebo "treatment" group and compare the absolute value of the effect size for this treatment group to the absolute value of the effect we compute for Massachusetts. The randomization inference p value is the fraction of these iterations for which the absolute value of the effect of the placebo state comprising 14 random counties exceeds the absolute value of the effect for the 14 counties of Massachusetts. We note that $p < 0.01$ in panel A for WC discharges and $p < 0.05$ for ER discharges per capita (panel B).

The results in Tables 2 and 3 indicate that health care reform caused a significant decline in the number of ER discharges billed to WC—a decline that is proportionally equal to, or greater than, the decrease in overall ER utilization. Because injured workers have less of an incentive to seek care outside of ERs than do those with non-work injuries, we conclude that the decreases in per capita WC discharges are too large to be explained by injured workers increasingly seeking care outside of the ER, alone. That is, the magnitude of our estimates suggests that the reform also caused a decline in the likelihood of billing WC for a given injury. In what follows, we present evidence for various types of discharges and injuries to shed light on heterogeneity in the effects of the reform and on the importance of shifting the location of care and on substitution between payers in explaining the decline in per capita WC discharges.

Table 4. Heterogeneous Effects by Weekend vs. Weekday Admission, and Wound vs. Musculoskeletal Injury

	Weekend admission (1)	*Weekday admission* (2)	*Wounds* (3)	*Musculoskeletal injuries* (4)
Panel A: Discharges billed to WC (per capita)				
DD coefficients				
Implementation period × MA	−0.002	−0.026***	−0.013***	−0.012***
	(0.002)	(0.007)	(0.004)	(0.003)
Post period × MA	−0.004***	−0.035***	−0.018***	−0.015***
	(0.001)	(0.005)	(0.003)	(0.002)
Pre-reform MA mean	0.083	0.403	0.237	0.156
Effect sizes (DD coefficient as % of pre-reform mean)				
Implementation period	−2.4%	**−6.5%**	**−5.5%**	**−7.7%**
Post period	**−4.8%**	**−8.7%**	**−7.6%**	**−9.6%**
Panel B: All ER discharges (per capita)				
DD coefficients				
Implementation period × MA	−0.149***	−0.401***	−0.067***	−0.077***
	(0.038)	(0.093)	(0.020)	(0.025)
Post period × MA	−0.167***	−0.541***	−0.077***	−0.090***
	(0.036)	(0.090)	(0.018)	(0.026)
Pre-reform MA mean	2.454	6.195	1.396	1.595
Effect sizes (DD coefficient as % of pre-reform mean)				
Implementation period	**−6.1%**	**−6.5%**	**−4.8%**	**−4.8%**
Post period	**−6.8%**	**−8.7%**	**−5.5%**	**−5.6%**
Panel C: Share of ER discharges billed to WC				
DD coefficients				
Implementation period × MA	0.001**	−0.001	0.002	−0.003**
	(0.000)	(0.001)	(0.002)	(0.001)
Post period × MA	0.001	−0.001	0.003*	−0.004***
	(0.000)	(0.001)	(0.002)	(0.001)
County-quarter observations	1,460	1,460	1,460	1,460

Notes: Wounds are coded as discharges with a 3-digit ICD-9 code between 850 and 989. Musculoskeletal injuries are coded as discharges with a 3-digit ICD-9 code between 710 and 739 or between 840 and 848. Results include same controls as in Table 2 and are weighted by the county population. Robust standard errors are presented in parentheses. Boldface type indicates that the corresponding coefficient estimate used to construct the effect size is statistically significantly different from 0 at the 10% level. DD, difference-in-differences; ER, emergency room; ICD-9, International Classification of Diseases, Ninth Revision; MA, Massachusetts; WC, workers' compensation.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Heterogeneous Effects

Table 4 presents estimated effects of Massachusetts health care reform on per capita ER discharges billed to WC based on type of admission. We expect smaller declines in WC discharges among injuries treated on weekends (column (1)) than for those admitted on weekdays (column (2)). Injuries occurring during the weekend are less likely to be work-related and therefore may involve less scope for shifting medical costs between health

insurance and WC. Such injuries are also less likely to be treated outside of the ER because most physicians' offices and some urgent care centers will be closed. Indeed, the number of per capita weekday discharges billed to WC declined by 7 to 9% in Massachusetts relative to comparison states, whereas the number of weekend discharges billed to WC declined between 0 and 5%. For weekday admissions, we find that the percentage decreases in WC discharges are identical in magnitude to the percentage decreases in overall ER discharges, while for weekend admissions, the decline in WC discharges is significantly smaller than the overall decrease in ER utilization.

In columns (3) and (4) we compare the effects of the reform on WC discharges for admissions that were diagnosed as wounds and admissions diagnosed as musculoskeletal injuries. We expect larger impacts on WC discharges for musculoskeletal injuries because the potential for fraudulent reporting or substitution between health insurance and WC is greater for these injuries (e.g., sprains and strains). Musculoskeletal injuries tend to be less verifiable than wounds because they often cannot be objectively measured, and providers must depend on workers' reports of pain to make a diagnosis. These injuries are also more difficult to link to a specific work-related cause, leaving more potential for uninsured workers to claim their non-work-related injuries were caused by work or for insured workers to bill health insurance instead of WC. One might expect that musculoskeletal injuries also involve more scope for shifting care to a non-ER setting, for example, if care for these injuries can more easily be delayed. Our results, however, indicate identical decreases in overall ER utilization for musculoskeletal conditions and wounds.

The estimates in columns (3) and (4) reveal larger percentage reductions in WC discharges for musculoskeletal injuries and smaller reductions for admissions diagnosed as wounds. (Note that one should not directly compare the coefficient estimates because the pre-reform means differ greatly.) Because musculoskeletal injuries do not exhibit more shifting away from the ER than do wounds in response to the reform (see panel B), the difference in the reform's impact on WC discharges must be attributable to the increased scope for substituting between WC and health insurance for less verifiable injuries. Indeed, we estimate a significant negative impact of health care reform on the share of musculoskeletal injuries billed to WC but no such reduction for wounds.

Comparing the effect sizes for WC discharges and all ER discharges can be helpful in interpreting these results. Suppose, for example, that following a health insurance expansion, patients with work-related injuries are equally likely to seek care in settings other than the ER as are those with non-work-related injuries. Then the estimated percentage decline in all ER discharges would be a good proxy for the amount of shifting away from the ER among injured workers. Any additional decline in WC discharges must be explained by substitution between payers (which could occur in response to fraudulent reporting of non-work injuries but could also be explained by

other provider and/or patient incentives). This back-of-the-envelope calculation yields a rough estimate of the role that payer substitution between health insurance and WC plays in explaining the reform-induced decrease in WC discharges per capita. Here we find that for musculoskeletal injuries, which are harder to verify, a decreased propensity to bill WC following a health insurance expansion is likely to explain 36 to 42% of the decline in per capita WC discharges.[19] Perhaps not surprisingly, our estimates for wounds indicate that the role for changing propensity to bill WC is smaller. Yet even among these easier-to-verify injuries, our calculation indicates that substitution between WC and health insurance explains at least 11 to 25% of the overall decline in ER discharges billed to WC.

This estimate is a *lower bound* for the role of substitution between payers because the assumption above is an extreme one. Given that injured workers face zero cost sharing under WC in either location, it is unlikely that injured workers would shift away from the ER at the same rate as those with non-work injuries in response to health care reform. Thus, we conclude from our estimates that Massachusetts health care reform not only may have induced some workers to seek care outside of the ER but also caused a decrease in the propensity to claim WC for a given injury, particularly for harder-to-verify musculoskeletal conditions such as sprains and strains.

Alternative Explanations and Corroborating Evidence

Table 5 explores the possibility that the decrease in WC discharges in Massachusetts relative to comparison states could be explained by concurrent trends in employment or workplace safety and provides corroborating evidence that health care reform affected WC costs and claims. We apply a parsimonious version of our DD approach containing only an indicator for Massachusetts, an indicator for the post period (2006 and later), their interaction, and year and state fixed effects, in order to document any differential post-reform trends in Massachusetts relative to the comparison states.

In panel A, we use BLS Current Employment Statistics (CES) data to analyze whether Massachusetts health care reform was associated with a decline in employment in Massachusetts relative to comparison states, in which case the number of workplace injuries may have fallen mechanically (and not in response to any direct effects of gaining health insurance). With the state-year employment-to-population ratio as the dependent variable, we find no evidence to suggest that the reform decreased employment. Rather, our

[19]We calculate this by assuming that the estimated percentage decline in *all* ER discharges is a good proxy for the amount of the decline in WC discharges attributable to shifting the site of care, while the rest could be attributable to substitution between payers. For musculoskeletal injuries in the implementation period, shifting between payers would explain 7.7 − 4.9 = 2.8 percentage points (or 36%) of the 7.7% decline in WC discharges. In the post period, shifting between payers could explain 9.6 − 5.6 = 4.0 percentage points (or 42%) of the 9.6% decline in WC discharges.

Table 5. Employment, Workplace Injuries, and WC Costs and Claims Following Massachusetts (MA) Health Care Reform

Dependent variable	*(1) HCUP states 2004–2008*	*(2) HCUP states 2001–2010*	*(3) All states 2004–2008*	*(4) All states 2001–2010*
A. Employment-to-population ratio[a]				
(Data source: CES; observation: state-year)				
(MA 2004 mean of dep var = 0.74)				
MA	0.073***	0.078***	0.101***	0.109***
	(0.001)	(0.002)	(0.001)	(0.001)
Post	−0.001	−0.059***	−0.000	−0.068***
	(0.003)	(0.008)	(0.003)	(0.005)
Post × MA	0.009**	0.004	0.007***	0.008**
	(0.002)	(0.004)	(0.002)	(0.003)
B. Work injuries (per 100 FTE)[b]				
(Data source: BLS SOII; observation: state-year)				
(MA 2004 mean of dep var = 4.3)				
MA	0.117**	0.083	−0.684***	−0.710***
	(0.037)	(0.048)	(0.020)	(0.022)
Post	−0.734**	−1.801**	−0.885***	−2.319***
	(0.139)	(0.423)	(0.085)	(0.096)
Post × MA	0.109	0.066	0.208***	0.322***
	(0.091)	(0.121)	(0.050)	(0.057)
C. WC medical benefits paid out (dollars per injury)[c]				
(Data source: NASI; observation: state-year)				
(MA 2004 mean of dep var = 4.10)				
MA	−0.956***	−0.604	−2.774***	−2.743***
	(0.100)	(0.534)	(0.177)	(0.195)
Post	1.796**	5.431*	0.902*	4.576***
	(0.474)	(1.921)	(0.497)	(0.687)
Post × MA	−1.594***	−2.207*	−0.576*	−1.126***
	(0.165)	(0.838)	(0.291)	(0.329)
D. WC cash benefits paid out (dollars per injury)[d]				
(Data source: NASI; observation: state-year)				
(MA 2004 mean of dep var = 7.86)				
MA	1.553	2.660	6.332***	2.897***
	(2.468)	(1.795)	(1.553)	(0.438)
Post	2.400	8.747**	0.369	3.346***
	(2.395)	(2.320)	(0.392)	(0.924)
Post × MA	−1.721**	−1.836	0.124	0.230
	(0.467)	(1.061)	(0.559)	(0.387)
E. Share of working-age adults receiving WC income[e]				
(Data source: CPS; observation: state-year)				
(MA 2004 mean of dep var = 0.011)				
MA	0.002**	−0.001	0.004***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Post	−0.001	0.001	−0.002***	−0.001***
	(0.002)	(0.005)	(0.001)	(0.000)
Post × MA	−0.004**	−0.002**	−0.001***	0.000
	(0.001)	(0.000)	(0.001)	(0.000)

Notes: Regressions are weighted by the state population. BLS SOII, Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses; CES, Current Employment Statistics; CPS, Current Population Survey; dep var, dependent variable; FTE, full-time employees; HCUP, Healthcare Cost and Utilization Project; NASI, National Academy of Social Insurance; WC, workers' compensation.

[a]Employment-to-population ratio = state employment (from CES) divided by population ages 15 to 64 from intercensal estimates.
[b]Work injury rate = all injuries (those with days away from work or job transfer or restriction, as well as those without days away from work or job transfer or restriction) per 100 FTE.
[c]WC medical benefits per capita = dollars paid out in WC medical benefits (from NASI data, in 2010 dollars) per workplace injury (from BLS SOII).
[d]WC cash benefits per capita = dollars paid out in WC indemnity benefits (from NASI data, in 2010 dollars) per workplace injury (from BLS SOII).
[e]State-year fraction of respondents ages 18 to 64 who report receiving WC income in last calendar year (from March CPS).
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

estimated coefficient is positive and statistically significant in column (1), in which the sample of state-years matches our main analysis, and in two of the three remaining columns, in which we expand the sample to include a longer time period and/or a larger set of comparison states. Panel B investigates whether the incidence of occupational injuries and illnesses fell in Massachusetts relative to other states during the post-reform period. We note that such a decline could occur even without a decrease in overall employment, because of coinciding trends in workplace safety or in employment in injury-prone industries. Using state-year BLS Survey of Occupational Injuries and Illnesses (SOII) data on the rate of all injuries (per 100 full-time equivalent workers), we estimate a DD coefficient that is positive in magnitude and is significant for the larger sample of all states. In short, it does not seem that decreasing employment or falling injury rates in Massachusetts could explain our results.

In panels C through E we provide suggestive, corroborating evidence for our conclusion that health care reform caused some shifting of care away from ERs *and* a decline in the propensity to claim WC. To do so, we consider whether the post-reform period was associated with a decline in WC benefit payouts or WC benefit recipiency in Massachusetts relative to comparison states. We first examine state-year WC medical benefit payouts as the dependent variable, divided by the number of work-related injuries and illnesses in that state and year (from SOII data). Our estimated DD coefficient is negative and significant in all four columns, indicating that health care reform was associated with a decrease in the average medical cost of a WC claim. A decline in medical benefits per injury is consistent with both mechanisms—fewer WC claims and care for workplace injuries shifting away from the ER to other, less costly settings.

The final two panels present two distinct measures of WC cash benefit claiming: state-year cash benefit payouts per injury (constructed from NASI and SOII data) and the state-year fraction of working-age adults in the Current Population Survey (CPS) who report receiving WC income. Here we also control for the changes in the generosity of each state's WC indemnity benefits by including the log of the state's maximum weekly Temporary Total Disability benefit. Massachusetts health care reform is associated with a decline in cash benefit payouts (panel D) per injury in our HCUP states;

our estimates are smaller in magnitude and not statistically significant when we expand the sample to include all states. Similarly, in three out of the four samples, we estimate a negative and statistically significant relationship between Massachusetts health care reform and WC cash benefit recipiency (panel E).

Conclusions

The impact of comprehensive health care reform on social insurance programs, such as WC, is of crucial importance for policymaking, yet these policies are often studied in isolation. The evidence in this article indicates that Massachusetts health care reform had important spillover effects on WC and suggests that cost savings in WC may be counted as an additional benefit of comprehensive health care reform.

Our primary results indicate that health care reform reduced the per capita number of ER discharges billed to WC by 6 to 8%. This finding survives a number of robustness and specification checks, including adding leads of the treatment or state-specific time trends, re-estimating the model dropping each comparison state individually, estimating the DD model at the state (rather than county) level, a synthetic control group approach, and randomization inference methods. We also document a particularly large impact of health care reform on WC discharges among those with musculoskeletal conditions (versus wounds) and weekday (versus weekend) admissions.

The estimated magnitude of the decrease in per capita WC discharges is too large to be explained by injured workers increasingly seeking care in non-ER settings, alone, leading us to conclude that health care reform also lowered the likelihood that an injured worker files a WC claim. In terms of external validity, such an effect of health insurance on WC-claiming decisions can be expected to extend beyond just those injuries and illnesses that could reasonably be treated in the ER. If anything, our estimates of this relationship, which are obtained by analyzing injuries that are disproportionately urgent or emergent, are likely to understate the effect of health care reform on WC-claiming propensities for the wider set of all work-related injuries and illnesses.

Without a more comprehensive view of all places of care we cannot precisely disentangle to what extent the reduction in ER discharges billed to WC is explained by patients seeking care outside of ERs versus injured workers responding to incentives to bill health insurance rather than WC. We note, however, that either mechanism would lead to decreased WC costs for employers and insurers (see Figure 2). Program costs are likely more affected by the decline in the propensity to claim WC than by shifting of care away from ERs, since ER care accounts for relatively little of overall WC medical costs. Furthermore, shifting the location of care affects only WC

medical costs, whereas a decrease in the number of WC claims could reduce both WC medical costs and the costs of indemnity benefits.

We also note that this shifting away from the ER and away from WC as a payer likely contributed to lower health care costs overall because costs are higher when a given injury is treated in the ER setting versus other locations (see, e.g., Weinick, Burns, and Mehrotra 2010; Ho et al. 2017) and when the payer is WC rather than group health insurance (see, e.g., Baker and Krueger 1995; Durbin, Corro, and Helvacian 1996). Injuries billed to WC tend to be costlier to treat because they involve increased utilization of care in more expensive settings, such as inpatient care (Baker and Krueger 1995; Durbin et al. 1996), as well as additional transaction costs associated with filing WC claims (see, e.g., Leigh and Ward 1997; Himmelstein, Buchanan, Dembe, and Stevens 1999; Schafermeyer 2007).

Given the similarity of the Massachusetts health care reform to the more recent national reform, our results shed light on the probable impacts of the ACA on state WC programs (and health care costs overall). Since 2014, WC medical costs and WC cash benefit costs have declined rapidly, both in total and per $100 of covered payroll (McLaren et al. 2018). Based on our evidence for Massachusetts, we conclude the ACA likely contributed to this decline in WC costs.

Clearly, the normative implications of our finding that health care reform reduced the propensity to claim WC depend on *why* this substitution toward billing health insurance occurs. On the one hand, if it occurs because prior to the reform, uninsured workers were fraudulently reporting non-work-related injuries as work-related in order to have WC cover their medical costs, then a reduction in this fraudulent reporting may be counted as a benefit of the reform. On the other hand, if substitution toward health insurance reflects injured workers choosing to bill health insurance instead of WC to cover the cost of on-the-job injuries, it is a less positive outcome. Such behavior might reflect workers' fear of stigmatization or retribution at their workplaces, lack of information about WC eligibility and benefits, or avoidance of transaction costs associated with filing a WC claim. Injured workers who bill their medical costs to health insurance instead of WC might also be less likely to report their injuries to their employers and less likely to receive the time off work they need to recover. Finally, billing the costs of a true work injury to health insurance rather than WC undercuts the ability of experience-rated WC insurance premiums to provide incentives for employers to maintain safe workplaces.

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