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TECHNICAL REPORT

The Impact of Health Care Reform on Workers' Compensation Medical Care

Evidence from Massachusetts

Paul Heaton

Supported by the Willis Research Network and the Hartford Financial Services Group, Inc.

Institute for Civil Justice

A RAND LAW, BUSINESS, AND REGULATION INSTITUTE

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Preface

This report analyzes the impact of health care reform on treatment and billing for medical care received through the workers' compensation (WC) system, drawing on the experience of Massachusetts as a case study. It should be of interest to stakeholders involved in state WC systems, including legislators, insurance regulators, WC insurers, attorneys, and academic researchers.

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Summary

Stakeholders in the workers' compensation (WC) system largely agree that health care reform measures such as those contained in the Patient Protection and Affordable Care Act (PPACA) have the potential to affect the cost and composition of medical care received under WC. So far, however, there has been no broad consensus on the magnitude or even direction of the likely impacts of reform. Moreover, the limited research literature on this topic draws mostly qualitative conclusions and highlights the considerable uncertainty that exists regarding reform's future impacts.

In this report, I used the experience of Massachusetts, which implemented a health care reform package in 2006 containing provisions similar to many of PPACA's key provisions, to develop quantitative, empirical evidence on the effects of reform. My analysis focused in particular on hospital care, drawing data from the State Emergency Department Data (SEDD) and State Inpatient Data (SID) files for Massachusetts. These data included observations on over 9.5 million emergency room (ER) visits and 3 million inpatient hospitalization episodes, and included detailed information on the diagnoses and medical procedures for each patient, patient demographics, billed charges, and source of payment.

Relative to nearby states, Massachusetts has a lower rate of recorded workplace injuries and illnesses, and its WC fee schedules provide a comparatively low rate of reimbursement to providers for medical services. These somewhat unique features of Massachusetts's WC system may affect the ability to generalize from Massachusetts to other contexts. Examining SEDD and SID data on the identity of payers over time, I found that the reform was successful at its primary goal of increasing health insurance coverage and reducing the number of uninsured. The share of patients accessing the ER who had no insurance fell from approximately 15 percent prior to the reform to about 9 percent after the reform, a 40 percent decrease. The increase in coverage can be explained by new enrollments in Medicaid rather than by uptake of private health insurance.

To arrive at empirical estimates of the reform's impact on WC bill and treatment volume and charging patterns, I conducted a projection analysis using 2005 data to predict the number of WC ER bills observed in future quarters, adjusting for the mix of patients observed in the ER. This analysis demonstrated that realized WC ER bill volume fell by 7 percent relative to expected volume in the period after the reform began, and the timing of the decline matched that of the reform's implementation. In addition, the results of a "dose-response" analysis suggest that segments of the population that experienced the largest increases in health insurance coverage during the reform also saw the largest declines in WC bill volume, providing further evidence that the reform reduced WC bills. These estimates suggest that the reform can account for a roughly 5 percent to 10 percent decline in WC ER bill volume.

The implementation of Massachusetts's health care reform partly overlapped the recession that began in December 2007, and a considerable body of evidence suggests that WC claiming activity is linked with business cycle conditions. However, four pieces of evidence suggest that the reform had impacts separate and apart from any changes in WC billing that occurred because of the business cycle: 1) segments of the population whose coverage expanded the most following the reform had the largest changes in WC billing; 2) declines in WC billing occurred in late 2006 and 2007, when the reform was being implemented but before the recession began; 3) parts of the state that saw little change in unemployment rates saw declines in WC billing that began as the reform was implemented; 4) the relationship between health coverage expansions and WC billing declines was strong even after measures of business cycle activity were directly controlled for.

Using projection and dose-response analyses that focused on hospital inpatients (whose average billed charges were $21,000, versus $900 for ER patients) and the 20 percent of ER patients with the most expensive medical conditions, I examined whether the decline in WC bills was observable for seriously injured patients. Both subgroup analyses showed a decline in WC bills, suggesting that reform may affect both lower-cost and high-cost WC patients.

To assess whether the reform affected hospital charges, I analyzed the evolution of billed charges for patients covered by WC and patients covered by other types of insurance, controlling for changes over time in the composition of the patient population. Although charges grew for all types of patients between 2005 and 2008, there is no evidence of differential charge growth among WC patients. Similarly, although available measures of treatment volume are somewhat limited, a differences-in-differences analysis comparing changes in treatment volume across the reform period for patients covered by WC versus patients covered by other types of insurance yielded little evidence of important impacts on treatment volume.

The findings of these analyses present important first evidence suggesting that health care reform may reduce WC billing volume and costs. Important questions do, however, remain. First, how readily these results will generalize to other states that implement health care reform is unclear. Second, only hospital care was considered; whether these results translate to other care modalities, such as outpatient visits or pharmaceutical prescriptions, remains to be seen. Third, only the short-run impacts of reform were assessed. Fourth, additional outcomes likely to be of interest to stakeholders, such as worker health or quality and appropriateness of treatment, were not considered. Despite these limitations, however, the results provide important evidence that health care reform may generate spillover effects on non–health insurance lines such as WC.

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Abbreviations

CCS	Clinical Classification Software
DIA	Department of Industrial Accidents
ER	emergency room
HCUP	Healthcare Cost and Utilization Project
ICD	International Classification for Diseases
IPAB	Independent Payment Advisory Board
PPACA	Patient Protection and Affordable Care Act
SEDD	State Emergency Department Data
SID	State Inpatient Data
WC	workers' compensation
WCRI	Workers Compensation Research Institute

CHAPTER ONE

Introduction

The Patient Protection and Affordable Care Act (PPACA), signed into law on March 23, 2010, marks a notable development in the broader effort to reform the U.S. health care system. PPACA arose in the wake of initiatives in several individual states, most notably Massachusetts, to enact comprehensive health care reforms that would expand the availability of coverage, increase quality, and lower costs. Although there is widespread agreement among stakeholders in the workers' compensation (WC) system that health care reform measures such as those contained in PPACA have the potential to affect the cost and composition of medical care received under WC, at this point there is no broad consensus as to the magnitude or even direction of likely impacts of reform. The limited research literature on this topic (e.g., Eaton, 2010; Swiss Re, 2010) draws mostly qualitative conclusions and highlights the considerable uncertainty that currently exists regarding reform's future impacts.

This report uses the experience of Massachusetts, which implemented a health care reform package in 2006 containing provisions similar to many of PPACA's key provisions, to develop quantitative, empirical evidence on the impacts of reform. Although important differences between Massachusetts and the nation as a whole counsel caution in generalizing from these findings, measuring how reform affected WC medical care billing patterns in Massachusetts in the first years following implementation is likely to inform discussions on the larger potential impacts of health reform on WC. My analysis suggests that WC hospital billing frequency fell by roughly 10 percent as a result of the reform, and this decline was observable both among the overall patient population and among those patients with relatively serious medical conditions. Billed charges and measures of treatment volume were not appreciably affected by the reform. Overall, these patterns suggest that the reform may, at least in the short run, reduce medical care costs borne by WC.

The implementation of Massachusetts's health care reform partly overlapped the recession that began in December 2007, and a considerable body of evidence suggests that WC claiming activity is linked with business cycle conditions (e.g., Brooker, Frank, and Tarasuk 1997; Hartwig et al., 1997; Boone and van Ours, 2006; Moore and Tompa, 2011). However, I present four pieces of evidence suggesting that reform had impacts separate and apart from any changes in WC billing that occurred because of the business cycle: 1) segments of the population whose coverage expanded the most following the reform had the largest changes in WC billing; 2) declines in WC billing occurred in late 2006 and 2007, when the reform was being implemented but before the recession began; 3) parts of the state that saw little change in unemployment rates saw declines in WC billing that began as the reform was implemented; 4) the relationship between health coverage expansions and WC billing declines was strong even after directly controlling for measures of business cycle activity.

Both the PPACA and Massachusetts's health care reforms were designed to address two perceived problems with the status quo health care system: the large share of individuals who remained uninsured under the primarily employer-based system for providing health coverage and the rising costs of health care as a share of total income. In thinking generically about the potential effects of health reform, it is helpful to differentiate between the coverage expansion components of reform, which are designed to address the first problem and tend to increase the amount of resources flowing into the health care system, and the cost containment provisions, which address the second problem and reduce resources flowing to providers.

There are several potential channels through which coverage expansions might plausibly impact the cost and functioning of WC systems. Workers with poor or no health insurance might use WC as a means to finance preventive or other types of care following an injury that are not directly connected to the injury itself. Expanding health insurance coverage in a manner that provides greater access to primary care for workers might reduce the incidence of such behavior.

Whereas in the above example, costs for primary care are shifted to the WC system, it is also possible that some work-related injuries legitimately belonging in the WC system might be compensated through health insurance. For example, if workers believe that filing a WC claim would have negative job repercussions, they may elect to conceal the fact that a particular injury is work related and pay for care associated with said injury through health insurance rather than WC. Alternatively, when WC is the only source of reimbursement for care associated with a particular injury, providers will of necessity bill WC; but when both health insurance and WC are available, providers may in some cases seek reimbursement from health insurers rather than WC insurers, particularly when there is ambiguity about whether a particular injury is compensable through WC. Such provider-driven cost shifting seems more plausible in a situation in which health insurance offers more generous reimbursement amounts than WC does.

Regardless of whether there is cost shifting into and/or out of the WC system, coverage expansions essentially provide a substitute for WC coverage, so they can be expected to, if anything, reduce the amount of care consumed within the WC system, and thus lower costs. The extent to which coverage expansions actually impact WC costs seems likely to relate to the amount of cost shifting within the system, the degree to which coverage expansions impact population segments likely to sustain work-related injuries, and the generosity of benefits provided under new health insurance plans.

Although not addressing reform specifically, a small body of research literature exists that considers the relationship between availability of health insurance coverage and WC claiming behavior. Card and McCall (1996), for example, find in an analysis of Minnesota data that workers with a low likelihood of having medical insurance are no less likely to file Monday[1] WC claims than are those likely to have insurance. Lakdawalla, Reville, and Seabury (2007) find that health insurance coverage is not robustly associated with WC claim filing after an injury once employer heterogeneity in insurance offerings has been accounted for. Based on these studies, we might expect that coverage expansions would not have a large effect on WC claiming. However, the applicability of these findings to a situation in which there is a widespread effort to boost coverage, as in Massachusetts and PPACA, remains unclear.

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[1] WC researchers have demonstrated that a disproportionate share of injuries occur on Mondays, a phenomenon researchers term the "Monday effect" (Smith, 1989). Some observers have taken the Monday effect as evidence that workers use WC to cover care for injuries sustained on weekends that are not work related and might otherwise be uncovered.

The potential impacts of cost containment provisions are more ambiguous and depend in part on the nature of the cost containment approach. One common form of cost containment is limitations on reimbursements offered to providers for particular services provided through Medicare and Medicaid. PPACA, for example, embodies an Independent Payment Advisory Board (IPAB) that has the ability to contain costs by reducing Medicare reimbursements to physicians and drug companies when Medicare cost projections exceed certain specified targets. Because WC payments are governed by fee schedules in most states, and WC rates are often tied to prevailing Medicare or Medicaid reimbursement rates, fee schedule changes that lower reimbursement rates in Medicare or Medicaid may have spillover effects on WC, reducing payments made by WC providers. The extent to which fee schedule reductions are likely to affect WC costs depends in part on how closely linked the fee structures are across systems.

In Massachusetts and elsewhere, policymakers have discussed a variety of alternative cost control measures, including tighter regulations on health insurer rate increases and movement to a global payments system that ties provider reimbursement to individual patients rather than specific services. The extent to which such cost control measures, if adopted, might influence WC costs remains unclear. Not allowing private health insurers to increase premiums, for example, might lead these insurers to lower provider reimbursements, which might in turn induce providers to shift costs to patients covered by other types of insurance and thus increase WC costs. Global payment systems that encourage better preventive care, in contrast, might reduce WC costs. Unfortunately, because Massachusetts had not implemented significant cost control measures during the period covered by this study, there is no clear evidence regarding the impacts of cost control provisions that might be associated with health care reform.

Thus far, the discussion has focused on how specific reform provisions might affect the incentives of individual workers to seek care through WC, but the reform might also have general equilibrium effects on the supply of or the demand for medical services. For example, in the short run, if the supply of medical services is relatively inelastic and coverage expansions increase overall demand for medical care, there may be queuing, which might discourage WC patients from seeking care and reduce utilization. In the longer run, health care reform might affect the supply of physicians in different specialties, which could increase or decrease the cost and convenience of seeking medical care under WC, depending on the nature of the supply shift. Indeed, there is some evidence that the supply of health care workers has increased in Massachusetts relative to the rest of the nation since the onset of the state's health reform (Staiger, Auerbach, and Beurhaus, 2011).

Given that there are plausible theoretical mechanisms through which health reform might increase or decrease WC claims and costs, an understanding of reform's impacts ultimately requires an empirical examination of how WC medical care patterns evolve following a reform episode. After discussing the specifics of Massachusetts reform efforts and my data sources in Chapter Two, I turn to this task in Chapter Three.

CHAPTER TWO

Background and Data

This chapter provides a brief summary of the major provisions of the Massachusetts reform bill and describes the data sources used to examine the reform's impact on hospital care. It also provides some basic statistics on WC in Massachusetts that may be helpful in situating this state relative to other parts of the country. The hospital data are used to demonstrate that the reform reduced the share of patients without insurance and changed the mix of payers.

2.1 Massachusetts's Health Care Reform

In April 2006, after substantial legislative debate in the latter part of 2005 and early 2006, Massachusetts Governor Mitt Romney signed a statute implementing a package of health care reform measures.[1] Massachusetts's reform efforts were primarily organized around five key provisions. First, the new law introduced, as of July 1, 2007, an *individual mandate* requiring tax filers to demonstrate proof of insurance coverage or face a tax penalty.[2] Second, the law implemented an *employer mandate* requiring businesses with 11 or more employees to offer insurance plans that met certain provisions for coverage and take-up to their employees or face a fine of $295 per worker. Third, the law implemented a state-run *health insurance exchange* called the Commonwealth Health Insurance Connector. One of the Connector's primary purposes was to reduce problems of adverse selection by pooling those who had previously sought coverage through the individual and small-group insurance markets. Fourth, the plan implemented a *state-subsidized low-cost insurance plan* called Commonwealth Care; this plan was designed to provide coverage to individuals or families that had more income than would qualify them for Medicaid but that might otherwise be unable to afford private health insurance. Finally, the plan included *Medicaid expansions* that broadened the allowable income ranges for MassHealth, the state's Medicaid program, and otherwise expanded eligibility.

One reason the Massachusetts reform has been widely studied by health policy researchers is that PPACA also includes an individual mandate, employer mandate, health insurance exchanges, subsidized low-cost plans, and Medicaid expansions. Thus, broadly speaking, the five main provisions in the Massachusetts reform are included in the national reform, although the details of how each element is implemented differ somewhat across the two reform pack-

[1] Chapter 58 of the Acts of 2006, 2006. A number of more comprehensive discussions of the specifics of the Massachusetts reform exist, including Raymond, 2007, and Bianchi, 2008.

[2] The penalty could be waived if filers demonstrated financial hardship that precluded them from purchasing coverage, and the size of the penalty was linked to Commonwealth Connector premiums. In 2008, the penalty for individual filers ranged from $17.50 to $76 per month of uninsurance, depending on the age and income of the filer.

ages.[3] PPACA contains some additional measures—such as a requirement that insurers spend a certain fraction of revenues on care and a tax subsidy for small businesses that provide insurance—that were not included in the Massachusetts reform.

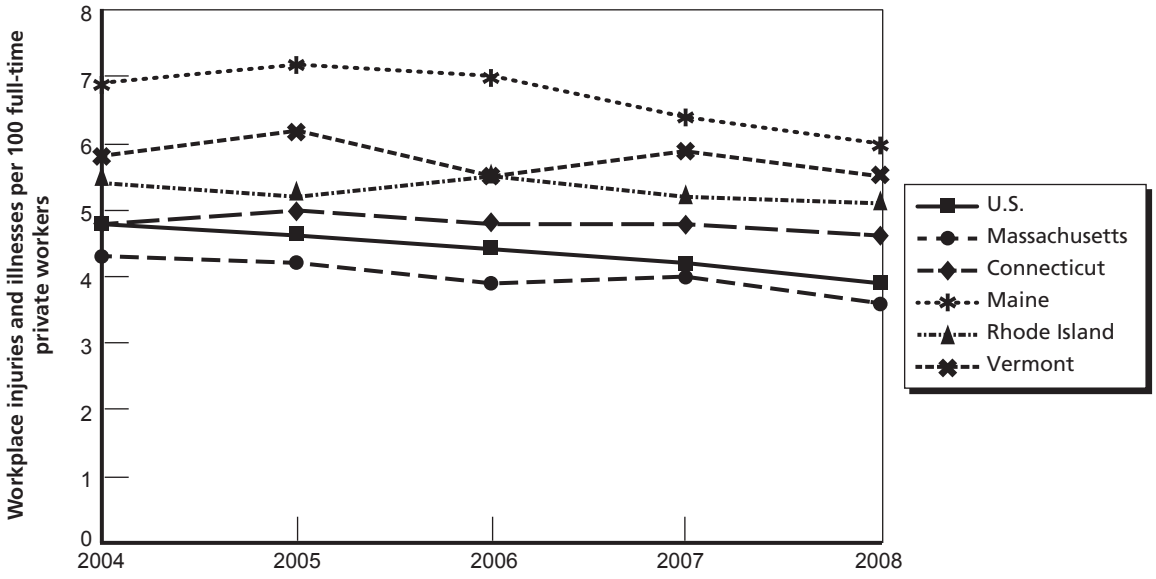
One important difference between the Massachusetts health care reform and PPACA occurs in the area of cost containment. The Massachusetts law does not contain specific cost control provisions.[4] Although cost containment provisions in PPACA are limited, they do exist, most notably the establishment of the IPAB.

2.2 Massachusetts's Workers' Compensation System

The WC system in Massachusetts is primarily funded through commercial insurance, with regulatory oversight by the Massachusetts Department of Industrial Accidents (DIA), Division of Insurance, Workers' Compensation Rating and Inspection Bureau, and Workers' Compensation Advisory Council. Employer premiums are determined through an administered pricing system; average premiums in 2006 were $1.70 per $100 of payroll, making Massachusetts 47th in the nation in premiums (Reinke and Manley, 2006).

In thinking about how Massachusetts's experience with health reform and WC might translate to other contexts, it is helpful to consider how the state's WC system performs relative to that of other states across a few basic metrics. Figure 2.1 plots trends in workplace injury and illness rates for Massachusetts, selected nearby states, and the nation as a whole

Figure 2.1
Trends in Workplace Injury in Massachusetts, Nearby States, and the Nation as a Whole, 2004–2008



SOURCE: Bureau of Labor Statistics, Boston Office.

RAND *TR1216-2.1*

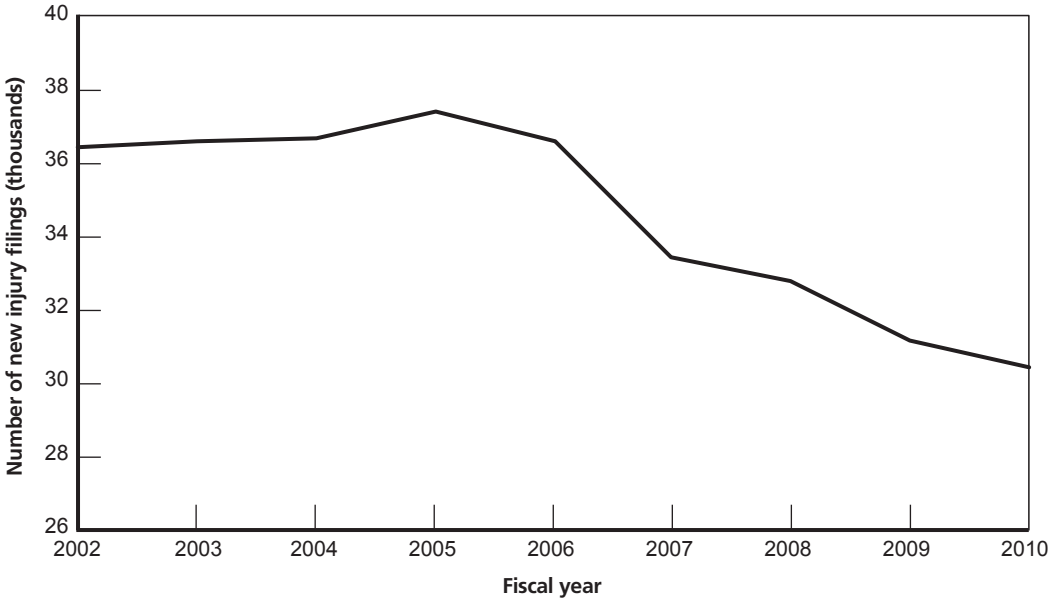
[3] Moreover, states are given some flexibility in how they implement certain PPACA provisions.

[4] Massachusetts regulators and lawmakers have since explored various options for cost containment.

between 2004 and 2008. Over the period during which reform was enacted and implemented in Massachusetts, recorded workplace injuries declined both in that state and in the nation as a whole; this decline represents a continuation of the trend in improved worker safety that has persisted for several decades. Although the pace of decline in Massachusetts mirrored that of the nation, it is notable that Massachusetts has consistently experienced the lowest per capita rates of workplace injury among the New England states and that its injury rate is below the national average.

Measures of WC claim activity have also declined in Massachusetts in recent years. Figure 2.2, for example, plots the number of First Report of Injury forms received by the DIA[5]—a proxy for the number of WC claims—between 2002 and 2010. These aggregate data do not appear to provide strong evidence for or against the notion that health care reform may have affected WC claiming: There was a larger than typical decline in filings between 2006 and 2007 as the reform was implemented, but the beginning of the decline predates the reform, and claims have also declined since 2008, suggesting that aggregate claim rates may have been impacted by other factors. As a comparison, Davis and Bar-Chaim (2011) estimate that WC claim frequency dropped by 15.3 percent nationally between 2005 and 2009, whereas the DIA data indicate a 16.7 percent decline over the same period in Massachusetts.

Figure 2.2
Trends in Employer Filings with the Massachusetts Department of Industrial Accidents, Office of Claims Administration



SOURCE: Massachusetts Workers' Compensation Advisory Council, various years.
RAND *TR1216-2.2*

[5] Employers are required to make these filings after receiving notice of any injury that is allegedly work related and incapacitates an employee from earning full wages for a period of five calendar days, criteria that would generally qualify the employee for WC payments. Compliance with this requirement is high, and employers found to be noncompliant are subject to fines.

In addition to having lower than average injury rates, Massachusetts appears to have lower rates of utilization and provider reimbursement across several metrics compared with many other states. Table 2.1, for example, reports the average number of visits and the average amount paid to various types of medical providers for WC claims by state. These averages are computed by the Workers Compensation Research Institute (WCRI) from data on individual claims compiled for each state. In general, both measures of utilization and average expenditures per claim are lower in Massachusetts relative to neighboring states and the median state monitored by WCRI. In some cases, the differences are fairly substantial—for example, although virtually all claims in all states involve a physician visit, payments to physicians in Massachusetts are 40 percent lower than average.

In Massachusetts, hospital payments made by WC insurers, as with all medical care received through the WC system, are guided by a WC fee schedule published by the Division of Health Care Finance and Policy. However, insurers, employers, and health care providers are permitted to negotiate alternative rates, so the schedule is not controlling. The state's fee schedule is set through a regulatory hearing process and has been adjusted fairly infrequently; over the time period covered by this study, a single fee schedule was in place.

Comparing WC reimbursements offered to medical providers for particular services to reimbursements available through Medicare provides one way to assess the relative generosity of fee schedules in different states. Coomer and Liu (2010) report that as of 2009, the WC reimbursement rate for a representative market basket of medical services was 8 percent above the Medicare reimbursement rate in Massachusetts, making Massachusetts the least generous

Table 2.1
Average Physician Utilization and Payments in WC Claims, by State, 2008–2009

Measure	Massachusetts	New Jersey	Pennsylvania	16-State Median
Average number of visits per claim to:				
Physician	7.2	8.7	10.9	9.8
Chiropractor	1.2	0.2	1.8	0.8
Physical/occupational therapist	5.2	10.6	9.6	7.5
Hospital outpatient provider	6.4	3.0	6.5	3.9
Other medical provider	2.6	3.1	3.8	3.7
Average medical payment (in $) per claim to:				
Physician	2,166	5,115	2,987	3,562
Chiropractor	77	25	229	74
Physical/occupational therapist	439	1,336	1,259	1,017
Hospital outpatient provider	1,752	2,227	2,573	2,645
Other medical provider	338	739	698	658

SOURCE: WCRI, 2012.

NOTE: Averages are for claims with more than seven days of lost time and have been adjusted by WCRI for injury and industry mix.

of all the states.[6] For emergency room (ER) services, WC reimbursements in Massachusetts schedule provides the lowest or among the lowest levels of reimbursement across a range of commonly used medical procedures. Thus, Massachusetts appears to be an outlier in terms of WC reimbursement rates.

Overall, these statistics suggest that WC in Massachusetts is a relatively low cost system compared with other states because injuries are less common than average, injury and claiming rates have been declining, and provider reimbursements are lower than in most other states. One potential consequence of Massachusetts's relatively low WC reimbursement rates for medical providers in the state is that they may have a stronger incentive than do providers in other states to shift costs of WC treatment to other forms of insurance, such as private health insurance, Medicare, and Medicaid.

2.3 Data Sources

My primary data are drawn from the State Emergency Department Data (SEDD) and State Inpatient Data (SID) files for Massachusetts, which are collected by the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project (HCUP). The SEDD contains abstracted patient records for ER visits that do not result in an outpatient observation stay or an inpatient admission. Sixty-five of 68 acute care hospitals accounting for approximately 99 percent of patient charges within the state contributed data to the SEDD. The SID contains records of inpatient hospital stays across 74 hospitals. Included in these files are information about the time and month of each visit, demographic characteristics of the patient, diagnoses codes, medical procedures performed, billed hospital charges, identity of primary and secondary payers for care, if any, and patient disposition. The payer codes included on each patient record identify the payer billed by the hospital for each patient's care—for example, Medicaid, Medicare, WC insurers, liability insurers, specific private health insurers (such as TRICARE or Blue Cross), or self-pay (in the case of individuals without insurance). Because I relied on hospital rather than claim data to be able to make comparisons with treatment and billing patterns for patients covered by payers other than WC, my unit of analysis was a WC bill rather than a WC claim. However, since insurers will typically not reimburse bills received from hospitals or other medical providers without a corresponding claim filed by a worker, a high correlation between WC bills and WC claims can be expected, although it is common for multiple treatment episodes to be contained within a single claim.

The main advantage of the HCUP data is that they provide a complete picture of hospital care in Massachusetts both before and after the health care reform was implemented, and contain considerable detail regarding patient characteristics and payers. From the perspective of this study, however, an important disadvantage of using hospital data is that they exclude some types of medical care—such as chiropractic visits and pharmaceutical prescriptions—that are argued to be important cost drivers in WC. Moreover, there are important differences between care offered in hospital and in non-hospital settings that may affect the interaction between billing incentives and health care reform. For example, in non-hospital settings, patients exercise considerably more autonomy over what and how much treatment to pursue, and non-hospital providers sometimes obtain significant fractions of their total revenue from

[6] The median reimbursement rate was 63 percent above Medicare.

WC. These differences counsel significant caution in extrapolating this study's findings to the broader universe of medical care provided by WC.

However, it should also be kept in mind that hospital care does account for a sizable fraction of WC medical costs. Recent estimates suggest that 40 percent of WC claims include ER charges; and Lipton, Cooper, and Robertson (2009) find that hospital costs account for almost one-third of total costs in the largest WC claims and about 20 percent of overall medical costs.

The HCUP data include information about billed hospital charges but not the actual amounts received by hospitals from payers, which may differ from billed charges because providers often negotiate discounts with particular insurers.

Table 2.2 presents summary statistics describing the basic attributes of patients included in the HCUP data. As expected, patients covered by WC are more likely to be male than the general patient population, and WC-covered inpatients are younger. Although there are substantially more ER visits than inpatient hospitalizations involving patients insured by WC, average charges for the comparatively small number of WC inpatient visits are quite large.

2.4 Changes in the Composition of Payers Following Health Care Reform

This section looks at how the composition of payers changed in Massachusetts following health care reform. If, contrary to its intent, health care reform had little impact on the rate of uninsurance or the composition of payers, it seems implausible to expect it to have appreciably changed WC billing or medical care patterns. However, in this section I demonstrate that health care reform was associated with a measurable decrease in the rate of uninsurance, at least among the ER patient population. Most of the coverage increase can be explained by Medicaid expansions versus uptake of private health insurance, and effects were more muted among hospital inpatients. These patterns suggest that impacts on WC medical care, if any, are most likely to be observable among ER patients, and, for the purposes of thinking about potential effects, the Massachusetts reform can largely be seen as a Medicaid-oriented expansion of coverage. These data also provide some guidance as to how the Massachusetts experience might differ from that of the nation as a whole as it implements PPACA.

To establish the fact that health reform in Massachusetts was effective at reducing the population of uninsured patients, Figures 2.3 and 2.4 plot the share of ER patients and hospital inpatients, respectively, who had no insurance coverage at the time of their treatment episode. Figure 2.3 demonstrates that there was an initial drop in uninsurance among ER patients as the MassHealth expansion became operative and the health insurance exchanges came on line, followed by a further decline after the individual mandate went into effect in July 2007. Overall, the share of ER patients who were uninsured fell from about 15 percent pre-reform to about 9 percent after reform, a 6 percentage point, or 40 percent, decline in uninsurance.

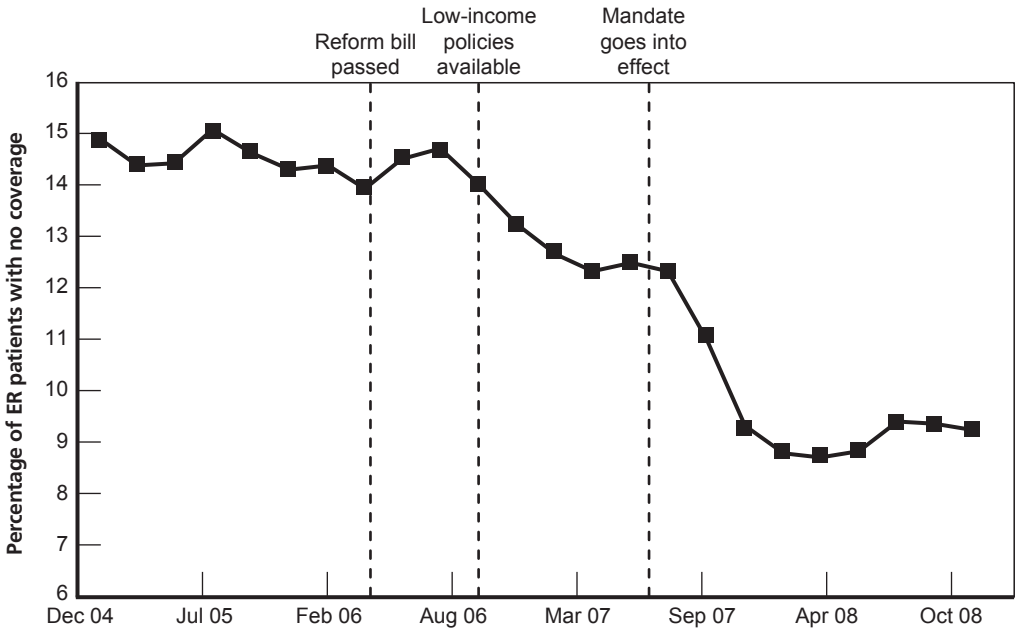
Figure 2.4 demonstrates similar but less pronounced patterns among hospital inpatients. Unsurprisingly, given the fact that hospitals, unlike ERs, are not required to take all patients, the share of hospital inpatients without insurance was low even prior to reform. However, the reform reduced the uninsured share of inpatients by roughly one-half, from a bit below 4 percent in 2005 to 2 percent in 2008.

Table 2.2
Average Characteristics of Hospital Patients in Massachusetts, 2005–2008

	ER Patients		Inpatients	
Characteristic	**All Patients**	**WC Patients**	**All Patients**	**WC Patients**
Female	.517	.304	.579	.220
	(.500)	(.460)	(.494)	(.414)
Age (years)	36.0	37.5	55.9	46.1
	(22.1)	(12.7)	(23.9)	(12.9)
Race				
White	.731	.780	.826	.841
	(.443)	(.414)	(.379)	(.366)
Black	.095	.069	.064	.045
	(.294)	(.253)	(.245)	(.206)
Hispanic	.121	.103	.065	.076
	(.326)	(.304)	(.246)	(.265)
Type of insurance				
Medicare	.157	.000	.455	.000
	(.364)	(.000)	(.498)	(.000)
Medicaid	.230	.000	.132	.000
	(.421)	(.000)	(.338)	(.000)
Private health	.404	.000	.340	.000
	(.491)	(.000)	(.474)	(.000)
WC	.035	1.000	.005	1.000
	(.185)	(.000)	(.067)	(.000)
None	.123	.000	.036	.000
	(.329)	(.000)	(.186)	(.000)
Number of diagnoses	1.96	1.62	7.29	4.49
	(1.24)	(0.94)	(4.01)	(3.09)
Number of procedures	6.20	3.91	1.57	2.19
	(6.50)	(4.12)	(2.09)	(2.31)
Length of stay (days)	0.11	0.05	4.92	3.96
	(0.32)	(0.21)	(6.45)	(5.86)
Died during hospitalization	.0019	.0002	.0226	.0041
	(.0441)	(.0136)	(.1485)	(.0642)
Total charges (current $)	1,220	889	21,535	27,437
	(1,386)	(969)	(36,249)	(43,645)
Number of Observations	9,581,152	338,657	3,064,801	13,941

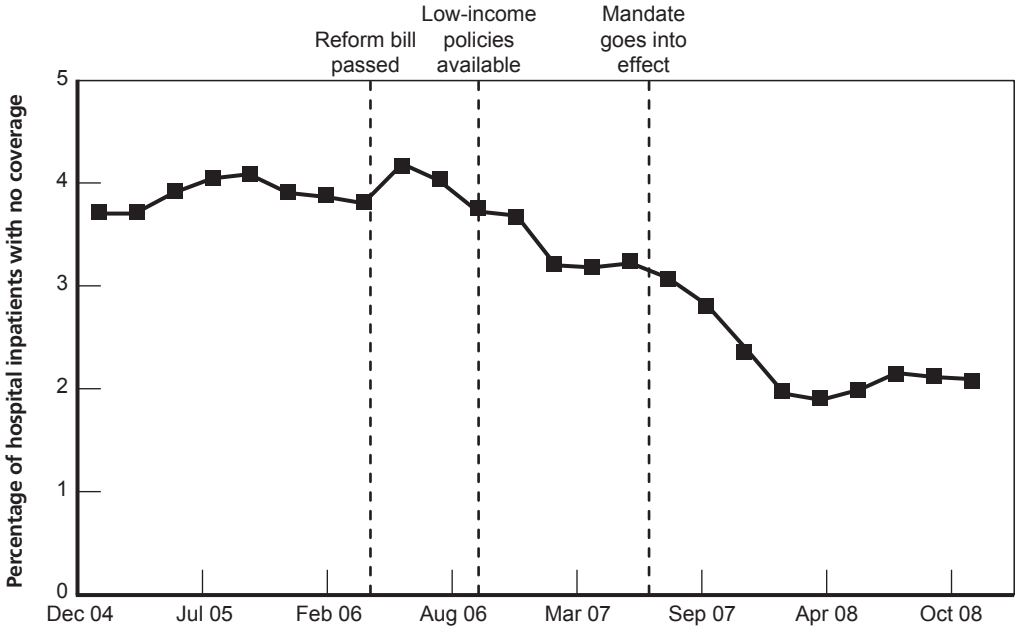
NOTE: Author's calculations from Massachusetts SID and SEDD data. Standard deviations are reported in parentheses. Number of procedures is measured using Current Procedural Terminology (CPT) procedures for the SEDD data and Clinical Classifications Software (CCS) procedures in the SID data.

Figure 2.3
Trends in Uninsurance Among Massachusetts ER Patients



NOTE: Author's calculation from Massachusetts SEDD data.
RAND *TR1216-2.3*

Figure 2.4
Trends in Uninsurance Among Massachusetts Hospital Inpatients



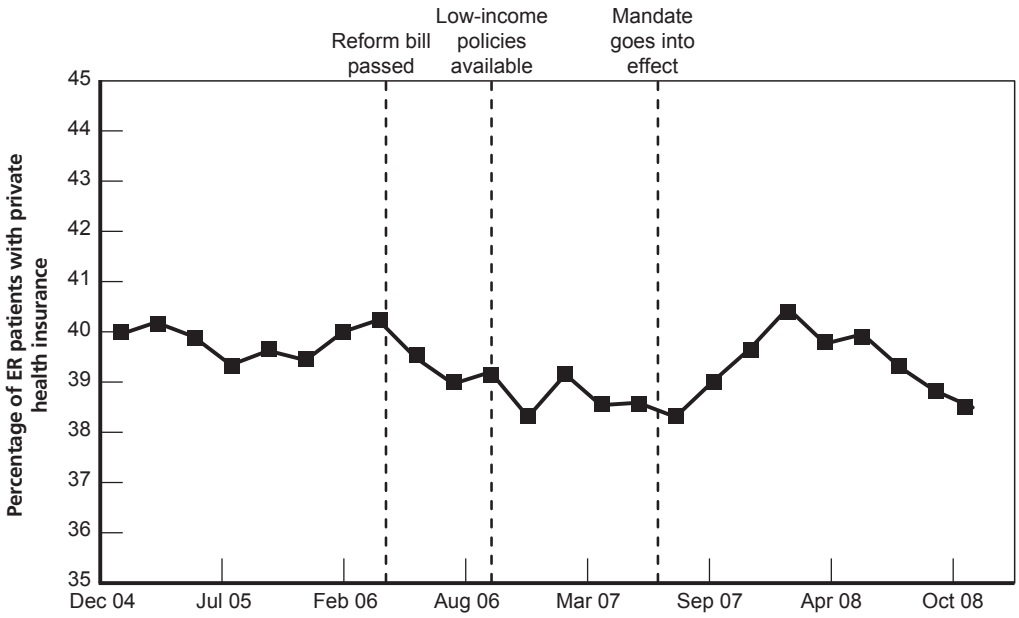
NOTE: Author's calculation from Massachusetts SID data.
RAND *TR1216-2.4*

Was the reform successful at encouraging individuals to sign up for private health insurance coverage, including private plans available on the new health insurance exchange? Figures 2.5 and 2.6 demonstrate that, at least among the hospital patient population, there was no obvious increase in private health coverage as the reform was implemented. Immediately following the onset of the individual mandate, there was a brief rise in private health insurance coverage among ER patients, but the share of ER patients with private health insurance had actually fallen slightly below pre-reform levels by the end of 2008.

Figure 2.7 demonstrates that almost all of the 6 percentage point decline in the uninsured share of the ER patient population can be explained by increases in Medicaid coverage. Around 21 percent of ER patients were covered by Medicaid in 2005; by 2008, this proportion had risen to about 27 percent. There was a similar but smaller rise in Medicaid enrollment among hospital inpatients, as can be seen in Figure 2.8, although in this case it is less apparent whether the increase stemmed primarily from health care reform or reflected a pre-existing trend in growth in Medicaid usage among hospital inpatients.

Over this same period, Medicare enrollments and the share of patients with care billed to multiple payers (not shown in figures) maintained their pre-reform trends. Overall, these patterns suggest that the primary impact of reform was to shift about 6 percent of the total patient population from no coverage to Medicaid. Thus, the Massachusetts reform was successful at expanding coverage, but in a particular fashion—by expanding Medicaid rather than private health insurance.

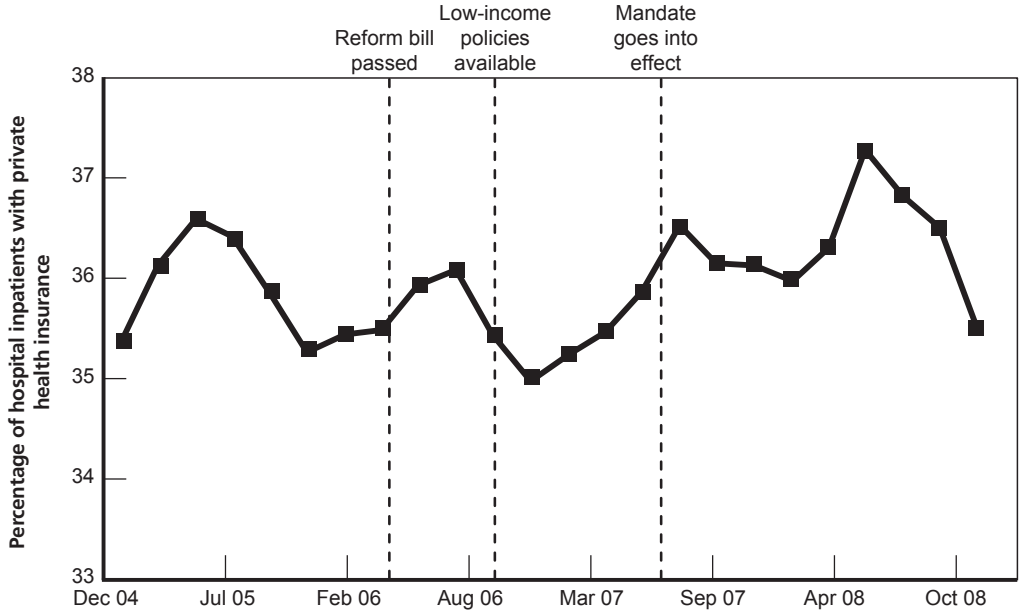
Figure 2.5
Private Health Insurance Coverage Among Massachusetts ER Patients



NOTE: Author's calculation from Massachusetts SEDD data.

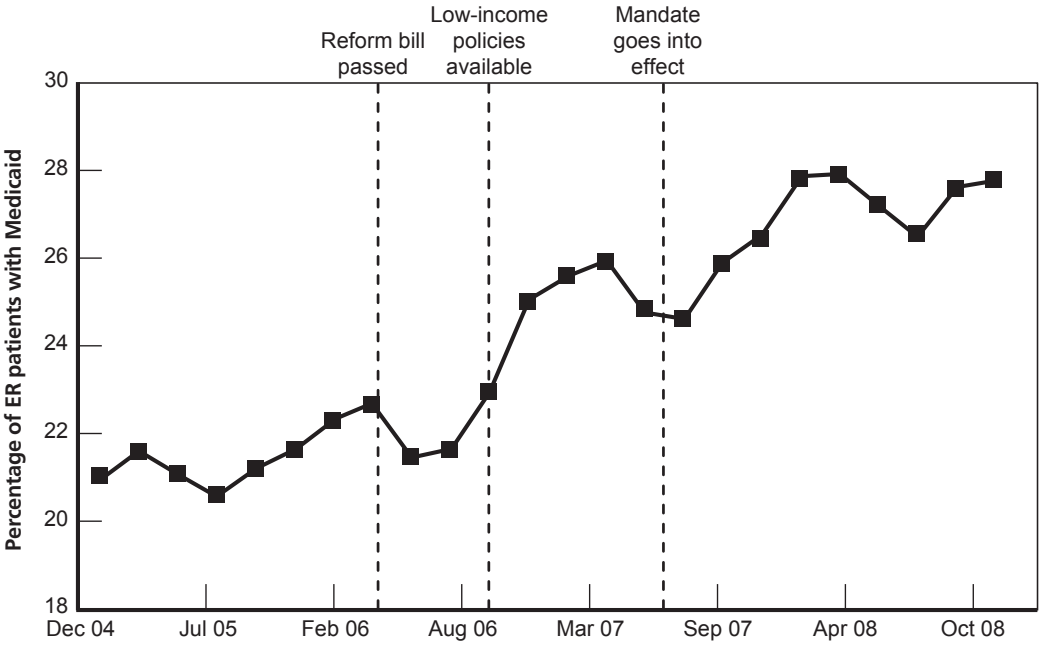
RAND *TR1216-2.5*

Figure 2.6
Private Health Insurance Coverage Among Massachusetts Hospital Inpatients



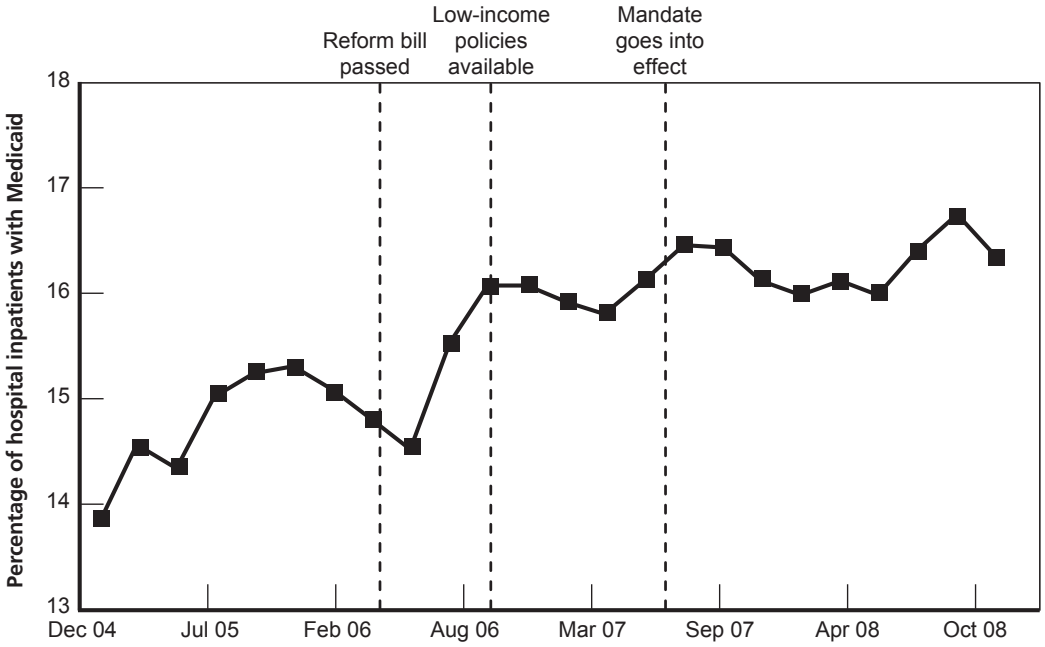
NOTE: Author's calculation from Massachusetts SID data.
RAND *TR1216-2.6*

Figure 2.7
Medicaid Coverage Among Massachusetts ER Patients



NOTE: Author's calculation from Massachusetts SEDD data.

Figure 2.8
Medicaid Coverage Among Massachusetts Hospital Inpatients



NOTE: Author's calculation from Massachusetts SID data.

Given that the reform apparently did have an economically important effect on the availability of health insurance coverage, it seems possible that it may have affected claiming or billing patterns for medical care covered through WC. We turn to an analysis of that issue in the next chapter.

CHAPTER THREE

Estimates of How Health Care Reform Impacted WC Billing

This chapter presents estimates of the effect that health care reform had on the amount and nature of hospital care paid for by WC. I first consider ER billing, and then separately assess billing for hospital inpatients. I next turn to an assessment of charging and treatment volume. Because no single empirical approach is likely to address all potential concerns related to confounding factors, I consider a range of alternative methods for assessing the reform's impacts. While it may be difficult to conclusively prove that reform had a particular causal effect on WC billing, the fact that I obtained similar findings using different sources of variation and different approaches for measuring the reform's impacts lends credence to my conclusion that health care reform likely resulted in a modest (5 percent to 10 percent) reduction in WC hospital costs.

A key empirical challenge I confronted was separating the impacts of health care reform from confounding factors that may have affected the functioning of WC markets in Massachusetts over the study period. Of particular concern was the economic downturn that began in December 2007 and may have led to a change in both the number and types of new WC bills, separate from any effects of the reform. However, I present four pieces of evidence that, when taken together, suggest that the decline in billing is not likely to primarily reflect the influence of the downturn. I show that 1) segments of the population whose coverage expanded most following the reform had the largest changes in WC billing, 2) declines in WC billing occurred in late 2006 and 2007, when the reform was being implemented but before the recession began, 3) parts of the state that saw little change in unemployment rates also saw large declines in WC billing that began as the reform was implemented, and 4) the relationship between health coverage expansions and WC billing declines was strong even after directly controlling for measures of business cycle activity.

3.1 Projecting WC ER Visits in the Absence of Health Care Reform

Because more than 20 times as many ER visits as inpatient hospitalizations are billed to WC, I initially focus on ER care. One way to empirically assess how health care reform may have impacted WC ER care volume is to project anticipated numbers of hospital bills based on billing patterns that existed prior to reform and compare these projected numbers to the actual realized number of bills post-reform. The difference between the projected and the actual number of bills provides one measure of the reform's impact.

To project WC bills using pre-reform data, I first estimated regression models in which the unit of observation was a patient and the outcome of interest was whether that patient's ER

care was billed to WC.[1] The explanatory variables included patient age, gender, race, and three-digit ZIP code of residence; the hour, month, and day of week, hospital, and source of admission; and indicators capturing up to three diagnosed medical conditions with accompanying E-codes.[2] For this analysis, I used only data from 2005, prior to the reform. I then projected the number of WC bills in later periods by applying my regression estimates to the observed set of patients appearing at the ER in later years. These projections provide estimates of the number of WC patients we would expect to see in 2006–2008 if billing patterns observed in 2005 persisted into these later years.

Essentially, the regressions measure the expected number of WC bills for a given patient, and the predictions apply these estimates to the population of patients observed in later years. For example, if, using the regression model, we determine that one out of every five patients with a particular set of demographic characteristics and medical conditions has care billed to WC, and then we observe 10 patients with those same characteristics in 2006, we would expect (other things being equal) two WC bills from those patients. If, on the other hand, health care reform has changed the likelihood that providers or patients bill injuries to WC, we might observe more or fewer bills.

The main limitation of this projection approach is that it captures not only the impacts of health care reform, but other time series variation in care volume that could not have been anticipated as of 2005.[3] For example, if there were safety improvements introduced in 2006 and 2007 that changed the number and types of patients with work-related injuries, using 2005 data might lead us to project more bills than would actually be realized in later years, but this difference would not be attributable to health care reform. Moreover, changes in WC billing that occurred due to the recession that began in 2007 would also not be captured by the projection model.

Although there is no way to definitively overcome this limitation of the projection approach, I can exploit information about the timing of the reform as a sort of "diagnostic check" for the projections. In particular, even though the projections begin in January 2006, we know that the reform was not passed until April 2006 and that implementation did not begin until the later part of 2006. If the projection model properly accounts for factors determining WC billing patterns other than health care reform, we would expect the projections to closely match realized bills up until the latter part of 2006, at which point the projections and reality would diverge as reform implementation began. If changes in billing are caused by other factors, we would not necessarily expect such timing in the divergence.[4]

Figure 3.1 plots the expected monthly number of ER bills from the projection model against the true number of bills observed in the data for 2005 to 2008. The projected and

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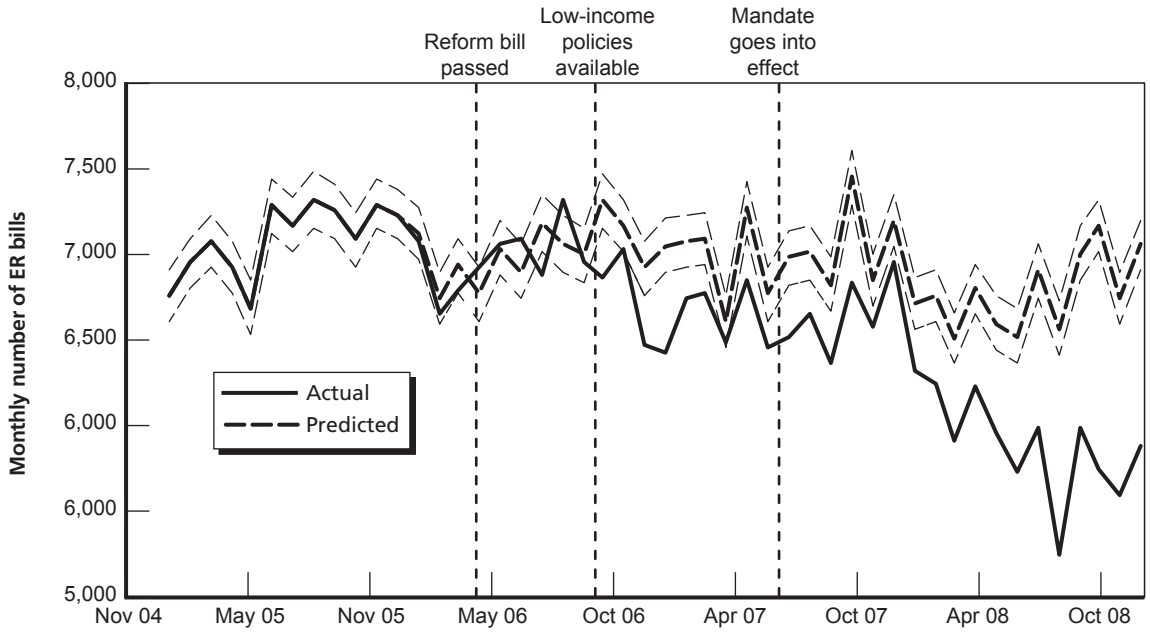
[1] Results from these regressions are available from the author upon request. The regressions include approximately 2.2 million observations.

[2] The diagnoses are divided into 272 conditions based on the HCUP CCS codes. Examples of conditions are "paralysis" and "abdominal pain." E-codes are additional codes defined by the International Classification for Diseases (ICD) coding system that provide further information about circumstances associated with particular medical conditions—for example, denoting whether a condition occurred because of an accident.

[3] Time series variation that purely affects the number of patients does not necessarily confound this analysis, since the projections account for the observed number of future patients.

[4] However, it is also the case that in general we might expect more accurate projections for periods closest to the estimation period.

Figure 3.1
Actual and Projected Monthly WC ER Bills in Massachusetts



NOTE: Author's calculation from Massachusetts SEDD data; dotted lines denote 95 percent confidence intervals for projections.

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actual values perfectly coincide in 2005 by construction, because 2005 data were used to initially estimate the model. In the first part of 2006, there does not appear to be evidence of systematic differences in the projected and realized numbers of bills. However, beginning shortly after the reform's implementation, actual WC bill counts fall below the projections, and this pattern persists through the end of 2008. In the later part of 2008, the disparity also grows appreciably.[5]

Table 3.1 reports the percentage difference between the projected number of bills and the true number of bills in each six-month period covering 2006 to 2008, along with 95 percent confidence intervals for these differences. For the first half of 2006, the number of projected bills is very similar to actual bills, and I cannot statistically rule out equality between the projected and actual bills. However, as implementation proceeded, statistically significant declines can be seen in WC bills, ranging from –3 percent to –18 percent. Over the entire period, there are 7.2 percent fewer WC bills than would have been expected based on 2005 data.

[5] As an additional validity check for the projection approach, I replicated this analysis but instead projected the number of Medicare bills rather than the number of WC bills. Because Medicare is a federal program and eligibility is determined primarily by age and federal disability determination, Medicare billing counts are not likely to have been affected by Massachusetts' reform. In contrast for my findings for WC, for Medicare I actually observe projected bills that are below actual bills in 2006-2008, and I do not observe systematic shifts in Medicare billing around the time the reform was implemented.

Table 3.1
Percentage Difference in Actual and Projected WC ER Billing Rates

Time Period	Difference: Projected vs. Actual (%)
1st half 2006	0.2
	[–0.7, 1.1]
2nd half 2006	–2.5*
	[–3.4, –1.6]
1st half 2007	–5.3*
	[–6.2, –4.3]
2nd half 2007	–5.5*
	[–6.4, –4.6]
1st half 2008	–9.3*
	[–10.3, –8.3]
2nd half 2008	–18.4*
	[–19.3, –17.4]
Overall post-reform	–7.2*
	[–7.6, –6.8]

NOTE: Author's calculations from Massachusetts SEDD data. 95 percent confidence intervals for the estimated differences are reported in brackets; * denotes estimates that are statistically significantly different from zero at the 5 percent level.

3.2 Accounting for the Effects of the Economic Downturn

One of the chief concerns with the estimates presented in the preceding section is that they do not account for the amount of injury-causing activity, which, if on the decline during the period that health reform was introduced, would lead to a lower than expected volume of WC hospital care. Given that WC claiming patterns are affected by general trends in employment and hours, of particular concern is the possibility that the impacts of health care reform and the impacts of the recession beginning in December 2007 may be confounded, because there was partial overlap in the timing of these two events. In this section, I describe a variety of additional analyses that I conducted to establish whether health care reform had an effect on WC billing separate and apart from any effects of the recession.

Dose-response analysis: If health care reform reduces WC medical care volume, in addition to observing a decline in overall WC ER bills following reform implementation, we might expect to observe larger declines in WC bills among segments of the population most affected by the reform. Alternatively, if the patterns documented in Section 3.1 primarily reflect aggregate factors other than reform that changed over time in Massachusetts, such as the business cycle, we would not necessarily expect to observe a strong relationship between group-level changes in coverage and WC billing rates.

To look for evidence of such a "dose-response" relationship in the Massachusetts data, I divided the patient population into cells by age/sex/race/ZIP code[6] and, for each cell, calculated the growth in the share of patients covered by Medicaid or private insurance between 2005 and 2008. I then compared the increase in health insurance coverage to the change in the share of hospital patients whose care was billed to WC over the same period.

As an illustration, among non-white male ER patients age 25 to 34 residing in Worcester, the share covered by Medicaid or private health insurance coverage grew from 42 percent in 2005 to 63 percent in 2008, a roughly 50 percent increase. Among non-white males age 25 to 34 from Amherst, in contrast, Medicaid or private health coverage grew from 47 percent to only 55 percent between 2005 and 2008. If health reform does indeed causally reduce WC billing, we might expect WC bills to have declined more among the former group, from Worcester, than the latter group, from Amherst. For my analysis, I essentially conducted such comparisons across 432 different population groups.

An important feature of this analysis is that, because it is a comparison across groups within the state, it makes no use at all of the aggregate variation in WC billing—which is the focus of Section 3.1—in measuring how health care reform may have impacted WC billing.[7] If the economic downturn can be thought of an aggregate shock affecting the entire state, then this analysis should be helpful in differentiating the impacts of health care reform from business cycle effects.

Figure 3.2 plots the relationship between the 2005 to 2008 coverage expansion and the 2005 to 2008 reduction in WC billing across population groups; here each point in the scatterplot represents one of the population cells defined above. The best-fit line depicted in the figure has a slope of –.082, indicating that a 1 percentage point increase in the share of patients covered by Medicaid or private insurance is associated with a .08 percentage point decline in the share of patients receiving WC bills. Based on the relationship outlined in Figure 3.2, health reform could explain a 13 percent decline in WC billing.[8]

As a test of the robustness of this relationship, Table 3.2 shows coefficients from linear regressions in which the outcome variable is the change in the share of ER patients that were covered by WC between 2005 and 2008 within a particular population cell, and the primary explanatory variable is the change in Medicaid/private health insurance coverage over the same period. Specification I reports estimates from a simple bivariate regression, which essentially estimates the best-fit line from Figure 3.2. There is a strong and statistically significant relationship between coverage expansion over the reform period and reductions in billing.

Exposure to work-related injuries varies across different segments of the population. For example, it has been well documented that men are more likely than women to sustain work-

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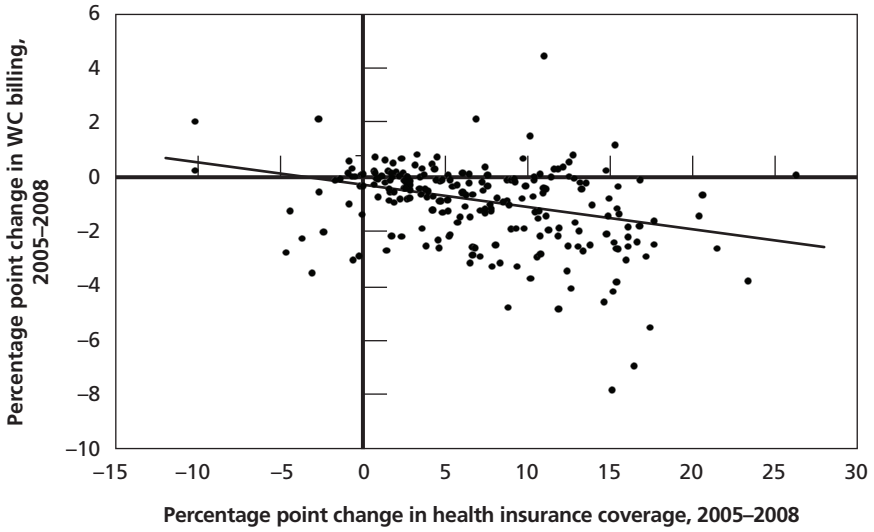
[6] The age categories were 12–24, 25–34, 35–44, 45–54, 55–64, and 65 and over; the race categories were white/non-white; and the ZIP code categories were based on the first three digits of the ZIP code.

[7] One way to see this is to note that Section 3.1, which focused on aggregate changes over time, showed that coverage increased on average and WC billing decreased, implying that the dots in Figure 3.2 would be centered in the lower right quadrant of the graph. However, one might also ask, regardless of where the dots are centered, whether the pattern of dispersion across different segments of the population also suggests a correlation between the coverage expansion and changes in WC billing.

[8] The calculations are as follows: the rate of Medicaid/private health insurance coverage rose by 6.7 percentage points following the implementation of reform, so the reform can explain a 6.7 × –.082 = –.549 percentage point change in the WC billing rate. Relative to the pre-reform average billing rate of 4.2, this represents a .549/4.2 = 13 percent decrease.

Figure 3.2
Relationship Between Growth in Health Insurance Coverage and Change in WC ER Billing, 2005–2008



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related injuries.[9] Because my analysis focused on changes in WC billing rather than billing levels, I implicitly controlled for differences across population groups in general patterns of WC billing. Nevertheless, it remains possible that uncontrolled factors might have changed for certain groups between 2005 and 2008 in a way that would affect both insurance coverage and WC billing. For example, if over this period women differentially sorted toward white-collar occupations that were more likely to provide private health insurance and less likely to involve

Table 3.2
Estimated Effect of Coverage Expansion on WC ER Billing, 2005–2008

	I	II	III	IV	V	VI
Effect of coverage expansion on WC billing, 2005–2008	–.082** (.014)	–.063** (.018)	–.044* (.020)	–.082** (.013)	–.064** (.015)	–.042* (.017)
Implied impact of reform on WC billing	–13.0%** (2.2)	–10.1%** (2.8)	–7.0%* (3.2)	–13.0%** (2.1)	–10.1%** (2.4)	–6.7%* (2.7)
Include age, race, sex, and ZIP code fixed effects?	No	Yes	Yes	No	Yes	Yes
Include two-way interactions for age, race, sex, and ZIP code?	No	No	Yes	No	No	Yes
Weight by cell size?	No	No	No	Yes	Yes	Yes

NOTE: Author's estimates from Massachusetts SEDD data. Each column reports results from a separate regression—specifications I through VI. Sample size for each regression is 432. Heteroskedasticity-robust standard errors are in parentheses. * denotes statistical significance at the two-tailed 5 percent level; ** at the 1 percent level.

[9] See, for example, Bureau of Labor Statistics, 2010.

physical labor that resulted in injury, this could generate a negative correlation between coverage expansion and WC billing absent any direct effect of health care reform.

To account for such possibilities, in specification II, I included fixed effects for age group, ZIP code, race, and gender as additional controls in my regressions measuring the association between coverage expansion and WC billing. In specification III (see Table 3.2), I also included a full set of two-way interactions between age, ZIP code, race, and gender. These controls allowed me to correctly measure the relationship between coverage expansion and WC billing in the face of a range of potentially unobserved confounding factors. For example, if there are unobserved factors affecting employment characteristics of those in a particular age group in a particular area or women or non-whites in a particular area, the inclusion of these controls allows me to still correctly estimate the relationship between coverage and WC bills. In specifications IV, V, and VI, I test the sensitivity of my results to the use of weights that allow cells containing more individuals to have a proportionately larger impact on the overall measured association between coverage and WC billing.

In all of these additional specifications, a statistically significant and economically important relationship between coverage expansion and WC billing can be observed. Moreover, the magnitude of the expected impact of reform based upon the dose-response evidence ranges from a 7 percent to a 13 percent reduction depending on the specification, an impact commensurate with the reduction documented in Section 3.1 based on time series evidence.

Timing of declines in billing: One simple piece of evidence suggesting the reform had an impact is the timing of the changes in billing. Table 3.1 indicates that there were statistically significant decreases in WC billing in the second half of 2006 and during 2007, when various provisions of the health reform went into effect. As shown in Figure A.1 (see Appendix), unemployment in Massachusetts was declining in 2006 and 2007, and only began to increase after the start of 2008. Thus, the decline in WC billing predated the period in which the downturn began to substantially affect employment in Massachusetts.

Billing changes in areas where unemployment remained low: As an additional check, I re-ran versions of my projection model focusing attention on Suffolk County,[10] which was less dramatically impacted by the downturn than other counties in Massachusetts.[11] Table 3.3 presents estimates of the predicted versus actual change in the number of WC bills for Suffolk County; these estimates are analogous to the estimates presented for the whole state in Table 3.1. Notably, when we focus our attention on an area that did not see a substantial uptick in unemployment between 2005 and 2008, we still observe a decline in WC bills of comparable magnitude to what we observed for the state as a whole.

This evidence, when combined with the dose-response evidence presented earlier, provides a fairly strong case against the hypothesis that the declines in WC billing primarily reflect the influence of the economic downturn. In particular, if the downturn can be viewed primarily as an aggregate event, then the dose-response analysis, which makes no use of aggregate variation, should effectively isolate impacts of reform. Alternatively, if the downturn was not an aggregate event, but, rather, affected different parts of the state differently, then one should be able to use patterns in WC billing in parts of the state least affected by the

[10] Suffolk County includes Boston. Although the patient records do not directly record county of residence, I approximated residence in this county using residence in ZIP codes beginning with 021 and 022.

[11] The annual average unemployment rate in Suffolk County was 5.3 percent in 2005 and 5.2 percent in 2008.

Table 3.3
Percentage Difference in Actual and Projected WC ER Billing Rates, Suffolk County

Time Period	Difference: Projected vs. Actual (%)
1st half 2006	–2.1
	[–4.6 , 0.5]
2nd half 2006	–3.5*
	[–6.0 , –1.0]
1st half 2007	–3.3*
	[–5.9 , –0.7]
2nd half 2007	–3.1*
	[–5.5 , –0.8]
1st half 2008	–7.0*
	[–9.7 , –4.2]
2nd half 2008	–12.1*
	[–14.7 , –9.4]
Overall 2006–2008	–5.3*
	[–6.4 , –4.2]

NOTE: Author's calculations from Massachusetts SEDD data. 95 percent confidence intervals for the estimated differences are reported in brackets; * denotes estimates that are statistically significantly different from zero at the 5 percent level.

downturn to distinguish the impacts of reform from those of the business cycle. In either case, the analysis supports the conclusion that the reform reduced WC billing.

Direct controls for business cycle effects: Finally, I also obtained county-level unemployment data from the Bureau of Labor Statistics and re-estimated the dose-response regressions, controlling explicitly for county-level changes in overall unemployment and employment in construction, manufacturing, and transportation—three industries that account for an important fraction of work injuries and that were significantly impacted by the downturn. These results, presented in Table 3.4, are very similar to the results presented in Table 3.2. Moreover, adding controls for different measures of the amount of economic activity occurring in sectors likely to generate work injuries had almost no impact on the estimates. If changes in coverage are highly correlated with business cycle activity, we should have obtained coefficients different from those of the dose-response analysis depending on whether we do or do not control for employment and other business cycle patterns. But we did not, which suggests that the intensity of the downturn and coverage expansion may not be particularly tightly confounded.

Overall, these four pieces of evidence suggest that the declines in WC billing cannot simply be explained by the economic downturn, but, rather, appear to genuinely result from the coverage expansions induced by health care reform.

Table 3.4
Estimated Effects of Coverage Expansion on WC ER Billing Accounting for Employment Changes

	I	II	III
Effect of coverage expansion on WC billing rate, 2005–2008	–.078** (.016)	–.089** (.015)	–.078* (.030)
Implied impact of reform on WC billing	–12.1%** (2.5)	–13.8%** (2.4)	–12.1%** (4.7)
Control for county-level change in unemployment?	Yes	Yes	Yes
Control for county-level change in manufacturing, transportation, and construction employment?	No	Yes	Yes
Include age, sex, and race fixed effects?	No	No	Yes

NOTE: Author's estimates from Massachusetts SEDD data. Each column reports results from a separate regression—specifications I, II, and III. Sample size for each regression is 432. Heteroskedasticity-robust standard errors are in parentheses. * denotes statistical significance at the two-tailed 5 percent level; ** at the 1 percent level.

3.3 Changes in the Probability of Billing a Work-Related Injury to WC

One possible mechanism through which health care reform might reduce WC bills is by inducing workers to use health insurance rather than WC to pay for work-related injuries. Alternatively, reform might lead to a reduction in care that is not work related but is nonetheless paid for by WC. This section attempts to develop evidence regarding the former mechanism by estimating how the probability of billing a work-related injury changed following the onset of reform.

For this analysis, I required a means of identifying work-related injuries independent of the payer's identity. To accomplish this, I exploited the E-codes included in patient records. E-codes are additional codes included as part of the ICD-9 diagnostic coding system; they allow providers to append additional information about the nature and circumstances of accidental injury. I focused in particular on patients whose case records included an E-code of E849.3, which indicates an injury occurring in an industrial place or on industrial premises, such as a factory, construction site, or railway yard. Injuries sustained in industrial locations are likely work related, so focusing on this set of patients enabled me to essentially consider only patients with work-related injuries. Over my sample period, more than 95,000 such patient records were observed in the data, and overall 74 percent of these ER visits were billed to WC.

Two limitations of this approach deserve mention. First, although it seems probable that the vast majority of patients in this sample sustained work-related injuries, it is possible that some injuries occurred at industrial sites but did not necessarily involve workers (for example, children who injure themselves after surreptitiously entering a construction site), and thus would not be covered by the WC system. Second, this sample represents only a subset of workers injured on the job—many patients who sustain injuries covered under WC, such as individuals in commercial vehicle accidents or white-collar workers, may not be injured at industrial sites. Insomuch as claiming patterns for industrial injuries differ from other work-related injuries, such differences will not be captured in this analysis.

To examine how the probability of claiming an industrial injury changed over time, I estimated regressions in which the outcome is a 0–1 indicator for whether a particular patient had care billed to WC, and the primary explanatory variables are indicators for each of the half-year periods from January 2005 through December 2008.[12] I also controlled for patient age, race, gender, hospital, diagnosis, and three-digit ZIP code, and the hour, month, day of week, and type of admission. The coefficients on the time indicators demonstrate how the probability of WC billing changed after controlling for changes over time in the injury distribution and patient demographics.

As shown in Table 3.5, although the rate at which industrial accidents were billed to WC remained relatively stable during the first year of reform implementation, by 2008 the probability that an industrial injury was billed to WC fell by 2.8 percentage points, a statistically significant drop that corresponds to a 4 percent decline in the number of bills. In other words, even among patients who were highly likely to have sustained work-related injuries, WC bills fell after health care reform was implemented.

Table 3.5
Changes over Time in the Likelihood That an Industrial Injury Is Billed to WC

Time Period	Difference in Billing Probability Relative to 1st Half of 2005
2nd half 2005	–.011
	(.008)
1st half 2006	–.005
	(.005)
2nd half 2006	.003
	(.009)
1st half 2007	.004
	(.013)
2nd half 2007	.002
	(.017)
1st half 2008	–.021**
	(.006)
2nd half 2008	–.028**
	(.009)
Overall 2006–2008	–.011*
	(.004)

NOTE: Author's calculations from Massachusetts SEDD data using regression model described in the text. Sample size is 95,045. The omitted reference group is patients injured during the first half of 2005; for these patients, the probability of receiving a WC bill was .761. Heteroskedasticity-robust standard errors are reported in parentheses. * denotes an estimate that is statistically significant at the 5 percent level; ** at the 1 percent level.

[12] The reference group was patients in the first half of 2005.

The largest declines in billing probability occurred in 2008. The recession might itself reduce the probability of work injuries being billed to WC by increasing workers' fear of job loss and thus lowering their willingness to report work-related injuries or by shifting the workforce toward contract workers not covered by WC. Thus, attributing the patterns from Table 3.5 primarily to health care reform may be inappropriate. At a minimum, Table 3.5 shows that the post-reform decline in the probability of billing a work-related injury was smaller than the overall decline in WC bills (Table 3.1), providing suggestive evidence that reform may have also operated through other mechanisms, such as reducing the use of WC for non-work-related injuries.

3.4 Effects on the Most Severe Bills

Although the results of my analysis up to this point indicate that the number of WC ER bills fell by about 10 percent following health care reform in Massachusetts, it is unclear whether this decline is likely to translate to a decline in WC ER costs of similar magnitude. It seems plausible that the use of private health insurance to pay for work-related injuries, if it occurs, might be more common for smaller, less complicated bills and less common for larger, more complicated bills for which patients may have strong financial incentives to ensure correct assignment to WC in order to facilitate WC indemnity claims. Under this scenario, care episodes that shift from the WC system to the private health insurance system would be lower cost than average, meaning that savings to the WC system would be lower in percentage terms than the percentage reduction in bills.

To examine whether the largest bills were also affected by health care reform, I replicated my analysis from Section 3.1, focusing on the "costliest" 20 percent of patients, whom I denote as "high-cost" patients. To identify these patients, I estimated a regression model using the 2005 data for patients covered by WC, where log(total billed hospital charge) was the dependent variable and the explanatory variables were the set of demographic and medical-condition controls listed above. The estimated coefficients from these regressions allowed me to predict the expected hospital bill for any WC patient with a given set of medical conditions, accounting for differences in characteristics, such as age, that might affect the costs of providing care. I next identified the medical conditions that were in the top quintile in terms of predicted effect on hospital charges, and classified patients with those conditions as high-cost patients.[13] Essentially, this approach allowed me to identify those patients who by virtue of their medical diagnosis were likely to incur particularly high hospital bills, and to ask whether these patients also experienced a reduction in realized bills relative to what might have been expected based on pre-reform billing patterns.

Table 3.6 reports the results of this analysis. As previously, the projection model does not provide evidence of a statistically significant change in the number of bills during the first half of 2006, prior to the implementation of the reform, but does show fewer than expected bills in subsequent periods. For patients with conditions ranking in the upper quintile of the cost

[13] For example, my estimates indicate that, controlling for other factors, patients diagnosed with skin infections have hospital charges that are 43 percent of the charges for the average WC patient, workers diagnosed with inflamed muscles have about average charges, and patients diagnosed with a fractured vertebra have bills that are about 73 percent higher than the average bill.

Table 3.6
Percentage Difference in Actual and Projected WC ER Billing Rates for High-Cost Patients

Time Period	Difference: Projected vs. Actual (%)
1st half 2006	1.4
	[3.5 , –0.6]
2nd half 2006	–3.1*
	[–1.1, –5.2]
1st half 2007	–3.3*
	[–1.2 , –5.4]
2nd half 2007	–3.4*
	[–1.4 , –5.5]
1st half 2008	–7.8*
	[–5.6 , –10.1]
2nd half 2008	–16.9*
	[–14.6 , –19.2]
Overall post-reform	–6.0*
	[–6.9 , –5.1]

NOTE: Author's calculations from Massachusetts SEDD data. 95 percent confidence intervals for the estimated differences are reported in brackets; * denotes estimates that are statistically significantly different from zero at the 5 percent level.

distribution, WC bills fell by a statistically significant 6 percent following reform. This pattern suggests that reform affected not only bills of lower value, but also bills for the most costly conditions.

3.5 Effects on Hospital Charges

The analyses so far indicate that the number of WC emergency room bills—one proxy for care volume or claim frequency—declined as a result of the reform. To understand how WC insurers' costs might be affected by the reform, in addition to understanding changes in claim frequency, we must also know how reform affects claim severity. The fact, established in the previous section, that bill counts declined among those with more costly medical conditions suggests that the reform did not shift the composition of bill recipients toward "sicker" patients. Nevertheless, it remains possible that the reform affected average ER charges directly. In this section, I assess whether the reform affected the amount of the typical ER bill, one way of capturing severity using available data.

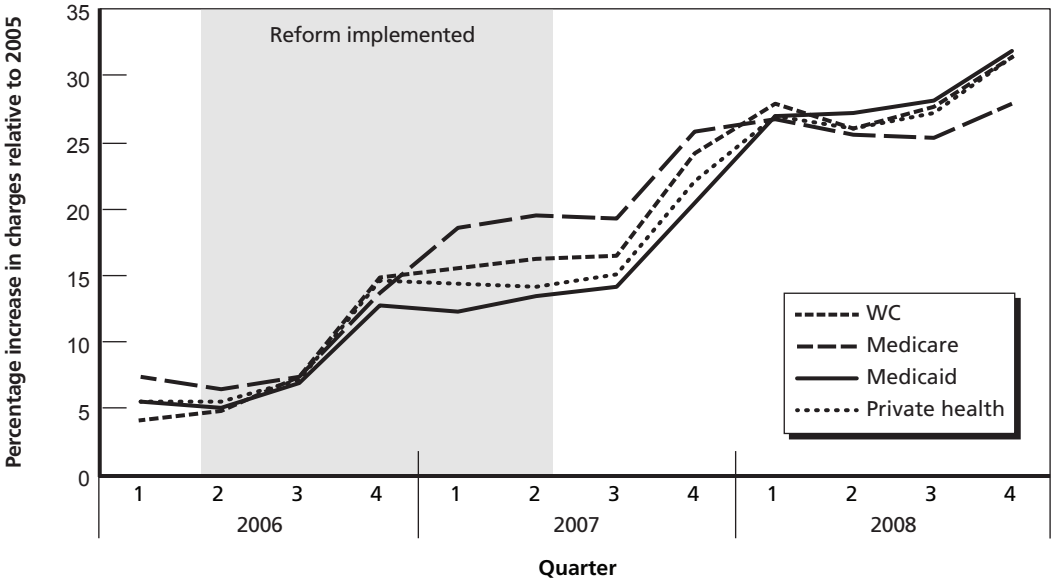
To examine how charges evolved over time holding fixed the composition of patients, I estimated a regression model in which the outcome variable is the log(billed charges) for the set of patients covered by a particular insurer, and the primary explanatory variables of interest are indicators for each of the calendar quarters in 2006 through 2008, with 2005 acting as the reference group. In these regressions, I also controlled for the same patient and treatment episode characteristics included in my previous analysis—age, gender, race, three-digit ZIP

code of residence, coded medical diagnosis, and treatment hospital. The estimated coefficients on the quarter indicators capture the average difference in hospital charges for patients treated in a particular quarter relative to observationally similar patients treated prior to the onset of reform. I estimated versions of these regressions separately for patients covered by WC, Medicare, Medicaid, and private health insurance.

Figure 3.3 plots the regression-adjusted ER charge patterns for WC patients and patients covered by other forms of insurance.[14] For patients with all types of coverage, charges grew appreciably between 2005 and the end of 2008, which is expected given the well-documented rapid pace of medical price inflation in recent years in the United States. However, there is no obvious anomalous pattern of charge growth during the period that the reform was implemented. Moreover, we also see very similar patterns in the evolution of charges among patients with WC, Medicaid, and private health insurance over the post-reform period, suggesting that most of the increase in WC charges can be attributed to general medical cost inflation. Overall, the patterns in Figure 3.3 provide little evidence that health reform had an important impact on WC billed ER charges.

I also conducted, in unreported regressions, a dose-response analysis of patterns in ER charges, examining whether changes in charges across population segments were related to coverage changes. The methods I used were analogous to those presented in Section 3.2. Consistent with the findings shown in Figure 3.3, there was no evidence that charges grew differentially among populations that experienced large versus small changes in coverage.

Figure 3.3
Evolution of Regression-Adjusted Billed ER Charges over Time



NOTE: Author's calculations from Massachusetts SEDD data. Charges have been regression adjusted to account for changes in the demographics and medical conditions of patients over time.

RAND *TR1216-3.3*

[14] The estimated coefficients and their standard errors are reported in Table A.1 of the Appendix.

3.6 Impacts for Hospital Inpatients

The impacts measured to this point have been for ER patients rather than hospital inpatients, a logical focus given that there are about 85,000 ER patients covered by WC in a typical year in Massachusetts, versus only about 3,500 inpatients. However, the average bill for an ER patient covered through his or her WC insurance is only about $900, versus an average charge of over $21,000 for WC inpatients, so it is important to consider the impacts for inpatients to understand how health reform might impact overall hospital costs borne by WC. In this section, I replicate my main analyses using the data on hospital inpatients.

Table 3.7 reports changes in the number of WC inpatient bills over time estimated from a projection model constructed as described in Section 3.1; this table is an analogue to Table 3.1 but for hospital inpatients. Consistent with the findings for ER care volume, there is no evidence of a difference in projected versus actual bills in the first part of 2006. However, as the various components of the health reform were implemented, the number of actual inpatient bills fell relative to what would be expected based on pre-reform billing patterns. Overall, there was a statistically significant 5 percent decline in the number of inpatient hospital bills sent to WC insurers following implementation of the reform. Since inpatients are likely to be more severely injured on average than ER patients are, the fact that the billing decline among inpatients is of roughly similar magnitude to the decline among ER patients further reinforces the conclusion from Section 3.4 that patients with both severe and less severe injuries were impacted by the reform.

Table 3.7
Percentage Difference in Actual and Projected WC Billing Rates for Hospital Inpatients

Time Period	Difference: Projected vs. Actual (%)
1st half 2006	–1.3
	[–6.5 , 3.9]
2nd half 2006	2.0%
	[–3.7 , 7.6]
1st half 2007	–5.7
	[–11.9 , 0.5]
2nd half 2007	–7.2*
	[–13.7 , –0.6]
1st half 2008	–7.5*
	[–13.8 , –1.2]
2nd half 2008	–8.9*
	[–15.8 , –2.0]
Overall 2006–2008	–4.8*
	[–7.5 , –2.2]

NOTE: Author's calculations from Massachusetts SID data. 95 percent confidence intervals for the estimated differences are reported in brackets; * denotes estimates that are statistically significantly different from zero at the 5 percent level.

I also conducted a dose-response analysis for hospital inpatients following the approach outlined in Section 3.2. Table 3.8 reports regression estimates of the relationship between the growth in insurance coverage for a particular segment of the population and that population segment's change in WC inpatient bills. The relationship achieves statistical significance at below the 5 percent level in only two of the six regression specifications, although it is marginally significant for all three unweighted specifications, including those with fixed effects. Given the relatively small number of WC inpatients, the somewhat imprecise nature of these estimates is not particularly surprising. The magnitude of the gradient is on par with that observed for ER patients. Although not as unequivocal as the results for ER patients, overall, these results, taken together with those presented in Table 3.7, seem to provide support for the conclusion that there was also a decline in the number of WC bills among hospital inpatients on the order of 5 percent to 10 percent.

Using the same methods described in Section 3.5, I also analyzed patterns in billed charges for hospital inpatients. Table A.2 in the Appendix presents the results of this analysis. For inpatients, charge patterns over time for those covered by WC did not always closely mirror charge patterns for patients covered by other forms of insurance, as they did in the ER case. Nevertheless, there does not appear to be a systematic shift in charging patterns for WC inpatients associated with the introduction of the reform; rather, charges fluctuate both above and below those of patients with other forms of insurance following the reform. These data thus do not make a compelling case that reform affected charging patterns, although the relatively modest number of inpatients covered through WC and corresponding noisiness of the data preclude drawing definitive conclusions.

3.7 Effects on Treatment Volume

Although information about the number and size of bills covered through WC is relevant for understanding total costs of the system, from the perspective of an injured worker, a more significant question might be whether reform affects the amount or types of treatment providers

Table 3.8
Estimated Effect of Coverage Expansion on WC Inpatient Billing, 2005–2008

	I	II	III	IV	V	VI
Effect of coverage expansion on WC billing rate, 2005–2008	–.030 (.018)	–.026 (.019)	–.036 (.022)	–.022** (.006)	–.015* (.007)	–.001 (.009)
Implied impact of reform on WC billing	–14.0% (8.2)	–12.2% (8.7)	–16.5% (10.38)	–10.4%** (2.9)	–6.9%* (3.1)	–0.7% (4.2)
Include age, race, sex, and ZIP code fixed effects?	No	Yes	Yes	No	Yes	Yes
Include two-way interactions for age, race, sex, and ZIP code?	No	No	Yes	No	No	Yes
Weight by cell size?	No	No	No	Yes	Yes	Yes

NOTE: Author's estimates from Massachusetts SID data. Each column reports results from a separate regression. Sample size for each regression is 432. Heteroskedasticity-robust standard errors are in parentheses. * denotes statistical significance at the two-tailed 5 percent level; ** at the 1 percent level.

offer patients with WC insurance. This section assesses whether treatment volume changed as a result of reform.

I considered two alternative measures of treatment volume. Each patient record includes one or more medical procedure codes that indicate the types of treatment received; as one measure of treatment volume, I considered the total count of coded procedures for each patient. Although in a general sense it seems logical to expect that patients with more coded procedures received more extensive treatment, this is only an approximation given that individual procedures differ in complexity and resource requirements. As an alternative measure of treatment volume, I also considered the number of overnight hospital days on the patient record. Overnight hospitalizations are uncommon but do occur among ER patients, and there is substantial variation across inpatients in the length of the hospital stay.

These outcomes offer only a rudimentary understanding of how the reform impacts treatment, both because they are fairly coarse measures of treatment volume and because many aspects of treatment other than volume might be affected by the reform. More ideally, it would be useful to examine the quality and appropriateness of treatment. Although some limited measures of appropriateness—such as the number of non-emergent medical conditions treated in the ER—can be constructed using the HCUP data, the present data do not permit us to observe the full spectrum of care received by each patient for a particular medical condition, and detailed examination of appropriateness was beyond the scope of the study. Moreover, there is probably less scope for individual agency regarding types and amounts of treatment in a hospital setting than in other care settings, so patterns in treatment received outside the hospital may differ from those shown below.

To analyze how the amount of treatment for WC patients evolved in the period following reform implementation, I used a differences-in-differences regression modeling approach. Because of coding changes or changes in clinical norms regarding treatment for various conditions, the amount of treatment, as captured by the two measures described above, might change over time for reasons unrelated to health care reform. To account for this possibility, I focused on a combined sample of WC patients, who may have been affected by the reform, and Medicare patients, whose treatment patterns should have been affected by coding changes or other changes to clinical practice but who should otherwise have been largely unaffected by the reform. The differences-in-differences approach contrasts treatment patterns between WC and Medicare patients before and after reform, and permits me to control for general time series changes in treatment volume.

To implement the differences-in-differences methodology, I estimated regression models in which the unit of observation is a patient and the outcome of interest is a measure of the volume of treatment.[15] The primary explanatory variables are an indicator for a patient covered through WC, time (month by year) fixed effects, and interactions between quarter and WC coverage for each of the calendar quarters during 2006 and 2008. The regressions also control for patient age and age squared, race, gender, number and type of medical conditions, residence ZIP code, and hospital, hour, and day of week of admission. The coefficients on the

[15] Given that the distribution of the counts of coded procedures is skewed, I used the log(number of procedures) as an outcome and estimated the regressions for this outcome using ordinary least squares. For hospital stay, there are appreciable numbers of zeros, so I estimated these regressions using a Poisson count model. In both cases, the estimated coefficients were converted to percentage changes for the results reported. A full set of regression results is available from the author upon request.

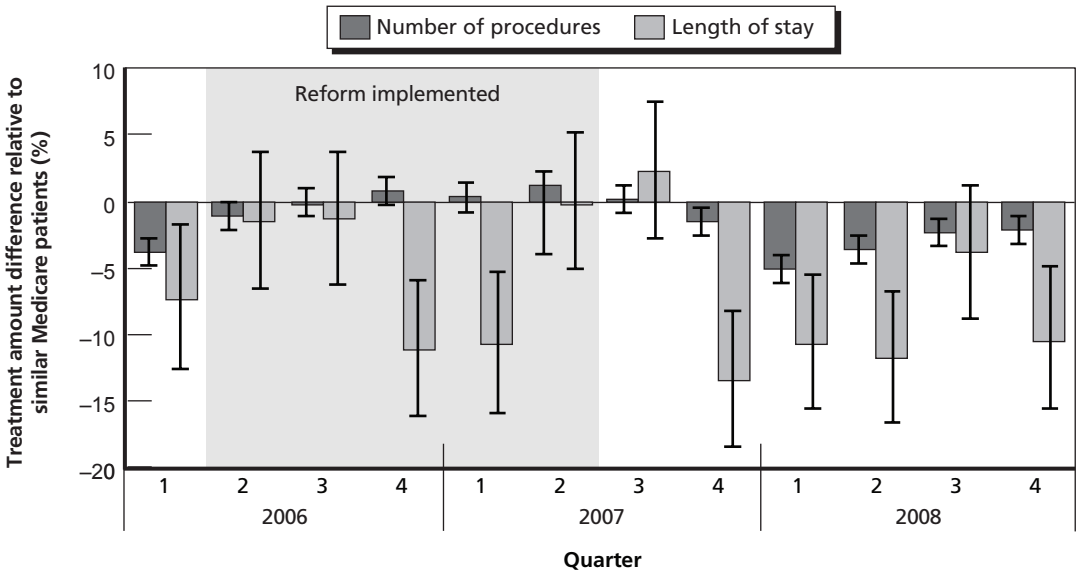
interaction terms demonstrate whether treatment amounts for WC patients treated following the reform were above or below what would have been expected based on the characteristics of each patient and the treatment patterns observed prior to reform.

Figures 3.4 (ER patients) and 3.5 (hospital inpatients) plot the differences in treatment over time for WC patients that were estimated using the regression model described above. The leftmost bar in Figure 3.4, for example, indicates that WC ER patients treated in the 1st quarter of 2006 received about 4 percent fewer medical procedures on average than what would have been expected based on prevailing treatment patterns in 2005, and this estimate is statistically significant.

Figure 3.4 reveals no consistent pattern in treatment associated with the introduction of health care reform. Although there is some evidence that both the number of coded procedures and the length of hospital stay were lower among WC ER patients in 2008, differences of similar magnitude can be observed in the first quarter of 2006, prior to enactment of the reform legislation. Moreover, in the third quarter of 2007, the point at which reform was having a large impact on coverage patterns due to the onset of the individual mandate (Figure 2.3), there is almost no difference in treatment patterns compared to the pre-reform period.

Figure 3.5 tells a similar story for hospital inpatients. Although there is some suggestion that length of stay for WC patients may have increased during the reform implementation period, the treatment differences in many later quarters are not statistically significant. For procedure volume, there is no consistent pattern, with WC treatment levels falling above the pre-reform benchmark in some quarters and below the benchmark in others. Overall,

Figure 3.4
Changes over Time in the Amount of Treatment Received by ER Patients



NOTE: This figure plots differences between ER patients covered by WC and ER Medicare patients across two different measures of the amount of treatment received. Differences are estimated from a regression model that controls for patient demographics, medical conditions, and circumstances of admission. The pre-reform period (2005) is used as a reference period. Whiskers denote 95 percent confidence bands for each estimate.

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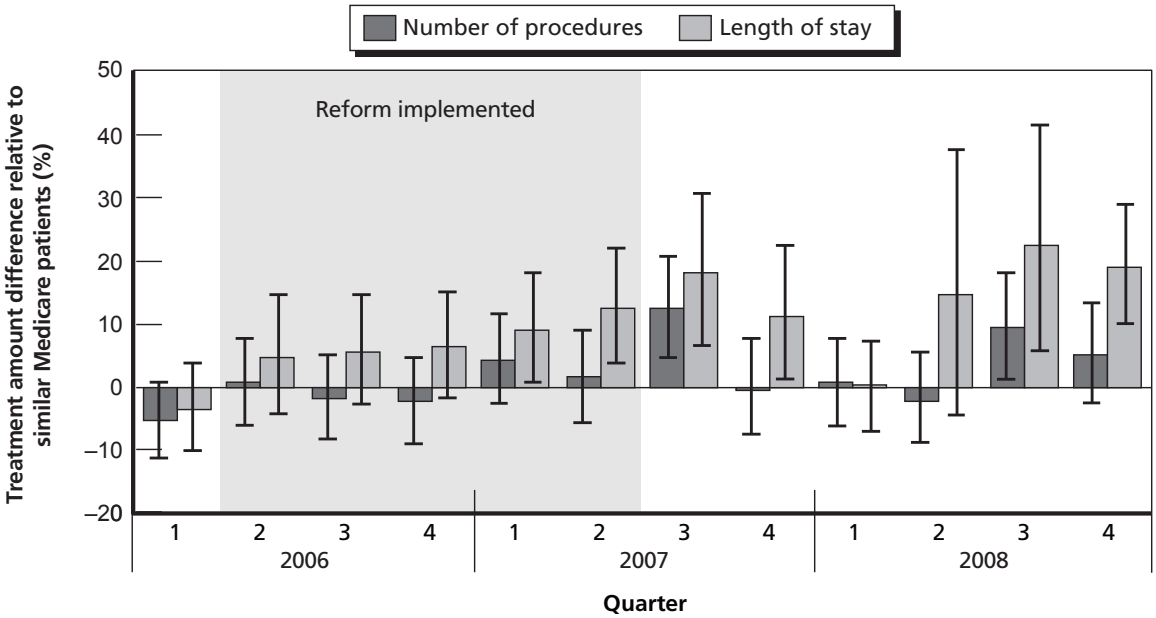
Figure 3.5
Changes over Time in the Amount of Treatment Received by Hospital Inpatients



NOTE: This figure plots differences between inpatients covered by WC and Medicare inpatients across two different measures of the amount of treatment received. Differences are estimated from a regression model that controls for patient demographics, medical conditions, and circumstances of admission. The pre-reform period (2005) is used as a reference period. Whiskers denote 95 percent confidence bands for each estimate.

RAND *TR1216-3.5*

these analyses do not provide strong evidence in favor of the notion that the reform had an important effect on the amount of treatment provided to hospital patients covered through WC. However, given the limited set of outcomes measures considered here, further examination of impacts of reform on treatment—perhaps by drawing from WC claims data—would be valuable.

3.8 Summary

This chapter of the report provided empirical estimates of the effect of health reform on WC care volume in Massachusetts. Using a range of approaches for assessing the relationship between reform and billing patterns, I found evidence that the reform reduced the number of ER and inpatient bills by 5 percent to 10 percent, did not measurably affect charges, and did not affect treatment volume. These patterns persist after employing a variety of empirical techniques to account for potential impacts of the economic downturn.

CHAPTER FOUR

Limitations

In considering the implications of this study's findings for our understanding of the likely impacts of PPACA or other broad-based efforts to reform the U.S. health care system, a number of the study's limitations are relevant. First, the fact that Massachusetts differs from the rest of the nation in important respects may affect the mapping between reform and WC outcomes. Massachusetts is wealthier, more densely populated, less ethnically and racially diverse, and contains a different occupational mix than the United States as a whole. In addition, reimbursement schedules for WC medical care in Massachusetts are lower than in most other states for many types of care.

Second, the particular features of Massachusetts's reform differ somewhat from those that may occur in other states. Massachusetts's coverage expansions, for example, were primarily achieved through Medicaid expansions, whereas other states might be more successful at expanding private health insurance take-up.[1] Private health insurance plans developed in response to reform in other states might feature a different mix of deductibles, co-pays, and other cost-sharing measures, which may affect incentives to bill care to WC.

Third, this analysis only considers hospital care. Although hospital care is an important component of overall WC medical spending, this study's analysis misses other WC cost drivers, such as pharmaceutical spending and specialist care received in clinic or outpatient settings. The reform's impact on these other forms of medical treatment may be quite different from its impact on hospital care, in which case the patterns outlined in this report might not be observed in looking at overall WC medicals. For many logical mechanisms that would explain a decline in WC billing—such as a decision on the part of patients or physicians to bill care to forms of insurance other than WC—there may be reason to expect that in non-hospital settings, where treatment and billing decisions may have more of an elective character, reform might exert an even stronger effect. In this case, the estimates presented here would likely represent a lower bound on the true impact of reform on WC treatment patterns and costs.

Fourth, the reform occurred shortly before a significant economic downturn, and general economic conditions have been shown to have important effects on both the number and composition of WC claims. It is possible that coverage expansions or other health care system reforms might have different impacts on WC billing if introduced during a period of low unemployment or economic expansion.

Fifth, this analysis necessarily captures only the short-run impacts of the reform. It is possible that some of the WC billing reductions observed initially in Massachusetts might

[1] Nevertheless, in many states it appears that a substantial fraction of the total increase in the covered population will come through Medicaid expansions (Auerbach et al., 2011a–e).

attenuate or increase as reform proceeds. As of the end of the sample period, Massachusetts had yet to implement significant cost control measures, and the extent to which treatment and charging decisions by hospitals were adjusted during the sample period in anticipation of future cost control efforts remains uncertain. Moreover, health care reform may ultimately lead to new payment models, changes in the composition of the health care workforce, and other general equilibrium effects that are not manifest in the first few years following the initiation of reform.

CHAPTER FIVE

Conclusions

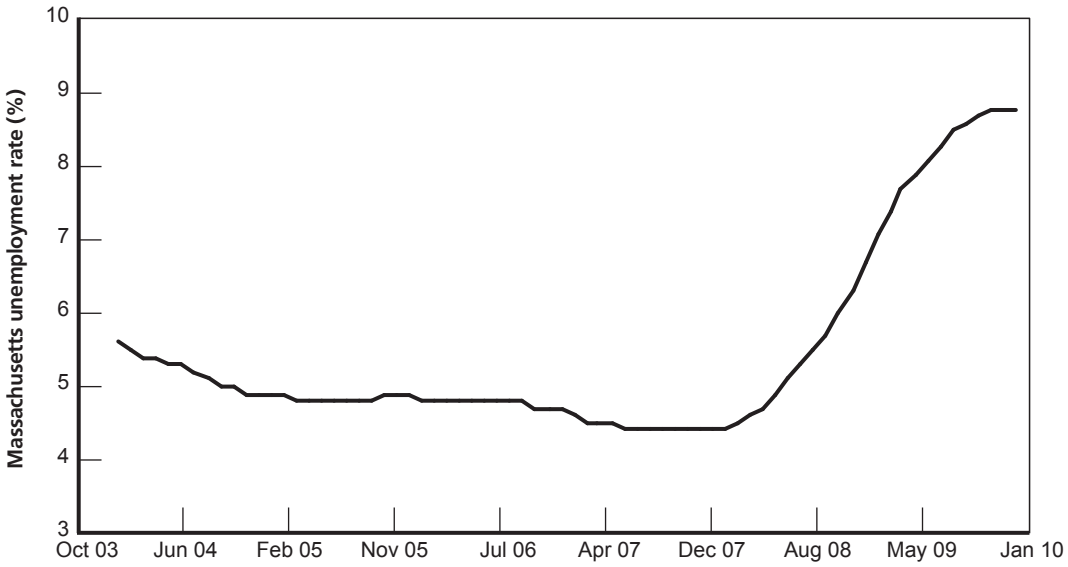
This report provides some of the first empirical evidence of the impact of health care reform on medical treatment received by WC patients. Following Massachusetts's implementation of a health care reform that included provisions similar to many of the key provisions of the PPACA, WC hospital billing volume fell by 5 percent to 10 percent. This decline can be plausibly attributed to the coverage expansions induced by health care reform. Billed charges for patients covered through WC increased in a manner consistent with general medical price inflation and were not obviously affected by the reform. Measures of treatment volume, such as length of hospital stay, were not discernably affected by the reform. These patterns are consistent with a situation in which coverage expansions led health insurers to pay for some care that would have been billed to WC in the absence of reform. Thus, reform may actually reduce medical costs borne by the WC system.

In evaluating the overall effects of health care reform, it is important to consider not only impacts on private health insurers, but also impacts on costs and functioning of other insurance products with a medical care component, including WC. Although the general understanding of how reform will affect WC is still nascent, the fact that reform in Massachusetts generated measurable impacts on WC billing frequency suggests that going forward, states should carefully consider how their implementation of health care reform provisions, such as those in the PPACA, might impact the functioning of their own WC insurance markets.

This analysis has also highlighted several areas in which current understanding of the impacts of health reform is incomplete. Given that incentives to consume and supply care may differ among patients and providers in the hospital versus non-hospital setting, one key area for further inquiry is to better understand how reform affects utilization of medical care under WC outside of the hospital. Due to data limitations, this study was unable to consider whether shifting care away from the WC system affected speed of recovery, health outcomes, return to work, and other variables related to the quality of care received by patients. Considering such outcomes is important for understanding the impacts of reform on worker health. Additionally, extending the analysis to consider longer-run impacts of reform will be important for understanding whether health reform is ultimately cost enhancing or cost reducing for WC.

Appendix

Figure A.1
Trends in Unemployment in Massachusetts



SOURCE: Bureau of Labor Statistics.

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Table A.1
Estimated Growth in ER Charges over Time

Difference in Log(Charges) Relative to 2005 in:	WC	Medicare	Medicaid	Private
Q1-2006	.038	.069	.051	.052
	(.005)	(.003)	(.002)	(.002)
Q2-2006	.046	.060	.047	.052
	(.004)	(.002)	(.002)	(.001)
Q3-2006	.071	.069	.065	.068
	(.004)	(.002)	(.002)	(.001)
Q4-2006	.138	.128	.120	.135
	(.005)	(.003)	(.002)	(.002)
Q1-2007	.143	.169	.114	.133
	(.012)	(.006)	(.005)	(.003)
Q2-2007	.150	.178	.124	.132
	(.013)	(.007)	(.005)	(.004)
Q3-2007	.152	.175	.131	.139
	(.013)	(.007)	(.005)	(.004)
Q4-2007	.215	.230	.184	.199
	(.013)	(.007)	(.005)	(.004)
Q1-2008	.246	.237	.239	.239
	(.005)	(.002)	(.002)	(.001)
Q2-2008	.231	.227	.240	.231
	(.005)	(.002)	(.002)	(.001)
Q3-2008	.243	.225	.247	.241
	(.004)	(.002)	(.002)	(.001)
Q4-2008	.273	.246	.276	.272
	(.005)	(.002)	(.002)	(.002)
N	336,433	1,483,889	2,166,449	3,827,868

NOTE: Author's estimates from Massachusetts SEDD data. Each column reports results from a separate regression. Heteroskedasticity-robust standard errors are in parentheses.

Table A.2
Estimated Growth in Inpatient Charges over Time

Difference in Log(Charges) Relative to 2005 in:	WC	Medicare	Medicaid	Private Health
Q1-2006	.029	.026	.024	.033
	(.025)	(.002)	(.005)	(.003)
Q2-2006	.062	.013	.009	.030
	(.025)	(.002)	(.005)	(.003)
Q3-2006	.059	.007	.013	.032
	(.025)	(.002)	(.005)	(.003)
Q4-2006	.043	.034	.031	.059
	(.027)	(.002)	(.005)	(.003)
Q1-2007	.099	.042	.054	.064
	(.024)	(.002)	(.004)	(.003)
Q2-2007	.069	.019	.040	.057
	(.025)	(.002)	(.004)	(.003)
Q3-2007	.097	.007	.034	.046
	(.026)	(.002)	(.004)	(.003)
Q4-2007	.096	.054	.091	.100
	(.026)	(.002)	(.004)	(.003)
Q1-2008	.102	.085	.109	.126
	(.025)	(.002)	(.004)	(.003)
Q2-2008	.042	.054	.083	.108
	(.025)	(.002)	(.004)	(.003)
Q3-2008	.169	.052	.077	.110
	(.027)	(.002)	(.004)	(.003)
Q4-2008	.192	.091	.107	.144
	(.027)	(.002)	(.004)	(.003)
N	13,935	1,393,717	403,559	1,039,827

NOTE: Author's estimates from Massachusetts SID data. Each column reports results from a separate regression. Heteroskedasticity-robust standard errors are in parentheses.

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