



# Loss Cost Components and Industrial Structure

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# Overview

- The Research Question
- The Data
- The Model
- Empirical Findings
- Conclusion

# Change in Industrial Structure

## Construction, Manufacturing, and Health Care Employment

- Over the past several years, the economy has undergone profound changes in employment proportion by industry
  - Most notable are the heavy job losses in construction and manufacturing, and the employment growth in health care
- During the years leading up to the 2007-2009 recession, in many states, employment in the construction sector expanded more strongly than employment overall
  - Then, the multi-year expansion of construction employment reversed—the contraction was swift and extensive
- It is not unusual that recessions serve as catalysts for structural change in the economy
  - The job losses in manufacturing may in part be permanent, and so may be the job gains in health care

# The Research Question

## Loss Cost Components and Industrial Structure

- The objective is to quantify the effect of the change in industrial structure on frequency and the severities, as defined in NCCI ratemaking
- The NCCI ratemaking data is as used in the trend analysis during the 2010 NCCI ratemaking season
  - 37 states are analyzed
  - Data are on a Paid basis—where applicable, the State Fund is included
- Forecasts for employment by industry and state through 2015 have been obtained from a professional forecasting firm

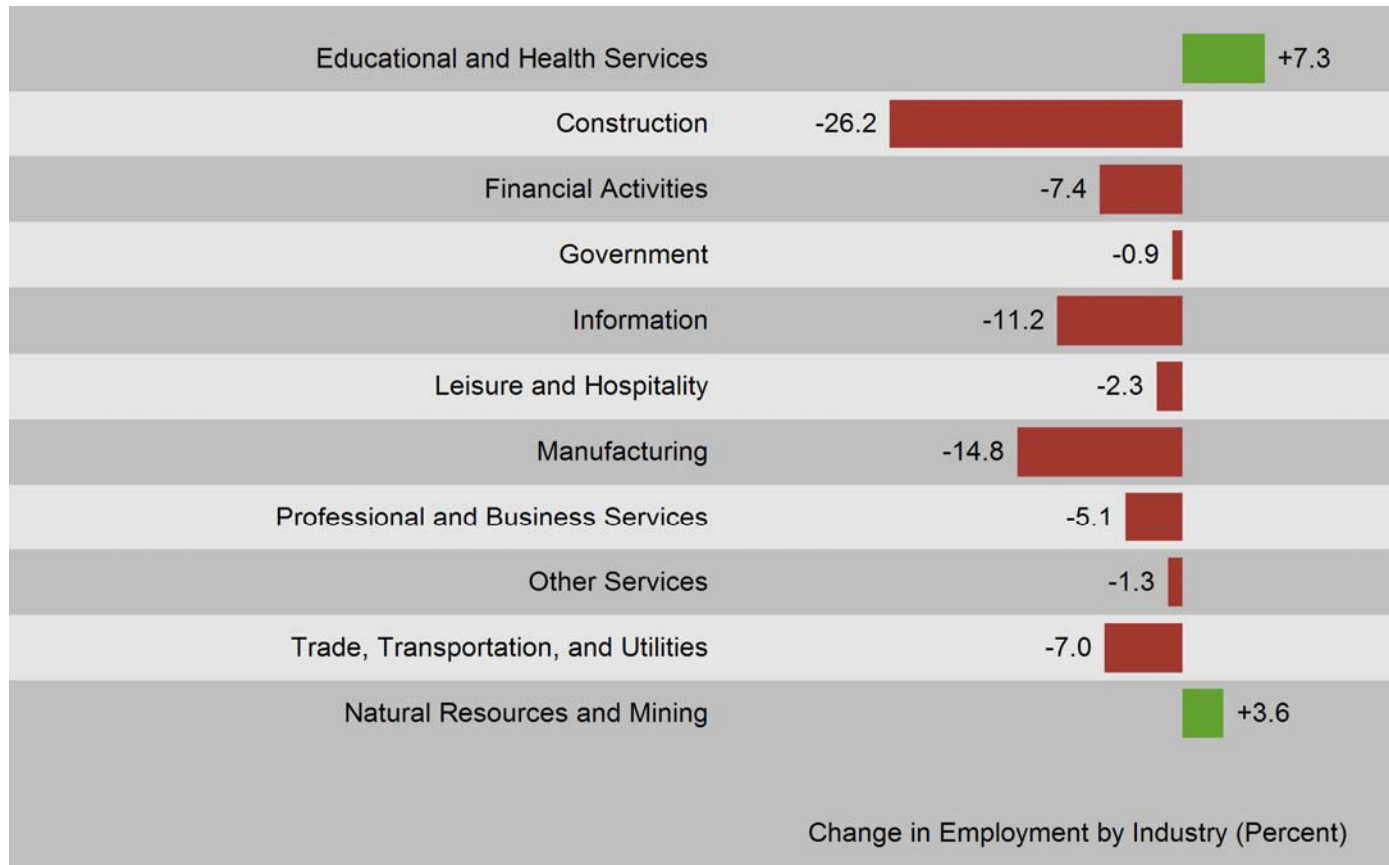
# Definitions

## Loss Cost Components in Ratemaking

- Frequency is defined as the ratio of the lost-time claim count (developed to ultimate) to on-leveled and wage-adjusted premium
- Severity is defined as the ratio of (on-leveled, developed-to-ultimate, and wage-adjusted) losses to the number of lost-time claims (developed to ultimate)
- The loss ratio is the product of frequency and the respective severity

# Change in Industrial Structure

## Change in Nonfarm Employment since Onset of Recession



Percentage change since the onset of the recession (peak of economic activity, December 2007).

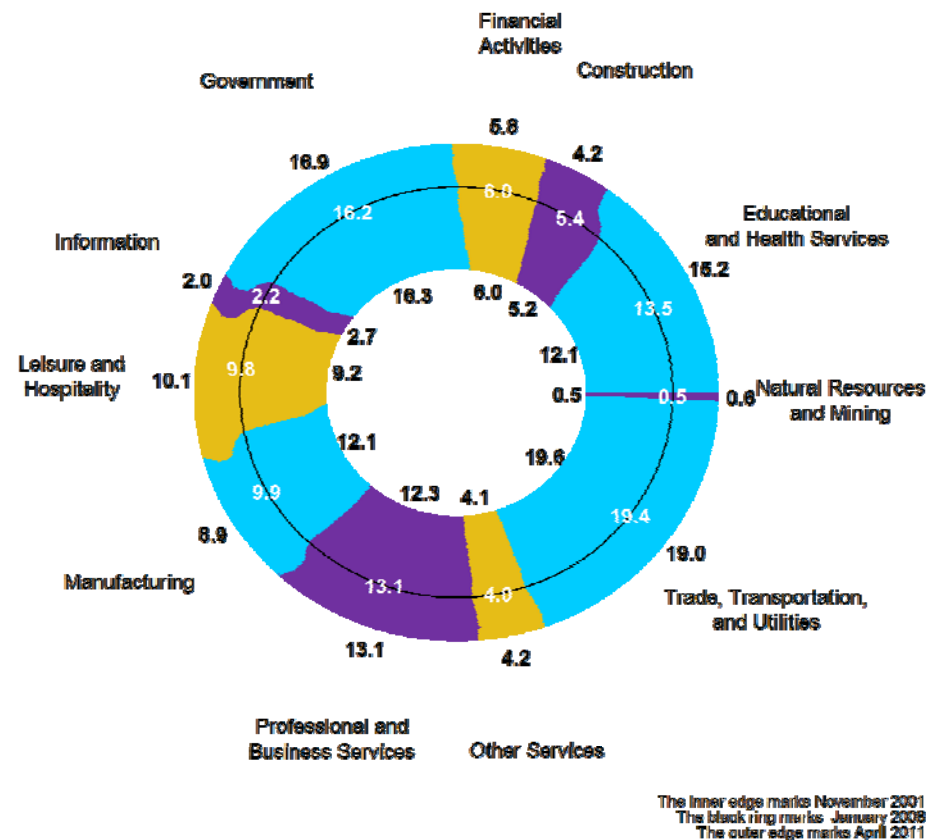
Seasonally adjusted. Frequency of observation: monthly; latest observed data point: April 2011.

Note that the public school system is part of Government. Educational and Health Services consists primarily of Health Care and Social Assistance.

Sources: US Bureau of Labor Statistics (BLS): Current Employment Statistics (CES), <http://www.bls.gov/ces>

# Change in Industrial Structure

## Nonfarm Employment Proportions



Private nonfarm employment, seasonally adjusted. Percentages may not add to 100 due to rounding. November 2001 marks the end of the 2001 recession. January 2008 marks the peak of employment. Frequency of observation: monthly; latest available data point: April 2011. Sources: US Bureau of Labor Statistics (BLS): Current Employment Statistics (CES), <http://www.bls.gov/ces>

# Industry Breakdown

## Private Nonfarm

	BLS Sectors and Supersectors	Industry Breakdown
<b>Service-providing</b>	Trade, Transportation, and Utilities	<b>Trade, Transportation, and Utilities</b>
	Education and Health Services	
	Financial Activities	}
	Information	
	Leisure and Hospitality	
	Professional and Business Services	
	Other Services	
	<b>Services NEC (Not Elsewhere Classified)</b>	
<b>Goods-producing</b>	Construction	<b>Construction</b>
	Manufacturing	<b>Manufacturing</b>
	Natural Resources and Mining	<b>Natural Resources and Mining</b>



# The Data

## Time Frames for Policy-Year and Accident-Year States

- For policy year states, the rates of change for frequency and the severities range from 1991 through 2008 (with the exception of Colorado, Nevada, and Texas)
- For Florida and Utah, which are accident-year states, the rates of change run from 1992 through 2009
- Employment is based on the BLS Current Employment Statistics (nonfarm payroll employment)
- The rate of employment growth is measured on a 12-month basis
  - For policy year states, growth is measured June over June (that is, June of the following calendar year over June of the current calendar year)
  - For accident year states, growth is measured December over December (that is, December of the current calendar year over December of the previous calendar year)

# The Statistical Model

## Dependent Variable and Covariates

- Log growth rates of frequency and severity are modeled at the state level on...
  - ...log growth rates of employment by industry
  - ...the first difference in the log rate of employment growth
- From the analysis of the link between BLS frequency and job flows it is known that frequency growth is related to the *change* in the rate of job creation
  - Here, employment growth refers to *net* job creation, which means that there is no breakdown into (gross) job creation and (gross) job destruction—this is because there are no forecasts readily available for job flows

# The Model

## Interpretation of Effects of Covariates

- All covariates are centered
  - The centering implies that the intercept represents the (geometric) rate of frequency growth in the steady state
- The regression coefficients that capture the industrial structure measure the change of frequency growth in percentage points in response to a one-percentage point change in employment growth in the industry in question
- All growth rates are on the logarithmic scale, which means that they correspond to geometric rates of growth (as required for the purpose of ratemaking)

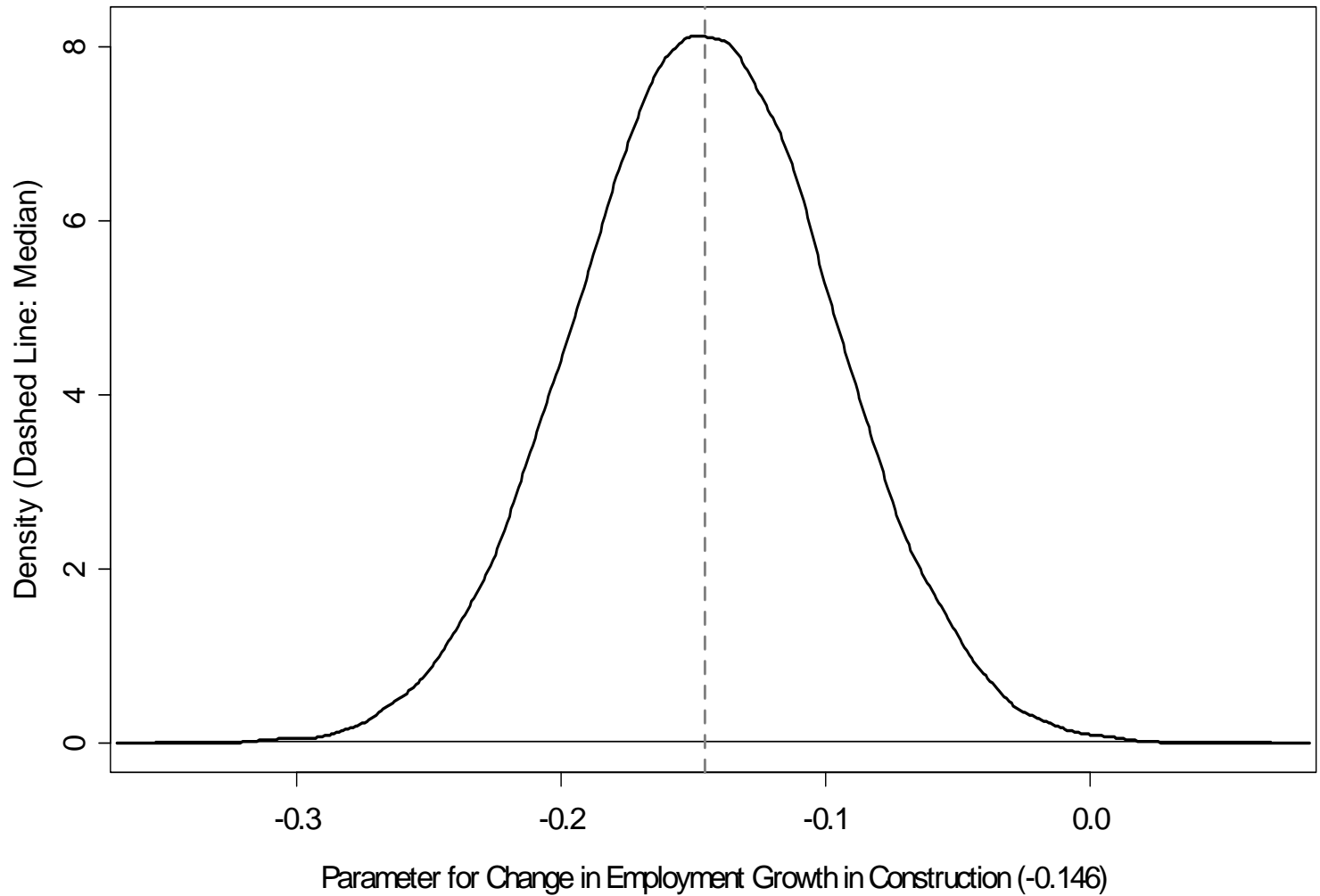
# The Model

## Likelihood and Estimation

- The likelihood is a discrete scale mixture of normal distributions
  - The variance of the normal is allowed to vary by state
- As a variation to this standard approach, ridge regression is applied
  - In ridge regression, the regression coefficients (of standardized covariates) share a common variance
  - Ridge regression imposes a penalty on large parameters—this is important where regression coefficients may comprise effects of correlated covariates
- All regression coefficients are common to all states
- The model is estimated by means of Markov-chain Monte Carlo simulation (MCMC)

# Construction

## Effect of Employment Growth on Frequency: Construction



# Regression Coefficients

## Frequency

Effect on Frequency Growth in Percentage Points in Response to a One-Percentage Point Change in Industry Employment Growth

Discrete Scale Mixture of Normal Distributions

	Standard Approach		
	Lower Bound	Central Estimate	Upper Bound
Trade, Transportation, and Utilities	-0.322	-0.123	0.078
Education and Health Services	-0.592	-0.400	-0.209
Services NEC	-0.113	0.107	0.326
Construction	-0.208	-0.146	-0.084
Manufacturing	0.051	0.146	0.243
Natural Resources and Mining	-0.063	-0.028	0.008

	Ridge Regression		
	Lower Bound	Central Estimate	Upper Bound
Trade, Transportation, and Utilities	-0.314	-0.118	0.077
Education and Health Services	-0.588	-0.396	-0.205
Services NEC	-0.116	0.097	0.307
Construction	-0.203	-0.141	-0.080
Manufacturing	0.049	0.143	0.238
Natural Resources and Mining	-0.063	-0.028	0.007

Note that that public school system is part of Government, not Education and Health Services. The bulk of jobs in Education and Health Services fall into the category Health Care and Social Assistance. The probability masses to the left of the lower bound and to the right of the upper bound each equal 10 percent

# Regression Coefficients

## Indemnity Severity

Effect on Indemnity Severity Growth in Percentage Points in Response to a One-Percentage Point Change in Industry Employment Growth

Discrete Scale Mixture of Normal Distributions

	Standard Approach		
	Lower Bound	<b>Central Estimate</b>	Upper Bound
Trade, Transportation, and Utilities	-0.196	0.105	0.398
Education and Health Services	-0.236	0.028	0.294
Services NEC	-0.535	-0.243	0.046
Construction	-0.031	0.058	0.146
Manufacturing	-0.157	-0.017	0.124
Natural Resources and Mining	-0.068	-0.018	0.032

	Ridge Regression		
	Lower Bound	<b>Central Estimate</b>	Upper Bound
Trade, Transportation, and Utilities	-0.193	0.091	0.375
Education and Health Services	-0.237	0.022	0.282
Services NEC	-0.491	-0.218	0.052
Construction	-0.031	0.054	0.139
Manufacturing	-0.155	-0.021	0.115
Natural Resources and Mining	-0.066	-0.017	0.032

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# Regression Coefficients

## Medical Severity

Effect on Medical Severity Growth in Percentage Points in Response to a One-Percentage Point Change in Industry Employment Growth

Discrete Scale Mixture of Normal Distributions

	Standard Approach		
	Lower Bound	Central Estimate	Upper Bound
Trade, Transportation, and Utilities	0.060	0.394	0.722
Education and Health Services	-0.147	0.129	0.404
Services NEC	-0.792	-0.476	-0.165
Construction	0.060	0.151	0.242
Manufacturing	-0.341	-0.193	-0.043
Natural Resources and Mining	-0.129	-0.080	-0.030

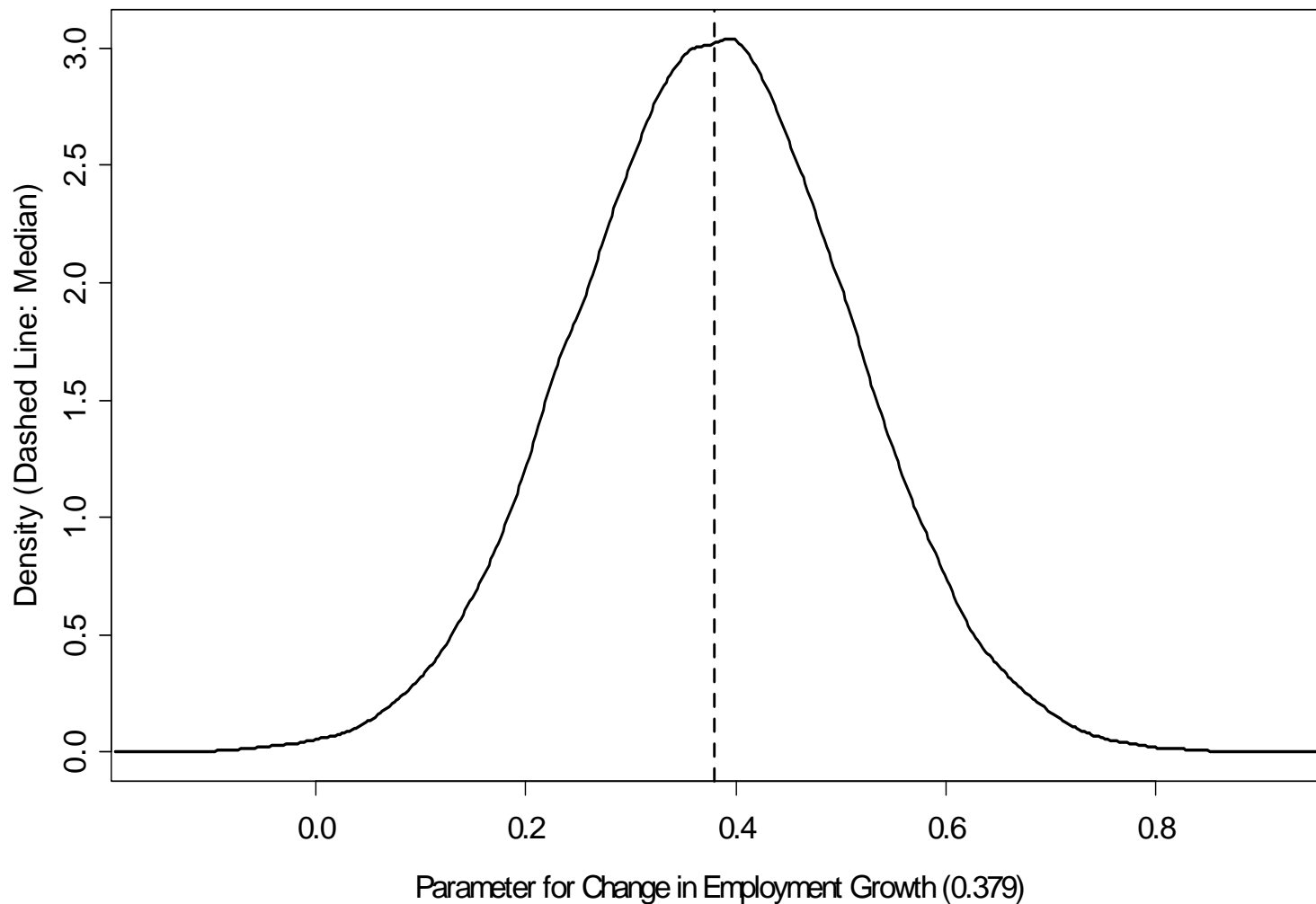
	Ridge Regression		
	Lower Bound	Central Estimate	Upper Bound
Trade, Transportation, and Utilities	0.033	0.354	0.665
Education and Health Services	-0.157	0.115	0.386
Services NEC	-0.726	-0.425	-0.125
Construction	0.054	0.141	0.230
Manufacturing	-0.331	-0.188	-0.042
Natural Resources and Mining	-0.126	-0.077	-0.028

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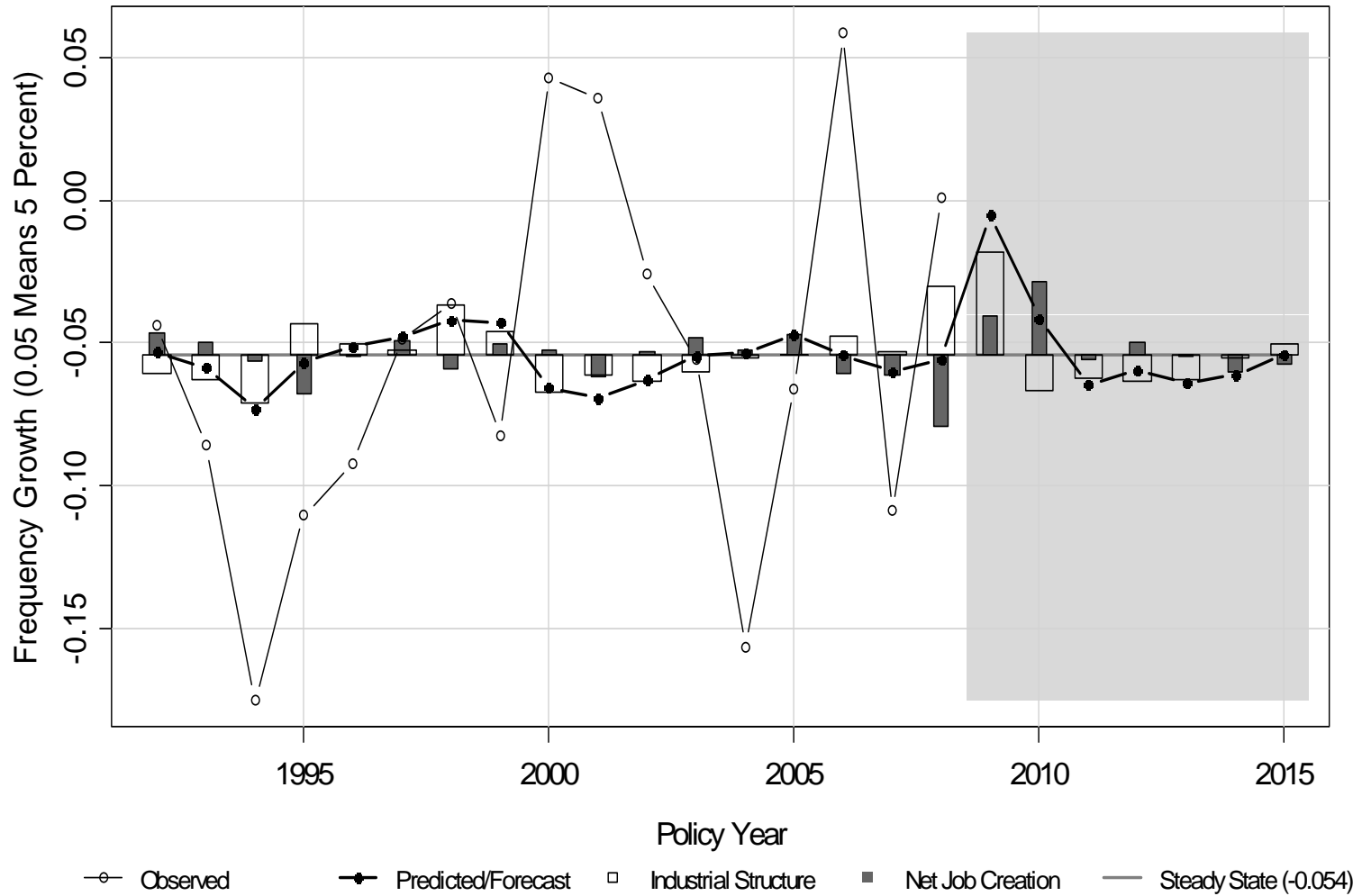
# Private Nonfarm Employment Growth

## Effect of Change in Net Job Creation on Frequency Growth



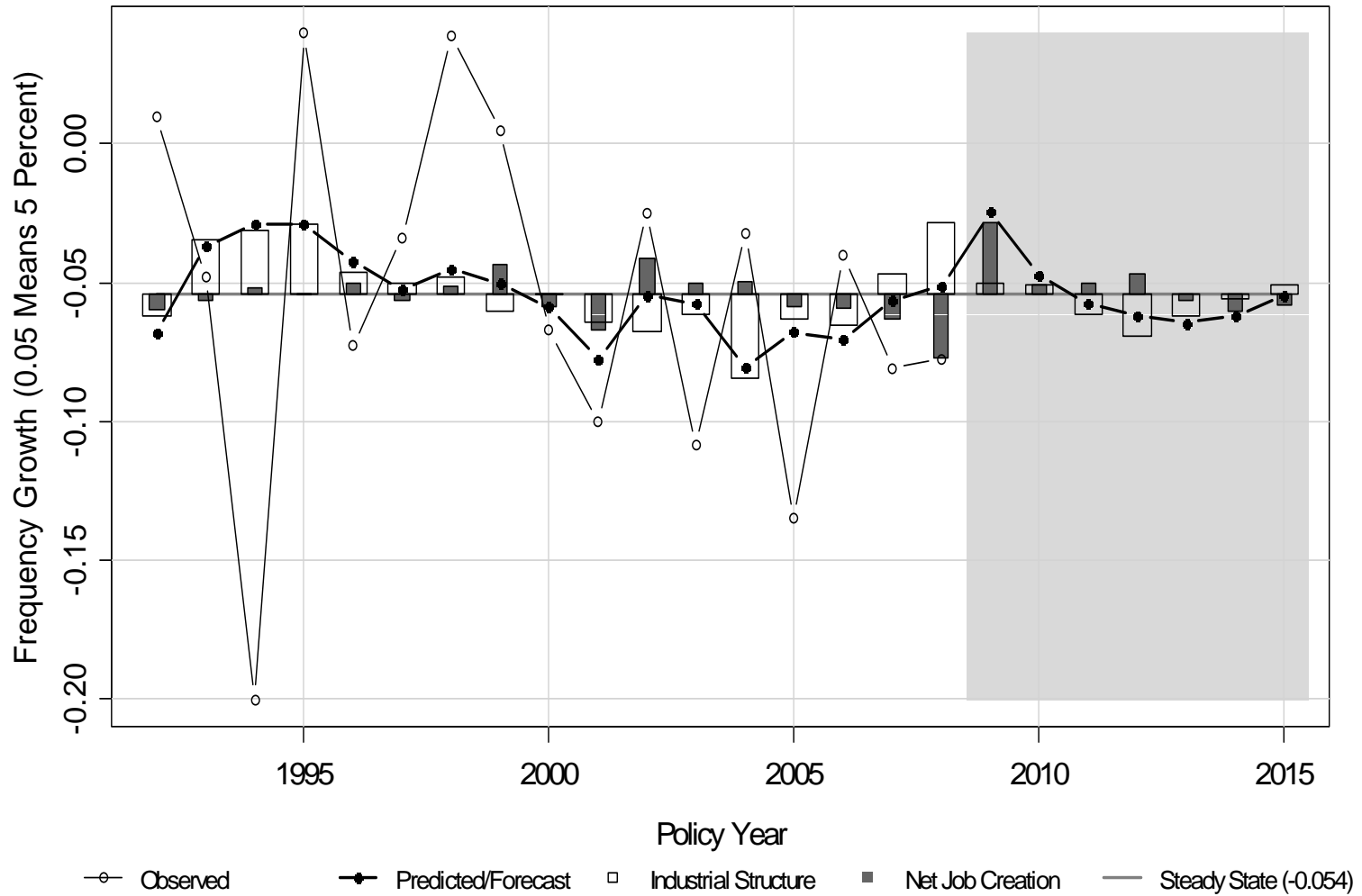
# State #1

## Job Losses in Construction Were Close to the National Average



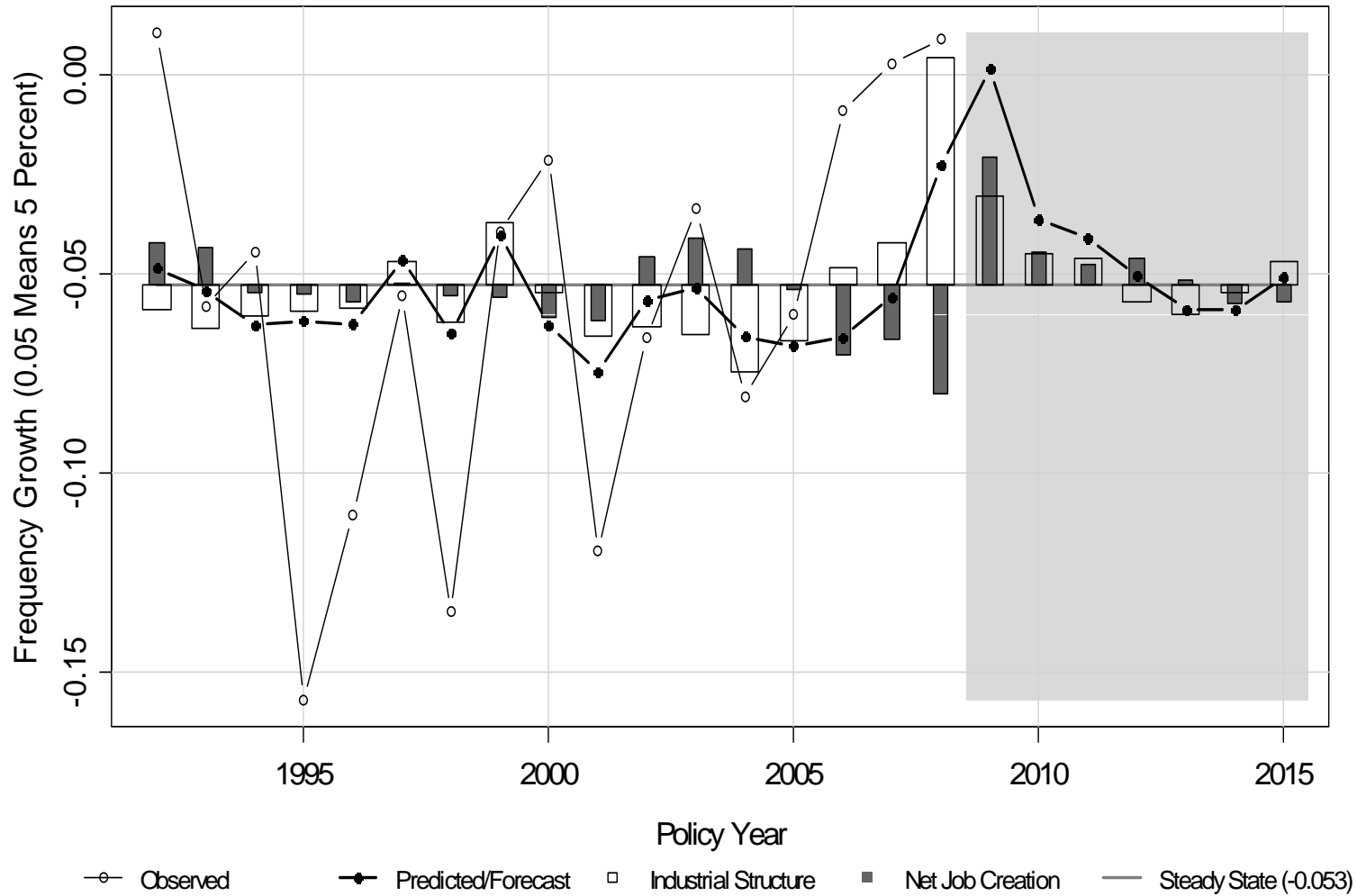
# State #2

## Job Losses in Construction Were Close to the National Average



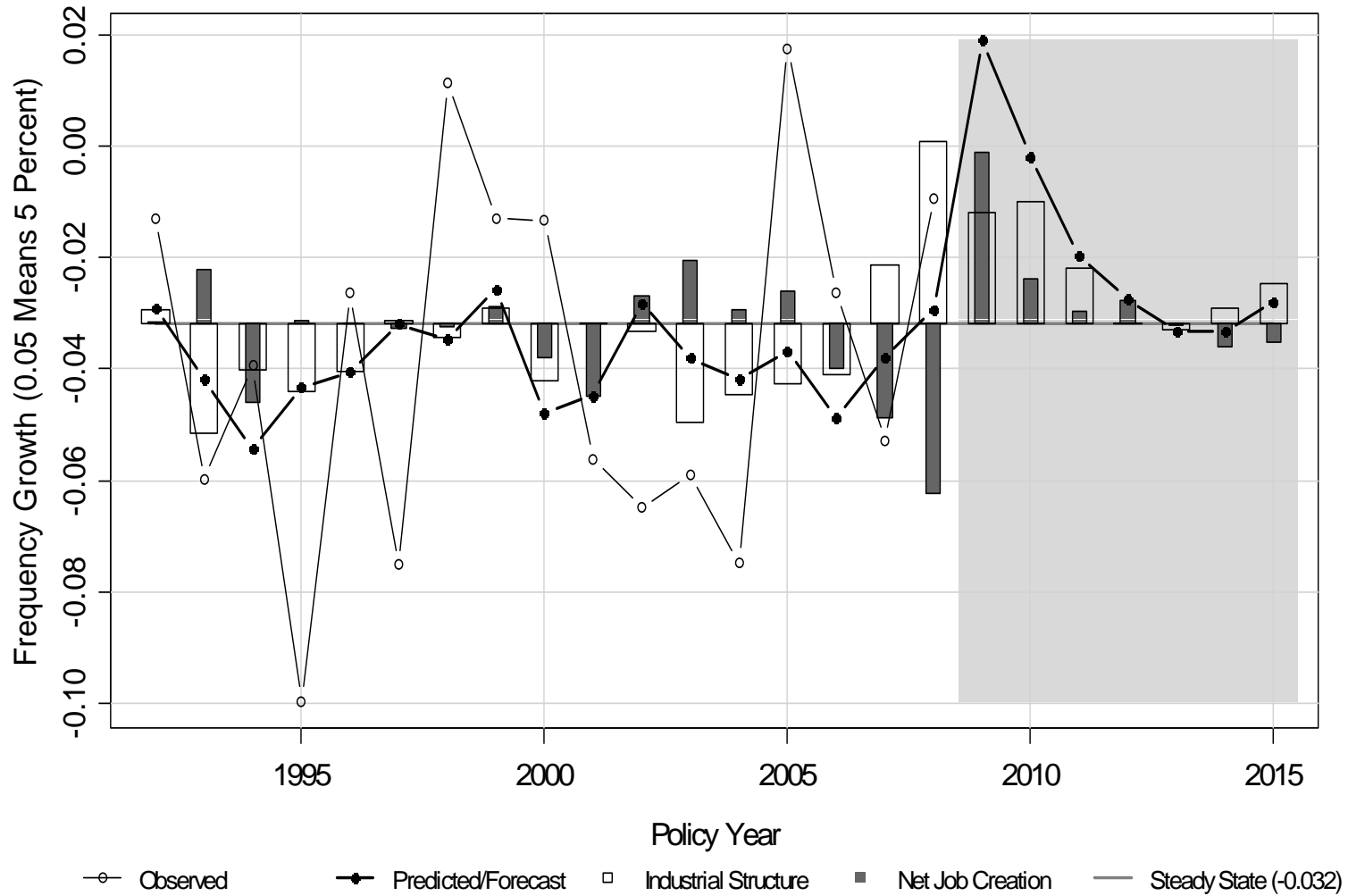
# State #3

## Job Losses in Construction Exceeded the National Average



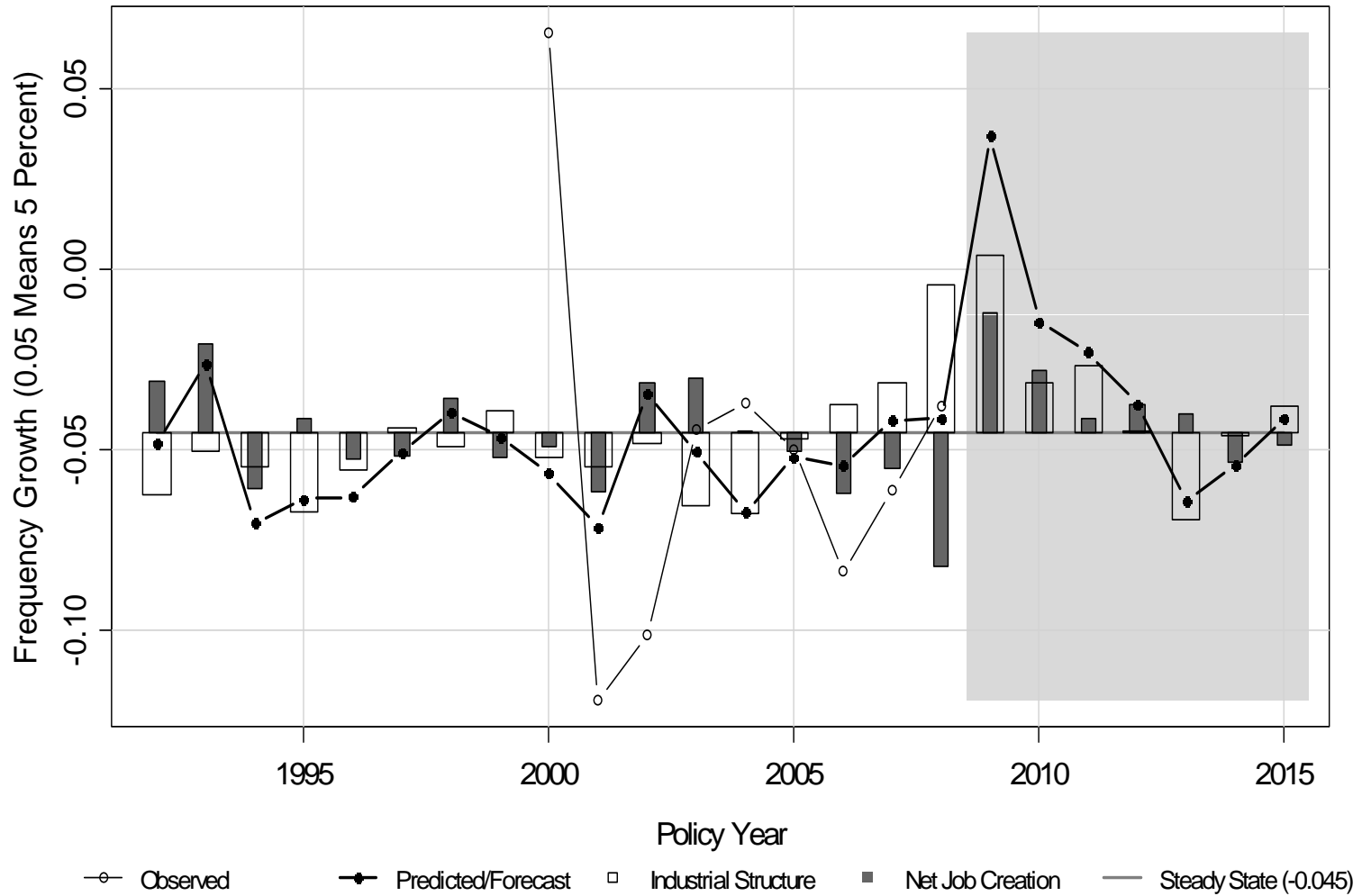
# State #4

## Job Losses in Construction Exceeded the National Average



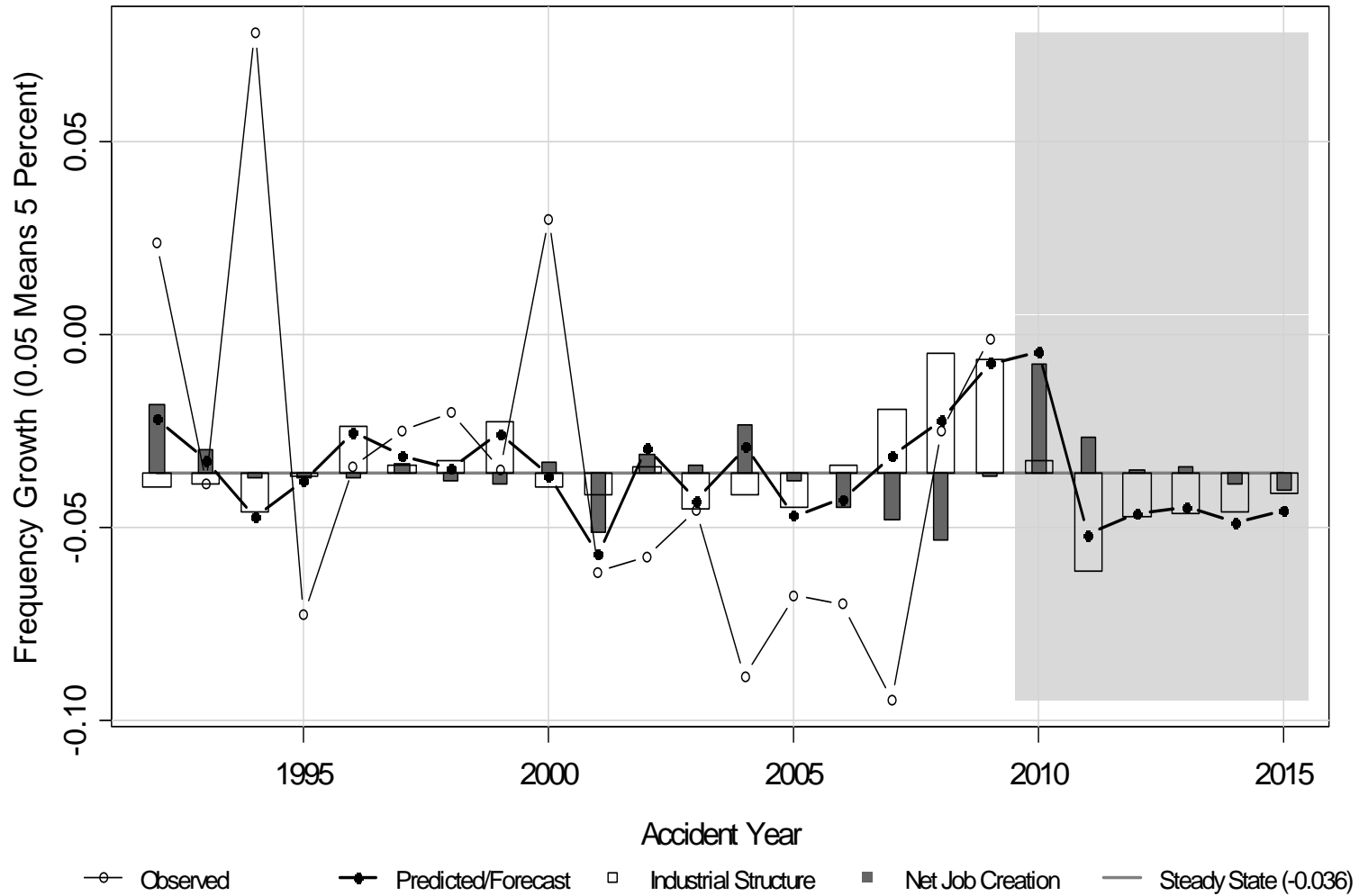
# State #5

## Job Losses in Construction Exceeded the National Average



# State #6

## Job Losses in Construction Exceeded the National Average



# Conclusion

## Summary of Findings

- The change in industrial structure concomitant with the 2007-2009 recession and its aftermath affects ratemaking loss cost components
  - The effect is largely due to the expansion and contraction of the construction sector
  - Thus, the effect is most pronounced in states that experienced a sharp downturn of the housing market
- There are offsetting effects on the part of the severities
  - Medical severity appears to be more responsive to a change in industrial structure than indemnity severity, although this finding should not be considered conclusive
- The effect is likely to be transitory
  - The rates of frequency and severity growth revert to their steady states as the economy returns to its trend rate of growth



# Caveat

- The model has not been tested using a holdout period
  - Such testing requires past employment forecasts (i.e., forecasts delivered in past years)
  - The ability of professional forecasters to anticipate recessions is limited
- The data exhibits a high degree of variance
- The steady state of frequency growth may have shifted with the industrial structure (although BLS data indicate little impact of the industrial structure on the rate of decline of workplace injury and illnesses per full-time equivalent employee)