Analyzing Workers Compensation Reform Impacts on Loss Development Patterns in NCCI Rate-Making

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Outline

- The Objective
- The Statistical Framework
- The Example of an Unidentified State
- Conclusion

The Statistical Framework

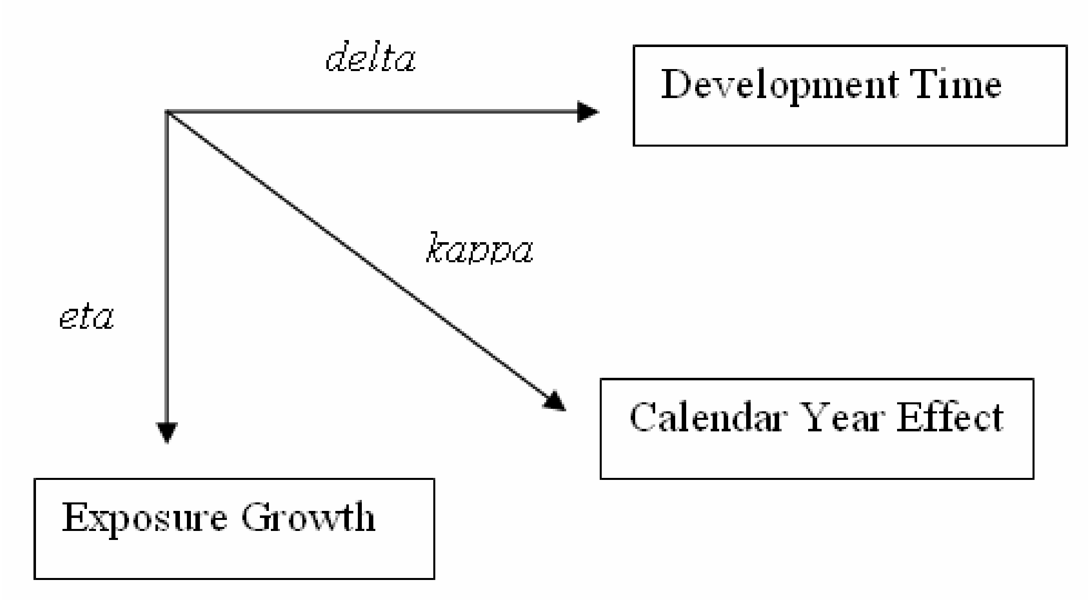
- Loss development can be modeled as a time series problem
- Once loss development is cast into a time series framework, the statistical technique of state-space modeling can be applied
- State-space models are flexible (by allowing for time-variation of parameters) and accommodating (to regulatory details)

The Statistical Framework

- There are three dimensions of time in a loss triangle
  - ✓ Exposure time (exposure growth across accident or policy years)
  - ✓ Calendar time (calendar year effect)
  - ✓ Development time (run-off, that is, decline in incremental payments, net of the calendar year effect)

The Statistical Framework

- The model is written in terms of (logarithmic) growth rates of incremental payments—these growth rates are allowed to be time-varying



The Statistical Framework

- The model is Bayesian
  - A (posterior) parameter estimate is the result of a prior that is taken to the data
    - All prior distributions are conjugate, that is, they are from the same family as the posterior distribution
    - Expert priors are used for the calendar year effect—to be discussed below

The Statistical Framework

- The model is estimated using the Metropolis-Hastings algorithm
  - The technique is also known as MCMC (Markov-chain Monte-Carlo simulation)
  - We use WinBUGS 1.4.2 and OpenBUGS 2.2.0 (the latter within the R package BRUGS)

The Statistical Framework

- The model fits to the logarithm of incremental payments
  - Negative incremental payments are coded as missing values
    - In Bayesian models, missing values are treated as parameters that need to be estimated

The Statistical Framework

- There is a stochastic add-up constraint in the model
  - This constraint ensures that for every development year, the sum of estimated incremental payments lines up with the observed cumulative payments
    - This technique, which is known as the cusum (cumulative sum) chart technique, is critical for interpolation when there are negative incremental payments

The Statistical Framework

- The calendar year effect (*kappa*)
  - An expert prior is used for the calendar year effect
    - Rate of CPI Medical Care inflation (“M-CPI”) for medical claims
    - Average weekly wage (QCEW), CPI, or fixed rate for escalating indemnity claims, depending the regulatory stipulation
    - Zero for non-escalating indemnity claims

The Statistical Framework

- The calendar year effect (*kappa*), *cont'd.*
  - The fraction of the incremental payment that goes to escalating indemnity claims is allowed to vary across development years
    - The model can handle up to two non-zero inflation rates (as demonstrated below)
    - The calendar year effect varies along the diagonal (as opposed to being constant on a given diagonal)

The Statistical Framework

- The calendar year effect (*kappa*), *cont'd.*
  - The inflation rate pertinent to workers compensation (WC) claims is known up to a constant
    - WC Infl. Rate = *kappa* + constant + error term
  - For instance, if the WC-pertinent rate of medical inflation differs systematically to M-CPI inflation, then this difference (the "constant") feeds into the run-off rate (*delta*)

The Statistical Framework

- The calendar year effect (*kappa*), cont'd.
  - Because any systematic difference between the WC-pertinent rate of inflation and the official rate of inflation feeds into the run-off rate (*delta*), it is this official rate of inflation (e.g., the M-CPI) that is relevant when projecting payments into the future
  - It is known that rates of inflation are close to random walks, which implies that the best forecast for any future rate of inflation is the current rate

The Statistical Framework

- The run-off rate (*delta*)
  - We assume a stationary rate of run-off for the unobserved development years
  - The projected rate of run-off merges with the rate of mortality (www.ssa.gov) in development year 60, unless the run-off is faster
    - No dynamic mortality model is used
      - According to a special report in the *New England Journal of Medicine* 352(11), pp.1138-1145, there is little ground for assuming continued gains in life expectancy

The Example of an Unidentified State

- Regulatory reforms
  - 1982
  - 1986 (minor; effect is modeled but not broken out)
  - 1990
  - 1992

The Example of an Unidentified State

- The object is to model the effect of the 1990/92 reform cluster on the loss development pattern
  - Pre-reform: Policy years 1983 through 1989
  - Post-reform: Policy years 1993-2004

The Example of an Unidentified State

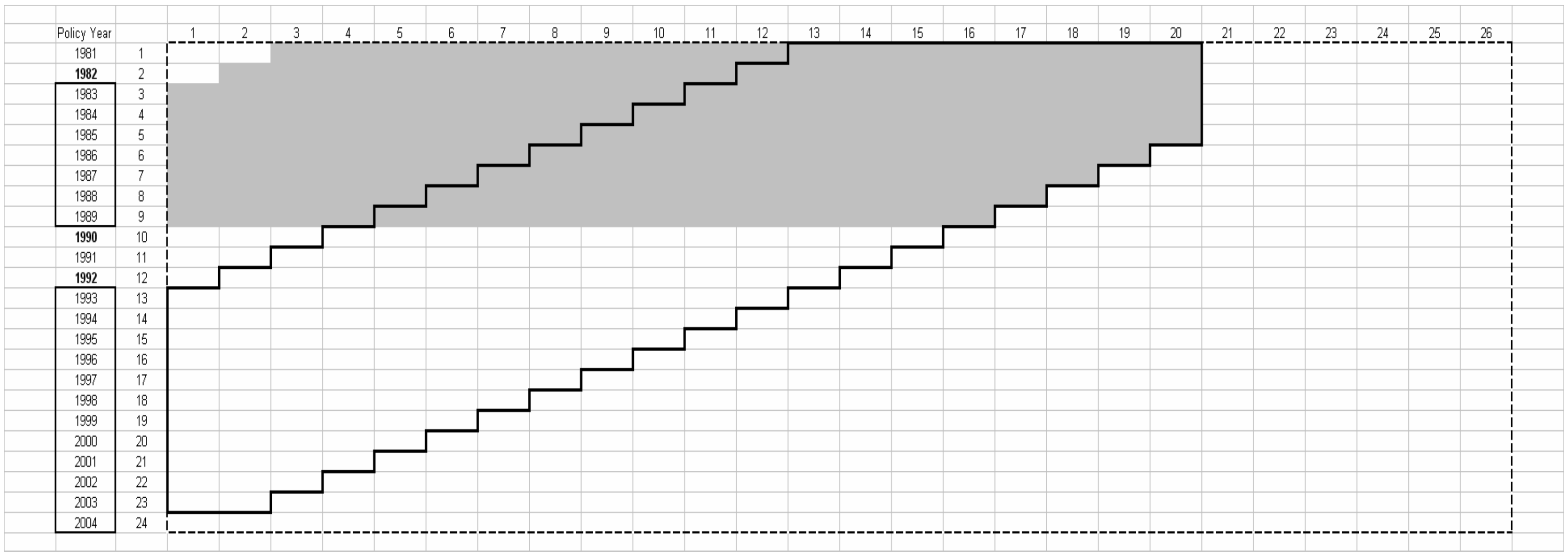
- Major reform items
  - Introduction of escalation of indemnity benefits at the rate of the CPI (regardless of the date of injury) for PTD claims, effective May 1991
    - Indemnity benefits for Fatal claims had been escalating at a fixed rate of 4 percent since June 1986
      - The model accounts for the escalation of Fatal claims, but the effect of this reform is not broken out in the following analysis (as mentioned)

The Example of an Unidentified State

- Major reform items, cont'd.
  - Limitation of TTD claims to 52 weeks
  - Tightening of standards for continued eligibility of indemnity benefits
  - For injuries past age 55, there is an immediate retirement offset; otherwise, there is a retirement offset starting five years prior to the official retirement age

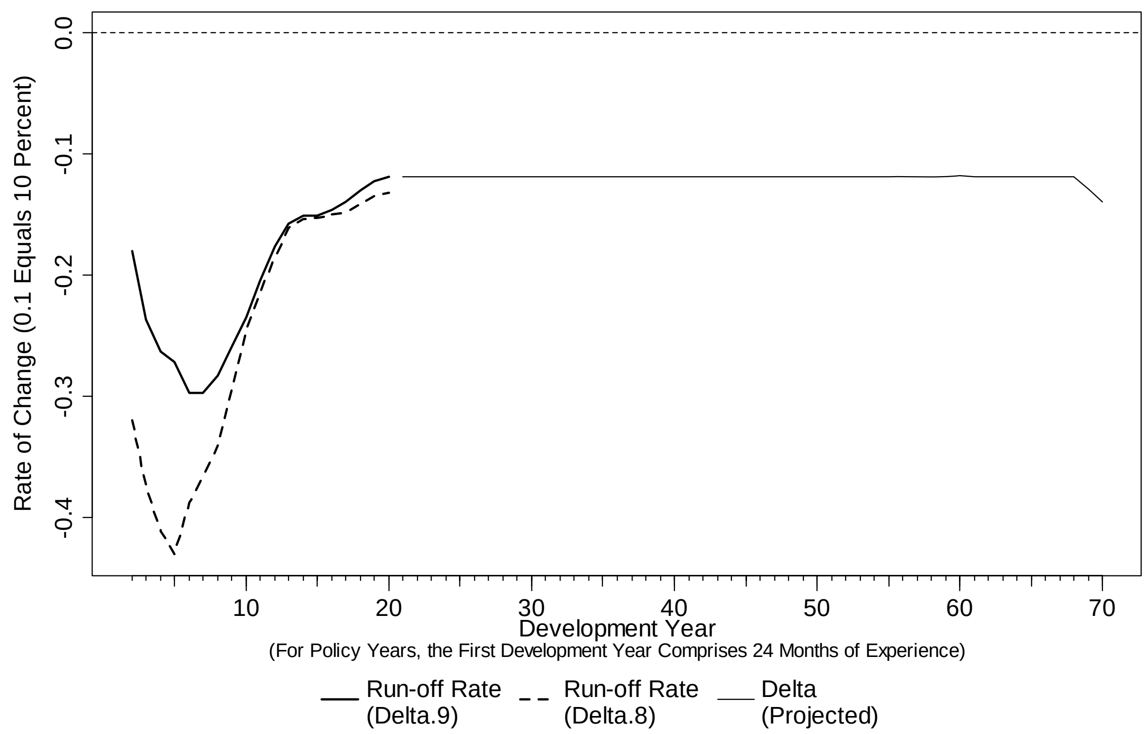
The Example of an Unidentified State

- Pre-reform and post-reform “triangles”



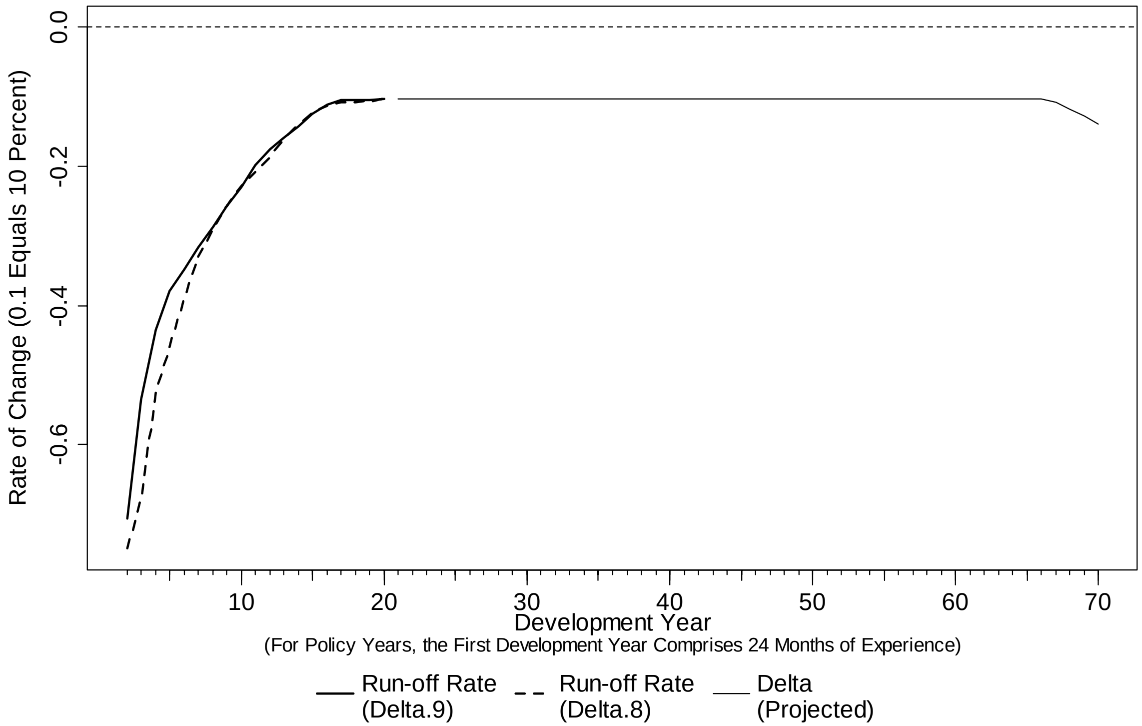
The Example of an Unidentified State

- Indemnity: *delta* (“9”: pre-reform; “8”: post-reform)



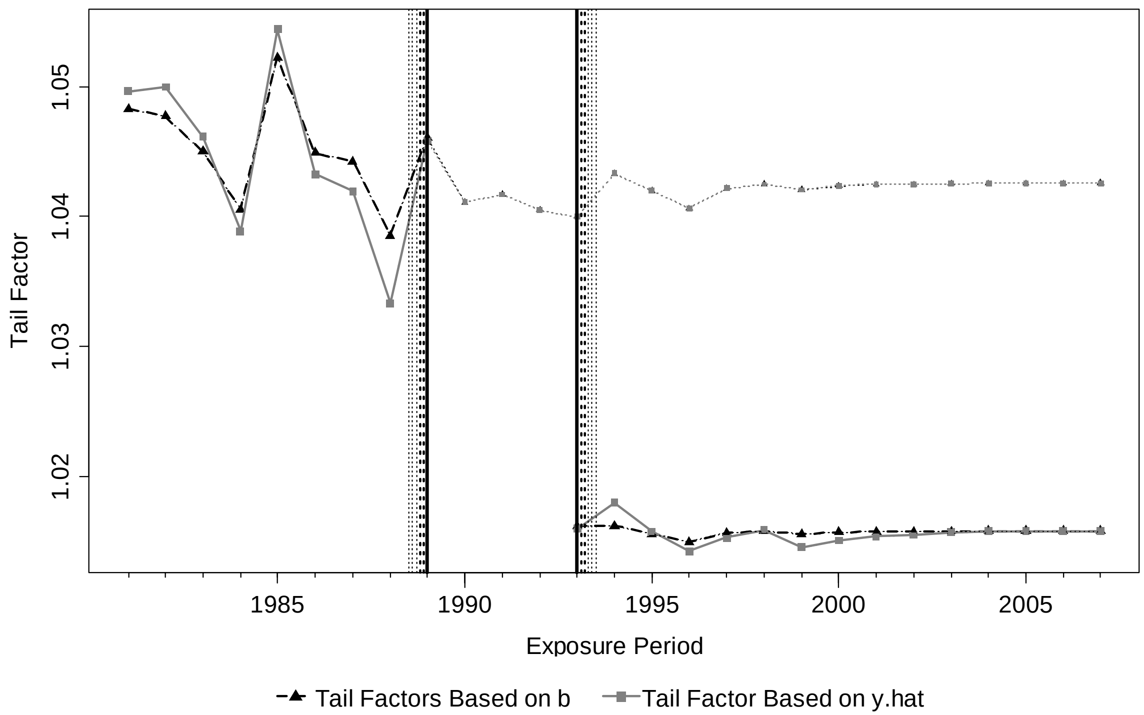
The Example of an Unidentified State

- Medical: *delta* (“9”: pre-reform; “8”: post-reform)



The Example of an Unidentified State

- Indemnity: Tail Factors by Regulatory Regime



The Example of an Unidentified State

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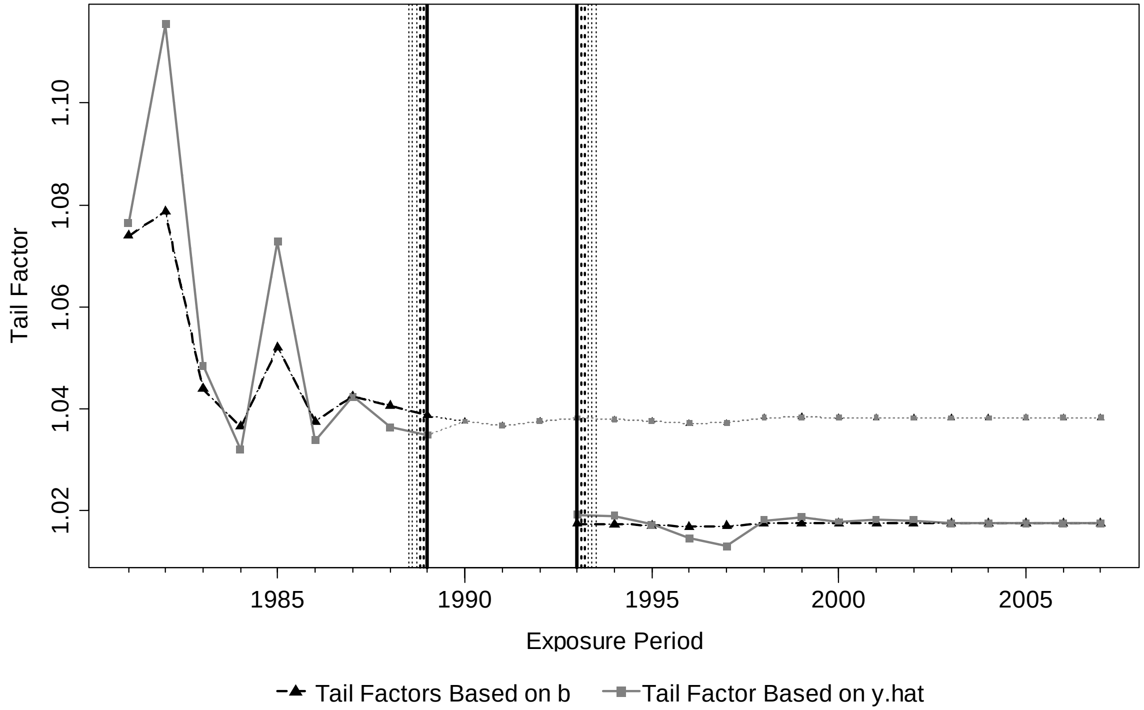
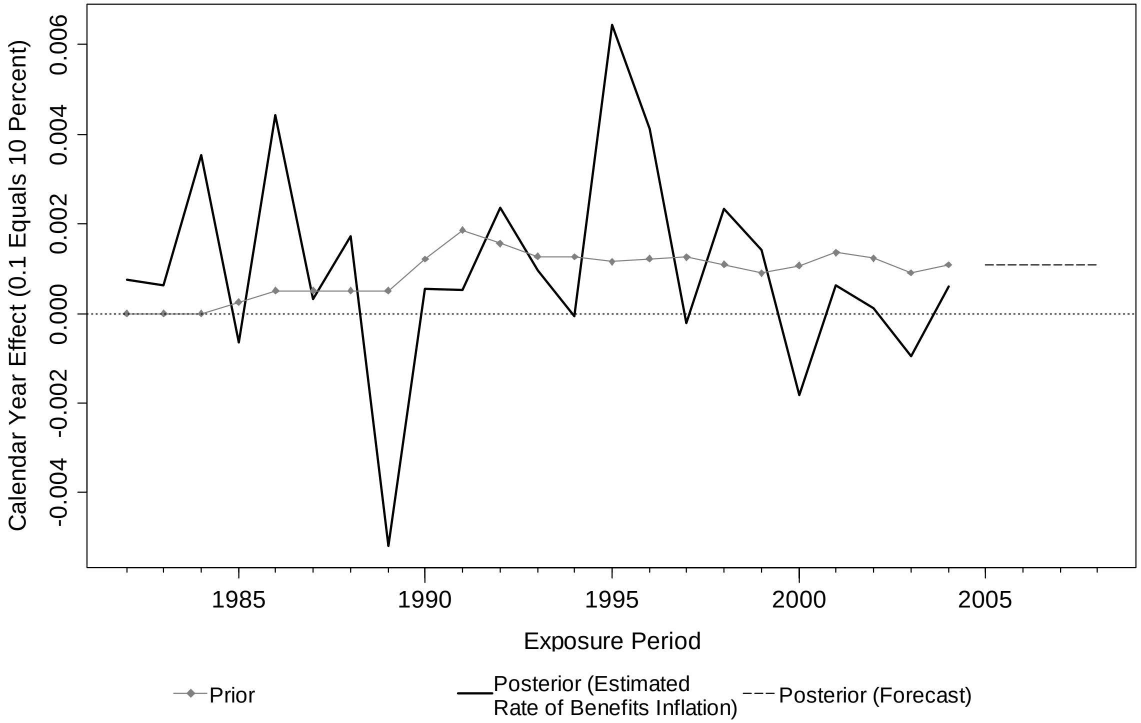


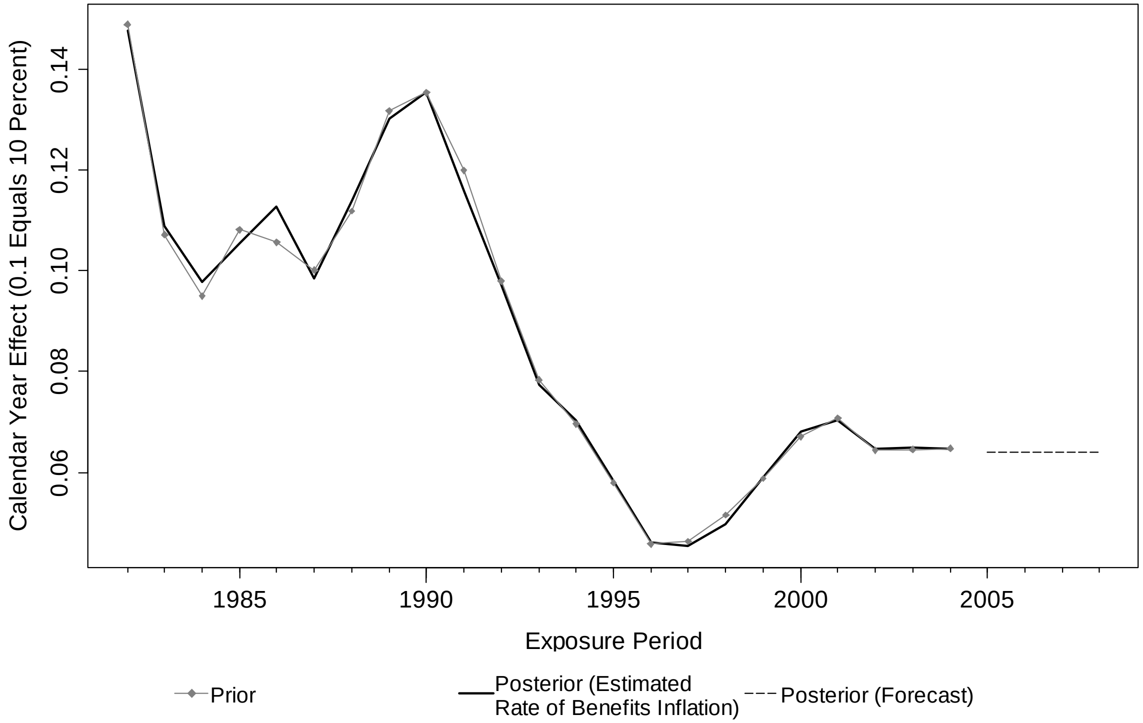
The Example of an Unidentified State

- Indemnity: Calendar Year Effect in First Column



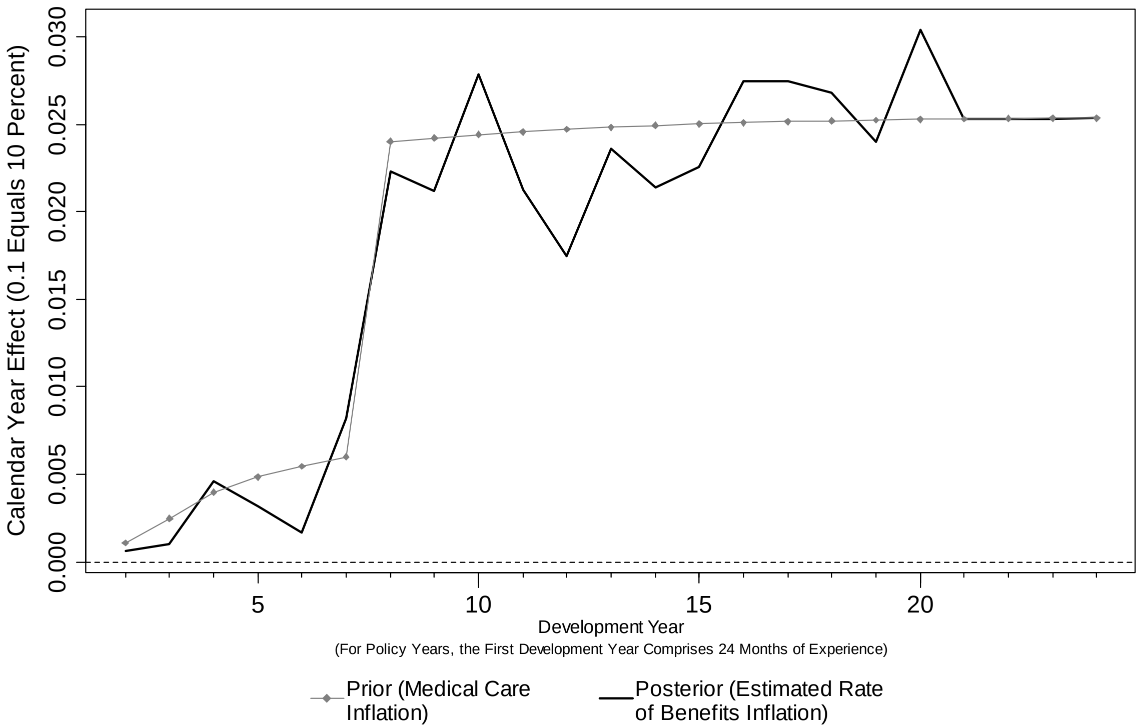
The Example of an Unidentified State

- Medical: Calendar Year Effect in First Column



The Example of an Unidentified State

- Indemnity: Calendar Year Effect on Final Diagonal



The Example of an Unidentified State

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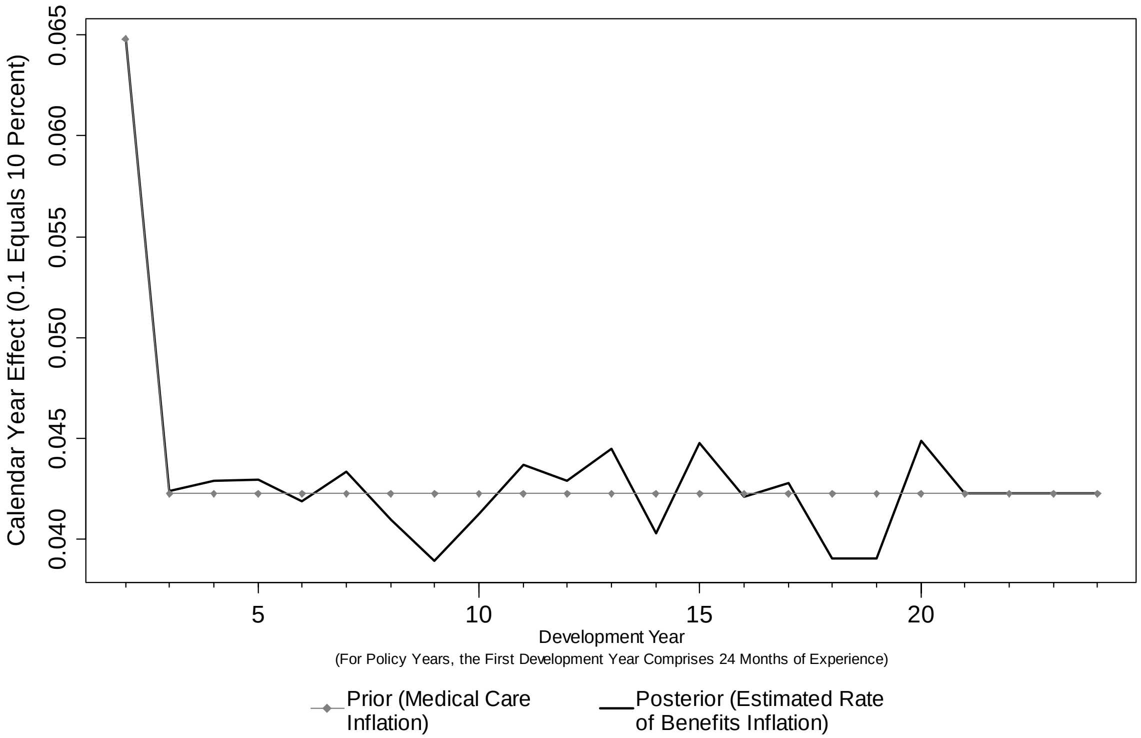

Conclusion

- NCCI has devised a loss development model that is capable of incorporating detailed statutory provisions
- The model allows the estimation of tail factors according to the applicable regulatory setting
- The model is capable of quantifying the impact of regulatory reforms on the ultimate loss and, hence, the tail factor