Workers Compensation:
New Developments in Development

Loss Development in Workers Compensation in the Presence of Legislative Reform

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Thanks to Chris Laws, Jose Ramos, and Manuel de la Guardia for research assistance

CAS Spring Meeting
Quebec City
June 16, 2008

Outline

- The Objective
- The Statistical Framework
- Application to an Unidentified State
- Conclusion

The Objective

- The development pattern of workers compensation losses is highly dependent on the legislative environment

- The loss development approach to estimating the ultimate loss and tail factor for NCCI ratemaking and reserving must be responsive to an changing legislative environment

  – The impact of the legislative environment on the development pattern can be quite complex, comprising both diagonal (calendar-year) effects and horizontal (exposure year) effects

The Statistical Framework

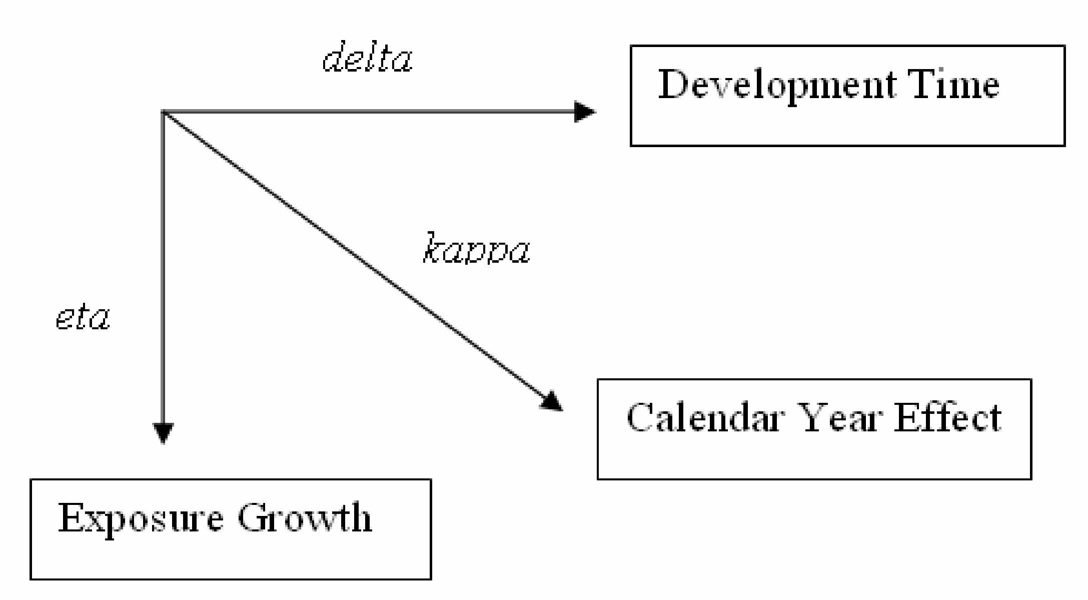
- Loss development can be modeled as a time series problem
- Once loss development is cast into a time series framework, the statistical technique of state-space modeling can be applied
- State-space models are flexible (by allowing for time-variation of parameters) and accommodating (to legislative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

The Statistical Framework

- There are three time axes in a loss triangle, which allow losses to grow in three dimensions
  - Exposure time
    - Exposure growth across accident or policy years
  - Calendar time
    - Calendar year effect
  - Development time or, synonymously, maturity
    - Run-off of incremental payments as claims mature, 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 based on 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 1.4.3 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 legislative 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 identified 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

Application to an Unidentified State

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

Application to 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

Application to an Unidentified State

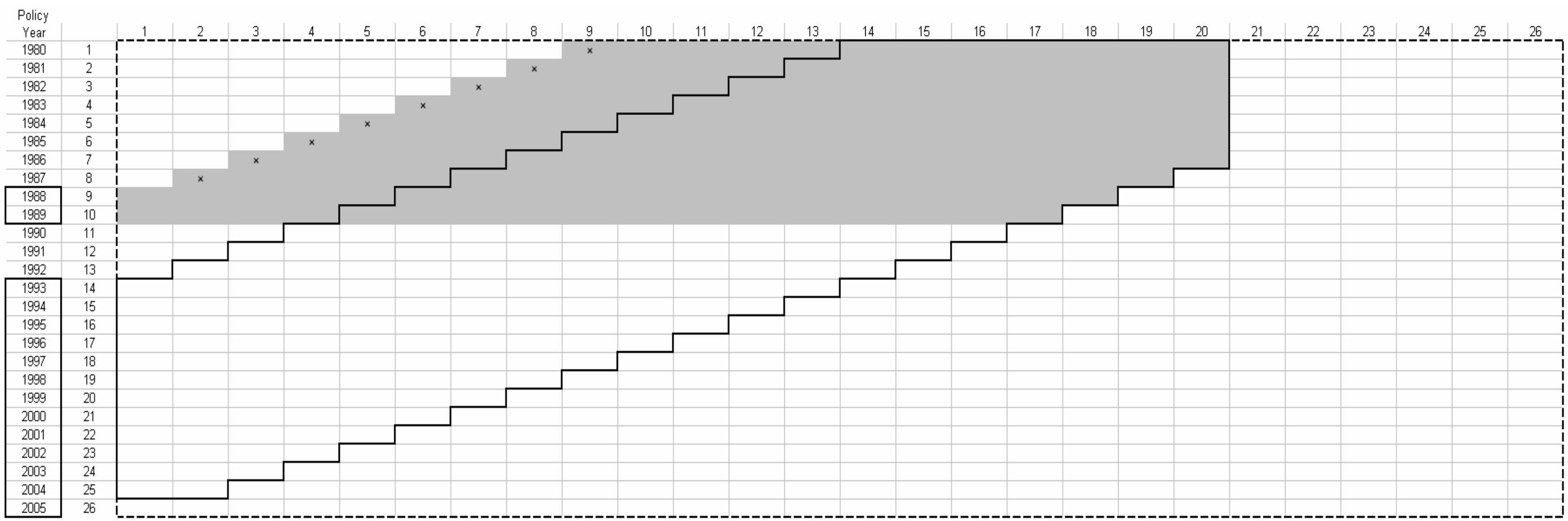
- Major reform items
  - Introduction of escalation of indemnity benefits at the rate of the CPI (regardless of the date of injury) for PTD claims, effective May 1991
    - Indemnity benefits for Fatal claims had been escalating at a fixed rate of 4 percent since June 1986
      - The model accounts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

Application to 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

Application to an Unidentified State

- Pre-reform and post-reform “triangles”

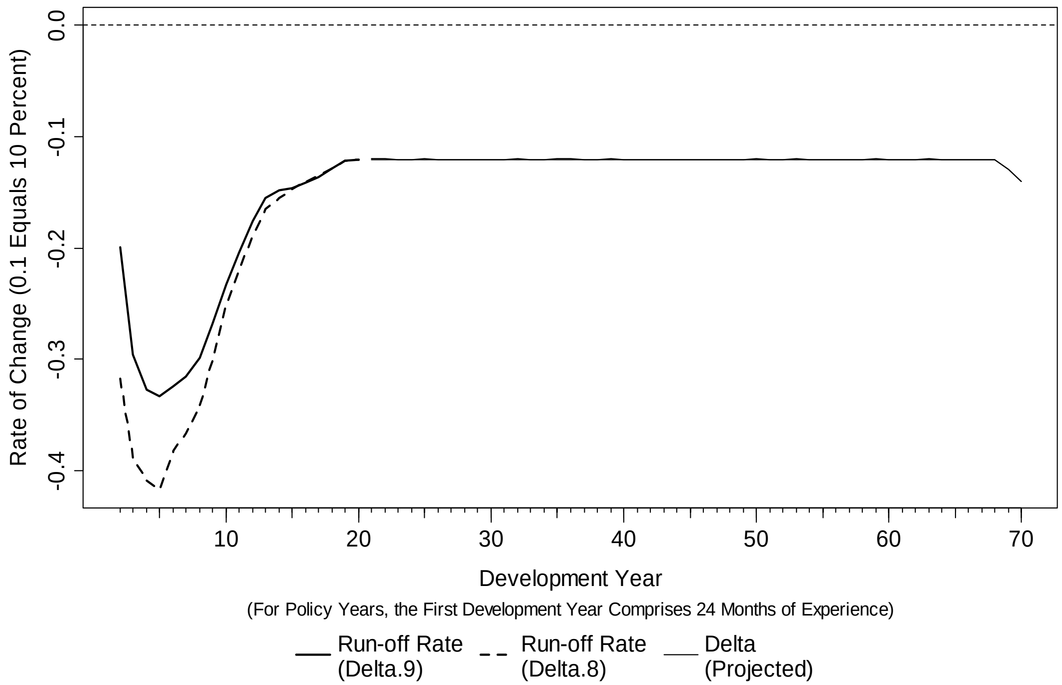


Shaded: Pre-reform; framed: Post-reform

×: only cumulative payments available

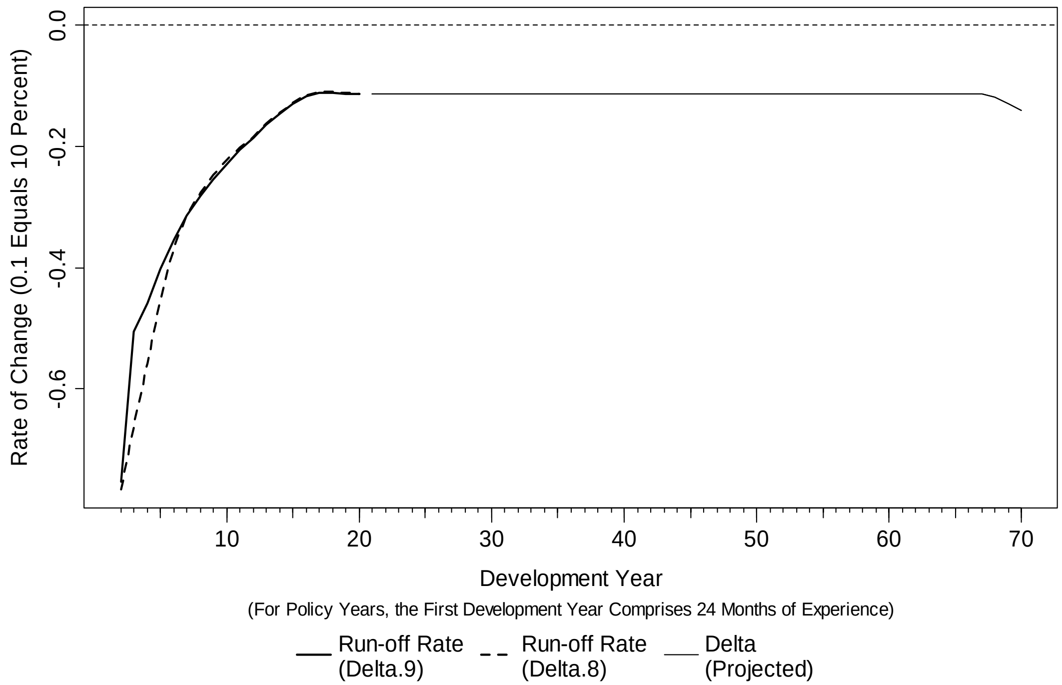
Application to an Unidentified State

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



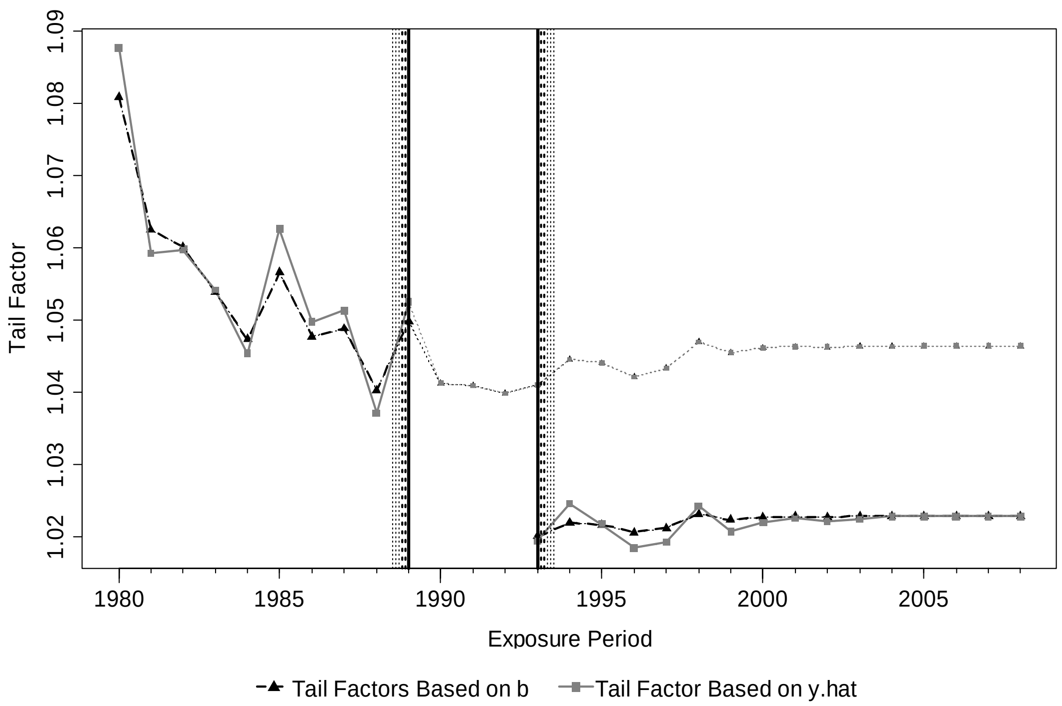
Application to an Unidentified State

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



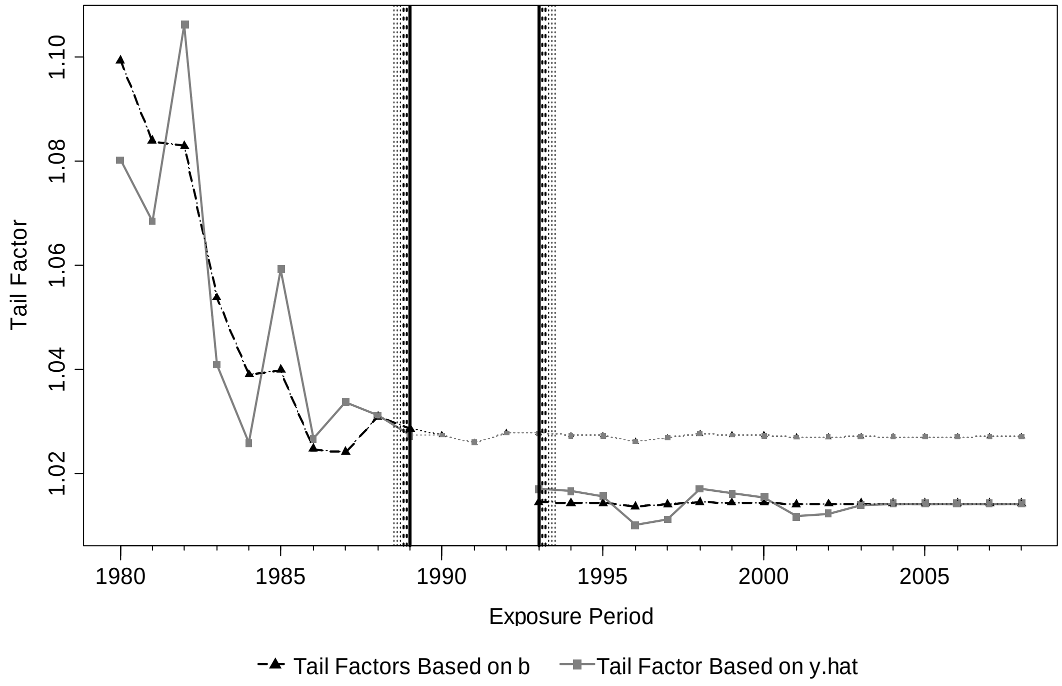
Application to an Unidentified State

- Indemnity: Tail Factors by Regulatory Regime



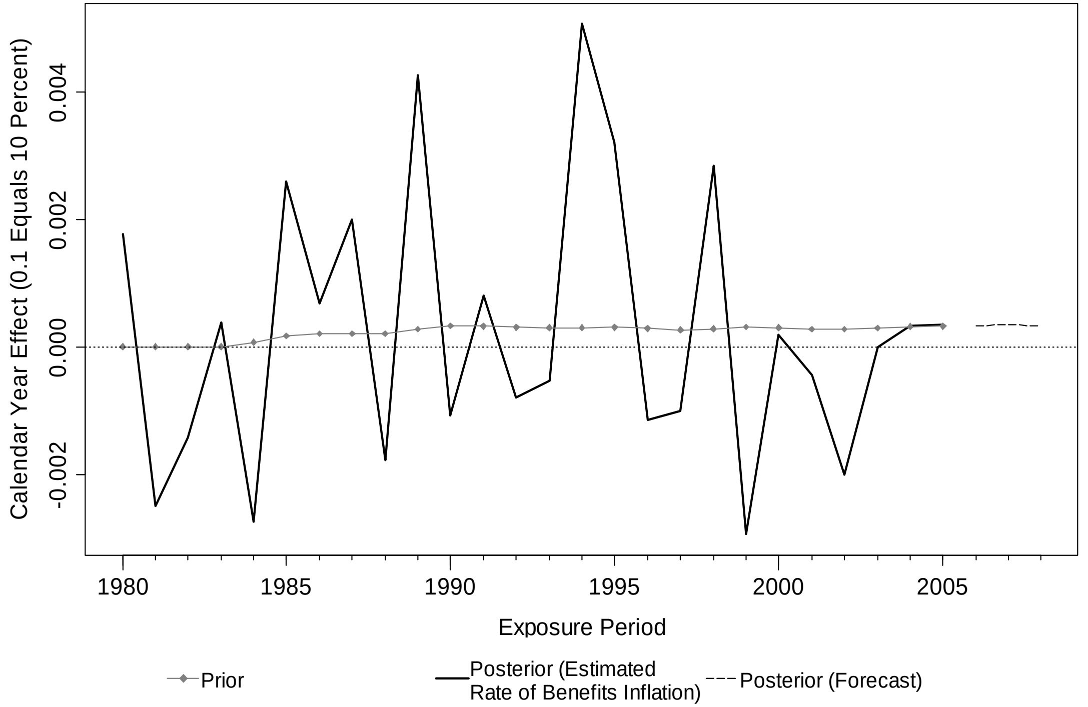
Application to an Unidentified State

- Medical: Tail Factors by Regulatory Regime



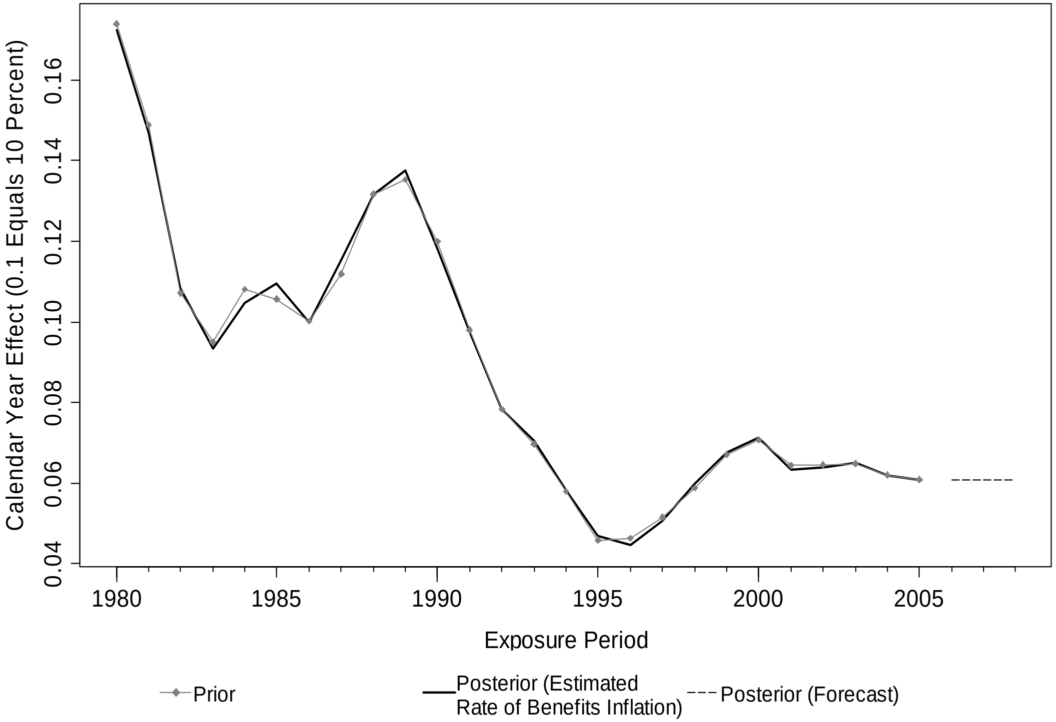
Application to an Unidentified State

- Indemnity: Calendar Year Effect in First Column



Application to an Unidentified State

- Medical: Calendar Year Effect in First Column

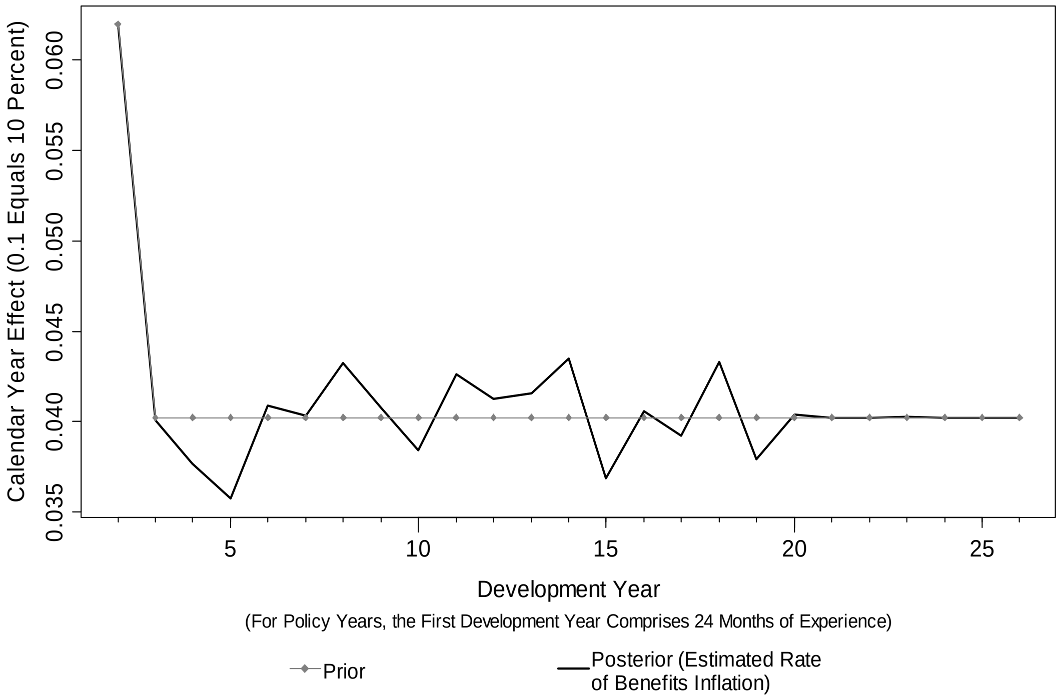


Application to an Unidentified State

- Indemnity: Calendar Year Effect on Final Diagonal

Application to an Unidentified State

- Medical: Calendar Year Effect on Final Diagonal



Conclusion

- NCCI has devised a loss development model that is capable of incorporating detailed legislative provisions
- The model allows for 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