Loss Development in Workers Compensation in the Presence of Legislative Reform

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CLRS 2008

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Outline

- The Objective
- The Statistical Framework
- Application to an Unidentified State
- Conclusion
- Current Enhancements in Progress

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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 a 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

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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)

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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

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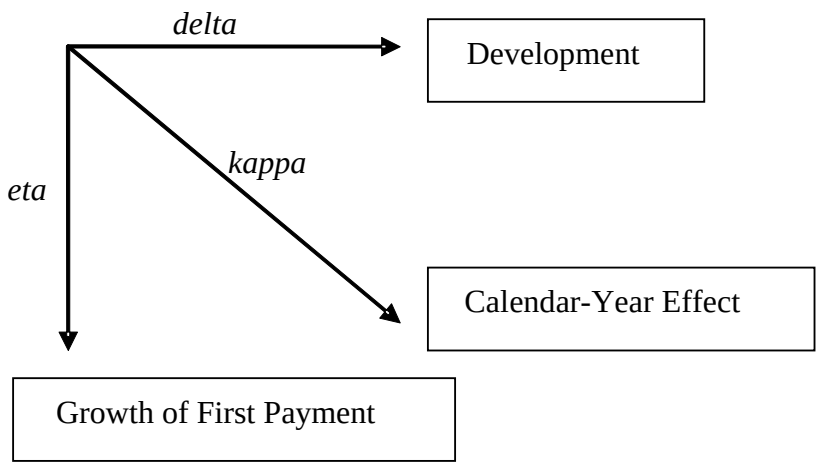
The Statistical Framework

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



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The Statistical Framework

- The model is Bayesian
  - The model is estimated by means of MCMC (Markov-chain Monte-Carlo simulation)
  - We use OpenBUGS 2.2.0 (within the R package BRUGS)

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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 two triangles are estimated jointly

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The Statistical Framework

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

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The Statistical Framework

- The calendar year effect (*kappa*)
  - The calendar year effect is modeled in a multi-level framework
    - At the first level, which pertains to the individual cell on the diagonal, the calendar year effect is normally distributed around its expert prior
    - At the second level, which pertains to the diagonal, the calendar year effect is normally distributed around zero

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The Statistical Framework

- The calendar year effect (*kappa*), *cont'd*
  - For indemnity, the expert prior is a weighted average of the average weekly wage (QCEW), the CPI, a fixed rate of escalation, and zero, depending on the legal stipulation in place and on the claims composition in the given development year
  - For medical, the expert prior is the M-CPI

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The Statistical Framework

- The calendar year effect (*kappa*), *cont'd*
  - Note that any systematic difference between the inflation rate pertinent to workers compensation and the official rate of inflation feeds into the run-off rate (*delta*), it is the official rate of inflation (e.g., the M-CPI) that is relevant when projecting payments into the future
    - For future calendar years, the official rate of inflation is assumed to follow a random walk with a small innovation variance (so as to model the *trend* rate of inflation)
  - The second-level calendar-year effect mean-reverts to zero in future calendar years according to the ACF (auto-correlation function) embedded in the history of this effect over the estimated time period

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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

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Application to an Unidentified State

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

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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

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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)

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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

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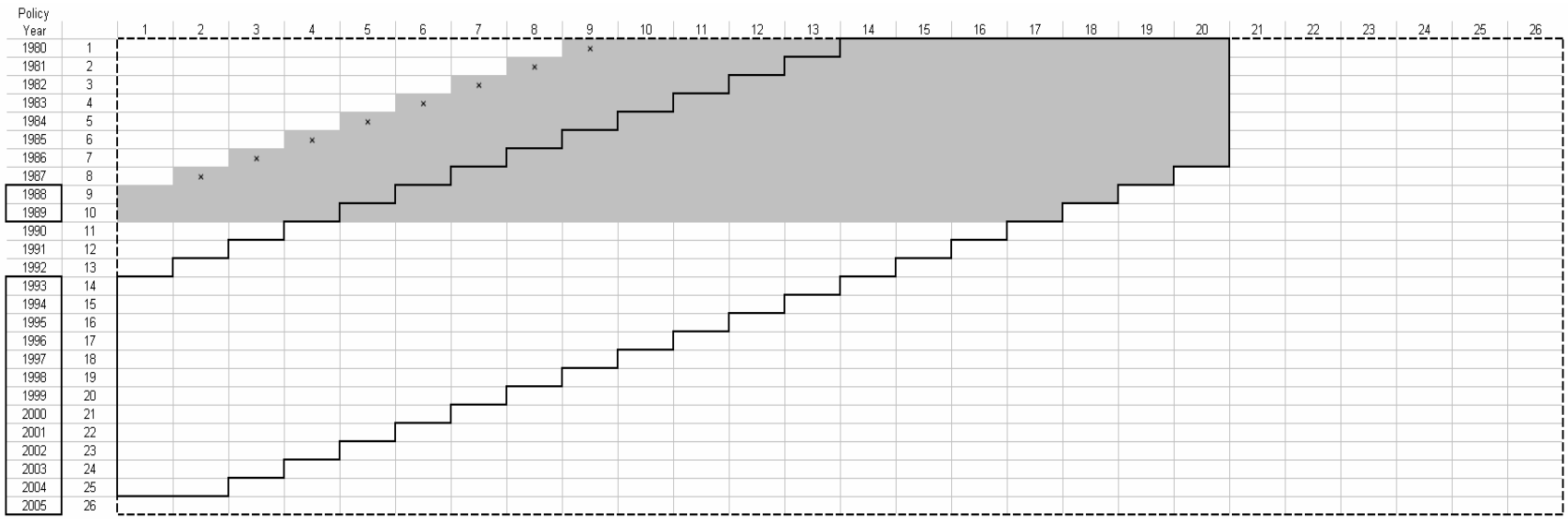
Application to an Unidentified State

- Pre-reform and post-reform “triangles”



Shaded: Pre-reform; framed: Post-reform

×: only cumulative payments available

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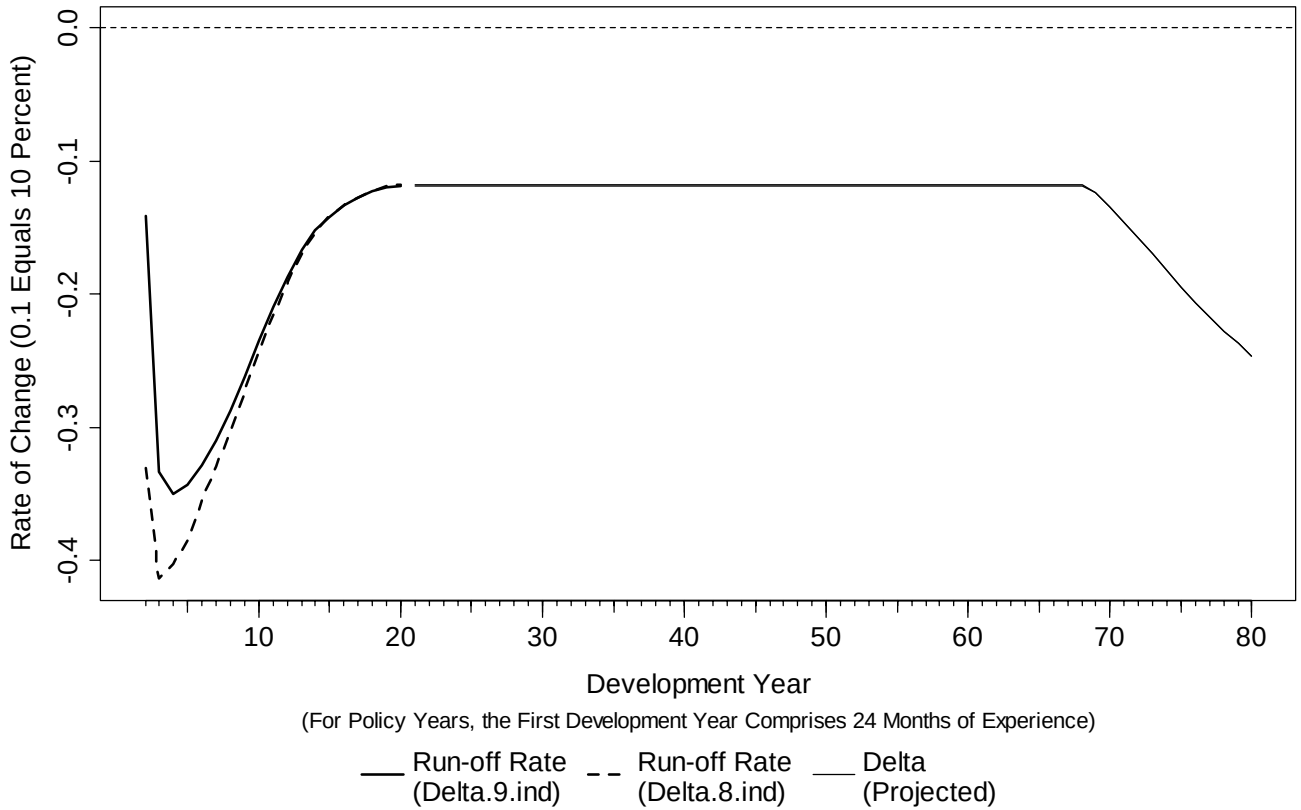
Application to an Unidentified State

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



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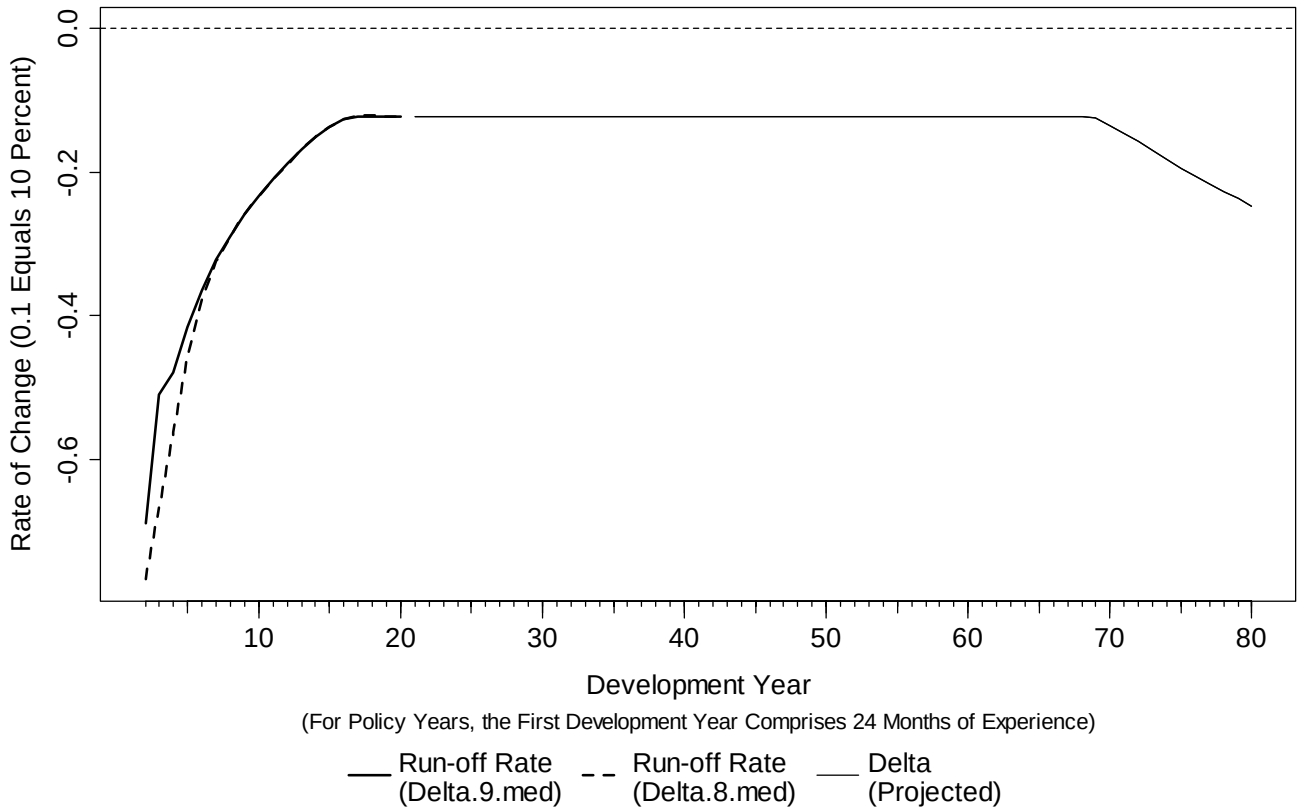
Application to an Unidentified State

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



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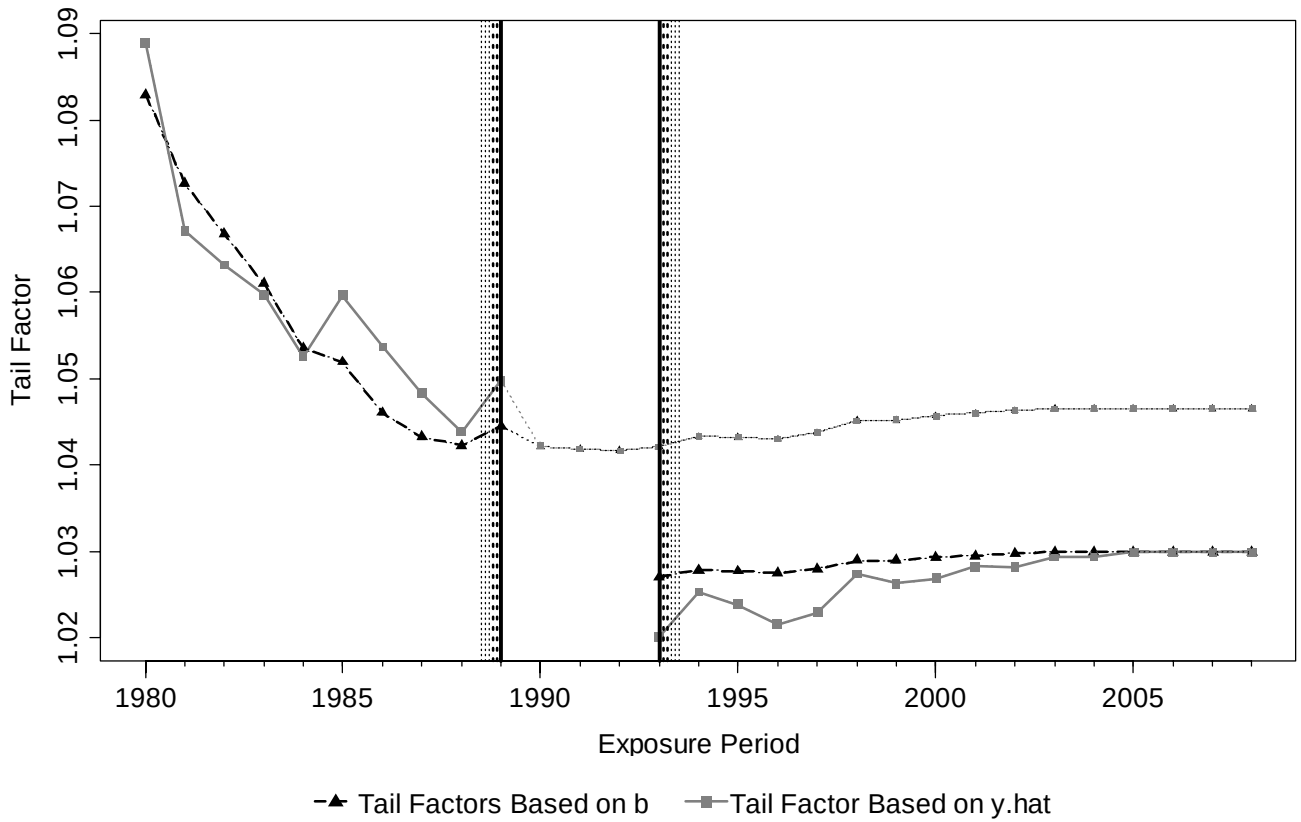
Application to an Unidentified State

- Indemnity: Tail Factors by Regulatory Regime



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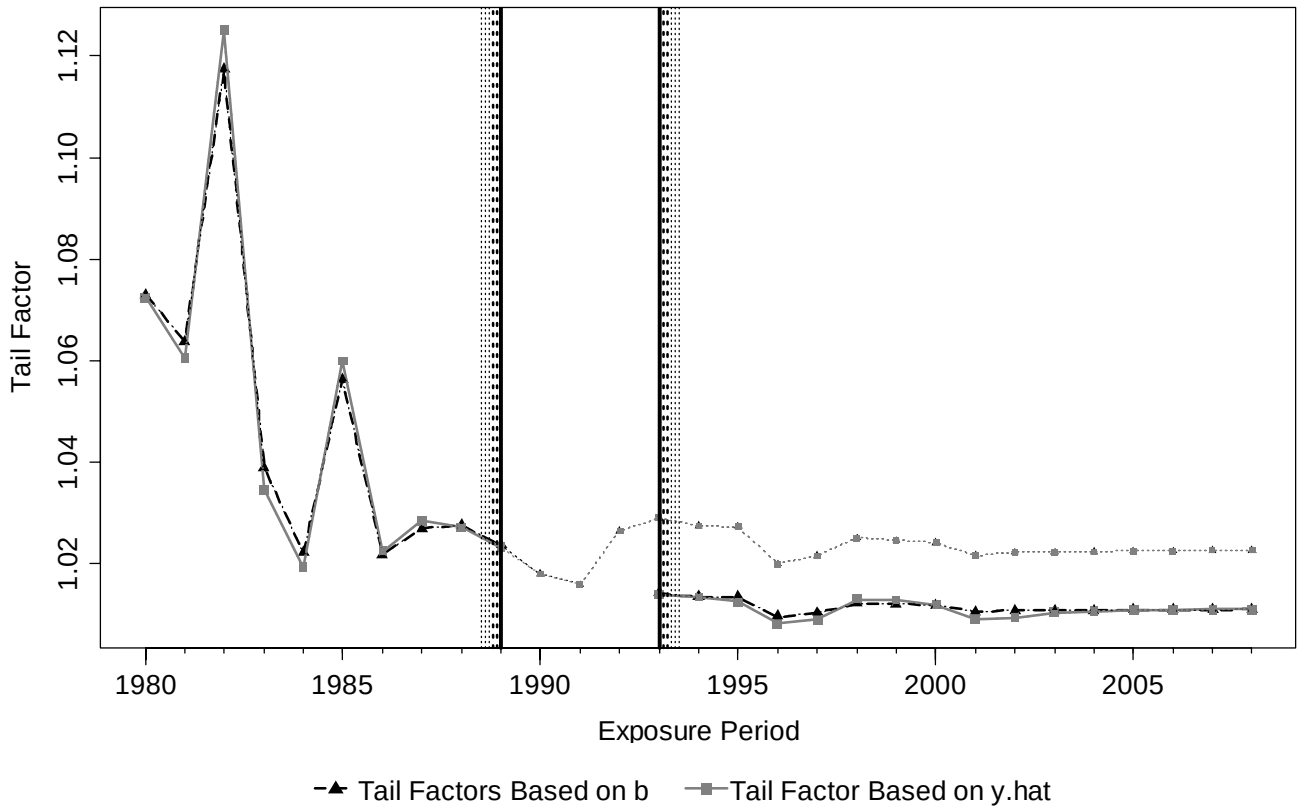
Application to an Unidentified State

- Medical: Tail Factors by Regulatory Regime



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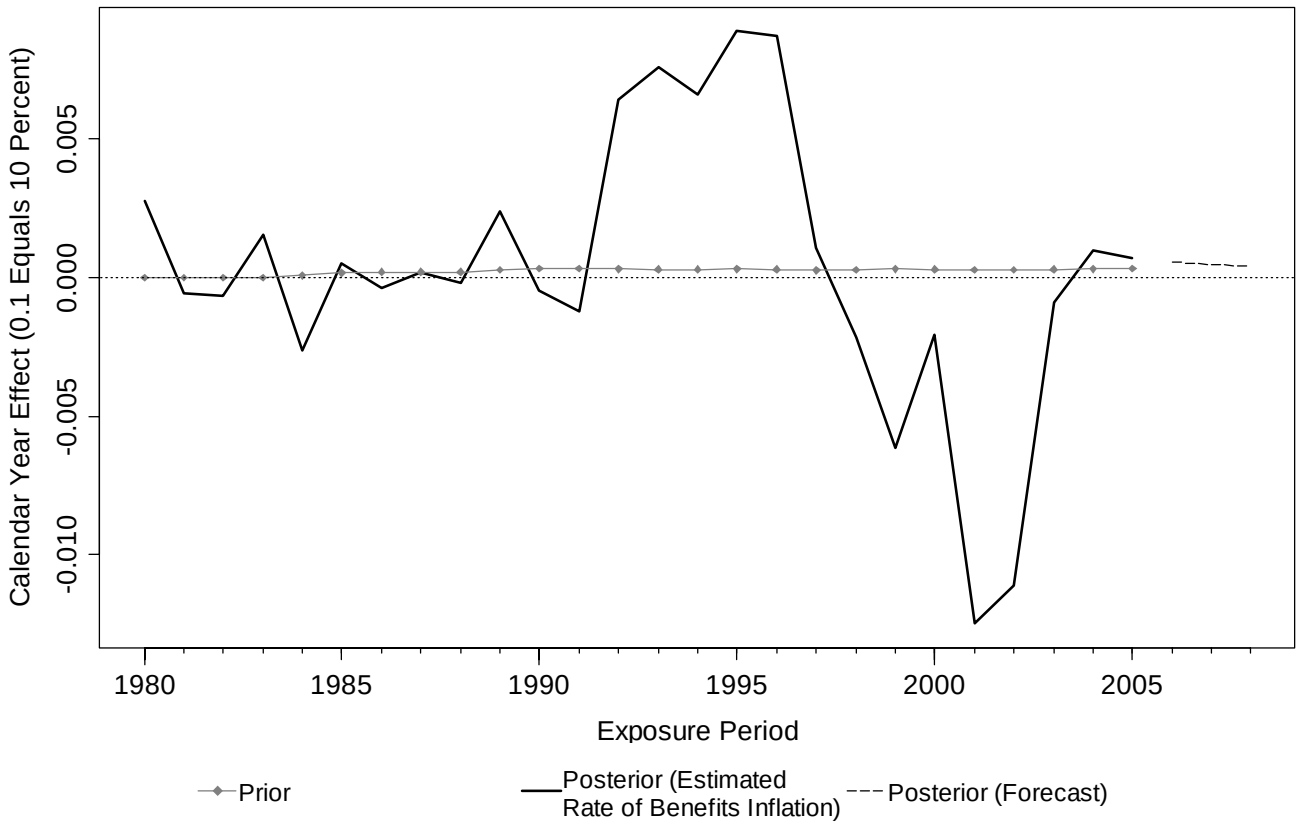
Application to an Unidentified State

- Indemnity: Calendar Year Effect in First Column



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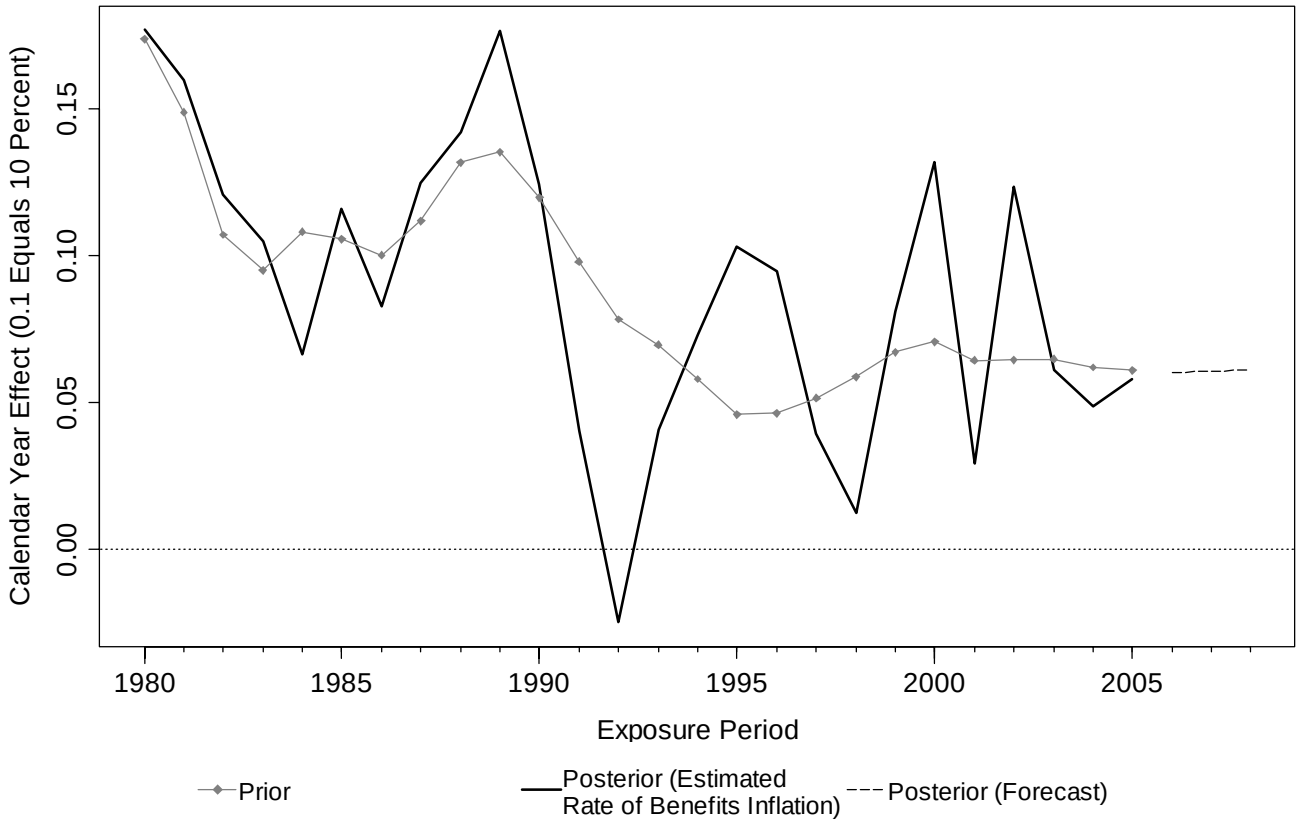
Application to an Unidentified State

- Medical: Calendar Year Effect in First Column



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Application to an Unidentified State

- Indemnity: Calendar Year Effect on Final Diagonal

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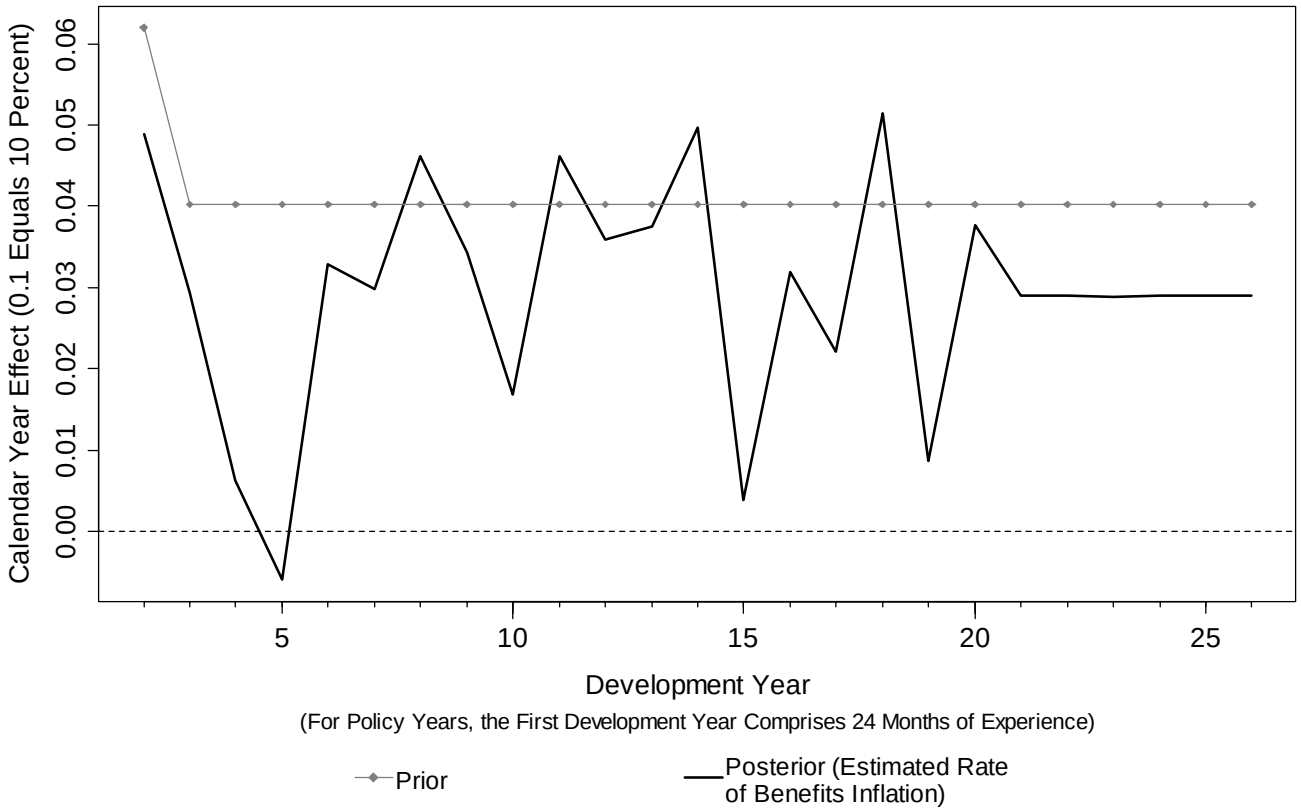
Application to an Unidentified State

- Medical: Calendar Year Effect on Final Diagonal



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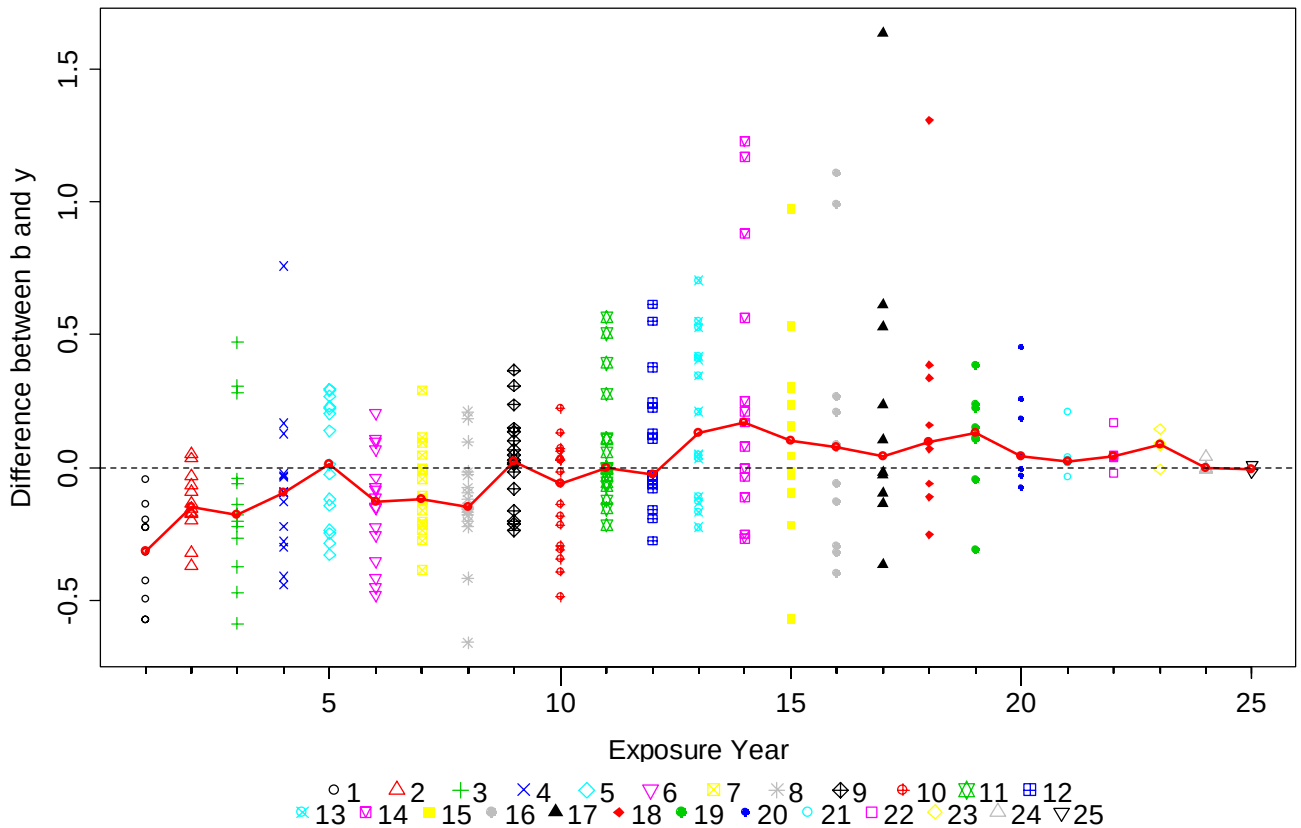
Application to an Unidentified State

- Indemnity: Residuals by Policy (Exposure) Year



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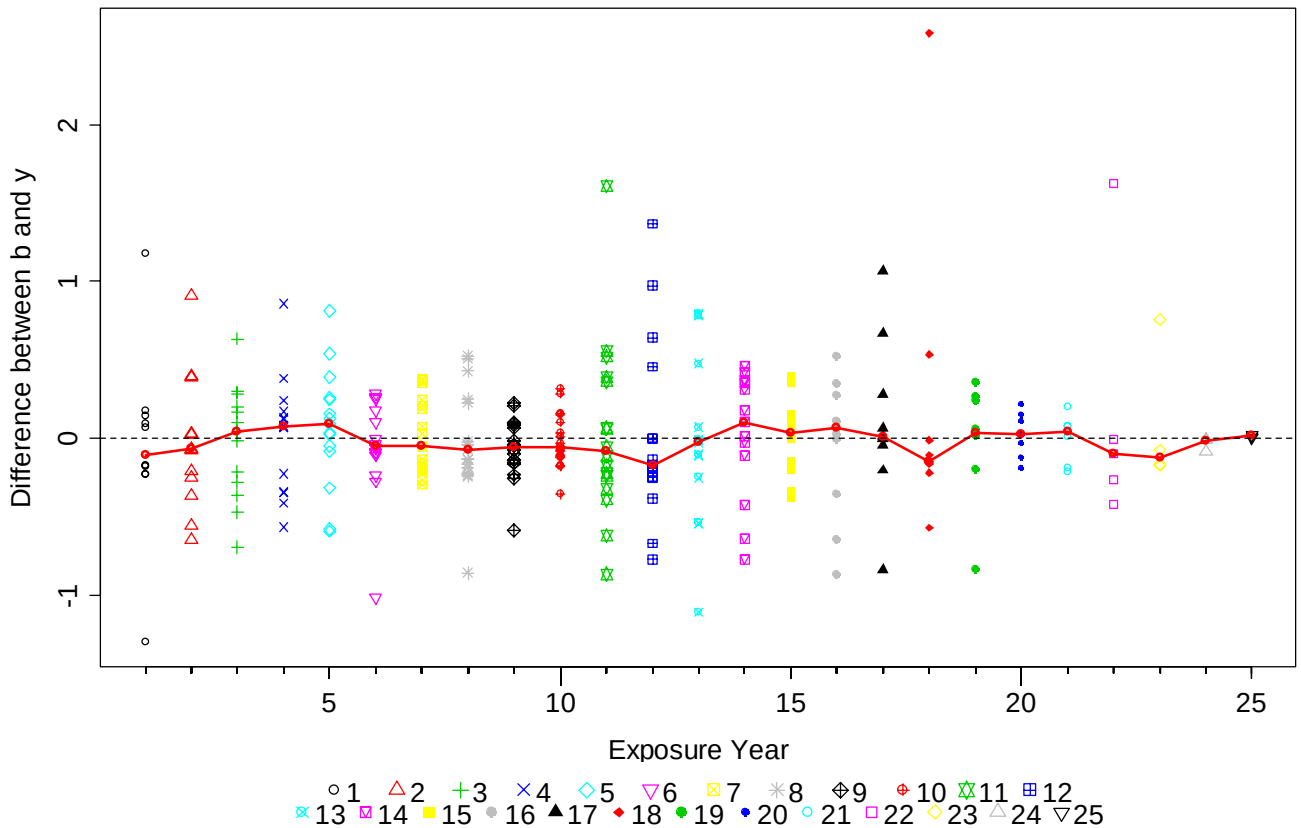
Application to an Unidentified State

- Medical: Residuals by Policy (Exposure) Year



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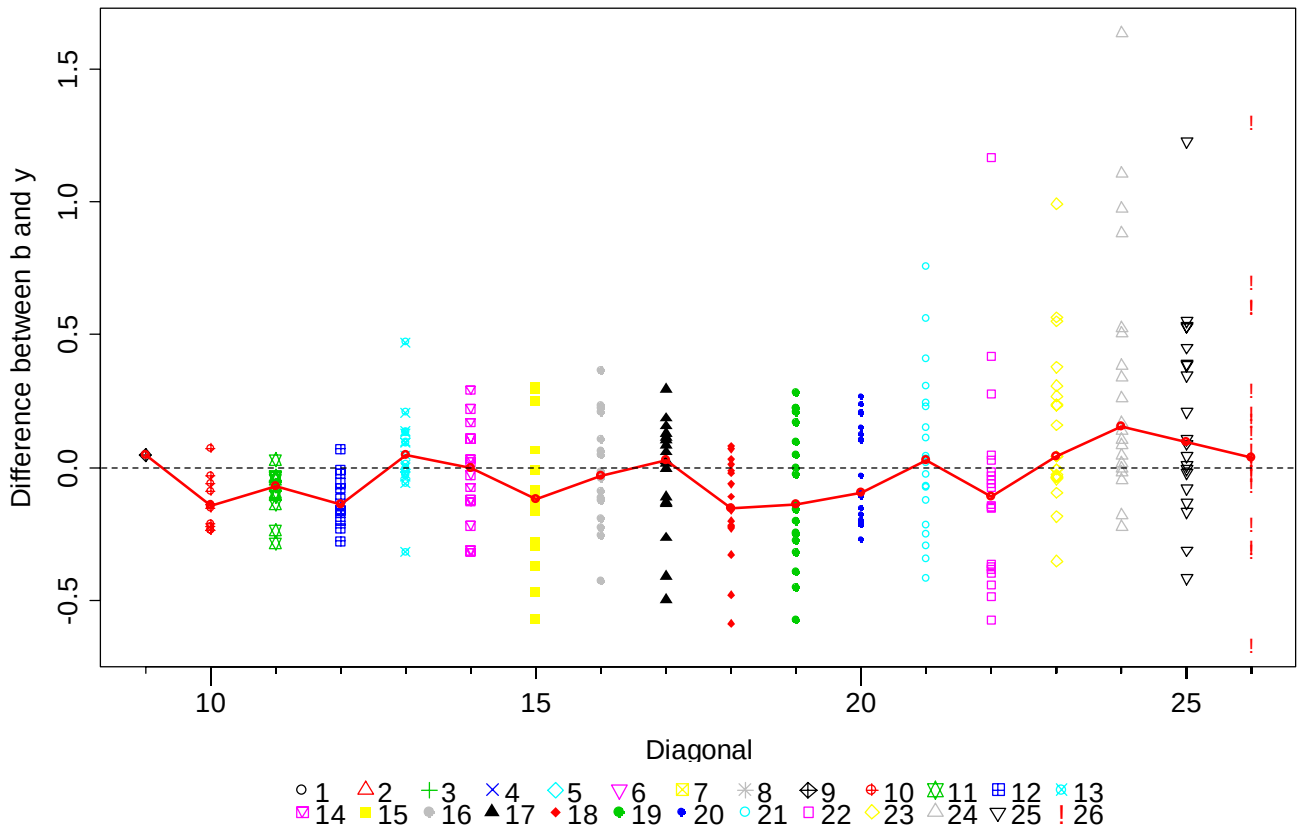
Application to an Unidentified State

- Indemnity: Residuals by Diagonal



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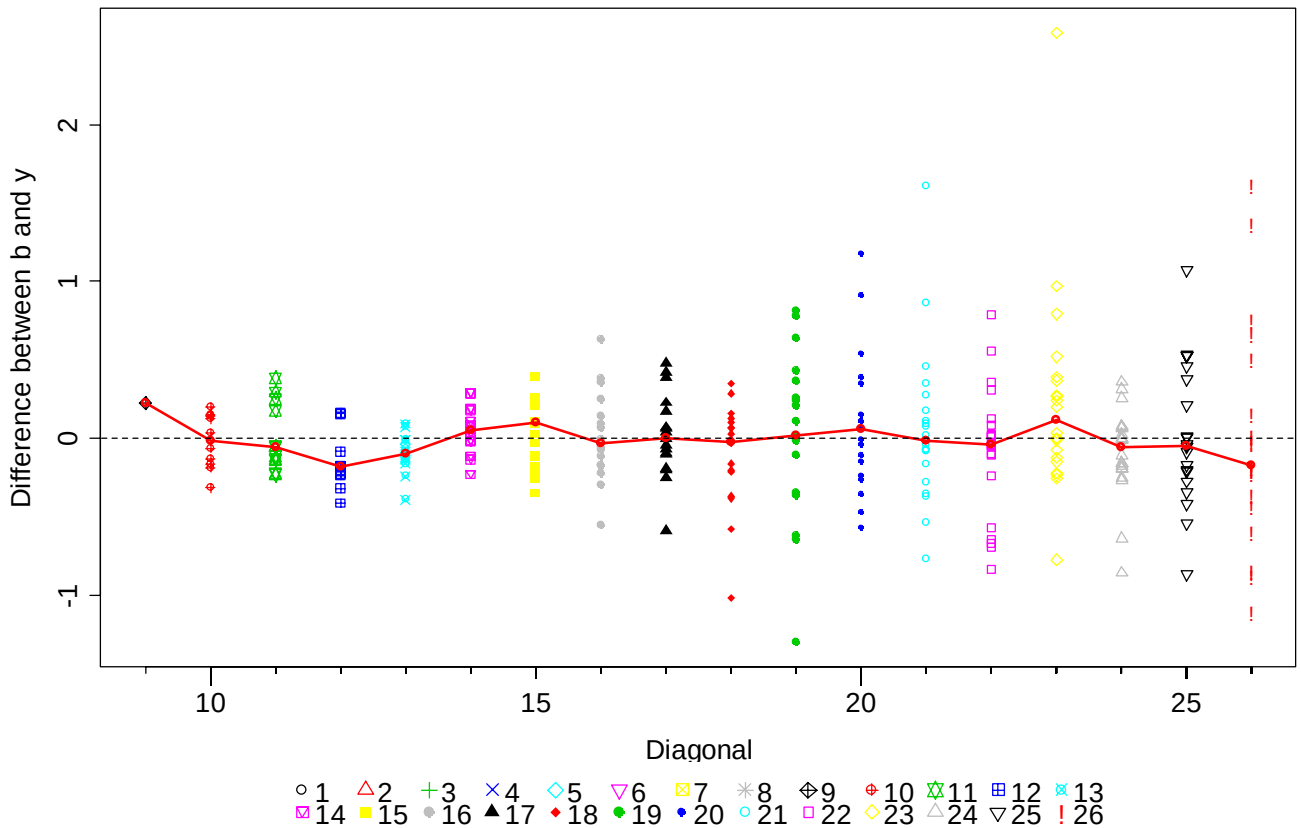
Application to an Unidentified State

- Medical: Residuals by Diagonal



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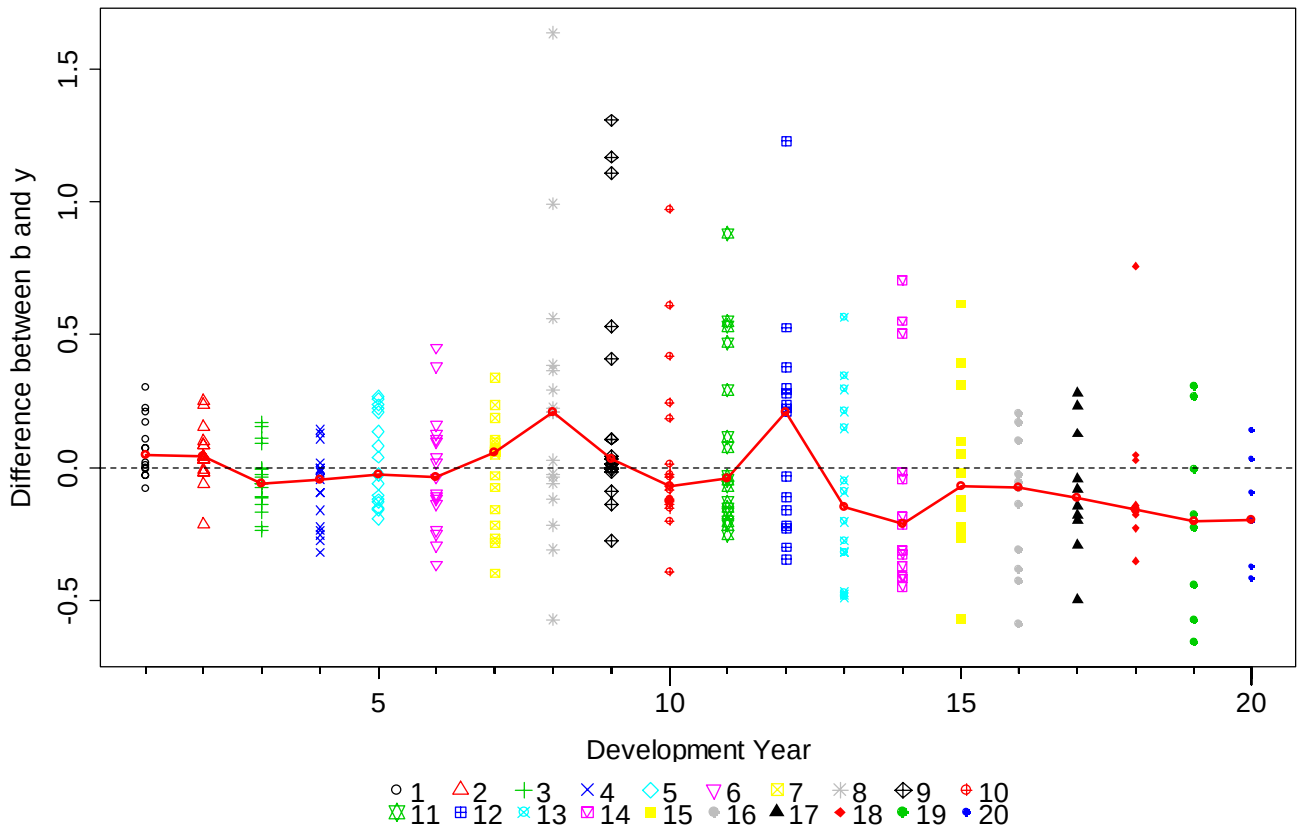
Application to an Unidentified State

- Indemnity: Residuals by Development Year



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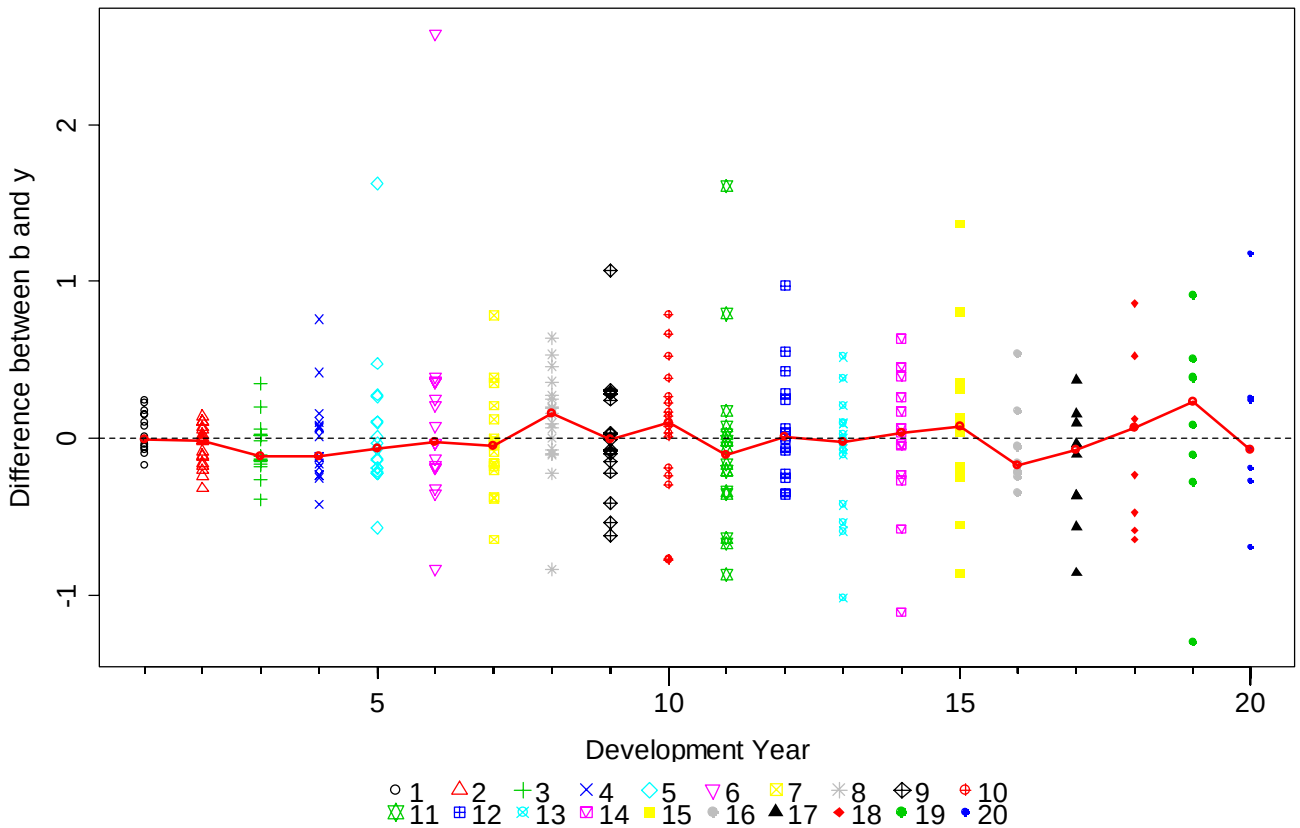
Application to an Unidentified State

- Medical: Residuals by Development Year



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Conclusion

- The loss development model is capable of incorporating detailed legislative provisions
- The model allows for the estimation of tail factors according to the applicable legislative setting
- The model is capable of quantifying the impact of regulatory reforms on the ultimate loss and, hence, the tail factor

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Current Enhancements in Progress

- A mortality model will be built into the model
  - That way, there will be a link between the final estimated *delta* and the rate of mortality
  - For high development years, the difference between *delta* and the rate of mortality may be interpreted as a calendar-year effect adjusted increase in severity

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