Testing Loss Reserving Methodology

A presentation to Casualty Actuaries of the Northwest

Tapio Boles, FCAS, MAAA

tapio.boles@towerswatson.com

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Primary goal of the project was to identify the most (and least) accurate methods under a variety of environments

- We tested multiple projection methods (with several parameterizations) under various environmental conditions
- Examples of environmental changes:
  - Bubble in calendar year inflation
  - Increase in case reserve adequacy
- Other goals include
  - Identifying methods that are biased high or low
  - Identifying methods that are very responsive or stable

List of methods tested in the original project

- Chain ladder
  - On paid losses
  - On reported losses
- Incremental loss methods
  - Incremental multiplicative on paid losses
  - Incremental additive on paid losses
- Berquist-Sherman adjustments
  - Adjustment for case reserve adequacy, on reported losses
  - Adjustment for claim settlement rate, on paid losses
- Hybrid methods
  - Multivariate regression for age 12 to 24, based on paid, case, reported
  - Standard chain ladder for age 24 to ultimate

List of methods tested in the paper

- Chain ladder
- Incremental loss methods
  - Incremental multiplicative
  - Incremental additive
  - Bühlmann's complementary loss ratio
- Case Reserve methods
  - Marker-Mohl backwards recursive
  - Atkinson case development
  - Modified Atkinson case development
- Berquist-Sherman adjustments
  - Adjustment for case reserve adequacy
  - Adjustment for claim settlement rate
  - Fleming-Mayer adjustment for claim settlement rate
- Joint Paid-Reported methods
  - Munich Chain Ladder
- Miscellaneous
  - Taylor's separation method
  - Weller's algebraic method

- Exposure-based methods
  - Budgeted loss
  - Bornhuetter-Ferguson
  - Modified Bornhuetter-Ferguson
  - Benktander
  - Cape Cod
- Regression methods
  - Brosius' least squares development
  - Murphy's least squares linear
  - Murphy's least squares multiplicative
  - Multivariate regression
  - Verrall's log-linear models
- Frequency-Severity methods
  - Adler-Kline claims closure model
  - Fisher-Lange claims closure model
  - Ghezzi's incremental closed severity
  - Ghezzi's ultimate unclosed severity
  - Cumulative frequency-severity

List of environments considered in the original project (plus the inverse of each)

1. Base environment (no changes)
2. Permanent increase in calendar-year medical inflation
3. Bubble in calendar-year medical inflation
4. Increase in frequency of serious claims (i.e., shift in claim types)
5. Increase in case reserve adequacy
6. Acceleration in claim settlement rates
7. Increase in claim frequency and severity
8. Temporary dip in claim frequency and slowdown in claim settlement and reporting
9. Gradual decrease in claim frequency and claim closure
10. Increase in severity, slowdown in claim settlement, and speed up in recognition of permanent partial claims
11. Rapid and severe environment deterioration
12. Decrease in frequency of small claims and slowdown in claim settlement

List of environments considered in the paper

1. Base environment (no changes)
2. Bubble in calendar year inflation
3. Increase in frequency of serious claims (i.e., shift in claim types)
4. Increase in case reserve adequacy
5. Acceleration in claim settlement rates
6. Combination of #4 and #5
7. Combination of #2 and #3
8. Sudden doubling of loss exposure without recognition

Identifying the environment in practice can be difficult

- Talk to claims staff, underwriters
- Look for leading indicators
  - Economic variables
  - Judicial decisions
  - Size and number of settlements
- Review diagnostics

Examples of common diagnostics that can be used to identify the current environment

- Triangle diagnostics (across the diagonal)
  - Changes in claim reporting patterns
  - Changes in claim settlement rate
  - Changes in case reserve adequacy
  - Changes in claim payment pattern
- Accident year diagnostics (down the column)
  - Changes in claim frequency
  - Changes in claim severity
  - Changes in the mix of claim types

Our approach: proxy data

- Hindsight testing is good but has limitations
- We used proxy data for two reasons
  - To measure errors at ultimate
  - To isolate environmental factors
- Primary test is accuracy of projection from age 12 to ultimate
  - First test is 1 year after start of environmental change
  - Second test is 2 years after, etc.
- Accuracy measured based on "mean error" and "mean absolute error"
- The paper focused solely on the medical component of workers' compensation

Building blocks of the proxy data

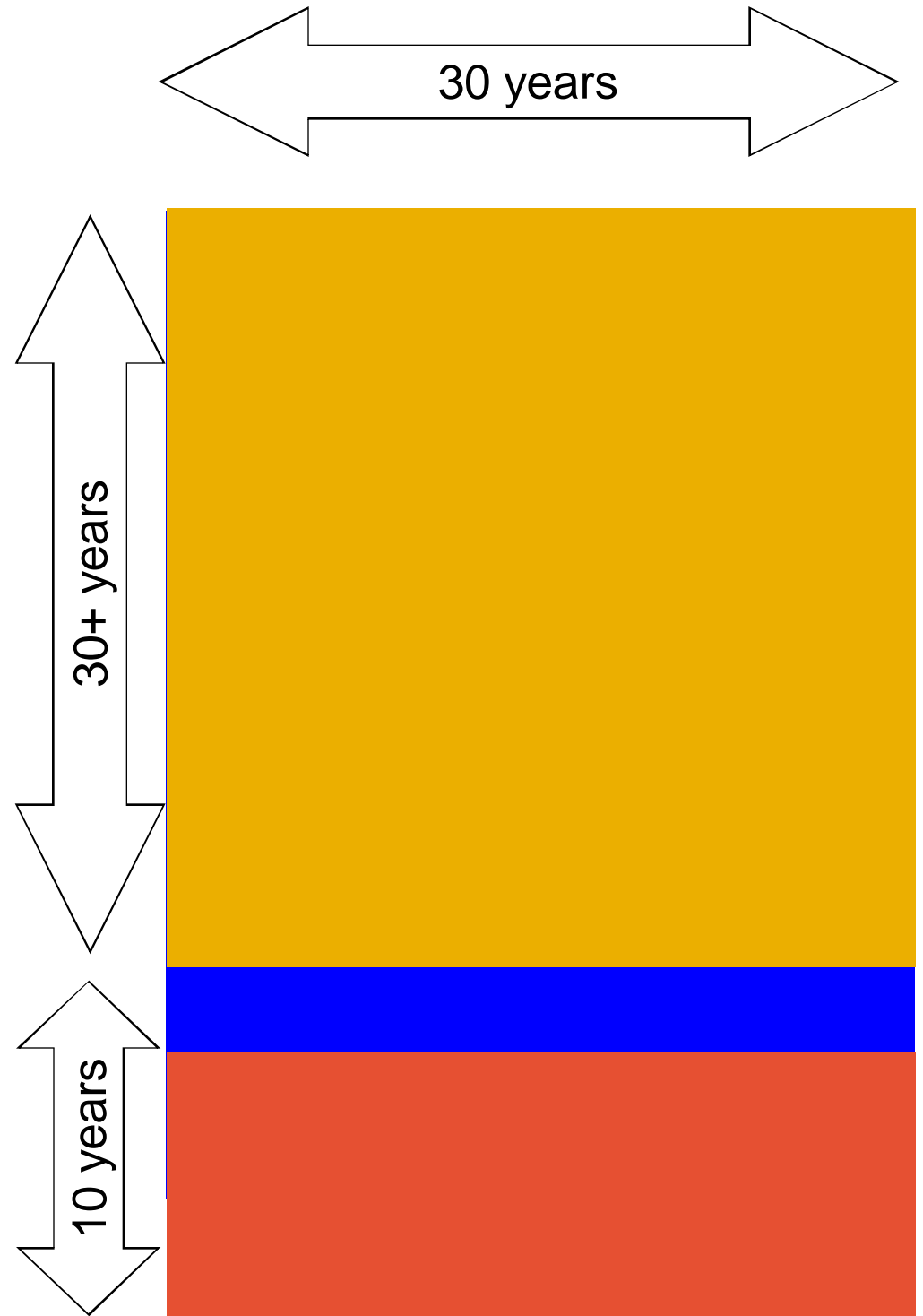| 1. Accident year data	2. Triangle data	3. Variability	4. Compilation

Exposure (volume)

Claim frequency

- Claim reporting ratios
- Claim closure ratios
- Incremental paid severity per open
- Incremental paid severity per closed
- Case reserve severity per open

Stochastic parameters
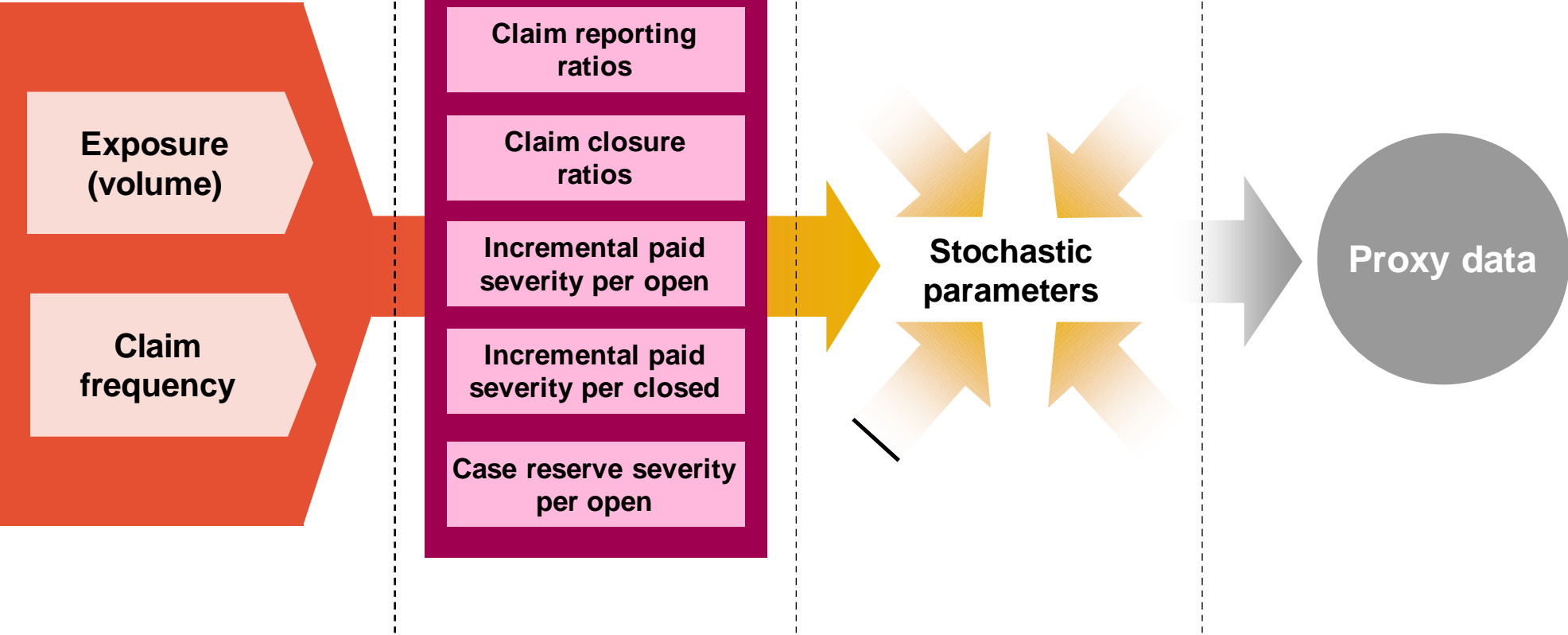
Proxy data

Shape of the proxy data: Calendar year changes

- Yellow: Long, stable history
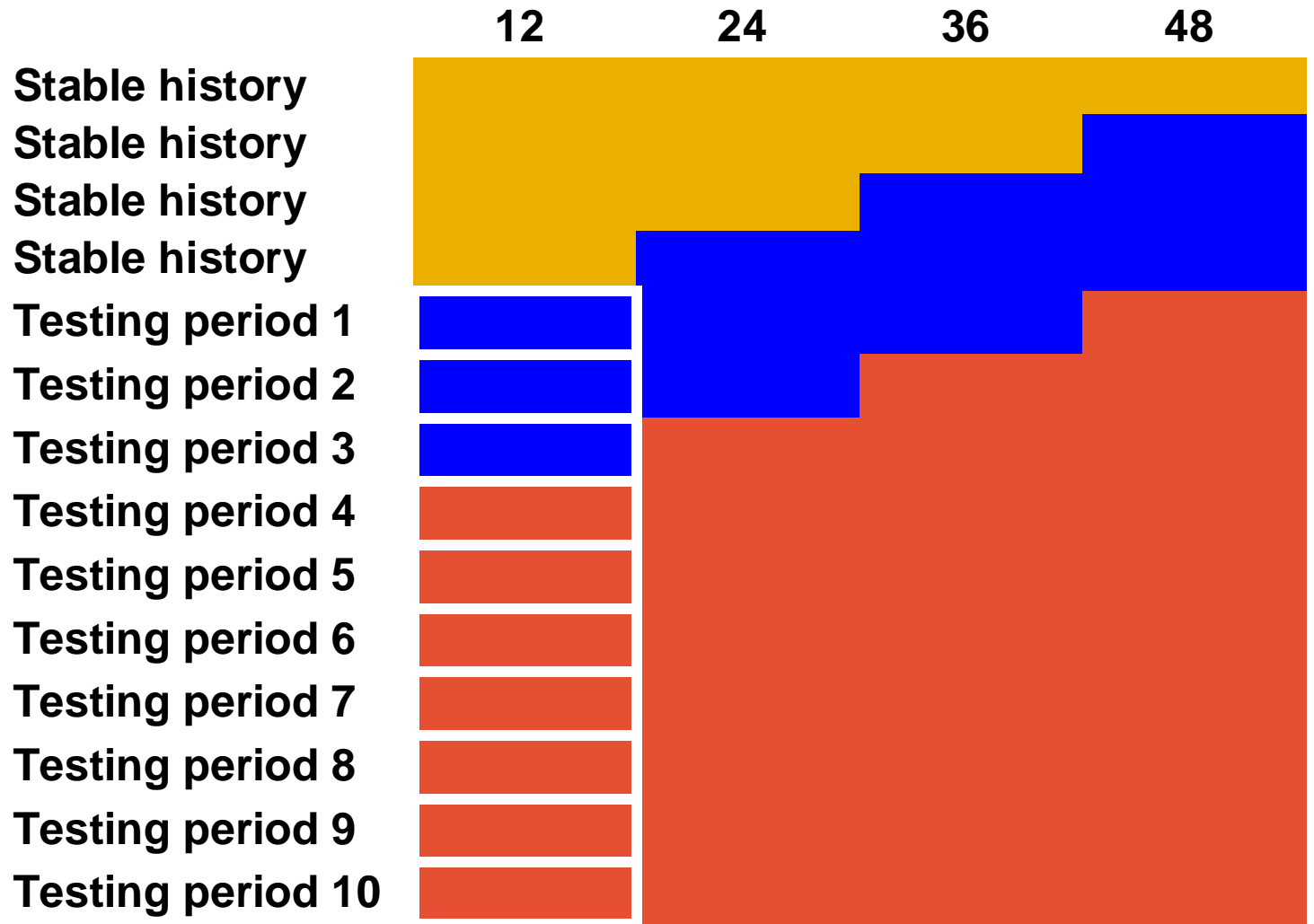- Blue: 3-5 years of environmental changes
- Red: Period post change
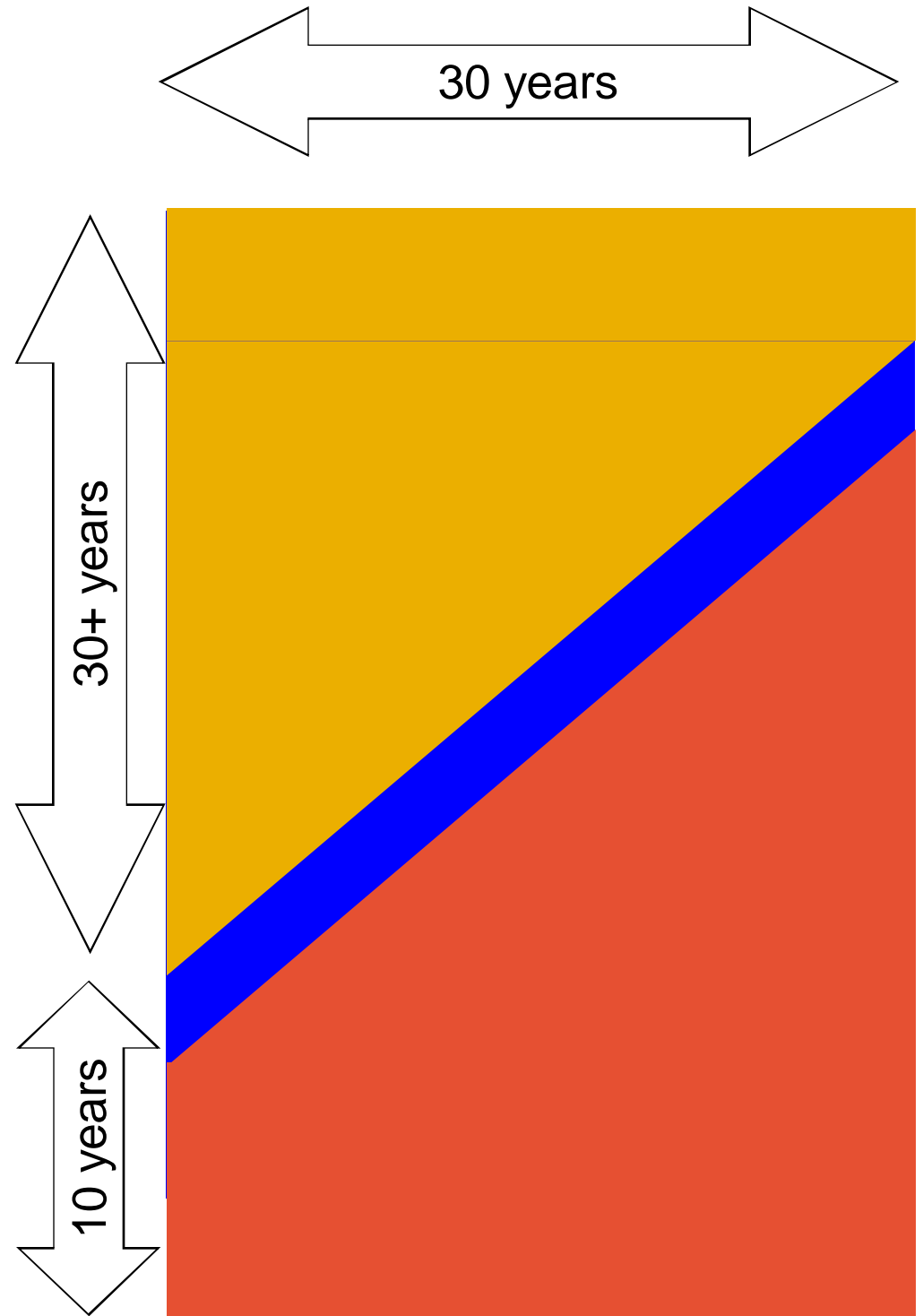
Shape of the proxy data: Accident year changes

- Yellow: Long, stable history
- Blue: 3-5 years of environmental changes
- Red: Period post change

Zoom in on testing period

	12	24	36	48
Stable history				
Stable history				
Stable history				
Stable history				
Testing period 1				
Testing period 2				
Testing period 3				
Testing period 4				
Testing period 5				
Testing period 6				
Testing period 7				
Testing period 8				
Testing period 9				
Testing period 10				

General findings

- Sticky vs. responsive methods
- Periods with significant upheaval
  - Cannot be addressed with mechanical methods
- Accident year vs. calendar year effects
  - Accident year effects (like increases in frequency) don't affect most projection methods unless there is also a change in development patterns
  - Calendar year effects (like inflationary impacts on payments) distort all methods to a certain extent, in some cases for several years after
- Independence and bias
  - If you can't identify the best method with certainty, it is often helpful to know which methods are likely to be biased low and which are biased high
  - When in doubt consider multiple methods that are relatively independent

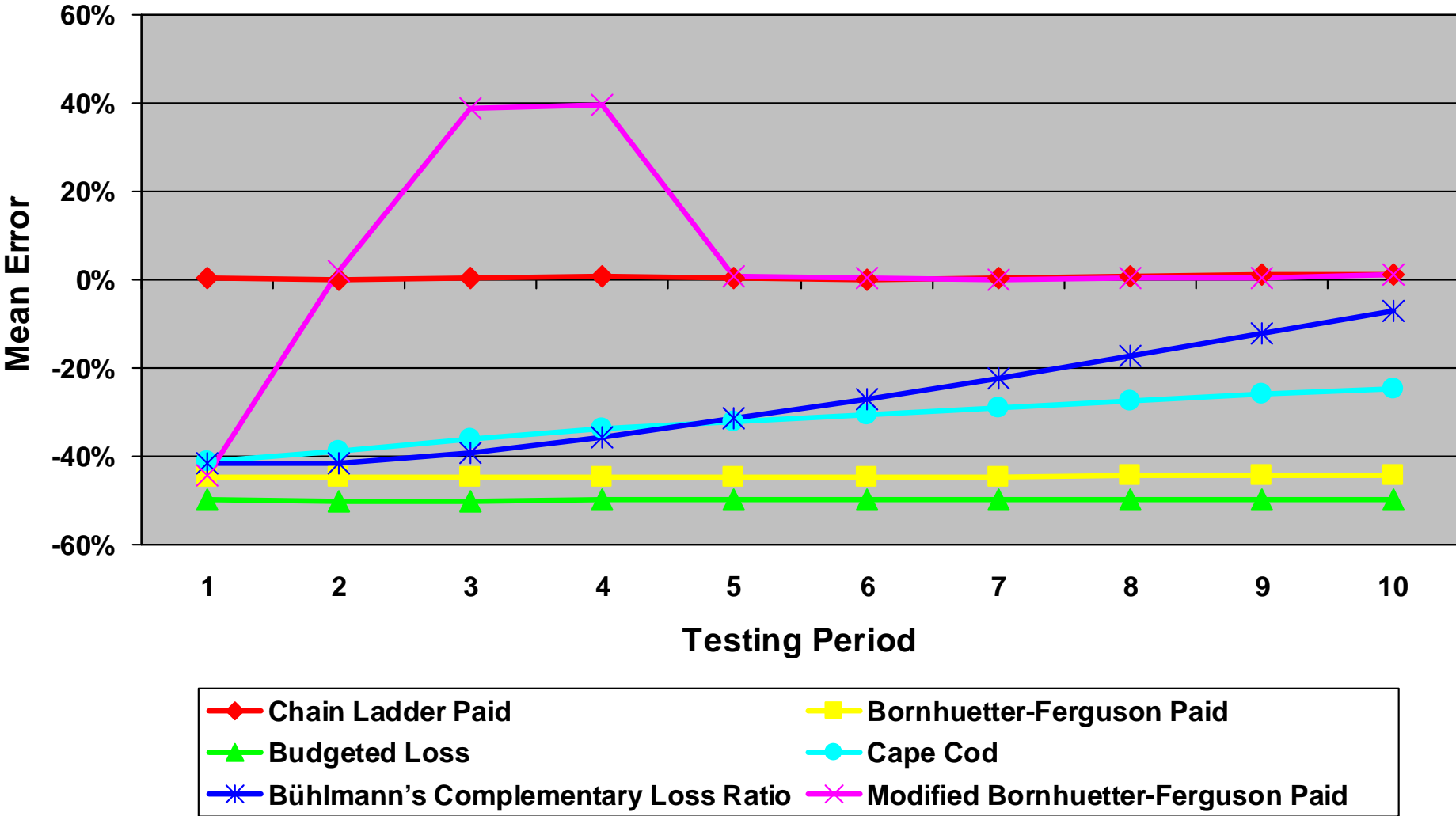# Residual noise affects methods' accuracy
Environment: Increase in frequency of serious claims
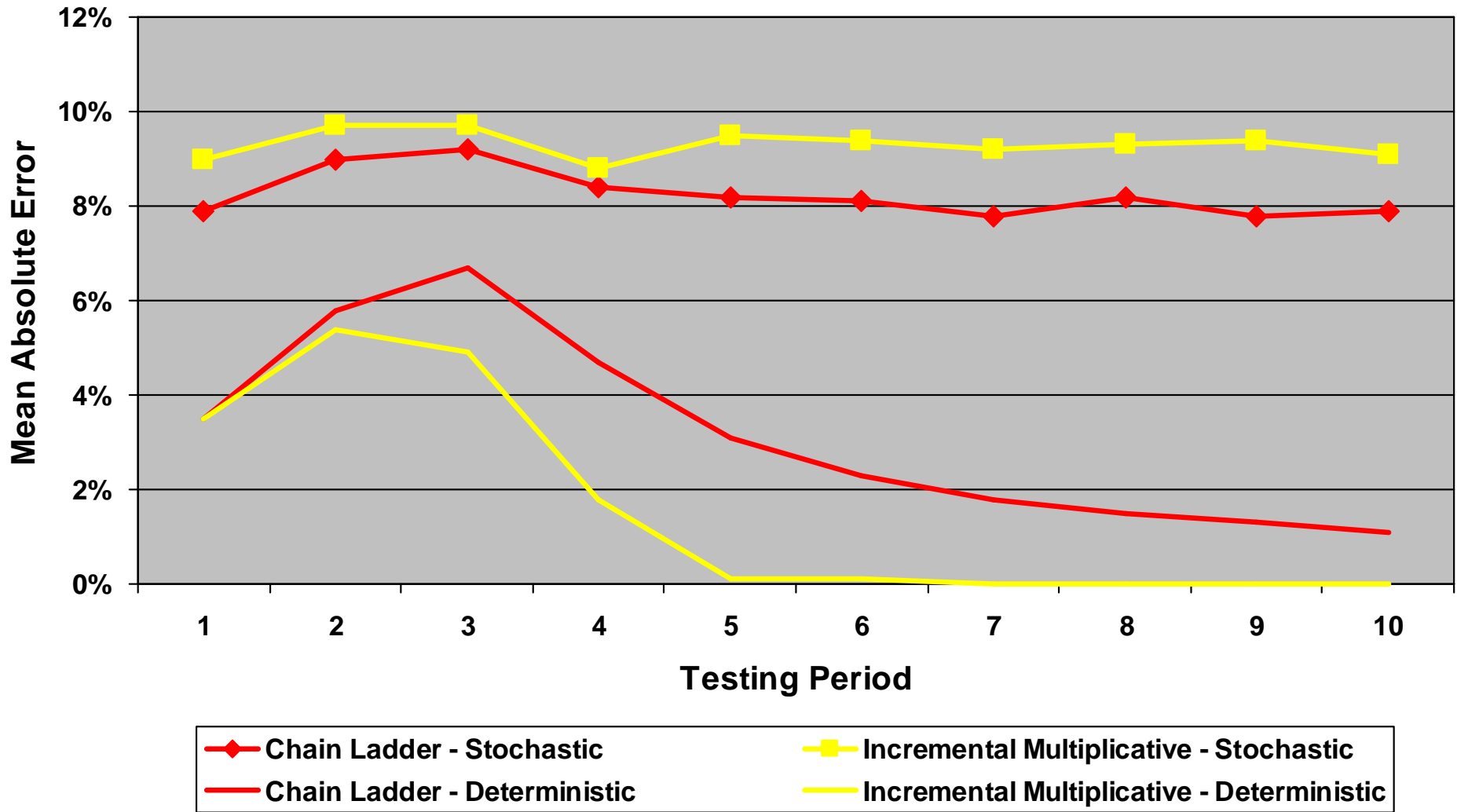
Note: Methods based on paid losses only. Parameters based on latest observation only

# Stable methods miss amid unstable conditions
Environment: Sudden doubling of loss exposure without recognition

Mean Error vs **Testing Period**

Legend:
- Chain Ladder Paid
- Budgeted Loss
- Bühlmann's Complementary Loss Ratio
- Bornhuetter-Ferguson Paid
- Cape Cod
- Modified Bornhuetter-Ferguson Paid

Note: Where applicable, parameters based on latest 3 years

Berquist-Sherman adjustments work as advertised
Environment: Increase in case reserve adequacy
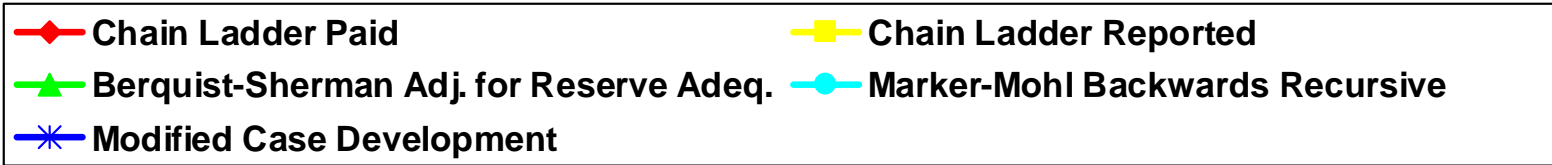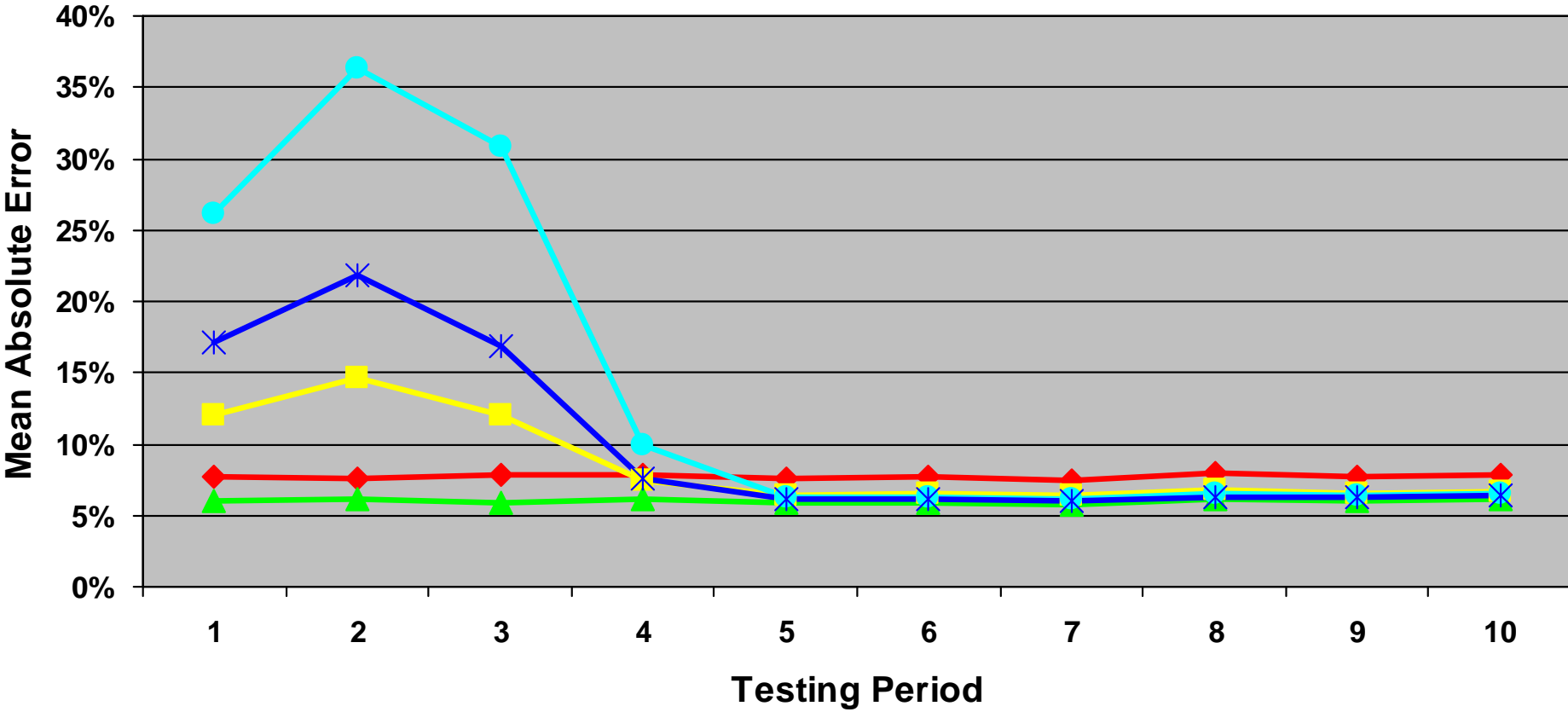
Note: Parameters based on latest 3 years

# Two methods every reserving actuary should know
Environment: Acceleration in claim settlement rates

Legend:
- Chain Ladder Paid (red diamonds)
- Fleming-Mayer Adj. for Claim Sett. (yellow squares)
- Berquist-Sherman Adj. for Claim Sett. (green triangles)
- Berquist-Sherman Adj. for Reserve Adeq. (cyan circles)
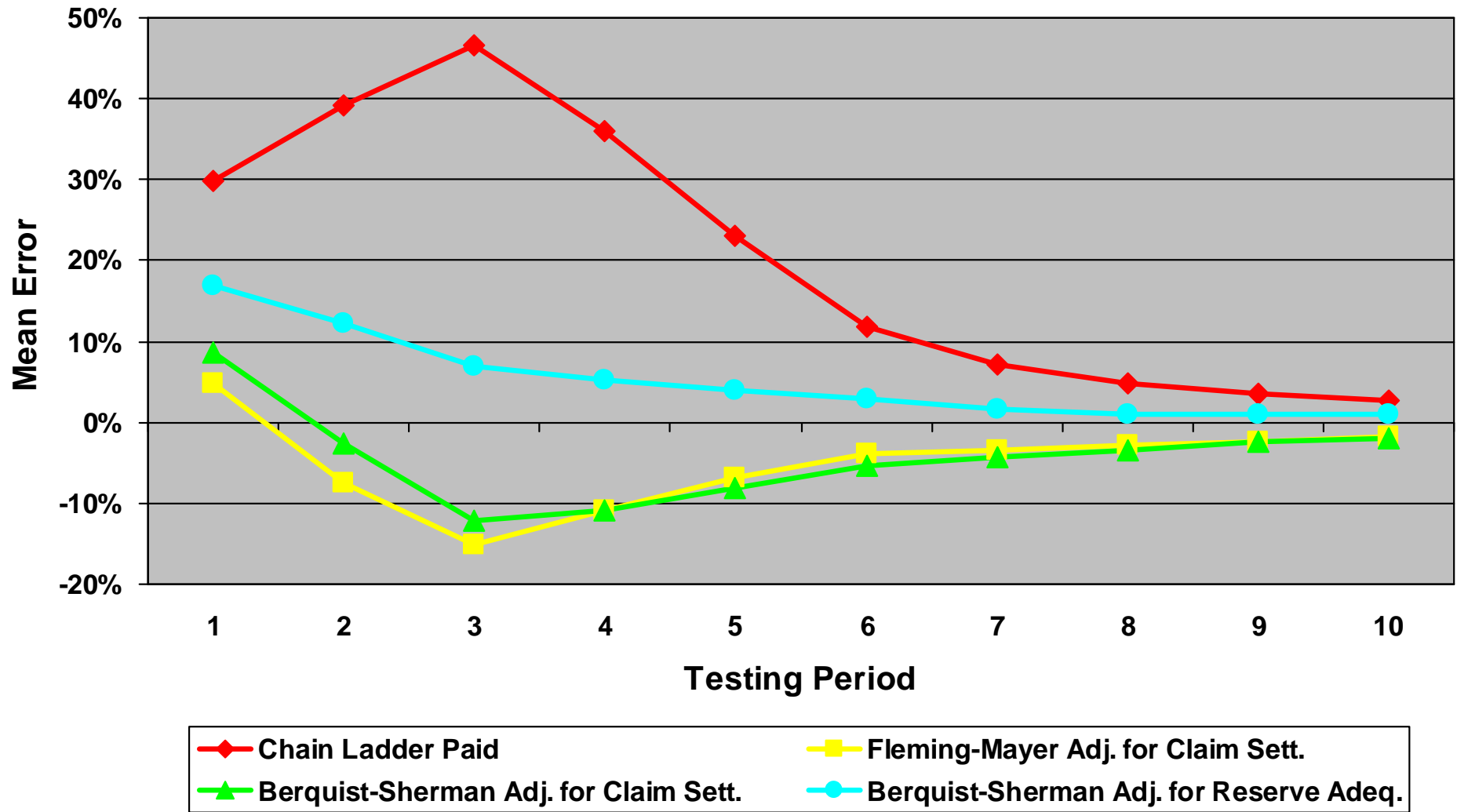
Note: Parameters based on latest 3 years
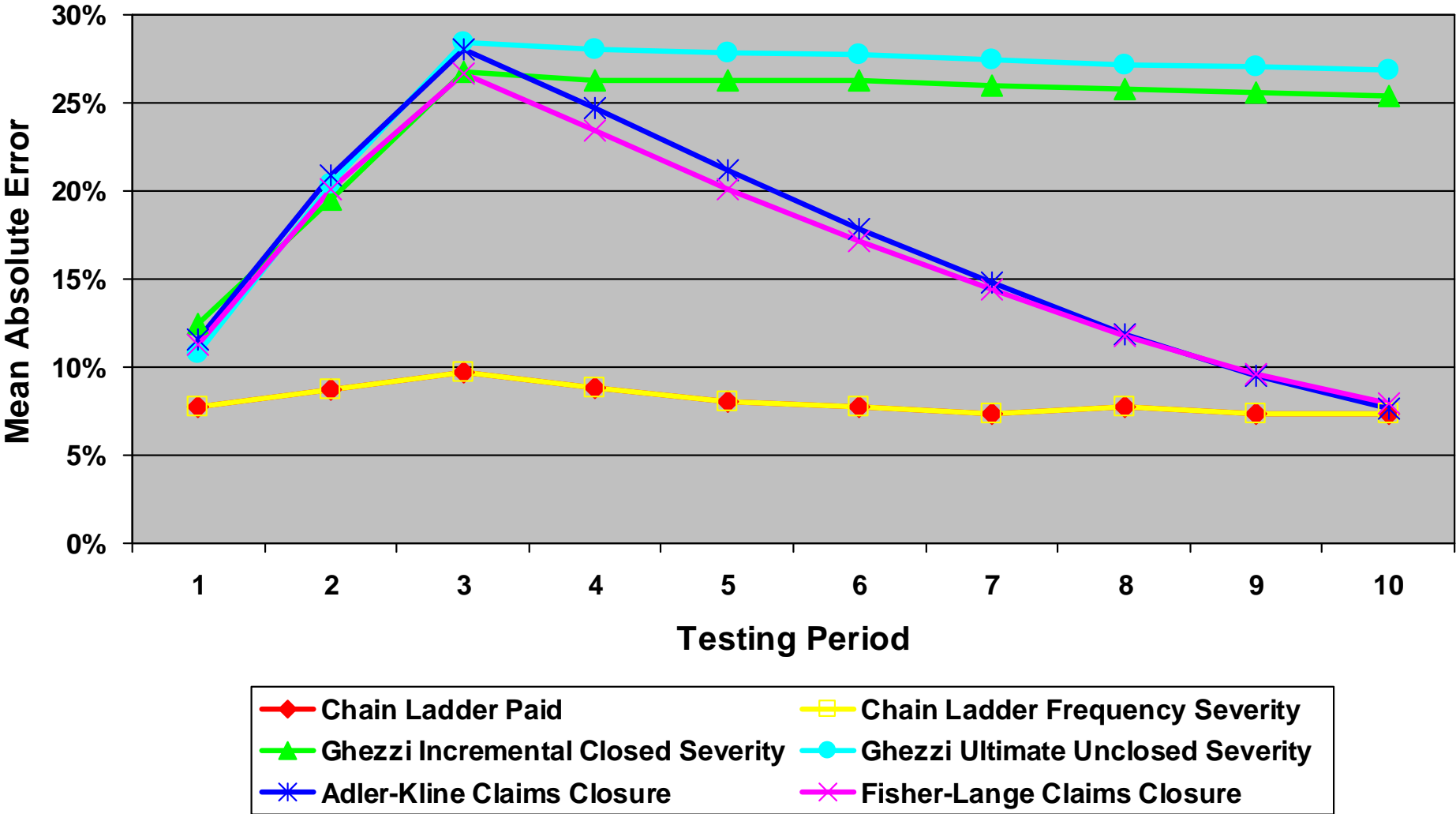
Claim closure models score
Environment: Acceleration in claim settlement rates
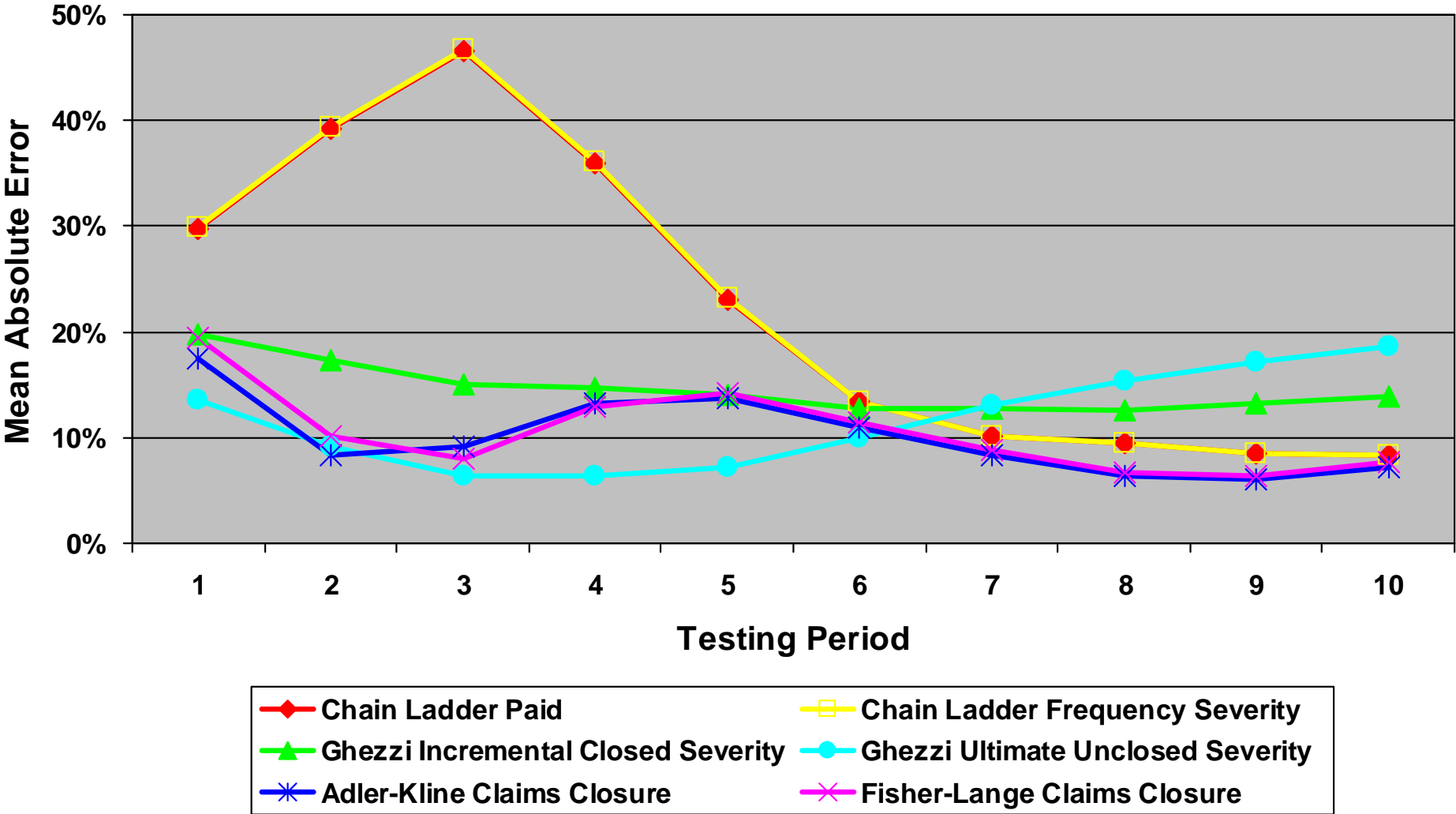
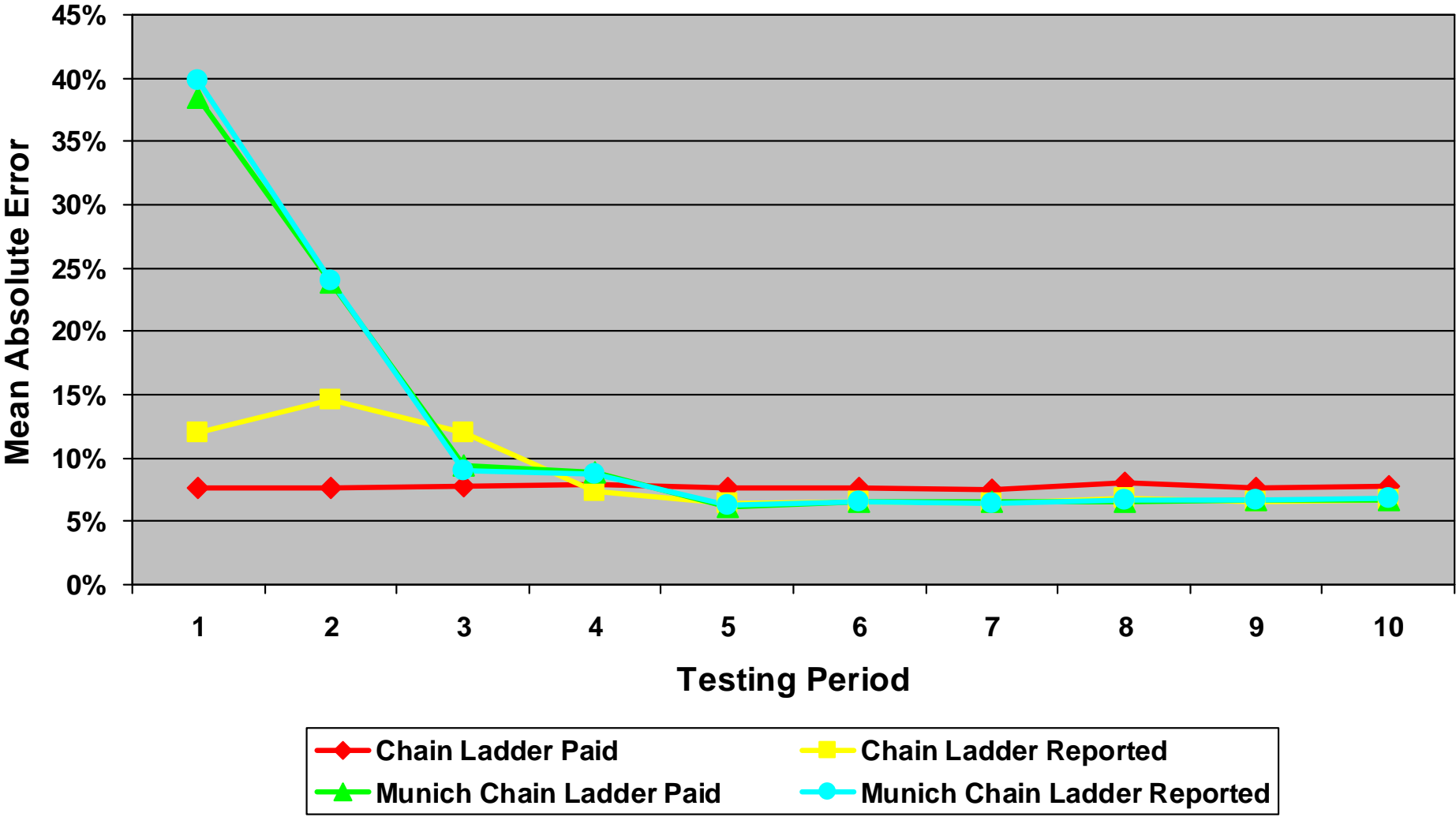Note: Parameters based on latest 3 years

Claim closure models go splat
Environment: Increase in frequency of serious claims

Legend:
- Chain Ladder Paid
- Chain Ladder Frequency Severity
- Ghezzi Incremental Closed Severity
- Ghezzi Ultimate Unclosed Severity
- Adler-Kline Claims Closure
- Fisher-Lange Claims Closure

Note: Parameters based on latest 3 years
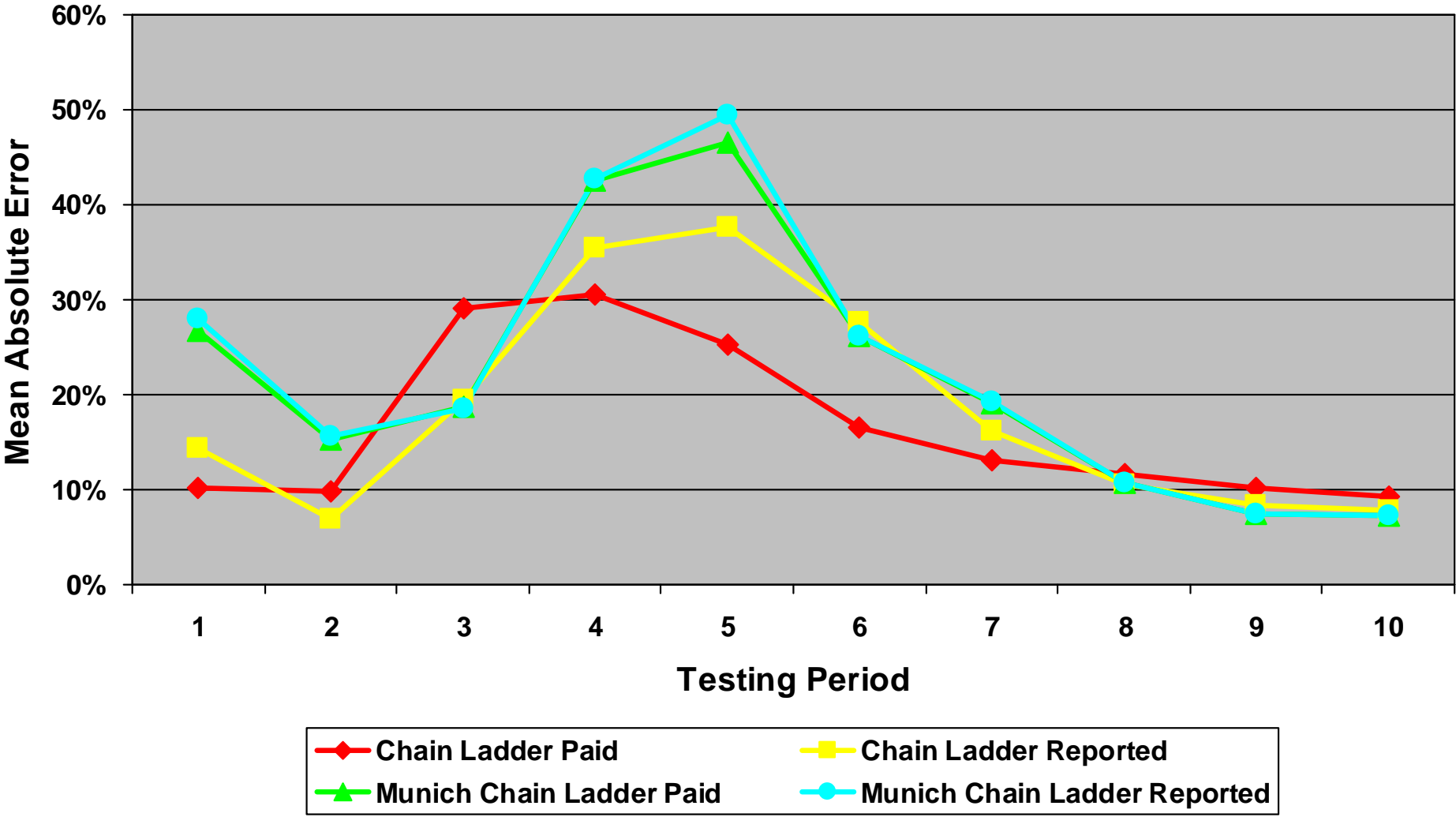
Double the data, double the error
Environment: Increase in case reserve adequacy

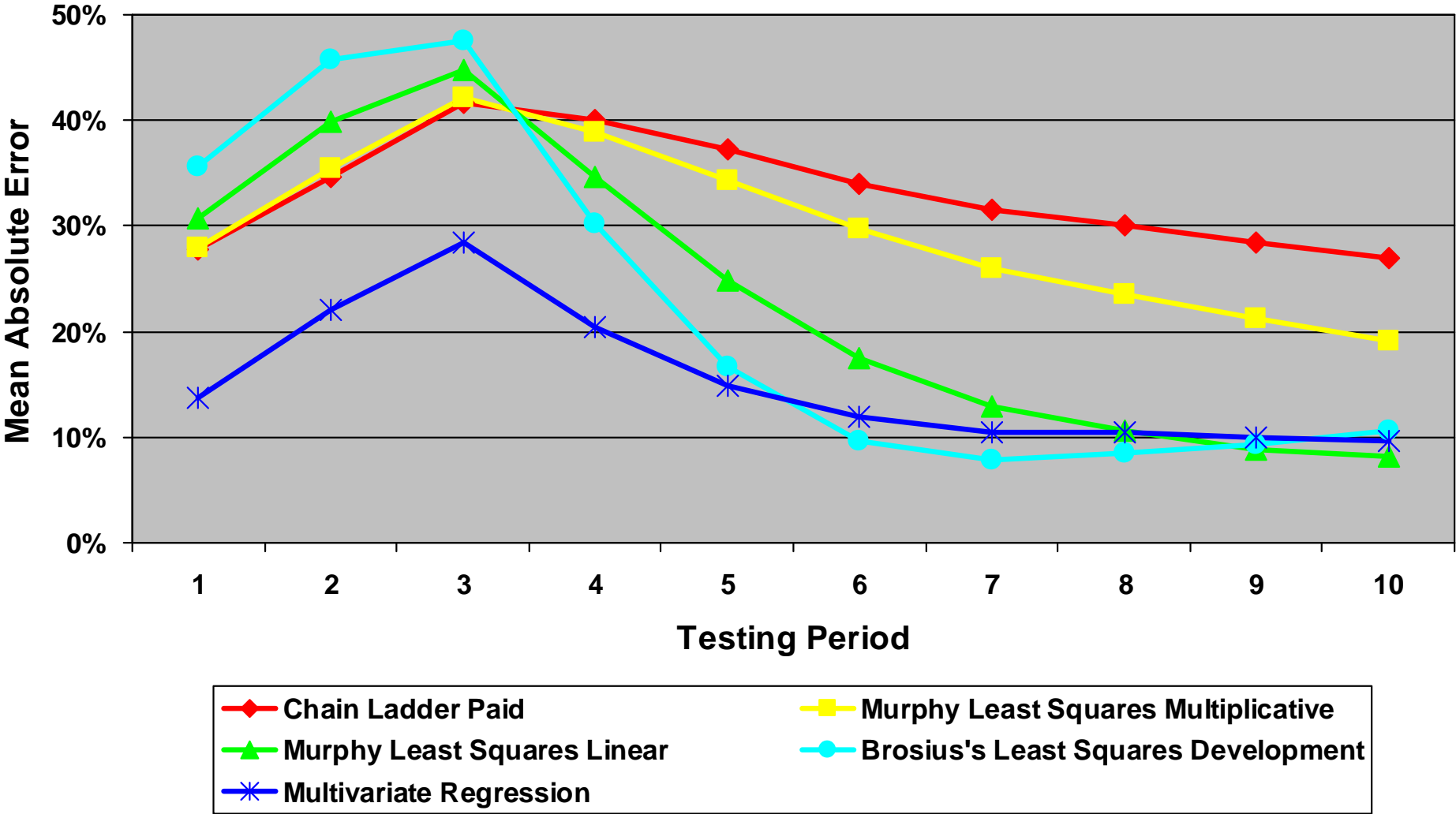Note: Parameters based on latest 3 years

Agree to disagree
Environment: Bubble in calendar year inflation

Note: Parameters based on latest 3 years

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Regression methods: More variables, more jagged edges
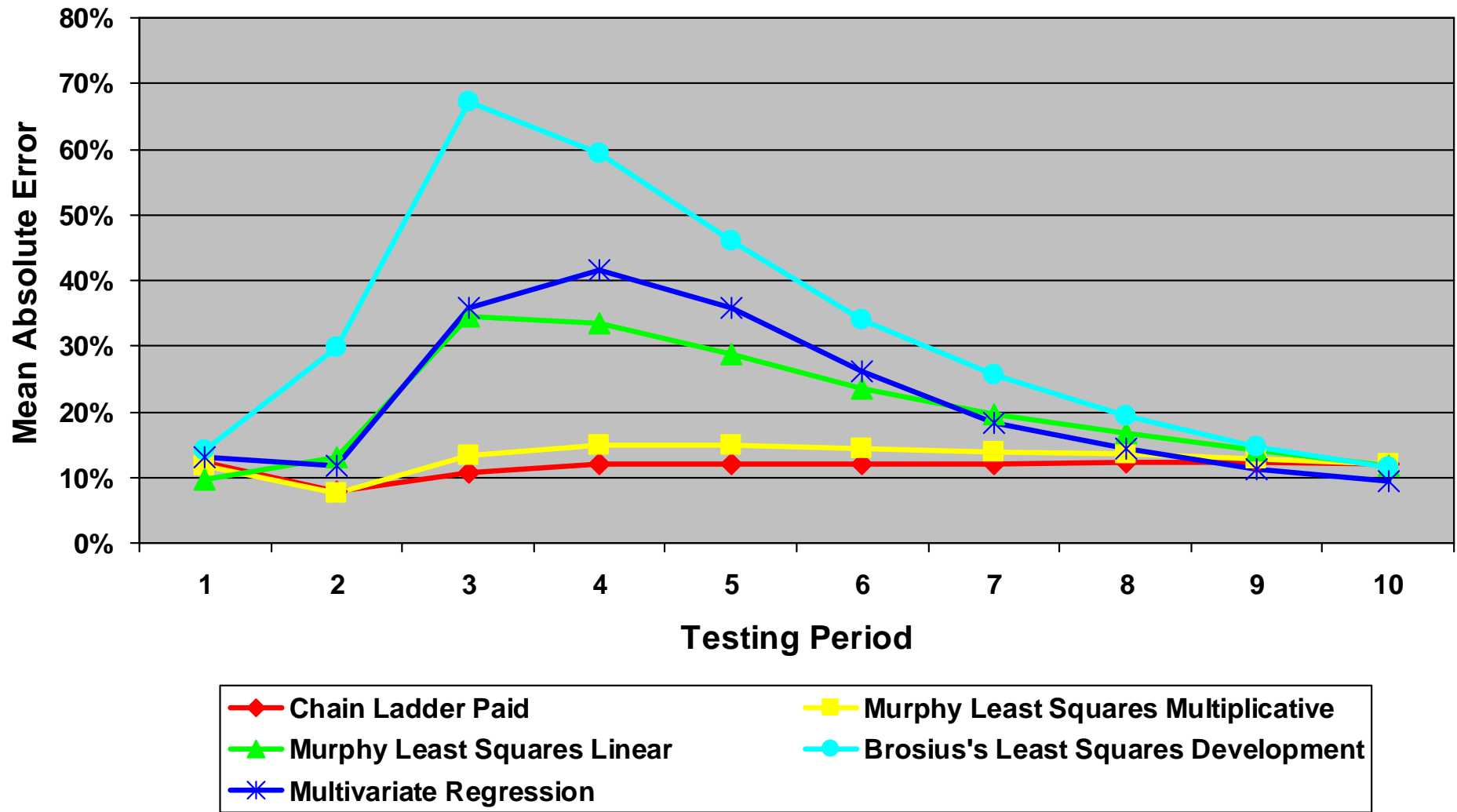## Environment: Acceleration in claim settlement rates

Note: Parameters based on all years

To paraphrase Occam's razor: Keep It Simple, Stupid
Environment: Bubble in calendar year inflation

Note: Parameters based on all years

Questions