Stochastic Modelling of Economic Risk and Application to LMI Reserving

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Agenda

- Background to LMI
- Liability Estimation
- Deterministic Valuation Approach
- Stochastic Economic Model
- Application of Model to Valuation
- Conclusions

Background to LMI

- LMI – Lenders Mortgage insurance
  - Insurer receives a single premium to indemnify the lender for losses arising on default of mortgage
  - Covers gap between loan outstanding and value of property (plus expenses & recoveries)
  - Exposure period spans well beyond one year
- $200 bn loans, 15 insurers, six captives, mono-line insurers
- Regulation of liability and risk margins under GPS210 – non prescriptive
- Recent proposed changes to MER estimation – no direct link to risk margins

Liability Estimation

- 2 stage process
  - Loan Discharge
  - Default: claim frequency and claim size
- Claim frequency modeled as a log linear function (GLM) of both loan characteristics and economic factors
- Average size a function (GLM) of loan characteristics only

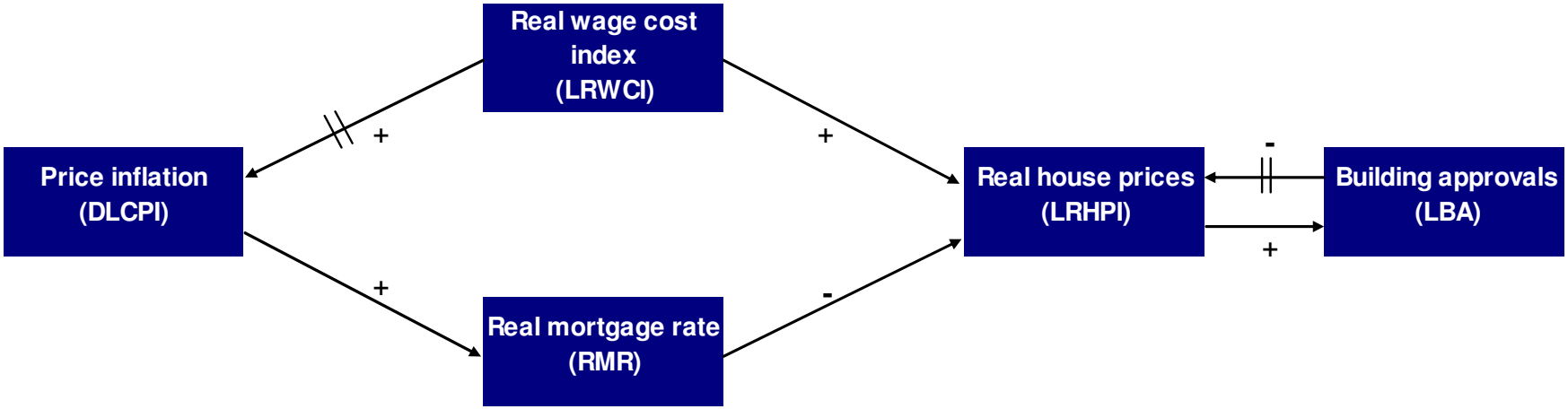
Deterministic Valuation Approach

- Economic forecasts fed into model projection
- Result is a best estimate of claims cost
- Risk margins derived from stress testing and scenario analysis
- Limitations:
  - Limited allowance for interrelationship of economic variables
  - Very difficult to allow for full range/distribution of economic variables
  - Disconnect between central estimate and risk margin estimation

Stochastic Economic Model

- Economic factors modelled by SCORE-X House Price Model (HPM)
- Modelled as a multivariate time series, which captures:
  - Short-term & long-term dynamics
  - Non-stationarity
- We ensure projections are consistent with market expectations

HPM: Framework



- Supply captured by building approvals (RBA preferred measure)
- Demand for housing determined by interaction of CPI, Wages and mortgage rates.
- Worked in real levels to explicitly model the effects of inflation

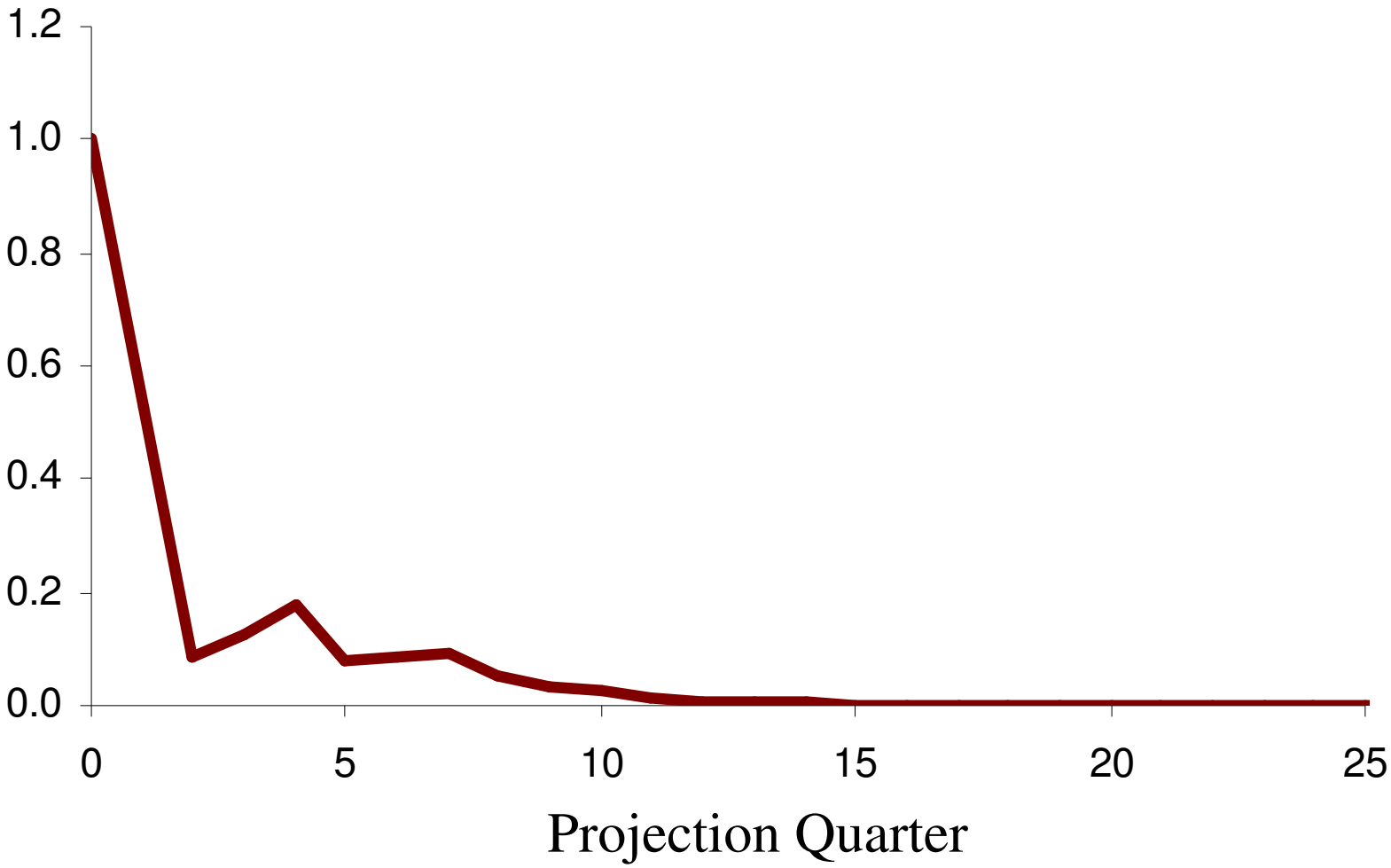
HPM: Vector Error Correction Model

$$Z_t = \begin{bmatrix} LRHPI \\ LRWCI \\ DLCPI \\ RMR \\ LBA \end{bmatrix}$$

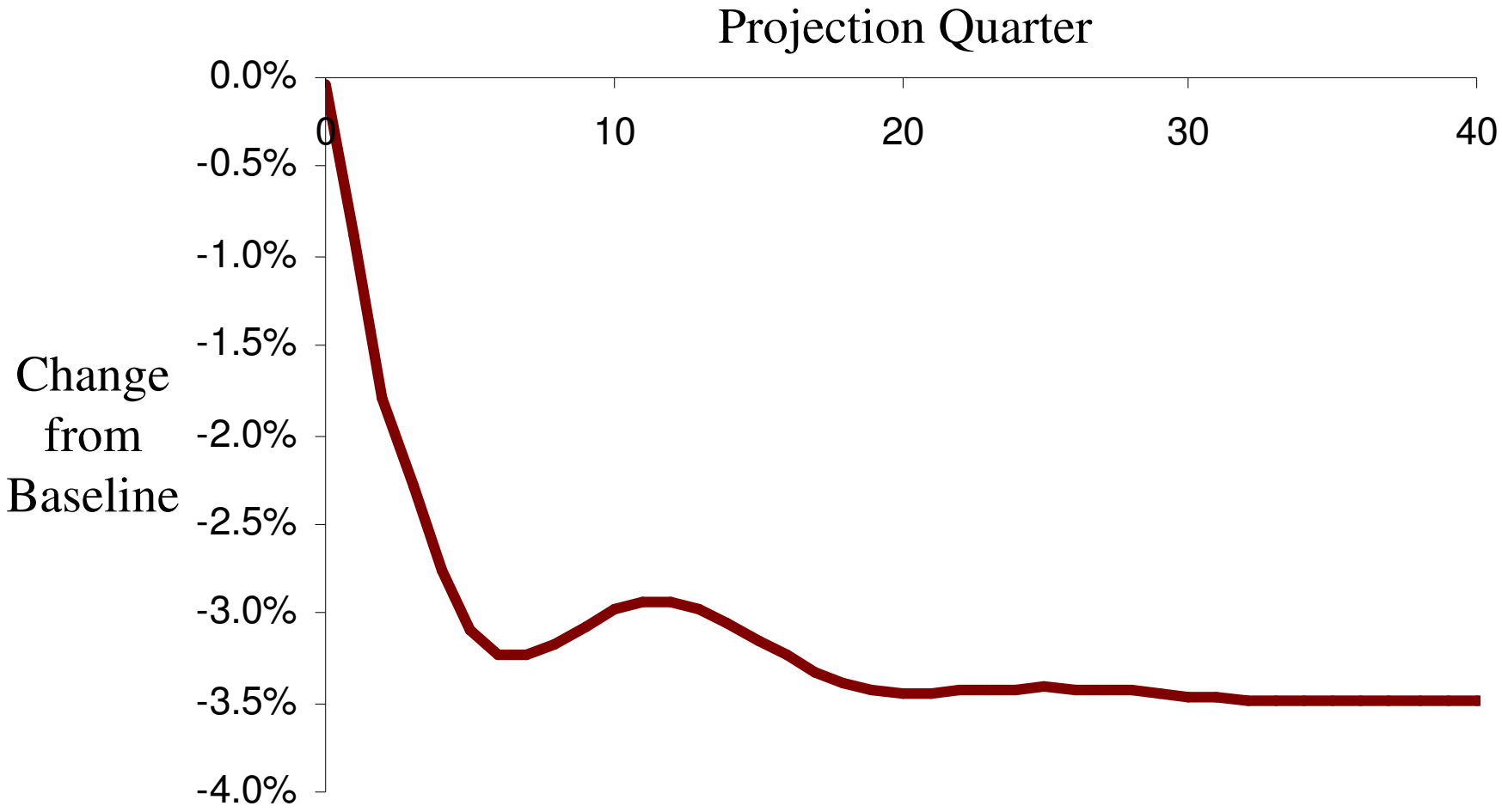
- $LRHPI$ — Log of Real House Price Index
- $LRWCI$ — Log of Real Wage Cost Index
- $DLCPI$ — Consumer Price Inflation
- RMR — Real Mortgage Rate
- LBA — Log of Building Approvals

$$\Delta Z_t = \underbrace{\mu + \alpha\beta^T Z_{t-1}}_{\text{Long-run}} + \underbrace{\sum_{j=1}^{3} \Gamma_j \Delta Z_{t-j} + D_t \Psi + \varepsilon_t}_{\text{Short-run}}$$

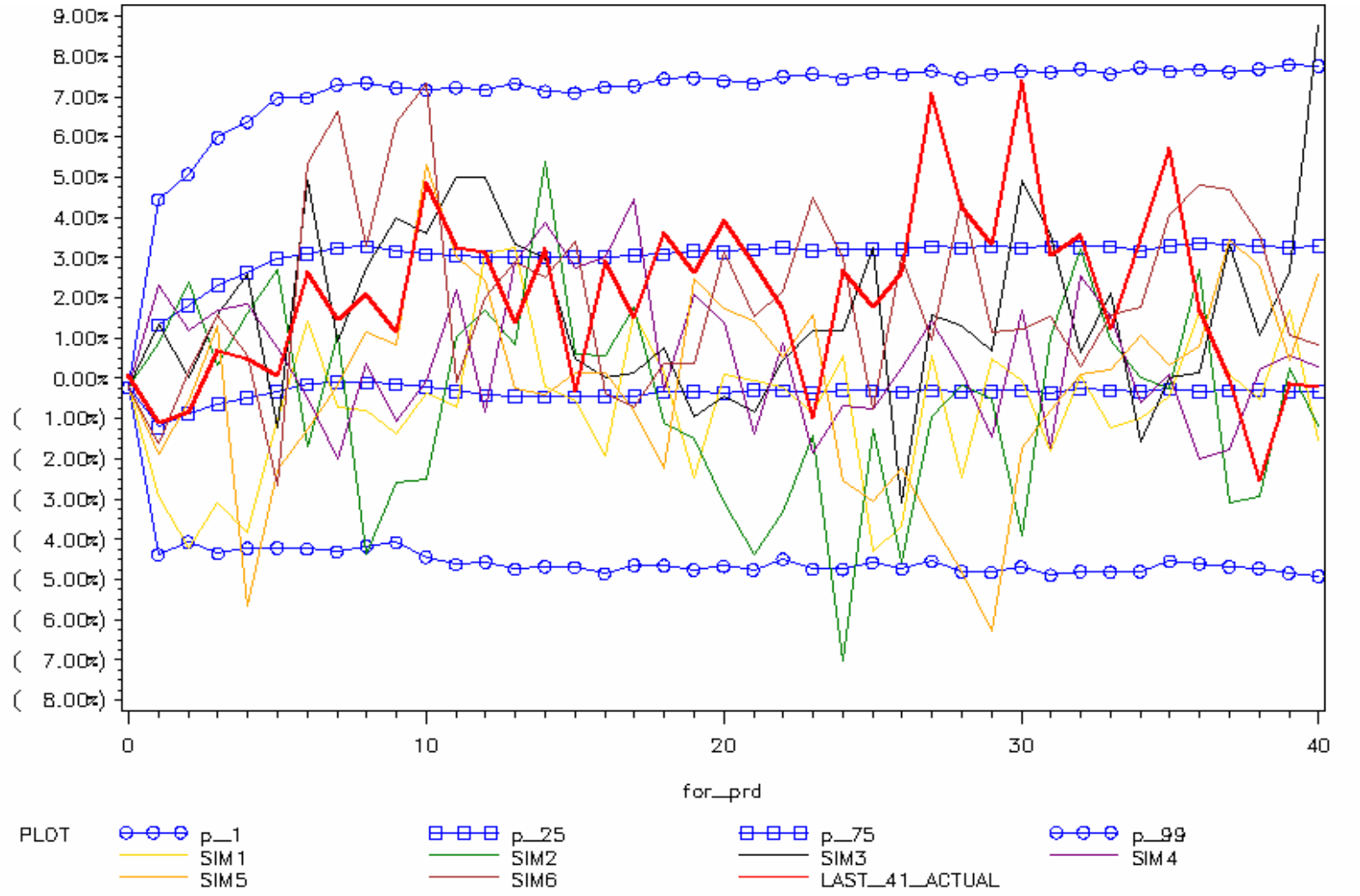
HPM: Persistence Profile



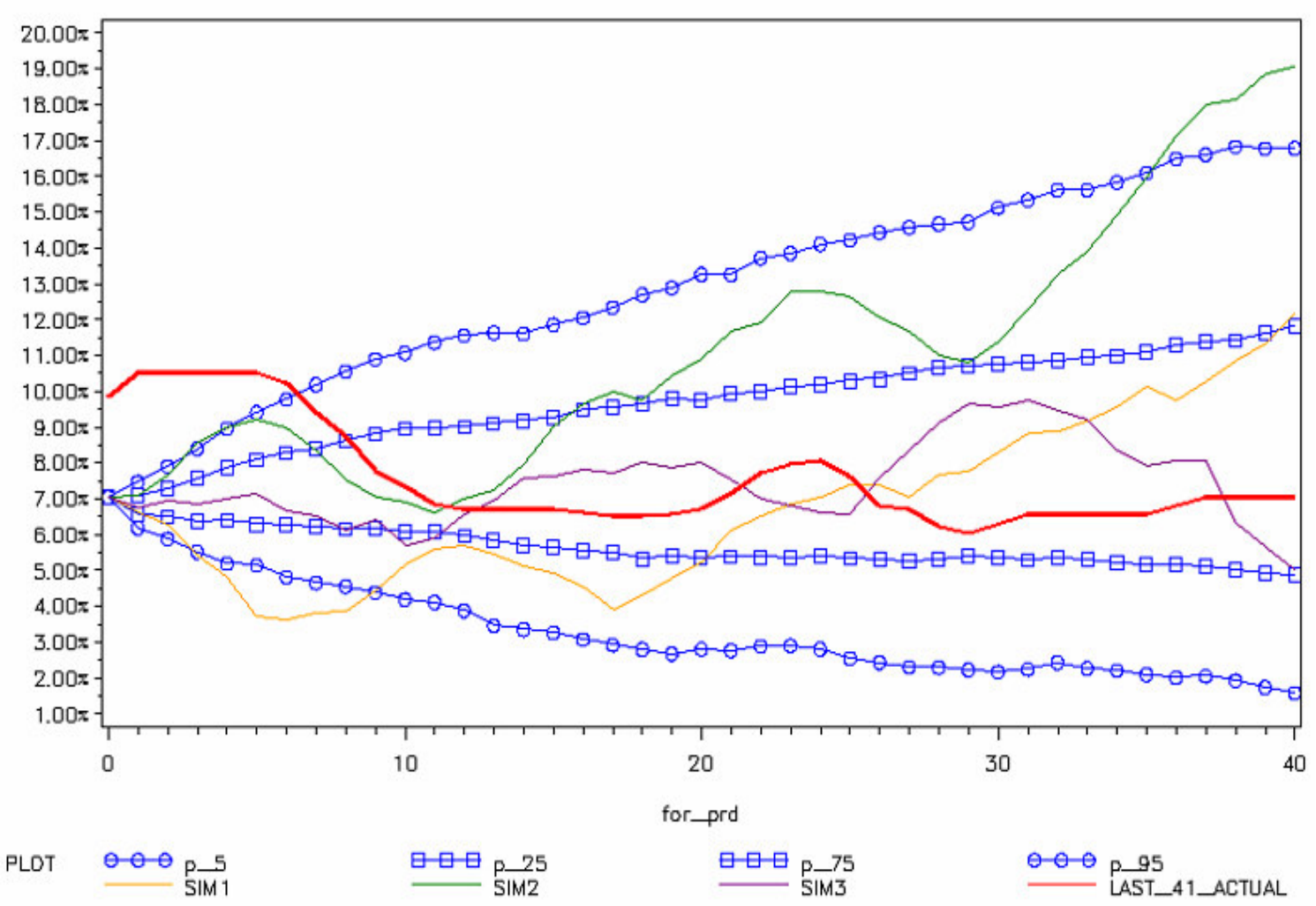
HPM: Impulse Response Function



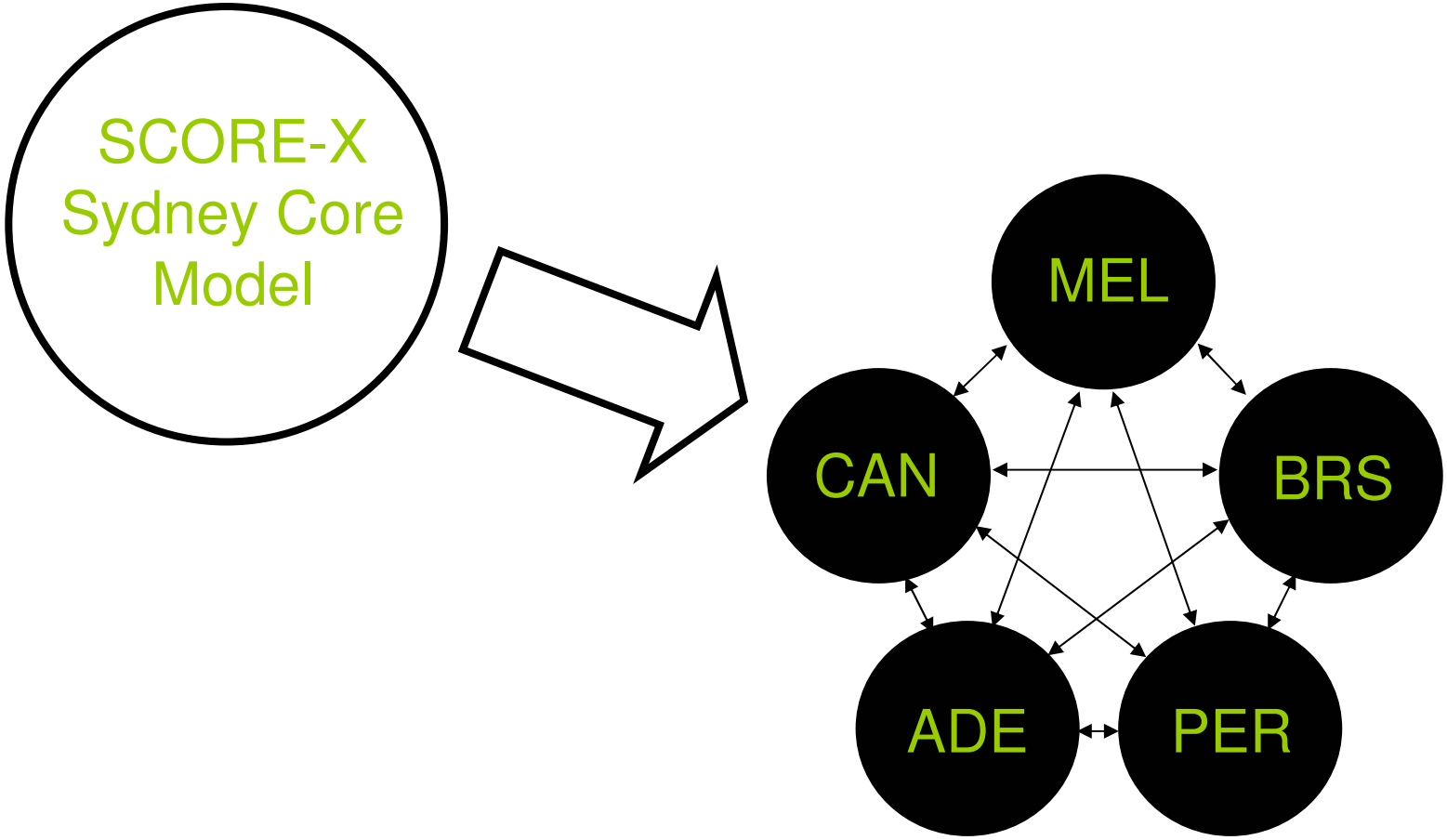
HPM: House Price Growth



HPM: Standard Mortgage Rates



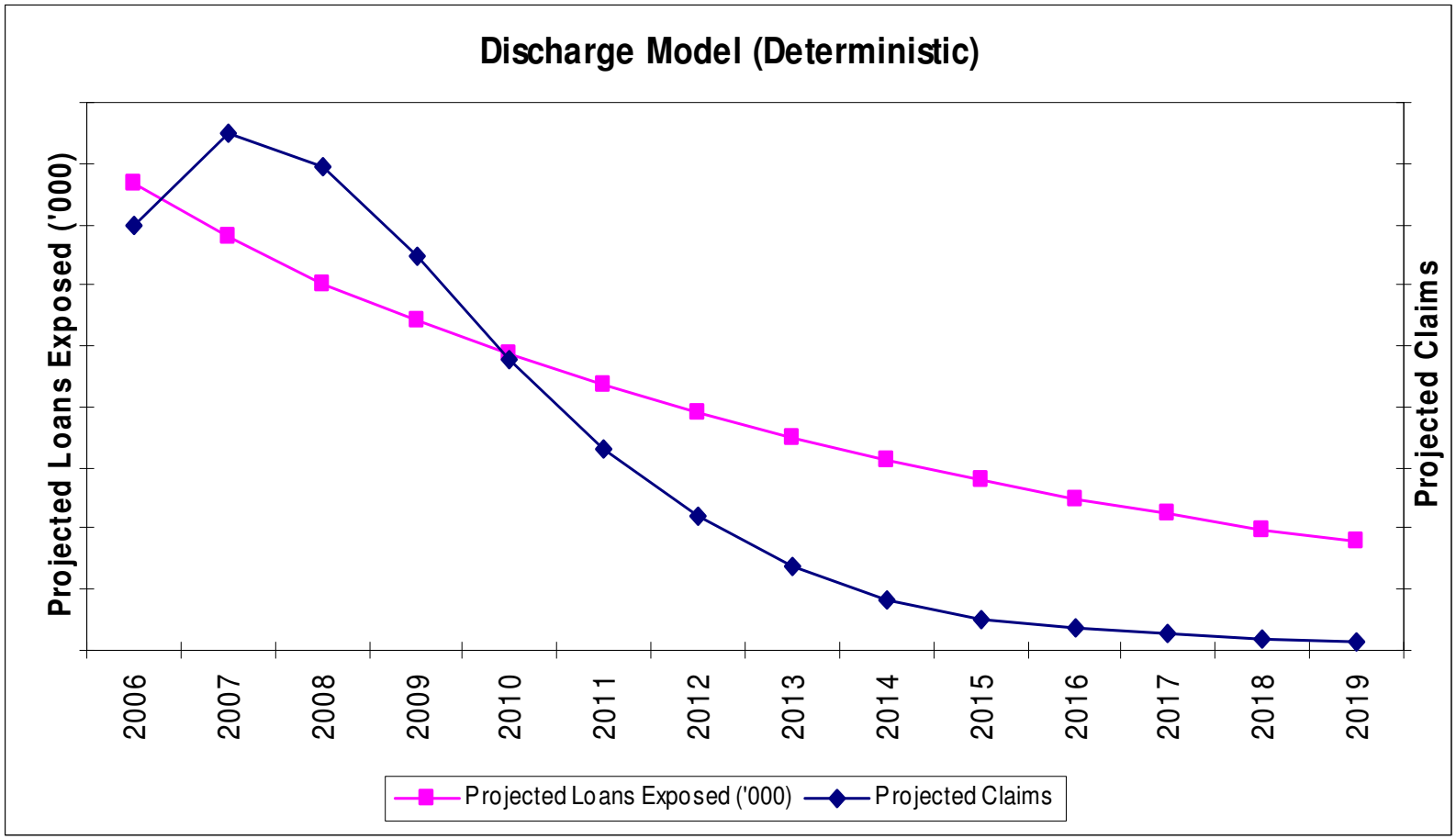
Interstate House Price Model



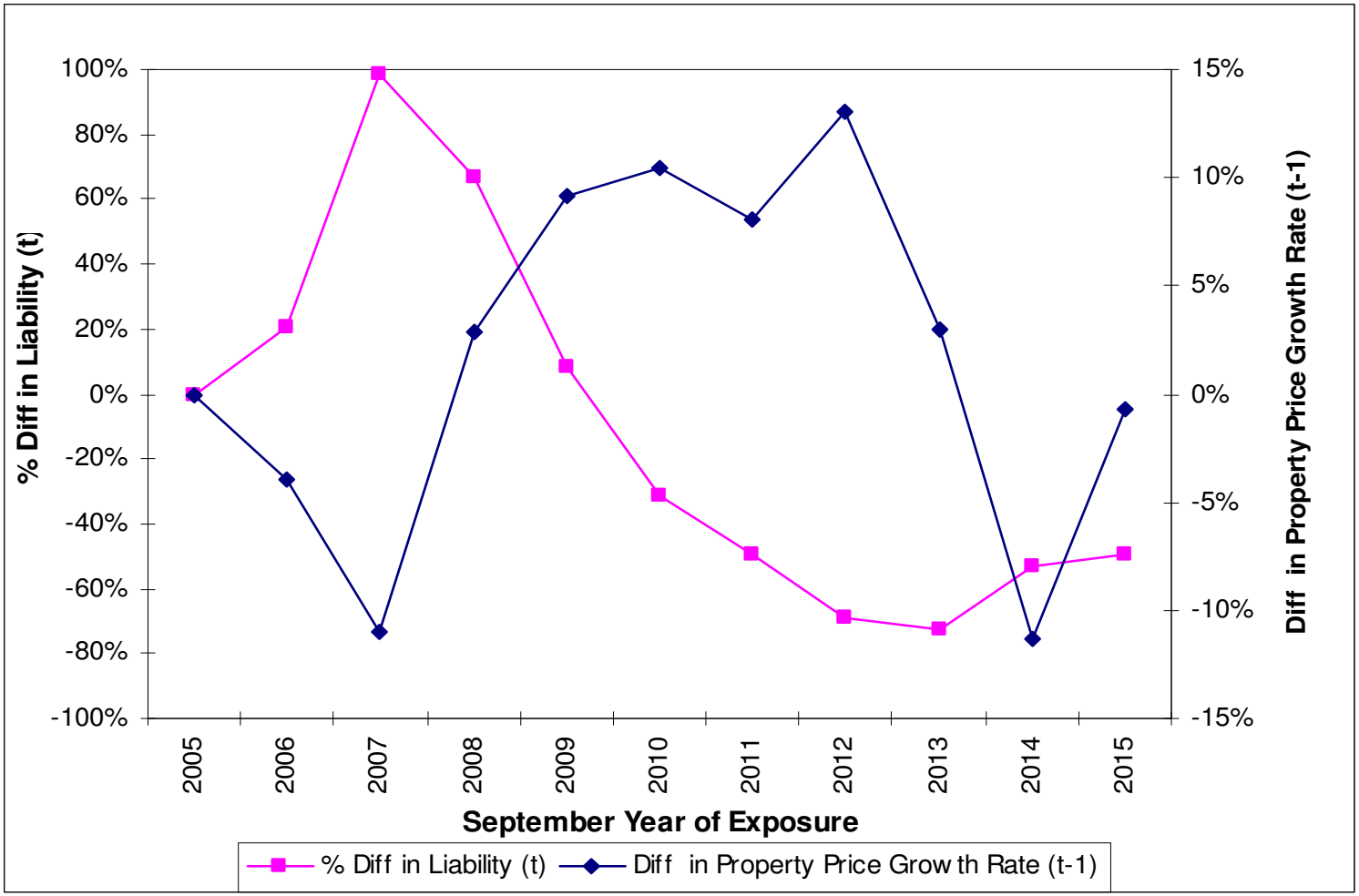
Stochastic Valuation Approach

- Deterministic valuation – set projection assumptions equal to median results from stochastic economic model
- Stochastic valuation, follow iterative process repeating deterministic calculation 10,000 times

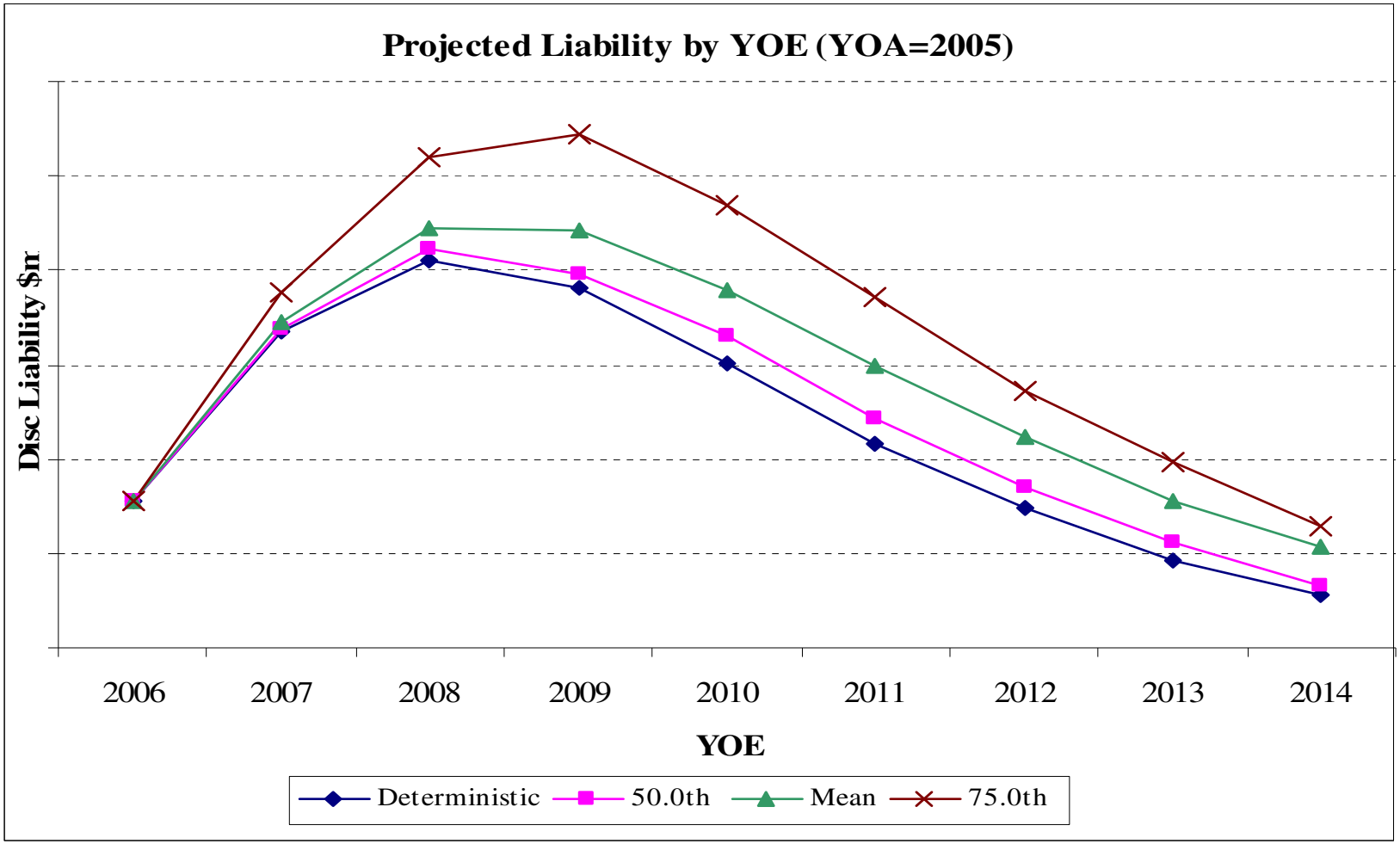
Projected Exposure Run-Off & Claims



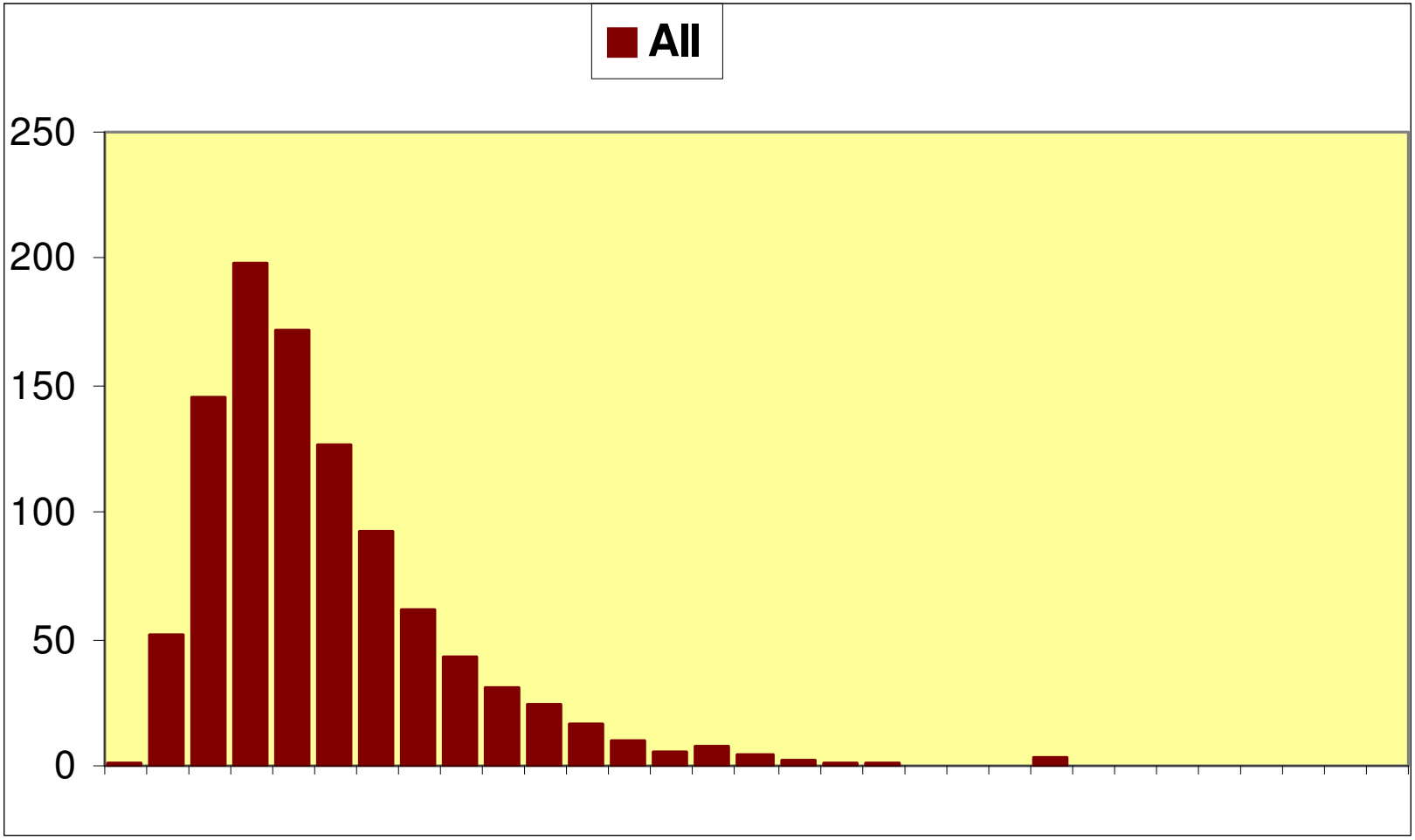
Analysis of a Single Simulation



Analysis of a Single Year of Advance



Empirical Distribution of Liability



Liability Distribution

- Liability significantly skewed to the downside
  - Extreme downside risk
  - Implicit skewness in economic outcomes
  - Credit risk threshold effects
  - Cyclicality in economic outcomes
  - Non-linear effects
- Mean from stochastic model 15-30% above the deterministic estimate
- Liability distribution non-lognormal, more highly skewed.
- APRA minimum (half CoV) applies in this case

Conclusions

- Systemic economic risk accounts for vast majority of uncertainty for this business
- Enforce consistency: same valuation model for central estimate **and** risk margin
- Use of lognormal for risk margins may be misleading
- Stochastic model more accurately captures inherent (non-lognormal) skewness
- Deterministic approach may significantly under-estimate the mean