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Stochastic Modelling

Peter McDade, AEGON UK
Craig Turnbull, Barrie & Hibbert

Agenda

- Introduction
- Pillar 1 - Peak 1
- Pillar 1 - Peak 2
  - Data
  - Audit
  - Analysis of movements
  - Comparability of results
- Pillar 2
  - Run-off v VaR
  - Univariate v Multivariate
- Stochastic models as a management tool
- Further applications

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Introduction – who wants stochastic modelling results?

- Regulators
  - FSA
    - Market-consistent guarantee costs (RBS / Pillar 1)
    - Risk-based capital assessment (ICA / Pillar 2)
  - Will other regulators follow FSA regime?
- Accountants
  - IAS, FRS 17, FRS 27
  - European Embedded Value
- Rating agencies
  - Risk-based capital assessment
  - Calculation and communication
- Internal management
  - Economic capital allocation and performance measurement
  - Risk / capital management
  - Product design / pricing

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Benefits of market-consistent stochastic modelling

- More objective valuation
- Captures option values
- Clarifies risk exposures
- Aid to decision making

Peak 1

- What is it good for?
- EU rules
- Stochastic GAOs
  - Are GAOs ‘special’?
  - Time value
  - Methodology
  - Stochastic v old deterministic

Peak 2

- Which peak bites?
- Peak 2 obviously? (time value, terminal bonus)
- But…
- Decision rules
- Monthly v annual steps

Data

- Controls
  - Data checks are vital
  - Asset shares are key
- Model points
  - Grouping criteria
  - Moneyness: forward not spot
  - Validations

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Audit

- Convergence
- Checks on results
  - Closed form: regular premiums, GAOs, decision rules
  - Don’t neglect stress test results – drive final balance sheet

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Analysis of movements

- Important as check and to aid understanding
- Difficult
- Development required
- Limitations
  - Will not pick up ‘consistent faults’ in data or methodology

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Comparability of results

- Market consistent methods help but consistency between offices still problematic
  - Choice of model
    - Interest rate / credit / equity volatility
  - Calibration
    - Risk free rate
    - Extrapolation of yield curve
    - Volatilities
      - Equity – price or total return
      - Credit
      - Fit to term structure & skew
      - Extrapolation of long volatilities
    - Correlations
    - Property

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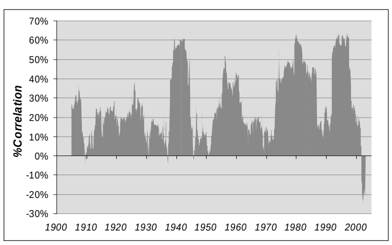
Example (1) - What is the ‘right’ correlation?



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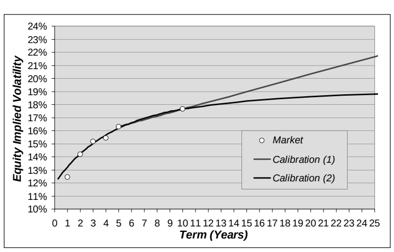
Example (2) – Extrapolating volatility



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Comparability of results

- PVFP on NP business!
- Decision rules (& approximations & changes)
- Should greater consistency be enforced? If so, how?

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Pillar 2

- Impossible task?
- Runoff v VAR
- Shock over 1 year v instantaneous
- Univariate v multivariate
  - Multivariate technically better, but…
  - Far more work
  - Can obscure exposure to individual risks
  - Harder to explain (Board, ratings agencies)
  - Benefits outweighed by costs?
  - Views differ (see later)

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Pillar 2 – Some Observations

- Hypothecation can make a big difference *[not just in pillar 2]*
  - Treating PVFP as asset or negative liability
  - Unit assets
  - Further incentive for efficient investment policy
- Risk interaction
- GN47 table
- FSA feedback

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Run-Off v VaR

- Different 'philosophies' on risk-based capital assessment
  - VaR approach intended to ensure that sufficient capital is available to switch into the 'matching' portfolio under adverse financial conditions
  - Run-off approach simply intended to ensure cashflow shortfalls can be funded as they arise
- Both have implementation challenges

Run-Off v VaR - Implementation Challenges

- Run-Off
  - Intermediate solvency
  - Sensitive to very long term asset and liability modelling assumptions
- VaR
  - Nested simulations (in theory!)
  - Estimating extreme short-term scenarios

Implementing VaR – Univariate v Multivariate

- Univariate
  - Calculate 99.5th percentile capital requirement for each individual risk factor (equities, interest rates…)
  - Combine the capital requirements using correlation matrix
- Multivariate
  - Estimate balance sheet sensitivities to changes in risk factors
  - Use one-year simulations and the sensitivities to project end-year balance sheet, and hence capital requirement

Univariate v Multivariate – Pro's and Con's

- Univariate
  - Simple (easy to explain to senior management)
  - But makes big assumptions
    - Ignores non-linearity; risk interaction
- Multivariate
  - More flexible and powerful
    - Can capture non-linearity and risk interaction
  - Can be extended to answer more questions with little further effort
    - More transparent approach to identifying and appraising candidate capital management approaches

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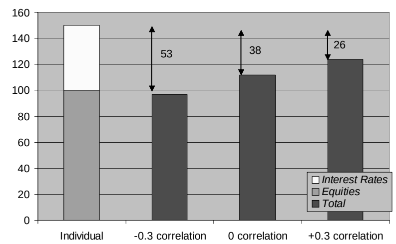
Pillar 2 and Correlations –
Estimating diversification benefits



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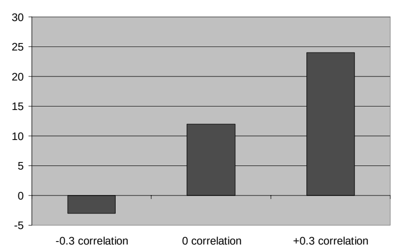
Pillar 2 and Correlations -
Analysing capital implications



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Senior management

- Have they engaged?
- How much do they need to know?
- Decision making
  - What weight should be given to peak 1 / peak 2 / pillar 2?
  - Decisions driven by worst of '3 peaks'
- Example: Sell corporate bonds and buy gilts
  - Hit to peak 1 (& EV) as lose liquidity premium
  - Improve peak 2 & pillar 2 as release credit capital
  - Reported profits?

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Stochastic modelling as a management tool

- Stochastic modelling more than just a regulatory obligation
- Provides management information that has never been available before
  - Estimates of costs, risks and capital requirements of with-profit business, after allowing for management actions

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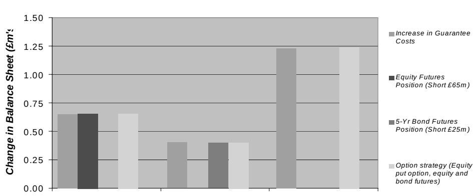
Stochastic modelling as a management tool
Matching the risk exposures



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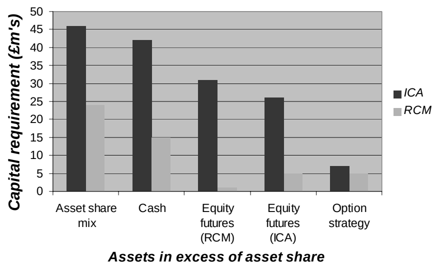
Stochastic modelling as a management tool
Appraising Candidate Investment Solutions



Further applications of stochastic modelling

- Employee stock option schemes
- Shareholder exposure
- Credit name exposure (using deltas)
- Operational risk
- Pension scheme modelling
- Product pricing
- Risk profiling
- Capital management

Further applications

- Economic capital model (parent company)
  - Allowance for own credit rating
  - Market value margins
  - To be used for capital assessment / product pricing / performance measurement

Lessons learned

- Better grasp of financial strength & risk exposures, though still much to understand
- Occam's razor – keep it simple
- Allow time to understand results – not just a production line!
- Incentive to reduce number of statutory entities within a group - diversification benefits (Pillar 2)

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Practical issues

- Frontiers continually advancing /demands growing
- Resources always constrained so need short cuts eg for intra year estimates:
  1. Closed form solutions (though hard to allow for RP & decision rules)
  2. Recalculate base result only
     - Base result volatile
     - But capital add-on reasonably stable (peak 2 & pillar 2)
     - So run base case and simply add on year end capital requirement
     - Likely to be at least as accurate as CFS?

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Practical issues

- Judgement required as to acceptability of compromises
- Balance of development v production ie best use of resources

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