Approaches to Setting Capital for Investment Guarantees

John Nicholls and Ismar Tuzovic

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Topics

• Approaches to setting capital margins
• A “theoretically correct” approach
• “Short-cut” approaches
International developments

- USA
- Ireland
- Europe
- China
- Japan
- Singapore
- Australia
USA – C3 Phase II capital

- C3 Phase II (risk based capital)
  - Total Asset Requirement (reported) = TAR(best efforts) + E x Max [0, TAR(adjusted) – TAR (best efforts)]
  - TAR based on Conditional Tail Expectation (90)
  - E not less than 0.05
  - Prudent Estimate assumptions
  - Working Reserve equal to the cash surrender value
- TAR (best efforts) reflect Clearly Defined Hedging Strategy
- TAR (adjusted) reflect risks that are not completely reduced, eliminated or considered
- Standard scenario minimum
USA – Actuarial Guideline XLIII reserves

• CTE Amount (reported) =
  E x CTE Amount (best efforts) + (1-E) CTE Amount (adjusted)
  – CTE Amount based on CTE (70)
  – E not more than 0.7 (not more than 0.3 if less than 12 months experience)
  – Prudent Estimate assumptions
  – Working Reserve equal to the cash surrender value
• CTE Amount (best efforts) reflect Clearly Defined Hedging Strategy
• CTE Amount (adjusted) reflects only hedge positions at the valuation date
• Standard scenario minimum
Ireland – Requirements for Reserving and Risk Governance for Variable Annuities

• Capital and Reserves the greater of:
  – Conditional Tail Expectation (95% for business issued from 1 Jan 2011, 90% for earlier business)
  – CTE 65 plus solvency and instantaneous change resilience margins
• An equivalent Value at Risk measure may be used
• No policy may be treated as an asset
• Lapse/surrender reflected only if this increases the CAR
Europe – Draft Report on Variable Annuities

• Committee of European Insurance and Occupational Pensions Supervisors Consultation Paper no. 83 – Draft Report on Variable Annuities

  – Considers supervision under both Solvency I and Solvency II frameworks

  – In relation to the Solvency II framework, findings include
    • adequate for technical provisions
    • standard formula approach not sufficient for capital requirements
    • principles for internal models suitable for VAs
Europe – Solvency II

- Solvency Capital Requirement
  - 99.5% Value at Risk measure over one year, considering change in “own funds”
  - Different timeframe can be considered provided level of protection for the policyholder is the same
  - Reflect dynamic hedge (subject to qualitative and quantitative limitations)
Japan – Insurance Solvency Regulations

• New solvency rules come into effect from March 2012
• For VA guarantees either Normative or Alternative approach can be applied
• In either case credit for hedging program available
• Normative approach
  – Minimum guarantee reserve under a stress
  – Calculation method to be specified by company, subject to regulatory approval
  – Standard or non-standard parameters may be used
    • risk coverage must be equivalent to that using standard parameters
  – Stresses as specified for Asset Value Volatility Risk
• Simplified normative approach may be used for business issued before March 2005
Japan – Insurance Solvency Regulations

• Alternative approach
  – Insurers may develop their own approach
  – Calculation method to be filed in advance with the regulator
  – Once applied, not allowed to switch back to Normative approach unless
    • Back-testing failed
    • Significant change in risk measurement models
  – Insurer must meet 13 specified criteria regarding risk management and risk measurement
China - Interim Rules for Variable Annuity Insurance Management

• Pricing
  – Based on parameters derived in prudent manner
  – Follow generally accepted actuarial standards, option pricing model or stochastic model
• Risk management
  – Dynamic hedging
  – Constant proportional portfolio insurance
• Arbitrage-free option pricing model or stochastic model for pricing and hedging
• Reserve for guarantee maximum of
  – CTE 70 based on stochastic model
    • Over life of the guarantees
    • Scenario independent assumptions to be best estimate plus a risk margin
  – Deterministic result from standard (stressed) scenario
• No credit for hedging in reserve calculations
Singapore

- Guidelines on Use of Internal Models for Liability and Capital Requirements for Life Insurance Products Containing Investment Guarantees with Non-Linear Payouts
- Greater of CTE 95 results with and without margins for adverse deviation applied to best estimate assumptions
- Swaps used to mitigate risk recognised as an asset on the balance sheet
- No credit for the swap when calculating liability or capital for duration mismatch risk
APRA capital review basis

• 99.5% probability that insurer will be able to absorb unexpected shocks or losses that may arise over a one-year period and continue to be able to meet its obligations to policyholders at the end of that period
• Capital Charge = Prudent Liability - Adjusted Liability
• Adjusted Liability = Max (RFBEL, BETV)
• Prudent Liability = Max (Stressed Liability, Stressed TV)
APRA’s Review of Capital Standards

• “The proposed standard asset risk capital charge will not adequately cater for the special features of variable annuities.”

• “It is likely that stochastic modelling would be required instead of the scenario-based calculations used for other types of products.”

  – May consider both asset risks and insurance risks simultaneously
APRA’s review of capital standards

- Proposal for variable annuities
  - Capital = E x Capital (Best Efforts) + (1-E) x Capital (Adjusted)
  - E can not be greater than 0.7 (0.3 if company has less than 12 months of experience)
Economic capital model

<table>
<thead>
<tr>
<th>Risk Measure definition</th>
<th>Time Horizon</th>
<th>Risk Measure</th>
<th>Risk Appetite</th>
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</thead>
<tbody>
<tr>
<td>Risks Covered</td>
<td></td>
<td>Risk Factors and Choice of Model</td>
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<tr>
<td>Impact Measure</td>
<td></td>
<td>Risk Bearing Value</td>
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<td>Aggregation</td>
<td></td>
<td>Dependence Structure</td>
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### APRA capital review basis - general

<table>
<thead>
<tr>
<th>Risk Measure definition</th>
<th>Time Horizon</th>
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<th>Risk Appetite</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
<td>VaR</td>
<td>99.5%</td>
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<table>
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<tr>
<th>Risks Covered</th>
<th>Risk Factors – Various</th>
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<td>Choice of Model – Stress</td>
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<table>
<thead>
<tr>
<th>Impact Measure</th>
<th>Risk Bearing Value</th>
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<tr>
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<td>Adjusted liability</td>
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<th>Aggregation</th>
<th>Dependence Structure</th>
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<tbody>
<tr>
<td></td>
<td>Correlation matrices</td>
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</table>
## APRA capital review basis - VA

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<th>Risk Measure definition</th>
<th>Time Horizon</th>
<th>Risk Measure</th>
<th>Risk Appetite</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Portfolio run-off</td>
<td>VaR/CTE?</td>
<td>???</td>
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</tbody>
</table>

### Risks Covered
- **Risk Factors** – Various
- **Choice of Model** – Stochastic & stress

### Impact Measure
- **Risk Bearing Value**
  - Risk-free best estimate liability

### Aggregation
- **Dependence Structure**
  - Market-based calibration / factors
Why at least partially stochastic over portfolio run-off?

- Market risk
- Basis risk
- Counterparty risk
- Legal risk
- Hedging program error
- Gap risk
- Delay risk
- Longevity risk
- Turbulence risk
- Path dependence
- Policyholder behaviour
- Parameter estimation

Risk will be present throughout the portfolio run-off
“Short-cut” approaches play an important role

- “Short-cut” approaches
  - Stress/scenario methods
  - Scenario selection techniques
  - Replicating portfolios
  - Projection period less than full run-off
- Potential roles
  - Floor for regulatory capital
  - Interim valuations
  - Fast close
  - Sensitivity analysis
## Investment Guarantee Products

<table>
<thead>
<tr>
<th></th>
<th>AXA Protected Retirement Guarantee</th>
<th>Macquarie Lifetime Income Guarantee</th>
<th>OnePath MoneyForLife</th>
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<tbody>
<tr>
<td>Lifetime income guarantee</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Guarantee rate</td>
<td>From 4.0% (age 60) to 5.0% (age 65)</td>
<td>3.5% (up to age 64)</td>
<td>4.0% (up to age 64)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.0% (age 65 to 69)</td>
<td>5.0% (from age 65)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5% (from age 70)</td>
<td></td>
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<tr>
<td></td>
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<td>Lifestyle Bonus</td>
<td></td>
</tr>
<tr>
<td>Investment strategies (growth allocation range)</td>
<td>Four (35% to 85%)</td>
<td>One (70%)</td>
<td>Three (35% to 60%)</td>
</tr>
<tr>
<td>Guarantee fee range</td>
<td>1.20% to 2.15% p.a. of account value</td>
<td>1.10% p.a. of Guarantee Base</td>
<td>1.15% to 1.45% p.a. of Protected Income Base</td>
</tr>
<tr>
<td>Ratchet</td>
<td>Annual</td>
<td>Annual</td>
<td>Annual</td>
</tr>
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Sample GMWB product

- Guarantee income payment of 5% for life
- Annual ratchet
- 50% Australian Equity, 50% Fixed Interest
- Guarantee charge 1.3%, account fee 1.5%
- Male age 65, in force 6 months
- Expense $200 per annum increasing with inflation
- Dynamic lapse
Modelling GMWB capital

• Nested stochastic model:
  – 1,000 real world scenarios
  – 1,000 risk-neutral scenarios coupled to real world scenarios via risk free rate and implied volatility at each point in time
• Real world projection uses stressed future experience assumptions based on APRA’s 2010 proposals
• Delta and parallel rho hedge
• Capital set as the negative of the minimum of the present value of future profits (shortfall)
Capital distribution: 1-yr horizon

GMWB Capital Requirement

-2% 0% 2% 4% 6% 8% 10%

0 100 200 300 400 500 600 700 800 900 1,000

Ranked Scenarios

Capital Amount

Unhedged
Hedged
APRA QIS 1

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Capital distribution: 35-yr horizon

GMWB Capital Requirement

- Unhedged
- Hedged
- APRA QIS 1
Scenario distribution: 1-yr horizon

GMWB Capital Requirement

Ranked Scenarios

Capital Amount

-2% 0% 2% 4% 6% 8% 10%

Unhedged
Hedged
Scenario distribution: 35-yr horizon

Adverse scenarios for hedge
Time to capital event

Cumulative Distribution of Capital time periods

- Unhedged
- Hedged

Capital Time Period (months)

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Capital distribution: 35-yr horizon

GMWB - Capital Requirement

Annualised equity return to capital time period

Capital Amount

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Capital distribution: 35-yr horizon

GMWB - Capital Requirement

Capital Amount

Annualised equity return to capital time period

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Capital distribution: 35-yr horizon

GMWB - Capital Requirement

20 Year implied volatility at capital time period

UnHedged Capital
Capital distribution: 35-yr horizon

GMWB - Capital Requirement

20 Year implied volatility at capital time period

Capital Amount

Hedged Capital
Capital distribution: 35-yr horizon

GMWB - Capital Requirement

20 year government bond yields at capital time period

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Capital distribution: 35-yr horizon

GMWB - Capital Requirement

20 year government bond yields at capital time period

Hedged Capital
Scenario selection techniques

- Reduce run time by selecting a scenario subset which approximates the full distribution
- The methodology used to select scenarios is known as the “Relative Present Value Distance Method” (Cheuh, 2001)
- Method based on calculating a relative distance measure between each pair of scenarios
- Method 1: distance measure on the implied volatility in each scenario
- Method 2: distance measure on accumulated surplus (loss) holding a 20 year put option.
Capital distribution: 1-yr horizon

GMWB Capital - representative scenario
Implied volatility method

Scenario Distribution vs. Capital Amount

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Capital distribution: 1-yr horizon

GMWB Capital - representative scenario
Implied volatility method

Scenario Distribution

Capital Amount

Hedged
Fitted

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Capital distribution: 35-yr horizon

GMWB Capital - representative scenario
Implied volatility method

Capital Amount

Scenario Distribution

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Capital distribution: 35-yr horizon

GMWB Capital - representative scenario
Implied volatility method

Scenario Distribution

Capital Amount

Hedged
Fitted

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Capital distribution: 1-yr horizon

GMWB Capital - representative scenario
Put option method

Scenario Distribution

Capital Amount

Unhedged
Fitted

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Capital distribution: 1-yr horizon

GMWB Capital - representative scenario
Put option method

Capital Amount

Scenario Distribution

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Capital distribution: 35-yr horizon

GWMB Capital - representative scenario
Put option method

Capital Amount

Scenario Distribution

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Capital distribution: 35-yr horizon

GWMB Capital - representative scenario
Put option method
Questions?

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References

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