Guarantees in insurance products

Joint Regional Seminar
18th – 25th June

Richard English
Agenda

- Why do we need to consider guarantees in product development?
- Identifying guarantees
- Methods for valuing guarantees
- New modelling challenges and practical issues
- Case studies
- Worked example
Why do we need to consider guarantees?

- Lessons learned the hard way
- Theoretical basis
- Reactions
Lessons learned the hard way – UK

- Equitable Life
  - In the 1950s, the EL started to sell GAR (Guaranteed Annuity Rate) policies
  - In the 1990s interest rates fell well below expected levels and the GARs became expensive
  - In 1994 EL attempted to cut payouts to GAR holders
  - In 2000 the UK Parliament ruled against EL forcing them to honour the GARs
  - EL was forced to put itself up for sale and close to new business

- New regulatory regime now requires companies to report cost of options and guarantees
Lessons learned the hard way – Taiwan

- Before 2001 pricing rates were high
- Current interest rate environment implies significant negative spread problems for the industry
- Several insurers have had to inject capital in recent years
  - In 2002 Shin Kong Financial Holding injected NT$19.6 billion to strengthen Shin Kong Life’s reserves
  - It further strengthened its capital position by issuing NT$15 billion of preferred stock over 2003-2004
  - Over 2005 and 2006 ING strengthened its reserves by EUR682 million
  - Prudential wrote off GBP21 million of DAC in 2005
Lessons learnt the hard way – Japan

- A familiar story of negative spreads caused by a zero interest environment
- Negative spreads ongoing in the current time
- Numerous companies became insolvent and underwent compulsory restructuring
  - Chiyoda Life
  - Kyoei Life
  - Tokyo Life
- Restructuring involved acquisition, often by a foreign insurer
- In the case of Aoba (formerly Nissan) Life the company was closed to new business
Theoretical basis

- Financial economics says that an option or guarantee has time value even if it is not currently biting.
- This value should be recognised!
- Considering guarantees when pricing will lead to identifying where the business is vulnerable:
  - Implies clues as to the best way to manage the product.
  - Better understanding of the risk inherent in selling a product.
Lessons learnt the hard way – outcome

- Analysts and investors are putting pressure on life insurers to quantify the cost of guarantees within their business
- Key principles of transparency and consistency
Reactions to guarantee related problems

- **UK**
  - GARs not being sold
  - In force book being hedged
  - Move towards more transparent unit linked type product

- **Taiwan**
  - Pricing interest rate lowered
  - Non par business introduced in 2003

- **Japan**
  - Guaranteed rates reduced
  - Foreign companies gained entry to the market
Identifying guarantees

- Definition
- Typical products
- Changes to product design
Definition

- An option or guarantee exists if *market conditions* and/or *policyholder behaviour* impact the cashflows arising from an insurance policy.
- Impact can be positive or negative.
Typical guarantees

- Variable annuity
  - Guaranteed Minimum Death Benefit (GMDB)

- Roll up on cash dividend
  - dividends from participating business kept in a separate account and rolled up at the guaranteed rate until policy exits
Profit sharing rules on participating business

- Seen in old style Taiwan products and common in Europe as well
- Reserve is rolled up deterministically at the guaranteed rate
- Policyholder is also credited with a proportion of the return in excess of the guaranteed rate (if any)

Reserve @ end = reserve @ start * (1+g)
PS amount = reserve @ start * x% * (1 – g)
Typical guarantees

- **Investment guarantee**
  - Minimum crediting rate on interest sensitive products

- **Guarantees on surrender**
  - No Market Value Adjustment (MVA) on surrender of UK Unitised With Profit (UWP) products

- **Guarantees on death**
  - Payout maximum of fund and GMDB on unit linked policies
Changes to product design

- Charge for guarantees but consider impact on competitiveness
- Limit guarantees e.g. investment guarantee does not apply to early retirements
- Investment strategy can have direct impact on rates
  - Does investment strategy become part of product design?
Pricing guarantees

- Closed form solution
- Replicating portfolio
- Monte Carlo modelling
Closed form solution

- Most common example would be to apply a variation on the Black-Scholes method
- Single premium bond, return applied to initial investment equal to the maximum of
  - 5% per annum
  - Return on Hang Seng Index
- Apply B-S formula for price of a put option

\[ P(S,T) = Ke^{-rT}\Phi(-d_2) - S\Phi(-d_1) \]
Replicating portfolio

- Same single premium example
  - Value of the liability including FOG is composed of
    - Zero coupon bond with nominal equal to guaranteed amount
    - Call option struck at guaranteed amount
Problems with these approaches

- Guarantees can be complicated
  - Our example is probably unrealistically simple
- Replicating assets unlikely to exist
- Formulae for analytical solutions become mathematically intractable
- Difficult to include impact of management actions and policyholder behaviour
Monte Carlo simulation

- Inputs to Monte Carlo simulation
  - Model to simulate the cashflow behaviour under varying investment scenarios
  - Economic scenario file

- Scenario file contains investment returns generated from the set of distributions that describe market movements

- Produce many results and take the average

Value of FOGS = Mean of stochastic run - Deterministic BE result
Monte Carlo simulation – Pros and cons

Pros
- Flexible – can be adapted to any guarantee that can be modeled
- Lots more information about product behaviour in adverse conditions
- Impact can be reduced by management actions

Cons
- Models can be complex and harder to check
- Building and calibrating Economic Scenario Generators not an “actuarial” activity
Monte Carlo simulation – Assumptions

- Non market assumptions should be best estimate
- Market assumptions should be market consistent
  - Risk neutral market consistency
  - Real world market consistency

Need to know
- Risk free yield curve
- Market implied volatilities
- Risky asset spreads if real world
Practical issues

- Market consistency in incomplete markets
- How accurately can we quantify the underlying statistical distributions?
- How well can we calibrate policyholder behaviour?
- What improvements are needed to current modeling capabilities?
Case studies – Scandinavia

- Unit linked product with minimum benefit based on %age of premium
- Average guarantee cost in the pricing was calculated as around 1% of PV premiums
- Rose to 2% at the 95th percentile
Case studies – UK

- With-profit pensions product with a guaranteed minimum investment return on premiums
- Guarantee cost calculated to be 0.41% per annum of the market value of liabilities
Worked example

Taiwanese Interest Sensitive Annuity
Worked example

- Single Premium Interest Sensitive Annuity with guaranteed crediting rate
- Premium of NT$600,000
- Crediting rate set as maximum of 2% and bond return less 1%
- 10,000 market consistent scenarios run through VIP software
- Backing assets are bonds (80%) and equity (20%)
- Cost of guarantee calculated by comparing mean PV of distributable earnings across all scenarios against the best estimate deterministic run
- Results also calculated with dynamic discontinuance
Dynamic discontinuance rule

- Best estimate rate = 3%
- Dynamic rate
  - When $X < 80\% = \text{Max}(1\%, \ 3\% \times X)$
  - When $80\% \leq x \leq 120\% = 3\%$
  - When $X > 120\% = \text{Min}(20\%, \ 3\% \times X)$
- $X = \text{market rate} / \text{crediting rate}$
- Market rate is based on 50:50 bond-equity split
## Worked example - Results: Best estimate scenario

<table>
<thead>
<tr>
<th>Projection year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distributable Earnings</strong></td>
<td>(48,759)</td>
<td>1,793</td>
<td>2,760</td>
<td>3,248</td>
<td>3,535</td>
</tr>
<tr>
<td>Crediting Rate</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
</tr>
<tr>
<td>Bond Return</td>
<td>1.80%</td>
<td>2.10%</td>
<td>2.37%</td>
<td>2.53%</td>
<td>2.65%</td>
</tr>
<tr>
<td>Investment Return</td>
<td>1.80%</td>
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<td>2.37%</td>
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</tr>
</tbody>
</table>

<table>
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<tr>
<th>Projection year</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distributable Earnings</strong></td>
<td>3,867</td>
<td>3,892</td>
<td>4,288</td>
<td>4,010</td>
<td>34,602</td>
</tr>
<tr>
<td>Crediting Rate</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
<td>2.00%</td>
</tr>
<tr>
<td>Bond Return</td>
<td>2.77%</td>
<td>2.79%</td>
<td>2.91%</td>
<td>2.85%</td>
<td>2.83%</td>
</tr>
<tr>
<td>Investment Return</td>
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**PV Earnings = 2,805**
Worked example - Results: Average stochastic result (no dynamic disc.)

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</thead>
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<tr>
<td>Distributable Earnings</td>
<td>(52,869)</td>
<td>(2,335)</td>
<td>(940)</td>
<td>(2,360)</td>
<td>648</td>
</tr>
<tr>
<td>Crediting Rate</td>
<td>3.00%</td>
<td>2.97%</td>
<td>2.94%</td>
<td>2.85%</td>
<td>2.78%</td>
</tr>
<tr>
<td>Bond Return</td>
<td>1.85%</td>
<td>2.13%</td>
<td>2.40%</td>
<td>2.55%</td>
<td>2.70%</td>
</tr>
<tr>
<td>Investment Return</td>
<td>1.83%</td>
<td>2.09%</td>
<td>2.43%</td>
<td>2.53%</td>
<td>2.72%</td>
</tr>
</tbody>
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<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributable Earnings</td>
<td>1,281</td>
<td>2,052</td>
<td>2,406</td>
<td>2,742</td>
<td>35,904</td>
</tr>
<tr>
<td>Crediting Rate</td>
<td>2.66%</td>
<td>2.60%</td>
<td>2.54%</td>
<td>2.50%</td>
<td>2.51%</td>
</tr>
<tr>
<td>Bond Return</td>
<td>2.77%</td>
<td>2.89%</td>
<td>2.96%</td>
<td>2.99%</td>
<td>3.01%</td>
</tr>
<tr>
<td>Investment Return</td>
<td>2.77%</td>
<td>2.90%</td>
<td>2.93%</td>
<td>2.98%</td>
<td>3.03%</td>
</tr>
</tbody>
</table>

PV Earnings = (20,411) => Cost of guarantee = 23,215
Worked example - Results:
Average stochastic result (with dynamic disc.)

Projection year | 1      | 2      | 3      | 4      | 5      |
----------------|--------|--------|--------|--------|--------|
**Distributable Earnings** | *(53,892)* | *(3,525)* | *(2,015)* | *(1,204)* | *(137)* |
Crediting Rate | 3.00%   | 2.97%   | 2.94%   | 2.85%   | 2.78%  |
Bond Return    | 1.85%   | 2.13%   | 2.40%   | 2.55%   | 2.70%  |
Investment Return | 1.83%   | 2.09%   | 2.43%   | 2.53%   | 2.72%  |

Projection year | 6      | 7      | 8      | 9      | 10     |
----------------|--------|--------|--------|--------|--------|
**Distributable Earnings** | 638    | 1,545  | 1,986  | 2,426  | 42,789 |
Crediting Rate | 2.66%   | 2.60%   | 2.54%   | 2.50%   | 2.51%  |
Bond Return    | 2.77%   | 2.89%   | 2.96%   | 2.99%   | 3.01%  |
Investment Return | 2.77%   | 2.90%   | 2.93%   | 2.98%   | 3.03%  |

**PV Earnings = (21,497)** => Cost of guarantee = 24,301
Graph of distributable earnings in the three results

- Best estimate
- Stochastic (no dynamic disc)
- Stochastic (with dynamic disc)
Conclusions

- Guarantees can lead to significant costs
- Therefore best practice is to consider them when designing and pricing insurance products
- Can affect all aspects of pricing
- Are guaranteed products viable?
- Are they profitable?
- Should we keep selling them?