Variable Annuities Working Party

- Presented paper to Faculty and Institute in March 2008
- Working Party members
  - Colin Ledlie
  - Dermot Corry
  - Gary Finkelstein
  - Alan Ritchie
  - Ken Su
  - Colin Wilson
- Colin Ledlie, Dermot and Gary will present here today
Introduction (Section 1)

- Variable Annuity
  - Can be a confusing term
  - Originated in the US
  - We defined it as "any unit-linked or managed fund vehicle which offers optional guarantee benefits as a choice for the customer"

- Similar products available for many years – e.g. Maturity Guarantees Working Party in 1980

- Fagan proposed a form of hedging for these types of guarantees in 1977 but the 1980 Working Party took the view that there would be practical disadvantages to this method

- Advances in hedging techniques have been the key enabler in recent years
Agenda

- Definitions
- Market Context
- Sample Product
- Customer Outcomes
- Risk Management
- Pricing
- Hedging and Market Risk Management
- Reserving and Capital
- Regulatory Issues
- Discussion Points
Definitions (Section 2)

- **GMDB** – Guarantee on death. May guarantee premium paid or the guarantee may include additional feature.
- **GMAB** – Accumulation benefit. As above with guarantee at surrender/maturity rather than death.
- **GMIB** – Income Benefit. Guarantees a minimum income at annuitisation.
- **GMWB** – Withdrawal Benefit. Guarantees a minimum withdrawal from the fund each year. Fund can still be surrendered so different from a traditional annuity.
- Variations of GMWB have withdrawal benefit payable for life.
UK Market Opportunity (Section 3)

- Bridges the gaps left by the decline of with-profits and defined benefit pension schemes
- Traditional annuities give strong guarantees but inflexible and result in fixed interest investment for up to 30 years
- Drawdown (or ARFs in Ireland) allow investment in risky assets but no income protection if market falls
- UK market scale (2006) - £9.6bn annuities, £2.6bn drawdown
- Face some regulatory challenges to product design
US Variable Annuity Sales ($bn)

Source: NAVA, Milliman
Japanese Net VA Assets

Source: Hoken Mainichi Shimbun.
European and Asian Developments

- Launches in Korea, Hong Kong, Taiwan etc
- Growing interest in Continental Europe
  - Aegon, Allianz, AXA, ING, Generali, Met Life, Munich Re (Ergo)
  - Others at the planning stage
- UK market
  - Aegon, Hartford, Lincoln, Met Life
  - Standard Life, Prudential and AXA have all announced that they are considering entering the market
- Majority of above based in Ireland but activity also in Luxembourg
- Germany changing regulations to allow VA business to be written by domestic German companies
Sample Product Design (Section 5)

- Guaranteed Minimum Withdrawal Benefit for life
- 5% pa of original premium guaranteed income at age 65 for life
- Annual Step-Up (subject to 15% maximum to age 75)
- 60% Equity Backing Ratio
- Charge for Guarantee 0.75% pa
Customer Outcomes (Section 6)

- Stochastic Analysis of outcomes
- Initially examine two selected scenarios – one bad (38) and one good (81)
- Compare VA with income drawdown
- Then move on to probability distributions of outcomes
- Treating Customers Fairly considerations
Simulation 38 – Fund Value and Guarantee Base

Variable Annuities

Simulation 38 — Fund Value and Guarantee Base

Figure 6.2.4a. Fund value and guarantee base, Scenario A
Simulation 81 – Fund Value and Guarantee Base

Figure 6.2.4b. Fund value and guarantee base, Scenario B
Probability Distribution – Income from Drawdown

Figure 6.3.3b. Percentiles of income through time, Drawdown
Figure 6.3.3a. Percentiles of income through time, Variable Annuity
Treating customers fairly

- Consider how the guarantee operates in a range of scenarios and appropriateness of product
- Information requirements for the distributor to allow them to understand the product
- Review products post sale – continuing to meet needs. Should they notify customer if guarantee is well out of the money?
- Careful consideration of any ability to review charges and/or benefits
Key Market Risks (Section 9)

- Equity asset value movements (referred to as Delta)
- Bond asset value movements (if bonds in portfolio)
- Changes in interest rates (Rho)
- Equity market volatility (Vega)
- Interest Rate volatility
- Correlation between interest rates and equity markets
- Performance of funds compared with underlying indices (basis risk)
- Pricing is normally fixed for a period of time
  - Ideally changes with market conditions
Key Non-Market Risks

- Lapse behaviour (or turning off guarantee)
- Mortality/Longevity
- Funds chosen by the policyholder
- Start of withdrawals
- Amount of withdrawals per annum
- Business mix – ages, genders etc
Pricing (Section 7)

- Key elements for market consistent pricing
  - Economic scenario generator
  - Model to project guarantee income and claim payments
- Assumptions on key variables
  - Mortality
  - Lapse, including dynamic behaviour if appropriate
  - Election rates
  - Etc.
Pricing of Sample Product in paper

- Market Consistent Cost at 30/06/07 = 0.49 % pa
- Sensitivity
  - 1% absolute fall in interest rates – 0.82 % pa
  - 25% relative increase in equity vol – 0.67 % pa
  - Longevity 80% of central assumptions – 0.60 % pa
  - Defer withdrawals for 3 years – 0.38%
  - Flat withdrawals rather than dynamic – 0.37%
Price to the customer

- Range of factors
  - Economic price
  - Competitive position
  - Perceived value of guarantee to customers
  - Willingness to change price if markets change
  - Hedging strategy
  - Capital and reserving requirements
  - Sensitivity of the price to assumptions
Hedging and Market Risk Management (Section 10)

- “Greek” commonly used to describe the market risks
- Delta - risk that UL fund falls in value
  - $\Delta = \frac{\partial V_L}{\partial V_A}$ (where $V_A$ denotes value of UL fund)
- Gamma – convexity of the liability option
  - $\Gamma = \frac{\partial \Delta}{\partial V_A} = \frac{\partial^2 V_L}{\partial V_A^2}$
- Rho – Risk of interest rate change
  - $\Rho = \frac{\partial V_L}{\partial r}$ (where $r$ is the interest rate)
- Vega – Volatility of the underlying assets
  - $\Vega = \frac{\partial V_L}{\partial \sigma_A}$
Hedging Techniques

- **Dynamic Hedging**
  - Using “Greeks” select assets which will move in the same way as the liability
  - Dynamically adjust hedge assets as value of “Greeks” changes
  - Depends on highly liquid assets with low trading costs

- **Static Hedging**
  - Use over the counter options
  - Work well for simple guarantees such as GMAB
  - Exotic hedges needed for more complex guarantees
  - Some rebalancing almost certainly required – e.g. demographic variations
  - Can be used as a core with a form of dynamic hedging for the rebalancing
Market Risk Management – Reinsurance

- Growing market in reinsurance
- Risk appetite varies – market, mortality/longevity, lapse, election
- Limited availability of full risk transfer
- Provides alternative for smaller books or new entrants
- Reinsurance company may have minimum size and other limitations
Impact of Hedging - Examples

- We examine the implications of various market stresses on the option value
  - With no hedging and different hedge strategies
- Then look at longer term profit and loss distribution projections
- This gives us some possible input for economic capital
Instantaneous Stresses (Section 10)

Table 10.8.4(a)

<table>
<thead>
<tr>
<th>#</th>
<th>Equities</th>
<th>Interest rates</th>
<th>Equity volatility</th>
<th>Swaption volatility</th>
<th>Capital strain (economic value)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unhedged</td>
</tr>
<tr>
<td>(i)</td>
<td>-5%</td>
<td></td>
<td></td>
<td></td>
<td>-253</td>
</tr>
<tr>
<td>(ii)</td>
<td>-25%</td>
<td></td>
<td></td>
<td></td>
<td>-1,959</td>
</tr>
<tr>
<td>(iii)</td>
<td></td>
<td>-1%</td>
<td></td>
<td></td>
<td>-1,939</td>
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<tr>
<td>(iv)</td>
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<td></td>
<td>+6%</td>
<td></td>
<td>-1,542</td>
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<tr>
<td>(v)</td>
<td></td>
<td></td>
<td></td>
<td>+3%</td>
<td>-200</td>
</tr>
<tr>
<td>(vi)</td>
<td>-25%</td>
<td>-1%</td>
<td>+6%</td>
<td>+3%</td>
<td>-5,767</td>
</tr>
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</table>
Projection over time – Unhedged

Figure 10.9.5(a). Unhedged quarterly P&L distribution WB product (£)
Hedged

Figure 10.9.5(c). Delta rho vega hedged quarterly P&L distribution WB product (£)
# Measures of Economic Capital at Risk

<table>
<thead>
<tr>
<th></th>
<th>Immediate Stress (capital strain/AV)</th>
<th>Cash Flow Projection (PVFP/AV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unhedged</td>
<td>5.8 %</td>
<td>12.9 %</td>
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<tr>
<td>Delta-Rho Hedge</td>
<td>2.9 %</td>
<td>2.5 %</td>
</tr>
<tr>
<td>Delta-Rho-Vega Hedge</td>
<td>0.0%</td>
<td>2.0%</td>
</tr>
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</table>
Reserving and Capital (Section 8)

- Stochastic approach needed to reserving
- Most common approach in Ireland is to use Conditional Tail Expectation (CTE) approach
- CTE approach adapted from the US method
- This involves projecting cashflows over the life of the policy for each scenario calculating reserve
- CTE reserve is average of worst scenarios
- Allowing for hedging involves nested stochastic projections of profits for each scenario
Solvency Margin

- Products carry investment risk => 4% solvency margin
- May be possible to issue base UL product and rider as distinct products => 4% applies to rider only
- Financial Regulator likes to see minimum total capital based on CTE 90
- Solvency II will lead to a change in approach
  - Easier to identify the impact of the different market aspects
- Solvency II does not currently allow adequately for Dynamic Hedging
- However also poor at dealing with basis risk, dynamic lapse, longevity etc
Regulatory Constraints (Section 11)

- HMRC limits on income drawdown (known as GAD limits) complicate the market in the UK.
- Can limit income payout when markets fall.
- Can force higher income when markets rise.
- Undesirable and lobbying for change.
- Not an issue in Ireland – though 3% ARF minimum withdrawal could cause similar issues.
# Market Conditions

<table>
<thead>
<tr>
<th></th>
<th>30/06/07</th>
<th>07/03/08</th>
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</thead>
<tbody>
<tr>
<td>FTSE 100</td>
<td>6608</td>
<td>5700</td>
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<tr>
<td>10 Year Equity Implied Volatility</td>
<td>20.0%</td>
<td>27.1%</td>
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<tr>
<td>20 Year Swap Rate</td>
<td>5.49%</td>
<td>4.90%</td>
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<tr>
<td>Swaption Volatility</td>
<td>12.0%</td>
<td>11.4%</td>
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<tr>
<td>(10 year option on 10 year swaps)</td>
<td></td>
<td></td>
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<tr>
<td>Cost of Guarantee</td>
<td>0.49 %</td>
<td>0.96%</td>
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</tbody>
</table>
Discussion Topics (1)

- Is the authors’ optimism regarding the prospects for the product justified?
- Is there a genuine consumer benefit from these products?
- Will domestic companies succeed in this market or will companies with established track records elsewhere dominate?
Discussion Topics (2)

- Will hedging techniques perform as intended in extreme market conditions?
- What changes to legislation would facilitate better outcomes for the customer (and acceptable outcomes for HMRC)?
- Are actuaries well equipped to develop and market these products?