Variable Annuities & Dynamic Hedging

7th ASHK Appointed Actuary Symposium

7th November 2007

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Tillinghast, a business of Towers Perrin
Agenda

- Overview – US and Japan
- Risk management for variable annuities
- Dynamic Hedging
- Applications of dynamic hedging
- Key decisions
- … and finally
Variable annuity (VA) sales are expected to reach another sales record this year

Mix of U.S. Annuity Gross Sales

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>CAGR VA</td>
<td>23%</td>
<td>3%</td>
<td>11%</td>
</tr>
<tr>
<td>CAGR FA</td>
<td>1%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>CAGR Total</td>
<td>14%</td>
<td>3%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Source: Variable sales from Tillinghast VALUE Survey, includes all non-pension variable annuity premiums (first-year and renewal, separate account and fixed account). Fixed sales from LIMRA, includes deferred and immediate annuities, EIAs, and MVA (excludes structured settlements).
### Typical current forms of VA death benefit and living benefit guarantees*

<table>
<thead>
<tr>
<th>Type</th>
<th>Nature of Guarantee</th>
<th>Typical Waiting Period</th>
<th>Typical Guarantee</th>
<th>Enhanced Feature</th>
<th>Typical Annual Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMDB</td>
<td>Lump sum on death</td>
<td>None</td>
<td>Annual ratchet or 5% roll-up, to age 80</td>
<td>Combination, or 7% roll-up</td>
<td>15 – 35 bps</td>
</tr>
<tr>
<td>GMWB</td>
<td>Guaranteed amounts via partial withdrawals</td>
<td>None</td>
<td>Return of premium via 7% withdrawals for 14 years</td>
<td>5% for life, periodic resets, bonus until withdrawal</td>
<td>40 – 75 bps</td>
</tr>
<tr>
<td>GMIB</td>
<td>Guaranteed income at annuitization</td>
<td>10 years</td>
<td>5% roll-up</td>
<td>Greater of 5% roll-up and annual reset</td>
<td>50 – 75 bps</td>
</tr>
<tr>
<td>GMAB</td>
<td>Guaranteed lump sum</td>
<td>10 years</td>
<td>Return of premium at year 10</td>
<td>Resets/combo products</td>
<td>25 – 50 bps</td>
</tr>
</tbody>
</table>

*Many features require diversification of assets.*
Lifetime GMWBs are driving VA sales in the US

### VA Sales ($ millions)

<table>
<thead>
<tr>
<th>Company</th>
<th>GLBs Offered</th>
<th>2006 VA Sales</th>
<th>4Q 2006</th>
<th>Full Year 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>MetLife</td>
<td>IB/WB</td>
<td>13,714</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>AXA</td>
<td>IB/WB</td>
<td>13,230</td>
<td>20%</td>
<td>24%</td>
</tr>
<tr>
<td>Hartford</td>
<td>GMWB</td>
<td>12,201</td>
<td>26%</td>
<td>7%</td>
</tr>
<tr>
<td>Lincoln</td>
<td>GMWB</td>
<td>10,294</td>
<td>36%</td>
<td>22%</td>
</tr>
<tr>
<td>Pacific Life</td>
<td>All</td>
<td>9,497</td>
<td>9%</td>
<td>32%</td>
</tr>
<tr>
<td>Nationwide</td>
<td>All</td>
<td>5,137</td>
<td>59%</td>
<td>40%</td>
</tr>
<tr>
<td>Genworth</td>
<td>GMWB</td>
<td>1,811</td>
<td>59%</td>
<td>66%</td>
</tr>
<tr>
<td>Market Estimate</td>
<td>-----</td>
<td>N/A</td>
<td>19%</td>
<td>17%</td>
</tr>
</tbody>
</table>

- AXA, Hartford, Genworth, Lincoln, Pacific Life, and Nationwide all introduced lifetime GMWBs in 2006
- 89% of VA sales in 2006 included GMWB feature

Source: Tillinghast VALUE Survey
Recent GMWB innovations have intensified focus on this feature

- First introduced by Hartford Life in 2002
- GMWB with annual reset (2004)
  - Lincoln National (65 bps fee) was first, significantly increased market share
  - Manulife introduced 5% bonus for each year where no withdrawal is made
- Lifetime GMWB withdrawals were introduced in 2003
  - 4% or 5% maximum withdrawal per year, varying by attained age
  - Most are offering a “bonus” feature now, as long as withdrawals are deferred
  - Many products have asset allocation restrictions to keep charges down
  - Prudential introduced combination GMAB/GMWB, now offering daily ratchets
  - 14 carriers have introduced a version for married couples earlier this year
- Hartford Life is offering higher maximum withdrawals for older ages (Sept 2006)
  - 5% for ages 60-65, grading to 7% at age 80
  - Also added lifetime GMWB, but with upside capped at 10%, in Nov 2006
- Sun Life introduced “Income Storage Benefit” (March 2007)
  - Unused GMWBs are stored for later withdrawal
- Prudential added lifetime GMWBs to their 401(k) product (July 2007)
79% of total VA assets of $1.4 trillion are in the Separate Account

Total VA assets: $1.38 trillion (12/31/06)
The largest average size VA policies are sold through wirehouses

Average Size/Policy

- Career Agent: $63,173
- Independent Agent/Financial Planner: $79,678
- Wirehouse: $93,435
- Bank: $78,277

Considerations in selling VA through various distribution channels

2006 VA Sales

- Banks: 13%
- Regional investment firms: 7%
- Independent Broker Dealer firms: 31%
- Career agents and controlled: 38%
- Direct/Other: 1%
- Wirehouses: 8%
- Share is small, dominated by Fidelity and Vanguard

Looking more like wirehouses

- Best opportunity for smaller manufacturers
- Larger independent B/D firms (including networks) are increasingly relying on preferred vendors

Includes TIAA, career companies

- Heavy proprietary focus

Preferred vendors
Reciprocal relationships
Variable Annuity Market is now almost Yen 15 trillion (US$125 billion) Hartford Life projects a market size of Yen 30 – 50 trillion by 2010 (US$ 250bn – 400bn)

VA Assets Under Management (JPY billion)

- CAGR of 90%
- CAGR of 39%
- Bank distribution permitted

March 2000: 65
March 2001: 146
March 2002: 276
March 2003: 1,127
March 2004: 3,103
March 2005: 5,748
March 2006: 10,961
March 2007: 14,816
~ 2010: 40,000
**Hartford Life has the leading market share of VA FUM, having grown to Yen 3.7 trillion in VA funds under management in 6 years, however VA sales are now shifting towards domestic insurers**

### Variable Annuity FUM at 31 March 2007 (FUM at 31 March 2006), Market share %.
The leading 11 providers account for 98% of the market

<table>
<thead>
<tr>
<th>Provider</th>
<th>2007 FUM (2006 FUM)</th>
<th>Market Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hartford</td>
<td>3,665 (3,152)</td>
<td>24.6%</td>
</tr>
<tr>
<td>Mitsui Sumitomo MetLife</td>
<td>2,132 (1,524)</td>
<td>14.3%</td>
</tr>
<tr>
<td>ING</td>
<td>1,877 (1,529)</td>
<td>12.6%</td>
</tr>
<tr>
<td>TMNFL</td>
<td>1,745 (1,065)</td>
<td>11.7%</td>
</tr>
<tr>
<td>Sumitomo</td>
<td>1,732 (688)</td>
<td>11.6%</td>
</tr>
<tr>
<td>Manulife</td>
<td>960 (776)</td>
<td>6.4%</td>
</tr>
<tr>
<td>Alico</td>
<td>642 (539)</td>
<td>4.3%</td>
</tr>
<tr>
<td>Mitsui Life</td>
<td>627 (546)</td>
<td>4.2%</td>
</tr>
<tr>
<td>T&amp;D Financial</td>
<td>615 (456)</td>
<td>4.1%</td>
</tr>
<tr>
<td>Dai-ichi</td>
<td>291 (273)</td>
<td>2.0%</td>
</tr>
<tr>
<td>Nippon Life</td>
<td>257 (252)</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

Unit: yen billion
The remaining providers share around 2% of the market

Variable Annuity FUM at 31 March 2007 (FUM at 31 March 2006), Market share%

<table>
<thead>
<tr>
<th>Provider</th>
<th>Market Share %</th>
<th>FUM (yen billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winterthur Swiss</td>
<td>0.69%</td>
<td>103 (71)</td>
</tr>
<tr>
<td>Sony Life</td>
<td>0.63%</td>
<td>94 (72)</td>
</tr>
<tr>
<td>AXA Life</td>
<td>0.53%</td>
<td>79 (31)</td>
</tr>
<tr>
<td>PCA Life</td>
<td>0.22%</td>
<td>33 (13)</td>
</tr>
<tr>
<td>Daido Life</td>
<td>0.15%</td>
<td>22 (18)</td>
</tr>
<tr>
<td>Meiji Yasuda Life</td>
<td>0.09%</td>
<td>14 (14)</td>
</tr>
<tr>
<td>Gibraltar Life</td>
<td>0.05%</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Mass Mutual</td>
<td>0.04%</td>
<td>6 (0)</td>
</tr>
<tr>
<td>Zurich</td>
<td>0.03%</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Prudential</td>
<td>0.01%</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Cardif</td>
<td>0.01%</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Fukoku Life</td>
<td>0.01%</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Unit: yen billion

The increase in funds under management slowed in FY2006 as new sales fell industry wide. The impact on different insurers varied.

Increase in VA Assets Under Management (JPY billion)
**PRODUCT AND MARKET TRENDS – JAPAN**

**Increase in FUM, FY2006 and FY2005**

**Domestic insurers gained ground in FY2006 vs the multi-nationals**

- TMNFL increased its funds under management by Yen 1,057 billion (US$ 8.8 bn) in FY2006

<table>
<thead>
<tr>
<th>Company</th>
<th>FY 2005</th>
<th>FY 2006</th>
<th>Increase</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMNFL</td>
<td>514</td>
<td>1,057</td>
<td>543</td>
<td>27.4%</td>
</tr>
<tr>
<td>Sumitomo</td>
<td>618</td>
<td>667</td>
<td>59</td>
<td>17.3%</td>
</tr>
<tr>
<td>Mitsui Sumitomo Metlife</td>
<td>608</td>
<td>608</td>
<td>0</td>
<td>15.8%</td>
</tr>
<tr>
<td>Hartford</td>
<td>513</td>
<td>1,383</td>
<td>870</td>
<td>26.5%</td>
</tr>
<tr>
<td>ING</td>
<td>348</td>
<td>789</td>
<td>441</td>
<td>15.1%</td>
</tr>
<tr>
<td>Manulife</td>
<td>184</td>
<td>412</td>
<td>228</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

Unit: yen billion

Percentages show market share % of increase in FUM for the year.
Variable Annuity Market Snapshot

- VA asset balance as at March 2007: Yen 14,816 billion (2.2 million policies)
- TMNFL recorded the largest increase in assets under management of Yen 1,056 billion
- Hartford still holds the top market share, although its share of increase in FUM halved in FY2006.
  - Hartford launched a new product “Adagio 3 WIN” in February 2007 in response
- AXA re-launched itself into the VA market in January 2007 with two new products
- Aegon and Allianz both announced plans in Q1 2007 to enter the VA market in 2008
  - Aegon in a joint venture with existing insurer Sony Life
  - Allianz on stand-alone basis
- Credit Agricole received its business licence in June 2007 and will start writing VA business this month
- Dai-Ichi Frontier Life, a subsidiary of Dai-Ichi Life, has also recently received its licence to commence VA business
  - Resona Bank has announced it is in talks with Dai-Ichi to form closer links, with Dai-Ichi to invest in non-voting preferred shares of Resona Bank
- Japan Post is expected to begin distribution of VAs in early to mid-2008 through its postal branches
The introduction of VA/ULG products presents a number of challenges which include...

- IT Infrastructure and personnel
  - Powerful capability is required
  - Smart modelling considerations
- Product design
  - Understanding implications of guarantee features (tail risk)
  - Exotic guarantees or simplification?
- Assumptions
  - Dynamic policyholder behavior
  - Longevity
- Pricing
  - Modeling tail risk
  - Risk-neutral vs. real-world scenarios
  - May need stochastic-on-stochastic, if hedging is incorporated
- Risk and capital management
  - Underlying capital requirements
  - Managing tail risk
Agenda

- Overview – US and Japan
- Risk management for variable annuities
- Dynamic Hedging
- Applications of dynamic hedging
- Key decisions
- … and finally
“You can’t use simple historical methods for pricing and managing the risk of variable annuities – you have to worry about advanced economics: volatility, non-parallel interest rate shifts, and so on,”

Neil McKay, Allianz Life
Life & Pensions Magazine, June 2007
Risk management

- One of the key characteristics of VAs are that they offer guarantees.
- Companies are providing various options to their clients, mostly put options, which are:
  - sensitive to macro and behavioural variables
  - could prove quite costly if they are not properly managed or hedged
- Therefore, risk management is a key issue that will be monitored by regulators, analysts, investors and policyholders.
- A company will be rewarded for good disclosure and risk management:
  - it demonstrates it has a clear understanding of the risks that are being taken on
  - it provides comfort around the risk management approach and helps to form conclusions
## Market risks and insurance risk

The interaction between the guarantees and the insurance risks are complex.

### Market Risks

<table>
<thead>
<tr>
<th>Delta (equity)</th>
<th>Rho (interest rates)</th>
<th>Vega (volatility)</th>
<th>Convexity (second order)</th>
</tr>
</thead>
</table>

### Insurance Risks

<table>
<thead>
<tr>
<th>Longevity</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lapse risk</td>
<td>Policyholder behaviour</td>
</tr>
<tr>
<td>New business volumes</td>
<td>Business mix</td>
</tr>
</tbody>
</table>

### Other Risks

<table>
<thead>
<tr>
<th>Operational risks</th>
<th>Misselling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counterparty default</td>
<td>Regulatory and tax</td>
</tr>
</tbody>
</table>

Some risk are easier to manage, e.g. hedge out market risk, others are less predictable, e.g. policyholder behaviour.
Risk management starts with product design and pricing

- Product design is the starting point for risk mitigation
  - Caps on benefit levels
  - Fund restrictions to reduce volatility and forces diversification
  - Limits on switching
  - Persistency “carrots” or incentives to defer option (e.g. Bonus if do not take withdrawal option)

- Pricing
  - These are complex options – Price on a market-consistent basis calibrated to market data
  - Include policyholder behaviour
  - Cost of hedging and risk capital
Operational risks

- Unit pricing risks
- Disclosure and sales process
  - Training for distributors in understanding and explaining VA products
  - Disclosure to policyholders
- Managing hedging program
  - Controls and processes for liability data
  - Model validations
  - Operating procedures for making trades
In 10% aller Fälle resultiert ein Verlust von mehr als 40% der Einlage.

Most adverse scenario

Best possible scenario

Gain/loss at maturity

Most of the time an extra return is generated but in few cases we observe substantial losses.
## The “Greeks”

<table>
<thead>
<tr>
<th>Greek</th>
<th>Definition</th>
<th>What do companies typically do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta</td>
<td>Sensitivity to a change of the underlying fund prices</td>
<td>- Run risk ‘naked’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Some but not normally for very long</td>
</tr>
<tr>
<td>Rho</td>
<td>Sensitivity to a change in interest rates</td>
<td>- Reinsurance</td>
</tr>
<tr>
<td>Vega</td>
<td>Sensitivity to a change in implied volatility</td>
<td>- Tailor-made derivatives from banks</td>
</tr>
<tr>
<td>Gamma</td>
<td>Sensitivity to a change in delta due to a change of the underlying fund prices</td>
<td>- Dynamic hedging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Managing market risk in-house</td>
</tr>
</tbody>
</table>
## Advantages and disadvantages of reinsurance

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low transaction costs</td>
<td>No internal knowledge is built up</td>
</tr>
<tr>
<td>Low systems / training costs</td>
<td>Expensive</td>
</tr>
<tr>
<td>Total costs known in advance,</td>
<td>Reinsurance margins</td>
</tr>
<tr>
<td>- may be able to front load charges</td>
<td>Inflexible: protection becomes outdated with changes in</td>
</tr>
<tr>
<td>- avoid variable charges</td>
<td>- Market conditions</td>
</tr>
<tr>
<td>External to the company – no need to</td>
<td>- Policyholder behaviour</td>
</tr>
<tr>
<td>- fundamentally affect business practices</td>
<td>Ability to write business is dependent on reinsurance being available</td>
</tr>
<tr>
<td>Less need for in-depth knowledge, easier to understand</td>
<td>Based on illiquid instruments</td>
</tr>
<tr>
<td></td>
<td>- Positions may be hard to unwind</td>
</tr>
<tr>
<td></td>
<td>May not have coverage available for all risks</td>
</tr>
<tr>
<td></td>
<td>Credit risk exposure</td>
</tr>
</tbody>
</table>
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- Dynamic Hedging
  - Applications of dynamic hedging
  - Key decisions
  - ... and finally
Dynamic Hedging ensures that the hedge portfolio is always sufficient to pay out the guaranteed benefits.

\[ \text{Value of funds} \geq \text{guarantee:} \]

\[ \text{Value of hedge portfolio} = 0 \]

\[ \text{Guarantee} \]

\[ \text{Value of funds} < \text{guarantee:} \]

\[ \text{Value of hedge portfolio is amount needed to fill up maturity benefit} \]
How is this possible?

If the hedge portfolio were invested in cash, the value of the necessary hedge portfolio would change with the underlying fund value but the hedge portfolio would stay more or less constant.
First we determine the sensitivity

Value of necessary hedge portfolio end of the next (short) period

-1 US$ current

Delta, e.g. US$5000
There are liquid instruments which depend on the same index

e. g. futures on this index

- Value of necessary hedge portfolio end of the next (short) period
- Value of a future contract

Index Value

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These instruments can be shorted

Value of necessary hedge portfolio end of the next (short) period

Value of a short future contract
And we can add some cash

Value of necessary hedge portfolio end of the next (short) period

Value of a short future contract plus some cash
And of course we can short exactly the right amount of swaptions, so that we have the same sensitivity.

Value of the hedge portfolio, consisting of the right amount of short futures and cash

Value of a short future contract plus some cash

Delta, e.g. US$ 5000

Value of necessary hedge portfolio end of the next (short) period

Index Value

-1 US$ current
Continuous hedging substantially reduces risk
Continuous hedging substantially reduces risk
Continuous hedging substantially reduces risk
Using this “dynamic hedging“ approach ensures that the value of the necessary hedge portfolio is always similar to the value of the actual existing hedge portfolio, especially so at maturity the value of the hedge portfolio is the gap you need to fill, or zero if the fund value is higher than the guarantee.

This approach works for all dependencies, like underlying fund value, interest rates, volatility etc., as long as we can identify liquid financial instruments which are similarly dependent on these financial market parameters.

This approach works for all kinds of guarantees.

Continuous re-hedging is necessary.
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The dynamic hedging effect

Gain/loss at maturity

Most adverse scenario  All possible scenarios  Best possible scenario

Not hedged  Monthly hedge
The tricky part is the determination of the sensitivities

Financial economics:
- Closed form solutions
- Stochastic simulation approaches:
  - market-consistent scenarios
  - project the financials
  - determine present value
  - average

This sounds easy, but
- policy by policy
- on a daily basis

Smart modelling
Hedging Operations – standard structure

Co. A → Live Market Data → Economic Scenario Generator → Co. B

In-force Policy Data From Mainframe → Co. C → Execute Trades

Product Assumptions → VA Hedging App → Greeks Calculator
Example: Hartford Life is now using approximately 1,000 servers for grid computing, mainly in their VA business.

Risk Management Technology

- Risk management technology is all about enabling massive computation
- Hartford Life deployed Grid Computing in 2004
  - Pioneers in the Life Insurance Industry

- Grid Computing works like a ‘virtual supercomputer’
  - Ties together servers and desktops into one big processing engine
  - Allows us to make use of our latent computing power
  - Enables tremendous scalability and resiliency

Source: Hartford Life.
Importance of dynamic hedging

“We have built an advanced, investment banking-grade hedging platform”

Neil McKay, Allianz Life

“...we have invested over $10million in systems to support these programs and currently spend between $2-3 million, for maintenance and enhancements for new products”

Lisa Kuklinski, MetLife

Source: Life & Pensions magazine
An informal industry survey of 20 large VA players indicates that most companies have some hedging program in place.

- Dynamic hedging — beyond Delta: 6 (35%)
- Dynamic hedging — Delta only: 12 (60%)
- Static hedging only: 1
- No hedging in place: 1

Source: Tillinghast Survey 2006
Advantages and disadvantages of dynamic hedging

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous adaptation of changing market conditions and lapse rates is possible</td>
<td>Transaction expenses</td>
</tr>
<tr>
<td>Based on very liquid instruments</td>
<td>Is complex and difficult to understand and to explain</td>
</tr>
<tr>
<td>- Low margins in prices</td>
<td>Requires internal agreement</td>
</tr>
<tr>
<td>- Easy to unwind positions</td>
<td>Requires continuous checks / controls and reporting</td>
</tr>
<tr>
<td>Limited credit risk</td>
<td>Operational risks by executing the trades</td>
</tr>
<tr>
<td>Gain better knowledge of risks</td>
<td>Total costs cannot be determined in advance</td>
</tr>
<tr>
<td>Makes product pricing and design more flexible</td>
<td>Additional expenses (Training, systems, etc.)</td>
</tr>
<tr>
<td>Reduces tail risk</td>
<td>Requires sophisticated systems / expertise</td>
</tr>
</tbody>
</table>
Reserving for variable annuities

- In Europe a number of firms reinsure to Ireland to take advantage of more favourable regulatory regime
  - Principles based regulation so can allow, to certain extent, for dynamic hedging in calculating reserves and capital requirements
  - Derivatives are admissible assets (subject to certain constraints)

- In U.S. reserve and capital requirements based on Conditional Tail Expectation
  - 65th percentile for reserves
  - 90th percentile for capital requirements
- Allow partial credit for hedging programs
Case Study: Impact of hedging on VA RBC and VA reserves

Key points
Hedging reduces capital but increases reserves (=CTE65) at time 0, TAR (=CTE90) is lower with hedging
Capital (=CTE90 – CTE65) reduces over time for both, eventually going to 0 due to moneyness of GMAB and overall fee revenue
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How should we hedge the market risk?

- Reinsurance can be an attractive first option:
  - Leverage expertise
  - Allows quick entry into the market, but....

- Insurance is about managing risk so why outsource to third party?
  - Ability to write business is dependent on capacity
  - Potentially expensive and may retain some residual risks

- Some combination of managing certain risks in-house and reinsuring others may be best solution?
Designing a hedging program

Key questions
- How do we set up a production platform that can automatically link policy level and market data?
- What expertise do we need?
- How do we link our actuarial expertise with capital markets knowledge?

Understanding hedge effectiveness is key:
- What is the impact of hedging on my (economic and regulatory) capital requirements?
- What is the impact of hedging on expected earnings and earnings volatility?
- What would be the impact of changes in policyholder behaviour?
- How do we communicate externally the reduction in risk due to our hedging programme?
What about the other risks?

- **Pricing and product design**
  - Important to accurately reflect risks in pricing – Is the charge sufficient?
  - Product design is an important way to mitigate risk

- **Insurance risks**
  - Need to consider interaction with market risks
  - Understanding potential policyholder behaviour is key

- **Operational risks**
  - Managing hedging platform
  - Sales process
  - Unit pricing

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**Key is proper risk governance structures with responsibility at senior management/board level combined with robust risk measures**
“The bottom line is that these products are lifetime guarantees so it is really important to the clients that the company that is offering these risks is pricing (and managing) them properly so that they are around in the long term.”

Lisa Kuklinski, MetLife
Life & Pensions Magazine, June 2007
Agenda

- Overview – US and Japan
- Risk management for variable annuities
- Dynamic Hedging
- Applications of dynamic hedging
- Key decisions

... and finally
Particularly as you move to more “sophisticated” products, customer and distribution:-
Product Success is a function of several opinions ...

- **Sales**
- **Overall Opinion**
  - **Product Opinion**
    - **Product Features**
      - Blah, blah, blah ..!!
      - Are they really different/better?...
      - Price ...
      - Breadth and flexibility
      - Rich GMxBs
      - Shape and level of fees and charges
    - **Fund Mix and Breadth**
      - Fund families
      - Number of sub-accounts
      - Asset class/investment objective coverage
      - Performance
    - **Compensation**
      - Amounts, structure and flexibility
      - Recognition
      - Marketing allowances
      - Commission
    - **Sales and Marketing Support**
      - Marketing materials
      - Training
      - Support
      - Responsiveness
      - Finance?
  - **Sales and Service Opinion**
    - Underwriting
    - Transaction accuracy and speed
    - Responsiveness
    - Customer servicing
    - Problem resolution
    - Technology
    - Service standards
  - **Brand Opinion**
    - Reputation/consumer franchise
    - Financial strength

Blah, blah, blah ..!!
Are they really different/better?...
Price ...
Breadth and flexibility
Rich GMxBs
Shape and level of fees and charges

Are they really different/better?...
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