Society of Actuaries in Ireland

Common Mistakes in Variable Annuity Hedging Programs:

Hedge to what? What to hedge?

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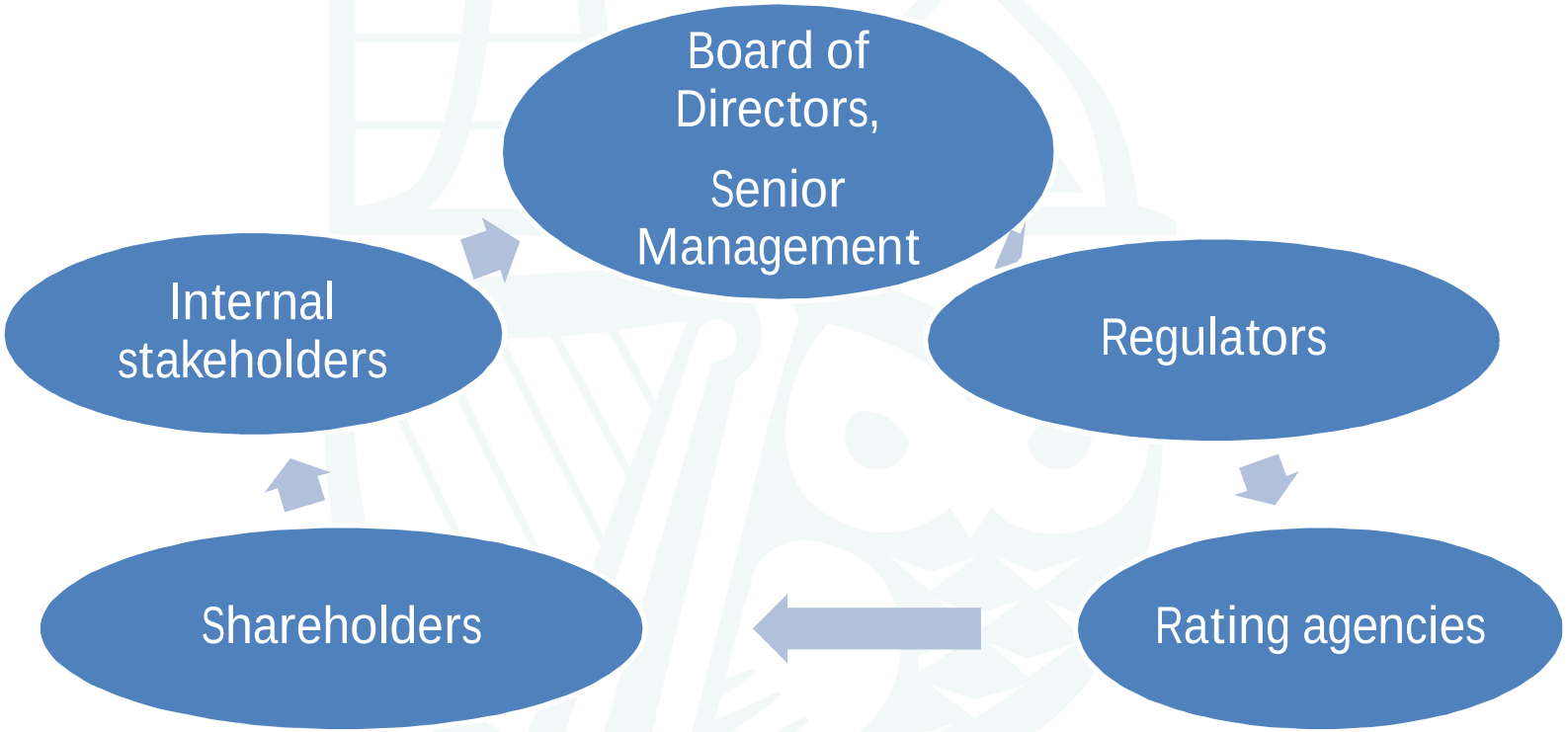
Agenda

1. Introduction
2. Communication: new product, in force
3. Infrastructure: administration, resources & personnel
4. Product Development and Pricing: design & pricing
5. Hedging: objective, strategy, rebalance, funding, models
6. Hedge Performance and Evaluation
7. Conclusions

1. Introduction

- Motivations
- Take-aways
- References
  - Variable Annuities – A Global Perspective. Edited by Tigran Kalberer and Kannoo Ravindran, Incisive Media, 2009
  - http://www.soa.org/Professional-Development/Event-Calendar/2013/invest-based-insurance-conference/Agenda-Day-2.aspx/2013-ireland-ibig-common-mistakes.pdf

2.1 Communication



- Do you fulfil communication expectations of various parties?
- Do you have a feedback loop regarding this process?

2.2 Communication: New Product Launch

Identify product's financial risk drivers

Actuarial Assumptions	• Lapse Rates • Mortality Rates • Benefit Utilization
Capital Markets	• Market Levels • Interest Rates • Volatility • Correlation

2.2 Communication: New Product Launch

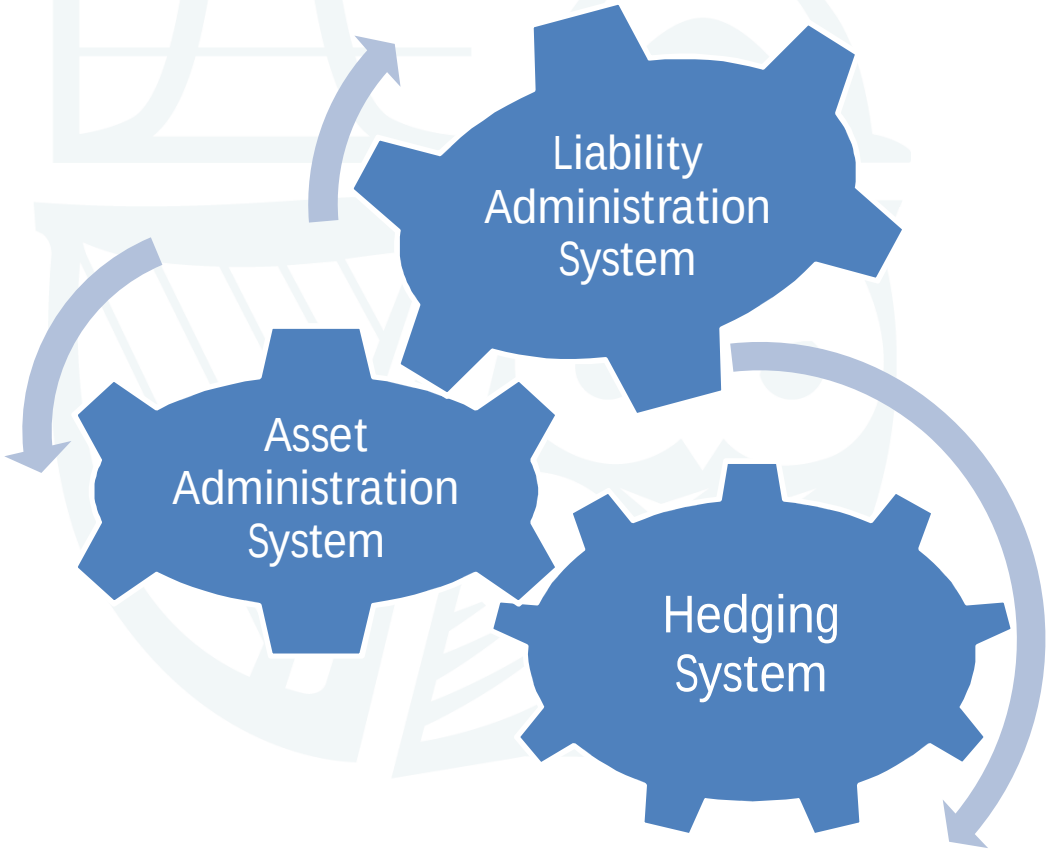
- Risk management levers
  - Hedging
  - Reinsurance
  - Product's design risk mitigaters
    - Raise fees on in force
      - Upon benefit step-up
      - At company's discretion
    - Switch fund offering to lower risk funds or risk managed funds or others
    - Buyback (or lapse incentive) programs
      - AXA, Transamerica, Hartford

2.3 Communication: In Force Products

Communication on in force product's performance

Product's Performance	• Actuarial assumptions A/E reports • Capital markets versus pricing • Benefit utilization • Benefit's ITM-ness
Product Actions	• Fee increases • Fund changes • Buyback programs
Risk Management	• Hedge effectiveness • Hedging attribution reports • Hedging costs vs. pricing assumptions

3.1 Infrastructure



3.2 Infrastructure: Administration Systems

Liability System	• Accurately administrates polices • Provide detailed seriatim policy data • Provide automatic feeds to hedging and other systems (e.g., accounting and ALM)
Asset System	• Can handle complex derivatives • Accurately revalue (market price, Greeks) • Provide automatic feeds to hedging and other systems (e.g., accounting and ALM)
Hedging System	• Receive automatic feeds from Liability and Asset systems • Update capital market parameters, generate scenarios • Accurately revalue liability (hedge target value, Greeks) • Determine hedging action • Performance, Attribution and Regulatory reports

3.3 Infrastructure: Resources and Personnel

- Do you have the right combination of team members?
  - IT
  - Operations
  - Quants
  - Liability Experts
  - Derivative Traders
  - Risk Manager
- Do you have proper check and balance in your team?
  - Separation of duties and responsibilities
    - individuals updating models and parameters vs. individuals running models

3.3 Infrastructure: Resources and Personnel

- Do you have key person risk?
  - Cross functional training
  - Thorough documentation of processes
  - Create contingency plans to fill in key persons when absence
- Do you maintain contact with the capital markets?
- Do you have a reward system to motivate your team?
- Do you have a plan for continuing education and training?
- Do you have a regular check up by external consultants of your hedging models and processes?

4.1 Product Development and Pricing:

Product Design

Limit Optionality	• Issue age restrictions • Minimum utilization age • Guarantees vary by age of 1st utilization • Minimum wait period
Guarantee Benefit Base	• Limit maximum increase • Tie increases to an index • Tie increases to account value performance
Guarantee's Fee	• Tie to an index • Tie to guarantee's benefit base • Company retain discretion to increase
Fund Restrictions	• Restrict allocation and rebalancing • Risk Management funds • Automatic rebalancing programs

4.1 Product Development and Pricing:

Product Design

Robustness

- Price stochastically
- Shock analysis and scenario analysis (capital markets)
- Sensitivity testing (actuarial assumptions and capital market assumptions)

Fund modelling

- Appropriately model underlying funds (risk managed funds)
- Automatic rebalancing

Capital market parameters

- Real world: base contract fees and expenses
- Risk neutral: benefit guarantees and fees
- Impact on product's performance over time

4.2 Product Development and Pricing:

Product Pricing

- Include all costs associated with hedging
- Model the hedge strategy
- Reserving and Capital
- Don ’t just price under current market conditions

5.1 Hedging: Hedge Objective

- Agreement with Board and Senior Management
  - Identify key risks and concerns
    - Economic Cost (payment of claims in excess of fees collected)
    - Reserve management (IFRS, US Statutory-AG43, US GAAP-FAS157, Solvency II) and Total capital management
- Set specific hedge objective
  - Translate identified key risks into a specific hedge objective
  - For “Economic Cost” may define as PV[expected guarantee claims paid] – PV[expected guarantee fees collected] valued on a market consistent risk neutral basis to be consistent with derivatives valuation methodology

5.1 Hedging: Hedge Objective

- Identify hedge objective's exposures to market movements
  - Delta (match by key index(s)?)
    - Hedge objectives likely be affected by change in equity markets
  - Rho (match by key duration?)
    - Is only applicable if hedge objective revaluation is affected by current risk free rates (IFRS and US FAS157)
  - Vega (match by key duration?)
    - Is only applicable if the hedge objective is revalued based on current volatility (most reserves do not require including: US AG43, US FAS157 and IFRS)

5.1 Hedging: Hedge Objective

- Identify hedge objective's exposures to market movements (continued)
  - Cross Greeks
    - If unable to hedge directly, still need to understand and monitor
  - Higher order Greeks
    - If unable to hedge directly, still need to understand and monitor
  - Other measures
    - Investigate worst case scenarios, company specific what-if scenarios

5.1 Hedging: Hedge Objective

- Identify disconnects between hedge objective's valuation and hedging instruments' valuation
  - Make sure the hedge objective can truly be hedged
  - Identify differences in calculation, parameters, and update frequency
  - US AG43 may be very difficult to effectively hedge
    - Returns based index's long-term historical returns (not risk-free rates)
    - Long-term historical realized volatility based (not implied volatility)
    - Take the average of 30% worse scenarios measured by maximum PV deficit over the projection period
  - Derivatives are valued using current capital market parameters (risk free rates, forward dividend yields, implied correlations & volatility)
    - Expected PV[expected derivative payments] – PV[expected derivative receivables] on a risk neutral basis

5.2 Hedging: Hedge Strategy

- Capital markets instruments
  - Hedging instruments match the hedge objective's exposures
    - Delta (options, futures, equity swaps)
    - Rho (options, interest rate swaps, floors)
    - Vega (options, variance swaps, VIX options and futures)
  - Hedge instruments' duration to align with the hedge strategy
    - More static hedge strategy align derivative's duration with liability (longer duration derivatives)
    - More dynamic hedge strategy use hedging instruments with shorter duration

5.2 Hedging: Hedge Strategy

- Capital markets instruments (continued)
  - Choose hedging instruments with appropriate liquidity to effectively manage the hedge strategy
    - More static hedge strategy can use less liquid instruments
      - During financial crisis, limited ability to trade OTC derivatives
    - More dynamic the hedge strategy requires more liquid instruments
      - Usually shorter duration exchange traded derivatives

5.2 Hedging: Hedge Strategy

- Be able to communicate properly
  - Hedge objective and identified disconnects
  - Hedging approach
  - Results of hedge program
    - Hedge effectiveness
    - Attribution analysis
    - Explain disconnects
    - Seek feedback and improvement

5.2 Hedging: Hedge Strategy

- Have a regular process to examine the hedge objective
  - Is the hedge objective effectively covering the risks of concern?
  - Has the risk of concern changed? Is a process in place yet?
    - During and after 2008 global financial crisis many VA writers modified their hedge objective and hedge strategies
  - Recognize and track unhedgeable risk factors that need regular monitoring, e.g., actuarial assumptions, basis mismatch, operational risks

5.3 Hedging: Hedge Rebalancing

- Is the frequency of the rebalancing consistent with strategy?
  - Dynamic strategy frequent rebalancing (daily, a few times/day)
    - Set deviation criteria of liability Greeks vs. hedge Greeks
    - If rebalance too frequently, may be paying just to get whipsawed
  - Static strategy rebalances less frequently (weekly, monthly)
    - Consider impact by net new business relative to in force
    - Set provisions for ad-hoc rebalancing under extreme conditions
  - May need to specify alternative hedge strategy and derivatives
    - Entering into the financial crisis several large carriers used long-dated OTC derivatives could not execute strategy, had to resort to shorter dated exchange traded derivatives

5.3 Hedging: Hedge Rebalancing

- Who determines rebalancing?
  - Identified individuals and hedge committee
- Rebalancing and no-rebalancing decisions should be recorded, including details for the decision
- Controlled trading process
  - To execute trades for rebalancing decision
  - To verify correct trades were executed
- Create a regular process to update and improve over time
  - ✓ Hedge objective
  - ✓ Hedge effectiveness
  - ✓ Hedging Instruments
  - ✓ Rebalancing criteria & frequency

5.4 Hedging: Funding

- Determine source and cost of funding
- Hedge operations may have to be funded upfront
  - Hedge program costs usually more immediate
  - May not be alignment of fees collected from hedged products and the cost of the hedge program
- Track the total cost of the hedge program
  - Have a process to track via Treasury and Finance Departments
  - Is expected hedging cost within product pricing and expectations?

5.5 Hedging: Models

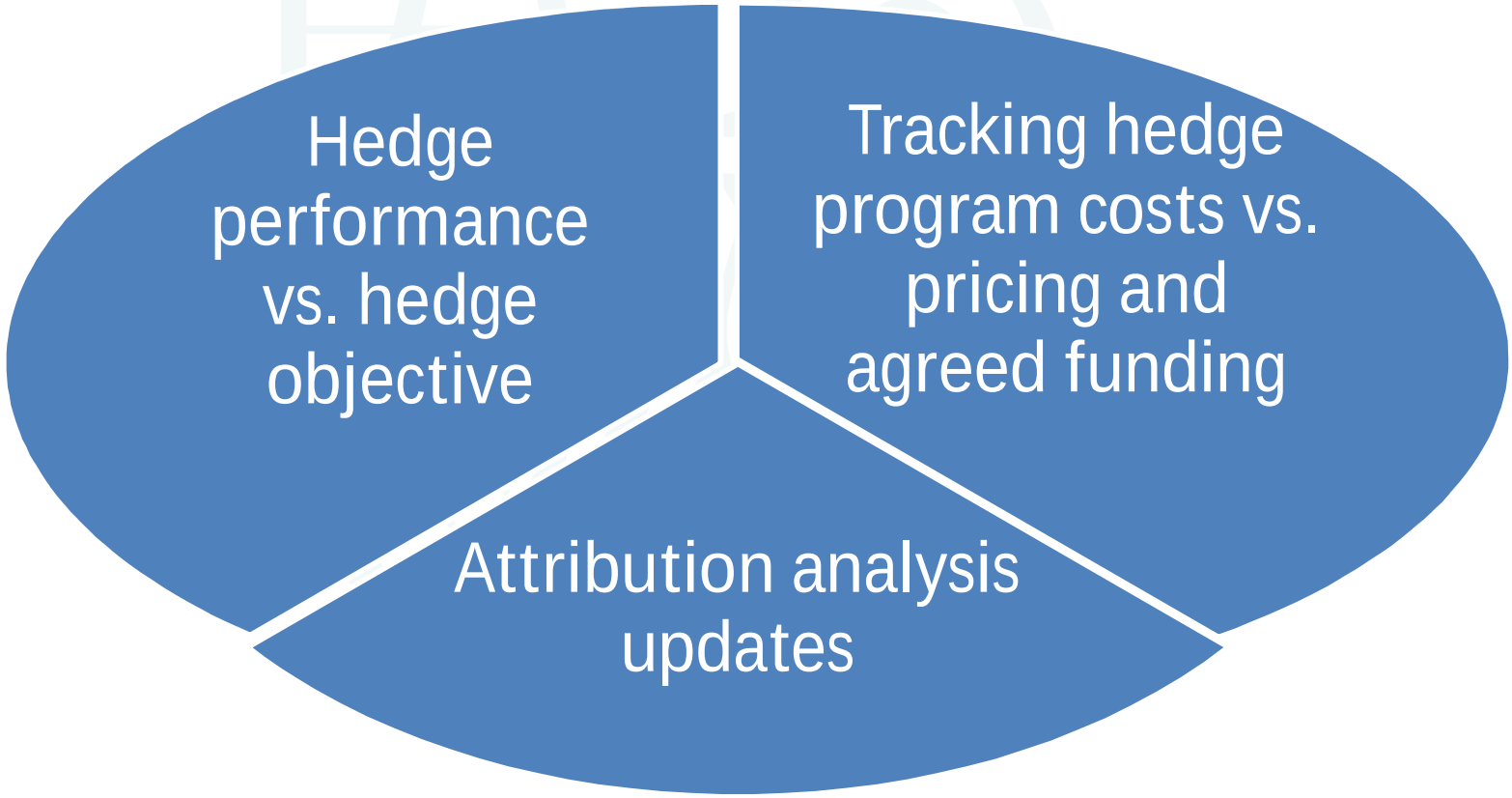
- Do you have the "right" model?
  - Model should be no more complex than it needs to be
    - Easier to understand, maintain, and explain
  - Does it properly capture key components?
    - Hedge objective's Greeks
    - Items for attribution analysis
      - Cross Greeks and higher order Greeks
      - Actuarial assumption actual versus expected
  - Has it been audited?
  - Fast enough to meet needs?
  - Realistic enough to reflect reality (tradable)?

5.5 Hedging: Models

- Automated process for data updates

  Liability data; Hedging derivatives data; Compiling results
- Regular process for assumption updates
  - Capital market assumptions
    - Reliable source
    - Updated for each valuation
  - Actuarial assumptions
    - Update regularly based on experience studies
    - Actuarial experience unfolds slowly over time, so need right frequency of updates (annually?)

6. Hedge Performance and Evaluation



6. Hedge Performance and Evaluation

- ✓ Do you evaluate your hedge performance correctly?
  - – Hedge performance measurement needs to be consistent with the defined hedge objective and hedge strategy
  - – Include all critical items covered by the hedge program
  - – Exclude items not being hedged and document the rationale of exclusion
    - Actuarial assumption deviations are captured in attribution may be excluded for hedge performance
- ✓ Do you utilize performance and evaluation results to improve hedge program and hedging models?

7. Conclusions

- Communication
  - With clear well-defined hedge objective
  - With thoroughly understanding pertinent regulations
  - With effective communication to senior management
  - With effective communication among departments
  - Need to ask the right questions at the right time

7. Conclusions

- Product Development and Pricing
  - ➢ Incorporate all costs of hedging and risk management
  - ➢ Incorporate impact of reserves and capital
  - ➢ Distinguish risk neutral pricing and real world purchasing instruments
  - ➢ Pay attention to macro trend on pricing impacts
  - ➢ Add appropriate margins to capital market assumptions
  - ➢ Add appropriate margins to actuarial assumptions
  - ➢ With ability to handle basis risks

7. Conclusions

- Hedging
  - Hedge to right objective
  - Use accurate capital market instruments to hedge
  - Use accurate capital market assumptions
  - Update actuarial assumptions properly
  - Design robust scenario and design stress tests appropriately
  - Not too conservative or not too optimistic
  - Not to make the model too complex to manage over time
  - Not to take the Greeks from system as "the only answer“

Disclaimer

- Materials presented above are personal opinions only, I own all errors.

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