Hedging at Your Insurance Company

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Primary Benefits and Motives of Establishing Hedging Programs

- Hedging can mitigate some of the volatility in earnings, especially for VA and EIA business and has become standard practice for many companies.

- Rating agencies are increasing their scrutiny of a company’s risk management practices. An effective hedging strategy will support a company’s ERM efforts.

- Analysts will view an effective hedge program as a positive aspect of a company’s operations, thereby enhancing shareholder value.
  - Peer pressure from largest companies as stock analysts understand effects of hedging on quality of earnings.

- Potentially lower and more stable capital required
  - C-3 Phase II
  - Internal economic capital
Overview

- Risk identification
- What am I trying to achieve?
- Which strategy to use?
- Implementation
- Review effectiveness
- Risks after hedging
Identify Risks

Define Objectives

Choose Strategies

Implementation

Review Effectiveness

More Risks?
Identify Risks

- Insurance companies undertake risks for a living
  - Mortality, morbidity, longevity, etc.

- But we want to pick our battles
  - Do not have strength on certain risks
  - Do not want to take too much risks

- Hedging is no stranger to insurance industry
  - Reinsurance
  - Duration / convexity management

- Typical financial risks
  - Interest rate
  - Market
  - Credit
  - Currency
Examples of Financial Risks in Insurance Products – Interest Rate

- Interest rate example 1 – Deferred annuity
  - Expect large surrender at end of SC period, but assets won’t mature yet
  - An interest rate spike would cause large capital loss
  - An interest rate forward contract can help lock in sell price

- Interest rate example 2 – Disability block in payout phase
  - Start with assets and no future product cash inflow
  - Liability much longer than assets
  - An interest rate drop when large assets mature would destroy yields
  - An interest rate swap (pay float / get fixed) can help lock in yield

- Both examples show asset/liability duration mismatch

- Sometimes duration match is difficult with on buying and selling assets
Examples of Financial Risks in Insurance Products – Market

- Market example 1 – Equity-index annuity
  - Offset some upside potential but no downside risk
  - Hold all equity vs. hold all bonds
  - Bonds + equity calls

- Market example 2 – Variable annuity
  - Low equity growth hurts fee-based revenue
  - Low equity growth puts various guarantees in the money
  - Equity + puts

- Equity is a simplified term
  - More fund choices

- Equity growth is not the only market risk
  - Volatility
Identify Risks

Define Objectives

Choose Strategies

Implementation

Review Effectiveness

More Risks?
Defined Hedging Goal

- Typical goals
  - Smooth earning patterns
  - Reduce required capital
  - Manage catastrophic events
  - Appropriately price product features

- Hedging usually has a negative expected value

- Help determine strategy

- Help set benchmark to measure effectiveness
  - Need quantifiable goals
Unhedged Earning Profile
Hedged Earning Profile
## Unhedged vs. Hedged

<table>
<thead>
<tr>
<th></th>
<th>Unheded</th>
<th>Hedged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>(5,000,000)</td>
<td>(1,210,915)</td>
</tr>
<tr>
<td>1%</td>
<td>(2,603,058)</td>
<td>(354,864)</td>
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<tr>
<td>5%</td>
<td>(1,069,164)</td>
<td>192,955</td>
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<tr>
<td>10%</td>
<td>(385,875)</td>
<td>436,987</td>
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<tr>
<td>35%</td>
<td>859,788</td>
<td>881,866</td>
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<tr>
<td>Median</td>
<td>1,215,607</td>
<td>1,008,945</td>
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<tr>
<td>Average</td>
<td>912,128</td>
<td>900,559</td>
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<tr>
<td>Stdev</td>
<td>985,463</td>
<td>351,951</td>
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</table>

- Reserves and capitals are often defined by tail (CTE65, CTE90)
Identify Risks
Define Objectives
Choose Strategies
Implementation
Review Effectiveness
More Risks?
Choose Hedging Strategy

- Some profiling of risk exposure is very helpful
  - Product features
    - Length of guarantees
    - Available fund options / Average fund size
  - Quantification of exposure
  - Risk tolerance

- Typical strategy
  - No hedging
  - Static hedging
  - Dynamic hedging
    - Delta hedging
    - Multiple Greek hedging
Static vs. Dynamic Hedging

- Static hedging
  - Similar to cash flow matching in bond portfolio management
  - Set up and let go
  - Buy from banks
  - Need Tom Hanks, get Tom Hanks

- Dynamic hedging (matching $\Delta$ only)
  - Similar to duration matching in bond portfolio management
  - Monitor and frequently rebalance
  - Do it yourself
  - Get someone that acts like Tom Hanks

- Dynamic hedging with multiple Greeks
  - Similar to duration and convexity matching in bond portfolio management
  - Monitor and frequently rebalance
  - Do it yourself (probably buy some from banks)
  - Get someone that looks and acts like Tom Hanks
Static Hedging vs. Dynamic $\Delta$ Hedging

- Have 1,000 stocks currently $60 each. Need to guarantee no lower than $50 in one year.

- Static hedging solution
  - Need 1,000 one-year put option on the stock @ strike price $50
  - Buy and leave it

- Dynamic hedging solution
  - Replicate $\Delta$ of the put – construct a portfolio with equal sensitivity to stock price change as the put (like duration match)
  - $\Delta$ (put) = $N(d1) - 1 = -14.6\%$ (stock +1%, put - 0.146%)  
  - $\Delta$ (short 14.6\% stock) = -14.6\% x $\Delta$ (stock) = -14.6\%
  - Solution: sell 146 shares of stocks

- 1,000 Stock + 1,000 put Vs. 1,000 Stock – 146 Stock
## Delta hedging example

<table>
<thead>
<tr>
<th>Stock price</th>
<th>50</th>
<th>55</th>
<th>58</th>
<th>59</th>
<th>59.5</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 Stock</td>
<td>50,000</td>
<td>55,000</td>
<td>58,000</td>
<td>59,000</td>
<td>59,500</td>
<td>60,000</td>
</tr>
<tr>
<td>1,000 Put</td>
<td>3,730</td>
<td>2,210</td>
<td>1,590</td>
<td>1,420</td>
<td>1,340</td>
<td>1,260</td>
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<tr>
<td>Total</td>
<td>53,730</td>
<td>57.21</td>
<td>59,590</td>
<td>60,420</td>
<td>60,840</td>
<td>61,260</td>
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<tr>
<td>854 Stock</td>
<td>42,700</td>
<td>46,970</td>
<td>49,530</td>
<td>50,390</td>
<td>50,810</td>
<td>51,240</td>
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<tr>
<td>Cash</td>
<td>10,020</td>
<td>10,020</td>
<td>10,020</td>
<td>10,020</td>
<td>10,020</td>
<td>10,020</td>
</tr>
<tr>
<td>Total</td>
<td>52,720</td>
<td>56,990</td>
<td>59,560</td>
<td>60,410</td>
<td>60,840</td>
<td>61,260</td>
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Problems with Static & Dynamic Hedging

- Static hedging
  - Too expensive
  - Limited availability

- Dynamic hedging
  - Hedging never perfect, even with multiple Greeks
  - Transaction cost due to frequent rebalance – buy low and sell high
  - Monitoring requires sophisticated modeling
  - Weak defense against catastrophic events

Dynamic hedging has become the winner.

How long will that last? Another “Black Monday”? 
Identify Risks
Define Objectives
Choose Strategies
Implementation
Review Effectiveness
More Risks?
Implementation

- Modeling - Inputs
  - Product / projection specifications
  - In force / new business data
  - Assumptions
    - Policyholder behavior
    - Economic scenarios
    - Shock scenarios: like duration calculation

- Modeling – Outputs
  - PV of claims and charges – used to estimate cost
  - Greeks at valuation date – used to drive hedging trades

- Execution
Modeling process

- In-Force Data
- Projection / Product Specs
- Scenario Files
- Baseline
- Asset Shock Up 1
- Volatility Shock Up 1
- Interest Shock Up 1

Output:
- Baseline Output
- Asset Shock Up 1 Output
- Volatility Shock Up 1 Output
- Interest Shock Up 1 Output
Economic Scenarios

- A hedging model is like any other model - “garbage in, garbage out” and scenario assumption is potentially the largest piece of garbage

- Real world vs. market consistent

- Elements covered
  - Asset indices
  - Asset volatilities
  - Interest rate curve
  - Interest rate volatilities
  - Foreign exchange rates
Real-world scenarios

Research / historic data

Management views on the future

Analysis of historic data

Projection

PAST

1986  1996  2006

FUTURE

2016
Market-consistent scenarios

Markets do not permit arbitrage

Past Unimportant

Projection fitting asset prices

Past

1986

1996

2006

2016

Future
Each Element Needs to Be Calibrated

- Interest rate
- Interest rate volatility
- Corporate bond volatility
- Equity volatility
- Property volatility
- Exchange rates
- Inflation

Yield curve
Swaptions
Credit derivatives, historic data
Equity options
Historic volatility – options do not exist
Exchange rate options
Index linked options, historic data
Practical Considerations

- Enhance speed performance
  - Scenario selection
  - Distributed processing
  - Smart modeling

- Rebalance frequency
  - Accuracy vs. cost

- Flexibility
  - Can be easily modified to reflect new product features
  - Can be easily modified to reflect new assets classes
  - Can be customized to reflect accounting regulations
Two Sides of Hedging Effectiveness

- Benefits – Did it achieve the goals? How much value added?
  - Smooth earning patterns
  - Reduce required capital
  - Manage catastrophic events
  - Appropriately price product features

- Costs
  - Overhead cost – modeling, monitoring, etc.
  - Transaction cost
  - Overhedging vs. underhedging
  - Tracking error
Hedging is NOT a Silver Bullet

- Pricing
  - Can the features be effectively hedged?
  - Is hedging cost incorporated in pricing?

- Basis risk

- Policyholder behavior

- Scenario simulation
  - Risks can be eliminated by assumptions
  - Is “abnormal” quite normal?

- Correlation, concentration & liquidity
  - Financial instruments are increasingly more correlated
  - Amaranth Advisors, New Century Financial

- Got a plan B?
Questions?