

Portfolio Hedging Strategies

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Milliman's Financial Risk Management Practice

THE LEADING INVESTMENT ADVISOR TO THE INSURANCE INDUSTRY FOR RISK MANAGEMENT

- Hedging over \$500 billion of retirement savings accounts via our outsourcing and advisory services
- Direct asset manager on over \$50 billion
- 24-hour trading of hedge assets via Chicago-Sydney-London platform
- 100+ professionals dedicated to financial risk management
- Assisted 12 of the top 15 European multinationals with guarantee product launches and hedge implementations



MILLIMAN'S PROTECTION STRATEGY PLATFORM

- Expanding protection strategies beyond the insurance sector
- Include hedge strategies directly within funds & client portfolios
- Integrate with major financial advisory platforms

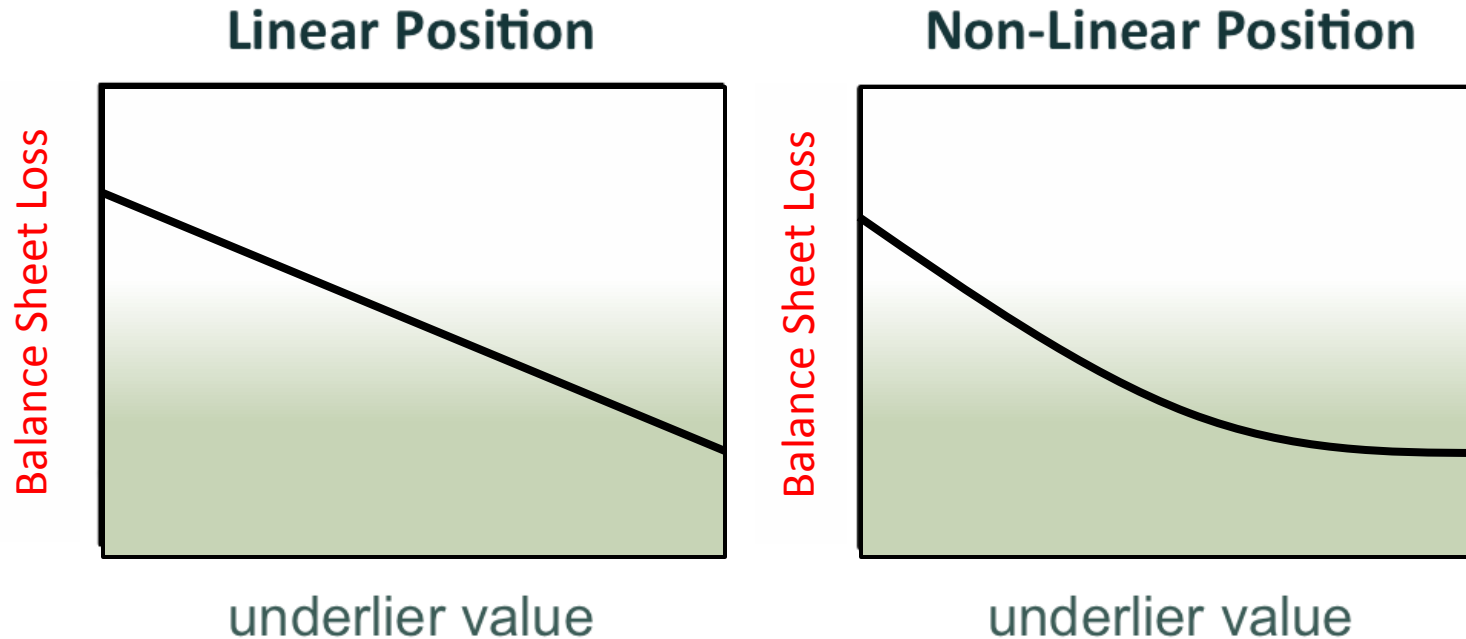
Agenda

- Hedging – An Insurer’s Perspective
 - Why Hedge?
 - Potential Hedge Solutions
- Sizing initial trades and managing positions over time
 - Sizing of trades
 - Option Purchase vs Option Replication
- Practical approaches for comparing potential hedges
- Conclusions

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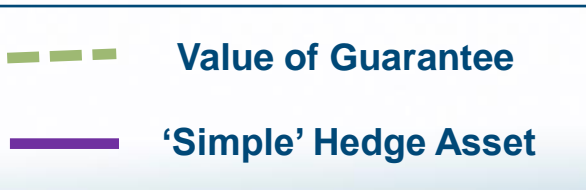
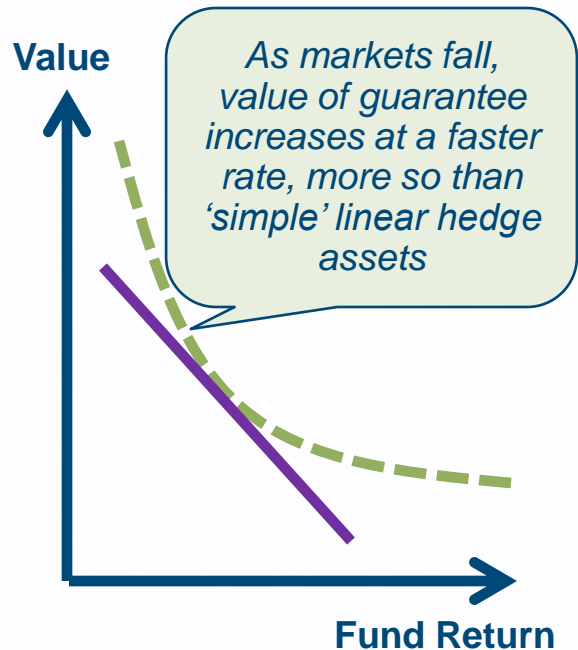
An Insurer's Perspective: Why Hedge?



- Embedded optionality in insurance guarantee liabilities
- Optionality exacerbated by customer behaviour

An Insurer's Perspective: Multiple Risks

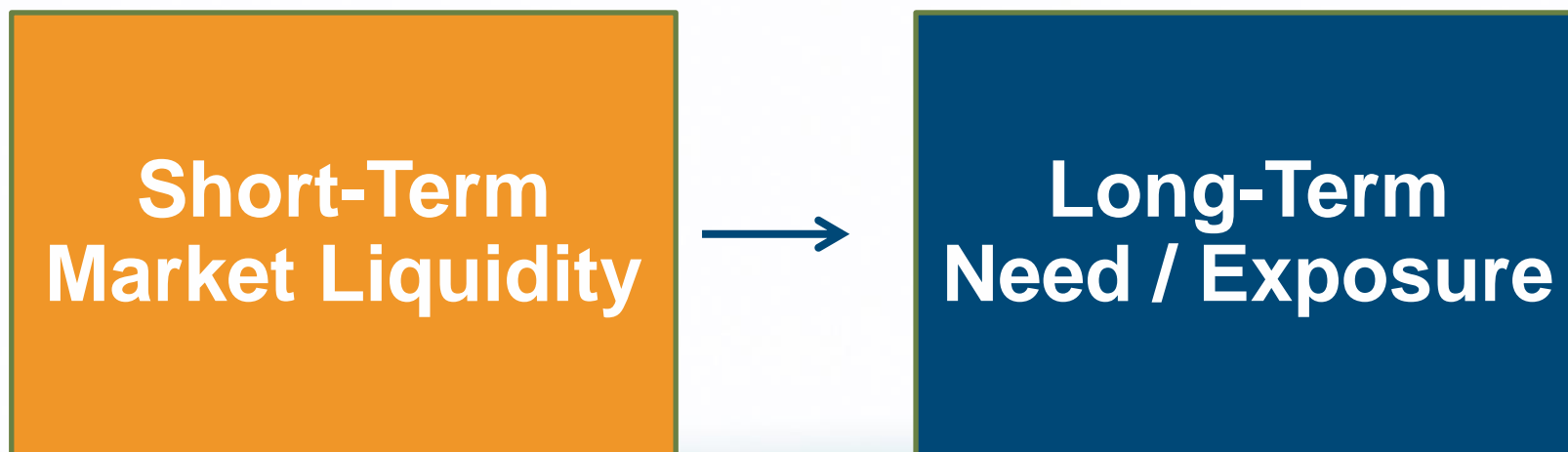
Complex Derivative → Highly sensitive to many market risk factors



- Risk that underlying fund returns insufficient to meet guarantee (i.e. taking on risk from the customer)
- Embedded optionality
- Product features e.g. Ratchets / Roll-ups → make risk exposure path-dependent and more complex
- Insurance guarantees are typically long-term duration product
- Volatility Risk → impacts on:
 - Balance sheet mark-to-market
 - Hedging costs, more volatility means more hedge re-balancing (i.e. a “replication cost” from realised gamma or option portfolio adjustment)

An Insurer's Perspective: Long-Term Risk

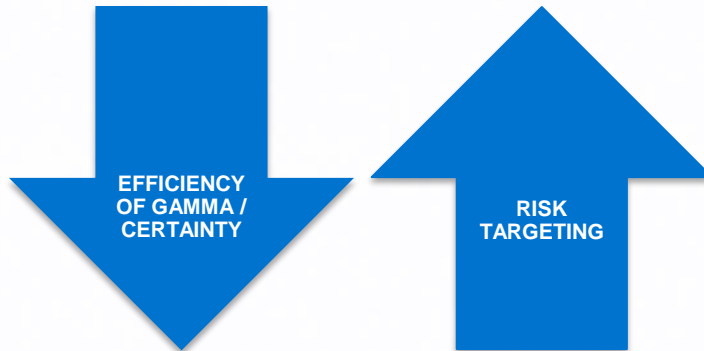
- Insurance Need: Long-Term Vega
 - Retirement guarantees often 30-40 years
 - Forward exposure from future regular premiums
 - Dynamic exposure due to portfolio changes and exotic nature of guarantees



An Insurer's Perspective: Hedge Solutions

“Option Replication”

Dynamic re-balancing of
Delta One
e.g. futures, forwards



“Option Purchase”

Straight Puts

Put Spreads

Calendars

Collars

Hedge Universe includes “Option Replication”:

- For 100% targeting of complex risk exposures
- Long-term nature of exposures (need to roll “option purchase” in any case)

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Sizing of Trades

STEP 1:

Risk Inventory

Liability portfolio valuations →

Equity, FX, rates, volatility prices →

Portfolio movements & modelling assumptions →

	Liability
	Position
Euro Delta	
DJ Euro Stoxx 50	101,809
Topix	26,711
FTSE 100	89,211
S&P 500	133,655
Total	351,387
Equity Vega	
DJ Euro Stoxx 50	26,711
Topix	89,211
FTSE 100	133,655
S&P 500	200,241
Total	249,578

Daily: Accurate

Real-time: Close Estimate

STEP 2:

What to Hedge?

Match out risk exposures

100% of Vega?

→ *“Option Purchase”*

100% of Delta?

→ *“Option Replication” if no vega hedging*

→ *Net of options is targeted residual delta*

Option Purchase vs Pure Replication

Tail Scenario VaR

	Option Purchase	Pure Replication
Protection in Realised Tail Scenarios (or Realised VaR)	Explicit	Constructed through replication
Balance Sheet VaR Vega Risk	More certainty in cost More protection	Less certainty in cost Less protection
Balance Sheet VaR Practicalities	<1 year options allowed?	Replication allowed? Replication feasible to model?

Conclusion: using options compared to pure replication is typically more favourable when considering tail risk. Both from a realised tail scenario and a balance sheet VaR measure. However, there are risks to both approaches.

Option Purchase vs Pure Replication

Expected P&L

30-day S&P 500 ATM Put Implied Volatility
less

30-day S&P 500 Historical Volatility (period after IVol observation)



8-year Statistics

Mean: 0.68%

Median: 1.79%

SD: 5.08%

Why bother with replication?

- Implied Volatility > Realised Volatility gap
- But subject to variation over time

Shouldn't forget:

- Comparative transaction costs
- Capital costs for tail VaR

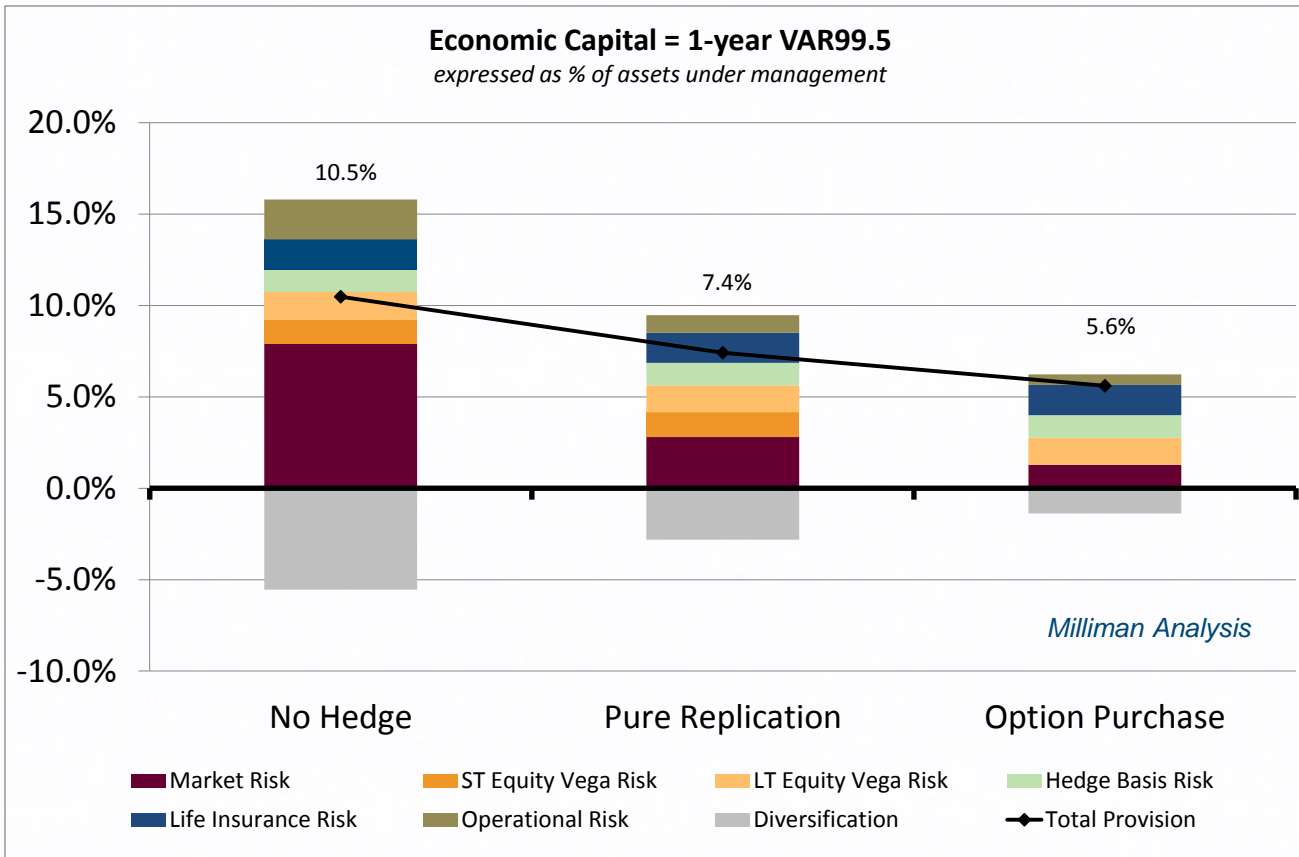
Conclusion: neither strategy is optimal all of the time. A combination of tactical option purchase and replication (to experience realised volatility) is likely to be most optimal over time.

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Practical Approaches to Comparing Hedges

Metric = Economic Capital VAR



How much capital is saved?

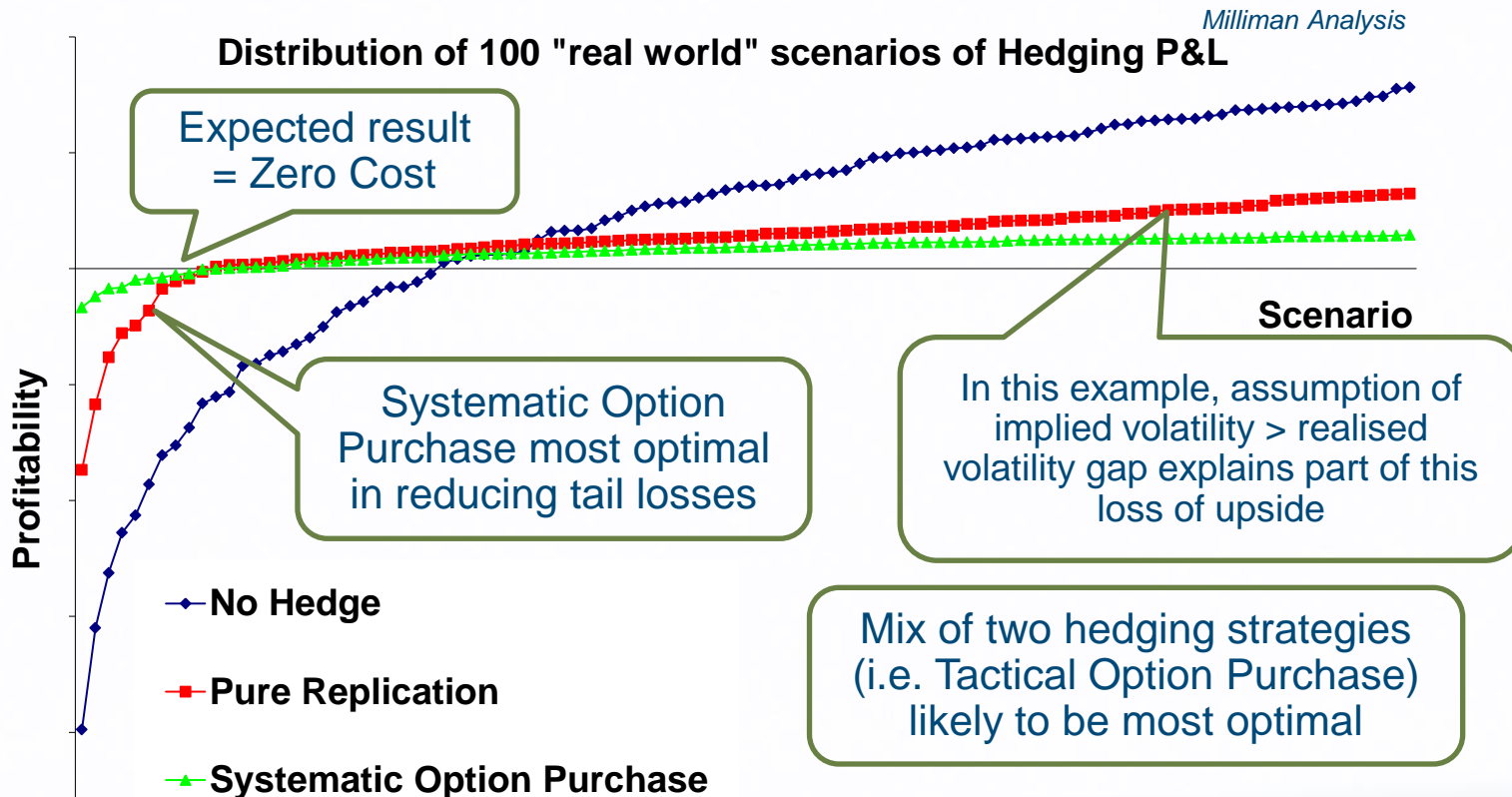
- Market risk reduction
- Short-term equity vega risk reduction
- Diversification loss

Illustrative insurance portfolio & hedge design only

These results are illustrative only and represent the performance of one particular hedging problem and hedging strategy. This analysis is model dependent, and all models have performance limitations. Alternative models may produce different results.

Practical Approaches to Comparing Hedges

Metric = Stochastic Distribution of Profitability



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Conclusions

- Long-term insurance guarantee products have embedded optionality and complex risk exposures that need to be hedged
- Given the long-term nature of guarantees any option-based hedge strategy would need periodic rolling and re-striking
- Given the complexity of risks, to fully hedge all exposures would require at least some level of option replication with delta one instruments too
- Key factors to consider when comparing strategies:
 - Tail VaR performance → typically favours option purchase strategies
 - Implied vs realised volatility gap → typically favours option replication strategies
 - Comparative transaction costs of rolling
- Key metrics for measuring performance:
 - Economic Capital VaR (for all risk exposures combined)
 - Distribution of Net Present Value of Profitability
- Overall a combination of tactical option purchase and option replication is likely to be most optimal over time

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