SOCIETY OF ACTUARIES

Investment Symposium
March 2009

F1–Trends in VA Product Development and Hedging Strategy

Niaz Haider
Peter Sun
Carl Mason
Rajesh Bhandula

Moderator

Ross Bowen

Investment SYMPOSIUM

BNP PARIBAS | CORPORATE & INVESTMENT BANKING

VA Risk Management

ρ (rho) - a hedgeable risk

Rajesh Bhandula
Director, Fixed Income Derivatives Marketing
+1 212 841 3116

Actuaries
Risk is Opportunity®

Rho – a hedgeable risk

- Most VA products are short a put option on the underlying through the various embedded guarantees

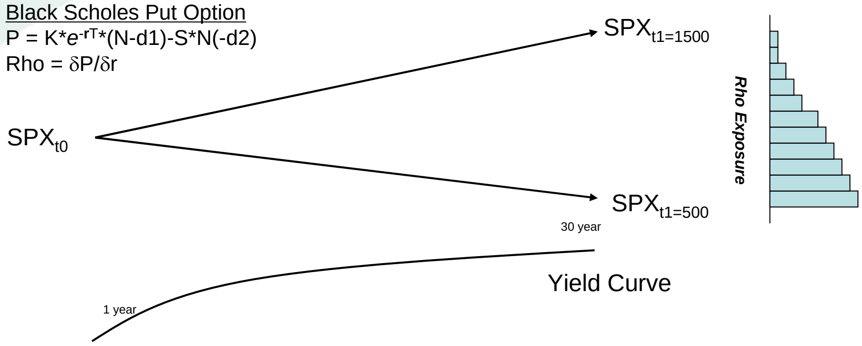
- Embedded put options have long expiries
  - GMDBs : option expiries easy to model from the life expectancies assumed in the VA portfolio
  - GLBs : Option expiries are shorter than GMDBs but more complicated to model

- Long expiry makes the value of the put option very sensitive to the level of interest rates
  - Option value increasing with interest rates going lower and vice versa

- Change in Rho due to change in the moneyness of the put option adds to the complexity of risk management

VA – Rate Risk (Rho) exposure

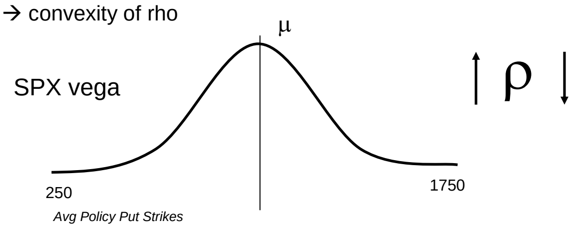
Black Scholes Put Option
$P = K*e^{-rT}*(N\text{-}d1)\text{-}S*N(\text{-}d2)$
$Rho = \delta P/\delta r$



- Regulatory rule changes require additional capital reserves held against GLBs.
- A portion of this capital calculation depends on the discounting effect of these long dated liabilities

VA – Correlation Cross-Gamma

- The Rho position increases incrementally with the moneyness of the average short equity put strike
- Option intrinsic value → incrementally shorter rho
- Option vega → convexity of rho



- So as equities sell off, the liability MTM increases - thereby requiring more rho coverage
- Furthermore, this coverage is required at an increasing rate as the market approaches the underlying average equity strikes

Why Hedge Rho?

- Change in the MTM of the VA liability attributed to change in rates can be very large (especially in high volatility environment)
  - Sensible if VA liabilities discounted with swap rate term structure

- Mitigation of the “Japan syndrome”:
  - Long periods of low rates/flat or inverted forwards associated with declining equity valuations
  - Flatter / inverted curve for a given rate level means higher discount factors

- Capital Relief under NAIC C-3 phase 2

Derivative Strategies to hedge Rho

Swap Strategies

- Interest Rate Swaps
  - Hedger receives fixed interest rate to pay floating rate on a notional amount at pre-determined intervals (e.g. every 3 months) for pre-determined term
- Forward Starting Swaps
  - Hedger receives fixed on a swap with the start date in the future e.g. 2 years forward starting 10 year swap
- Zero Coupon Swaps
  - Hedger receives one fixed interest payment at maturity of the swap to pay / receive one cashflow at maturity which is the future value of the compounded floating interest rate amounts during the life of the swap

Option Strategies

- Receiver Swaptions
  - A receiver swaption gives the owner of the swaption the right to enter into a swap to receive the fixed rate and pay the floating rate. Swaption is in the money when the market swap rate for the underlying swap is below the strike
  - Example : 1y10y 3% RTR (1 year option on a 10 year swap that gives the buyer right to receive 3% fixed rate and pay LIBOR if the 10y swap rate is below 3% at expiry of the swaption
- Interest Rate Floors
  - Interest rate floor is a series of European put options or floorlets on a specified reference rate, usually LIBOR. The buyer of the floor receives money if on the maturity of any of the floorlets, the reference rate fixed is below the agreed strike rate of the floor
  - Common Indices: CMS, Libor
  - Forward starting (5X10, 5X15)

New products applicable as Rho hedges

Separation of curve risk from the level of rates

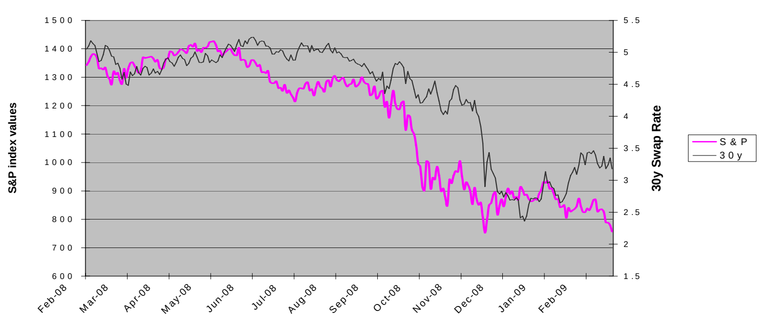
- All other things equal, a flatter forward curve generates higher discount factors
- Curve correlation products can hedge the shape of the forward curve
  - Example: 5x15 Floor on (CMS30 –CMS5) struck at zero
  - If purchased in a steeper yield curve environment, can be quite cheap
  - Positively convex payoff in the event of either a bull or bear flattening or inversion
  - Can cheapen further by conditioning floor payment contingent to CMS30 < 4%

Correlation products condition the hedge

- GLB liability MTM a function of the joint probability of the underlying declining in a low rate environment
- Correlation products can condition a rho hedge on the price of the underlying
  - Example:
  - 10y floor on 10CMS struck at 2.50% conditioned on S&P500 yoy D -10%
  - 10y floor on 10CMS struck at 2.50% conditioned on S&P500 below 850
- Correlation rho hedges presume underlying delta is hedged!

Variable Annuity Hedging – Effects

- Beginning in spring of 2008, Rho hedgers began to receive fixed 10y to 30y swaps
- Peak coverage concentrated in the 20-30 year area of the swap curve



- Cause and effect – as equity prices fall in the 2nd half '08 →VA hedgers delta hedge (sell SPX futures).
- SPX closer to short put strike position →Shorter rho position → must continue to receive fixed
- Rates were lower when higher rho coverage was needed

Disclaimer

•The material in this document was produced BNP Paribas Securities Corp. (“BNPP”).

•This document is only directed at institutional investors as defined by the National Association of Securities Dealers. Any investment or investment activity to which this document relates is available only to and will be engaged in only with relevant persons. This document is not intended for retail customers and should not be passed on to any such persons. Any person who is not a relevant person should not act or rely on this document or any of its contents.

•The information and opinions contained in this presentation have been obtained from public sources believed to be reliable, but no representation or warranty, express or implied, is made that such information is accurate or complete and it should not be relied upon as such. Information and opinions contained in the report are published for the assistance of recipients, but are not to be relied upon as authoritative or taken in substitution for the exercise of judgement by any recipient, and are subject to change without notice.

•This presentation is not, and should not be construed as, an offer document or an offer or solicitation to buy or sell any investments. No BNP Paribas Group Company accepts any liability whatsoever for any direct or consequential loss arising from any use of material contained in this presentation. This presentation is confidential and is submitted to selected recipients only. It may not be reproduced (in whole or in part) to any other person without the prior written consent of BNPP. A BNP Paribas Group Company and/or persons connected with it may effect or have effected a transaction for their own account in the investments referred to in the material contained in this report or any related investment before the material is published to any BNPP customers. On the date of this report, a BNP Paribas Group Company, persons connected with it and their respective directors and/or representatives and/or employees may have a long or short position in any of the investments mentioned in this presentation and may purchase and/or sell the investments at any time in the open market or otherwise, in each case either as principal or as agent. Additionally, a BNP Paribas Group Company within the previous twelve months may have acted as an investment banker or may have provided significant advice or investment services to the companies or in relation to the investment(s) mentioned in this presentation.

•BNPP is a U.S. registered broker dealer and a FINRA and NYSE member.

•By accepting this document you agree to be bound by the foregoing limitations.

Investment SYMPOSIUM

BNP PARIBAS | CORPORATE & INVESTMENT BANKING

The VA Hedging Environment

Carl Mason
Head of Equity Derivatives Strategy, Americas
+1 212 841 2225

Insurance Flow Sales
+1 212 841 3249

Actuaries
Risk is Opportunity.

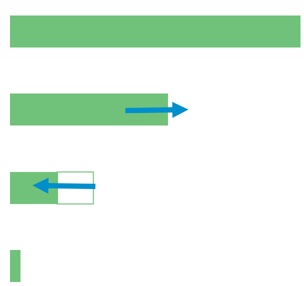
Contents

1. Challenges for the VA Hedging Framework

The VA Hedging Framework

VA Community Adoption

1. ***Delta***
   The Underlying
2. ***Gamma***
   Realized Volatility
3. ***Vega***
   Implied Volatility
4. $\phi, \eta, \iota, \varphi, \kappa, \mu, \nu, \xi$ **or** ψ **?**
   Dividends



Source: BNP Paribas

Delta – Locking in the Roll Cost

Delta

Mark-to-market P/L due to stock price change

LB guarantees make insurers **long delta**

Historically sold index futures to hedge delta

- Many VA hedgers are switching to selling **total return swaps**
  - those doing so are selling swaps to cover 60%-80% of their delta-hedge
  - EAFE especially popular; also SPTR
- Why?
  - lock-in a price for the quarterly futures roll
  - a **total return** instrument can hedge delta and dividend exposure of the VA liability
  - cash flows can be timed to aid the liquidity of the liability + hedge portfolio

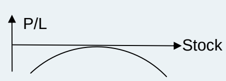
Gamma – Attention Focused on the Short-Term

Gamma

Change in delta due to a stock price change

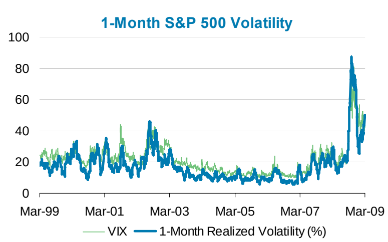
LB guarantees make insurers **short gamma**

Without gamma hedging, an insurer's delta hedge falls short, when stocks move

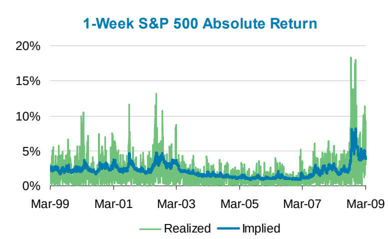


the *speed* at which a delta-hedge *fails* when stocks move

- Implied volatility is historically "rich", even vs. recent realized volatility
  - however short-dated options have been a fairly good buy through 2009
- VA hedgers continue to buy gamma
  - buy 1-year OTM put options
  - growing interest in shorter maturities – liquidity less of an issue



Source: BNP Paribas, Bloomberg



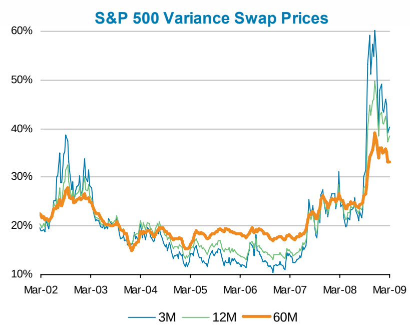
Source: BNP Paribas

Vega – Elevated Implied Volatility on Liquidity Squeeze

Vega

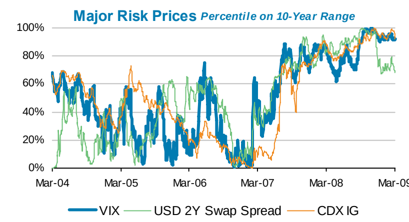
Mark-to-market P/L due to a change in market volatility expectations (implied volatility)

The cost of future gamma hedging makes insurers short vega



Source: BNP Paribas

- Long-term implied volatility elevated
  - reflects a liquidity risk premium
  - we expect long-term implied vol to decline after vol term structure flattens
- Vega hedgers buy long-term puts, var swaps or forward-starting var swaps
  - some closed out existing positions
  - some “selling tails” via variance swap buy-writes, conditional variance swaps



Source: BNP Paribas, Bloomberg

Dividends – Learn From The Street

2003

Dividend declines brought structured product dealers’ attention to dividend risk

- The *Street* is structurally long dividends

2004 – 2006

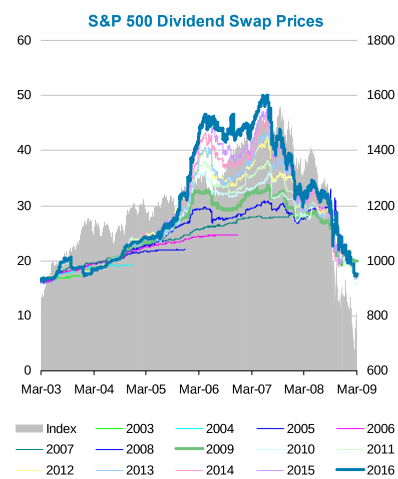
Dealers sought dividend lay-off partners

- Explosion of dividend swap trading

Today

Active two-way dividend swap market

- Traditional investors can now express an active view on future dividends
- You can trade futures on EuroSTOXX 50 dividends out to six years at Eurex



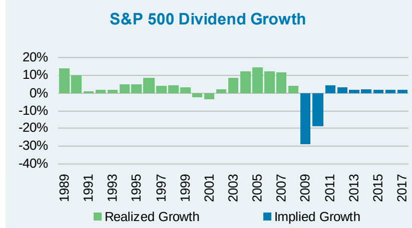
Source: BNP Paribas

Dividends – The Long Dividend Bias

- VA providers are also long dividends
  - LB guarantees are based on stock total returns, but many hedges pay out based on stock price returns
  - put options' vega mark is based on dividend assumptions

    dividend expectations ↓
    ⇨ forward price ↑
    ⇨ OTM put vega ↓

- Implied dividends typically grow slower than realized dividends
  - partly due to equity risk premium
  - partly due to excess supply of dividends from end-users



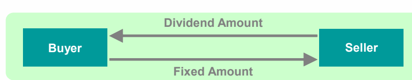
Source: BNP Paribas

Investors trade dividend swaps to

1. Target the timing of an earnings view
   - stocks depend on fundamentals (E) and long-term sentiment (P/E)
   - dividend swaps depend on E
2. Diversify an equity portfolio
3. Play dividend term-structure steepness

Dividends – Sell Dividend Swaps to Manage Risk

At maturity, the swap buyer and seller exchange cash flows



Index dividend swaps give exposure to an index's dividend stream -- equivalent to the dividends that index holders receive, taking index changes into account

Stock dividend swaps give exposure to a single stock's dividends

Dividend swaps pay out based on ordinary cash and stock dividends, but **exclude special dividends**

Sample Index Dividend Swap Termsheet

Trade Date	26 August, 2008
Start Date	31 December, 2009
Maturity Date	31 December, 2010
Index	S&P 500
No. of Baskets	100,000
Fixed Strike	28.00
Fixed Amount	Number of Baskets x Fixed Strike
Dividend Amount	Number of Baskets x $\sum_t \sum_i \frac{n_{it} \times d_{it}}{D_t}$
t	each weekday from Start to Maturity
i	each share in the Index on t
d_{it}	the dividend for share$_i$ on t
n_{it}	number of shares$_i$ in the index on t
D_t	index divisor on t

Forward-starting -- a 2010 swap pays 2010 dividends only

The fixed strike is the swap's price -- the **implied dividend**

The dividend amount is **accumulated** through the year to maturity

Gross dividends, before withholding and tax credits

2. Portfolio Hedging Outside the VA Sphere

Portfolio Hedging Today – "Short Volatility"

- With implied volatility elevated, a put option's price is historically high
  - places a great drag on performance should stocks trade higher
- "Short volatility" hedges are in vogue
  - buy a put-spread collar
  - buy a *vega-minus hedge*
- Elevated implied volatility helps the pricing of the put-spread collar and VMH
  - hedge a portfolio against stocks grinding lower
  - impose only a small hurdle (if any) for portfolio profit on a stock gain

put-spread collar

Benefit	more immediate upside participation than put
Cost	limited downside protection ceiling on upside participation
	if stocks tumble, pay considerably to roll protection to lower strikes

vega-minus hedge

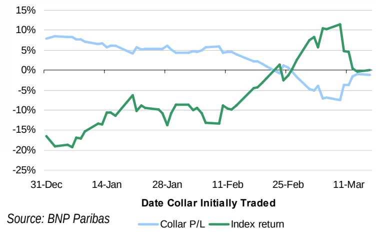
embeds a series of overlapping short-dated put-spread collars, strikes fixed at future dates

Benefit	may profit if stocks range-bound over year
	if stocks rise through the year, hedged portfolio will likely participate, subject to a small drag
Cost	if stocks plummet one month but do not bounce back the next, hedge may be lacking at year end

Portfolio Hedging Today – An Active Process

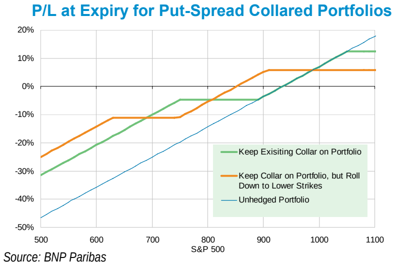
- The severe early-2009 market decline illustrated a put-spread collar limitation
  - limited downside protection on especially sharp market declines
- The bear-market rally provides an opportunity to roll down to lower strikes
  - recently executed put-spread collars face diminishing marginal gains should stocks retrace their 2009 lows soon
  - by rolling the collar, gain protection at index levels below where the current put-spread collar can deliver
- Alternatively, roll into a VMH, a strategy where strike rolling is *automatically* embedded

Current P/L of S&P 500 Put-Spread Collars Executed Earlier This Year



Source: BNP Paribas

P/L at Expiry for Put-Spread Collared Portfolios

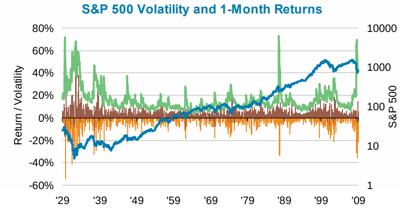


Source: BNP Paribas

Active Investors Crush Skew

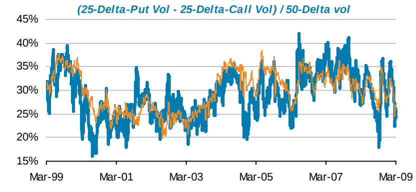
- Recent rally is a manifestation of a high volatility regime
  - in high volatility regimes we see many switches from bear to bull and back again
  - asymmetry between the ease in maintaining long and short positions promotes bear market squeezes
- Implied volatility skew steepness "crushed"
  - hedged investors rolling put-spreads
  - collared and unvested investors chasing rallies, buying OTM calls
- You might care because
  - less steep skew makes OTM puts less expensive relative to OTM calls

S&P 500 Volatility and 1-Month Returns



Source: BNP Paribas, Bloomberg

Skew Steepness
(25-Delta-Put Vol - 25-Delta-Call Vol) / 50-Delta vol



Source: BNP Paribas, Optionmetrics

Conclusions

- VA hedgers can do much to tighten up their delta-hedging
  - consider roll costs
  - consider dividends

- VA hedgers face liquidity constraints in a challenging market
  - implied volatility elevated
  - hedges driven to the short term

- Learn from the lessons of more nimble hedgers
  - don't buy tails if liquidity is limited
  - consider short volatility hedges + **be more active**

Disclaimer

Prospering in the Financial Crisis

2009 Investment Actuary Symposium

Peter Sun, CFA, FSA, MAAA
Milliman Financial Risk Management Practice

Milliman

Ingredients for Success

Milliman

This is NOT a Traditional Actuarial Team

- Cross-discipline talents are needed for a successful hedging program

Capital Markets	Technology
Quantitative Development	Actuarial

Basic Principles

- Use technology & financial engineering for transformational improvement in the retirement security system
- ***Principles***
  - Simplicity
  - Transparency
  - Reliability

The impact of the current financial crisis

Milliman

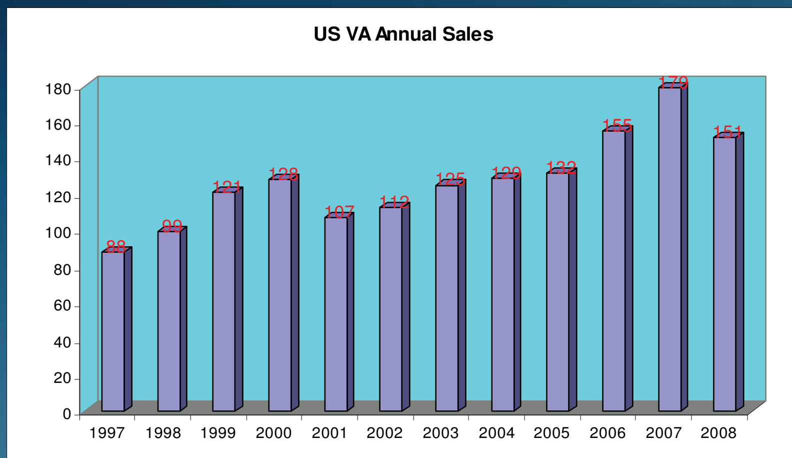
VA Continues to be a Critical Product

- Insurance companies are in the asset accumulation business
  - Pure protection business is still important, but asset accumulation products are becoming increasing significant
  - VA is especially important
  - Innovations in guarantee features has fueled the recent VA growth
- This trend is true in US, Asia and Europe

Milliman

VA Sales Are Sensitive to Market

- There is $151 billion of VA sales in the US
- VA asset is $1.3 trillion, whereas the US GDP is $14 trillion



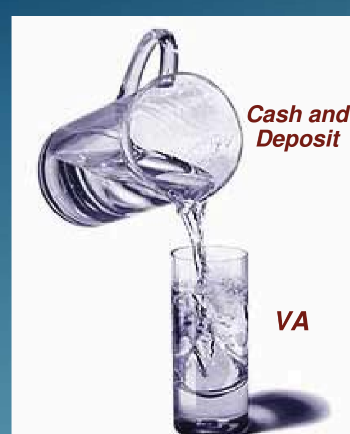
Milliman

We Expect Japan VA to Grow

- Japan is likely to continue to experience the effect of savings transfer from low yielding deposits to VA with guarantees
  - More than 50% of Japanese assets are in cash and deposit
- Low interest rate environment will help

	Japan		US	
Cash & Deposit	6,585	51%	5,602	17%
Bond	282	2%	2,624	8%
Equity	1,009	8%	10,747	32%
Mutual Fund	541	4%	4,208	13%
Life Insurance	1,971	15%	1,078	3%
Pension	1,397	11%	6,032	18%
Others	1,054	8%	2,930	9%
Total	12,839	100%	33,220	100%

Billion US$, Japan data as of 3/2006, source Bank of Japan.
US data as of 2005, source Board of Governors of the Federal Reserve



Milliman

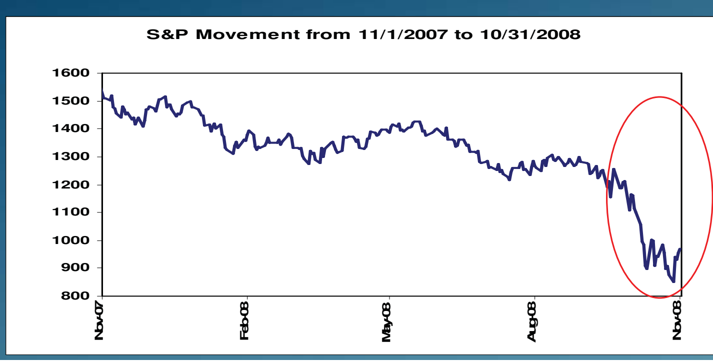
The Recent Financial Crisis has been Severe

- Failure of well known financial institutions
  - Lehman Brothers, Merrill Lynch, Bear Stern
  - Credit risk is brought to the fore
- Worldwide decline in equity market
- Rapid reduction of interest rates
- Increased volatility

Milliman

Worldwide Equity Market Decline

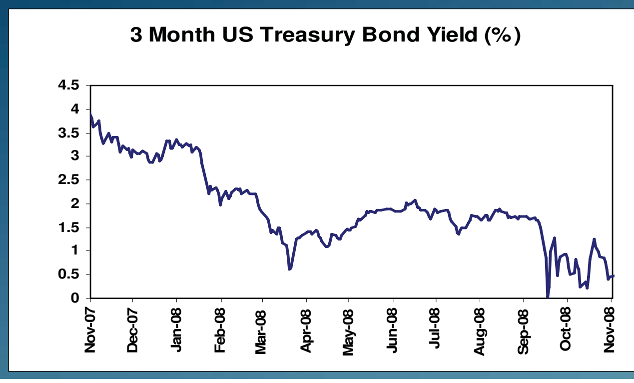
- Equity Market Turbulence Worldwide
  - S&P lost 47% Oct 2007 to Oct 2008
  - In October 2008 alone:
    - S&P lost 17%
    - Japan: Topix dropped 21.3%
    - Europe: FTSE lost 11.7%
      STOXX lost 12.5%



Milliman

Rapid Reduction of Interest Rates

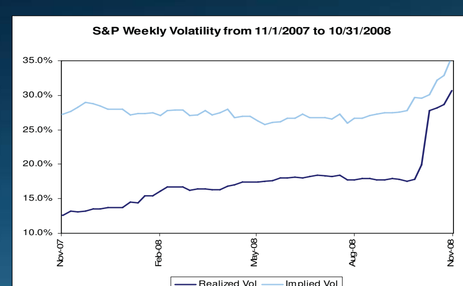
- US Treasury price up and yield close to zero
  - Flight to safety
- FED cut rates
- Bond price tumbled and yield high
  - Credit spread widened

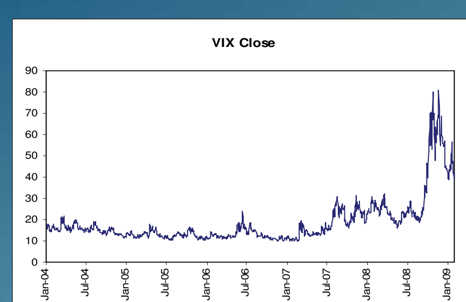


Milliman

Significant Increase in Volatility

- Both realized and implied volatility shot up
- Realized vol tripled
- Implied Vol at 40% by October 2008
- Forced liquidation of hedge funds helped amplify the market volatilities

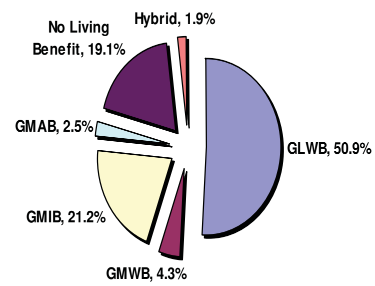




Milliman

VA Writers Incur Large Liabilities

- Guarantees prove valuable to policyholders in financial crisis
  - GLWB becoming the retirement vehicle of choice around the world
- Most policies are becoming in-the-money
- It is estimated that aggregate benefit value to exceed the aggregate account value by about $232 billion by October 31, 2008
  - Larger than the GDP of over 130 countries



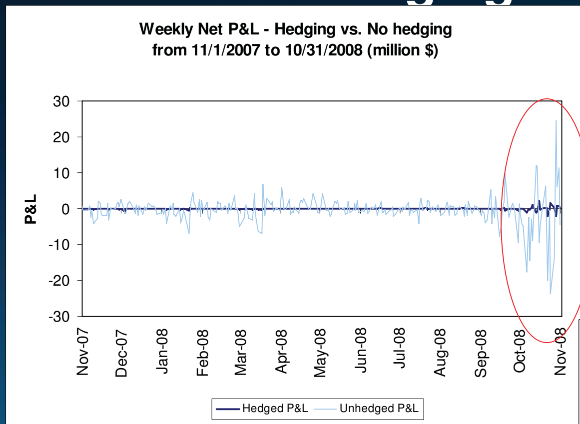
Milliman

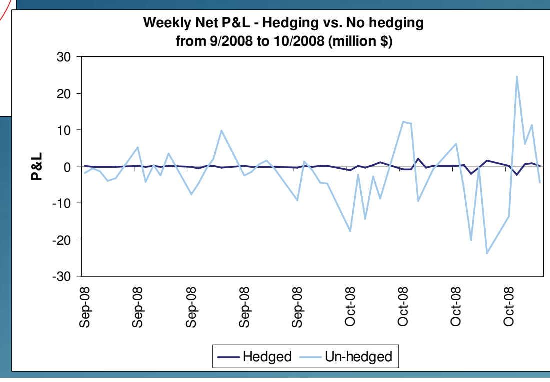
Hedging Programs Have Performed Well

- It is estimated hedging has saved the insurance industry about $40 billion in September and October in 2008
  - Save many companies from solvency issues
- Hedging programs are on average 93% effective in recouping the capital market losses that hedging programs were designed to protect
- Most hedging payoffs are due to movement in equity and exchange rates
- Hedging is not fool-proof
  - In-depth understanding of risk management is required

Milliman

Illustrative Hedging Results





Milliman

What Has Worked, What hasn’t

Milliman

What Has Worked

- Insurance company hedging programs are designed to reduce the exposures to capital market risks
  - Do not take risks to make a profit
- Use simple hedging instruments
  - Futures contracts
  - Plain vanilla options
  - Little counterparty risk
- Be highly transparent
  - Open discussion of hedging methodologies
  - Reviewed and audited by multiple parties
  - Contained operational risks

Milliman

Dynamic Hedging Best Practices

- Development of Analytical Tools is essential
  - Liability valuation capabilities
  - Asset valuation and market monitoring tools
  - IT infrastructure and grid computing capabilities
- Strategy Development and Testing
- Dedicated staff for hedging activity
  - Capital markets professionals/traders
  - Actuarial modelers & students
  - Technology experts
  - Quantitative code developers
- Operational and trading controls
- Performance measurement and monitoring
  - Hedge effectiveness
  - Actuarial experience

Milliman

Make Risk Management an Integral Part of the Business

- Start early
  - Think through the implications of risk management from product conception
  - Can avoid unexpected results down the road
- Start late
  - It is never too late to start hedging
  - Hedging will not recoup losses in the past, but can protect solvency in the future
- Have an evolving process
  - All good hedging programs started simple
  - They evolve towards perfection through continuous refinements
- Senior management support is the key

Milliman

What Hasn't Worked

- Leave critical exposure unhedged
- Follow accounting peculiarities blindly
  - US GAAP SOP03-1, Canadian GAAP are not fair valued
  - Following non-fair value accounting rules blindly hurt the economic fundamentals
- Deviate from sound risk management principles
  - Under pricing
  - Unchecked fund allocation
- Keep hedging practice as a secret
  - Leaving blind spots in hedging programs

Milliman

Companies' Reactions to the Crisis

Milliman

Companies' Reactions

- Tighten hedging programs
  - Basis mismatch containment
  - Policyholder anti-selection management
  - Enhanced operational control
- Repricing
  - Pull back on benefit offering
  - Increase fees charge
  - Even for inforce business within contract limits
- Commissions
  - Review of commission schedules to ensure DAC amortization

Milliman

Mergers and Acquisitions

- We have seen dramatically increased interest in M&A activities
- Companies with weak risk management results will be gobbled up by companies with strong risk management results
- The difference between the weak and strong companies are not obvious during good economic times
- Only the strong companies can survive this round of financial storm
- Hedging best practice is the deciding factor

Milliman

Regulators, Investors, Rating Agencies

Milliman

Regulators

- More awareness of the need for risk management
  – Allowing more credit in statutory reporting if hedge effectiveness is proven
- Company avoidance of unreasonable regulation
  – Example is to avoid standard scenario requirements through internal or external off-shore reinsurance
- Regulators are experimenting too!
  – Regulators are leaving backdoors such as "permitted practices"

Milliman

Investors

- Very focused on risk management practice
  – Hedging program performance is always asked about during conference calls
- Clear and rapid reward and penalty for good and bad practices
  – Movement of company stock price is largely driven by the results of risk management practice for major VA writers
- In need of a clear and transparent benchmark for the entire VA industry
- Demand improved accounting standard that accurately reflects economic fundamentals

Milliman

Rating Agencies

- Taking an economic fundamental view
  - See through corporate structure vairations
- CTE approach
  - S&P ratings BBB, A, AA, AAA correspond to CTE(90), CTE(95), CTE(97), CTE(99)
- Recognizing hedging programs
- Hedging credit to increase as rating agencies get more comfortable with insurance companies' ability to run hedging programs
  - S&P currently allows 50% credit

Milliman

Case Studies

Milliman

Case Study 1: Successful Company

- A major multinational VA writer
- Company stock is least affected in peer group
- Viewed positively by the market as the company with the best risk management practices
- Is in a strong position to benefit from current financial crisis

Milliman

How Did They do it?

- Followed all sound risk management principles
  - Simple instruments
  - Transparent approach
  - Management focus
- Hedged all major exposures
- Implemented industry best practices over time
- Worked with advisors from the inception

Milliman

Case Study 2: Not So Successful Company

- A major multinational VA writer
  - Quickly losing market share
- Company stock is down by over 80% in past year
- Suffered downgrades from rating agencies and analysts
- Company currently in a crisis mode
- Left certain critical exposures unhedged
  - Was OK in normal times, but quickly blows up in crisis time
- Program was not open so problems not identified early

Milliman

In Summary

- VA will continue to be a strong product
- VA will evolve as a result of the recent financial crisis
- Companies with strong risk management practices will come out ahead from this financial crisis
- Risk management will be the key to differentiate the winners and losers

Milliman

Thank you

Milliman

Chicago
71 S. Wacker Drive, 31st Floor
Chicago, IL
T: +1 312 726 0677
E: peter.sun@milliman.com

Peter Sun, CFA, FSA, MAAA