

Insurance Risk Management

Hedging Equity Risk

Ken Mungan, FSA, MAAA

Financial Risk Management, Practice Leader

January 2010

Limitations and Disclosures

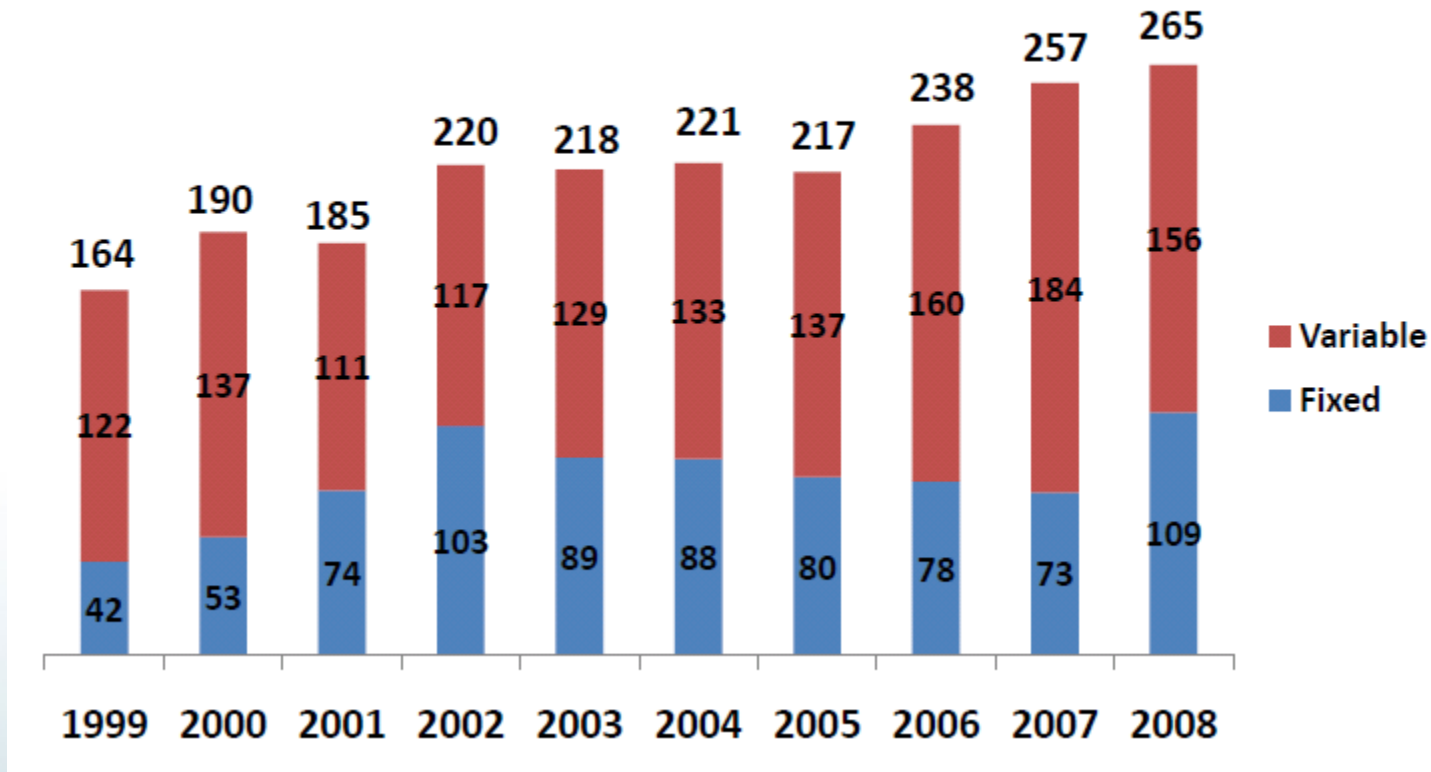
- Past performance is not indicative of future results. Recipients must make their own independent decisions regarding any strategies or securities or financial instruments mentioned herein.
- Milliman Inc. does not make any representations that products or services described or referenced herein are suitable or appropriate for the recipient. Many of the products and services described or referenced herein involve significant risks, and the recipient should not make any decision or enter into any transaction unless the recipient has fully understood all such risks and has independently determined that such decisions or transactions are appropriate for the recipient.
- Any discussion of risks contained herein with respect to any product or service should not be considered to be a disclosure of all risks or a complete discussion of the risks involved.
- The recipient should not construe any of the material contained herein as investment, hedging, trading, legal, regulatory, tax, accounting or other advice. The recipient should not act on any information in this document without consulting its investment, hedging, trading, legal, regulatory, tax, accounting and other advisors.

Annuity Market: An Overview

- Annuities constitute a significant share of the insurance market with \$265 Billion in annual sales and \$1.68 Trillion in net assets as of 2008.
- Annuities allow buyers to accumulate money through tax-deferred savings and provide lifelong monthly income.
- The annuity market offers a variety of alternative structures:
 - **Deferred Annuities** have assets accumulating on a tax-deferred basis until distributions start while **Immediate Annuities** begin payments immediately.
 - **Fixed Annuities** provide payouts with a minimum rate of investment return while **Variable Annuities (VAs)** provide returns that vary based on the performance of underlying investments.
 - Fixed Annuities can be **Fixed “Declared Rate” Annuities (FAs)** with a fixed rate of return or **Equity Indexed Annuities (EIAs or FIAs)** where returns are based on returns on a benchmark index.

Annuity Industry Sales

Annuity Sales Estimates 1999-2008



Source: LIMRA

Equity Indexed Annuities (EIAs)

- An Equity Indexed Annuity is a fixed annuity that provides an investment return that is a function of the change in the level of an index, such as the S&P 500 with a guaranteed minimum return.
- EIAs are a combination of a zero coupon bond and call options purchased with the interest that would normally have been credited.
- The credited rate on EIAs can be based on various designs:
 - Crediting method used to measure the change in the underlying index (e.g. point-to-point or annual reset).
 - Participation rate which is the percentage of the calculated index gain credited to the contract owner as interest.
 - Spread / margin which is the percentage by which the gross index gain is reduced before being credited to the contract owner as interest.
 - Caps on the maximum index-based interest credited to the contract owner.

Static vs Dynamic Hedging of EIAs

- Static Hedging involves buying matching OTC options from dealers to offset the risk providing a simple but more costly solution.
- Dynamic hedging involves replicating the complex Call option written to the policyholder through hedging transactions:
 - Risk hedged using futures and European options
 - Hedge portfolio has to be rebalanced frequently to match Greeks
- Expected or average hedge cost is typically lower for dynamic hedging as compared to static hedging using OTC options.
- Dynamic hedging can improve product competitiveness due to lower cost and the ability to offer a wider range of product designs.

Variable Annuities (VAs)

- In the case of VAs, contract owners can choose from a wide range of investment options or subaccounts, each of which generally invests in shares of a single underlying mutual fund or “fund of funds.”
- VA contract owners can direct the allocation of their contract value among subaccounts that can include equity funds, bond funds, actively managed funds, index funds, domestic funds, and international funds.
- The investment return and payout for variable annuities can vary based on the performance of the underlying subaccounts chosen.
- VAs offer guarantees to protect a contract owner's investment:
 - Death benefits provide principal protection in the event of death
 - Living benefit features protect against investment and/or longevity risk by providing guarantees that cover income, accumulation, and withdrawals for either a fixed number of years or for life.

Risk Management for VAs

- VA guarantees create significant equity market exposure since the insurer is selling a long-dated exotic Put option on equity markets.
- Customer demand for richer guarantees has resulted in more complex products with increasing exposure to equity market performance.
- VA risk management entails both capital market and actuarial risks:

Capital Market

- Market movements
- Interest rates
- Volatility
- Correlation
- Basis Risk

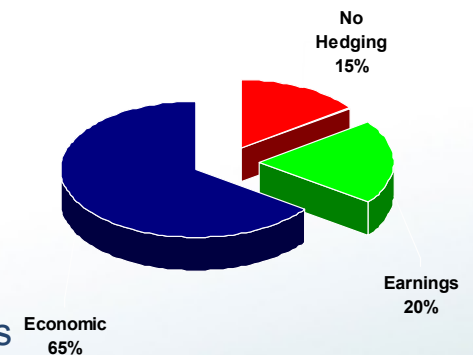
Actuarial

- Lapse
- Longevity
- Utilization
- Asset Allocation

Risk Management for VAs (contd.)

- **Economic Risk**
 - Risks that impact actual claims
 - Equity markets : GMDB, GMWB, GMAB, GMIB
 - Equity and interest rates : GMIB
 - Cost of dynamic hedging sensitive to interest rates
 - Interest on cash/loans from hedging program will impact results
 - For longer term guarantees like GMWB, the interest rate sensitivity is larger
- **Accounting Risk**
 - FAS 133 (GMWB, GMAB)
 - Valued based on current equity levels, interest rates and implied volatilities
 - Hedge Delta, Vega and Rho (3-greek)
 - GAAP SOP 03-01 (GMDB, GMIB)
 - Less market sensitive
- **Capital Reduction**
 - RBC C3 Phase II gets hedge credit

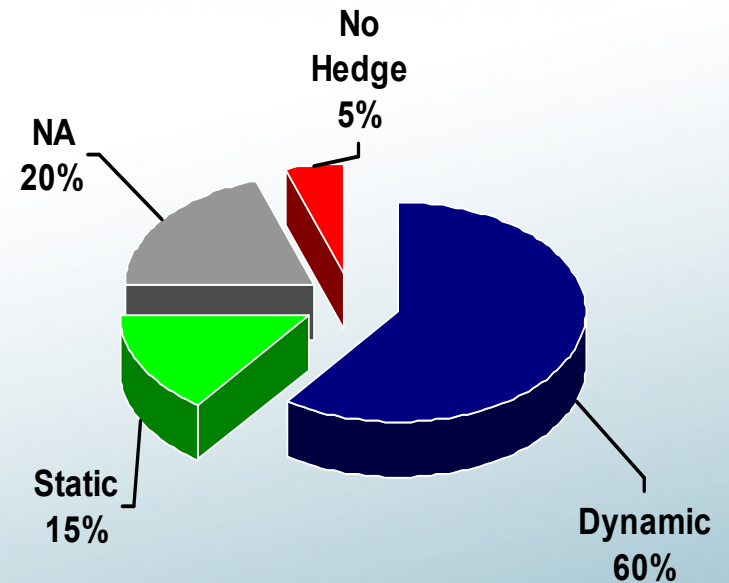
Primary Objectives of the Hedge



Source: Moody's Survey

Hedging Strategies for VAs

- Stay Naked
 - Assume enough capital pays for claims
- Static
 - Exotic derivative to manage capital market risk
- Semi-Static
 - Buy and hold using a portfolio of options
- Dynamic
 - Need to manufacture the risk management internally
- Reinsurance
 - Mitigate capital market and actuarial risks



Source: Moody's Survey

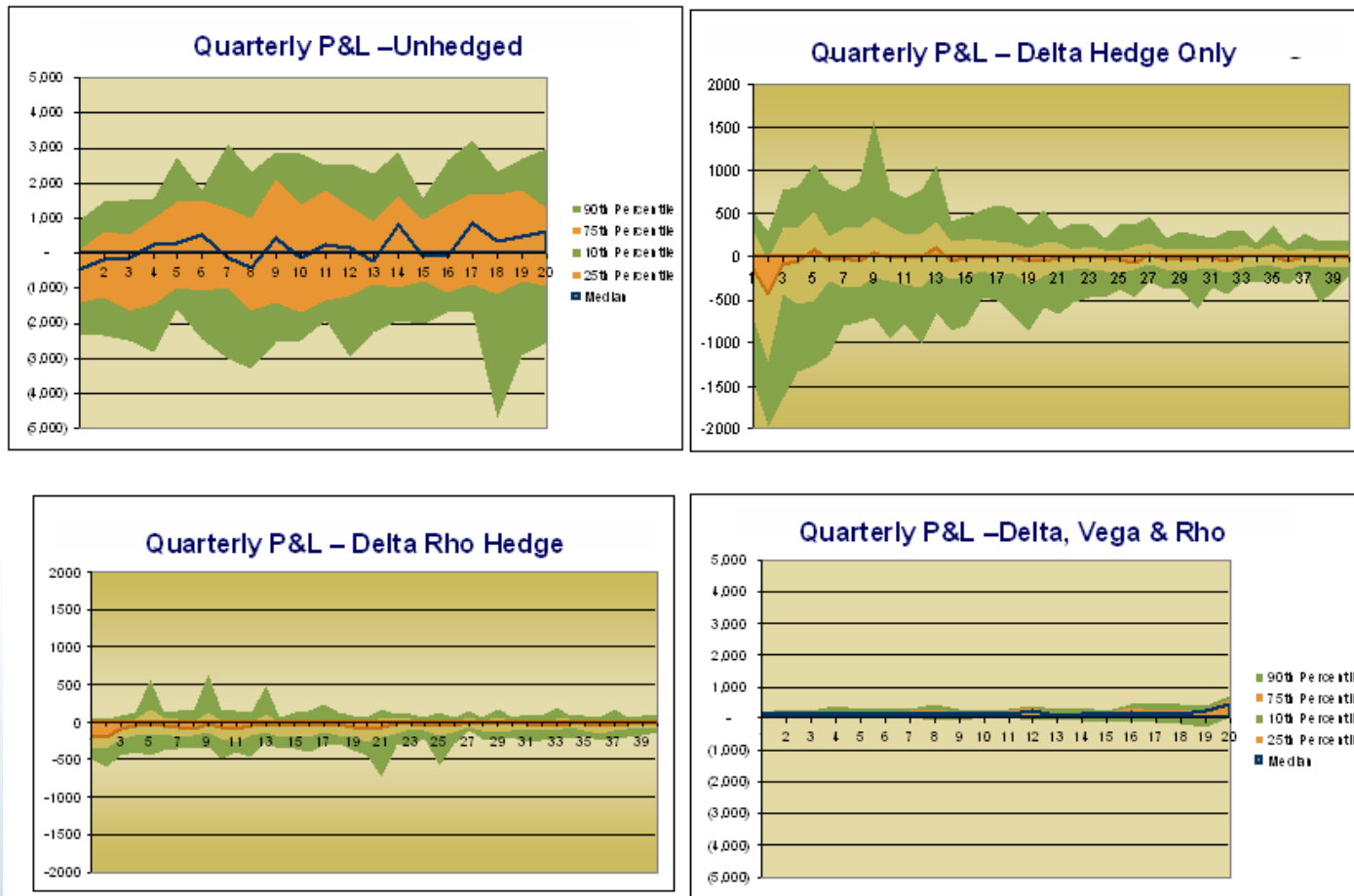
Dynamic Hedging

- Delta hedging can be a powerful and cost-effective way to hedge the equity risk resulting from EIA and VA guarantees.
- The following sensitivities or “Greeks” are typically risk-managed:
 - Delta is the sensitivity of the guarantee / option value to market price movements
 - Gamma is the sensitivity of delta to market price movements
 - Rho is the sensitivity of the guarantee / option value to interest rate movements
 - Vega is the sensitivity of the guarantee / option value to changes in implied volatility
 - Theta is the sensitivity of the option value to passage of time

Hedging the Greeks

	Options (Put / Call / Exotic)	Index Futures & Swaps	Variance Swaps	Interest Rate Futures & Swaps
Delta	✓	✓		
Vega	✓		✓	
Rho	✓	✓		✓

Impact of Hedging on P&L



Aftermath of Financial Crisis

- Investors battered by market upheaval have changed their focus to preserving and protect their investments in a defensive mode.
- Financial advisors and academics, who may have been skeptical of annuities in the past, are now suggesting that these products are suitable for people who do not have old-fashioned pension plans.
- New and redesigned variable annuities are coming to market as insurers react to market demand while at the same time striving to manage the cost of manufacturing the underlying guarantees.
- A transformation of the VA business is under way as insurers try to come up with a sustainable product that people want to buy to help save for retirement and protect against a deep market downturn.

Performance of Insurer Hedging Programs

- Dynamic hedging programs have proved to be very effective in mitigating losses from guarantees in the severe market downturn of 2008.
- Milliman estimates that hedge programs have been 93% effective in achieving their goals during the Sept-Oct 2008 period.
- VA hedging programs have saved the life insurance industry an estimated \$40 billion due to hedge gains in the 2008 downturn.
- The widespread use of the simple, liquid and transparent exchange traded hedging instruments helped the life insurance industry avoid the pitfalls faced by the rest of the financial industry.

Post-crisis Challenges for Insurers

- While static and dynamic hedging helped insurers manage the risk of options embedded in annuity products, they also created concerns about counterparty risks, especially in the aftermath of the Lehman bankruptcy.
- The long-dated nature of options embedded within VA guarantee products pose valuation challenges for insurers.
 - The OTC options markets provides limited reference points limited to tenors of 1- to 5-year market at most and estimating volatility levels for longer tenors poses many challenges.
 - Implied volatilities can be extremely volatile because of illiquid markets dominated by hedge funds and investment banks exposed to forced liquidation triggering cycles of severe option price movements.

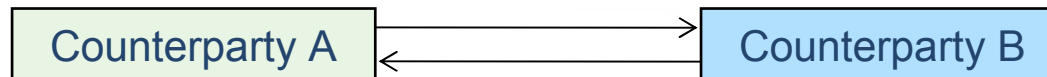
Counterparty Risk: OTC vs Exchange Traded

- Hedging alternatives include both Over-the-Counter (“OTC”) Derivatives and Exchange Traded Derivatives.
- While OTC Derivatives can be customized to a greater extent, Exchange Traded Derivatives offer a lower cost alternative with lower counterparty risk.

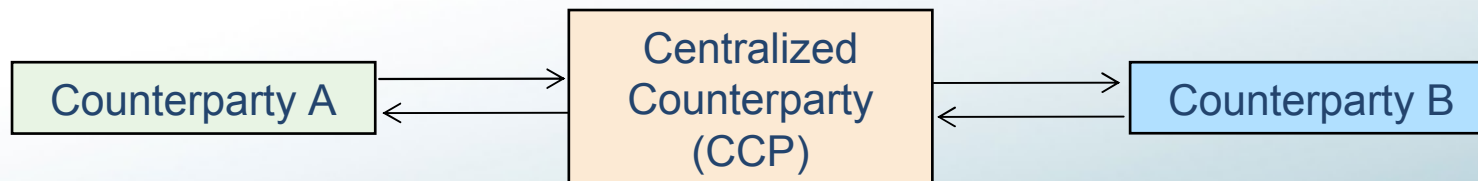
Exchange Traded Derivatives	OTC Derivatives
Terms are standardized and are specified by the respective exchanges	Terms mutually agreed exclusively between Pension Plan and the bank counterparty
Simple products without any possibility of customization	Products can range from simple to complex with desired level of customization
Organized exchange based market with specific and detailed trading rules	Negotiated transactions with Broker/Dealers offering two-way markets
Pricing is transparent and quotes are available from multiple data providers	Pricing is somewhat opaque and especially so for complex customized products

Management of Counterparty Risk

Over-the-counter (OTC) Derivatives



Exchange Traded Derivatives



Benefits of Centralized Clearing

- An exchange traded contract is a legal agreement between a buyer (or seller) and the Centralized Counterparty (CCP) of a futures exchange.
- The benefit of centralized clearing is that the CCP guarantees the financial performance of clearing members.
- The CCP becomes the buyer to the selling clearing member, and the seller to the buying clearing member.
- In order to guarantee the performance of all clearing members, a derivatives CCP collateralizes, or “margins,” its credit exposure to each of the other clearing members.
- The required collateral is based on historical price volatility of the instruments and the number of open positions that a clearing member has with the CCP.

Benefits of Centralized Clearing (contd.)

- Clearing members' clients collateralize the risk of their positions with their respective clearing members by providing eligible assets.
- The CCP protects itself against daily mark-to-market movements by requiring variation margin or "settlement variation."
- Since there are always an equal number of buyers and sellers for each futures contract, the CCP collects cash variation margin from clearing members having an aggregate debit balance and pays those funds to clearing members having an aggregate credit balance.
- Clearing members receiving variation margin on behalf of their clients complete the process by crediting that variation margin to the individual accounts of clients whose futures contracts have increased in value.

Valuation of long-dated options

- Variable Annuity (VA) guarantee writers need a reference point for valuation and risk management of these long-term liabilities.
- Likewise, market participants need to estimate implied volatilities for valuing long-dated options such as the CBOE's FLEX (FLexible EXchange®) options.
- Current approaches for estimating long-dated volatility levels rely on observed levels in the OTC market:
 - OTC market is dominated by hedge funds and investment banks that are exposed to forced liquidation which can trigger cycles of volatile option price movements.
 - The OTC options market is generally a 1- to 5-year market at most and therefore estimating volatility levels for longer tenors can pose many challenges.

The Milliman Guarantee Index

- The Milliman Guarantee Index provides volatility parameters for VA guarantee valuation on a monthly basis including a risk adjustment that reflects the uncertainty in life insurers' ultimate cost of funding VA guarantee claims.
- To construct the Index, Milliman reflects market data using an analytical process that produces a 1- to 30-year term structure of expected and risk-adjusted volatility parameters plus a correlation matrix for various market indices.

Milliman Guarantee Index Methodology

- The Milliman Guarantee Index is based on a GARCH(1,1) model that is commonly used to analyze historical data for equity returns and make predictions about future volatility.
- Key parameters driving the evolution of volatility are long-term target volatility level (σ^∞), rate of mean reversion to the long-term target (γ), and level of variability in realized market volatility (α).
- GARCH(1,1), reflects
 - Spikes and fluctuations in volatility over time
 - High volatility environment associated with a financial crisis
- MG-Index results will reflect both the GARCH(1,1) stochastic volatility calibration process and transactional data from market surveys.

Milliman Guarantee Index Methodology (Contd.)

- Key assumptions underlying the Milliman Guarantee Index:
 - Equity returns are driven by an underlying instantaneous market volatility, which itself undergoes a random-walk process.
 - The volatility/random-walk exhibits persistence, such that a high volatility period is more likely immediately following another high-volatility period, and less likely immediately following a low-volatility period.
 - Changes in the underlying volatility are driven stochastically by a “volatility of volatility” parameter, which determines how much variability there is between volatilities in different periods, over the short term.
 - The underlying volatility exhibits mean reversion characterized by a mean reversion rate and a mean reversion target. Periods of volatility that are abnormally high or low are anticipated to be transient, and the market will revert to a long-term equilibrium characterized by the mean reversion rate.

Rationale for Milliman Guarantee Index

- VA guarantees have no liquidity and life insurers are not exposed to forced liquidation, and hence reflecting the liquidity premium built into OTC option prices distorts the financial condition of life insurers.
- In addition, VA guarantees are commonly 20- to 30-year options whereas the OTC options market is a one- to five-year market.
- The Milliman Guarantee Index allows for transparency:
 - Expected hedge costs can be quoted based on MG-Index
 - Expected hedge gains can be predicted by analysts and investors
- The index supports comparisons of results across companies:
 - Hedge costs & product charges can be easily compared by analysts & investors to:
 - Identify aggressive / conservative pricing practices
 - Estimate product margins

Accounting and Actuarial Backdrop

- Guidance from the Academy of Actuaries and from the Financial Accounting Standards Board (FASB) appears to support a new approach to address valuation issues for inactive or illiquid markets.
- The Academy of Actuaries in a Practice Note describes a methodology based on extrapolating “... long term volatilities from the observable volatilities at shorter durations,” which is similar to the Milliman Guarantee Index approach.
- FASB guidance under FAS 157-3 and FAS 157-4 states that “... use of a reporting entity’s own assumptions about future cash flows and appropriately risk-adjusted discount rates is acceptable where relevant observable inputs are not available,” which is consistent with the Milliman Guarantee Index approach.

Milliman Hedge Cost Index

- Milliman also publishes an expected cost of hedging indicator to demonstrate the impact of changes in volatility levels and interest rate assumptions on the cost of hedging VA guarantees.
- Indicative hedge costs for a hypothetical Lifetime GMWB block are calculated using the Milliman Guarantee Index and current swap interest rate levels.
- Attribution analysis for the results helps Milliman Guarantee Index users better understand the monthly changes in hedge cost based on movements in volatility and risk-free interest rates.

Recent Market Developments

- Retail investors are gradually returning to equity markets with great trepidation in light of the recent market turmoil, and demanding guarantees and other tools to limit downside risk.
- Typical mutual fund offerings do not offer guarantees
 - Do not employ risk management techniques
 - Subject to severe market fluctuations
- Financial services firms and financial advisors are offering some tools such as Asset Allocation Models to manage downside risk
 - Do not employ risk management techniques
 - Target a specific equity allocation (e.g. 40% or 100%)
 - Maintain constant equity allocation regardless market conditions
 - Typically: Conservative, Moderately Conservative, Moderate, Moderately Aggressive, Aggressive

Milliman Solutions for Fund Risk Management

- Capital Protection within individual funds and customer accounts
 - Include hedge overlay within specific core funds
 - Include hedge assets directly within the customer's account
 - Equity & FX futures, put options
 - Unleveraged, inverse ETF's
- Asset Allocation Models with volatility management process
 - Employ active risk management strategy
 - Target specific risk level
 - Maintain a constant volatility level for each model
- Fund-of-Funds
 - Volatility management & capital protection carried out in management of fund-of-funds

Conclusions

- Fixed and variable annuities will continue to capture a significant share of the investment market place since they can provide downside protection and offer one of the few viable alternatives to replace traditional pension plans.
- Insurers will continue to use hedging programs which have proved to be very effective in mitigating losses from guarantees.
- Counterparty risk management and valuation challenges are being addressed by increasing use of exchange traded instruments and tools such as the Milliman Guarantee Index.
- Emerging trends in the fund management marketplace include incorporating hedging strategies into retail funds and off the balance sheet of the insurer, offering lower costs and reduced risk.

Milliman, Inc
Financial Risk Management
71 S. Wacker Drive, 31st Floor
Chicago, IL 60606
Ph: +1 312.726.0677
Fx: +1 312 499.5700
www.milliman.com