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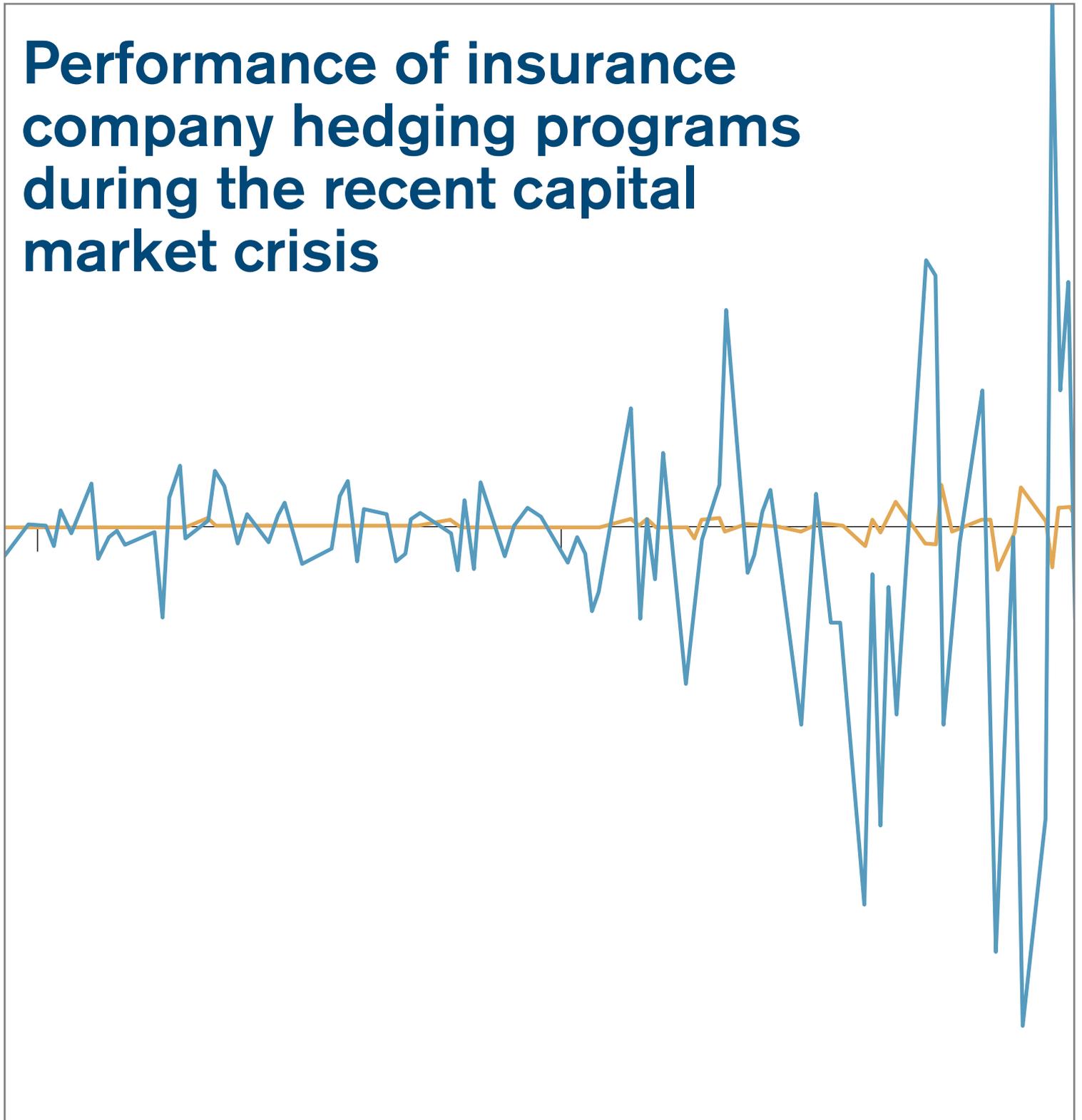
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# Performance of insurance company hedging programs during the recent capital market crisis





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## EXECUTIVE SUMMARY

The recent period of market turbulence has been very severe, and most guarantees embedded in variable annuity (VA) products have become in-the-money, meaning that the guaranteed benefit now has greater value than the assets accumulated in the policyholder's account balances. Most major VA writers have implemented hedging programmes to protect earnings and capital. In this report, we examine the questions of how these programmes have performed in recent months and of how VA lines are affecting insurance company bottom lines during the most intense bear market in recent memory. Additionally, in this European edition of the report, we address what the hedge effectiveness experience has been, and what the associated capital requirements are in Europe.

- Our analysis of the health of our clients' VAs and their guarantees used sampling and arrived at some encouraging conclusions:
- Based on Milliman's knowledge of major VA writers in the United States, hedging programmes have been very effective in mitigating the losses from VA guarantees.
- Based on an analysis of actual results among our clients and on a study of the US industry, VA hedge programmes have been approximately 93% effective in achieving their goals during the September and October period of 2008. Overall, VA hedging programmes have saved the US life insurance industry an estimated \$40 billion because of hedge gains resulting from the September and October market declines.
- An updated analysis for European VA hedge programmes extended to the end of December 2008 shows a similar hedge effectiveness result of 94.5%.
- VA hedge programmes emphasise the use of the simplest, most liquid, and transparent hedge assets available. This emphasis on simplicity has helped the life insurance industry to avoid the pitfalls found in the banking industry. In general, life insurers have avoided the complex financial instruments favoured by banks, and they have emphasised redundancy and reliability in their operational processes.
- Guarantees in VA products have demonstrated their value to consumers. These guarantees have protected the ability of policyholders to generate a reliable income during retirement.
- This period of market turmoil has served as a test for leakages in existing hedging programmes and will prompt insurance companies to further tighten these programmes. In particular, insurers realise that there are limits to the equity allocation that can be included in a guaranteed product, and there is a need for reasonably close tracking between funds included in a guaranteed product and hedgeable indexes.
- The market stress has highlighted unhedged risk exposures such as US GAAP deferred-acquisition-costs (DAC) amortisation revenue and guarantees that are not subject to mark-to-market accounting. Hedging activity is likely to increase in an effort to cover these exposures.

We believe the risk-management structure based on hedging will continue to be a pillar for the VA business. We also believe the lessons learned will usher in a period of rapid evolution in product innovation, enterprise risk management, regulation, and accounting, and that VA-type guarantees may eventually be used to protect other kinds of retirement-savings products.

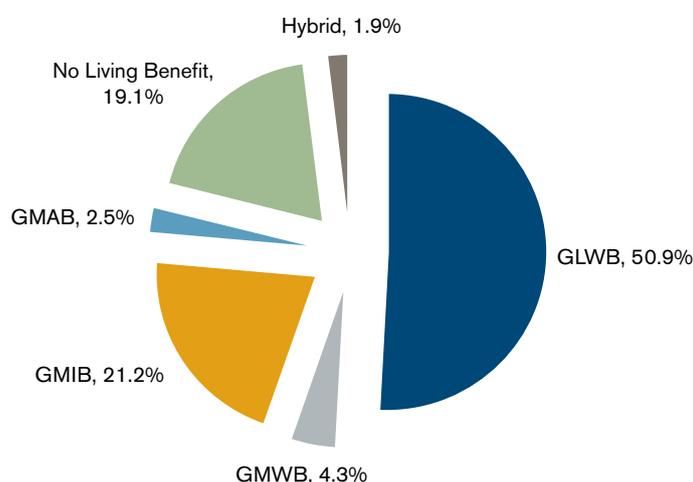
### Methodology

This study analysed the universe of Milliman clients, considering both hedged and unhedged results along with results from both Milliman's hedging and from clients' internal use of Milliman software to hedge their own exposure, based on fair-value reporting. Industry-wide results were sampled from the analysis of clients and from other industry data.

## THE VALUE OF A GUARANTEE

While the vast majority of current US VA products offer basic return-of-premium guaranteed minimum death benefit (GMDB) as a default feature, more sophisticated GMDB designs and living benefits, such as the guaranteed minimum accumulation benefit (GMAB), guaranteed minimum income benefit (GMIB), or guaranteed minimum (or lifetime) withdrawal benefit (GMWB, GLWB), are very popular with policyholders. GLWB has been the dominant choice in the past two years, as illustrated in Figure 1.

**FIGURE 1: US VA LIVING BENEFIT SALES DISTRIBUTION IN SECOND QUARTER 2008**



\*Source: LIMRA

These guarantees have proven valuable to policyholders during this financial crisis because they offer protection for their investments. Indeed, GLWBs, the guaranteed minimum withdrawal benefits that apply for the life of the customer, are becoming the retirement vehicle of choice in many global markets. In the UK, these products are expected to capture a significant share of the post-retirement market, which is currently polarised between fixed annuities and income drawdown. Across Europe, they are being launched by many of the leading multinationals and are generating significant interest and encouraging sales. A detailed description of the VA business can be found in Appendix I.

However, the attractive guarantees provided to policyholders can create large liabilities to VA writers when account balances are reduced by markets falling below the guaranteed benefits. This is the current situation given recent market experience. In the United States, we estimate that the aggregate benefit value exceeds the aggregate account value by about \$232 billion as of October 31, 2008.

These exposures will be reflected on VA writers' financial statements, but the magnitude will not be as high as the exposure because not all policyholders will exercise their guarantees immediately. More importantly, major VA writers have implemented hedging programmes to counter this increase in liabilities.

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## HEDGING PROGRAMME PERFORMANCE

Recent capital market movements have substantially increased VA guarantee liabilities. The major drivers are equity levels, interest rates, volatility, and exchange rates. Appendix II has a more extensive description of the capital market movements.

To mitigate the risks from capital market movements, nearly all major VA writers have implemented hedging programmes. There are many forms of hedging programmes aimed at protecting different risk exposures. The most common are:

- Delta/rho, which protect against equity and interest-rate movements
- Delta/vega/rho, which protect against equity, interest-rate, and implied-volatility movements

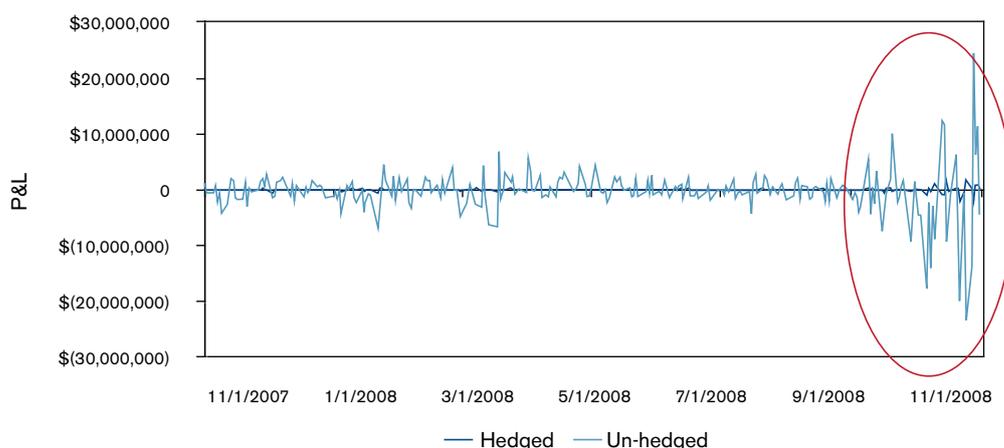
Milliman has been working with most major VA writers. Based on our experience, it appears VA hedging programmes have been working as intended.

**We have focused our study on the aggregate profits and losses (P&L) for the companies within the September/October 2008 scope of this study. We found that hedging has been on average 93% effective in recouping the capital-market losses that hedging programmes were designed to protect**

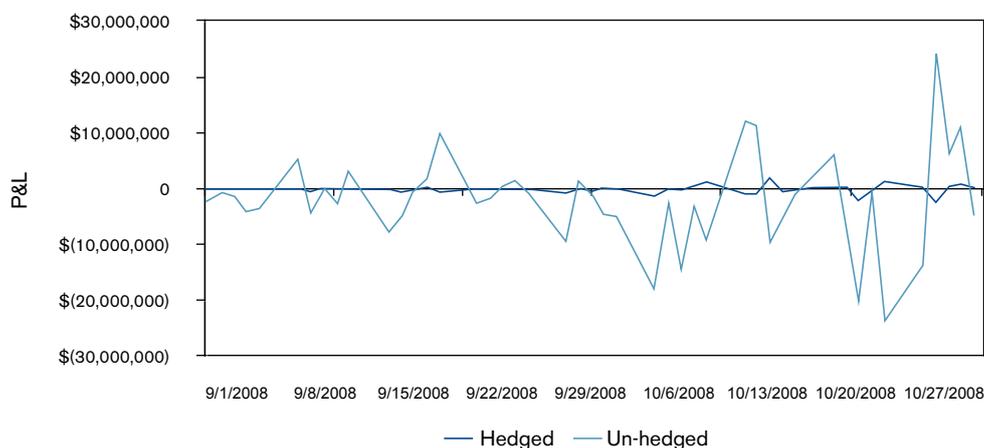
We have focused our study on the aggregate profits and losses (P&L) for the companies within the September/October 2008 scope of this study. We found that hedging has been on average 93% effective in recouping the capital-market losses that hedging programmes were designed to protect against. Industry-wide, we estimate hedging has saved the US insurance industry around \$40 billion over these two months. Without the payoffs from hedging programmes, some major US VA writers would have encountered solvency issues.

We have normalised our results to US\$1 billion of assets under management as of September 1, 2008. Figure 2 shows the fair-value weekly P&L of the business over the past 12 months on a fully hedged and non-hedged basis. This block of business has a mixture of GMDB, GMIB, GMAB, GMWB, and GLWB benefits. The P&L is very volatile without hedging. Figure 3 shows the results in more detail.

**FIGURE 2: WEEKLY NET P&L—HEDGING VS. NO HEDGING, NOV. 1, 2007—OCT. 31, 2008**



**FIGURE 3: WEEKLY NET P&L—HEDGING VS. NO HEDGING, SEPT.-OCT. 2008**



The table in Figure 4 illustrates the match between hedged VA guarantee liabilities and hedge assets. These results are drawn from actual hedging programmes, and are reflective of typical industry hedging practices. The results have been normalised to US\$1 billion of account value as of September 1, 2008.

**FIGURE 4: TYPICAL HEDGED LIABILITY MOVEMENTS AND HEDGE PAYOFFS FOR US\$1 BILLION ACCOUNT VALUE OVER SEPTEMBER AND OCTOBER 2008 (US\$ MILLIONS)**

TIME PERIOD	CHANGE IN HEDGED LIABILITY		CHANGE IN ASSET			TOTAL	HEDGE EFFECTIVENESS
	EQUITY	INT. RATE	VOL	FX			
SEP-08	20.7	11.6	3.7	0.9	2.6	18.7	90%
OCT-08	47.2	21.6	4.0	6.2	12.7	44.4	94%
9/2008 - 10/2008	67.9	33.2	7.6	7.2	15.2	63.2	93%

Although each individual VA writer's situation is different, it is clear that most of the hedge payoff over the period Sep-Oct 2008 were due to the movements in equity markets. Depending upon the market, fluctuations in FX, interest rates and volatility were also significant.

The analysis above considers only those risk factors that an insurer deliberately hedged. As we will discuss in the remainder of the report, insurers did not fully hedge their market-risk exposures, and unhedged risk exposures will generate losses in a market decline.

Although each individual VA writer's situation is different, it is clear that most of the hedge payoff over the period Sep-Oct 2008 were due to the movements in equity markets. Depending upon the market, fluctuations in FX, interest rates and volatility were also significant.

Hedging is not a panacea for all issues encountered in the financial crisis. For example, the dramatic increase in volatility has generated losses associated with unhedged vega risks. Similarly, in the time of market turbulence, increases in the correlation between various equity markets are seen, further contributing to the combined volatility of the overall block, potentially contributing to losses in some cases.

The hedging programmes run by VA writers are designed to reduce the exposures of insurance companies to capital-market risks. The hedging programmes themselves do not seek to generate a profit for the life insurer. This is the opposite of other institutions where complex structures are set up to take calculated market risks in order to profit from market movements. The hedging programmes follow clearly defined routines and use simple liquid instruments such as futures contracts and plain vanilla options. This relatively simple structure has produced predictable results for life insurers and limited exposures to counterparty credit risks. This contrasts with the experience of investment banks and hedge funds, which utilised more complex, illiquid, and credit-exposed securities. These complex securities became difficult to value with diminished liquidity during the financial crisis.

Hedging by life insurers is highly transparent, and is based upon sound theoretical and academically robust techniques that are not trade secrets. Such techniques are discussed widely among actuaries, investment professionals, auditors, regulators, consultants, and analysts. This open exchange has led to the formation of industry best practices, which have performed as expected.

## EFFECT ON CAPITAL REQUIREMENTS IN EUROPE

Over the last few years, VA products have been launched in many European markets by leading multinational companies. There is an increasing awareness of and focus on these products, as their unique product proposition positions them well compared to traditional unit-linked and annuity products. Sales continue to grow as more providers enter the market responding to increased demand from distributors.

In Europe, the majority of products launched to date have been written on a cross-border basis from Ireland or Luxembourg, or reinsured internationally either with group companies or externally. For the business that remains on balance sheets located in EU countries, the capital requirements for the products are currently based under the Solvency I regime, which requires solvency capital of 4% of unit reserves for any guaranteed products.<sup>1</sup> However, the industry is increasingly focusing on the capital requirements that will apply when the Solvency II initiatives become effective, which is currently planned for 2012. These are currently still under development. The methodology and basis most likely to be used are outlined in the latest Quantitative Impact Study (QIS4).

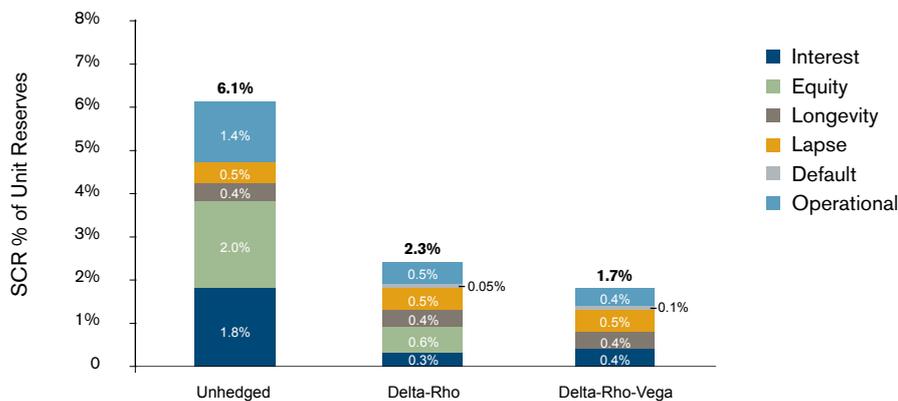
Under the Solvency II initiative, companies will be required to assess solvency using a market-consistent basis for the valuation of assets and liabilities. Capital is determined by assessing the losses that would occur to the realistic balance sheet from a broad array of risk-factor stresses, including market risk, life underwriting risk, non-life underwriting risk, health risk, counterparty default risk, and operational risk. These risk-factor categories are further composed of sub-factors; for example, market risk covers interest-rate risk, equity market risk, property risk, currency risk, credit-spread risk, and concentration risk. A formulaic approach is used based upon the immediate stress test methodology, with the stresses calibrated to the 99.5th percentile level over a one-year time horizon. These stresses are applied on a univariate basis, with the overall results being aggregated through the use of a correlation matrix that allows for the diversifying effects between each risk factor.

In order to demonstrate the impact of hedging on solvency capital, we have assessed a hypothetical GMWB 4.5% for life product sold to a 65-year-old male, with the guarantee denominated in Euros and an investment allocation of 50% equities (EURO STOXX) and 50% European bonds (government). The charge for the guarantee is 1% p.a. We have calibrated the model based upon February 2009 European capital-market conditions, which resulted in an economic hedge cost of 75 bps p.a. The following graph shows the solvency capital requirement (SCR) results for this product, broken down by risk factor, for unhedged, delta rho (DR) and delta rho vega (DRV) hedge strategies.<sup>2</sup>

1 In some countries, local regulators allow for bifurcation of the guarantee from the base unit-linked contract, with the base unit-linked contract subject to only 1% solvency capital, with 4% applied to the guarantee reserves of the rider policy.

2 Operational risk capital has been modeled as an additional 30% on top of all other risk factors. This is a simplified approach, given that operational risk is not able to be appropriately quantified on a hypothetical basis.

**FIGURE 5: GMWB SCR BY HEDGE STRATEGY & RISK FACTOR**

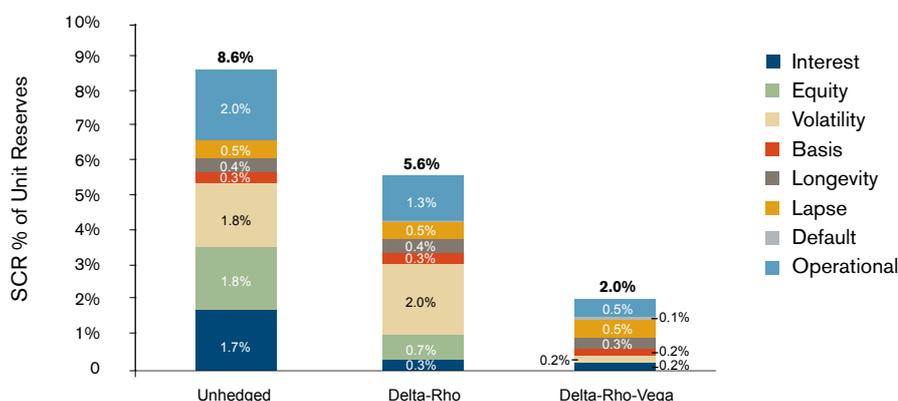


The previous analysis demonstrates that hedging leads to a reduction in solvency capital from around 6.1% down to 2.3% or 1.7%. The further reduction from the DR to the DRV strategy is due to the mitigating impact on equity risk that the use of a put option has. The diversification benefit has been prorated in order to derive the risk-factor contributions.

There are two major limitations with this approach, however. The first is that under the current QIS4 guidelines, there is no account for additional risk factors, the most significant being volatility or basis risk. In order to account for this, we have modified the above SCR calculation to incorporate these risk factors, based upon a relatively simple +10% absolute shock to equity-implied volatilities, in addition to a +8% absolute shock to swaption-implied volatilities and a -3.5% shock to all fund exposures (hedge index levels remain constant).<sup>3</sup> Note that these stresses are indicative only.<sup>4</sup> The graph below presents the equivalent economic capital results on this basis.

3 Basis risk is shown as an additional univariate shock similar to all other market shocks. Although it could be considered to be part of other shocks (equity, property, currency, bond fund/interest rate), it is cleaner and simpler to treat it on a consistent basis across all hedge strategies.  
4 Note that stresses to other risk factors may also be included to the extent that they are relevant and material on a product-by-product basis.

FIGURE 6: GMWB MODIFIED SCR BY HEDGE STRATEGY & RISK FACTOR



The calibration of the volatility stress could perhaps be argued over, but it is clear that it is a material risk left exposed under an unhedged or DR-hedged basis. The DRV hedge, however, is very effective at mitigating this risk, resulting in a capital requirement of about 2%. Notably, the largest risks contributing to this result relate to operational, lapse, and longevity risks, with the residual capital-market risks being negligible. The balance of risks is also quite spread on the DRV basis, unlike the DR basis. The impact of this result clearly needs to be weighed against the additional cost involved in vega hedges, as well as the risk involved in paying for protection during times of higher market-implied volatility.

The other limitation with the above methodology is that it assumes that all stresses are instantaneous in nature and that any dynamic hedge strategy is unable to be rebalanced during the stress. This will naturally tend to favour strategies using derivatives that provide protection in such situations, such as out-of-the-money put options, which provide an element of gamma or gap-risk hedging. Notably, however, companies are allowed to use an alternative method to the above based upon the use of internal models. For VA business, this is likely to involve the use of nested stochastic financial projections, which are more appropriate tools to capture cash-flow risks associated with long-term products and their associated dynamic hedging strategies. As competition increases in the VA industry, we expect companies to make greater use of internal models in order to optimise capital and profitability through the use of product design and risk-management techniques. Examples of analysis of these types of techniques can be found in Ledlie et.al. (2008).<sup>5</sup>

<sup>5</sup> Ledlie, M.C., Corry D.P., Finkelstein, G.S., Ritchie, A.J., Su, K., & Wilson, D.C.E. (2008). *Variable Annuities. Annals of Actuarial Science* (Institute and Faculty of Actuaries).

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## FUTURE PROSPECTS

We believe that the recent round of market upheaval will be a potent catalyst for a series of changes in the VA market.

In the past several years, the VA product competition in the United States has pushed companies to offer increasingly richer benefits for increasingly higher fees. The recent market movements will likely make the hedge cost for these richer benefits significantly higher, and this will likely continue until the markets stabilise. Companies will redesign their product features to deal with higher hedge costs. Across Europe, we are also expecting to see increased repricing and redesigning activity.

Another important area of product evolution is the management of acquisition expenses. Counting commissions, bonuses, and other costs, acquisition expenses incurred for new business have become as much as 7% to 8% of the initial premium. These acquisition costs are capitalised as a deferred-acquisition cost (DAC) and amortised over the expected future revenue streams. Because the revenue streams are based on account values, the recent decline of capital markets results in a significant reduction of future expected revenues, which has led to DAC recoverability issues and write-downs in a number of cases. This has little to do with guarantees or hedging, but it is possible to extend the hedging to protect the future revenue stream supporting DAC. There must be an appropriate match between the level and market sensitivity of VA distribution costs and VA base-product revenue. It is increasingly clear that the industry is not currently achieving the necessary alignment.

Accounting principles for VA business are also likely to undergo review. Today, VA writers commonly use data from the over-the-counter (OTC) options market for volatility parameters when valuing guarantees. However, there is a fundamental disconnect between the OTC options market and VA guarantees. The OTC market is dominated by hedge funds and investment banks that are exposed to forced liquidation. For example, hedge funds, using leverage provided by prime brokers, manage options-based investment strategies. Declines in mark-to-market values trigger forced liquidations of option positions. Aggregated across the investment bank and hedge fund community, exposure to forced liquidation commonly triggers cycles of volatile option-price movements. A particularly severe spike in option prices was observed in September and October 2008 because of these liquidity factors.

VA guarantees have no liquidity. Given that VA guarantees have no cash value, life insurers are not exposed to forced liquidation. There is a substantial liquidity premium built into OTC options prices. Reflecting this premium in VA guarantees can potentially distort the financial condition of life insurers and risk misleading investors.

There is currently much industry debate about the appropriateness of using various methodologies to determine volatility assumptions. Some consider the use of OTC option prices as being a structurally inappropriate reference point for VA guarantee valuation because of the considerable difference in durations between the VA liabilities, which can commonly extend to 30 years and beyond, versus the OTC options market, which is only liquid generally up to five or 10 years. The extrapolation of OTC volatilities beyond the short term therefore often needs to be done on a mark-to-model basis, using a methodology that attempts to model what long-term volatilities would be if a liquid market in the appropriate underlying instruments did exist.

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In the United States, Financial Accounting Standards Board (FASB) staff position paper 157-3 (FAS 157-3) appears to provide justification for a new approach to the fair valuation of VA guarantees. FAS 157-3 addresses valuation for instruments when a market is not active. Given that there is no liquidity in the OTC options market in the 20- to 30-year maturity range, and that the liquidity characteristics of VA guarantees do not match those in the OTC options market, life insurers are justified in applying the guidance in FAS 157-3 to VA guarantee valuation.

In particular, the paper notes that, "In determining fair value for a financial asset, the 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.... Regardless of the valuation technique used, an entity must include appropriate risk adjustments that market participants would make for non-performance and liquidity risks."

We believe that life insurers will modify their valuation technique to account for these factors.

Hedging programmes will face their fair share of evolution, too, although the general framework has been working. The areas that are generating the most attention are basis risk, gap and volatility risks, policyholder anti-selection risk, and rebalancing strategy refinements.

Basis mismatch has attracted attention among several VA writers. Fundamentally, the rapid market movement has changed the composition of both VA funds and their replicating indexes. For example, the weight of financial company stocks has fallen dramatically. Another reason for basis mismatch in the recent period is the increased correlation of indexes in a down market. Improved *smart* fund-mapping techniques can manage the basis mismatch increase to some extent, but the main lesson for VA writers is that the funds underlying VA policies need to closely track indexes on which hedges are available. In Europe, basis risk has been less of an issue, as VA writers have tended to be more cautious in their fund offerings than their US counterparts by offering only funds that have low residual basis risk to the relevant hedge indices.

We have also seen some limited evidence of policyholder anti-selection. This includes policyholders who put large amounts of money in funds with the highest possible volatility. A company pricing based on an average fund allocation would be adversely affected in this case. Fortunately, this kind of anti-selection behaviour can be detected through performance-attribution analysis. To combat it, explicit restrictions in fund selections are becoming more common in the VA industry.

The recent market volatility has placed VA hedging programmes under stress. Life insurers have varied in the degree to which they hedged exposure to a change in market volatility. Sustained, high volatility may generate losses for VA hedging programmes that haven't hedged volatility risk. However, it is important to note that these losses are a mark-to-market effect and not a realised cash loss. For the loss to be permanent and reflected in realised cash flows, volatility will need to remain elevated for many years. If volatility does remain at current year-end levels for many years, consumers will likely no longer be attracted to equity-based savings products. Instead, they will demand low-risk, fixed-income, and traditional annuity products. Under this scenario, life insurers would likely close to new VA business and the management of in-force VA blocks would change dramatically to maximise revenue and minimise capital-market risk to the greatest extent possible.

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## CONCLUSIONS

**VA products have become an important cornerstone of the retirement savings industry in many of the world's developed markets. They have proven their value to both existing policyholders, who have been protected during the market declines of 2008, as well as to potential future policyholders who are now more concerned about losing retirement wealth,**

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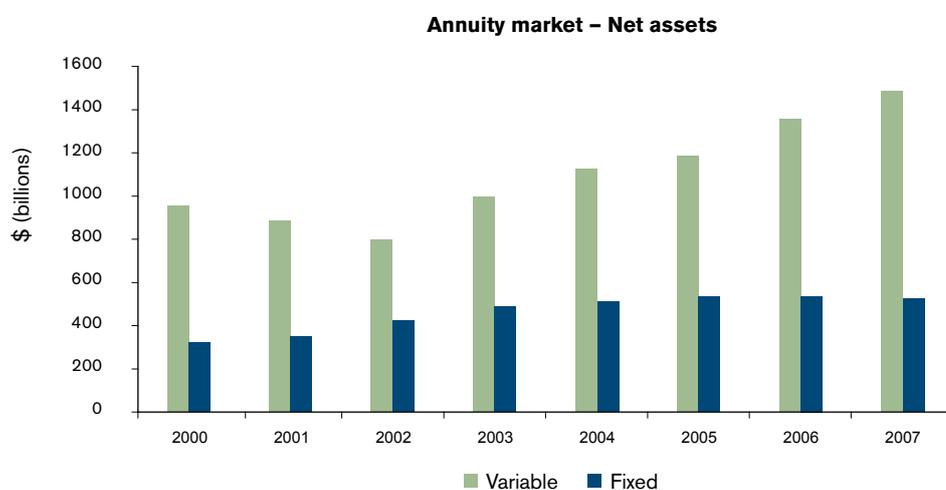
However, VA guarantees have also generated large liabilities and increased capital requirements for US life insurers. In recent analyst conference calls, major VA producers have reported that their hedging programmes have been working as intended, which is evidenced by the results of this survey. Clearly those companies that implemented a robust hedging programme have been very happy to have it in place.

As a result of the 2008 market experience, we expect the use of hedging to increase to cover previously unhedged risks, and products to be repriced and redesigned to facilitate more robust hedging while still meeting the core needs of the global retirement savings industry.

## APPENDIX I: OVERVIEW OF THE VA BUSINESS

The VA market in the United States has experienced rapid growth in recent years. According to the National Association for Variable Annuities (NAVA), the total VA industry net assets were \$1.41 trillion as of June 30, 2008, as compared to the 2007 US GDP of \$13.8 trillion (see Figure 7). As illustrated in Figure 8, variable annuities have surpassed fixed annuities as the dominant savings vehicle for Baby Boomers to save for their retirement.

**FIGURE 7: VARIABLE AND FIXED ANNUITIES TOTAL ASSETS**

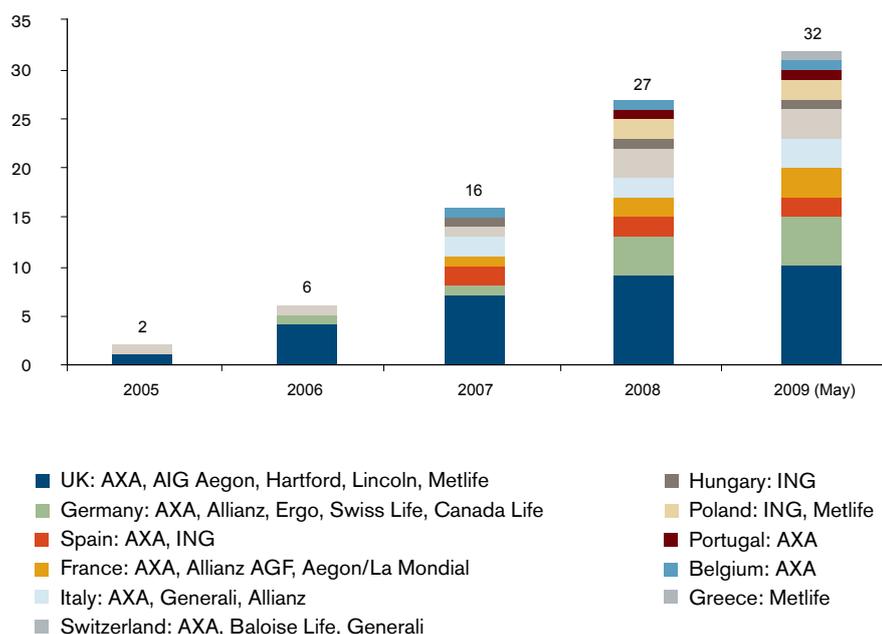


**FIGURE 8: VARIABLE AND FIXED ANNUITIES TOTAL SALES VOLUMES**



Sales in Europe have been encouraging over the last few years as VA products have been introduced across multiple European markets. Because information about the volume of new and in-force business in the market is not publicly available, Figure 9 illustrates the growth in the number of VA products in force in the various markets.

**FIGURE 9: NUMBER OF VARIABLE PRODUCTS IN-FORCE BY EUROPEAN MARKET BY YEAR**



VA sales were particularly robust with the introduction of guarantees of the VA assets. The embedded guarantees in VAs are attractive to consumers because they provide a minimal floor of benefits when VA assets perform poorly, and yet leave upside potential for good VA asset performance. This feature makes VAs compare favourably to alternatives such as fixed annuities, bank certificates of deposit (CDs), or mutual funds. While fixed annuities and bank CDs are guaranteed, they do not offer participation in the capital markets. Conversely, mutual funds offer participation in the capital markets, but the investor could suffer significant losses.

## APPENDIX II: OVERVIEW OF CAPITAL-MARKET CONDITIONS

The capital market has experienced dramatic turbulence in the past year, particularly in October 2008. In financial modelling, *tail scenario* is the term used to describe the very worst scenarios. One can safely say that we are currently in a tail scenario. The present financial crisis has been dominated by high-profile institution failures, but the most relevant issues for hedging programmes are declining equity markets, increased volatility, and falling interest rates. As shown in Figure 10, the S&P 500 index lost 47% of its value between October 31, 2007, and October 31, 2008. This is probably the worst 12-month market decline ever experienced anywhere.

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**FIGURE 10: S&P INDEX MOVEMENT IN 2008**

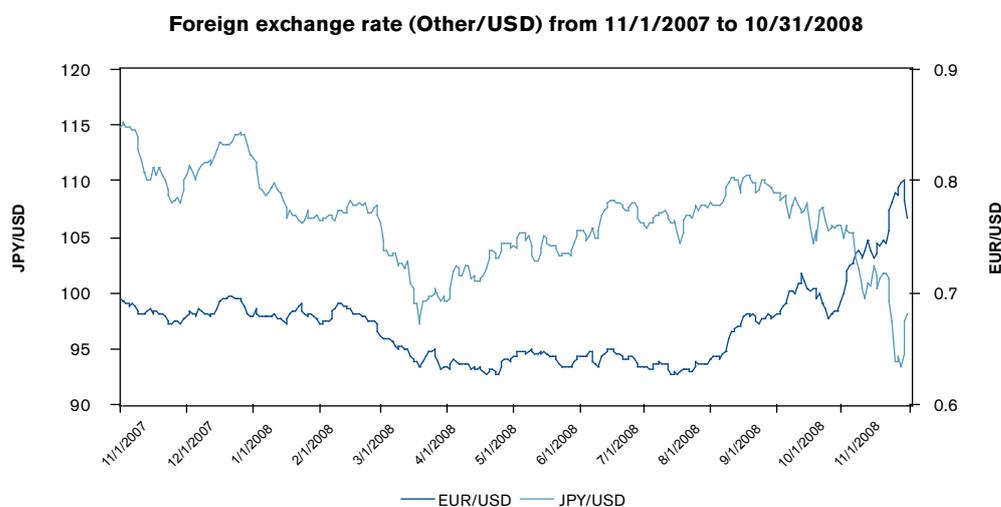
**S&P movement from 11/1/2007 to 10/31/2008**



October 2008 is by far the worst month in the past year, with the S&P dropping 17%. This capital-market decline is not limited to the United States. We also saw drops of 21.3% in Japan's TOPIX index, 11.7% in the UK's FTSE index, and 12.5% in Europe's STOXX index.

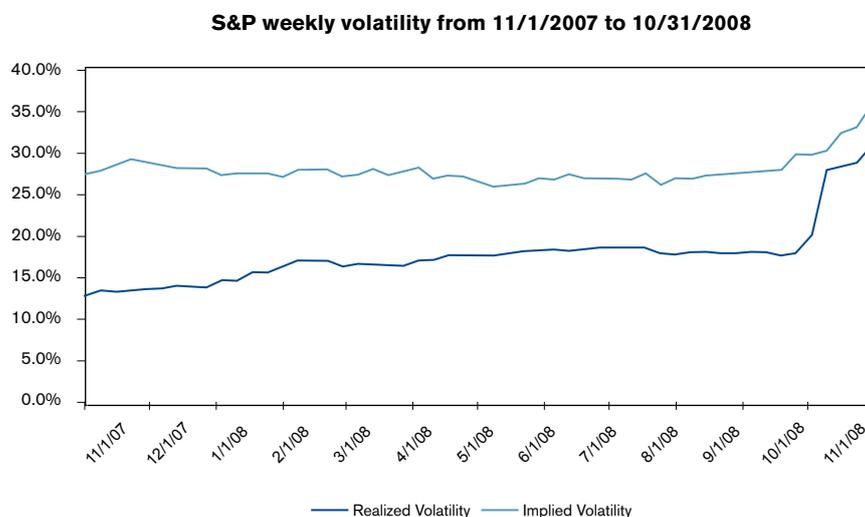
Not only have the equity markets moved dramatically, but the foreign exchange (FX) market also has experienced significant changes. For example, the exchange rate of the Japanese yen to the US dollar dropped from 114.67 to 98.23 within a year. Figure 11 illustrates the FX market movements in the past year. Many of the assets of VA writers have exposure to foreign economies. The drop in the US dollar exacerbates the decline in the global equity markets.

**FIGURE 11: FOREIGN EXCHANGE RATES TO US DOLLAR**



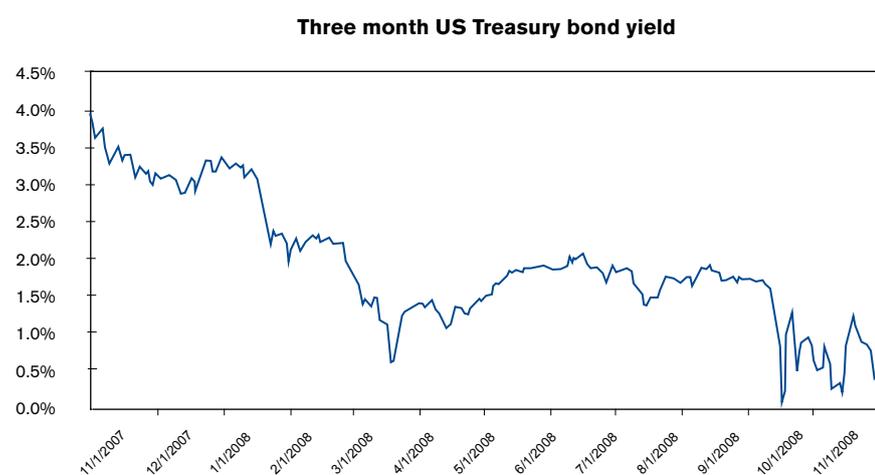
Both the implied and realised volatilities have increased significantly. The annualised volatility is 40% as of October 2008. Figure 12 illustrates the pattern of the S&P 500 volatilities over the past year. The prolonged daily swing of up to 10% is literally unseen in history.

**FIGURE 12: S&P INDEX WEEKLY REALISED AND IMPLIED VOLATILITY**



In response to the financial crisis and in order to increase liquidity, governmental actions have caused the government bond rates to reduce to historical low points. The current US Federal Reserve rate is the lowest since 1990, as illustrated in Figure 13.

**FIGURE 13: INTEREST RATE MOVEMENT**



However, there are some bright spots in this gloomy picture. While availability of credit and securitised debt—mortgages in particular—have dried up, and there have been temporary suspensions of taking short positions on individual stocks, liquidity in the index-futures and interest-rate-swap markets have remained very high. The collateralisation process through the margining system of exchange-traded futures and credit-support annexes for swaps has been extremely effective at dealing with credit risk in respect to these instruments. This is very good news for VA writers because these derivatives are the foundations of VA hedging programmes.

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