OLIVER WYMAN

VARIABLE ANNUITY VOLATILITY MANAGEMENT

AN ERA OF RISK-CONTROL

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ABOUT OLIVER WYMAN'S 2017 RESEARCH REPORT:

Variable Annuity Volatility Management: An Era of Risk-control

In the fall of 2017, S&P Dow Jones Indices, LLC ("S&P DJI") commissioned and paid Oliver Wyman to conduct an assessment and write a report on the merits of various in-product volatility risk management solutions from the perspective of both insurers and policyholders. However, the report is solely the work of Oliver Wyman.

This research analyzes a central question: what is impact of in-market volatility risk management solutions on clients and insurers using equity-based guarantee products?

The paper also explores the challenges faced by the industry in implementing these volatility risk management strategies and introduces a potential "next generation" solution that could minimize the extent to which these challenges materialize.

CONTENTS

EXECUTIVE SUMMARY

The global Financial Crisis motivated insurers offering guaranteed variable annuity (VA) products to innovate risk management solutions that mitigate risk exposure to sharp spikes in equity market volatility. Asset transfer programs, "risk-control" funds of various forms, and market-linked fees and benefits have become common fixtures within new guaranteed VA products, with risk-control funds gaining prevalence.

The rapid introduction of these solutions left little time for insurers to evaluate the optimal balance of risk management benefits against client perception of value. Subsequent performance highlighted the shortcomings in risk-control fund performance benchmarks and has fueled a client perception that these funds erode the "upside potential" of VAs. As a result, several manufacturers who embraced these solutions are now partially or completely unwinding their solutions with substantial impacts on balance sheet risk and economics.

This paper examines the properties of alternative volatility management solutions from the perspective of both policyholders and guarantee manufacturers, with a focus on the role of volatility-indexed fees in a potential "next generation" solution. Its purpose is to provide a framework for manufacturers to evaluate the trade-offs associated with each solution, as well as the implications of certain features.

The findings from our research suggest several points for manufacturers considering the use of or changes to product-based volatility management solutions:

- **Risk management benefits of each solution are significant**
  - All solutions examined materially improved insurer balance sheet economic risk profile – indicating that insurers contemplating a complete repudiation of product-based volatility management solutions should weigh such decisions heavily against the attendant benefits in marketing and distribution.
- **Circumstances in which risk management benefits are realized vary sharply**
  - All risk solutions are effective in the "body" of market risk distributions (i.e. to moderate changes in volatility). Risk-control funds and asset-transfer programs tend to best mitigate sharp spikes in volatility such as those experienced in the Financial Crisis, whereas market-indexed solutions provide less protection.
- **VIX-indexing and capped volatility impact investment performance the least**
  - Target volatility, capital preservation and asset-transfer programs alter returns and disrupt traditional performance benchmarking – the crux of the perception-oriented challenges experienced to date with these funds. Capped volatility solutions tend to have limited to no impact in the majority of years, and VIX-based solutions, while modestly altering returns, seldom result in material deviations in client separate account returns.

- **Joint VIX-indexed fees and capped volatility offers a “tail + body” risk solution with limited client impact**
  - A joint “capped volatility with VIX-indexed fees” solution may provide protection against all volatility environments without meaningfully altering investment upside return potential and can retain traditional performance benchmarks like the S&P500 with low likelihood of overlay-driven performance deviations.

Given the interest in volatility management solutions within VAs, we anticipate continued refinement of existing risk controls and innovative new solutions that will balance risk management benefits, economic profiles, and client impacts.

1. INTRODUCTION

The fallout from the global Financial Crisis significantly altered both (i) the perception of investment risks faced by policyholders approaching retirement and (ii) the management of balance sheet risks arising from equity-based guarantees written by insurers. In the wake of the crisis, insurers launched three broad solutions to manage their balance sheet exposures without upending the client proposition for investing in such products. These solutions include:

Asset transfer programs	Insurer-driven programs that re-allocate client discretionary funds to bond funds based on the in-the-moneyness of contracts
Volatility-managed/risk-control funds	Fund features that dynamically rebalance allocation to equities depending on a target or trigger level of realized volatility
Market-linked rider fees	Fee feature that adjusts the level of rider fees tied to a prevailing market index, e.g. volatility index or US treasury rates

Upon introduction, each solution was met with fanfare by insurers and policyholders alike, with insurers willing to offer stronger guarantees to products requiring one or more solution, and clients eager to seek the strongest guarantees available while gaining protection against the severe market declines recently experienced. However, in the wake of a near-decade old bull market recovery we observe a shift in the market, leading to a potentially “new optimum” in the balance of client impact and insurer risk management benefits. This shift appears to have been driven by three forces:

- Fading of investors’ scars from the crisis in the wake of 300+% increase in the S&P 500 total return index since it’s low in March 2009
- Insurers restoring their appetite for equity risk overall, driven by a 28% increase in Adjusted Capital since YE 2009
- Insurers looking for sales following declines in VA GMxB sales, driven by a multitude of factors

This paper examines the impact of the in-market volatility risk management on clients and insurers using equity-based guarantee products. The audience for this report includes financial professionals such as insurance company product and risk management executives and broker-dealers. It is organized into sections addressing the following topics:

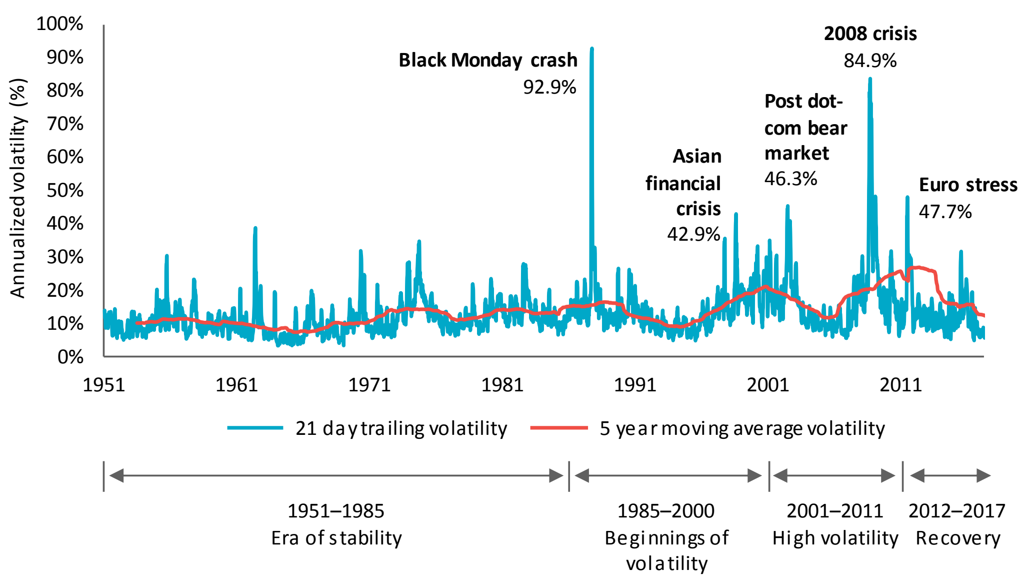
- Recent trends in market volatility and its effect on clients and insurers
- Impact of “existing” volatility risk solutions on insurer and client metrics
- Next generation of volatility risk management solutions

2. RECENT TRENDS IN MARKET VOLATILITY AND ITS EFFECT ON CLIENTS AND INSURERS

2.1. A NEW ERA OF VOLATILITY

In recent years, the equity markets have experienced radical changes in market environments. Long-run average equity return volatility has risen and, despite the historic low volatility experienced in recent months, temporary periods of sharply increased market volatility are now quite common. As Exhibit 1 shows, during 1950 to 1985 – the "Era of Stability" – equity market volatility averaged only 11.2% and spikes in realized volatility above 25% were infrequent. However, by the mid-1980s, market volatility began to rise. Volatility averaged 13.9% from 1986–1999, highlighted by the "Black Monday" crash of 1987 and the more prolonged volatility associated with the Asian Financial Crisis in the late 1990s.

EXHIBIT 1: REALIZED VOLATILITY OF THE S&P 500 INDEX FROM 1951–1H2017

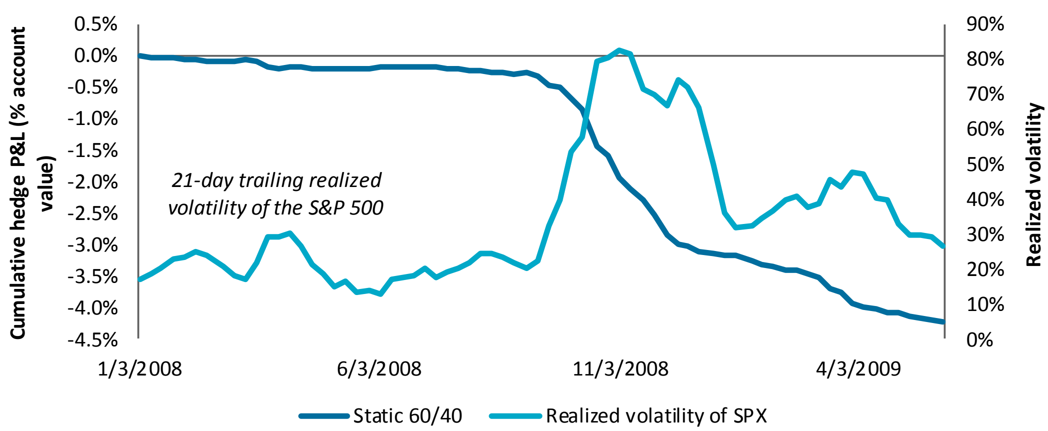


Mean	11.2%	13.9%	18.7%	11.8%
Proportion of days with >25% volatility	2.3%	4.6%	19.3%	1.5%

Source: Thomson Reuters Datastream

The new millennium has borne witness to a marked increase in both average volatility and the frequency of volatility spikes, with three major events marring the landscape. These include the post dot-com bubble; the Financial Crisis of 2008–2009, the uncertainty related to Euro-zone sovereign debt, and now, the calm across markets possibly attributable to a surplus of cash awaiting investment driven by accommodative monetary policy. The crisis in particular exacted a heavy toll on insurers, who experienced sharp "gamma volatility losses" under traditional static 60/40 funds. Exhibit 2 shows that from January 2008 to April 2009, an insurer guaranteeing a static 60/40 fund would possibly have experienced -4.22% cumulative volatility losses in hedge P&Ls for a representative "delta hedging" program (see Section 3.1.3 for more details).

EXHIBIT 2: SIMULATED MANUFACTURER HEDGE PROGRAM PERFORMANCE DURING THE FINANCIAL CRISIS OF 2008 AND 2009 (STATIC 60/40 FUND)

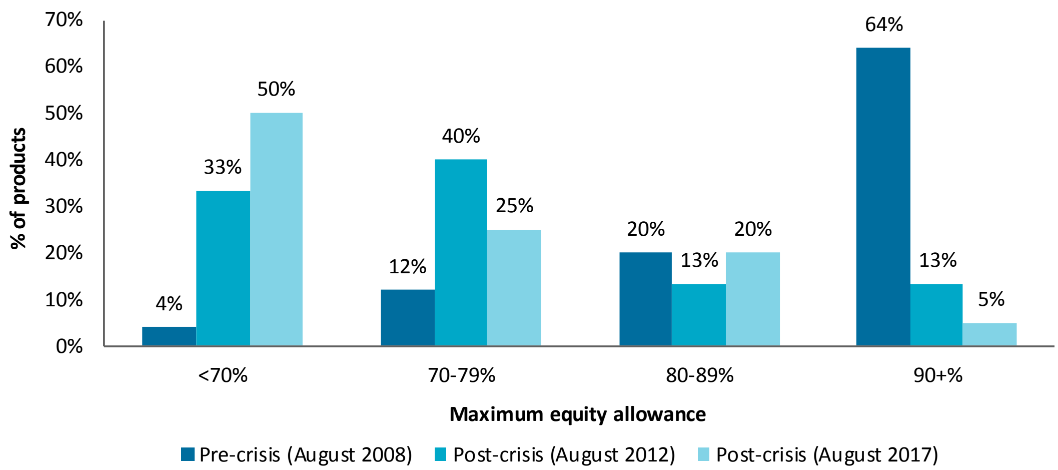


Source: Oliver Wyman analysis

2.2. PRODUCT MANUFACTURERS RESPONSE

Manufacturers of equity-based guarantees responded to the crisis and subsequent changes in capital markets conditions with a decreased appetite for equity risk. Changes in insurer product offerings in the aftermath of the 2008 crisis were rapid with products pulled altogether or sharply scaled back. Modifications within the guaranteed income space have been particularly significant, as product manufacturers have made significant changes to both benefit levels and investment restrictions. As Exhibit 3 shows, within the retail variable annuity (VA) space – which still accounts for the lion's share of equity-based guaranteed income sales – maximum equity allowances have been reduced post-crisis to cope with the increased market volatility. The average maximum equity allowance of guaranteed income products fell from 90% in 2008 to 65% in 2017.

EXHIBIT 3: CHANGE IN MAXIMUM EQUITY ALLOWANCE OF GUARANTEED INCOME PRODUCTS



Note: 2008, sample of 25 products; 2012, sample of 15 products; 2017, sample of 20 products.
Source: Company filings of major guaranteed income products.

2.3. INNOVATIVE VOLATILITY MANAGEMENT SOLUTIONS

Policyholders, asset managers and product manufacturers are seeking new ways to create product portfolios that:

- Reduce balance sheet exposure to difficult-to-hedge risks such as "volatility spikes"
- Enable insurers to support meaningful retirement income levels
- Minimize the loss of investment "upside potential" perceived by clients (critical to fending off further loss of market share from other income product types)

Insurers introduced an array of volatility risk management solutions to address the above objectives. Solutions broadly fell into three categories: asset-transfer programs, risk-control or volatility-managed funds, and market-linked fees and benefits. These solutions are described in Exhibit 4.

Asset-transfer programs (ATP) manage risk by re-allocating client discretionary funds based on contract in-the-moneyness. Risk-control funds, which encompass a broad range of fund strategies, adjust positions in response to market signals of risk. Market-linked fees, a more recent product innovation, seek to provide risk management by linking rider fees to movements in key market drivers. Most common market-linked fee structures include VIX-indexed features that link rider fees to the VIX, a market index reflecting implied volatility, and US treasury (UST)-indexed features that link roll-up or payout rates to UST yields.

EXHIBIT 4: OVERVIEW OF VOLATILITY MANAGEMENT STRATEGIES IN THE RETAIL VA SPACE

Strategy		Performance objective of fund
	Asset transfer programs	Re-allocate client discretionary funds to bond funds based on in-the-moneyness of the contract; transfers occur at a defined ratio of account value to benefit base (AV / BB)
Volatility-managed funds	**Capped volatility**	Cap the expected volatility of fund returns at a defined level, e.g. realized volatility not to exceed 30%
Volatility-managed funds	**Target volatility**	Target a specific and constant level of volatility of fund returns, e.g. targeting 15% volatility
Volatility-managed funds	**Capital preservation**	Fund risk position declines if prior performance is poor, or positions are used to 'hedge" changes in the cost of the company's guarantees
Market-linked rider fees	**VIX–indexed fees**	Target rider charge based on prevailing level of VIX Subject to (i) ceiling, and (ii) floor
Market-linked rider fees	**UST–indexed**	Target rider charge or other features (e.g. roll-up and/or payout rates) based on prevailing level of 10-year US treasury

The mechanics underlying the fund strategies prescribed by each of the risk-controls are illustrated in the following exhibits.

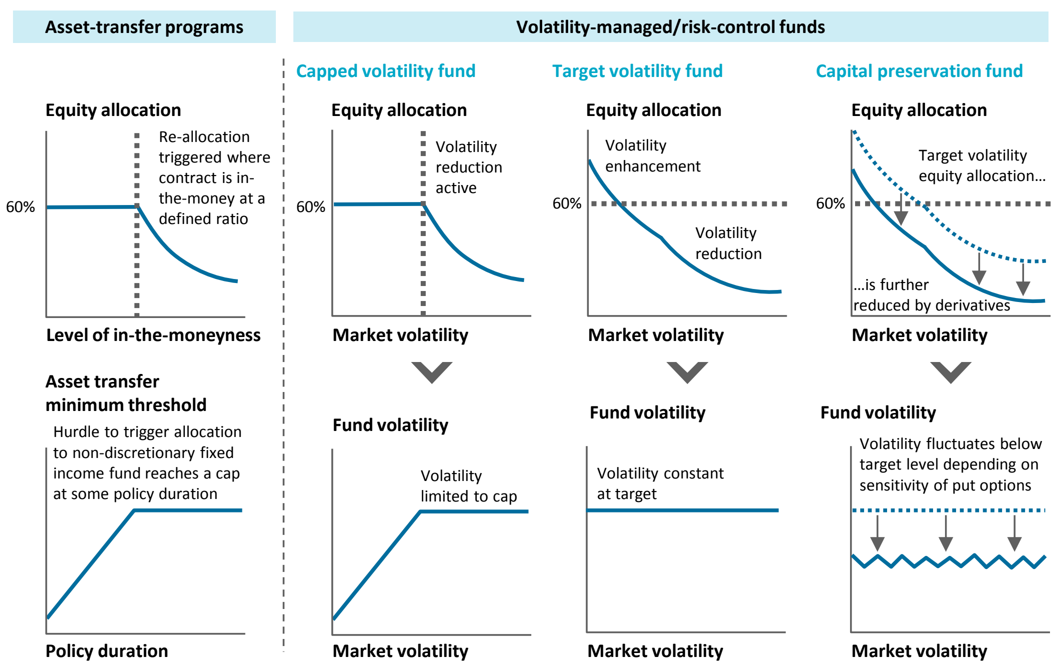
As shown in Exhibit 5, capped volatility programs engage when market volatility exceeds a pre-defined volatility "cap". In such instances, the equity allocation of the fund is maximized under the constraint of maintaining the capped level of fund volatility. If market volatility falls below the volatility cap, the original fund's equity allocation is restored. The goal of this fund is to leave the traditional static allocations intact except during periods of crisis or other times of elevated uncertainty.

Similarly, a target volatility strategy sets a pre-defined fund volatility target that remains constant in the fund's investment lifetime. The equity allocation of the fund is routinely adjusted to ensure the fund is performing at or near its desired volatility level. When market volatility is low, the fund increases equity allocations beyond long-term target allocations, and when market volatility is high, the fund reduces equity allocations below these target allocations.

The capital preservation strategy (also known as self-hedging) extends the target volatility mechanics. It uses futures and other derivatives to mitigate the risk of the fund following market declines – in this case by simulating the return impact of a put option holding. Because the mitigation of the fund occurs after a decline in market returns, the changes in asset allocation trail changes in market returns.

The ATP adjusts investment allocations based on guarantee moneyness and policy duration. Re-allocation is triggered at the point where defined ratios of guarantee-moneyness exceed a minimum threshold. The ratio determines the amount of discretionary holdings subject to a compulsory allocation into insurer-controlled fixed income funds.

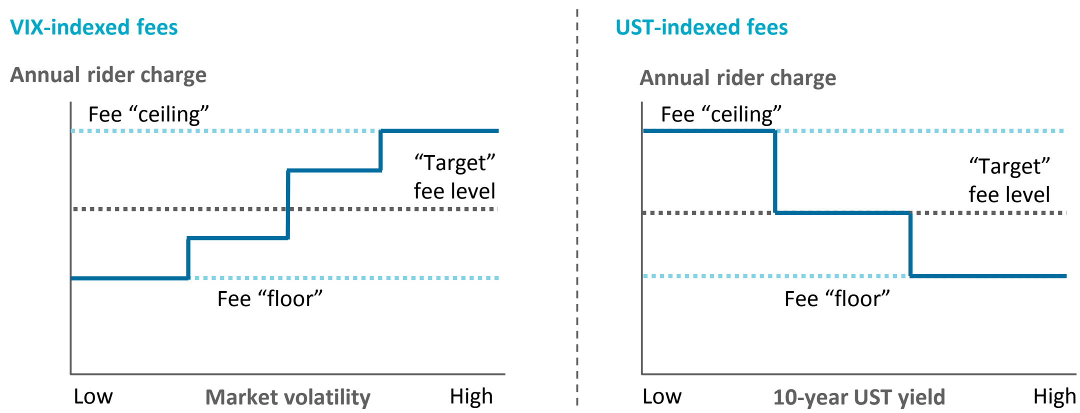
EXHIBIT 5: ILLUSTRATION OF FUND RISK-CONTROL APPROACHES



Source: Oliver Wyman analysis

Exhibit 6 provides an overview of market-linked fee solutions. The goal of the VIX-indexed fee feature is to adjust rider charges on a quarterly basis in line with changes in market volatility, in this case as defined by the VIX index. The rider fee adjusts around a base fee level plus an incremental amount for every unit that the VIX exceeds a target value, and is bound overall by a floor and ceiling value. The feature increases rider fees in highly volatile periods in an attempt to better match fees to changes in volatility. The UST-indexed feature reflects a similar mechanism except that the rider is tied to the 10-year UST yield, increasing fees in low yield environments and decreasing fees when yields are higher.

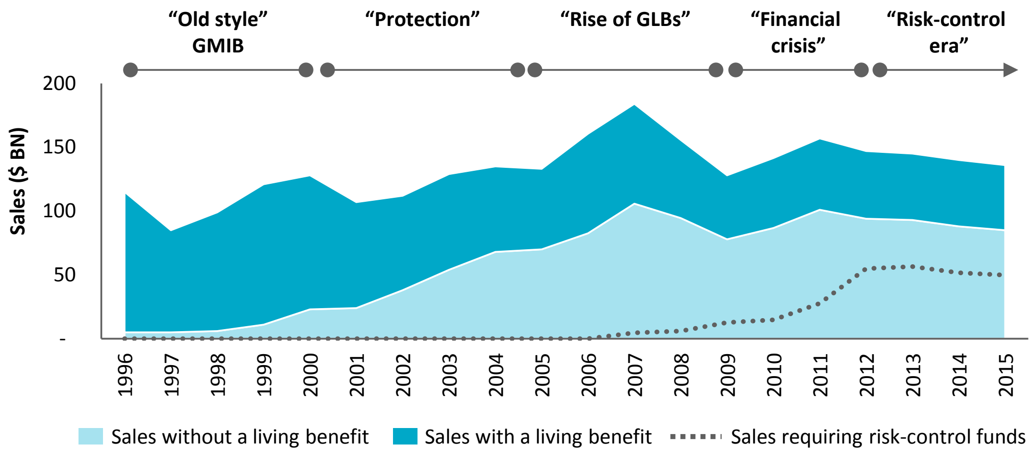
EXHIBIT 6: ILLUSTRATION OF MARKET-LINKED FEE APPROACHES



Source: Oliver Wyman analysis

Sales data demonstrates the historical viability of the above product propositions. Volatility management solutions, predominantly risk-control funds, have become commonplace among new VA product offerings. As shown in Exhibit 7, the share of VA products requiring a risk-control fund mechanism has significantly risen since Prudential introduced the concept to the market in 2007, with particularly strong growth in 2011 and 2012.

EXHIBIT 7: INDUSTRY VA SALES AND SHARE REQUIRING RISK-CONTROL FUNDS OVER THE PAST 20 YEARS (1996 – 2015)



	“Old style” GMIB	Protection era	Rise of GLBs	Financial Crisis	Risk-control era
Product	• Tax-driven product • Early death benefits (GMDB)	• Accumulation benefit (AB) gains following • ‘Old style’ GMIB sales increase	• Withdrawal benefit invented; IB enhanced • Living benefits core to sales; “feature war”	• Sales decline with “flight to safety” • Writers scale back benefits	• Growth restored by heightened client need and new VA advisors
Funds	• Fund offerings key	• Dotcom bust – fund story fades	• Limited investment restrictions	• Shift to passive • More allocation restrictions	• Embrace of risk-control funds

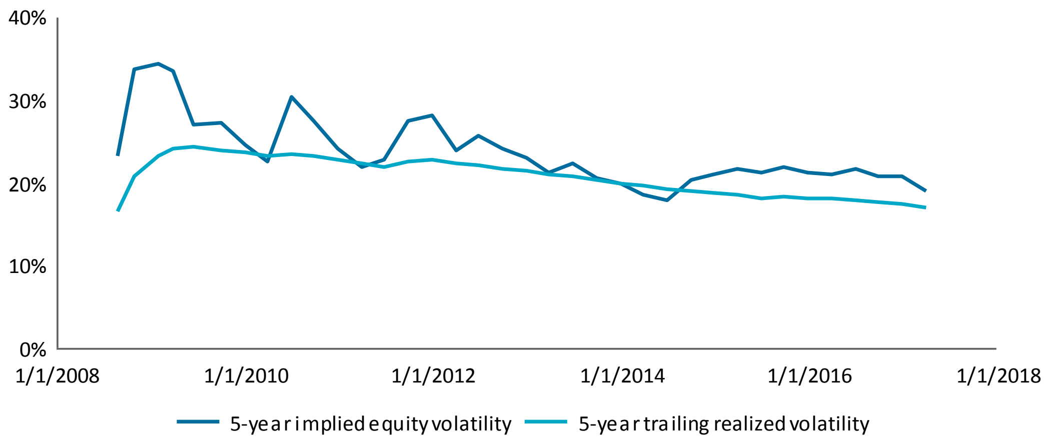
Source: IRI, LIMRA Living Benefit Election Rate Survey, JPMorgan. Share of sales requiring managed-volatility based on sales of product filings.

There are two compelling reasons for the continued research and development of volatility management solutions.

First, the new business market remains the largest in the life/annuity sector despite recent decreases in sales, with annual retail VA sales of approximately $100 BN, the majority of which have guarantees.

Second, there is a substantial “volatility premium” that a product-based solution can offload to the market to save expenses for both insurers and clients. Standard insurer practice in guarantee pricing is to use the market price for volatility (especially for tenors up to five years) because their hedges are constructed based on actual market instruments. However, the “real world” tends to realize lower volatility than market-implied estimates (see Exhibit 8 for a comparison of realized and implied volatility). By using risk controls to achieve a certain realized volatility, insurers are able to transfer the value of the equity volatility risk premiums from the sellers of options to investors in guaranteed variable annuity contracts. This phenomenon is observable given the prevalence of insurers willing to write richer benefits on products that have risk-control solutions.

EXHIBIT 8: COMPARISON OF 5-YEAR REALIZED AND IMPLIED VOLATILITY – SHOWN ON QUARTERLY BASIS (Q3 2008 TO Q1 2017)



Source: Oliver Wyman analysis. Thomson Reuters Datastream.

2.4. CHALLENGES OF "FIRST GENERATION" SOLUTIONS

The rapid adoption of volatility management solutions left insurers with little time to assess implementation and communication challenges, which were important to the product proposition for clients and their advisors. Insurers experienced three broad categories of challenges: performance benchmarking, loss of "upside potential", and lack of clarity of investment thesis.

We describe each of the challenges below.

- **Performance benchmarking** – insurers were unable to define suitable benchmarks for funds that had a risk-control overlay and often assigned improper benchmarks – including the use of the S&P 500 for funds with equity allocations closer to 60%. Clients who were "oversold" on the benefits of volatility management held false expectations of the level of risk-and-return potential, resulting in dissatisfaction during the bull market equity returns. The lack of transparency caused investors to blame "underperformance" of any type on risk-control features.
- **Loss of "upside potential"** – in the recent bull-market, the risk control overlays in certain cases resulted in lower equity ratios and allocations, which in turn caused under-performance. This phenomenon is applicable mostly to risk-control funds, but similar issues are observed to varying extents with asset-transfer programs and market-linked fees. Regardless, as risk-control features lost money, they also started falling out of favor.

- **Clarity of investment thesis** – clients and advisors have been providing feedback that indicates a growing skepticism and concern over investing savings in “black box” solutions. Clients are unable to distinguish risk-control features that are balanced in terms of client/insurer interest from highly insurer-centric strategies that do not provide credible standalone investment theses.

As we explain the results of our analysis of existing solutions in the next section, the above challenges will emerge as recurring themes. Ultimately, as will be discussed in Section 4, a “next generation” solution will need to address the above challenges to be considered a viable volatility management solution.

3. ANALYTICAL RESULTS OF EXISTING SOLUTIONS: ASSESSMENT FRAMEWORK OVERVIEW

The previous section illustrated the key challenges insurers and policyholders faced because of the rapid introduction of volatility risk management strategies for guarantee products. This section introduces an analytical framework to evaluate these risk solutions, considering metrics that reflect insurers', clients' (policyholder) and their advisors' perspectives.

MANUFACTURER PERSPECTIVE

Our representation of insurer perspectives reflects three principal objectives in the manufacturing of equity-based guarantee products:

Write profitable business	• Product design teams must satisfy bottom-line at-issue economic value and/or IRR thresholds. Volatility management solutions can safeguard pricing measures against fluctuations in equity market implied volatility and reduce the "volatility cost" component of guarantee pricing
Stabilize asset-liability management (ALM) and hedging performance	• Insurer hedging teams seek solutions to stabilize the ALM and hedging of equity-based guarantees. Volatility management solutions stabilize ALM performance by narrowing the dispersion in liability value changes due to equity market movements that cause "convexity" losses • Another concern specific to certain volatility solutions is "basis risk" – particularly if equity positions in the funds fluctuate in ways not mirrored by the insurer equity hedging program
Optimize capital requirements	• Insurers aim to reduce the "tails" in liability performance outcomes that drive increased Statutory reserve and capital levels

CLIENT AND ADVISOR PERSPECTIVE

A clear assessment of the client value implications of volatility management is critical to understanding the level of performance transparency, which has historically been the key challenge of "first generation" risk-control solutions. We can broadly express the performance and risk trade-offs that clients consider in purchasing equity-based guarantee products through two principal objectives:

Maintain investment upside potential	• Clients invest in equity-based portfolios to harness potential market upside. Analyzing the upside potential and risk-adjusted performance of the volatility management strategies will determine how well this goal can be achieved
Minimize impact to guarantee value	• Clients invest in variable annuities instead of direct investments to obtain an income guarantee, and are motivated to maximize their retirement incomes. Any impact of the risk-control strategies on guarantee value should be considered

Our analysis examines the effect of applying different risk-control solutions to a retail VA Lifetime GMWB product representative of those in the industry today (see Appendix A: Product design and modeling methodology for the assumptions used). Additionally, Exhibit 9 summarizes the parameters that we test for each solution (see Appendix B: Volatility risk management solution details for the mechanics of each solution).

EXHIBIT 9: PARAMETERS OF THE VOLATILITY MANAGEMENT STRATEGIES FOR TESTING

Strategy	Parameter specification
Asset-transfer program	• Define $Guarantee\ Ratio = 1 - account\ value\ to\ benefit\ base\ (AV/BB)$ • Define a minimum threshold point as $Threshold = minimum(50\%, 10\% + 2\%\ x\ policy\ duration)$ • Fixed income allocation is driven by extent to which the ratio exceeds the threshold point within a 10% band, e.g., given a ratio of 30% and a threshold of 20%, the allocation to fixed income would be 100%
Capped volatility	• Realized volatility not to exceed 30% • Equity allocation not to exceed target of 60%
Target volatility	• Realized volatility of 15% targeted • Fund can at most allocate 66% to equities through the use of leverage
Capital preservation	• Assumes a similar implied equity allocation as the target volatility • Implied equity allocation is adjusted based on the delta of a 5-year rolling put option
VIX–indexed fees	• After an initial lock-in year at a base fee, the rider fee calculated each quarter as $100\ bps + 10\ bps\ x\ (VIX - 20)$ • Rider fee is subject to an overall floor of 75 bps and a ceiling of 250 bps • Value of the VIX input is based on spot VIX for simplicity of modeling

The following sections translate the discussed insurer and client objectives into metrics and compare how each of the volatility management solutions performs.

3.1. ANALYTICAL RESULTS OF EXISTING SOLUTIONS: IMPACT OF VOLATILITY MANAGEMENT FROM MANUFACTURERS' PERSPECTIVES

This section evaluates the volatility management solutions from the insurer risk and economic perspective. The metrics defined in Exhibit 10 align with the objectives discussed previously. Note that for the purposes of this paper, a review of Statutory reserve impacts is excluded due to inconsistent industry practices with respect to the projection of volatility in real-world tail scenarios (and pending regulatory guidance on this modeling topic), but nevertheless is an important area for manufacturers to assess.

EXHIBIT 10: KEY INSURER CONCERNS REGARDING THE IMPLEMENTATION OF RISK-CONTROL TECHNIQUES

Objective	Metric	Description and evaluation	Insurer concerns
Write profitable business	Guarantee cost (GC)	• Definition: risk-neutral GC at-issue, defined as PV of rider fees less PV of guarantee claims • Evaluation standard: % reduction in "volatility cost" (difference in GC between a static 60/40 and 100% cash fund); higher % reduction is better	• Do the risk-controls reduce the hedge cost (risk neutral value) of the guarantees?
Stabilize ALM and hedging performance	Hedge ratio	• Definition: efficiency with which a position is hedged • Evaluation standard: % change in PV of total cash flows given a 1% decrease in volatility; lower hedge ratio % reflect improved efficiency	• Do the volatility management strategies improve key hedge ratios (in particular Vega)?
	Hedge-ability	• Definition: dispersion in liability value changes due to equity movements • Evaluation standard: cumulative hedge P&L losses over 2008 and 2009; lower losses are better	• How well do the risk-control strategies minimize hedge P&L losses in crises?
	"Basis risk"	• Definition: realized effect of tracking error produced by imperfect knowledge of investment positions • Evaluation standard: proportion of time that weekly equity allocation changes are non-zero (illustrated for risk-control funds only); lower proportion of non-zero changes reflects less tracking error	• Can our risk management and hedging groups effectively mirror the changing fund positions?
Optimize capital requirements	Reserve impact and volatility	• Definition: portfolio values in "tail" of the distribution • Evaluation standard: real-world conditional tail expectation at the 70th, 90th and 98th percentiles; lower losses reflects better "tail" performance	• Do the funds reduce Statutory reserve requirements (and volatility of reserves)?

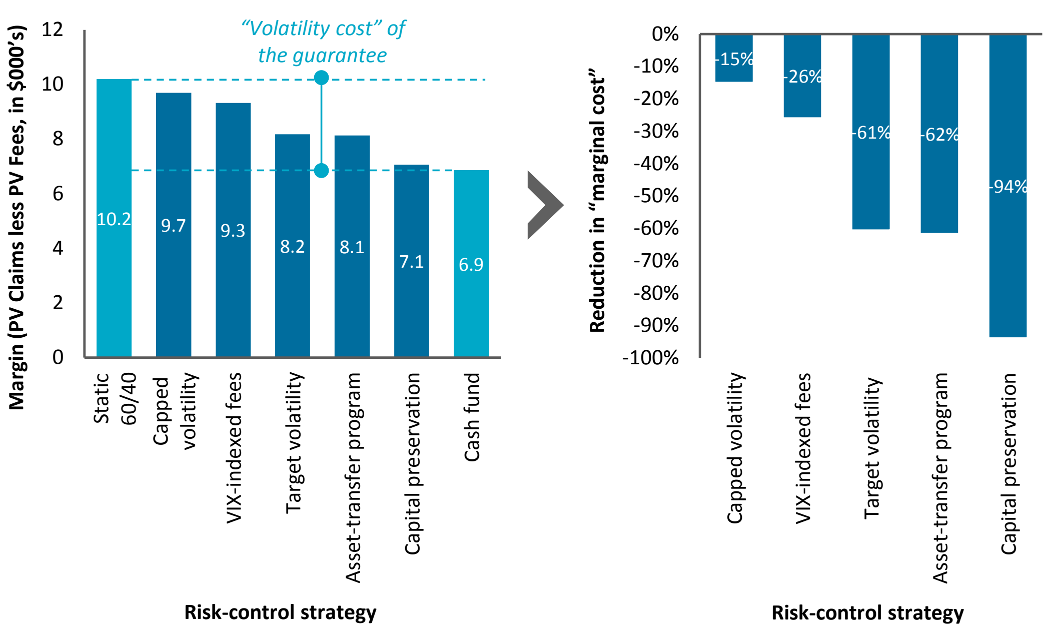
3.1.1. IMPACT ON COST OF UNDERWRITING THE GUARANTEE

The first metric evaluated is the risk-neutral guarantee cost:

$$Guarantee\ cost\ =\ PV\ of\ rider\ fees - PV\ of\ guarantee\ claims$$

Guarantee claim cost determines substantially the rider fee and dictates the limitations on the richness of guaranteed income benefits. Exhibit 11 shows the benefits from each solution based on "volatility cost", which we define as the difference in guarantee cost between the static 60/40 strategy and a static 100% cash "riskless" allocation. A figure of 50%, for example, indicates that a risk control overlay can reduce guarantee cost to the midway point between the static allocation and the cash allocation. The exhibit emphasizes the effectiveness of fund-based solutions which tend to provide the greatest reduction.

EXHIBIT 11: REDUCTION IN "VOLATILITY COST" OF THE GUARANTEE



Note: Chart on left hand side represents the margin on a $100,000 policy
Source: Oliver Wyman analysis

The exhibit illustrates the following:

- "Crisis protection" capped volatility funds eliminate only a small portion of the volatility cost arising from the guarantee and fees given that it activates only when equity volatility exceeds 30%
- More active risk-control funds, such as the target volatility and capital preservation strategies, achieve substantial degrees of cost reduction, reducing the margin by

about 60% to 90% of the way from that of a static 60/40 fund to a pure cash portfolio

- The asset-transfer program performs as well as the target volatility feature as it reallocates funds in a timely manner when contracts become in-the-money at a certain trigger level
- VIX-based solutions achieve a moderate "volatility cost" reduction of 26%. The indexing feature is triggered during heightened periods of volatility, increasing fees to insurers and simultaneously increasing claim costs

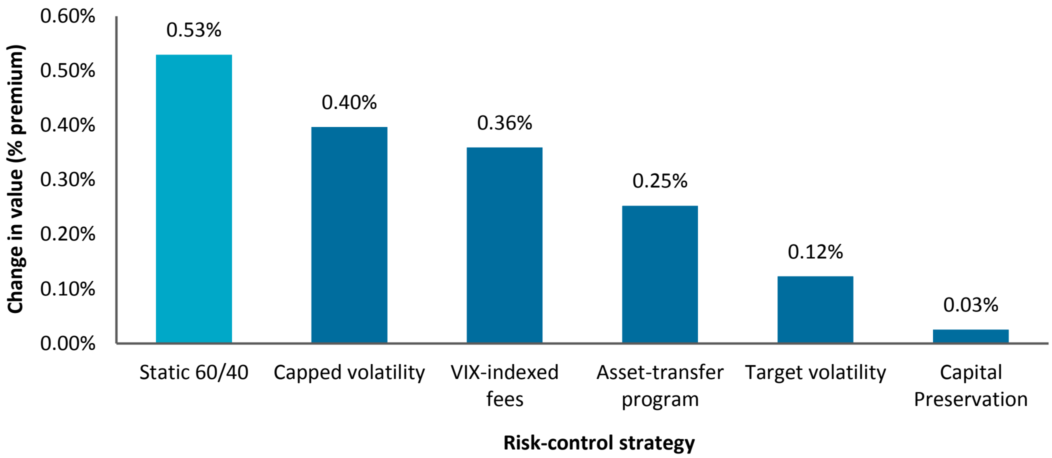
Another observation from Exhibit 11 is the relatively high level of the guarantee even under a cash fund – an artifact of today's low interest rate environment. While an increase in interest rates would reduce guarantee costs, the benefits of the risk solutions on volatility cost nevertheless would be preserved.

3.1.2. IMPACT ON HEDGE RATIOS

Risk-control strategies also reduce hedge ratios, which can help to stabilize the performance of an insurer's hedge program.

Exhibit 12 examines how each risk-control strategy is affected by exposure to changes in future levels of expected equity volatility ("Vega"). Vega reduction is present across each strategy, but risk-control fund solutions provide the greatest benefits. This is logical, as the target volatility and capital preservation funds are active features, designed to keep volatility low or stable in any equity volatility environment, high or low. Capped volatility funds, by contrast, activate only in crisis levels of volatility, providing on average less Vega reduction. The VIX-based solution provides a similar level of Vega reduction as the capped volatility feature, but achieves this reduction by adjusting fees to better match the liability convexity losses in different volatility environments. Lastly, the asset-transfer program provides moderate Vega reduction as it activates depending on contract in-the-moneyness and does not directly manage underlying fund volatility.

EXHIBIT 12: IMPACT OF RISK-CONTROL FUNDS ON KEY HEDGE RATIO – VEGA (IMPACT OF A 1% REDUCTION IN VOLATILITY)



Source: Oliver Wyman analysis

A reduction in equity volatility is important given the challenge many insurers face in managing both short-term and long-term volatility risk, as the hedging strategies rely heavily on derivatives (many involving illiquid, long-term options) to hedge their exposures.

3.1.3. IMPACT ON HEDGE-ABILITY

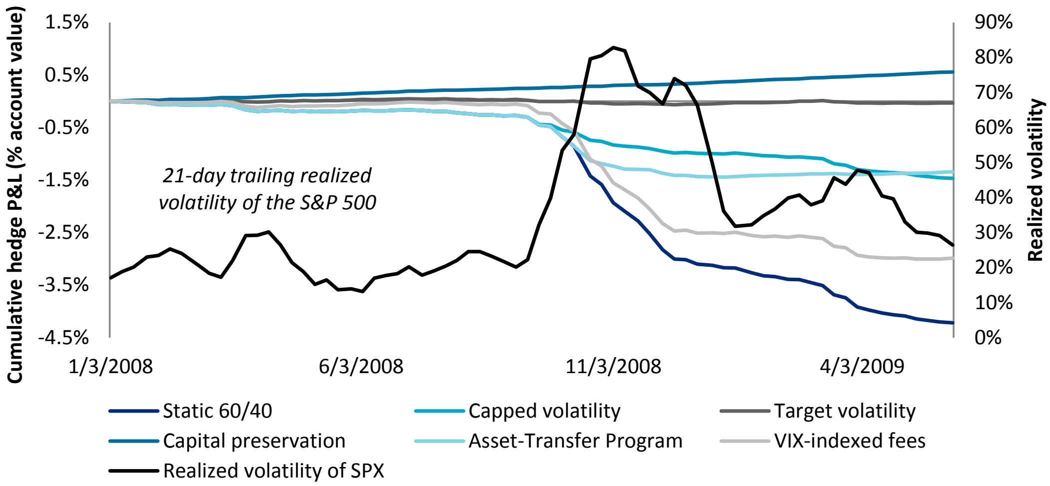
Insurers are particularly concerned with managing volatility and hedging in tail scenarios to stabilize cash flows. The benefits of reduced volatility exposure in the Financial Crisis are illustrated in Exhibit 13, which shows a P&L simulation of the performance of a "two Greek" (Delta and Rho) hedge strategy typical in the industry for a representative guarantee portfolio[1]. Delta measures the change in guarantee cost due to a change in the underlying asset values, and Rho measures the change in guarantee cost due to a change in interest rates. The exhibit makes evident how the extreme spike in volatility experienced during the fourth quarter of 2008 resulted in significant losses for hedge programs built around traditional static allocation funds.

The financial performance of hedge programs around risk-control funds and asset transfer programs is markedly more stable during this volatile period, as risk-control mechanisms are activated to reduce the frequency and severity of the ultra-large daily returns that contributed to hedge breakage. We note that VIX-indexed solutions – while

[1] This instance of the dynamic hedge program hedges only exposure to equity market returns and interest rates; it does not contain any direct hedging of equity market volatility. This type of hedge program design is common among guarantee manufacturers

performing incrementally better than a static fund – do not generate sufficient additional cash to offset extreme "tail spikes" in volatility.

EXHIBIT 13: SIMULATED MANUFACTURER HEDGE PROGRAM PERFORMANCE DURING THE FINANCIAL CRISIS OF 2008 AND 2009 (EXISTING VOLATILITY RISK SOLUTIONS)



Source: Oliver Wyman analysis

From 2008 through June 1, 2009, the resulting simulated cumulative hedge losses are as follows:

Strategy	Cumulative hedge P&L impact
Capital preservation	• Hedge gain of 0.6% (due to complete de-risking)
Target volatility	• Slight loss (~0.0%)
Asset-transfer program	• Loss of 1.3%
Capped volatility	• Loss of 1.5%
VIX-indexed fees	• Loss of 3.0%
Static 60/40	• Loss of 4.2%

Each exhibit is measured as a percent of the starting guaranteed account value[2]. The strong performance of the risk-control strategies and asset transfer programs during the 2008 Financial Crisis is due mainly to their active response to increases in market volatility and increases in contract in-the-moneyness. As volatility spiked considerably and equity values fell, the strategies became heavily invested in cash (or fixed income in the case of asset-transfer programs), leading to volatility levels near expectations and stabilization of cash flows despite the market turmoil.

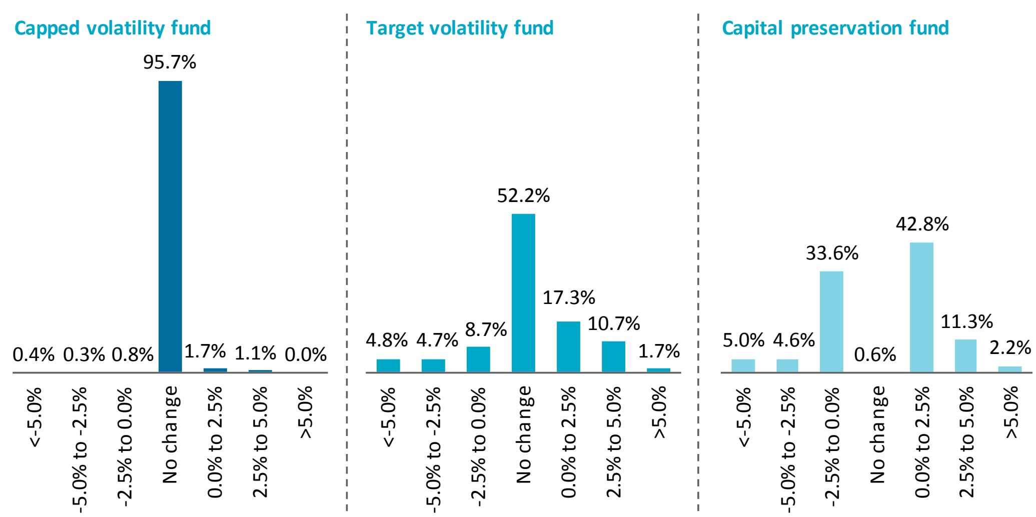
[2] Hedge performance is calculated as the convexity gain/loss relative to a portfolio with an assumed 16% equity volatility

3.1.4. IMPACT ON "BASIS RISK"

"Basis risk" affects insurer balance sheets when the underlying the market exposure of client funds are not known precisely – either due to stock selection or asset allocation – and mismatch against hedge derivative positions. The form of basis risk relevant for an evaluation of volatility management solutions are mismatches arising from fast moving changes in the underlying client fund allocations due to volatility management solutions not mimicked by the hedge team. This is a particular concern for risk-control funds, which due to 1940 Act uniform disclosure requirements, are not able to share exact positions with insurer hedge teams. A high volatility period can result in rapidly fluctuating fund asset allocations and hence larger basis risk – a phenomenon largely untested given few periods of heightened volatility since the advent of risk-control funds in VAs.

Exhibit 14 shows the weekly change in equity allocations historically for risk-control fund strategies. The more active risk controls, target volatility and capital preservation, exhibit more frequent large equity allocation changes. Capped volatility funds modify allocations only during crisis levels of volatility, producing less frequent changes. Not shown are the VIX-indexed solutions which preserve static allocations over time, and asset-transfer programs, which are managed by insurers contractually and hence subject to much less uncertainty in asset allocation.

EXHIBIT 14: EQUITY "DELTA" (CHANGE IN EQUITY ALLOCATION) BY RISK-CONTROL FUND HISTORICALLY FROM 1970 TO 1H 2017 ON A WEEKLY BASIS



Source: Oliver Wyman analysis

Exhibit 15 summarizes the results covered in this section and shows how each strategy performs relative to a static 60/40 fund. Key section conclusions are as follows:

- All of the risk-control solutions are effective in the "body" of market risk distributions, albeit to varying degrees
- Risk-control fund solutions are required to address tail scenarios, while VIX-indexing alone provides insufficient protection
- VIX-based solutions, as well as capped volatility, can be the most operationally straightforward to administer

EXHIBIT 15: SCORECARD OF RISK-CONTROL STRATEGIES ON INSURER METRICS

Objective	Metric	Measure	Static 60/40	ATP	Capped volatility	Target volatility	Capital preser-vation	VIX-indexed fees
Write profitable business	Guarantee cost	Reduction in "volatility cost" of guarantee	*N/A*	62%	15%	61%	94%	26%
Stabilize ALM and hedging performance	Hedge ratio	Vega – impact of a 1% reduction in volatility (% premium)	0.53%	0.25%	0.40%	0.12%	0.03%	0.36%
	Hedge-ability	Stability of hedge P&L (2008 hedge gain/loss)	-4.2%	-1.3%	-1.5%	~0.0%	+0.6%	-3.0%
	"Basis risk"	% of weeks that have a non-zero equity allocation change	*N/A*	*N/A*	4%	48%	99%	*N/A*

3.2. ANALYTICAL RESULTS OF EXISTING SOLUTIONS: IMPACT OF VOLATILITY MANAGEMENT FROM CLIENTS' PERSPECTIVE

The prior section evaluated how risk-control funds may affect the insurer risk profile. This section examines the potential impact of risk-control strategies on client and advisor objectives – both investment performance characteristics and impact on guaranteed income.

Exhibit 16 outlines the client value metrics examined. The client goal to maintain investment upside potential can be understood by analyzing the return and risk profile, equity allocation over time, and cumulative fees paid of each volatility management solution. The client goal to pay less is represented by average fees paid – with variations relevant only for the VIX-based solution given it adjusts rider fees whereas other solutions alter client fund positions. The client goal of guaranteed income is assessed based on the levels of guaranteed income at the time of withdrawal, which is influenced by the frequency and amount of fund value increases that trigger a "step-up" in the guaranteed income amount.

Note the analysis of the asset-transfer program is limited to where we can evaluate metrics prospectively. This is because the asset-transfer program has a policy duration component, which may alter performance depending on the fund start date.

EXHIBIT 16: SUMMARY OF CLIENT VALUE MEASURES

Objective	Metric	Description and evaluation	Client and advisor concerns
Maintain investment upside potential	Return and volatility characteristics	• Definition: historical funds returns net of fees and historical realized volatility • Evaluation standard: returns relative to realized volatility over certain periods	• Do the solutions materially alter the overall investment proposition? • Do the solutions provide compelling back-testing?
	Long-term equity allocation	• Definition: equity allocation over time • Evaluation standard: average allocation to equity historically; higher allocations maximize return performance	• Do the funds produce permit sufficient "upside potential"? • Can the funds be adequately benchmarked?
	Cumulative fees paid (applies to VIX-indexed fee strategies only)	• Definition: cumulative fees paid relative to a traditional static fund • Evaluation standard: fees assessed historically, and prospectively (PV of fees as % of PV of benefit base)	• How much additional fees are required for the risk-control features?
Minimize impact to guarantee value	Guaranteed income levels	• Definition: guaranteed withdrawals for a policyholder age 70 with issue age of 55 • Evaluation standard: assessed historically ($000's) and prospectively (%) relative to a $100K initial premium	• Do the funds maximize guaranteed income in retirement?

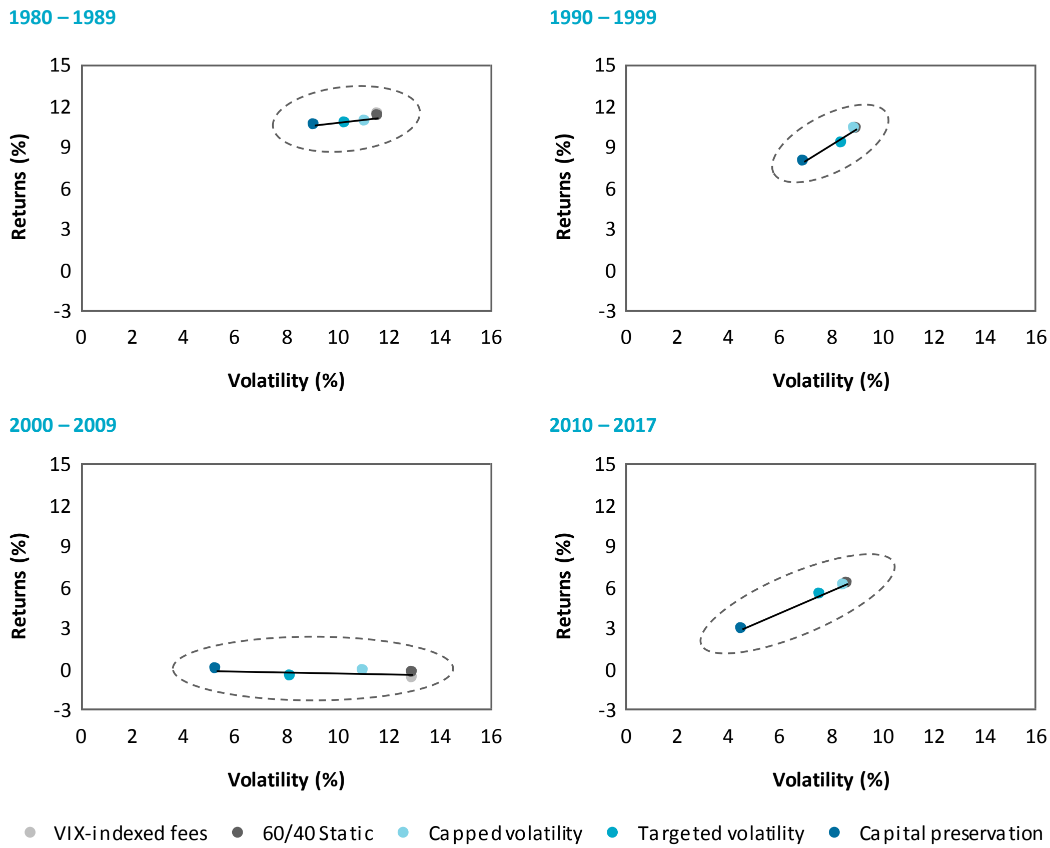
The remainder of this section evaluates the performance of the volatility management strategies across these metrics.

3.2.1. POTENTIAL IMPACT ON CLIENT FUND RETURN AND VOLATILITY

A simple tenet of investing is "more risk, more expected returns." The analysis of the risk controls historical risk-and-return profile can help determine the approximate risk level of the different funds – and hence the approximate amount of upside potential.

Exhibit 17 applies this theory to risk-control funds by comparing historical return (net of fees) and volatility performance for several decades. If the risk-and-return relationship holds then we may be able to reach conclusions about the relative upside potential of the various volatility management strategies.

EXHIBIT 17: PLOT OF HISTORICAL ANNUALIZED FUND RETURNS (NET OF FEES) AND VOLATILITY



Notes: 1) Each strategy assumes that a new fund was started at the start of 1970; 2) Fees included management expense ratios, rider fees, and investment management fees; 3) VIX-strategy assumes that initial 1-year policy period (where rider fees are locked in) has passed; 4) Living benefit fees were calculated as percent of a benefit base (which includes an annual ratchet and 6% simple roll-up)
Source: Oliver Wyman analysis

For each decade, the exhibit shows a modest relationship between return and volatility. This is an important characteristic of the risk-control overlays: the objective of the risk-control funds is not to generate “alpha” but to harvest prevailing market “Beta”.

Moreover, we note the following additional observations from Exhibit 17:

- Capped volatility and VIX-indexed fee portfolios offer effectively the same return and volatility profile as the corresponding static allocation fund
- Target volatility and capital preservation tend to reduce volatility more (although the amount varies by decade observed) – with consequently “lower beta” returns

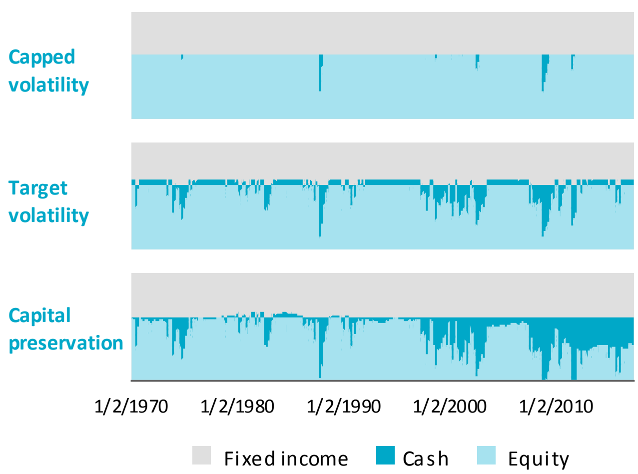
While history is unlikely to repeat itself, we think this analysis suggests that the relative realized volatility of the fund is a useful measure of “upside potential” – recognizing that markets must rise to realize this potential.

3.2.2. IMPACT ON LONG-RUN EQUITY RATIO

We measure long-term average fund equity ratios for two reasons: first, as mentioned, a key characteristic of the risk-control overlays is how their returns are a function of volatility and hence market “beta”. Second, the equity ratio is an indicator of how well the funds for a given volatility risk management strategy can be benchmarked and to what extent they affect the perception of market upside.

Long-run equity ratios are expected to vary by risk-control solution, with the more invasive risk-control overlays maintaining lower equity ratios. Exhibit 18 shows the historical equity ratios particularly for the risk-control fund strategies, which affect fund allocations. This exhibit illustrates the intensity of risk-controls in each fund.

EXHIBIT 18: HISTORICAL EQUITY ALLOCATION PROFILE OF RISK-CONTROL FUNDS



	Average allocation to real investments		% of time equity allocation is <60%	
	2000 to 2017	1970 to 2017	2000 to 2017	1970 to 2017
Capped volatility	58.9%	59.4%	7.6%	4.0%
Target volatility	54.8%	58.2%	45.2%	35.7%
Capital preservation	32.5%	45.4%	100.0%	86.1%

Source: Oliver Wyman analysis

The reader may observe the following:

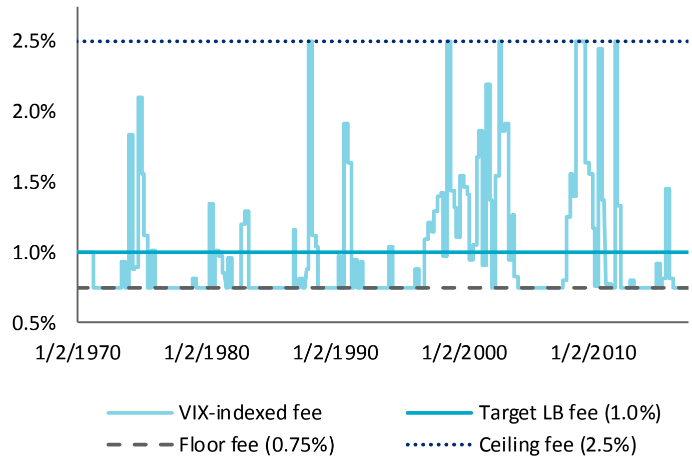
- Capped volatility engages its risk-control infrequently and only during periods of high market volatility. As a result, the fund maintains a long run equity ratio of 59% over the entire forty-seven year period, virtually unchanged from the static 60/40 allocation. This allows the fund to be communicated more transparently and reduces challenges with performance benchmarking (though still not perfectly)
- Target volatility and capital preservation are frequently "active". Target volatility can increase equity allocations beyond 60% in calm markets, but invests heavily in cash in highly volatile periods
- Capital preservation has meaningfully lower equity ratios, and is usually below the target equity allocation. As a result, it is less likely to support a perception of long-term upside potential

3.2.3. IMPACT ON CUMULATIVE FEES PAID

Fees affect upside potential in at least two ways: first, by reducing long-term account accumulation, and second by influencing the frequency and magnitude of any guarantee step-ups. We examine this characteristic of the VIX-based solution for completeness, using the other static fee solutions as a reference point.

Exhibit 19 illustrates the historical time series of a VIX-based fee. The VIX-indexing formula we used – similar to solutions currently or formerly in the market – would have resulted in a fee of 101 bps (~1% above target) over the entire period, and 114 bps (~14% above target) since 2000. The fee ceiling was reached only in six quarters during the 47-year period examined from 1970 to 1H 2017.

EXHIBIT 19: THEORETICAL ANNUALIZED FEES FOR VIX-INDEXED STRATEGY (1970–1H2017)

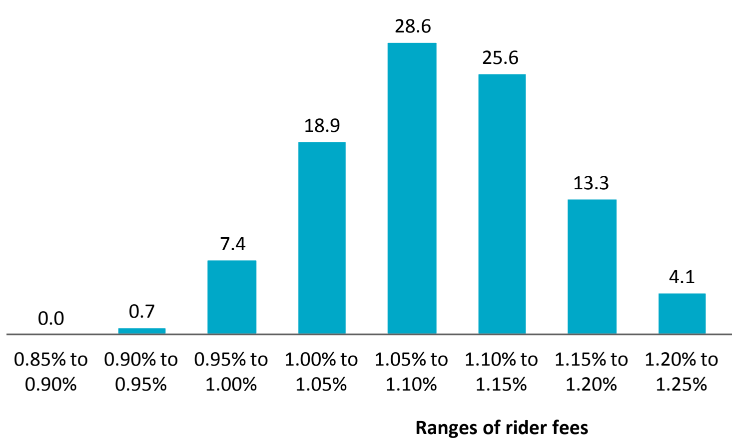


Average LB fee (%)	
2000 to 2017	1970 to 2017
1.14%	1.01%

Source: Oliver Wyman analysis

We examine VIX-indexed fees using prospective real-world scenarios as well. Exhibit 20 shows the distribution of present value of fees as a percentage of the present value of benefit bases for a contract issued at age 55 with withdrawals starting after 10 years. The analysis corroborates more recent historical fee experience. Cumulative fees paid are on average 9% higher (109 bps) relative to the 100 bps target, and seldom exceed 25% above target (125 bps).

EXHIBIT 20: DISTRIBUTION OF AVERAGE THEORETICAL VIX-INDEXED FEES (PV FEES/PV BENEFIT BASE) FOR CONTRACT ISSUED AT AGE 55 WITH WITHDRAWAL STARTING AT 65



Statistics	
Average	1.09%
Std. dev.	0.07%
25th-ile	1.05%
75th-ile	1.14%

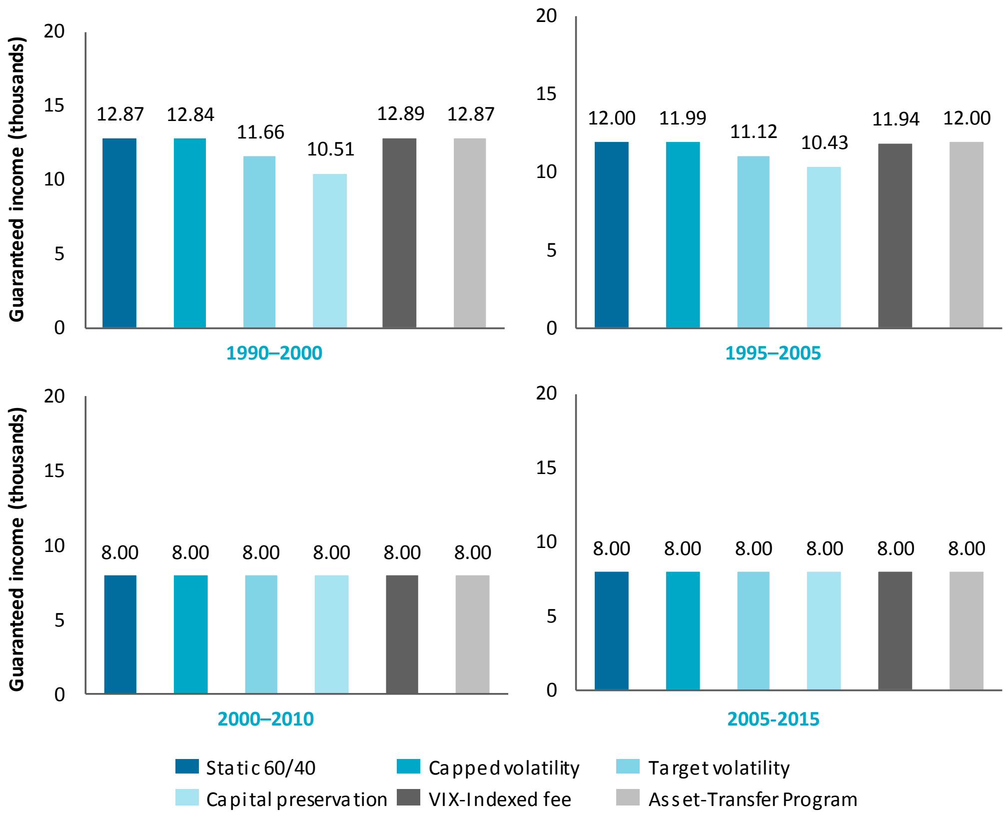
Source: Oliver Wyman analysis

3.2.4. IMPACT ON GUARANTEED INCOME LEVELS

Lastly, we evaluate the impact of volatility management strategies on income guarantees features. Because high volatility of funds increases the likelihood of triggering step-up features of income guarantee features, volatility reducing mechanisms may reduce the expected level of income to clients. We examine this phenomenon both historically and prospectively, on a modeled basis.

Exhibit 21 compares the guaranteed income feature of a model policy which invests $100,000 in a VA with a standard lifetime GMWB with withdrawals commencing 10 years later with the various risk-control techniques for four different historical periods[3]. Across the strategies, only capital preservation and target volatility solutions discernibly appears to affect average guaranteed income levels relative to a static fund.

EXHIBIT 21: GUARANTEED INCOME IN FIRST YEAR OF WITHDRAWAL AFTER 10 YEARS OF INVESTMENT ACCUMULATION ($100 K INITIAL INVESTMENT)



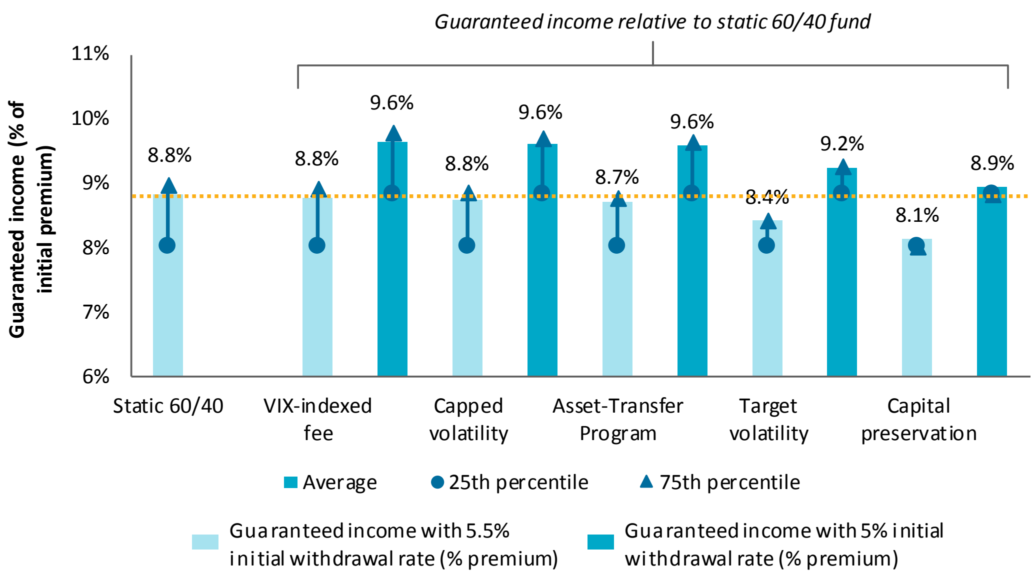
Notes: 1) The chart above uses a modelled policy with a return of 6% (simple) per year and withdrawal rate of 5% per year; 2) Fees are removed from account values (annual MER of 1.3%, investment management fee of 1.0%, and a rider fee of 1%)

[3] Note that management and investment management fees are assumed to be equal across volatility management strategies.

Source: Oliver Wyman analysis

Exhibit 22 examines the guaranteed income results across a set of real-world scenarios, which are based on statistical distributions that are consistent with real-world assumed volatility, equity and bond growth assumptions.

EXHIBIT 22: AVERAGE GUARANTEED INCOME LEVEL FIVE YEARS INTO WITHDRAWAL PERIOD



Notes: 1) Guaranteed income feature based on prospectively generated real-world scenarios; 2) Analysis assumes policyholder aged 55 begins withdrawing at the age of 65
Source: Oliver Wyman analysis

Similar to the historical analysis, only target volatility and capital preservation have an apparent discernible impact on average guaranteed income levels. However, these more active funds do not necessarily result in lower client income levels in practice chiefly for one reason – insurers are willing to write policies with stronger income guarantee features only if such funds are used in client investment allocations. Exhibit 22 shows a theoretical policy has an increase in simulated guaranteed income with a +50bps higher guaranteed withdrawal rate. This comparison highlights the "accumulation vs. income" trade-off faced by clients and their advisors.

Exhibit 23 summarizes the result of the client metrics and shows how each risk-control strategy performs relatively. Key section conclusions are as follows:

- Target volatility and capital preservation strategies have substantially greater potential to alter returns, and disrupt traditional performance benchmarking
- Capped volatility solutions will likely have limited to no impact in the majority of years, simplifying performance benchmarking and client communications

- VIX-based solutions appears to modestly alter returns but seldom result in material performance deviations

EXHIBIT 23: SCORECARD OF RISK-CONTROL STRATEGIES ON CLIENT METRICS

Objective	Metric	Measure	Static 60/40	Asset-Transfer Program	Capped volatility	Target Volatility	Capital preservation	VIX-indexed Fees
Maintain investment upside potential	Return and volatility characteristics	• 2000–2009						
		– Returns	-0.37%	N/A	-0.25%	-0.55%	-0.06%	-0.73%
		– Volatility	12.92%	N/A	11.05%	8.19%	5.26%	12.92%
		• 2010–2017:						
		– Returns	6.19%	N/A	6.05%	5.40%	2.82%	6.20%
		– Volatility	8.65%	N/A	8.52%	7.60%	4.55%	8.65%
	Long-term equity allocation	• Average allocation to real investments						
		– 2000–2017	60%	N/A	59%	55%	33%	60%
		– 1970–2017	60%	N/A	59%	58%	45%	60%
	Cumulative fees paid	• (Historical) Average fees (1970–2017)	100	N/A	100	100	100	101
		• (Prospective) Fees paid						
		– Average	100	100	100	100	100	109
		– 75th %-ile	100	100	100	100	100	114
		– 25th %-ile	100	100	100	100	100	105
Minimize impact to guarantee value	Guaranteed income levels	• (Prospective) Initial withdrawal rate of						
		– 5%	8.8%	8.7%	8.8%	8.4%	8.1%	8.8%
		– 5.5%	*N/A*	9.6%	9.6%	9.2%	8.9%	9.6%

4. “NEXT GENERATION” VOLATILITY MANAGEMENT SOLUTIONS

The previous section analyzed the impact of existing volatility management solutions from insurer and client perspectives. This section focuses on a potential “next generation” solution that combines a VIX-indexed fee with an underlying capped volatility fund. This design helps protect insurer balance sheets against volatility risk across a variety of market volatility environments but with a substantially reduced challenge of investment performance attribution and benchmarking.

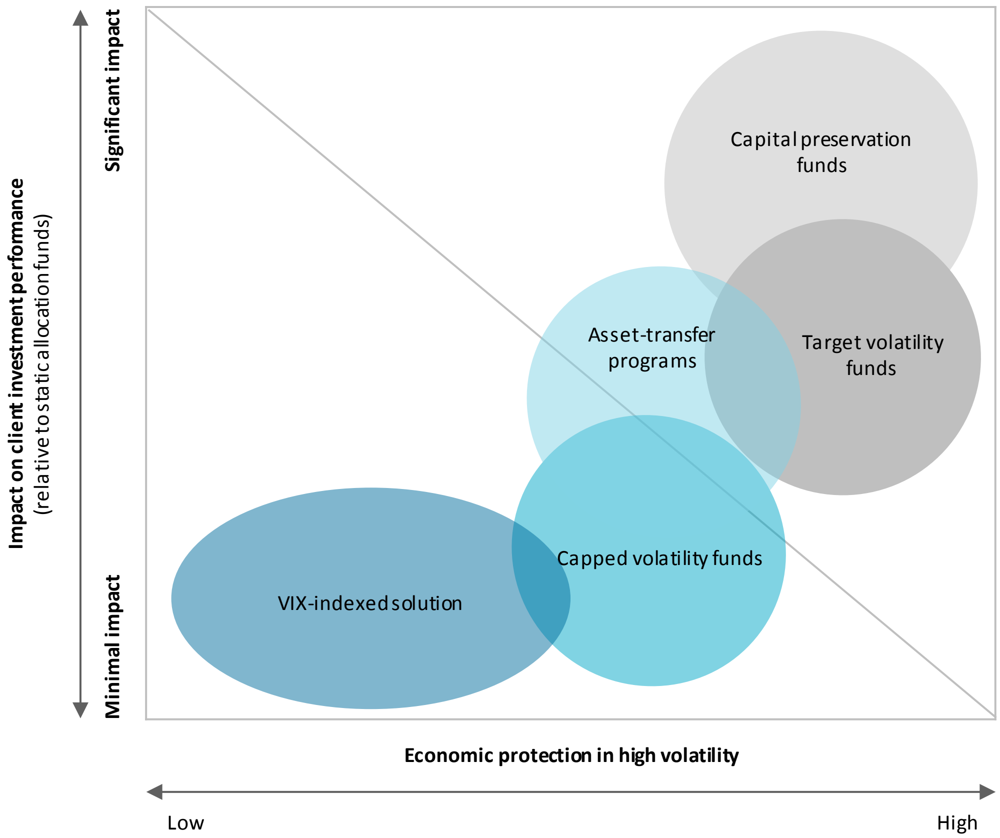
Section contents compare the “next generation” solution against existing solutions using the same client and insurer metrics examined previously.

4.1. MOTIVATION FOR A “NEXT GENERATION” SOLUTION

Prior sections explored insurers’ recent challenges with risk-control fund strategies, including the inability to define suitable benchmarks for performance purposes, loss of “upside potential”, and client and advisor skepticism of “black box” investing approaches. Each risk-control strategy discussed thus far experiences these challenges, albeit to varying extents.

Exhibit 24 summarizes the relative strengths and weaknesses of individual strategies by comparing the impact on investment performance versus level of volatility protection.

EXHIBIT 24: ILLUSTRATIVE ASSESSMENT OF THE IMPACT OF RISK-CONTROLS ON CLIENT INVESTMENT PERFORMANCE AND VOLATILITY PROTECTION



Source: Oliver Wyman analysis

More active fund-based strategies, such as capital preservation and target volatility, protect well against volatility risk in all environments but substantially alter the return profile of the underlying funds. On the other end of the spectrum, VIX-indexed fees and capped volatility fund solutions seems to only modestly affect client fund returns – but provide lower, albeit complementary, levels of volatility protection with only modest impacts on client returns. The complementarity of protection is by volatility environment – VIX-indexed fees protect better in “moderately high” volatility environments whereas capped volatility protects only in “spike” environments.

The reason VIX-indexed solutions tend to be less effective in “spike” volatility environments arises from the relationship between the P&L of a dynamic hedge program and the volatility of underlying fund returns. Dynamic hedge program P&Ls suffer volatility losses proportional to the square of volatility, whereas conventional VIX-indexed solutions (based on industry standards today) adjust fees linearly in response to changes in volatility. Exhibit 24 illustrates this phenomenon and describes when a VIX-based solution is most effective.

EXHIBIT 25: LIABILITY CONVEXITY AND EFFECTIVENESS OF VIX-INDEXED FEE RISK SOLUTIONS

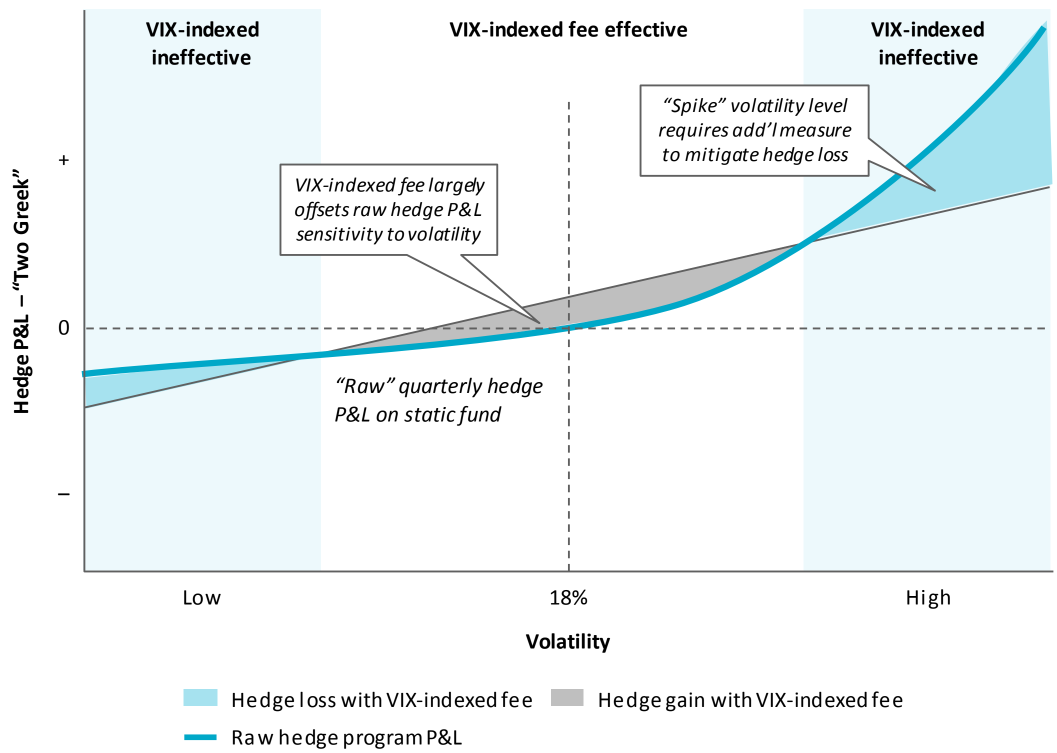


Exhibit 25 highlights the following properties of VIX-based solutions:

- Most effective in the "body" of the volatility distribution, defined as smaller deviations in volatility relative to norms. The VIX-based solution generates fees that would largely offset any hedge P&L losses due to volatility changes
- Least effective in the "tail" of the distribution, defined as "spikes" or "deep valleys" in volatility. This is because the incremental fees in a "spike" scenario are insufficient to offset the hedge P&L losses driven by the square of volatility, and reduced fees are too great in periods of extremely low volatility

We note a simple fee floor addresses the concern about the "deep valleys" in volatility – perhaps 30% below the long-run target fee level. However, "spike" volatility scenarios – the greatest concern to insurers – require additional protection beyond today's VIX-indexed fee solutions.

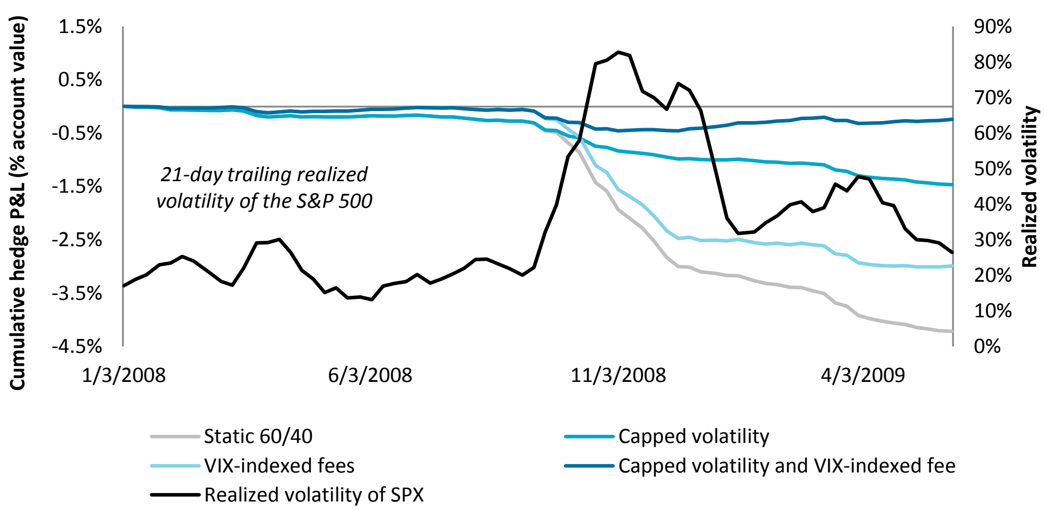
A capped volatility fund can provide exactly such additional protection in "spike" scenarios. This joint risk solution also minimizes the impact on client investment performance, as the risk-control overlays seldom affect underlying fund allocations except in the rare case of extreme spikes, where we anticipate a greater tolerance for deviations of fund returns from benchmarks.

The remainder of this section examines the performance of this solution and considerations for tailoring specific parameters.

4.2. ECONOMIC PERFORMANCE RESULTS

Combining VIX-indexed fee and capped volatility risk solutions have the potential to minimize the volatility-driven "convexity losses" and stabilize cash flows over time. Exhibit 26 illustrates how the joint solutions compared to its individual risk overlays on hedge P&L performance during the Financial Crisis. Note that for the simplicity of modeling the VIX-indexed solution, fees adjust based on the spot value of the VIX[4].

EXHIBIT 26: SIMULATED MANUFACTURER HEDGE PROGRAM PERFORMANCE DURING THE 2008–2009 FINANCIAL CRISIS (VIX-INDEXED AND CAPPED VOLATILITY SOLUTIONS)



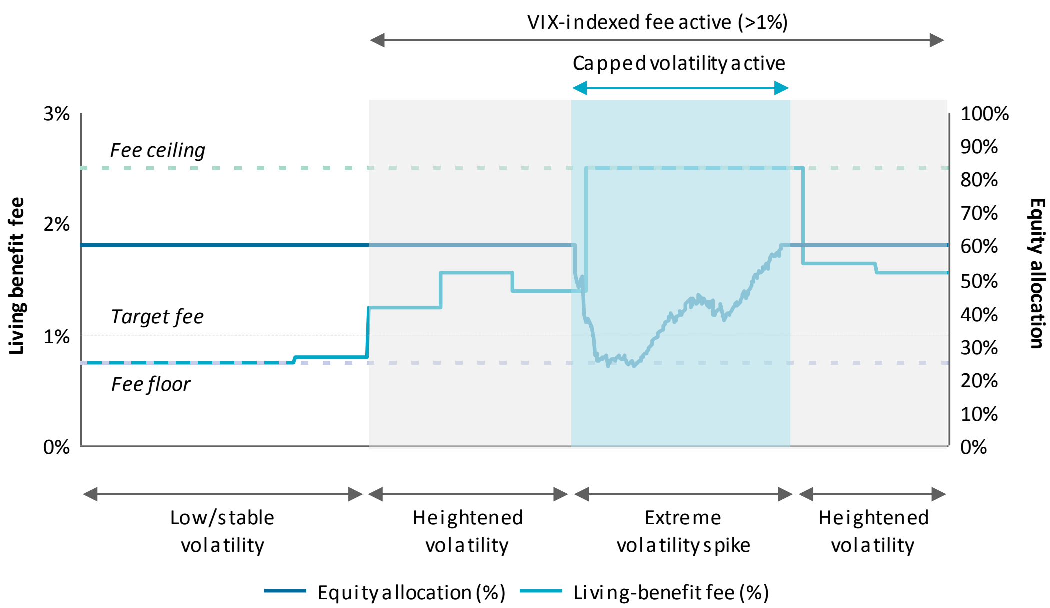
Source: Oliver Wyman analysis

The exhibit shows that a joint risk solution operates relatively better than its individual component overlays, resulting in a slight loss of -0.24%. The capped volatility fund provides the majority of the protection during the spike in volatility, and the incremental fees from the VIX-indexed component of the solution – while insufficient to offset hedge P&L losses completely – stabilize overall cash flows.

4 VIX-indexing may also occur based on pre-defined trailing average VIX to smooth adjustments in fees.

Exhibit 27 illustrates the underlying effects on fees and equity allocations of the joint risk solution in the lead up to, during, and shortly after the Financial Crisis. The VIX-indexed component of the solution is active (produces a rider fee greater than the target fee of 1%) during heightened and crisis periods of volatility. During the crisis, both the VIX-indexed fee and capped volatility features are active.

EXHIBIT 27: RISK CONTROL MECHANICS OF A JOINT CAPPED VOLATILITY AND VIX-INDEXED FEE SOLUTION



The joint "VIX-indexed and capped volatility" solution is also assessed against a subset of the insurer and client metrics discussed in Section 3. We observe the following:

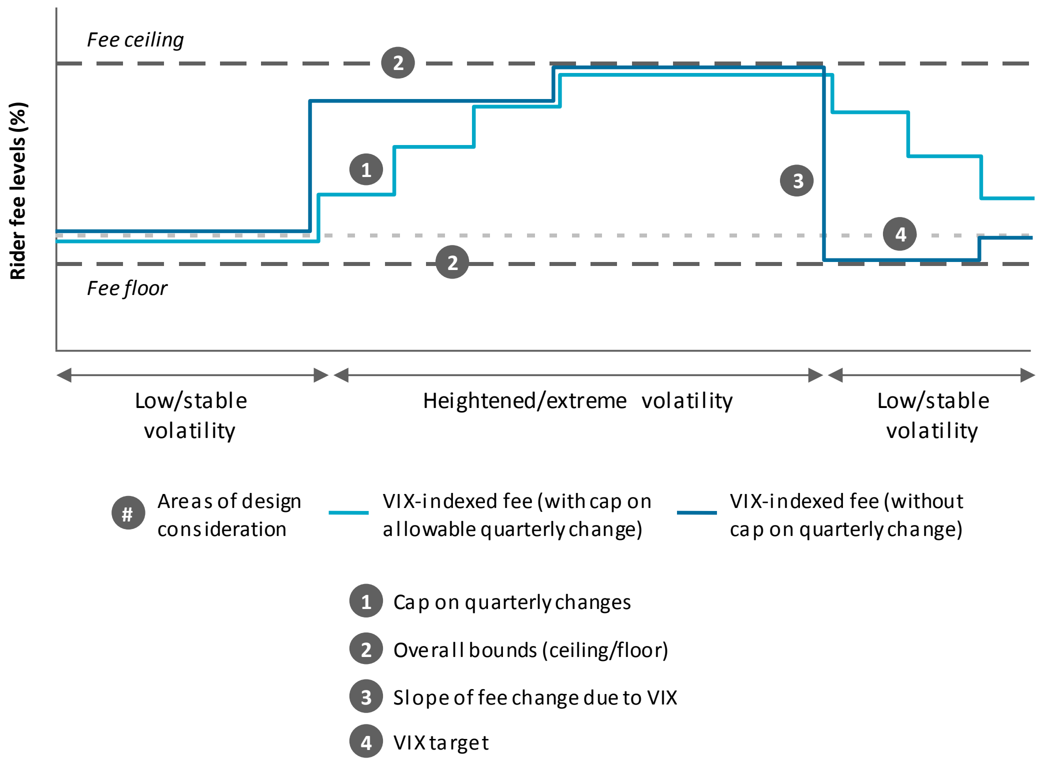
- **Insurer metrics:** The joint VIX-indexed and capped volatility solution provides additive protection in reducing "volatility cost" and Vega. The joint solution realizes a 40% "volatility cost" reduction and a 0.24% Vega, more effective than its individual component risk overlays. This arises because the VIX-indexed fee and capped volatility affect different aspects of VA product features. The notable reduction in Vega illustrates how well the solution stabilizes cash flows over time to changes in volatility
- **Client metrics:** As expected, the joint risk solution minimally affects client value metrics. The overall return performance of the joint solution is driven by a combination of the individual risk overlays based on when each is active. The level of volatility is driven by the capped volatility feature, which directly impacts fund allocation. Alternatively, prospective fees are driven by the VIX-indexed fee feature. Lastly, the joint solution does not have a discernible impact on guaranteed income withdrawal rates.

The above observations are illustrated in Exhibit 29 at the end of the next section.

4.3. PARAMETER CONSIDERATIONS

Insurers may further tailor the joint VIX-indexed and capped volatility solution to meet their risk management objectives. The capped volatility feature is straightforward to modify, given an insurer need only select a specific trigger level. Hence, this section will focus on the VIX-indexed fee parameters. Exhibit 28 illustrates the key parameters to discuss.

EXHIBIT 28: SOLUTION DESIGN ELEMENTS OF VIX-INDEXED FEE



The following describes a few considerations by each parameter and outlines the current market specifications used by industry participants.

Cap on quarterly changes	• Caps limit how much rider fees can adjust quarterly and moderate the overall volatility of the rider fee • Insurers should consider setting the fee to balance client needs versus their own risk management objectives • A VIX-indexed solution with a quarterly cap adjusts less quickly to prevailing VIX levels and provides less economic protection
Fee "floor" and "ceiling" boundaries	• Living benefit fees may be capped overall by a floor and ceiling, possibly in addition to a quarterly cap • These parameters allow insurers to collect a minimum rider fee in low volatility periods, and protect clients from very large fees in high volatility periods • Additionally, wider bounds allow fees to adjust more in line with changes in volatility, providing significant Vega reduction
Slope of fee change due to VIX	• The sensitivity of the rider fee to changes in the VIX index drives the level of volatility protection • We suggest insurers set the slope based on individual product characteristics, notably its at-issue "Vega" • Insurers may consider a slope value to complement the capped volatility trigger, so that when the VIX-based solution hits its ceiling, the capped volatility feature activates
VIX target	• The VIX target is the hurdle above and below which values of the VIX increase or decrease rider fees, respectively • This parameter depends on insurers' expectations of future volatility and regarding competitor fee levels

See Appendix C: "Next generation" solution sensitivity analysis, for a summary about how these parameters affect select insurer and client metrics. Manufacturers should explore the parameters with their product design teams to find a solution that best meets their company's and clients' needs.

Exhibit 29 illustrates how a joint "VIX and capped volatility" solution performs relative to its component overlays and a static 60/40 fund. Key section conclusions are as follows:

- Joint "VIX-indexed fee and capped volatility" risk solution provides holistic protection for insurers (in "body" and "tail" of market risk distributions)
- Joint solution balances client concerns and is better able to address common challenges such as performance benchmarking and preserving "upside" potential
- Insurers can tailor parameters to realize greater risk management benefits (especially "Vega" reduction), depending on their company's and clients' objectives

EXHIBIT 29: JOINT RISK SOLUTION (COMBINED VIX-INDEXED AND CAPPED VOLATILITY) IMPACT ON SELECT METRICS UNDER BASELINE ASSUMPTIONS

	Measure			Joint risk solution	Capped volatility	VIX-indexed fee	Static 60/40 fund
Insurer metrics	Reduction in "volatility cost" of guarantee			40%	15%	26%	N/A
	Vega – impact of a 1% reduction in volatility (% premium)			0.24%	0.40%	0.36%	0.53%
	Stability of hedge P&L (2008 hedge gain/loss)			-0.24%	-1.47%	-2.99%	-4.22%
Client metrics	Returns and volatility character-istics	2000–2009	Returns	-0.61%	-0.25%	-0.73%	-0.37%
			Volatility	11.05%	11.05%	12.92%	12.92%
		2010–2017	Returns	6.06%	6.05%	6.20%	6.19%
			Volatility	8.51%	8.52%	8.65%	8.65%
	(Historical) Fees paid – average			101 bps	100 bps	101 bps	100 bps
	(Prospective) Fees paid – average			109 bps	100 bps	109 bps	100 bps
	(Prospective) Initial withdrawal rate at 5%			8.7%	8.8%	8.8%	8.8%

Appendix D: Summary of results provides a complete overview of all metrics assessed in this paper across existing and "next generation" solutions.

5. CONCLUSIONS

The advent of volatility management solutions since the Financial Crisis represented a substantial step-forward in the provision of secure retirement income products to the retail marketplace. By transferring largely unwanted investment risks back to the capital markets, "first generation" volatility management solutions enabled insurers to offer more generous retirement guarantees without material sacrifice to the client investment thesis.

However, with the rapidity of introduction, several challenges emerged with these solutions that no single risk control solution adequately could address completely.

Analysis of five common volatility management solutions in the marketplace today – plus a "next generation" joint solution that combines a VIX-indexed fee and a capped volatility feature – highlight considerations relevant for insurers contemplating the introduction, augmentation, or removal of risk-controls in their products. These key considerations are as follows:

- Risk-control features provide material risk management benefits, albeit to varied extents, and their removal must be considered strongly
- The type of market environment affects the effectiveness of risk solutions. All risk-control features are effective in the "body" to an extent, but risk-control funds and asset-transfer programs are the most effective in "tail" scenarios. VIX-indexing solutions provide insufficient protection in volatility "spikes"
- More invasive risk-control overlays – such as capital preservation and target volatility – have historically experienced the greatest challenges due to lack of performance transparency and persistent benchmark deviation. VIX-indexed and capped volatility funds historically have minimally affected investment performance
- Potential "next generation" solution combines VIX-indexed fee and capped volatility to balance the risk management benefit against client and advisor perception
- Insurers can tailor such a "next generation" solution to their specific product and risk appetite in a straightforward manner

Given the rapid adoption of volatility management solutions within VAs and their adoption in the broader marketplace, we anticipate continued interest in these controls and a push by insurers for innovative solutions that overcome challenges while providing significant risk management benefits.

APPENDIX A: PRODUCT DESIGN AND MODELING METHODOLOGY

Oliver Wyman applied its proprietary annuity customer value model to project cash flows and accumulation values for volatility management products across a series of economic scenarios. This appendix discusses the key assumptions that went into defining the product testing and aspects of the methodology.

BASE PRODUCT AND GLWB DESIGN SUMMARY

The following table lists the base design features implemented for the VA product tested in this paper.

	Feature	**Product design assumption**
General	MER	1.30%
	Surrender charges	8/7/6/5/4/3/2/0
	Equity risk allocation	60% equity/40% bond
Death benefit (DB)	DB fee	0%
	DB type	Return of Principal (ROP)
Living benefit (LB)	LB fee	1.00%
	LB type	Withdrawal benefit (WB)
	Roll-up term	10 years
	Roll-up rate	6% simple
	Ratchet	Annual (<85 years)
	Annual withdrawals	3.% for ages 55 to 59 4% for ages 60 to 64 5% for ages 65 to 74 6% for ages 75+

ECONOMIC SCENARIOS AND INVESTMENT RETURNS

The analysis uses Monte Carlo simulations specifically calibrated for both risk-neutral evaluation (for insurer perspectives) and real world (for client perspectives). Model results were produced along 1,000 economic scenarios produced via a proprietary economic scenario generator. For the risk-neutral analysis, the inputs are as follows:

- Equity and bond returns and interest rates were simulated using stochastic log volatility models developed by Oliver Wyman, which were calibrated to market observable prices and measures
- A volatility surface was generated using a stochastic, auto-regressive model and calibrated to a market-based forward volatility curve
- Real-world scenarios were generated using a similar methodology but were adjusted for bond risk premiums, average long-run equity returns, and were adjusted for volatility risk spreads in simulating values of the VIX

All guarantee modeling in this paper assumes an underlying portfolio allocation of 60% equity and 40% fixed income. Equity returns are assumed to follow the S&P 500 and fixed income returns are assumed to follow the Barclays US aggregate bond index.

ACTUARIAL AND CLIENT BEHAVIOR ASSUMPTIONS

The model incorporates the following assumptions:

- Mortality: Based on a 55% male/45% female blend of the Annuity 2000 mortality tables. A mortality improvement factor (Projection scale G) was applied to reflect diminishing rates of mortality over time
- Lapse: Lapses incorporate a base lapse rate adjusted for a dynamic lapse factor:
  - *Base Lapse:* is a function of surrender charge schedule where policy year 1 lapse rates are 2%, year 2 is 3%, year 3 is 4%, and years 4+ of the surrender charge period is 5%. A 35% lapse shock is applied after the end of the surrender charge period, followed by a 15% ultimate lapse rate thereafter
  - *Dynamic lapse factor:* is based on the moneyness of the living benefit (LB) rider, where the more in-the-money the contract is, the lower the lapse rates as policyholders have less incentive to lapse when the LB rider is rich. The following standard factor is used and is subject to a ceiling of 2 (doubling):

    $$Factor = Minimum(2, \left(\frac{Account\ value}{LB\ base}\right)^3)$$
- Withdrawals: Assume 100% utilization of maximum annual guaranteed withdrawals

- Mode cell weights: A simplified distribution of policyholder cell behavior is assumed as part of the risk-neutral analyses. The following table outlines the cell weights:

	Issue Age							
Withdrawal delay	45	50	55	60	65	70	75	**TOTAL**
Immediate					10%	10%	5%	**25%**
Unconditional 5			5%	20%	10%			**35%**
Unconditional 10		10%	15%					**25%**
Unconditional 20					15%			**15%**
TOTAL	**0%**	**10%**	**20%**	**20%**	**35%**	**10%**	**5%**	**100%**

APPENDIX B: VOLATILITY RISK MANAGEMENT SOLUTION DETAILS

Oliver Wyman modeled several volatility management programs to evaluate insurer and client value in terms of risk and cash flows. This appendix discusses the details of the modeled risk-control solutions:

1. Asset-transfer program
2. Capped volatility
3. Target volatility
4. Capital preservation
5. VIX-indexed fee

1. ASSET TRANSFER PROGRAM

The goal of an asset-transfer program (ATP) is to adjust investment allocations based on guarantee moneyness and policy duration. The program measures guarantee moneyness via a defined ratio, which in turn is compared to a threshold to determine the amount of discretionary holdings subject to a compulsory allocation into insurer-controlled fixed income funds. The ratio and threshold are calculated as follows:

$$Guarantee\ Ratio\ (GR) = 1 - \frac{Account\ value}{Benefit\ base}$$

$$Threshold = minimum(50\%, 10\% + policy\ duration\ x\ 2\%)$$

Note that the policy duration is measured in years. The amount that the guarantee ratio exceeds the threshold, subject to some band, determines the allocation. If this band is set to 10%, the proportion to allocate into a fixed income fund is given as follows:

$$Allocation = \frac{GR - Threshold}{band} = \frac{GR - Threshold}{0.1}$$

Assuming a target 40% fixed income allocation, the asset-transfer program could re-allocate funds to anywhere between 40–100% in fixed income. For example, if the guarantee ratio is 30% and the threshold is 20%, the allocation would be 100%.

2. CAPPED VOLATILITY

The goal of the capped volatility feature is to reduce the fund's equity exposure when the realized equity volatility of the fund rises above a trigger level. For the purposes of the paper, this trigger level is set as 30%. The realized equity volatility is monitored on a daily basis and calculated as the 21-day trailing realized volatility, as follows:

$$\sigma = \sqrt{\frac{252 \sum_{j=1}^{21} r_j^2}{21}}$$

Where r_j is equal to the weighted average daily return of the equity portfolio.

If the realized equity volatility exceeds the 30% volatility cap, the portfolio is de-risked using futures. The de-risking amount is determined based on an "equity ratio":

$$Equity\ ratio = minimum(100\%, \frac{30\%}{realized\ equity\ volatility})$$

The equity ratio is then multiplied by the target equity allocation to determine the new equity allocation. The equity ratio is calculated on a daily basis, and the portfolio is continually de-risked until the realized equity volatility is below 30%. Then, the equity allocation is moved back to normal levels.

3. TARGET VOLATILITY

The goal of the target volatility feature is to use futures to target a short-term annualized volatility of the fund to a pre-defined value, which in this case is set to 15%. The equity position is reduced if the short-term equity volatility exceeds 15% and is increased if the volatility measure falls below 15%. The target volatility fund additionally allows for leverage, where cash is borrowed to increase the equity allocation above its target.

The short-term equity annualized volatility is calculated similarly to the formula specified for the capped volatility feature. The de-risking amount is determined on the basis of an "equity ratio", calculated as:

$$Equity\ ratio = minimum(110\%, \frac{15\%}{realized\ equity\ volatility})$$

The 110% maximum is set to allow for leverage. The equity ratio is then multiplied by the target equity allocation to determine the new equity allocation on a daily basis.

4. CAPITAL PRESERVATION

The capital preservation feature extends the target volatility mechanics with the goal of further hedging equity volatility. On a daily basis, the futures position is set based on the target volatility strategy, adjusted by the delta position of a rolling five-year put option. The “equity ratio” is reduced by this amount of delta, and is then multiplied by the target equity allocation to determine the new equity allocation.

The moneyness of the put-option is adjusted for equity returns and is gradually restored to an at-the-money level. A rate of reversion of 5% is applied to the strike price of the put-option, and is expressed as $Strike = Strike + 0.05\ x\ (Spot - Strike)$, where the strike resets at the start of every month.

5. VIX-INDEXED FEE

The goal of the VIX-indexed fee feature is to adjust LB rider fees in line with changes in the VIX, a measure of short-term implied volatility. The product in this paper assumes an initial lock-in period where the fee stays at the base fee level for the first year before adjusting on a quarterly basis. The living benefit fee is calculated as the base level fee and an adjustment amount that modifies the base fee by an incremental number of bps for every unit the VIX is above a target VIX threshold. The quarterly living benefit fee is based on the following expression:

$$Living\ Benefit\ Fee = Base\ Fee + VIX\ sensitivity\ x\ (VIX - VIX\ target)$$

$$Living\ Benefit\ Fee = 100\ bps + 10\ bps\ x\ (VIX - 20)$$

Where the overall living benefit fee is bound by a ceiling of 250 bps and a floor of 75 bps. Note that for model simplicity, the VIX parameter in the above expression uses spot values, but there are other ways of applying the VIX (e.g. trailing average VIX).

APPENDIX C: "NEXT GENERATION" SOLUTION SENSITIVITY ANALYSIS

The first exhibit illustrates the impact of various isolated parameter changes on a joint "VIX-indexed fee and capped volatility" solution across select metrics. The second looks at the combined impact of changes in the overall bounds and other parameters.

JOINT CAPPED VOLATILITY AND VIX-INDEXED FEE SENSITIVITY ANALYSIS

		Insurer metrics			*Client metrics*		
Feature	**Scenario**	**Reduction in "volatility cost"**	**Vega**	**2008 hedge P&L gain/ loss**	**Historical returns ('00–'09, '10–'17)**	**Prospective average fees [2]**	**Withdrawal rate% at 70[2]**
	Baseline assumptions[1]	40%	0.24%	-0.24%	2000–2009 -0.61% 2010–2017 6.06%	109 bps	8.72%
1 Cap on quarterly changes	Add quarterly cap (30 bps)	25%	0.25%	-0.63%	2000–2009 -0.56% 2010–2017 6.13%	101 bps	8.75%
2 Overall bounds	Increase in fee ceiling (to 5%)	49%	0.20%	+0.10%	2000–2009 -0.69% 2010–2017 6.03%	111 bps	8.72%
	Decrease in fee ceiling (to 2%)	33%	0.26%	-0.57%	2000–2009 -0.54% 2010–2017 6.10%	106 bps	8.73%
	Decrease in fee floor (to 0%)	8%	0.15%	-0.24%	2000–2009 -0.44% 2010–2017 6.24%	97 bps	8.77%
3 Slope of fee change due to VIX	+5 bps in VIX multiplier (15 bps)	51%	0.22%	-0.12%	2000–2009 -0.74% 2010–2017 6.04%	115 bps	8.71%
	-5 bps in VIX multiplier (5 bps)	24%	0.28%	-0.69%	2000–2009 -0.42% 2010–2017 6.10%	101 bps	8.75%
4 VIX target	+2% point in VIX target (18%)	55%	0.22%	-0.09%	2000–2009 -0.76% 2010–2017 5.95%	119 bps	8.70%
	-2% point in VIX target (22%)	28%	0.26%	-0.39%	2000–2009 -0.49% 2010–2017 6.12%	101 bps	8.75%

Notes: 1) Baseline assumptions for the VIX-indexed portion of the solution: no cap on quarterly change, floor of 75 bps, ceiling of 250 bps, target fee of 100 bps, VIX sensitivity of 10 bps, VIX threshold of 20, and spot VIX used; 2) Reflects (i) average prospective fees and (ii) initial withdrawal rates at age 70, for a policyholder aged 55 with withdrawals starting after 10 years (at the age of 65).
Source: Oliver Wyman analysis

IMPACT ON "VEGA" OF MODIFYING OVERALL BOUNDS AND OTHER VIX-BASED PARAMETERS

2		**Overall ceiling**	**2.50%**	**5.00%**	**5.00%**	**2.50%**
		Overall floor	**0.75%**	**0.00%**	**0.75%**	**0.00%**
	Feature	**Scenario**	**Baseline bounds**	**Widened bounds**	**Upper bound increased**	**Lower bound decreased**
		Baseline joint 'VIX and capped vol' solution	0.24%	0.11%	0.20%	0.15%
1	Cap on quarterly changes	Add quarterly cap (30 bps)	0.25%	0.15%	0.25%	0.15%
3	Slope of fee change due to VIX	+5 bps in VIX multiplier (15 bps)	0.22%	0.04%	0.15%	0.11%
		-5 bps in VIX multiplier (5 bps)	0.28%	0.24%	0.28%	0.25%
4	VIX target	+2% point in VIX target (18%)	0.22%	0.11%	0.18%	0.15%
		-2% point in VIX target (22%)	0.26%	0.12%	0.23%	0.15%

Source: Oliver Wyman analysis

We observe the following results based on the exhibits:

- Across parameters, historical investment performance, historical volatility, and policy parameters are relatively unaffected. The baseline joint risk- solution realizes the majority of benefits in reducing volatility, and any minor deviation is driven by differences in fees collected
- A quarterly cap reduces average fees collected due to how it moderates both increases and decreases in volatility. In turn, this increases the "volatility cost" and generates less incremental fees to reduce hedge P&L losses in the Financial Crisis
- Changes in fee ceilings only tend to have relatively little impact on insurer and client metrics, with the exception of during crises. The overall ceiling is seldom realized in most periods; however, the impact on hedge P&Ls is more apparent during crisis levels of volatility, where the ceiling is more likely to be achieved
- Changes in fee floors have a greater impact than changes to fee ceilings across parameters. There is a sizeable reduction in fees, given lower volatility levels on average; however, there is also a greater reduction in Vega due to the matching of fees to changes in guarantee costs due to volatility
- The slope and VIX targets, similar to the quarterly cap, are the most sensitive parameters. However, when combined with a widening of overall bounds (ceiling and floor), the slope parameter has the potential for much greater Vega reduction

APPENDIX D: SUMMARY OF RESULTS

	Objective	Metric	Measure	Static 60/40	ATP	Capped volatility	Target volatility	Capital preservation	VIX-indexed fees	Joint "VIX / capped vol" solution
Insurer perspective	Write profitable business	Guarantee cost	Reduction in "volatility cost" of guarantee	*N/A*	62%	15%	61%	94%	26%	40%
	Stabilize ALM and hedging performance	Hedge ratio	Vega – impact of a 1% reduction in volatility (% premium)	0.53%	0.25%	0.40%	0.12%	0.03%	0.36%	0.24%
		Hedge-ability	Stability of hedge P&L (2008 hedge gain/loss)	4.2%	-1.3%	-1.5%	~0.0%	+0.6%	-3.0%	-0.2%
		"Basis risk"	% of weeks that have a non-zero equity allocation change	*N/A*	*N/A*	4%	48%	99%	N/A	*Not tested*
Client perspective	Maintain investment upside potential	Return and volatility characteristics	• 2000–2009:							
			– Returns	-0.37%	*N/A*	-0.25%	-0.55%	-0.06%	-0.73%	-0.61%
			– Volatility	12.92%	*N/A*	11.05%	8.19%	5.26%	12.92%	11.05%
			• 2010–2017:							
			– Returns	6.19%	*N/A*	6.05%	5.40%	2.82%	6.20%	6.06%
			– Volatility	8.65%	*N/A*	8.52%	7.60%	4.55%	8.65%	8.51%
		Long-term equity allocation	• Average allocation to real investments							
			– 2000–2017	60%	*N/A*	59%	55%	33%	60%	*Not tested*
			– 1970–2017	60%	*N/A*	59%	58%	45%	60%	*Not tested*
		Cumulative fees paid	• (Historical) Average fees (1970–2017)	100	*N/A*	100	100	100	101	101
			• (Prospective) Fees paid							
			– Average	100	100	100	100	100	109	109
			– 75th %-ile	100	100	100	100	100	114	*Not tested*
			– 25th %-ile	100	100	100	100	100	105	*Not tested*
	Minimize impact to guarantee value	Guaranteed income levels	• (Prospective) Initial withdrawal rate of							
			– 5%	8.8%	8.7%	8.8%	8.4%	8.1%	8.8%	8.7%
			– 5.5%	*N/A*	9.6%	9.6%	9.2%	8.9%	9.6%	*Not tested*

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