



Variable Annuities—An Analysis of Financial Stability

March 2013

The Geneva Association

(The International Association for the Study of Insurance Economics)

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Variable Annuities—An Analysis of Financial Stability

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- *Systemic Risk in Insurance—An analysis of insurance and financial stability*, published in February 2010. This document provides a description of the fundamental role of insurance in financial stability and examines whether systemic risk exists in insurance.
- *Key Financial Stability Issues in Insurance*, released in July 2010, comprises analytical work carried out on specific issues that had been raised by regulatory and supervisory counterparts in areas such as investment management, liquidity management, limits of insurability, crisis resolution mechanisms in insurance and the confused concept of an “insurance run” (supposedly akin to a bank run).
- *Considerations for Identifying Systemically Important Institutions in Insurance*, published in April 2011 which details the development of a comprehensive approach for identifying potentially systemically risky activities and the entities that carry them out.
- *Insurance and Resolution in Light of the Systemic Debate*, was published in February 2012 to respond to the need for a more detailed analysis of how insurance recovery and resolution mechanisms work. It examines existing features of recovery and resolution mechanisms in insurance and their relation to ongoing international supervisory and regulatory discussion on systemic risk. It also proposes recommendations for possible measures to increase the existing resilience of financial systems.
- *Surrenders in the Life Insurance Industry and their Impact on Liquidity* was published in August 2012. Offering a comprehensive understanding of the effects of liquidity stresses in insurance, this report seeks to highlight the mechanisms and existing resilience and responses of the industry to liquidity crunches and thereby provides a basis of understanding for any further discussions on the issue.

This most recent report, the sixth in the FSI series, is based on the work of the Variable Annuities Working Group, a subgroup to the FSI-WG, that was co-chaired by Daniel Haefeli at The Geneva Association. The working group included the following members: Blaise Bourgeois, AXA; Josh Braverman, AXA-Equitable; Marc Costantini, Manulife; Regynald Heurtelou, MetLife; David Hopewell, Transamerica-Aegon; Stefan Jaschke, Munich Re; Lisa Klukinsky, MetLife; Nick Lane, AXA-Equitable; Makoto Okubo, Nippon Life; Sellan Paolo, Generali; Bryan Pinsky, Prudential Financial; Bill Schwegler, Transamerica-Hegon; Yiji Starr, Manulife; and Vadim Zinkovsky, MetLife.

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Executive summary

The aim of this paper is to elaborate on the characteristics and management of variable annuities and to evaluate how variable annuities should be considered in the discussion on systemic risk¹ in the insurance industry.

Variable annuities fulfil a compelling social need of the ageing population worldwide by providing a product that delivers certainty of income in retirement. This at a time when the growing cohorts of the baby-boomer generation are reaching retirement age. At the same time, other sources of retirement income are increasingly unsustainable (e.g. state pensions) and disappearing (e.g. defined benefit plans). As a result, variable annuities have seen a substantial increase in sales over the last two decades in most markets in contrast to other sources of retirement income and other insurance products that have not gained the same level of market appeal. Well managed, variable annuities alleviate the risk for millions of individuals worldwide to outlive their assets in retirement.

Variable annuities are carefully regulated products. The frameworks for reserving and capital allocations to back variable annuities are clearly defined in all the jurisdictions in which variable annuities are currently available, for example, the U.S, Canada, Europe and China. Further regulatory strengthening has also taken place in the wake of the financial crisis² and variable annuities are carefully monitored by local and group supervisory authorities who commonly subject companies to further internal model and economic capital risk measures.

Variable annuities share many features of other insurance products. They bundle insurance risk, market risk, and behavioural risk, and pool idiosyncratic risks. Like other insurance products, variable annuities have an inverted production cycle: premiums are paid upfront and contractual payments are made many years in the future when an insured event occurs. Variable annuity writers follow a liability driven investment approach designed to manage the risks so that any product guarantees can be paid when they fall due.

In a number of aspects however, variable annuities differ from other insurance products. They provide more choice, within limits, to the policyholder regarding their benefits over the course of the policy. Moreover, they typically provide greater transparency on the market value of the invested funds and the associated guarantees and fees. It is this greater transparency coupled with enhanced policyholder flexibility which requires the insurer to monitor the value of all the relevant guarantees frequently. Variable annuities receive significant attention by companies, management and supervisors as well as require sophisticated IT systems, actuarial models and highly qualified specialists.

1 We use the Financial Stability Board definition of systemic risk as “the risk of disruption to the flow of financial services that is (i) caused by an impairment of all or parts of the financial system; and (ii) has the potential to have serious negative consequences for the real economy.”

2 E.g. C-3 Phase II, actuarial guideline XLIII in the U.S. and the Irish-based reserving framework.

Even if they appear more complex, variable annuity products entail the same risk factors as other life and savings products and are carefully managed to reduce risk exposures. The main risks of variable annuities are insurance risk, market risks and policyholder behaviour risks. Variable annuity writers have developed many tools to manage these risks including product design, risk pooling, asset liability management and a diverse overall balance sheet which provides natural hedges.

Variable annuity writers use derivatives (hedging) for risk management purposes, not to speculate. The derivatives are actively managed through dedicated hedging programmes and teams. Similar to other products variable annuity writers follow a rigid asset liability management approach. The increased policyholder flexibility requires however a more frequent reassessment of the hedging positions commonly referred to as dynamic hedging. Dynamic hedging programmes are not set up with the aim of making speculative gains but are designed and applied according to strict risk management rules to mitigate exposures to various market movements stemming from the guarantees provided to policyholders.

Variable annuity hedging programmes have proven effective for insurers even during the years of the financial crisis. Studies show that hedges achieved 93 per cent effectiveness, saving the industry during the two months of September and October 2008 alone an amount of roughly US\$ 40bn without causing counterparty problems.³

Strong enterprise risk management systems (ERM) are in place for the management of variable annuity portfolios based on more than thirty years of actuarial, financial mathematics and IT infrastructure development.

Derivatives are valuable instruments in the management of variable annuities. Insurers' use of derivatives represents a fraction of overall derivative markets. Annual National Association of Insurance Commissioners' (NAIC) surveys and various investment bank derivative market reports show that the total U.S. insurance industry derivative positions (comprising the totality of life and savings activities) represent less than 1 per cent of total volumes worldwide. Variable annuity hedging programmes typically operate using the most liquid exchange-traded and over the counter (OTC) derivative instruments that exist in the world (e.g. U.S. bond treasury futures, S&P500 futures, US\$, EUR and JPY swaps, swaptions and equity put options). The use of derivatives to manage any liability driven business is a sound risk practice that does not pose any form of systemic risk irrespective of the portfolios size or interconnectedness.

Counterparty risk management is an integral part of an insurer's ERM framework.

In order to understand the impact of potential events on a variable annuity writer and how this may be considered in light of the systemic risk discussions, it is important to consider how the product and the variable annuity writer are connected with other players in the financial sector. Variable annuity writers use derivatives to reduce the same risks naturally present in any life and savings product that provide financial or insurance-type guarantees. Without the usage of derivatives, the insurer's financial results would suffer greater volatility with the commensurate implications for the stability of the company and the overall financial system.

There are a number of scenarios that can negatively impact insurers writing variable annuities. The report addresses the scenarios considered to be the most critical ones. However, even in case of a disruption of derivative markets the evidence suggests variable annuity writers would not create or amplify a systemic risk event that originated elsewhere in the financial system.

Furthermore, the impact of stress scenarios will vary by insurer due to the differing nature of its variable annuity book, the particularities of its overall insurance portfolio and its individual risk management strategy. The scenarios considered in this report cover adverse financial market

³ Sun *et al.* (2009), Chopra *et al.* (2009).

conditions, increased hedging transactions costs or unavailability of hedging, and a shortfall of reserves.

Diversification within variable annuity portfolios, and across variable annuity portfolios and other life and savings' business lines. As for any insurance activity variable annuity portfolios are diversified in a number of ways including, but not exclusively, by the number of policies, the time of sale and the variety of products and product features.

Variable annuities inherently entail various degrees of countercyclical components. Clients value the guarantees offered to them by the policies and are therefore unlikely to initiate fire sales of their investments when markets trend down—experience indicates quite the reverse effect. Also, the ultimate holders of variable annuity guarantees are retail clients whose reactions are less sophisticated than those of institutional investors.

To the extent variable annuity writers have diversified balance sheets (often the case for multinational composite companies), losses arising from the variable annuity activity may find natural hedges with other lines of business such as mortality risk offsetting longevity risk which is typically a very important component in variable annuity portfolios.

In the detailed analysis of the potentially adverse scenarios for variable annuity writers, **our research did not identify a scenario that would make a variable annuity writer a source or amplifier of systemic risk to the global financial system** and the wider economy. Experience has shown that life insurers, including variable annuity writers, can to a certain extent, absorb, rather than amplify or accelerate, risks received from counterparties or from extreme scenarios.

1. Background

Variable annuities (VAs), as they are known in the United States (U.S.), are life and savings unit-linked insurance products which offer various types of financial guarantees and/or living benefits to fulfil various client needs. In Europe, they are characterised as unit-linked products with external and individual guarantees. In Canada, they are often referred to as segregated funds products. They are fully regulated insurance products in all developed insurance markets.

Variable annuities are long-term life insurance contracts between individuals and an insurer used for retirement and other long-term savings/income purposes. Variable annuities typically allow policyholders to accumulate assets during an “accumulation phase” and provide income during a “withdrawal phase” and an “insured phase,” subject to an automated withdrawal coupon or an individual client choice to annuitise its accumulated asset base.”

While this paper will focus on variable annuities, it is important to understand there are several types of annuities, all of which carry varying levels of risk and guarantees.

Annuities are sold as either immediate annuities, which begin making annuity payments immediately, or deferred annuities, which defer the onset of annuity payments until some later date (typically when the annuity owner retires). During the deferral or accumulation phase, the annuity owner makes premium payments into the annuity and the savings inside the annuity grows to maximise the later annuity payments back to the annuity owner. Annuities provide a variety of features designed to meet different needs. Depending on risk tolerance, an owner can choose a fixed annuity, which provides stable returns, or a variable annuity which is backed by equity investments for potentially greater, but less certain, returns. Variable annuities also provide policyholder access to funds and have a different policy structure, with policyholder funds being invested in a “separate account” apart from other insurer assets.

In what follows, we will explore the deferred variable annuity in more detail. Specifically we will look at its development over time and the utilisation of optional riders as a way to provide income to the investor.

The variable annuity initially enters the accumulation phase (investment component) during which the policyholder is able to allocate the account value to several underlying subaccounts of the insurer’s separate account.⁴ The subaccounts have many characteristics similar to a mutual fund, including the policyholder bearing the investment risk as the account values will change to reflect the performance of the subaccounts.

The withdrawal phase starts when the policyholder begins taking regular withdrawals from the assets invested in the variable annuity. The withdrawal rates are usually determined by rates guaranteed by the insurer at the time the variable annuity contract is issued.

4 ACLI (2011).

The policyholder enters the insured phase only if their investment account value has been reduced to zero as a result of the compliant withdrawals, investment losses or other charges as specified in the contract. The risk for providing the withdrawal amounts for both the selected period of time and at the predetermined rates is borne by the insurer. In light of the risks covered by the contract, only a regulated insurance entity may issue variable annuity contracts.

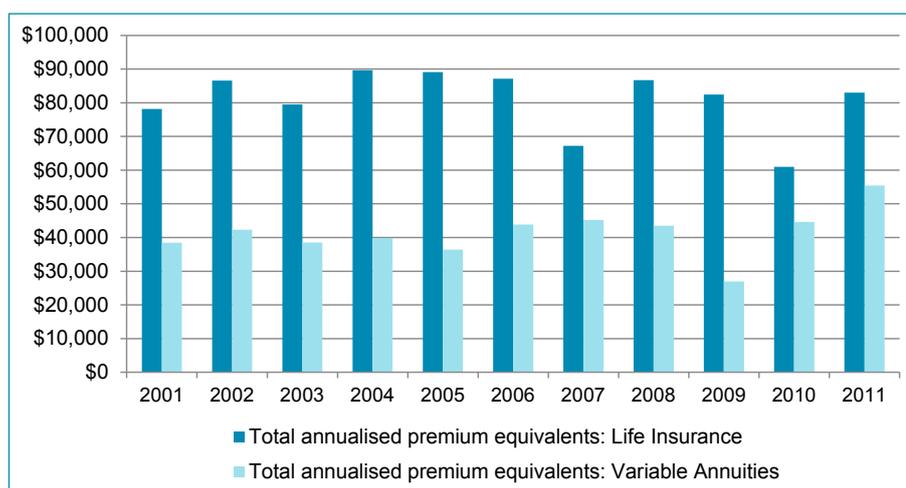
Optional benefit riders on variable annuity contracts have been made widely available by nearly all large annuity writers. These benefit riders fall under the generic terms of either Guaranteed Minimum Income Benefits (GMIB) or Guaranteed Minimum Withdrawal Benefits (GMWB), collectively known as GMxBs. Similar to annuitisation, GMxBs give the annuity owner the right to receive specific guaranteed income amounts, even if the annuity value has been depleted. In addition to guaranteed income, GMxBs also provide the investor with the advantage of remaining invested in the underlying subaccounts, provided the account value has not been depleted, and the flexibility to alter the frequency of the income programme.

1.1. Variable annuities in the context of other life insurance products

It is customary for annuity writers to have a large presence in traditional life insurance markets. Substantial scale in life insurance product lines provides a natural offset to the variable annuity business regarding mortality and longevity risks. Simply put, the risks of people dying sooner than expected in some products offsets some of the risks of people living longer than expected in some other products, especially those with GMWBs.

Figure 1 below shows a comparison of insurance sales and variable annuity sales in the U.S. Insurance sales have traditionally outpaced variable annuity sales, however variable annuity sales are becoming a substantial component of the life insurance offering in the U.S.⁵

Figure 1: Comparison of life insurance and variable annuity sales (US\$m)



Source: ACLI (2012).

5 For insurance: total annualised premium equivalents (APE) are comprised of 100 per cent of first year and renewal premiums and 10 per cent of single premiums sales. For variable annuities: total APE are comprised of 100 per cent of renewal premiums and 10 per cent of single and first year premiums and deposits sales.

1.2. Variable annuity market development

Variable annuities were introduced in the U.S. by the Teachers Insurance and Annuities Association-College Retirement Equity Fund (TIAA-CREF) in 1952.⁶ The modern day variable annuity market developed in the early 1990s in the U.S. Similar products were launched in Japan in the late 1990s and in the mid-2000s in Europe.

A strong bull equity market in the 1990s helped drive the sales growth in the U.S. as high-income earners searched for ways to invest on a more tax efficient basis. As shown in Figure 2, variable annuity sales doubled from 1993 to 1994 and were over four times higher by 1998.

Figure 2: U.S. variable annuity sales (LHS) and assets under management (RHS) from 1993 to 2011 (US\$m)



Source: Morningstar Annuity Research Center, 1993–2011 data.

Early product enhancements focused on providing protection features to the annuity purchaser in addition to the pure investment features the annuity already provided. The initial benefits were in the form of Guaranteed Minimum Death Benefits (GMDB). Initially a modest guarantee return of principal feature was added to the variable annuity contract insuring that an amount equal to at least the premium paid would be returned to the annuity's beneficiary when the triggering life dies. This feature was subsequently augmented to reflect any market gains on each contract anniversary. More recent GMDB improvements saw the introduction of minimum indexing benefits that increase the benefit at a predetermined rate resulting in a higher death benefit for the policyholder.

The variable annuity market in the U.S. underwent a shift beginning in the late 1990s as features moved away from tax-deferred accumulation and modest death benefits to optional guaranteed income and withdrawal benefits.

In 1998, insurers began to introduce a series of optional "Living Benefit" riders to variable annuity contracts known as Guaranteed Minimum Income Benefits (GMIB). These benefits enhanced the traditional payout guarantees of the variable annuity contract. In addition, they refocused the value proposition to the guaranteed income and insurance features of the product.

Similar to the traditional standard annuitisation provision, a GMIB rider guarantees a stream of income for a specific period of time (usually the policyholder's life) beginning at a predetermined date (usually at least ten years from the issuance of the annuity). The GMIB provided an additional layer of insurance to the payout phase. This new rider provided a minimum guaranteed annual

⁶ Poterba (1997), p. 24.

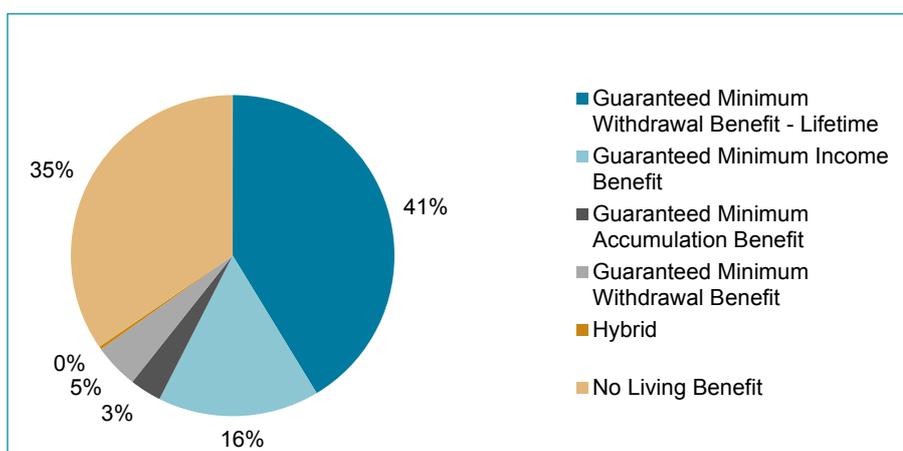
income based on a client’s purchase payments increased on an annual basis by a predetermined “roll up” percentage. Similar to traditional annuitisation, the election of income from a GMIB rider required an irrevocable decision by the investor.

The introduction of GMIB riders was the industry’s adaptation of the variable annuity as the American “baby boom” generation reached age 50, in order to meet the changing needs of these investors as they shifted their focus from asset accumulation to retirement income planning and asset decumulation. The ageing population combined with further product innovation drove annual retail variable annuity sales from US\$88bn in 1997 to over US\$137bn by 2000.

In 2002, the Guaranteed Minimum Withdrawal Benefit for Life (GMWB) was introduced as an optional rider on a variable annuity policy. The GMWB rider provided insurance features similar to the GMIB rider such as predetermined guaranteed lifetime income amounts together with additional client benefits. The rider provided the policyholder with the flexibility of choosing when to begin receiving the guaranteed income without the deferral period the GMIB rider required. The GMWB also allowed the policyholder to receive guaranteed payments through withdrawals from the policy without the requirement to enter into the irrevocable process of annuitisation.

Throughout the 2000s, GMWB riders proliferated across the U.S. industry. The ageing of the population combined with more robust GMWB riders led to greater acceptance of variable annuities by investors. Sales rose to over US\$183bn by 2007. By the third quarter of 2012, GMWB or GMIB riders were elected on over 62 per cent of new variable annuity sales in the U.S. as shown in the figure below.⁷ For most variable annuity investors, the use of optional riders represents the preferred method for annuitising retirement assets and providing insurance against both market risk and longevity risk through the use of a predetermined minimum future income.

Figure 3: Variable annuity assets by living benefit



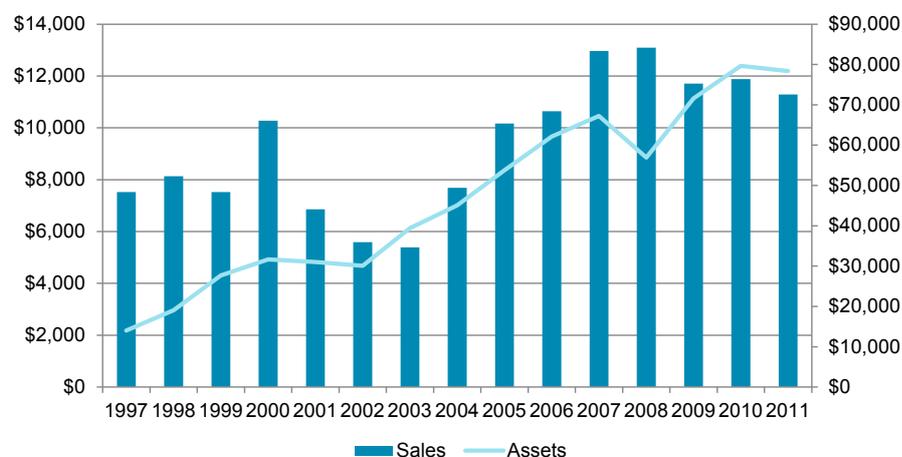
Source: LIMRA (2012a).

Similar sales results and consumer acceptance of variable annuities with guaranteed income and withdrawal benefit riders were witnessed in both Japan (the second largest variable annuity market) and in Canada.

Sales and asset increases in Canada are shown in Figure 4. The GMWB feature was introduced to the Canadian market in 2006-2007, leading to significant sales increases, which mirror the U.S. market.

⁷ LIMRA (2012a).

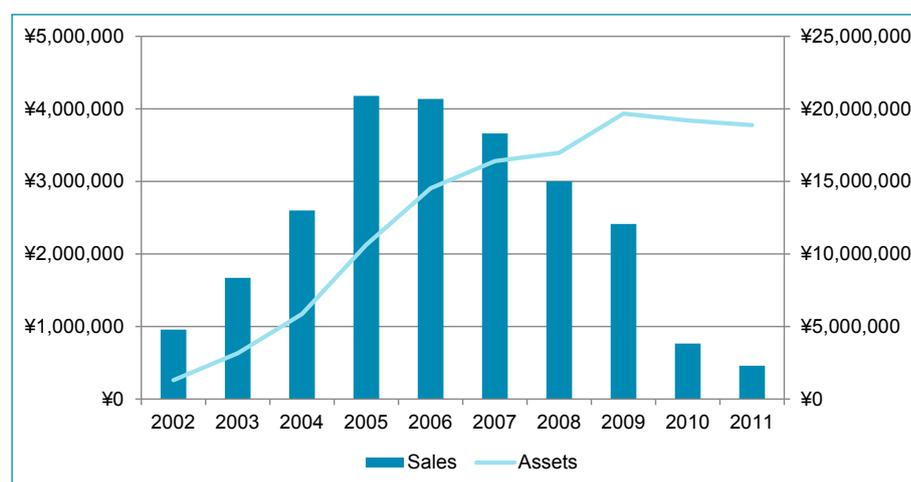
Figure 4: Canada variable annuity sales (LHS) and assets under management (RHS) from 2000 to 2011 (C\$m)



Source: LIMRA (2012a), as reported by participating companies.

The Japanese variable annuity market started around 2000 with GMDB-only variable annuities that mimicked U.S. variable annuities. They offered a variety of funds, with few, or no, fund restrictions. In 2002/2003, living benefits were introduced, beginning with fixed-term income and withdrawal benefits. Step-up benefits were few, if any, and funds were limited to fixed asset allocations of Japanese equities and bonds, and foreign equities and bonds. All asset classes were closely tied to market indices.

Figure 5: Japanese variable annuity sales (LHS) and assets under management (RHS) from 2002 to 2011 (JPYm)



Source: The Life Insurance Association of Japan, 2002–2011 data.

The rapid growth of this market was fuelled by the deregulation of variable annuity sales by banks. Banks quickly became the predominant distribution channel for variable annuities. The surge in sales was led by foreign players such as The Hartford, Citi Insurance, and ING. From 2003 to 2007, the products expanded to include lifetime guaranteed withdrawal products with more aggressive step-up benefits. Funds continued to be limited to fixed allocations of the four asset classes.

Once the financial crisis hit in 2008, many of the foreign players exited the market or significantly de-risked their products. Variable annuities quickly lost most of their sales momentum at this point, as banks found it much easier to sell fixed-interest rate annuity and life insurance products. Today, variable annuity sales have come down to pre-2008 levels in the JPY200-500bn range.

In Europe, the variable annuity market is even more recent with products being marketed as variable annuities since the mid 2000s. At the end of 2009 there were €168bn of technical provisions relating to variable annuities and €188bn at the end of H1 2010.⁸

1.3. Variable annuity market outlook

There are a number of signs that variable annuities have gained acceptance as mainstream retirement planning vehicles in the U.S. Industry sales and assets steadily tracked upward prior to the financial crisis and have shown signs of recovery following the crisis.

On a macro level, much of this success is attributable to the wave of ageing baby boomers approaching or entering retirement and who, as a result, are creating a huge demand for individualised retirement income-oriented solutions in the wake of increased longevity and declining pension security from both employers and the government. Moreover, persistent equity market volatility combined with prolonged low interest rates on fixed-income investments have only worked to highlight the value of the guaranteed income available to the policyholder through a variable annuity.

The direction of publicly supported pension plans, such as the Social Security system in the U.S., is well known. Given the ageing baby boomers, the ratio of current workers, who fund the Social Security system, to retirees, who receive Social Security benefits, is steadily declining. The U.S. Social Security programme was introduced in the 1940s and, in the mid 1950s there were approximately 8.6 workers for every retiree. As recently as 2000, there were 3.4 workers for every retiree. Currently, it's projected that by 2030 there will be only 2.1 workers per retiree.⁹

Those currently at or near retirement may expect their benefits to remain intact for many years to come. But it is also reasonable to expect that, at some point, future retirees may be subject to some type of benefit reduction or means testing.

A second retirement income source many people look to is the traditional “defined benefit” pension. However, the traditional pension is becoming a thing of the past. The percentage of American workers who have an employment-based defined benefit retirement plan has dropped from 84 per cent in 1979 to 32 per cent in 2007.¹⁰

As the presence of traditional defined benefit pensions has declined, defined contribution plans, such as 401(k)s and similar plans, have become more common. In 1983, 14 per cent of Americans were covered only by a 401(k) (or similar) plan. During the next decade, this number dramatically rose to over 40 per cent. By around 2005, this number increased to almost 63 per cent. This rise in popularity of the defined contribution plan has marked the beginning of a new era in retirement planning. Variable annuities are becoming increasingly important as part of the mix of available solutions because each retiree has become responsible for the security of his or her own retirement income. As this shift in responsibility continues to progress, more and more individuals may look to the variable annuity and the guaranteed income it provides through annuitisation, GMIB, or GMWB riders as a means for individuals to insure their longevity risks.

8 EIOPA (2011).

9 OASDI (2001).

10 Employee Benefit Research Institute (2008), Table 4.1a.

2. Variable annuity characteristics

Like many traditional insurance products, variable annuities provide guaranteed benefits that are payable contingent on the occurrences of uncertain future events regardless of the performance of the assets that back those products. Like immediate annuities, the majority of variable annuities sold today provide guaranteed payments regardless of the performance of the assets held by the insurer to back the contract.

2.1. Variable annuity product features

While variable annuities take many forms, each can be described as the combination of two primary elements: (1) an investment account, and (2) guarantees.

1. The investment account (separate account)

The core investment account is a basket of investment funds, or subaccounts. The options typically include stock funds, bond funds and money market accounts. Policyholders allocate premiums into the subaccounts and often have the ability to change the allocation and to contribute additional premiums. The benefits provided by the guarantees are a function of the performance of the investment account.

Policyholders have typically had significant discretion of the movement of funds from one subaccount to another. Recent product innovations have added constraints to this ability by limiting the percentage of funds in the riskiest investments or by automatically rebalancing allocations in times of market stress. These limitations are designed to reduce the market risk to the insurer in adverse market scenarios.

The insurer typically holds the investment account funds in a separate account protected from claims against the insurer in the event of insolvency and for which the policyholder bears all the investment risk.

The policyholder maintains access to the funds in the investment account at all times. However, full surrenders prior to the payout phase (or annuitisation) result in forfeiture of the guarantees, and partial surrenders above contractually permitted levels result in proportional reductions to guarantees. In addition, early surrender penalties may be levied.

2. Guarantees

Variable annuity guarantees are calculated in reference to the “benefits base,” which is a notional amount used to determine the amount of payments to the policyholder from guarantees. The benefits base may differ from the value of the investment account as a result of various guarantees on the benefits base. Variable annuities generally provide guaranteed appreciation of the benefits base even if the account value has not grown.

Four primary types of variable annuity guarantees exist:

- **Guaranteed minimum income benefit (GMIB).** A GMIB guarantees the ability to take out (through annuitisation) a stream of income for life, based on the greater of the actual account value or the benefits base, following a waiting period. The benefit amount is also a function of the policyholder's age at annuitisation. It is important to note that the option to annuitise a GMIB is a one-time, irreversible decision.
- **Guaranteed minimum withdrawal benefit (GMWB).** A GMWB guarantees the policyholder the ability to withdraw a specified percentage of the benefits base for a specified number of years. These withdrawals become the contract's annuitisation mechanism. The withdrawal amount is a function of the age of the annuitant, and the decision to withdraw is made each year. An enhancement of the GMWB concept is the guaranteed lifetime withdrawal benefit (GLWB), under which a certain percentage of the benefits base can be withdrawn as long as the annuitant survives.
- **Guaranteed minimum death benefit (GMDB).** A GMDB guarantees a specified lump sum on death regardless of the performance of the underlying account value. The most basic GMDB guarantees the return of principal, adjusted for any partial withdrawals.
- **Guaranteed minimum accumulation benefit (GMAB).** A GMAB guarantees a specified lump sum on a specific maturity date or anniversary regardless of the performance of the underlying funds.

The most common forms of guarantees associated with the growth of the benefit base are:

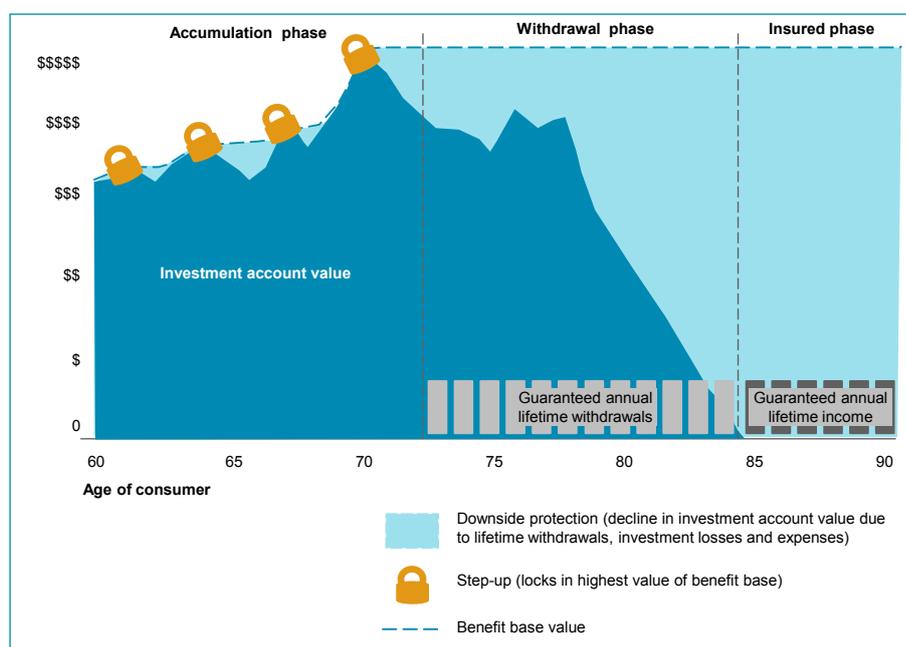
- **Roll-ups.** This is the simplest form of return guarantee. A roll-up provides guaranteed appreciation of the benefits base at a specific interest rate. The guarantee may accrue on a simple or compound interest basis. A 0 per cent roll-up is the same as a return-of-principal guarantee.
- **Ratchets.** Also called a "high watermark." With a ratchet, the benefits base is set equal to the highest of all values of the underlying funds throughout the accumulation phase, evaluated at a pre-defined time interval (e.g. annually). At various frequencies the existing benefits base is compared to the account value, and if the account value is higher, the benefits base is "ratcheted" up to the new level.
- **Resets.** Resets are triggered at the discretion of the policyholder. They involve a comparison of the current account value to the original account value, and the benefits base is reset to the higher level. Other policy provisions such as a waiting period may be reset as well.
- Some variable annuities offer guaranteed appreciation of the benefits base that combines one or more of the above forms of guarantees. For example, a common combination guarantee is the maximum of a roll-up and a ratchet.

Variable annuity guarantees are typically backed by an insurer's general account. As a consequence, the additional risks introduced by the variable annuity guarantees and their associated reserves and asset liability management strategies are commingled with other risks assumed by the insurer. This allows for some risk offsets and diversification effects.

2.2. The variable annuity life cycle

The most common forms of variable annuity riders, namely GMIBs and GMWBs, allow policyholders to accumulate assets during the accumulation phase and provide guaranteed income during the withdrawal and insured phases. The emphasis of the accumulation phase is investment, while the emphasis of the withdrawal and insured phases is longevity protection.

Figure 6: Accumulation, withdrawal and insured phases of a variable annuity with GMWB



Source: United States General Accountability Office (2012).

During the accumulation phase, the benefits base may be subject to guaranteed appreciation. This guaranteed appreciation increases the value of the benefits that will be available during the withdrawal and insured phases.¹¹

The withdrawal or payout amounts are determined by rates guaranteed by the insurer at the time the variable annuity contract is issued.

2.3. Economics of variable annuity contracts

From the insurer's perspective, variable annuity benefits and costs are funded by a variety of fees and charges assessed against the policyholder's assets invested in the variable annuity and specified in the contract. This unbundled and highly transparent charging structure is unusual among insurance products. Offsetting this, insurers have various expenses associated with issuing the contracts, administering the contracts, and providing the contractual benefits.

Sources of revenue to variable annuity writers from the variable annuity products include:

- **Rider charge.** This is a fee levied for specific return guarantee benefits. Often these benefits are sold as riders (optional features). Some recent contracts grant the insurer the right to increase charges in order to offset higher-than-expected hedging costs.
- **Insurance charge.** This is a fee levied to compensate the insurer for providing a minimum death benefit and for administrative expenses. The fee is typically stated as a percentage of the account value.
- **Administrative expense charge.** This is a fee that covers ongoing servicing by the insurer, applied as a percentage of the account value. Expense charges are frequently combined with mortality charges ("M&E fees").

¹¹ For GMIBs the policyholder elects an income at the end of the accumulation phase and the policy goes straight to the insured phase.

- **Surrender charge.** Surrender charges are a percentage of the account value and apply during the first several years of the policy. In general, surrender charges offset up-front commissions paid to sales representatives. Some variable annuities offer the policyholder surrender charge-free access to a limited portion of the account value through a “free partial withdrawal” feature.
- **Investment management charge.** This is a fee that compensates the managers of the underlying investment funds for their services. It is typically stated as a percentage of the account value.

Figure 7: Key variable annuity cash flows

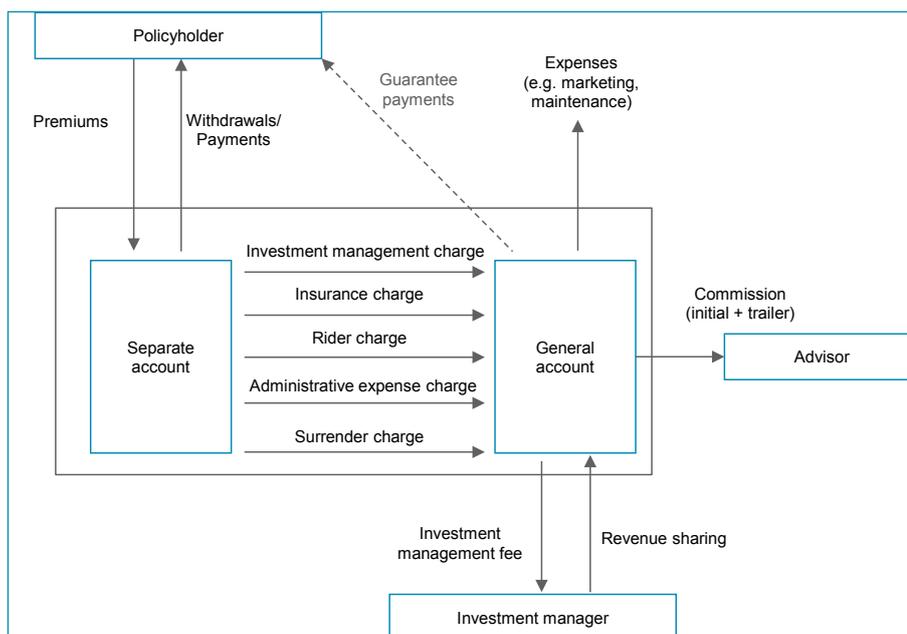


Table 1: Key cash flow descriptions

Cash flow	Description
Initial commission	Paid by insurer to advisor at policy issue Typically ~5% of deposit
Trailer commission	Paid by insurer to advisor in Years 2+ while business is in force Typically 0.5%–1%. May be a function of premium/deposit or Account Value (AV)
Investment management fee (IMF)	Fee charge for the management of the funds in the policy Typical 50–200 bps of AV for actively managed funds and 20-30 bps of AV for passively managed funds Investment manager shares IMF with insurer
Insurance charge	Sometimes called M&E (Mortality and Expenses) Typically 100–200 bps of AV
Rider charge	Fee to support rider benefits Ranges between 50–200 bps of Guaranteed Value (GV), depending on the combination of riders.
Administrative expense charge	Fee for contract admin; typically US\$25-50
Surrender charge	Paid by policyholder to insurer in the event of lapse (to compensate for commission paid) Typically 7–8%; declining by 1% per annum

Sources of expenses to variable annuity writers from the variable annuity products include:

- **Acquisition costs.** These include agent sales commissions, marketing costs, and issue costs. Commission rates generally range between 4-8 per cent of the up-front premium.

Trail commissions, if any, are typically 1 per cent or less. Because no separate charge is typically levied to cover acquisition costs, such costs are implicitly funded by the other fees and charges.

- **Administrative costs.** These are ongoing costs associated with policy maintenance.
- **Benefit costs.** These are the costs of providing the guarantees, often estimated by the costs of hedging.
- **Cost of capital.** This is the economic cost of capital required either by company management or external parties (e.g. regulators and rating agencies), including the effect of taxes to be paid on an insurer's profits.

The main sources of profit or loss to a variable annuity writer from the variable annuity products they write are a function of the insurer's ability to recoup the costs of:

- providing the guarantees
- providing investment management services
- selling the contract.

The first source of profit or loss is whether the fees charged for the guarantees are sufficient to cover the payment of the guarantees (including holding reserves and capital and performing risk management activities such as hedging). The cost of the guarantees is, in turn, driven by the development of insurance risk factors (e.g. longevity), relative to expectations. The market risks are frequently hedged, and if so, the hedging may be less than fully effective due to differences between the characteristics of the hedging portfolio and the characteristics of the guarantees. Such differences also place profit at risk.

The two other sources of profit or loss are unrelated to the guarantees. One is whether the fees charged for managing the policy are sufficient relative to the insurer's administrative costs and trail commissions. The other is whether fees charged for early surrender and other sources of profit are sufficient to offset commissions and issue costs. In general, products are priced on a holistic basis.

Even if an insurer uses derivatives to hedge the impact of market movements on their balance sheet, the profitability of variable annuities may vary significantly based on market conditions. A market decline reduces fee revenue and increases capital requirements. In addition, market volatility and low interest rates may increase hedging costs and the value of future guarantees.

2.4. Cash flows and liquidity

Even though the existence of benefits base guarantees may appear to place variable annuity guarantees "in the money" (i.e. the benefits base is greater than the investment fund), the ability of the policyholder to access the guarantees is constrained. Should the policyholder fully surrender the contract, the cash paid is not the benefits base, but rather the account value reduced for any surrender charges. Therefore, market declines, while making the benefit guarantees more valuable and requiring insurers to hold appropriate reserves and capital buffers, generally lead to fewer cash-outs and less liquidity risk, as the primary risk to the insurer involves paying the appreciated benefits over time.

As a consequence, variable annuities do not pose a "run on the bank" risk to insurers in the case of declining equity markets. In general, a "run on the bank" risk exists when customers of a financial institution have discretionary access to lump sums of money. With variable annuities, however, the policyholder's choices are limited. As shown below, either the guarantee itself is based on a series of payments over time or the policyholder's ability to access the guarantee (i.e. receive cash payments related to the guarantee) is limited to specific times or events.

Table 2: Explanation of guarantee

	Access to guarantees	Payment of guarantees
GMIB	Discretionary (with constraints)	Spread out over time
GMWB	Discretionary (with constraints)	Spread out over time
GMDB	Not discretionary; guarantee payable only upon death	Lump sum
GMAB	Not discretionary; guarantee payable on a specific date	Lump sum

2.5. Comparison of variable annuity characteristics with other insurance products

Variable annuities share many characteristics, as described by the International Association of Insurance Supervisors (IAIS), of “traditional” insurance products. Like most insurance products, variable annuities bundle insurance risk, market risk, and behavioural risk. Because of the insurance risk component, the significant majority of variable annuity contracts satisfy important characteristics of traditional insurance as described in the IAIS November 2011 report, *Insurance and Financial Stability*.¹²

- **The law of large numbers and aggregation of a large number of idiosyncratic risks.** GMIBs and GMWBs insure against longevity risk, while GMDBs insure against mortality risk. Risk pooling is a significant element of the variable annuity business model.
- **An inverted production cycle.** Like all traditional insurance products, variable annuity policyholders pay premiums upfront (in the form of charges for the guarantees), and contractual payments are made if an insured event occurs.
- **A liability driven investment approach.** The investment and hedging strategies used by variable annuity writers are specifically designed to manage risk so that guarantees can be paid. In this regard, they use similar tools and techniques as liability-driven investment strategies for the asset liability management (e.g. duration matching and convexity hedging) of traditional products.
- **Claims result in cash outflows that are paid in increments, contingent upon the mortality or longevity of the policyholder, over an extended period of time.** Because variable annuity guarantees have no value in the event of a discretionary policy lapse in many scenarios, the guarantees do not pose significant liquidity risk to the insurer. GMDB claims are paid upon an individual’s death, GMIB and GMWB benefits are paid out over time (contingent upon survival and depletion of the account value), and GMABs are payable only at specific, predetermined times. In addition, most variable annuity writers seek to distribute sales in a broadly even manner over time in order to avoid overexposure to a particular set of market conditions, thus gaining the benefit of a form of “time diversification”. For a given volume of exposure, a more dispersed maturity profile (maturities spread through time) is less risky (in terms of potential payout on the guarantees) than a more concentrated one.

There are three areas in which variable annuities differ from traditional insurance. Note that these are differences in degree only, as the characteristics listed are generally also present in traditional insurance, but to a lesser degree than in variable annuities. The three areas are:

- **Election.** Variable annuity guarantees are often payable not only on the occurrence of a specific event (e.g. death or survival), but also on the decision of the policyholder to elect benefits within limits. While the discretionary ability to elect or utilise benefits is

¹² IAIS (2011).

an important feature of variable annuities, all insurance products contain some element of policyholder behaviour risk.

- **GMABs.** Because the payment of a GMAB benefit is contingent only on survival to the predetermined payment date, GMABs have relatively less insurance risk than other types of living benefits. In addition, the guarantee, while paid at a predetermined time, is normally paid as a lump sum. GMABs are optional riders, not included on all variable annuity policies and represent the lowest utilised optional rider.
- **Commingling of insurance risks and market risks.** Like most insurance products, either insurance risk factors or market risk factors may cause the assets underlying the variable annuity contract to be insufficient to cover contract benefits (i.e. guarantees). However, with variable annuities, the insurance and market risk factors are interrelated because the benefit payments are a function of market performance and return guarantees. There is a similar interrelationship between insurance and market risks in other products that possess a policyholder investment component, such as variable universal life insurance. This commingling of risks impacts risk management. Insurance risks are typically managed through diversification, and diversification reduces risk by reducing the magnitude of relative outcomes. With variable annuities, however, a fully diversified portfolio still leaves the insurer exposed to market risk, but this is mitigated by adequate product design and hedging strategies.

3. Variable annuity risk management

As discussed earlier, variable annuities provide the policyholder with an investment with a set of guarantees, the most common and relevant, especially in the U.S., being the guaranteed lifetime income to retirees. As with the offering of any traditional insurance solution, regardless of the coverage being applied, certain risks are incurred by the issuing insurer. It is imperative that the insurer not only understands and has the ability to measure these risks, but also to effectively manage these risks while holding the appropriate levels of regulatory or economic capital to support the satisfaction of these obligations to the policyholder.

In this chapter, we will first describe at a high level the nature of the risks being incurred as well as the typical types of risk management techniques employed. Following this discussion will be a more detailed description of each risk with the specific risk management techniques used to ensure adequate management of the specific risk. In addition to the discussion of risk and risk management at the product level, we will also discuss the importance of managing these risks at the enterprise level given natural offsetting risks.

3.1. Key risks

There are generally three buckets of risk that exist with almost all life insurance products, variable annuities included. These are:

- insurance risk
- market risk
- behavioural or utilisation risk.

For variable annuities specifically:

- **Longevity risk** is the primary *insurance risk* due to the nature of the income guarantees that are offered; some mortality risk exists due to the nature of the death benefit guarantees that are offered.
- **Equity risk and interest rate risk** are the primary *market risks* due to 1) the underlying equity and fixed-income investments that drive the policyholder's account value performance and 2) the long-term nature of the income guarantees. In addition, some credit risk also is present in the fixed-income investments.
- **Persistency risk and benefit utilisation risk** are the primary *behavioural or utilisation risks* due to the nature of the product structure which generally has the insurer receiving revenue over time and insurance claims being paid well into the future.

Primary “Lines of Defence”

Insurers use a number of lines of defence to manage the above buckets of risks. These are:

- product design and prudence in assumptions
- risk pooling (“law of large numbers”)
- natural hedges and a diverse balance sheet
- asset liability management and reinsurance
- stress scenario analysis for single and combined shocks and the appropriate provision and management of economic risk capital.

These lines of defence are employed to varying degrees in an insurer’s risk management strategy, depending on the nature of the risk and the availability and effectiveness of each method. Not all of the lines of defence listed are used with all risks or types of insurance. For instance, reinsurance is generally not used as a primary risk management strategy for variable annuities due to the current limited availability of reinsurance for variable annuity guaranteed benefits.

3.1.1. Insurance risk

Longevity risk—the risk that mortality assumptions are not accurate, and policyholders live longer, on average, than expected—is the primary insurance risk for variable annuities because of the lifetime income guarantees provided to policyholders. This risk is analogous to that which insurers incur when offering other insurance solutions such as fixed annuities, Single Premium Immediate Annuities (SPIAs), Deferred Income Annuities (DIAs), and institutional group policies that provide annuity guarantees.

The mortality assumptions are determined from actuarial studies. These studies are across long periods of time and large numbers of lives, creating a high degree of credibility and confidence in their accuracy. However, longevity risk is still present as the purchasers of these insurance products may not exactly match the population expectations, to which may be added a number of factors that can result in the population in general living longer than expected, including population health improvements and medical enhancements.

The first line of defence for managing longevity risk is product design. Variable annuities generally have age requirements or restrictions for both product issuance and income commencement. These restrictions help limit the length of time during which income would be paid. The level of guaranteed lifetime income also typically varies by age, guaranteeing more income to older policyholders because they have shorter life expectancies.

Embedding these controls within the product design has proven to effectively limit the amount of longevity risk incurred as well as help mitigate the exposures associated with the longevity risk that remains. Prudence in pricing assumptions plays an important role in product design. In terms of longevity risk, prudence entails assuming that policyholder longevity is higher than observed experience, typically through static adjustments to mortality tables (e.g. 90 per cent of tabular mortality rates) or explicitly modelling mortality improvement. In addition, sensitivity testing or stress scenario analysis of longevity and mortality risk is performed as part of the product design and pricing process. Similar prudence applies to assumptions used in reserving, capital, and hedging calculations.

The second line of defence used to manage longevity risk is risk pooling, which has been proven to be a highly effective way to manage insurance risks across all types of traditional insurance products for decades if not centuries. Risk pooling requires the issuance of policies to a large number of policyholders, and to issue them to people that are socially and demographically consistent with the population used to determine the mortality assumptions. By issuing this large

number of contracts, the insurer gains high degrees of confidence in their estimates due to the “law of large numbers”. Since the individual policyholder’s life expectancy is independent of that of all other policyholders, and the risks are idiosyncratic, the principles associated with the law of large numbers are satisfied, resulting in the pool of policyholders exhibiting very minimal deviation from the expected mortality assumptions.

The third line of defence for managing longevity risk is diversification of businesses within the insurer. Most variable annuities offer some level of death benefit protection, which exposes the insurer to mortality risk in addition to the longevity risk discussed above. Therefore, very effective natural hedging is directly embedded in some variable annuity products.

Variable annuity writers can also achieve diversification through lines of business that incur mortality risk from other insurance products like life insurance. This means of offsetting risk is often referred to as “natural hedging”. In order for natural hedges to be effective, the risks must be negatively correlated. Longevity and mortality risk are negatively correlated as one is concerned with a population living longer than expected while the other is concerned with the same population living shorter than expected. As long as these two populations are similar demographically and impacted by the same types of factors that can affect life expectancy, the insurer will receive some risk management coverage by offering both annuity and life insurance solutions. However, the effectiveness of this form of “natural hedge” across different product lines is limited by the fact that cohorts with life insurance exposure are usually younger than the cohorts that carry most of the longevity risk in GMWB products.

Reinsurance of longevity risk embedded in fixed annuitant and pensioner lives has been available for many years and will likely be available to variable annuity writers as their books move into withdrawal and insured phases. Reinsurance of longevity is typically attractive to reinsurers with large books of mortality risk as they can benefit from natural hedges.

3.1.2. Market risk

Market risk is the risk of adverse financial impact due to changes in market factors, and it includes interest rate risk, equity market risk, foreign exchange (FX) risk and credit risk. Whether or not an insurance product contains a policyholder investment component as with certain types of life insurance and annuities, market risk is present in some form and to some degree with all types of insurance, from homeowner’s insurance to term and whole life insurance to fixed and variable annuities. The table below provides some examples of market risks present in various types of insurance.

Table 3: Examples of market risks in various types of insurance products

Type of insurance product	Market risks
Homeowner’s insurance	<ul style="list-style-type: none"> • Interest rates • Credit risk • Real estate prices • Commodities
Term life insurance	<ul style="list-style-type: none"> • Interest rates • Credit risk
Whole life insurance (including universal life and variable universal life)	<ul style="list-style-type: none"> • Interest rates • Credit risk • Equity markets
Fixed annuities	<ul style="list-style-type: none"> • Interest rates • Credit risk
Variable annuities	<ul style="list-style-type: none"> • Interest rates • Credit risk • Equity markets

Insurers must make assumptions about the performance of various capital market factors when pricing and reserving for these products, and market risk exists to the extent that capital markets perform differently than assumed in pricing and reserving calculations. For instance, reserve calculations in the U.S. include assumptions about the returns earned on fixed-income assets backing reserves. To the extent that actual returns are lower than those assumed, the insurer would have to increase reserves, all else being equal. For insurance products that contain a policyholder investment component, such as variable universal life and variable annuities, market risk is also present because the performance of the underlying funds impacts the value of the guaranteed benefits promised to policyholders and thus impacts the amount of insurer liabilities set aside to provide for expected claims associated with those guaranteed benefits.

The primary market risks that variable annuities present are equity risk and interest rate risk. Declines in policyholder account values due to equity market declines or shifts in the interest rate environment increase a variable annuity writer's exposure to the risk that the account value may be insufficient to fund the level of guarantees promised by the contract and thus increase expected living benefit claims. Further, declining interest rates increase the present value of the long-term income guarantees provided by the contract. Changes in capital markets can result in increases or decreases in the required reserves and the capital that the variable annuity writer must set aside to meet its obligations to policyholders. Left unmanaged or managed inappropriately, this can introduce significant balance-sheet volatility and solvency risk for insurers.

The measurement and management of market risk differs in some ways from that of insurance risk. While the pooling of independent and idiosyncratic risks is a reasonable approach for measuring and managing insurance risk, a different approach is required for the measurement and management of market risk. Unlike insurance risk, there is generally only a limited diversification benefit with respect to market risk for a cohort of policies. Market risk is not idiosyncratic—adverse changes in capital market factors can affect many policies in the same way and at the same time, resulting in risk exposure that has not been diversified away. Thus, the law of large numbers does not apply and pooling does not serve to reduce uncertainty associated with a given market risk factor. Because of this, methods other than risk pooling which enable risk offsets are necessary for managing the market risk incurred by an insurer.

Insurers' lines of defence for managing market risk include some methods that are similar to those used to manage insurance and behavioural risks and some that differ due to the distinct characteristics of market risk discussed above. Insurers manage market risk through product design and asset liability management, as well as through the natural hedges afforded by a diverse business mix. Each of these is discussed below.

Product design

Just as product design enables insurers to limit the amount of insurance and behaviour risk that they take on, it also allows insurers to limit their market risk exposure. With variable annuities, this typically includes:

- **Investment restrictions and requirements.** Variable annuity writers may impose equity exposure limits and restrictions based on investment type, asset character, or fund performance relative to benchmarks. Most often requirements also exist around diversification of the underlying investments to minimise volatility of the policyholder's asset values.
- **Fees.** Variable annuity writers may apply different fee levels based on the equity allocation or underlying investment selection of the policyholder account, or external capital market conditions such as equity market volatility or interest rate levels.
- **Guaranteed benefits.** Variable annuity writers may adjust benefit features, such as the guaranteed growth rate that is applied to the benefit base, based on the equity allocation

or investment selection of the policyholder account or external capital market conditions such as equity market volatility or interest rate levels.

- **Product- or fund-based risk management.** Variable annuity writers may include self-governing mechanisms within their products. These mechanisms operate to reduce the risk of significant declines in policyholder account values relative to the level of certain guaranteed benefits by adjusting the allocation between equities and fixed-income investments when certain risk triggers are met. This re-allocation can be done at the individual contract level or within the investment fund. For example, variable annuity writers may utilise funds which operate according to risk-reducing strategies, such as volatility managed funds, for use with certain products or optional guaranteed benefits.

Prudence in pricing assumptions also plays an important role in product design. Market risk is appropriately captured by projecting cash flows over a large number of independent scenarios of equity returns and interest rates, in order to capture a sufficiently wide range of outcomes and “tail risk”. It is typical to use 1,000 to 500,000 scenarios in a stochastic projection. Prudence in assumptions exists as these stochastic scenarios may be based on average interest rate levels, equity returns or credit spreads which are lower-than-average historical experience, and volatility that is higher than historical averages. Insurers perform sensitivity testing, or stress scenario analysis, of capital markets assumptions, and may alter product design based on the product’s sensitivity to key capital market shocks. Similar techniques to reflect prudence in assumptions apply to reserving, capital and hedging calculations for variable annuities.

Product design is an insurer’s first line of defence, as it serves as a means for risk avoidance and risk limitation. For the market risk that remains, insurers employ asset-liability management techniques and also benefit from the offsetting market risk profiles of other lines of business.

Asset Liability Management (ALM)

ALM is the process of neutralising cash flows or changes in value related to certain market risks in a portfolio of liabilities through the purchase of assets which possess offsetting cash flows or sensitivity to market risk factors. It is commonly used to manage the market risks in insurance products, and it includes cash flow and duration matching as well as static and dynamic hedging techniques. These methods of purchasing assets to offset certain liability risks are appropriate techniques for managing market risk, as the market risks cannot be diversified away by issuing large numbers of policies.

In order to maximise the effectiveness of an asset liability management strategy, one must first understand the nature of the liability cash flows. They can be certain, or they can have some level of uncertainty and/or optionality. They can be of short duration or long duration. These attributes are perhaps the most important ones to consider. Once the liability cash flows are fully understood, the insurer must then determine its goals for the programme (e.g. cash matching, minimising the volatility of financial statements, etc.) and then the best portfolio of assets to purchase in order to maximise the effectiveness of its programme. Some examples of asset liability management programmes that have proven effective for other forms of traditional insurance are described below.

Table 4: Examples of ALM programmes

Product	Description
Single Premium Immediate Annuities (SPIAs)	<ul style="list-style-type: none"> The cash flows of SPIAs are certain except for the life contingent component which is dependent on the overall longevity of the population of policyholders. Generally insurers employ either a cash flow matching principle or a duration matching principle in managing market risks for SPIAs. <ul style="list-style-type: none"> Cash flow matching looks to create a portfolio of bond assets where the combined cash flows from coupon and principle payments are the same as the expected annuity cash flows to the population of policyholders. Duration matching looks to create a portfolio of bond assets where the weighted average duration is equal to the weighted average duration of the expected annuity cash flows. Either of these strategies is fairly static but still need to be monitored as the series of expected liability cash flows will likely have some element of uncertainty, perhaps due to longevity being different than expected and/or the block of business continuing to grow with new sales of annuity contracts. These strategies have proven highly effective for insurers as they have managed these types of liabilities for over a century using these techniques.
Fixed Deferred Annuities (FAs)	<ul style="list-style-type: none"> The cash flows of FAs have more uncertainty and higher optionality than SPIAs, as policyholders can request a partial or full withdrawal of their account value at any time (generally a back-end loading exists for some period of time to help reduce this activity and increase the “certainty” of these liability cash flows); however, if the policyholder chooses to annuitise (a low percentage of policyholders choose this option in the U.S.), the liability cash flows look very similar to those of SPIAs. Generally insurers use a more dynamic version of cash flow matching or duration matching for FAs given the higher uncertainty and optionality of the liability cash flows. Since policyholder actions may be partially driven by changes in the interest rate environment and the “value” of other investment alternatives available to them in the future, insurers may also incorporate the use of interest rate derivatives in the asset portfolio in order to better manage towards the goals of their chosen programme. It should be noted that insurance companies have also effectively managed the asset liability risk associated with FAs for many decades.¹²
Fixed Equity Indexed Annuities (EIAs)	<ul style="list-style-type: none"> EIAs are a version of FAs but they provide a level of interest credited to the policyholder that is contingent on the performance of certain equity indices (often with a floor and cap as well as a prescribed participation rate or percentage of the index's gain). Given this contingent interest rate determination, the liability cash flows of EIAs are even more uncertain and experience a higher level of optionality than that of FAs. Insurance companies will still employ one of the two strategies listed above for SPIAs or FAs, but will further enhance this strategy in order to include other types of derivatives including equity index options and/or futures. While the asset liability management programme is more complex given the wider scope of assets included in the portfolio, insurers have been able to continue to very effectively manage the market risks for books of EIAs through asset liability management techniques.
Variable Annuities	<ul style="list-style-type: none"> Variable annuities continue on the liability cash flow spectrum and have further cash flow volatility with higher levels of optionality than EIAs. Insurance companies will again utilise a similar strategy as above, and will further broaden the spectrum and magnitude of usage of the derivatives incorporated into the asset portfolio. Insurance companies will purchase derivatives at the time of issuing the variable annuity to the policyholder, and will then adjust that portfolio of derivative assets as appropriate throughout the lifetime of the variable annuity contract. Therefore, these programmes are oftentimes considered “dynamic” hedging programmes, even though a portion of the derivative assets are purchased up-front and the adjustments are made over a long period of time and generally in smaller increments. Dynamic hedging requires frequent rebalancing of the hedge portfolio, as the price or other characteristics (such as volatility) of the items being hedged change. This contrasts with a static hedge that does not require any rebalancing once the hedge position is initially established.

13 However, in the early 1990's a small number of fixed annuity insurers in the U.S. did not manage well the investment declines caused by the recession of 1990-1991. Those companies were resolved in an orderly manner and their failures did not cause any material impact on other financial institutions nor on the general economy, e.g. there was no evidence that their failure caused or amplified any systemic risk. Insurance regulators in the U.S. adopted Risk-Based Capital requirements shortly after this time period.

Variable annuity hedging programmes

With variable annuities, dynamic hedging is an ALM strategy that plays a critically important and effective role in reducing balance-sheet volatility and protecting insurer solvency. Financial reporting frameworks which require market consistent valuation treat certain variable annuity liabilities like derivatives without explicitly reflecting the distinct differences between insurance liabilities and traded derivatives, namely their lack of liquidity or tradeability, and the longevity and behavioural components of the liabilities. These valuation frameworks thus introduce balance-sheet volatility for insurers, for which dynamic hedging serves as an effective volatility management tool. Capital markets hedging programmes employed by variable annuity writers are designed to manage the remaining market risk incurred by the insurer after the market risk mitigation afforded by product design. The objective of these hedging programmes is to neutralise the impact of market risk associated with variable annuity guaranteed living benefits. That is, the investment gains or losses on the assets purchased should offset increases or decreases in the value of the liability due to capital market factors, creating a near zero net impact. Through hedging, the insurer effectively trades upside potential for the removal of downside risk that could pose threats to solvency if left unhedged, creating a better known stream of cash flows rather than uncertain and volatile financial exposure for the insurer to manage. The cost of these derivative asset purchases is effectively covered by the fees charged for the guarantees offered.

Variable annuity hedging programmes are well-defined risk management strategies and, as such, the key elements of the programme are explicitly stated in the strategy. This includes identification of the hedging target, the market risk factors to be managed and the hedging instruments used to execute the risk management strategy, as well as rebalancing frequency. Each is discussed below.

- **Hedging target.** The hedging target is the item for which market risk is being managed through the hedging programme. Hedging targets may differ from one insurer to the next, but typically the hedging target is an economic or accounting measure of the insurer's liability associated with variable annuity living benefits. The hedging target exhibits sensitivity to market risks, with changes in value driven by changes in equity markets or interest rates and other market risk factors. These sensitivities are measured so that assets with offsetting capital markets sensitivities can be identified and purchased to hedge the change in value of the hedging target related to changes in the risk factor. The ability to measure the market risk sensitivity of the hedging target is important for both execution of the hedging strategy and determining the effectiveness of the hedging programme.
- **Market risks to be hedged.** The liability associated with variable annuity living benefits is sensitive to changes in equity market returns, interest rates, foreign exchange rates and volatility. The capital market sensitivities are often referred to as "Greeks" due to the Greek letters used to denote each quantity. Typically one or more of the following Greeks are managed in variable annuity hedging programmes:
 - Delta: the sensitivity of the value of the guarantee to changes in the price of the underlying asset. Delta hedging involves the purchase of assets which offset the change in value of the hedging target due to changes in the underlying equity market indices.
 - Rho: the sensitivity of the value of the guarantee to changes in interest rates. Rho hedging involves the purchase of assets or the use of agreements such as swaps to offset the change in value of the hedging target with changes in interest rate.
 - Vega: the sensitivity of the value of the guarantee to changes in the market implied volatility of the underlying asset. Vega hedging involves purchasing equity or interest

rate options to offset the change in value of the hedging target with respect to changes in equity and interest rate volatility.

- Second order Greeks and Cross Greeks may also be managed as part of variable annuity hedging programmes. Second order Greeks measure the exposure to convexity risk (variation of Delta and Rho). Cross Greeks measure the sensitivity of one Greek to changes in another Greek.
- **Hedging instruments.** Variable annuity hedging programmes use a wide variety of financial instruments to manage market risk. The choice of instrument depends on the specific market risk being managed, as different instruments are used to neutralise the impact of different risks. Equity risk is typically managed through the use of exchange-traded equity futures contracts. Interest rate risk is typically managed through exchange-traded interest rate futures contracts and over-the-counter (OTC) interest rate swaps. Likewise, foreign exchange rate risk is typically managed through exchange-traded foreign exchange futures and over-the-counter foreign exchange forward contracts. Volatility risk is typically managed through equity put options and swaptions. Non-insurance companies also use these instruments for hedging, but may use more complex, exotic or customised instruments as well. An important consideration for variable annuity hedging programmes is that the instruments used are simple to value and possess limited counterparty risk. Counterparty risk on derivatives is minimised through daily and weekly collateral requirements (and margin call settlements). Further, many of the hedging instruments used have deep, liquid markets and represent hedgeable indices such as the S&P 500, EuroStoxx 50, Nikkei 225 and NASDAQ. Exotic derivative instruments and customised contracts are employed to a lesser extent in insurer hedging programmes.
- **Rebalancing frequency.** The variable annuity hedging strategy also defines the valuation and rebalancing frequency applied. The portfolio of assets constructed to offset the capital markets sensitivity of the liabilities will be rebalanced depending on the market risk being hedged, the instruments used, and the risk profile of the hedging target.
- **Typical hedging portfolio.** The characteristics of a variable annuity hedging portfolio are dependent upon a number of factors including product design, insurer hedge strategy, capital market conditions, and age of the variable annuity in-force book; thus the makeup of the hedge portfolio will vary over time and from one insurer to the next. Generally speaking, however, variable annuity hedging entails use of “vanilla” instruments such as exchange-traded and over-the-counter futures and swaps, and so a “typical” hedge portfolio consists primarily of these instruments. Given the typical product design and current market conditions, very long duration interest rate swaps (20 to 30 years) comprise the majority of a typical hedge portfolio. Shorter-term equity futures (1 year or less) make up a relatively small proportion of the hedge portfolio.

Key considerations for variable annuity hedging programmes

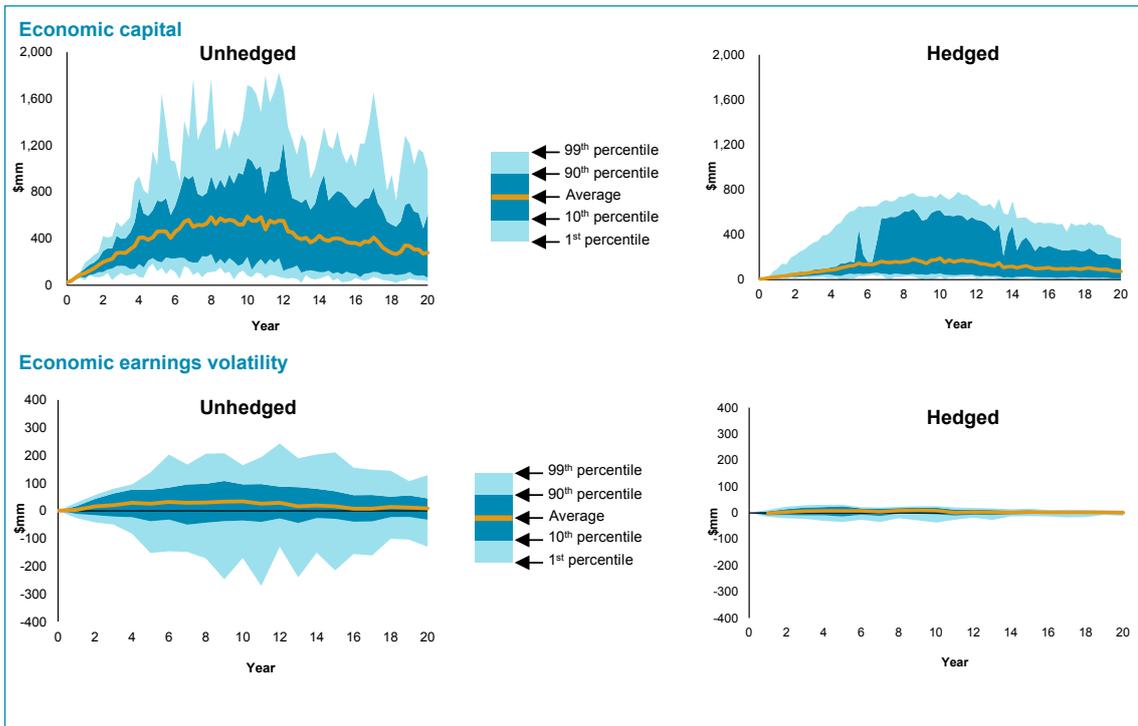
Hedging serves to manage the market risk that remains in variable annuity guaranteed benefits after this risk is first limited through product design. The following table briefly discusses the various options for hedging.

Table 5: Various options for hedging

Hedging risk management option	Description
Do not hedge (“go naked”)	<ul style="list-style-type: none"> Retain market risks on insurer’s balance sheet. Liability will increase and decrease as fund prices, interest rates and volatilities change. Volatility in P&L and required capital.
Static hedging	<ul style="list-style-type: none"> Purchase exchange-traded or OTC derivatives to provide the necessary profile to offset a significant portion of market risks. Structured hedges can be expensive and may not be adapted to changes in mortality and policyholder behaviour.
Dynamic hedging	<ul style="list-style-type: none"> Dynamic hedging involves the purchase of a portfolio of derivatives (hedge portfolio) whose values moves in the opposite direction to the “value” of liabilities. Requires relatively frequent rebalancing to keep the hedge portfolio “matched” to the liabilities (due to convexities in the value of the liabilities). “Greeks” are used to determine how to rebalance the portfolio of hedge assets (futures, swaps, options...)
Reinsure (external)	<ul style="list-style-type: none"> Transfer of risks to a reinsurer who will (for a premium) cover all or some of the guarantee costs, subject to counterparty risk. Transactions can be complicated and include significant restrictions (i.e. the direct insurance writer still retains some risk).

The potential impact of a hedging programme is illustrated below, showing the economic capital and earnings for an illustrative hedged and unhedged variable annuity portfolio.

Figure 8: Impact of hedging programme on illustrative variable annuity portfolio



Source: Oliver Wyman analysis.

Because of the requirements associated with hedging programmes, which include the use of simple instruments with deep, liquid markets and low counterparty risk, as well as the need to manage basis risk, the hedging strategy serves as a strong influence on product design. The hedging strategy impacts the design of guaranteed benefits as well as the investment and asset allocation requirements and restrictions imposed.

It is important to recognise the risks that are not hedged in the hedging programme. Variable annuity guaranteed benefits are sensitive to other risks in addition to equity, interest rate, foreign exchange rate and volatility risks. These include basis risk, insurance risk and policyholder behaviour risk. Basis risk arises due to imperfect matching between the assets underlying the variable annuity guarantees and the instruments used to hedge. This is because hedge instruments are based on tradable indices, whereas the underlying policyholder assets are generally invested in actively managed equity and fixed income funds. Basis risk is managed through investment restrictions which limit the amount of mismatch that exists between variable annuity funds and the indices underlying hedging instruments. Insurance and policyholder behaviour risks will also impact the value of liabilities, and changes in value due to these risks cannot be hedged using capital markets hedging instruments. As discussed, insurers employ other methods to manage insurance and behavioural risks.

Hedging involves additional risks associated with transaction costs and the availability of hedging instruments. Insurers will incur costs associated with purchasing hedging instruments and holding collateral for certain hedging arrangements, over and above the cost of the hedging instrument itself. Transaction costs are considered in the insurer's hedging strategy—insurers minimise the risk that transaction costs become prohibitive and that hedging instruments remain available even under stressed market conditions by mainly using instruments which have deep, liquid markets and limited counterparty risk.

Variable annuity hedging programmes operate for purposes of risk mitigation and, like other asset liability management techniques, are clearly defined for and measured against risk management objectives. Insurers do not engage in hedging activities for opportunistic trading, profit, or leverage. In fact, because insurer hedging programmes are focused on neutralising changes in value of liabilities, insurers give up the potential for positive financial impacts in exchange for protection against downside risk. These programmes therefore result in a de-leveraging of the insurer's balance sheet.

Hedging is part of an insurer's overall Enterprise risk management (ERM) framework. ERM is a comprehensive framework that defines an insurer's enterprise-wide approach to risk identification, measurement, management, and governance. The variable annuity hedging strategy and hedge programme effectiveness are subject to the oversight of the insurer's ERM function.

Hedging is regulated in various ways. In the U.S., insurers are required to file a Derivatives Use Plan, which describes the types and use of derivative instruments held by insurers. The statutory reserve and capital guidance for U.S. variable annuities (Actuarial Guideline XLIII and Risk Based Capital C-3 Phase II) specifies the requirements that insurers must meet in order to take account of hedging when calculating statutory reserves and capital, which includes the concept of a Clearly Defined Hedging Strategy. Additionally, the domiciliary regulator has authority at any time to request information regarding an insurers' hedging programme.

Diverse balance sheet and natural hedges

In addition to the market risk management achieved through product design and asset liability management, an insurer or reinsurer is able to manage its risk exposure in part through a diverse business mix. A diverse business mix allows for the offsetting impact of natural hedges. Just as natural hedges between life insurance and annuity lines of business allow for management of insurance risk through offsetting mortality and longevity risk exposures, a diverse business mix allows for offsets between lines of business which have negative correlation with respect to a given market risk factor. For instance, some types of insurance are exposed to low or decreasing interest rates while some are exposed to high or rising interest rates. Since different lines of business will generally be subject to the same market forces, insurers will achieve material risk reducing benefits.

3.1.3. Behavioural risk

Behavioural or utilisation risk is the risk to insurers that policyholders make decisions that do not align with the assumptions made by the insurer. More specifically, the primary risks in variable annuity guarantees are the assumed degree of persistency/lapse rates and benefit utilisation. Policyholders may terminate their guarantee by lapsing their policies or cancelling their optional benefit riders. How long a policyholder persists and the magnitude of lapse rates determine the length of time the provider will receive their fees, as well as the length of time the provider assumes the risk of providing the guarantees.

Some form of persistency and benefit utilisation risk exists in many traditional insurance solutions, specifically those that can be impacted by a decision made by the insured. For example, life insurance, disability insurance, equity indexed annuities and deferred income annuities are insurance products that have exposure to behaviour risk due to some degree of flexibility in premium payments and withdrawal and policy lapse decisions made by policyholders.

Assumptions made by variable annuity writers will vary based on the types of products offered and experience studies performed by the insurer. However, it is very common that dynamic policyholder behaviour assumptions related to the rate of persistency, annuitisation and withdrawals will be employed. The dynamic nature of these assumptions is generally linked to the differential between the guaranteed amount and account value. For instance, a large spread between these two factors where the guaranteed amount exceeds the account value can lead to low lapse rates and high withdrawal rates. Other factors such as policyholders' age, income tax situation, economic status and knowledge of variable annuity guarantees may have a strong impact on policyholders' decision-making process regarding their policies. Lastly, as new products are offered by the industry or as a result of changes in legislation, policyholders may modify the way they use their existing guarantees.

Variable annuity writers use the following, already mentioned lines of defence to mitigate the risk of policyholder behaviour:

- **Product design:** Policyholder behaviour can be managed or reduced through restrictions or limiting product design.
- **Risk pooling:** By issuing policies to large numbers of idiosyncratic lives, risk pooling can reduce behavioural risk, as it is the aggregate behaviour across the entire population of policyholders which is of utmost importance to the insurer.

Product design allows the insurer to eliminate or restrict behaviour and to reduce the impact of certain behaviours. Below are the ways that variable annuity writers use product design to manage behaviour risk:

- **Level of the guarantees offered to clients.** The types and levels of guarantees offered impact what risks an insurer bears, and at what cost. For example, lifetime income guarantee writers can reduce risk based on the level of guaranteed lifetime income promised and how much this income automatically increases. Offering certain guaranteed increases in future guaranteed income can help mitigate investor behaviour risk by offering value if the commencement of taking income is delayed, thereby reducing the number of years the variable annuity writer bears the risk based on the policyholder's life expectancy. These design elements help neutralise the insurer's financial exposure regardless of when a policyholder begins taking income from the annuity.
- **Investment platform.** Variable annuity writers can help manage risk through the investment choices made available to clients. For example, requiring clients to invest in a well-diversified set of investment choices or limiting high investment risk choices can help reduce behaviour risk because changes made across investments by a policyholder will have only a small impact on the financial exposure to the insurer.

- **Restrictions on client behaviour.** Variable annuity writers can help manage risk by placing a range of restrictions and requirements on client behaviour. For example, clients may be required to wait a certain number of years before commencing income or be of a minimum age to commence income. Other examples of restrictions include maximum amounts that can be taken in any given year and limited window periods where the client can choose to annuitise.
- **Pricing.** Variable annuity writers often have the right to increase the level of the fees assessed under certain circumstances. These circumstances can include times when behaviours are materially different from expectations. Moreover variable annuity writers can adopt prudent assumptions when pricing the products to further mitigate risks of adverse behaviour relative to assumptions selected.

While these techniques vary according to insurer, they all attempt to mitigate some or all of the behavioural risks incurred.

Product design has been and will continue to be a very effective tool in managing behaviour risk. However, since living benefits have only been offered for the past decade or so, experience around these types of behaviours is limited. Therefore, insurers have generally relied on more conservative/prudent assumptions to account for this additional uncertainty, and they perform sensitivity testing or stress scenario analysis of behavioural assumptions. As insurers continue to observe patterns of behaviours, assumptions and product designs may be altered if necessary to help further manage these exposures.

Risk pooling is the second line of defence that variable annuity writers use to manage behaviour risk. Individuals make decisions and behave according to their own financial goals and circumstances, which can differ due to timing, risk preference/tolerance, other sources of savings and income, taxes, etc. As these decisions and behaviours are idiosyncratic, risk pooling enables more predictable behavioural experience over large groups of policyholders. For example, younger policyholders tend to defer income while older policyholders draw income sooner. Therefore, understanding and controlling who can purchase these products is a key risk management tool used by insurers.

3.2. Enterprise Risk Management (ERM)

ERM is a comprehensive framework that defines an insurer's enterprise-wide approach to risk identification, measurement, management and governance. ERM frameworks are guided by the core principles of internal controls, separation of risk-taking activity from risk governance and cover the broad spectrum of risks faced by insurers. These principles are demonstrated in the insurer's ERM practices, which include:

- comprehensive and consistent approaches to risk identification and risk measurement
- clearly defined processes for addressing and monitoring risk exposures
- oversight provided by an ERM function, headed by a chief risk officer
- frequent internal risk assessments and internal audits
- consideration of the broad spectrum of risks faced by an enterprise across all of its business activities
- consideration of the broad range of stakeholders (including policyholders, regulators, shareholders, employees, and society) when making decisions about risk and risk management.

The insurance industry is committed to the development of ERM frameworks and ongoing work with regulators and professional actuarial and risk management organisations such as the Institute

and Faculty of Actuaries and, in the U.S., the Society of Actuaries and the American Academy of Actuaries, to identify and develop ERM best practices. ERM is not specific to variable annuities but is an important item to consider when discussing the risks and risk management activities for variable annuities and other types of insurance.

Therefore, it is important to consider the pros and cons of managing certain insurance risks at the product level rather than at the enterprise level. Oftentimes these risks can be much more effectively managed at the enterprise level rather than isolating them and managing them individually.

4. Transmission mechanisms

In this chapter, we detail the various parties—both direct and indirect—to a variable annuity contract, discuss how the various participants are interconnected, and compares the level of interconnectedness to traditional business in both normal and stressed market conditions.

4.1. Interconnections through variable annuities

A variable annuity is a contract issued by an **insurance company** to the **policyholder**. The policyholder is typically an individual, but can also be a trust or a group policyholder such as an employer or plan sponsor. The insurer is the provider of the guarantee, setting the contract terms. The policyholder is the receiver of the guarantee.

There are a number of indirect parties to the agreement.

- The majority of variable annuities are sold via **intermediaries** such as career agents, financial advisors, broker-dealers or commercial banks. These intermediaries have access to the products of one or more companies, and advise their clients on the product that best suits their needs.

The insurer typically enters into agreements with the following parties:

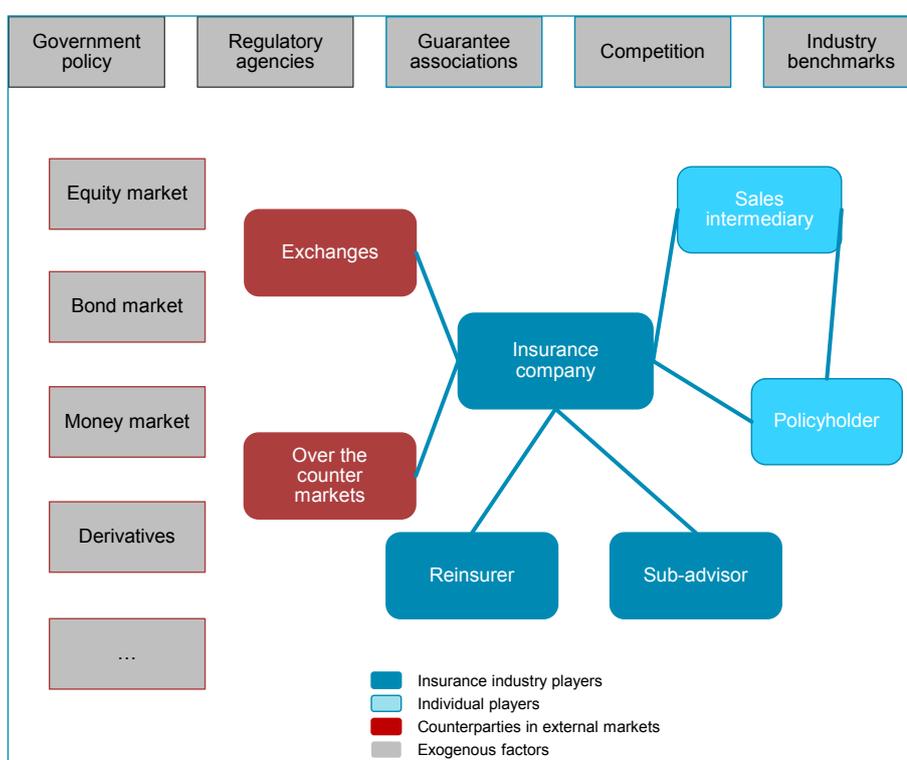
- **Subadvisors** are engaged by the insurer to manage the various subaccount fund offerings in the Separate Account. Subadvisors are typically professional money management firms that provide specific expertise in active and passive portfolio management and asset allocation, and often have a recognisable name brand from the mutual fund industry. Alternatively, an insurer may provide its own subadvisors. Increasingly, with the advent of target volatility funds, these subadvisors perform strategic asset allocation.
- To manage the market risk present in the variable annuity contract, the insurer generally purchases instruments from **financial market participants** via exchanges or over-the-counter trades with private counterparties. These counterparties may be investment banks, pension plans or other financial institutions. These instruments help offset the insurer's exposure to market risk.
- **Reinsurers** may provide solutions to mitigate market and insurance risk. As described in the previous chapter, external reinsurance is not currently widely used for variable annuities except in Japan, although in the future reinsurance of certain risks may be used in the withdrawal and insured phases of variable annuity product lifecycles to mitigate insurance risks such as longevity.

However, these contracts and agreements do not exist in a vacuum. Additional indirect parties who nevertheless exert influence over contract performance and financial outcomes include the following:

- **Insurance competitors** create variable annuity supply based on capacity and risk appetite. Other financial services companies may provide competing retirement solutions and product alternatives. Industry benchmarking agencies may provide competitor product information.
- **Regulatory agencies** (each country’s domestic insurance regulator(s)) may approve products for sale, promulgate accounting standards, impose capital requirements and provide other types of supervision.
- **Guarantee associations** provide a policyholder protection in the event of insurer insolvency.

The following figure shows the interconnections between the different parties. The parties that have real, contractual connections are connected by lines.

Figure 9: Parties involved in variable annuities



The interconnections that exist between these participants may include:

- **Policyholders:** can influence the final value of a guarantee through exercising their contractual options as well as their mortality and/or longevity. However, since the majority of annuities are sold to individuals in a retail setting, behaviour is generally dispersed.
- **Intermediary:** can influence policyholder behaviour, but the impact is dispersed in a retail environment.
- **Subadvisors:** can impact fund performance, but generally have well-defined targets and benchmarks. Basis risk exists to the extent that assets in subaccounts perform differently from market indices used for asset-liability management.
- **Investment markets:** provide assets held by the insurer in both the separate and general accounts, and are impacted by interest rates, credit spreads, and overall market performance.

- Financial market participants (Exchange and OTC): directly impact performance of risk management programmes. Insurance markets can potentially move the market with large transactions, but this would be rare (i.e. when hedging a block that had not previously been hedged). Counterparty risk is mitigated by collateral requirements or the use of exchange traded instruments. Collateral requirements can create liquidity risk for the insurer by requiring that collateral be posted in good scenarios, e.g. when equity markets are strong. Liquidity could trigger counterparty default, and the insurance industry is likely to be on the receiving end of the risk, e.g. when equity markets are weak and hedging instruments are in favour of the variable annuity writers.
- Insurance competitors: can drive product differentiation and market evolution; relative attractiveness of offerings (variable annuity and other alternatives) can influence policyholder behaviour.
- Guarantee associations: can create policyholder confidence but variable annuity writer insolvencies are thus far untested. Additionally, there is a possibility of contagion from a failed insurer to healthy insurers by increased guarantee fund assessments.
- Regulatory agencies (in U.S., Securities & Exchange Commission (SEC) and states): can influence competitor offerings.

4.2. Variable annuity versus traditional insurance transmission mechanisms

There are many similarities between variable annuities and traditional insurance in terms of transmission mechanisms and interconnections. Other more traditional types of insurance such as fixed annuities and life insurance are contracts between insurers and policyholders, often sold by intermediaries, relying on financial market participants for asset-liability management and reinsurers for risk management. It should be noted that these products are also supervised by regulators (with SEC supervision being particular to variable products in the U.S.).

Comparing the interconnectedness of variable annuity parties to the interconnectedness of traditional parties:

- Policyholder behaviour: present in variable annuity via lapse, flexible premiums, withdrawal utilisation, annuitisation utilisation, transfers (older products without allocation requirements). Present in traditional products via book value withdrawals, minimum guaranteed interest rates and loan provisions.
- Impact of financial markets: ALM is used for both variable annuity and traditional products. Some natural hedges may exist between variable annuities and traditional products.

Table 6 below compares variable annuity exposure to these different types of risks with that of a systematic withdrawal programme, and with other types of traditional insurance products. The “VA” columns are blanket categories encompassing death benefit only contracts as well as withdrawal benefits and income benefits. Note that the concentration of the risk will vary based on the level of the guarantee.

It is a qualitative assessment of who is the primary risk-taker on each of the various risks present in the contract. The abbreviation “IC” denotes the situations where the insurer makes a full guarantee and absorbs all or most of the risk. Conversely, the notation “PH” denotes the situations where the policyholder is not on the receiving end of a guarantee. The policyholder is effectively self-insuring the risk, accepting any upside or downside. However, the demarcation may not be as clear-cut and there may be some risk-sharing between the insurer and the policyholder, depending on the structure of the product.

Table 6: Assessment of primary risk taker

	Systematic withdrawal programme	Unit linked	VA accum phase	VA withdr phase	VA insured phase	Single premium immediate annuity	Fixed annuity	Term life
Longevity risk	PH	NA	NA	IC	IC	IC	NA	NA
Mortality risk	NA	IC	IC	NA	NA	NA	NA	IC
Equity risk	PH	PH	IC	IC	IC	NA	NA	NA
Interest rate risk	PH	PH	IC	IC	IC	IC	IC	IC
Credit risk	PH	PH	IC	IC	IC	IC	IC	IC
Persistence risk	NA	IC	IC	IC	IC	NA	IC	IC
Behaviour or utilisation risk	NA	IC	IC	IC	IC	NA	IC	NA

IC Insurance company guarantees the risk, and bears all or part of the impact of any adverse deviations

PH Policyholder bears the risk, and bears all or part of the impact of any adverse deviations

--- Dotted line denotes natural hedge

Interactions during normal conditions are described by consistent sales, no mass changes in policyholder behaviour, continuous product evolution, the availability of ALM instruments and the daily collateralisation of hedges.

During stressed market conditions, there may be some disruptions in variable annuity supply if competitors exit the market. There may also be supply disruptions in terms of financial instruments (e.g. derivatives). However, as described in the risk management section, this will be less of an issue in exchange-traded liquid instruments such as futures, and more of an issue in exotic OTC instruments. Exchange traded instruments represent a significant portion of ALM programmes and this percentage will increase with Dodd-Frank requirements (i.e. central clearing). With these changes, we expect the majority of the derivatives held by insurers to be exchange-traded.

Recent variable annuity product innovation has included the use of product or fund-based risk management strategies such as contract-specific trading algorithms and target volatility fund asset allocation requirements. Volatility targeting is an investment strategy aimed at maintaining a stable level of volatility.

Target volatility funds are used to protect the level of investment funds and smooth investment returns through good/bad market scenarios. They may be more procyclical than fixed-allocation mixed funds as the underlying algorithms move money into risky assets during good times (i.e. at low volatility) and withdraw money out of risky assets during bad times (i.e. at high volatility). Target volatility funds are not unique to variable annuities. Similar strategies could apply to individual fund offerings, with similar outcomes. However, there is a diverse array of target volatility offerings, with different trading algorithms and different triggers. This would serve to mitigate concentration risk.

4.3. Interconnections through derivatives

Dynamic hedging strategies often involve exchange-traded futures contracts, which were successfully traded during the financial crisis, with settlement systems of exchanges protecting the value of these contracts. Despite increased tension on the credit-worthiness of many financial institutions, the collateralisation process (margin system and credit support agreements in place for swaps in particular) has been extremely effective at dealing with credit risk on a global scale.

The study from McKinsey states that “by the end of 2007, most of the major variable annuity writers were operating large scale hedging programmes that rivalled small trading floors in investment banks and had open positions in futures, swaps and options that reached into the billions of dollars.”¹⁴

Although factually correct, hedging programmes have never sought to compete with investment banks on option trading or market making activities. On the contrary, hedging programmes have been designed by variable annuity writers to mitigate the risks embedded in variable annuity products (namely equity risk, interest rate risk and volatility risk).

The following table shows the types of hedges and size of hedge notionals used by a sample of U.S. insurers for their Guaranteed Living Benefit (GLB) products as at 3Q12.

Table 7: Types of hedges of a sample of U.S. insurers

	Notional as a % of VA assets with GLB elected		
	Equity hedges	Interest rate hedges	Total
Company A	4%	54%	57%
Company B	80%	12%	92%
Company C	22%	26%	48%
Company D	75%	0%	75%
Company E	9%	19%	28%
Company F	10%	25%	34%
Average	39%	25%	64%

Source: LIMRA (2012a and 2012b)

This analysis indicates that insurers have very different hedging programmes according to types of hedges and size of positions, driven by their different risk profiles and hedging objectives. This indicates that the behaviour of insurers, and the impact on their portfolios of market events, will be different.

The following table shows the types of derivatives held by U.S. life insurers at the end of 2010 and 2011.

Table 8: Types of derivatives held by U.S. life insurers (US\$bn notional)

Year	Total	Swaps	Options	Futures	Forwards
2011	1,321	777	454	57	34
2010	1,018	591	354	47	26

Source: NAIC (2013).

Life insurers’ use of derivatives in 2011 has increased from 2010 with swaps, followed by options being the most widely used type of derivatives.

¹⁴ Chopra *et al.* (2009).

Hedging and replication are the primary goals pursued for more than 90 per cent of the hedges engaged in by life insurers (yield enhancement accounts for a marginal portion of the derivatives). Interest rate, equity and currency risk management (where necessary) represent in excess of 90 per cent of the underlying market risks that insurers seek to reduce.

The capital markets on which the majority of hedging programmes operate are the deepest and most liquid markets in the world (e.g. U.S. Treasuries, S&P 500 Futures, U.S. and European swap markets, plain vanilla short-term OTC equity options). Liquidity in interest rate swaps and bond futures markets has remained high, owing in part to governmental and Central Bank interventions, to mitigate historical low points.

The current average daily implied volume for the S&P 500 E-mini¹⁵ is over US\$140bn, far exceeding the combined traded dollar volume of the underlying 500 stocks. The table below shows the daily traded volumes on various segments of the U.S. Treasury bond market (the U.S. debt is the largest and most liquid in the world).

Table 9: U.S. Treasury market trading volumes (US\$bn)

Maturity (year)	2	5	10	15	25	Total
Average daily trading volume	45	54	111	38	4	252

Source: Futures Industry Association and Newedge USA, LLC.

Industry data is publicly available and known to regulators: U.S. insurers report their derivative positions in Schedule DB of quarterly and annual financial statements. The NAIC *Derivatives Instruments Model Regulation* (#282)¹⁶ sets standards for the prudent use of derivatives by insurers (requiring in particular written guidelines outlining the objectives of derivatives transacted upon, the internal control procedures and the credit risk management process—also known as the Derivatives Use Plan). The newly adopted *Own Risk and Solvency Assessment* (ORSA)¹⁷ requirements will provide detailed, comprehensive information to regulators regarding an insurer's risk exposures, risk management (including hedging), and other information on solvency.

The following table shows estimates from JP Morgan on the breakdown of the use of derivatives by U.S. insurers.

Table 10: Use of derivatives instruments

Total US\$bn 2011	Assets	VA	Liabilities	Other	Future cashflow
100%	41%	23%	16%	14%	7%

Source: JP Morgan estimates.

Over 80 per cent of all derivatives positions of the U.S. insurance industry are used for ALM purposes (including duration gap, convexity hedging and currency matching).

Within the space of variable annuity products, interest rate risks represent circa 53 per cent of the total hedges used, equities nearly 36 per cent and currency hedges roughly 11 per cent. In total, derivatives used for variable annuities represent a total outstanding notional of US\$245bn.¹⁸ In terms of footprint, variable annuities are therefore a minor component of U.S. insurers' footprint in the market which itself is negligible as shown below.

15 The S&P 500 E-mini is an electronically traded stock market index futures contract on the Chicago Mercantile Exchange.

16 NAIC (2009).

17 NAIC (2012).

18 JP Morgan (2012).

According to the semi-annual survey run by the Bank for International Settlements (BIS), the total outstanding notional amounts for OTC derivatives as of June 2012 were as follows (out of a total of US\$638tn total contracts):

Table 11: Breaddown of outstanding notionals for OTC derivatives (June 2012)

Type	Total (US\$tn)	Denominated currency for derivatives			
		Euro	US\$	JPY	Other
Interest rate swaps	379	36%	33%	12%	19%
Equity-linked contracts	6	40%	30%	10%	20%

Source: Bank for International Settlements.

Note that the US\$379tn for interest rate swaps are part of a larger market of interest-rate related contracts of US\$494tn).

The market footprint of all U.S. insurers on the capital markets can therefore be summarised as below, noting that these figures do not include derivatives transacted through captive reinsurance companies.

Table 12: Market footprint of U.S. insurers (US\$ bn)

Type	Total market	U.S. share	U.S. insurance derivatives	Insurer share
Interest rate	494,000	33%	940	0.6%
Equity	6,000	30%	164	9,1%
Total derivatives	638,000	33%	1,321	0.6%

Source: Bank for International Settlements, JP Morgan estimates.

The **U.S. insurance industry**, which is by far the world's biggest market, exhibits an aggregate market footprint of **less than 1 per cent of the total outstanding derivative notionals reported in official public sources**.

The following table shows the top 10 counterparty exposure for U.S. life insurers at the end of 2011.

Table 13: Notional value of U.S. life insurers' exposure to Top 10 derivatives counterparties

Counterparty	Exposure	Percentage
Deutsche Bank	144	10.9%
Credit Suisse	117	8.9%
Goldman Sachs	111	8.4%
Barclays	108	8.2%
JP Morgan	101	7.6%
BNP Paribas	95	7.2%
Bank of America Merrill Lynch	92	7.0%
Morgan Stanley	84	6.4%
Citigroup	75	5.7%
UBS	44	3.3%
Total (top 10)	972	73.6%
Other	349	26.4%
Total	1,321	100%

Source: NAIC (2013).

Similar to the derivatives market in general, the counterparties in the life insurance industry are relatively concentrated in a small number of financial institutions. However, some derivatives have high liquidity and are subject to daily cash settlements, which mean significantly lower credit risk.

The counterparty risk is expected to change going forward when certain OTC derivatives begin to settle through centralised clearinghouses, a requirement of the federal Dodd-Frank Wall Street Reform and Consumer Protection Act. This should further reduce the risk of a loss from a failed counterparty.

While variable annuities are complex products and have a number of interconnected parties, the evidence suggests that these interconnections are similar to those of other insurance products and that exposures to counterparties are limited.

5. Stress scenarios for variable annuities

As for other insurance products, variable annuities contain a number of risk dimensions outlined in the previous chapters, which may be considered “risky” from an earnings or capital standpoint, hence the need for regulatory and robust ERM frameworks to address these risks.

A number of jurisdictions have defined specific (albeit different) frameworks to set variable annuity reserving requirements or to measure the amount of capital to back the tail-risk events of these products. Frameworks range from statutory reserving requirements clearly defined by regulators or supported by actuarial guidelines (mostly the U.S. and Japanese approach) to more economic views of the risks defined within insurers’ internal models (mostly the European, U.K. and Swiss approach).

As part of their own ERM frameworks, variable annuity writers may also define *ad hoc* stress scenarios to further complete the range of analysis performed on these products to test their resiliency to various market or customer situations, set appropriate risk appetite limits and to ensure adequate risk management measures are taken (whether in product design, pricing or hedging) to mitigate various exposures.

This chapter demonstrates the effectiveness of these hedging programmes during the 2008–2009 global financial crisis. It shows how a generic variable annuity product would typically react to various shocks, using a portfolio representative of the current industry practice.

5.1. Heterogeneity of impact of stress events

As presented in Chapter 3 (on risk management), most if not all variable annuity writers have developed static or dynamic hedging programmes or a combination of both to mitigate/offset some of the risks raised by variable annuity guarantees. Although its capacity has significantly reduced since 2003, reinsurance cover is still used in some cases to reduce exposures to financial and non-financial risks.

Most insurers use a combination of these strategies to manage their exposures, consistent with their balance sheet capacity and risk appetite limits.

The use of exchange-traded and OTC derivatives by insurers may, on an absolute basis, appear large at first sight. However, insurers’ use of derivatives needs to be considered within the broader context of their ALM frameworks and the overall market use of derivative instruments as discussed in Chapter 4.

This notional amount also needs to be looked at within the depth of most of the derivatives’ markets on which variable annuity writers and their natural market or bank counterparts operate (e.g. U.S. Treasury futures, interest rate swaps, S&P 500/EuroStoxx/Nikkei futures, OTC swaptions and equity options, and total return swaps).

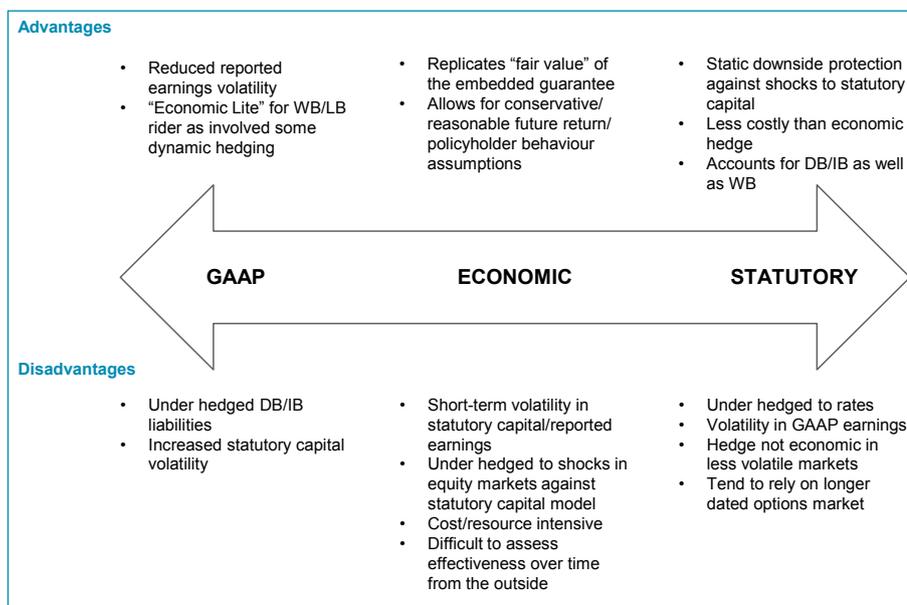
There is a wide range of accounting and regulatory frameworks across countries (especially between the U.S., Europe and Asia/Japan) supporting a broad array of goals for variable annuity hedging programmes (hedging to a statutory reserves and earnings base versus International Financial Reporting Standards (IFRS) or economic reserves or capital view).

The measure used to value the liability in the hedge programme significantly impacts the amount of risk protection. There are three primary views of living benefits products, yet only one can be hedged at a time:

- Fair value based (International Financial Reporting Standards (IFRS) or economic)
- Statutory earnings and capital
- Generally Accepted Accounting Principles (GAAP) earnings.

The heterogeneity in accounting standards and economic incentives therefore means variable annuity writers may choose to hedge different types of risks and thereby select different types of hedging instruments, as illustrated in Credit Suisse’s research paper entitled *US Variable Annuities—Assessing the Risks* (June 2012).

Figure 10: Overview of hedge approaches

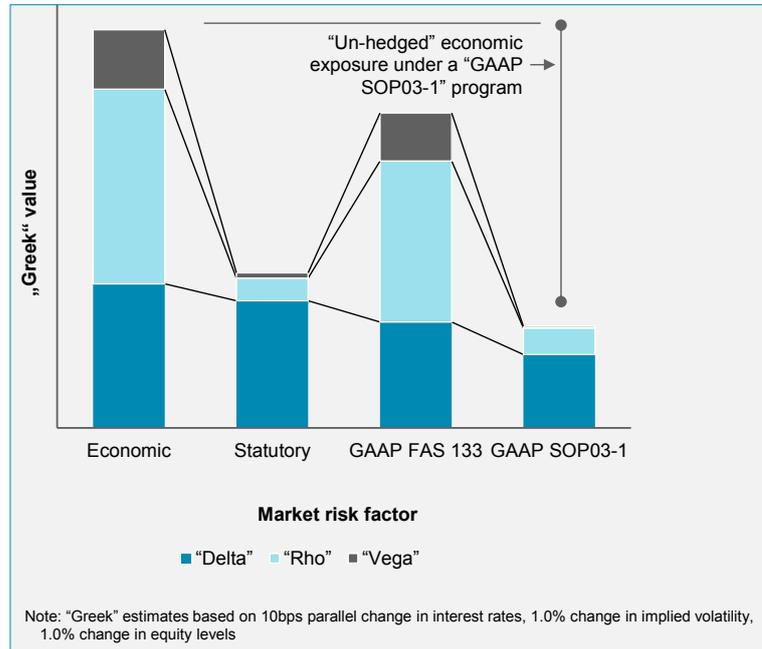


Source: Credit Suisse (2012).

The market sensitivity, captured by the “Greeks”, is markedly different depending on the view taken (and illustrated in the following figure).

- Economic views reflect the greatest sensitivity.
- Statutory views generally reflect less sensitivity, but exact levels change with “in the moneyness”.
- Earnings GAAP approaches are generally least sensitive (in particular with regards to interest rate risks).

Figure 11: Varying market sensitivity by hedging approach—illustrative policy with moderate investment risk

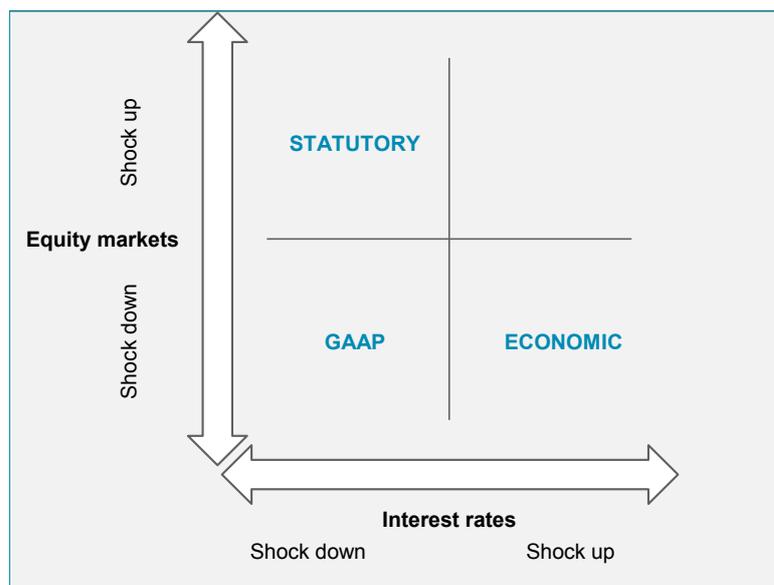


Source: Oliver Wyman analysis.

Rho (sensitivity to interest rates) is a significant driver of the difference between frameworks. This is because the fair value of guarantee payments is based on current market interest rates, which increases market sensitivity, whereas the statutory framework relies more on long-term estimates of interest rates, which can reduce the sensitivity.

Depending on which hedging methodology the insurer is using, risks will impact its balance sheet differently. The figure below highlights the most relevant risks for the three hedge methodologies.

Figure 12: Biggest risk for three hedge approaches



Source: Credit Suisse research (2012).

Credit Suisse estimates that statutory liabilities tend to be more sensitive to changes in equity markets and less sensitive to changes in interest rates and implied volatility. Statutory liabilities tend to not be as interest-rate sensitive as derivatives that are “fair valued”. Insurers that hedge to “economics” tend to be most concerned with replicating the fair value of the variable annuity guarantee with hedge assets so that longer-term cash flows are matched. Economically targeted hedge programmes cause GAAP earnings and statutory capital volatility over shorter time frames.¹⁹ In other jurisdictions, like Switzerland, the differences between statutory, accounting and economic views may be small or absent. Hence, economic hedging is the natural choice for legal entities based in such jurisdictions.

Given the heterogeneity of the various hedging programmes implemented by insurers and the variety of business they have written over the past years, it is worth considering how insurers writing variable annuities, and their hedging programmes, performed during the 2008–2009 financial crisis.

5.2. Riding out the storm: variable annuities in 2008–2009

Variable annuities have proven to be valuable to policyholders during the global financial crisis because they provide insurance guarantees that are tied to policyholder invested assets, unlike traditional unit-linked products, which are more widely held.

401(k) plans in the U.S. have indeed seen their US\$6tn asset base depleted by *circa* 25 per cent during the financial crisis of 2008–2009 for long-term tenure and large plan holders (>US\$ 200,000).

Variable annuities have seen the liability base of large variable annuity writers increase by an amount of US\$232bn in excess of a total account value base of *circa* US\$1.2tn (in 2008) without triggering any bankruptcies within the insurance industry.

Some variable annuity writers have nonetheless incurred profit and loss (P&L) attribution losses as a result of hedge programme breakages, costing the industry *circa* US\$4bn in September and October 2008 alone according to a report by consulting firm McKinsey.²⁰ This seemingly low efficiency of hedging programmes can be explained by a number of reasons, all of which have helped the industry adapt its product design, change its fund line-up and seek to further reduce tail risk.

These losses need, however, to be put in the context of unprecedented market movements: interest rates experienced swings of up to 40 bps per day in U.S. and EU (with interest rates trending to absolute lows in many currencies); equity markets dropped substantially (S&P 500 lost 37 per cent of its value in 2008 or 47 per cent between October 2007 and October 2008), with annualised realised volatility in excess of 40 per cent; finally the implied volatility VIX index increased to an all-time high of 80 per cent in the fall of 2008, making the purchase of protection more onerous for insurers globally.

In the context of this “perfect storm”, the variable annuity industry at large has proven to be resilient for several key reasons:

- **Not all policyholders will exercise/have exercised their guarantees at the worst possible point in time for insurers.** As described in the product design section, variable annuity products usually consist of an initial accumulation phase (of generally 10–15 years) before a payment phase (which can last between 5–10 years) where policyholders reduce their account value until such point where the payments guaranteed by the insurer are triggered (insured phase). Variable annuities in 2008 were still mostly in accumulation phase so the cost to insurers was more marked-to-market than a real cash or capital strain.

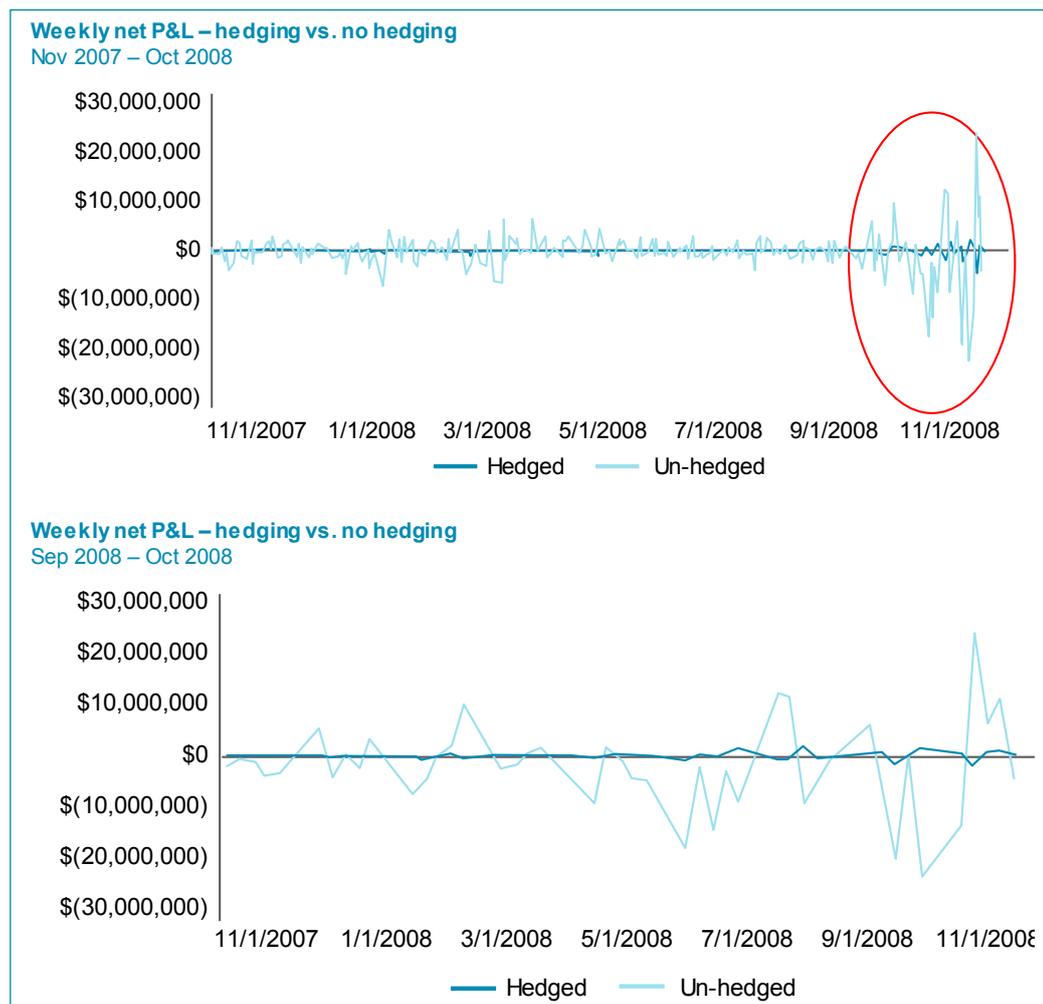
¹⁹ Credit Suisse (2012).

²⁰ Chopra *et al.* (2009).

- **Hedging programmes in place since 2003 have proven to be on average 93 per cent effective** in recouping capital market losses suffered by decreasing account value bases (according to a Milliman survey²¹). Industry-wide, Milliman estimates that hedging programmes in place at the time have probably saved the U.S. insurance industry US\$40bn over the two extreme months of September and October 2008.

The following figure shows results of U.S. variable annuity writers as of September 2008 (normalised to US\$1bn of assets under management), with a business mix of GMDB, GMIB, GMAB, GMWB, and GLWB benefits. It shows the impact that the hedging programmes had on reducing the impact of the market events.

Figure 13: Weekly P&L comparison



Source: Sun *et al.* (2009).

- **Hedging programmes were and are not designed to enhance the revenue sources of variable annuity products.** They rather follow clearly defined routines and use simple and easy to value derivative instruments such as equity and interest rate futures contracts for risk management, and plain vanilla equity and interest rate options to smooth out changes in liability values.
- **Capital markets on which the majority of hedging programmes operate are the deepest and most liquid markets in the world** (including U.S. bond treasury futures, S&P 500 futures, US\$, Euro and JPY swaps, swaptions and equity put options). They are

21 Sun *et al.* (2009).

the most secured in terms of collateral arrangements (daily margin calls on most exchange-traded markets) and have not shown any sign of contraction during the financial turmoil (derivatives worldwide have actually increased by a compound annual growth rate of 8 per cent per annum over 2006–2011). Despite heightened tensions on the credit worthiness of many financial institutions, bid-ask spreads of most hedge instruments have remained within tight competitive bounds.

This unprecedented recent crisis has revealed certain opportunities to improve product designs and fund offers. It has challenged hedging approaches and traditional risk modelling, which variable annuity writers have addressed:

- The variable annuity industry has undertaken **massive changes in fund selection**: more passively managed funds have progressively replaced active funds to reduce potential sources of basis risk (stemming from the performance mismatch between the separate account fund and the replicating index used for hedging).
- **Product- or fund-based risk management mechanisms** such as predetermined asset rebalancing features embedded in some variable annuity product designs or the use of target volatility funds have also enabled policyholders to achieve better risk-adjusted return investment profiles in down market scenarios.
- **Hedging programmes aimed at further mitigating tail risks have been implemented**, in particular with respect to volatility risk. This should help the industry better absorb the next crisis if any such one occurs (e.g. the summer of 2011 which experienced a spike in short-term volatility and a significant drop in interest rates upon the downgrade of the U.S. sovereign rating).
- While traditional hedging relies on sound theoretical and academically robust techniques, the risks encountered in 2008 led **many variable annuity writers to consider extreme stress scenario testing before launching new products** to the market to ensure the risk profile can sustain various tail risks. Product design has proven to be the first line of defence.

Despite numerous examples of runs on banks during this crisis (e.g. Washington Mutual and Northern Rock) and even with the rescue of AIG, the insurance sector and variable annuity writers in particular have not suffered a similar distrust from its clients. On the contrary, policyholders have come to realise the value of the guarantees offered to them by the industry. The guarantees offered to policyholders in variable annuity products have in fact acted as an effective countercyclical buffer to the crisis of 2008 and 2009.

In the aftermath of the financial crisis, risk management practices and teams have been strengthened in many companies, with the aim of balancing the necessary value proposition to address a growing client need for asset accumulation and protection to serve retirement needs with more resilient product designs and risk mitigation solutions to resist extreme financial and non-financial events.

The stability of the industry has also been reinforced by regulatory changes, in the context of Solvency II and changes in the U.S. statutory framework with the introduction of tailored reserve and capital requirements, which in their own ways add to the security of the offer to policyholders.

5.3 Quantitative impact of market stresses on a representative variable annuity portfolio

To assess the impact of market stresses on the balance sheet of a variable annuity writer, we have constructed a “representative” variable annuity writer which has been selling variable annuity business over the past nine years. The insurer has a portfolio consisting of approximately 40 per

cent of the products exposed to GMDBs and 60 per cent of the products exposed to GMWBs. The insurer assets and liabilities are valued on an economic (market value) basis and the capital requirements are determined on an economic basis. The insurer has implemented a derivatives hedging strategy based on its liabilities which is considered to be 90 per cent effective. Further details of the representative variable annuity writer can be found in Appendix B.

We subject this variable annuity writer to four market stresses consisting of an increase and decline in equity markets and an upward and downward movement in interest rates. For each of these four scenarios, we consider the impact on the insurer’s assets and liabilities and its capital requirements over three months, 12 months and 24 months after the market stress. The Geneva Association also shows results for the insurer as if they had not implemented their derivatives hedging programme. The variable annuity liability represents the best estimate of the cost of providing the guarantees to the policyholder (and other expenses) less the value of any charges on the policy. A negative liability means that the present value of the charges is expected to cover the present value of the cost of providing the guarantees.

The four market stresses are summarised below. Further details of the market stresses can be found in Appendix B.

Figure 14: Summary of market stresses

Equity markets	Shock up	<ul style="list-style-type: none"> • 45% increase in equity market over 3 months • 100 bps decrease in interest rates over two years 	<ul style="list-style-type: none"> • 45% increase in equity market over 3 months • 200 bps increase in interest rates over two years
	Shock down	<ul style="list-style-type: none"> • 45% decrease in equity market over 3 months • 100 bps decrease in interest rates over two years 	<ul style="list-style-type: none"> • 45% decrease in equity market over 3 months • 200 bps increase in interest rates over two years
		Interest rates	
		Shock down	Shock up

Source: Oliver Wyman analysis.

Table 14 page 48 shows the results for the four market stresses.

1. In the scenario where the equity market falls and interest rates fall, the variable annuity liabilities increase substantially as the guarantees move to being “in the money” and therefore are more expensive for the insurer. The economic capital requirement also increases reflecting the increased cost of the guarantees. However, where the insurer has purchased derivatives to hedge out the movement in variable annuity liabilities, it will receive large payments from the derivatives counterparties, offsetting the increase in liabilities and significantly reducing the potential loss if it was unhedged.
2. In the scenario where the equity market rises and interest rates rise, the variable annuity liabilities decrease substantially as the guarantees move to being “out of the money”. The insurer benefits from additional revenues earned on the policies due to the higher account value (with charges linked to account values). As the account values (separate account

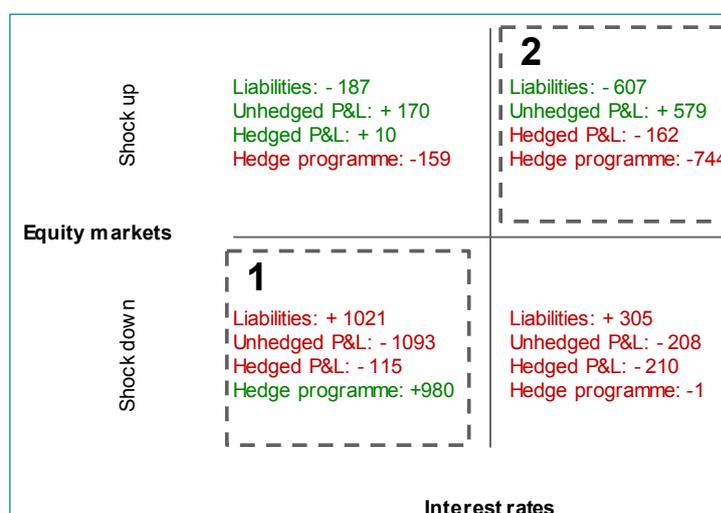
values) have increased substantially, more policyholders are likely to surrender their policies to look for potential superior products in the market. Where an insurer had purchased derivatives to hedge the movement in variable annuity liabilities, these derivatives would now likely be a liability on the balance sheet of the insurer, and the insurer would be making payments to the derivatives counterparty. This is reflected through the negative hedge receipts, which are payments from the insurer to the derivatives counterparty offset by decreases in the variable annuity liabilities.

Table 14: Impact of market stresses on representative variable annuity writer

	Base case		Equity up, Int rate up		Equity up, Int rate down		Equity down, Int rate up		Equity down, Int rate down	
	No hedging	Hedging	No hedging	Hedging	No hedging	Hedging	No hedging	Hedging	No hedging	Hedging
Starting balance sheet										
VA liabilities (best estimate guarantee)	(256)	(256)	(256)	(256)	(256)	(256)	(256)	(256)	(256)	(256)
Required capital (economic)	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
Separate account value	9,121	9,121	9,121	9,121	9,121	9,121	9,121	9,121	9,121	9,121
Balance sheet after 3 months										
VA liabilities (best estimate guarantee)	(228)	(228)	(744)	(744)	(702)	(702)	455	455	528	528
Required capital (economic)	1,374	1,374	1,149	1,149	1,225	1,225	1,397	1,397	1,463	1,463
Hedging programme profit/(loss)	-	-	-	(486)	-	(423)	-	512	-	603
Separate account value	8,890	8,890	10,876	10,876	10,969	10,969	6,930	6,930	6,999	6,999
3 month profit/(loss)	(2)	(2)	514	27	471	48	(691)	(178)	(764)	(161)
Balance sheet after 12 months										
VA liabilities (best estimate guarantee)	(142)	(142)	(712)	(712)	(463)	(463)	340	340	758	758
Required capital (economic)	1,307	1,307	875	875	1,286	1,286	1,187	1,187	1,549	1,549
Hedging programme profit/(loss)	-	(1)	-	(619)	-	(294)	-	255	-	795
Separate account value	8,210	8,210	9,745	9,745	10,258	10,258	6,247	6,247	6,587	6,587
12 month profit/(loss)	(11)	(12)	552	(66)	303	9	(480)	(225)	(945)	(150)
Balance sheet after 24 months										
VA liabilities (best estimate guarantee)	(39)	(39)	(646)	(646)	(226)	(226)	266	266	982	982
Required capital (economic)	1,231	1,231	683	683	1,477	1,477	969	969	1,618	1,618
Hedging programme profit/(loss)	-	(4)	-	(745)	-	(163)	-	(5)	-	976
Separate account value	7,290	7,290	8,337	8,337	9,237	9,237	5,379	5,379	5,970	5,970
24 month profit/(loss)	(18)	(21)	561	(183)	152	(11)	(226)	(231)	(1,111)	(136)

Source: Oliver Wyman analysis.

Figure 15: Impact on VA liabilities and P&L after 24 months relative to base case



Source: Oliver Wyman analysis.

5.4. Qualitative impact of selected stress events on variable annuity writers

Global variable annuity business is dominated by GMWB and GMIB contracts (mainly in the U.S.), with some GMAB and GMDB-type contracts and lifelong GMDBs.

As a general rule, the main directional market risks for variable annuity products are equity and interest rates. Foreign exchange risks are present in certain products with exposure to international markets (foreign equity indices or foreign bonds).

Capital requirements backing unhedged variable annuity business can be substantially reduced if the main directional market risks are hedged using a range of plain vanilla derivative instruments (e.g. equity index futures, interest rate swaps and foreign exchange forwards). Hedging more risk factors (such as convexity, volatility or correlation) further reduces market risks, but may on the other hand increase counterparty credit risk (or funding costs), which may in turn increase interconnectedness.

Since the dominant portion of global variable annuity writers hedge the main directional market risks to reduce P&L volatility and for capital efficiency reasons, the following sections focus on the impact of the residual risks remaining net of a “typical” hedging programme (which now very often embeds capped volatility fund structures and a mix of first and second order hedging instruments). Further details on these residual risks, and an assessment of their impact are discussed in Appendix C.

The industry highlights some features that may in certain market conditions tend to increase the risk profile of variable annuity writers:

- surrender benefits
- reset options (reset of roll-up base to ratchet level)
- roll-up rates set at high absolute and relative levels.

Severity and impact on society of selected stress events

Given the long-term nature of variable annuities and variety of product designs (including fund line-ups and guarantee features) as well as hedging approaches and accounting/regulatory differences, there is not a single macro scenario which would put a single player or the whole industry at risk as losses or shortcomings may arise from a range of sources. Ring-fencing variable annuities would add to the stress, not reduce it, as there could be natural offsets between risks carried by variable annuity products and those embedded in other life and savings products (such as protection and health insurance).

Three scenarios which could impact individual variable annuity writers and the industry, which vary in nature and their time horizon, are discussed below.

The timing of the losses depends on the nature of the risk, in particular whether the event is sudden and results in an immediate impact (e.g. market crash) or if the impact of the event emerges over time (e.g. increases in life expectancy).

Table 15: Summary of scenarios

Scenario	Event	Does scenario effect individ. VA writer?	Does scenario effect industry?	Factors to be considered when assessing impact of event
P&L losses due to adverse financial market conditions	2008 repeats intermittently	✓	✓	<ul style="list-style-type: none"> Impact differs by company due to product design, portfolio mix, hedging approaches
	Long period of low interest rates	✓	✓	<ul style="list-style-type: none"> Impact differs by company due to product design, portfolio mix (especially level of guarantees) To the extent that interest rate decreases are hedged over time and the business is repriced, event should not materialise critical losses to the industry
Increased hedging transaction costs or counterparty defaults	A partial or total disruption of the derivatives market	✓	✓	<ul style="list-style-type: none"> In the event of a partial market disruption, insurers likely migrate to more liquid instruments. In the event of a more extensive disruption to derivatives markets insurers would still have many viable options for managing variable annuity-related market risks (e.g. hedging strategies which require less frequent trading, using exchange-traded funds or even accept increased risks for a period of time, subject to regulatory constraints)
	Major bank hedge counterparty defaults	✓	✓	<ul style="list-style-type: none"> Not lasting impact due to intensified competition amongst surviving banks
	Variable annuity writer unable to post collateral	✓	✗	<ul style="list-style-type: none"> Impact depends on the size of positions and terms agreed to in financial covenants
	Mass surrenders	✓	✓	<ul style="list-style-type: none"> The most adverse environment for mass surrenders would occur if equity markets are rising and interest rates are high. Even in such an environment, however, policyholders would generally not be inclined to surrender a product that provides equity exposure, particularly if they incurred surrender charges
Misestimate of technical assumptions leading to shortfall of reserves	Policyholder behaviour more efficient (including higher election rates and more intensive use of optionalities)	✓	✗	<ul style="list-style-type: none"> Impact emerges over time as variable annuity writers adjust reserves
	Increased life expectancy	✓	✓	<ul style="list-style-type: none"> Impact emerges over time as variable annuity writers adjust reserves

The way the losses are measured also influences the impact on the insurer:

- Profit and loss: emerges differently given under different standards (e.g. statutory, U.S. GAAP, IFRS, economic)

- Solvency position: depends on the jurisdiction of the business and the solvency requirements (e.g. U.S., Europe, Japan).

Each of the scenarios above is discussed in more detail below.

Scenario 1 – P&L losses resulting from adverse or extreme financial market conditions

- **High volatility and gap risks** (e.g. 2008 repeats intermittently over the next 30 years): Assessing its probability is arguably difficult given the conjunction of macroeconomic environment, market microstructure and absence of regulatory elements leading up to such an event (including customer protection on mortgages, financial leverage, speculative credit derivative positions and opacity of conduits/structured investment vehicles (SIVs) on bank balance sheets).
- **Low absolute interest rate scenario for extended period of time** (e.g. Japan) could cause losses through P&L, given the level of guarantees offered but to the extent the rate decreases are steadily hedged over 20 years and business repriced on a regular basis, this risk should not materialise in critical losses for the industry.

In a purely economic framework, hedging helps reduce at least the impact of market risks associated with these products by 80-90 per cent.

If and when variable annuities are hedged systematically and repriced on a regular basis, the exposure of insurers to adverse or extreme market scenarios is significantly reduced. In the case of an upward shock (e.g. equity market up 20 per cent and interest rates up 200 bps over a short time period), losses on the asset side would be more than compensated for by gains on liability reserves. An up-market scenario is also more likely to leave the non-variable annuity portion of a life insurance portfolio in a good financial position.

While extreme financial market conditions may eventually impact the solvency of insurers, which would be resolved using the existing solvency framework in a given jurisdiction, these solvency concerns of insurers would not necessarily have systemic risk implications, as discussed in Section 5.5.

Scenario 2 – Market tensions leading to a liquidity squeeze with increased transaction costs and counterparty default (bank or variable annuity writer)

In this scenario, a variable annuity writer's risk management strategy is interrupted as a result of one or more factors.

- **A partial or total disruption of the derivatives market** could change the insurer's risk management strategy but would not necessarily create either a solvency or systemic risk impact. As with all insurance products, derivatives are helpful but not essential for effective asset-liability management.

In the event of a partial market disruption, insurers wishing to maintain a dynamic hedging strategy could and likely would migrate to more liquid instruments. For example, they could use exchange-traded derivatives instead of over-the-counter derivatives or they could change the tenor of instruments they purchase.

In the event of a more extensive disruption to derivatives markets, insurers would still have many viable options for managing variable annuity-related market risks. While some hedging activity is motivated by solvency and "tail risk" concerns, a significant portion of dynamic hedging results from a desire to mitigate balance sheet volatility resulting from market value-like accounting standards, either IFRS/GAAP or internal economic. In the event of a disrupted market, therefore, insurers would likely accept additional accounting

volatility and migrate to hedging strategies which require less frequent trading. In the very remote scenario of the complete unavailability of all hedging derivatives, insurers could still mitigate the major variable annuity-related market risks by, for example, purchasing long-dated Treasuries (to mitigate interest rate risk) and shorting stock indices or exchange-traded funds (to mitigate equity market risk). In addition, insurers could choose to accept increased risks for a period of time, subject to internal risk appetite rules and other potential regulatory constraints. The absence of functioning derivatives markets may increase solvency risks for insurers due to potential increased balance sheet and earnings volatility. Like other insurer solvency risks, this does not in and of itself pose systemic risk for the broader financial system. Although not an impossible event, the contraction for a prolonged period of time of the most liquid derivatives markets in the world is seen as very remote event with far greater consequences to the overall financial system than just variable annuity products.

- **A major bank counterparty defaulting** would leave a variable annuity writer naked on its hedge positions. The Lehman collapse experience showed however that such a failure, in fact, intensified competition amongst surviving banks to increase their client coverage base rather than dismantled any form of traditional derivatives activity. While this scenario would temporarily increase solvency risk for the insurer, the effects would not be transmitted in a systemic manner to other financial institutions.
- **A variable annuity writer is unable to pay a collateral call** due to specific liquidity issues (which would be an issue for a single variable annuity writer, and is not likely to be an industry-wide or systemic risk issue). Depending on the size of the positions and terms agreed in its financial covenants, this could have impact on the counterparties of the single variable annuity writer, hence the need to have strong liquidity management as part of companies' ERM frameworks.
- **A variable annuity writer faces a mass run on account values** forcing an early unwinding of its hedge assets. Depending on the market situation in which this mass surrender takes place, the consequences for each variable annuity writer would be different, and the effects would not be transmitted in a systemic manner to other financial institutions. From the variable annuity writer's standpoint, the most adverse environment for mass surrenders would occur if equity markets are rising and interest rates are high. Even in such an environment, however, policyholders would generally not be inclined to surrender a product that provides equity exposure, particularly if they incurred surrender charges.

In summary, none of the scenarios in which the variable annuity writer's risk management strategy would be disrupted presents a systemic risk, e.g., a situation where a failure of a variable annuity writer would occur and lead to a failure of another financial institution or disruption in financial markets or the real economy.

Scenario 3 – Misestimation of technical assumptions leading to a shortfall in reserve when delivering payoff in the insured phase

- **Policyholder behaviour is more efficient than planned initially** (e.g. more intensive use of optionalities offered in product and higher benefit election rates). As policyholder behaviour generally develops or changes over time, given the length of most variable annuity contracts (10–15 years on average at inception), variable annuity writers adjust their reserves over time.
- **Life expectancy improvement factors are higher than expected** in best-estimate assumptions. For biometric risks as well, variable annuity writers will adjust their reserves over time as the consequence of life expectancy increases does not emerge overnight.

It is the responsibility of insurers to regularly review their assumptions based on actual to expected experience and adjust their reserves if needed. These risks emerge over time and are not subject to instantaneous, binary changes that could put the entire financial system at risk.

A shortfall in reserves due to the misestimation of technical assumptions may lead to a solvency issue for a particular variable annuity writer and would be resolved using the existing solvency framework in a given jurisdiction. It would, however, neither create nor amplify a systemic risk event.

5.5. Resolution of variable annuity business

This section is based on The Geneva Association report *Insurance and Resolution in Light of the Systemic Risk Debate*²² and draws on The Geneva Association response to the IAIS consultation on proposed policy measures for G-SIIs.²³

The report considers the scenario whereby a significant market event impacts a hypothetical life insurer writing life insurance and variable annuities with additional guarantees, how the company reacts to this impact and any potential knock-on effects on key external stakeholders.

The failure of the hypothetical insurer in the scenario discussed does not threaten the financial system. It shows that management and regulators take actions to reduce the impact on the insurer (and external parties). If these are proved insufficient, the insurer is resolved using a standard insurance resolution process.

In the event of resolution, one should consider the impact on the derivatives portfolios often held by insurers to manage risks associated with variable annuities.

OTC derivatives transactions will be subject to an International Standard Derivatives Agreement (ISDA) and Credit Support Annex (CSA) between the insurer and the derivatives counterparty. The ISDA will contain a number of standard terms and a schedule of additional terms negotiated between the counterparties including any early termination rights. The ISDA will cover all (netted) OTC derivatives transactions with a given counterparty.

In the event of early termination, normal market disciplines would apply with any negative mark to market value being paid to the relevant counterparty. To the extent that the majority of derivative transactions are fully collateralised, any resultant cash call on the insurer would be dependent on the value of uncollateralised derivatives and whether the position of the contract was to the favour of the insurer or to the counterparty at the point of termination. Where the insurer is “in the money” on the derivative then early termination would result in receipt of cash from the counterparty, rather than a cash call.

The default risk arising from derivatives liabilities, which can generate a spillover of significant losses to other financial institutions, should be addressed by regulating the derivatives market. Centralised clearing with daily/weekly margin calls for derivatives, which so far have been traded OTC, is likely to become more common market practice. This largely eliminates the impact of any default. The Financial Stability Board (FSB), which has set up a separate work stream for the regulation of the OTC derivatives market, European Market Infrastructure Regulation and Dodd Frank regulation, will contribute to further secure this framework.

It should also be considered that derivatives counterparties are large financial institutions which all impose reciprocal credit limits. In that case, the consequences on derivatives counterparties of a large insurance run off, involving the unwinding of derivatives positions, would be quantitatively limited and manageable from a systemic perspective.

22 The Geneva Association (2012a).

23 The Geneva Association (2012b).

In light of the above, particularly that insurance resolution tools can be applied to an insurer as a going concern without formal insolvency, and that the majority of derivatives are collateralised in any case, the evidence suggests that a large derivatives portfolio held by an insurer materially impacts the ability for the insurance business to be resolved in an orderly manner were such an insurer to get into difficulty.

In most jurisdictions there are policyholder protection schemes, such as the U.S. system of state guaranty associations, which would provide some additional funds in the event of an insurer failing with its statutory assets less than the statutory value of its liabilities.

6. Considerations regarding variable annuities and systemic risk

Variable annuities are life and savings insurance products sold by life insurers which entail many features shared with “traditional” insurance products including:

- prepaid premiums
- reserving mechanisms and capital frameworks
- long-term and illiquid liabilities
- asset liability matching approach as part of an integrated risk management approach
- pooling of idiosyncratic risks.

Variable annuities are regulated as insurance products and are subject to all insurance regulations and legislation. They are overseen by local regulators and supervisors and covered by policyholder protection schemes.

Variable annuities are retail products for retail customers. These policyholders exhibit idiosyncratic behaviour and react to sudden market movements in a heterogeneous manner and not suddenly so there is less potential for mass surrenders. Even in case of mass surrenders, the evidence does not suggest a liquidity issue for the insurer due to the sale of assets. This is due to clearly identified assets (in the separate account) that would be sold to pay any surrender value to the policyholder (on surrender the policyholder would get back the account value less any surrender charges). As noted earlier in the report, in such a scenario the insurer guarantee expires and releases general account liabilities, benefiting capital and surplus.

Variable annuity product designs have been responsive to changes to and the emergence of different product risk profiles as insurers have gained more experience with these products and the way policyholders utilise their benefits. There have been many revisions of benefit structures and charges in response to changing consumer demand (e.g. the emergence of living benefits) and market environment, in particular, the various limitations on policyholder options around investments have reduced the overall level of market risk within variable annuities.

Variable annuities are one type of a wide range of products offered by insurers in their insurance portfolio. When considering the impact of any event on an insurer, one must consider the impact on the overall business and not consider the variable annuity portfolio in isolation. Significant diversification benefits exist across different product lines which provide stability for the overall portfolio during any impacts.

Variable annuities, whilst sharing many characteristics with traditional insurance products also have some important differences. This includes a heightened degree of manageability and transparency that reflects the level of optionality open to the policyholder.

Variable annuity products are considered as part of dedicated ERM frameworks along with other insurance products.

Derivatives are used extensively by insurers in hedging programmes as part of their risk management of variable annuities. However, the more extensive use of derivatives by variable annuity writers does not mean that they pose a systemic risk. In particular, there are a number of measures in the derivatives contracts and individual firm policies which mitigate the impact of any potential difficulties arising from derivatives counterparties and market movements. These are briefly discussed below:

- Derivatives contracts have collateral requirements (either OTC derivatives or through exchanges) that reduce the impact of the derivatives counterparty defaulting.
- Hedging of risks is performed in a coordinated and rational way for the purposes of risk management by highly qualified seasoned professionals within a secured internal control framework (with clear segregation of duties between fund management and hedging operations, front office execution roles and valuation teams, seconded by model and operational controls, regular internal and external audits, and regulatory reviews). While a failure of an individual insurer could occur, such a scenario is itself idiosyncratic and unlikely to lead to a systemic risk scenario for other financial institutions or financial markets generally. Variable annuity hedging is not conducted for profit or for leverage.
- The derivatives portfolio of variable annuity writers consists of a combination of both short and long-term derivatives contracts. These contracts may require regular rebalancing to ensure that the derivatives portfolio matches the characteristics of variable annuity portfolio.
- There are currently many regulatory changes being enacted regarding the derivatives market (e.g. Dodd-Frank, Financial Stability Board (FSB) derivatives reform) aimed at strengthening the market and increasing the confidence in market participants. The Geneva Association supports these measures and others those that will make derivative contracts more resilient—not only for variable annuity writers but also for all insurance product writers.
- The majority of the instruments used for variable annuity hedging, such as plain vanilla options and interest rate swaps, are simple and available through deep and liquid markets.

The usage of derivatives for ALM purposes significantly reduces insolvency risk (as illustrated in Figures 8 and 13) as it reduces the volatility of both the economic earnings and economic capital. For systemic risk, the consequences of using derivatives for ALM purposes also have offsetting impacts. Whilst the interconnectedness between insurers and the financial system is increased, the insurers' solvency position is significantly improved due to the smoothing effect of derivatives on portfolio volatility, thereby reducing its potential for failure and systemic risk exposure. Conversely, a variable annuity writer that does not use derivatives has the opposite position with an increased insolvency risk which does not necessarily reduce its systemic risk. The usage of derivatives for ALM purposes therefore reduces systemic risk and supports the solvency of insurers.

Of all of the scenarios considered that may cause problems for variable annuity writers, our research did not identify any that have the potential to create or amplify systemic risk across the financial services sector and the wider economy.

Regulators are particularly concerned about scenarios that involve significant market drops and/or sharp interest rate downward movements:

- Most variable annuity blocks of business are hedged against market movements and interest rate movements (albeit to differing degrees).
- In the tail scenarios where equities drop and interest rates decrease, variable annuity writers would be net beneficiaries of positive settlements/collateral given their derivatives positions (short positions on equities and receiver positions on rates). If there is an increase

in surrenders, insurers would additionally benefit as any liabilities for guarantees would be released benefiting capital and surplus.

- The reverse scenarios (i.e. equities up, interest rates up) would create a liquidity demand on insurers to settle collateral on their derivatives positions and that is a risk the company should monitor closely. However, this may cause pressure on individual insurers, depending on their individual positions, but not the financial system in general, which would be experiencing a positive business and financial market environment .

Given the low amount of notional derivatives positions held by the insurance industry relative to the overall derivatives markets, it is difficult to envisage a scenario where derivatives would not be available over an extended period of time for insurers to adjust their derivatives position.

Variable annuity writers follow different hedging strategies due to differing variable annuity portfolios, overall mix of business and hedging objectives. Therefore the impact of any market movements and interest rate changes will not be identical across all variable annuity writers.

Even in the very unlikely event of a complete disruption in derivatives markets, variable annuity writers would still have many viable options for managing market risks and would likely choose to accept increased risks for a period of time, subject to internal risk appetite rules and other potential regulatory constraints. The absence of functioning derivatives markets may increase solvency risks for insurers as it provides a higher volatility of capital and earnings but our research does not identify this as an immediate risk event leading to a systemic crisis.

When considering variable annuities in relation to the systemic risk discussion, there is a distinction between issues that relate to the solvency risk of insurers and issues that relate to the systemic risk of insurers. Solvency risk is already considered through comprehensive insurance regulations and relates to the ability of insurers to pay policyholder claims. Systemic risk relates to the widespread disruption of the flow of financial services.

Variable annuities represent a robust solution to the financial challenges posed by an ageing population and growing cohorts of retirees. To date, they have demonstrated stability through a significant crisis, and are continually updated and strengthened in light of lessons learned and changing market environments. Our research has not identified any scenario that would make the failure of a variable annuity writer the source or amplifier of systemic risk for global financial markets or the real economy.

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Appendix B.

Details of modelling of scenarios

Source: Oliver Wyman

Representative variable annuity writer

Product types

- GMDB
 - annual ratchet to age 80
- GMWB
 - return of deposit on death
 - 5 per cent roll-up if withdrawals have not started (5 per cent of deposit)
 - 5 per cent withdrawal for life, for withdrawals commencing after age 60
 - assume all age bands commence withdrawals at age 60.

Fees	GMDB	GMWB
Admin	\$50 per policy per year	\$50
M&E	1.25% of account value (AV)	1.25% of AV
IMF	1% of AV	1% of AV
DB Rider Fee	0.25% of AV	
WB Rider Fee		1% of payment base

Business mix

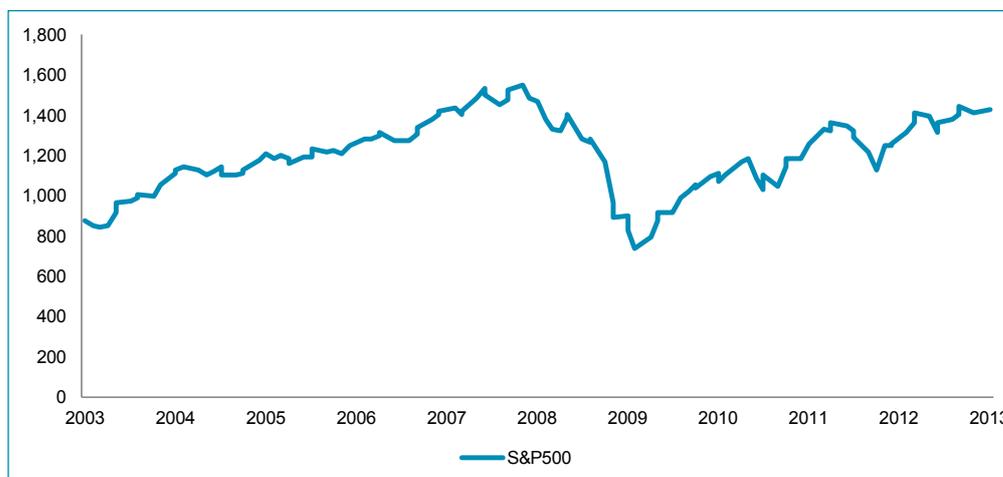
- 10 billion premium
 - 4 billion GMDB
 - 6 billion GMWB

Table 16: Split of premium by issue year and age

MM	Issue year	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Age		10%	15%	15%	18%	18%	10%	5%	5%	5%	100%
50	15%	150.0	225.0	225.0	262.5	262.5	150.0	75.0	75.0	75.0	1,500
55	20%	200.0	300.0	300.0	350.0	350.0	200.0	100.0	100.0	100.0	2,000
60	25%	250.0	375.0	375.0	437.5	437.5	250.0	125.0	125.0	125.0	2,500
65	25%	250.0	375.0	375.0	437.5	437.5	250.0	125.0	125.0	125.0	2,500
70	15%	150.0	225.0	225.0	262.5	262.5	150.0	75.0	75.0	75.0	1,500
Total	100%	1,000	1,275	1,500	1,750	1,750	1,000	500	500	500	10,000

Contract state

Figure 16: S&P 500 index, 2003 to 2013



Source: Datastream, Oliver Wyman analysis.

- Some cohorts issued between 2004 and 2012 should have growth in Account Value (AV).
- Make conservative assumption that contracts have zero growth (AV = premium).
- Withdrawal Benefit Payment Base is adjusted for rollups (which puts the guarantee in the money).
- AV are adjusted for withdrawals where applicable.

Actuarial assumptions

- Investment mix:
 - 50 per cent S&P 500
 - 50 per cent investment grade bonds
- Interest rates as at year end 2012
- Surrender charge

Duration	0	1	2	3	4	5	6	7+
Surrender charge %	7%	6%	5%	4%	3%	2%	1%	0%

- Withdrawals
 - 0 for GMDB portfolio
 - 4.5 per cent commencing at age 60 for WB, 0 prior to age 60 (4.5 per cent reflects some inefficiency in utilisation)
- Lapses
 - Grade from 1 per cent to 5 per cent during surrender charge period, 18 per cent in year 7 and 9 per cent thereafter
 - Lapse dynamics
 - DB: proportional to AV/GMDB (min 0.3, max 2.0), e.g. AV/GMDB * Base Lapse Rate
 - WB: proportional to AV/CommutedGMWB (min 0.3, max 2.0)
- Mortality
 - 95 per cent of 1996 A2000 table (Source: SOA.org)

Hedging portfolio

- Delta:
 - 1 per cent shock to S&P 500 exposure
 - Assume 90 per cent of exposure can be hedged using cash and futures position
- Rho:
 - 10 bps shock
 - Assume 90 per cent of exposure can be hedged

Capital calculation: Simple single shock approach:

- Equity: down 25 per cent
- Equity volatility: up 10 per cent
- Interest rates: parallel down 50 bps (floor of 0 per cent)
- Rate volatility: additional 5 per cent to Black Scholes volatility
- Lapse risk: reduce by 50 per cent (base lapse)
- Mortality risk: increase rates 10 per cent
- Longevity risk: decrease rates 10 per cent
- Utilisation: full 5 per cent withdrawal.

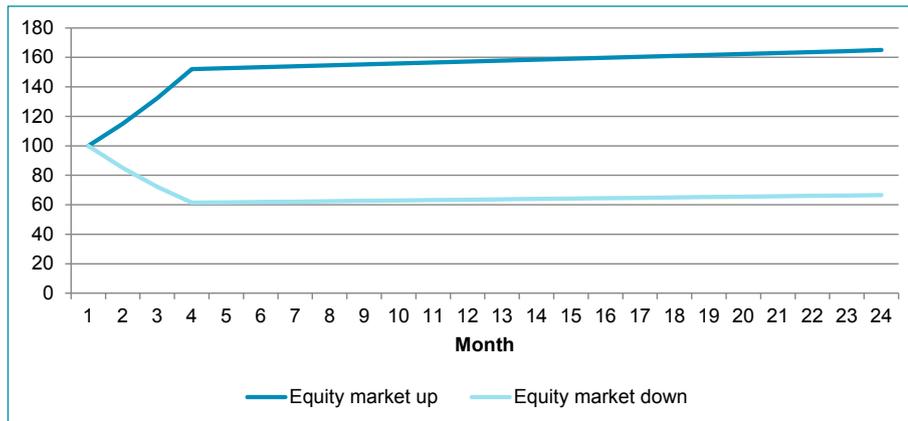
Market stresses

Figure 17: Summary of four market stresses

Equity markets	Shock up	<ul style="list-style-type: none"> • 45% increase in equity market over 3 months • 100 bps decrease in interest rates over two years 	<ul style="list-style-type: none"> • 45% increase in equity market over 3 months • 200 bps increase in interest rates over two years
	Shock down	<ul style="list-style-type: none"> • 45% decrease in equity market over 3 months • 100 bps decrease in interest rates over two years 	<ul style="list-style-type: none"> • 45% decrease in equity market over 3 months • 200 bps increase in interest rates over two years
		Shock down	Shock up
		Interest rates	

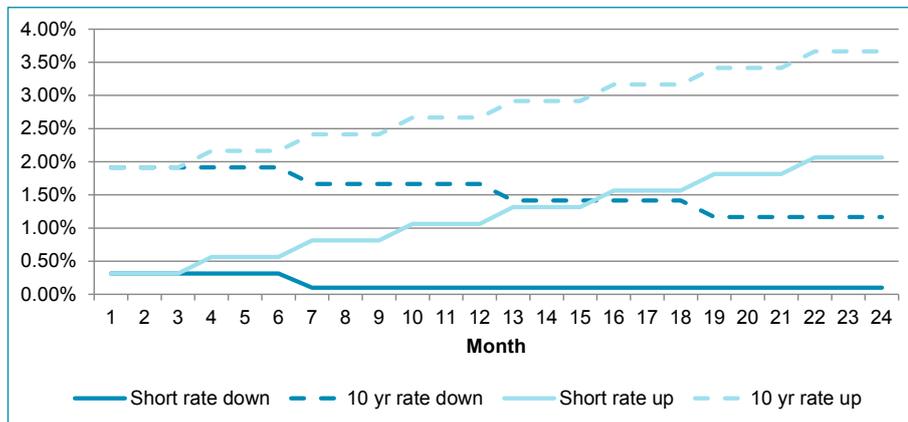
Source: Oliver Wyman analysis.

Figure 18: Equity market stresses



Source: Oliver Wyman analysis.

Figure 19: Interest rate stresses



Source: Oliver Wyman analysis.

Appendix C.

Consideration of “residual” risks of hedging

Since the dominant portion of global variable annuity writers hedge the main directional market risks (i.e. first and second order equity and interest rate risks) to reduce P&L volatility and for capital efficiency reasons, the following section focuses on the impact of the residual risks remaining net of a “typical” hedging programme (which now very often embeds capped volatility fund structures and a mix of first and second order hedging instruments).

The following table lists categories of risks for these products and provides a high-level assessment of their hedgeability and severity in terms of impacts should risks materialise.

Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Insurance risk						
Increase in life expectancy after age 65 (biometric risk)	<ul style="list-style-type: none"> Variable annuity products which pay out income over a policyholder's future lifetime are exposed to longevity risk. 	Low	Medium	Low	Low	<ul style="list-style-type: none"> Offsetting life portfolios and death benefit riders embedded in the variable annuity product may provide for natural hedges, but this will depend on the structure of the portfolios (including age bands and sum assureds). Prudent reserving and pricing basis and stress scenario analysis.
Market risk						
Level and convexity risks for equities and interest rates	<ul style="list-style-type: none"> Both 1st and 2nd order market risks are hedged by most variable annuity writers. Interest rate curve risk ("rho") can be hedged out to 20–30 years in most major markets. Beyond 30 years, various adjustments exist. The risk profile of some variable annuity products may also depend on the levels of realised correlations between different equity indexes, foreign exchange rates and interest rates – correlation risk can be seen as another form of convexity risk. 	High	Medium	Medium	Low	<ul style="list-style-type: none"> Product design. Daily rebalancing of portfolio. 2nd order hedge instruments to mitigate convexity exposures.

Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Basis and fund mapping risks	<ul style="list-style-type: none"> • Basis risk stems from a range of potential sources: <ul style="list-style-type: none"> – General disconnect between the performance of actively managed unit-linked funds in which policyholders invest their premium and assets used to perform the hedging programme (e.g. equity market indices). – Spread between bonds and interest rate swaps: to the extent that fund investments are typically in government or corporate bonds, but hedging often employs swaps, the exposure to the bond-swap spread (or other interest rate spreads) remains unhedged. • Fund mapping. Hedging index exposures using related, but different, indices (e.g. exposure to TOPIX hedged using Nikkei futures and options). 	Low	Medium	Low	Low	<ul style="list-style-type: none"> • More passively managed funds, single investment concentration rules, asset allocation / profiled funds, short-selling techniques.
Transaction costs (bid/ask spreads) and risk of market illiquidity	<ul style="list-style-type: none"> • Bid/ask spreads on various hedging instruments may fluctuate over time (depending on the level of risk aversion and competition in the market). 	Low	Medium	Medium	Low	<ul style="list-style-type: none"> • New regulations or specific risk aversion in capital markets not in the hand of insurers. • Product design to make guarantees less derivative-intensive.
Long-term vega risks	<ul style="list-style-type: none"> • Volatility risk (“vega”) can be hedged out to 10–20 years for the main market risk factors (equity, rates and foreign exchange in the major currencies), although the most liquid exchange traded instruments only trade out to shorter maturities. • Some long-term vega risk remains. 	Medium	Low	Low	Low / Low	<ul style="list-style-type: none"> • Long-term vega risks are significantly reduced by volatility-controlled funds.

Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Skew and gap risks	<ul style="list-style-type: none"> Since 2009, variable annuity writers have introduced “volatility control funds,” which significantly reduce the investment into risky assets (typically equity) when the volatility of the risky assets increases (exact trigger varies by companies but broad mechanism is quite similar). Such funds remove trend risks in volatility (known as long-term vega discussed above). Depending on the type of trigger used in the volatility control fund (e.g. implied or realised volatility signal, convexity sensitivity measure, macro-algorithm based on various risk measures), the strategy of delta-hedging the guarantees can vary and can still be subject to “jumps” in the risky investment bucket. 	Medium	Medium	High	Medium	<ul style="list-style-type: none"> Effect depends on the hedging program and on the mix of old and new generations of variable annuity products. “Gap” risk can be hedged by rolling short-dated put options. Variable annuity writers are exposed to the relative price difference between puts and variance swaps, depending on what mix of put options and variance swaps is employed in the hedging.
Short-selling costs	<ul style="list-style-type: none"> Most variable annuity products are managed with a fully invested underlying fund (unit-link component) overlaid with a guarantee rider on which the hedging programme applies to offset variations in the liability profile. Regardless of the exact hedging strategy pursued, any form of hedge producing these offsets will suffer if the cost of “going short” increases. 	Low	Low	Low	Low / Low	<ul style="list-style-type: none"> Include slippage cost or recognition of imperfect hedging (frictional costs) in initial pricing to secure margins. Embed certain hedge or guarantee features in the investment fund itself to avoid short-selling costs. Establish short-selling agreements with the fund. Contractual clauses that allow insurer to pass increasing hedge costs back to policyholders.

Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Cross-currency risk	<ul style="list-style-type: none"> • During and shortly after the financial crisis, the US dollar emerged as the “safe heaven” currency. • Keeping funds in the “safe” US\$ and exchanging the floating rate US\$ payments for floating rate payments in another currency became increasingly costly. • Depending on the exact hedging programme, this has potentially produced gains or losses for variable annuity writers operating on an international scale. 	High	Low	Low	Low / Low	<ul style="list-style-type: none"> • Foreign exchange hedging.

Counterparty risk and cost of collateral risk

Counterparty default risk	<ul style="list-style-type: none"> • If a (banking) counterparty to a variable annuity writer defaults, then there would likely be some turbulence in the market and some time needed to re-establish a hedge with another counterparty, with prices potentially moving either way (a price increase known as “wrong-way risk”). 	High	High	High	Medium	<ul style="list-style-type: none"> • Derivatives transactions are always collateralised, either because they are executed on institutional markets where margin calls are compulsory or because it is now standard market practice between big institutional financial corporations to collateralise any OTC contract (including swaps, options). • Rules and limits on counterparty concentration. • Collateral management specific to each company.
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Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Collateral funding costs	<ul style="list-style-type: none"> An increase in the costs of providing collateral for hedge instruments may be caused by: <ul style="list-style-type: none"> (a) higher margin requirements on centrally cleared instruments (due to a change in regulation for instance) or (b) higher costs for paying interest on cash collateral in OTC transactions (funding cost related to rating or choice of currency). 	Low	Low	Medium	Low	<ul style="list-style-type: none"> Most hedging programmes are fully collateralised. Rules and limits on counterparty concentration. Collateral management specific to each company.
Behavioural risks						
Persistency risk	<ul style="list-style-type: none"> VA products are generally priced with base and dynamic surrender assumptions that aim to reflect a certain degree of policyholder rationality. Surrenders may be explained by a variety of factors including financial rationality and tax implications. Pricing assumptions are often set on prudent basis relative to “best estimates” originating from experience analyses, given the fundamental unpredictability and wide variety of a very large set of policyholder behaviours. When guarantees are “out of the money” (resp. “in the money”), surrenders are more likely to cause a loss (resp. gain) to variable annuity writers. 	Low	Medium	Medium	Medium	<ul style="list-style-type: none"> Policy design: Ratchets, upfront and surrender charges, tax incentives and commission clawbacks, may disincentivise policyholders to lapse early and at worst possible point in time for variable annuity writer.

Type of risk	Description	Hedge-ability	Severity	Speed of risk	Impact to VA writer / financial industry	Solutions to mitigate exposure
Benefit utilisation risk	<ul style="list-style-type: none"> Benefit utilisation risk covers all the elements that may influence the utilisation rate of the various options (that were) often offered in variable annuity products: <ul style="list-style-type: none"> “\$ for \$” withdrawal on U.S. variable annuity products in particular. Partial withdrawal and partial surrenders. Income Benefit election rate for GMIB (at the end of the accumulation phase). Withdrawal deferral period switch for GMWBL riders. Fund switching (e.g. choice to move investments to more volatile funds thus making guarantees more costly to hedge). 	Low	Medium	Medium	Medium	<ul style="list-style-type: none"> Prudent pricing and hedging assumptions are key elements to preserve adequate levels of reserves over the long run, although assumptions may be adjusted based on experience.
Operational risk						
Range of exposures including IT, staff, governance, and hedge operations	<ul style="list-style-type: none"> Managing a book of variable annuities requires significant investment in front to back-office IT valuation systems, human capital and tight governance (including trade approvals, 2nd eye checks, definition of rebalancing thresholds, escalation processes). Failures can happen which may disrupt the normal course of hedging and valuation for variable annuity writers. Fraud in claims management is less of an issue for variable annuities compared to other life businesses. 	Low	Medium	Medium	Low	<ul style="list-style-type: none"> Enterprise Risk Management framework including Business Continuity Planning, internal controls, IT integrity and HR management

Appendix D.

Glossary

ALM	Asset Liability Management
APE	Annualised Premium Equivalents
BIS	Bank for International Settlements
CSA	Credit Support Annex
DIAs	Deferred Income Annuities
EIAs	Fixed Equity Indexed Annuities
ERM	Enterprise Risk Management
FAS	Fixed Deferred Annuities
FSB	Financial Stability Board
GAAP	Generally Accepted Accounting Principles
GLB	Guaranteed Living Benefit
GMAB	Guaranteed Minimum Accumulation Benefit
GMDB	Guaranteed Minimum Death Benefits
GMIB	Guaranteed Minimum Income Benefit
GMWB	Guaranteed Minimum Withdrawal Benefit
GMxBs	GMIBs and GMWBs
IAIS	International Association of Insurance Supervisors
IFRS	International Financial Reporting Standards
ISDA	International Standard Derivatives Agreement
NAIC	National Association of Insurance Commissioners
OTC	over-the-counter
SPIAS	Single Premium Immediate Annuities
SIVs	Structured Investment Vehicles
TIAA-CREF	Teachers Insurance and Annuities Association-College Retirement Equity Fund

The Geneva Association

The Geneva Association:

a. provides a platform for insurance CEOs:

The Geneva Association acts as a forum for its members, providing a worldwide unique platform for the top insurance CEOs. It organises the framework for its members to exchange ideas and discuss key strategic issues, especially at the General Assembly where once per year over 50 of the world's top insurance CEOs gather.

b. maintains dialogue with international institutions:

The Geneva Association uses its special risk and insurance expertise and in-depth knowledge to raise subjects of relevance to the insurance sector in global forums. The Geneva Association is the leading interface of the insurance industry with relevant international institutions and advocates the role of insurance and its relevance to the modern economy.

c. organises expert networks:

The Geneva Association organises global networks for experts in various fields linked to insurance: finance, regulation, risk management, pension provision, health, etc. It also manages several extra-company networks of specialists from its members' companies: chief financial officers, chief risk officers, chief investment officers, chief communication officers, the Amsterdam Circle of Chief Economists (ACCE), as well as the Liability Regimes Planning Board with leading underwriters and claims-handlers.

d. conducts research:

The Geneva Association investigates the growing importance of worldwide insurance activities in all sectors of the economy. It tries to identify fundamental trends and strategic issues where insurance plays a substantial role or which influence the insurance sector. In parallel, The Geneva Association develops and encourages various initiatives concerning the evolution—in economic and cultural terms—of risk management and the notion of uncertainty in the modern economy.

e. publishes leading insurance journals, newsletters, books and monographs:

- **journals:** *The Geneva Papers on Risk and Insurance Issues and Practice* (4 issues per year) and *The Geneva Risk and Insurance Review* (2 issues per year);
- **special reports:** The Geneva Association reports tackle issues of strategic importance to the insurance industry that warrant special attention and particular analysis;
- **The Geneva Association newsletters**, published usually twice a year, on Insurance and Finance, Risk Management, PROGRES (regulation and supervision), Insurance Economics, Life and Pensions (life insurance, pension and retirement), Health and Ageing, General Information and World Fire Statistics;
- **books and monographs.**

f. organises conferences and seminars:

Throughout the year, The Geneva Association organises or supports about 20 conferences and seminars on topics which are of high relevance to the insurance industry, gathering experts from all sectors and backgrounds to combine their knowledge. The events are topics—and issues—oriented and aim at developing new knowledge and insights as well as providing platforms for expert opinion interchange.

g. stimulates and sponsors research in insurance and risk management:

The Geneva Association has several ways of stimulating and sponsoring research work in risk management and insurance-related fields through the availability of research grants, scholarships, prizes and support for publishing.

The Geneva Association membership is limited to a maximum of 90 people, the CEOs of the most prominent insurance companies in the world. It is a non-profit organisation based in Geneva, Switzerland.

The Financial Stability in Insurance (FSI) Initiative

The FSI Initiative is composed of insurance and finance experts from Geneva Association member companies as well as The Geneva Association's own Insurance and Finance Research Programme.

The members of the FSI Steering Committee are:

- Allianz: Volker Deville
- Aviva: Robin Spencer
- AXA: JCyrille de Montgolfier
- Manulife: Peter Wilkinson
- MetLife: Stanley Talbi
- Munich Re: Joachim Oechslein
- Nippon Life: Seiji Kito
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- Tokio Marine: Toshihiro Okamura
- Zurich Insurance Company: Axel P. Lehmann
- The Geneva Association: John H. Fitzpatrick

Co-ordination: Daniel Haefeli, Head of Insurance and Finance at The Geneva Association

Publications of The Geneva Association

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The Geneva Reports—Risk and Insurance Research

- *No. 6: Addressing the Challenge of Global Ageing—Funding Issues and Insurance Solutions*, edited by Patrick M. Liedtke and Kai-Uwe Schanz, June 2012
- *No. 5: Extreme events and insurance: 2011 annus horribilis*, edited by Christophe Courbage and Walter R. Stahel, March 2012
- *No. 4: September 11: Ten Years On—Lasting impact on the world of risk and insurance*, edited by Patrick M. Liedtke and Kai-Uwe Schanz, September 2011
- *No. 3: Anatomy of the credit crisis—An insurance reader from The Geneva Association*, edited by Patrick M. Liedtke, January 2010
- *No. 2: The insurance industry and climate change—Contribution to the global debate*, by The Geneva Association, July 2009
- *No. 1: Regulation and intervention in the insurance industry—fundamental issues*, by E. Baltensperger, P. Buomberger, A.A. Iuppa, B. Keller and A. Wicki, February 2008

E-newsletters

- **Insurance and Finance** deals with research activities in the fields of finance where they are relevant to the insurance and risk management sector.
 - **Insurance and Finance 11**, February 2013
 - **Special Issue on G-20 London Summit**, April 2009

Insurance and Finance special contributions:

- **SC 15** *Identifying and Responding to Volatility Issues*, November 2012
- **SC 14** *Reflections on a High-Quality G-SIFI Designation Process in Insurance*, April 2012
- **SC 13** *The More Underlying Capital, the Greater the Financial and Societal Stability?*, March 2012
- **SC 12** *Insurance Companies' Highly Controlled Use of Derivatives Has Also Resulted in Protection from the Rogue Trader Problem*, January 2012
- **SC 11** *The Costs of the Financial Crisis for Insurance Policyholders*, May 2011
- **SC10** *Variable Annuities with Guarantees and Use of Hedging*, March 2011
- **SC9** *The Global Financial Crisis and the Insurance Industry—Frequently Asked Questions*, by Patrick M. Liedtke and Kai-Uwe Schanz
- **SC8** *Parallax: Striving for a More Resilient International Financial Architecture*, by Patrick M. Liedtke
- **SC7** *The Geneva Association Letter to the Finance Ministers and Central Bank Governors of the G-20*, 5 November 2009
- **SC6** *Everything you wanted to know about the crisis ...but were afraid to ask*, by Denis Kessler
- **SC5** *G20 Falls Short on Insurance*, by Patrick M. Liedtke, published in the *Financial Times*, 7 April 2009
- **SC4** *Insurance Comments to the G-20 London Summit Leaders' Statement of 2 April 2009*, by Patrick M. Liedtke, 6 April 2009
- **SC3** *Lessons from the Credit Crisis: An Investment Practitioner's Point of View*, by Guido Furer and Jérôme Haegeli, 20 February 2009
- **SC2** *The Credit Crisis and the Insurance Industry—10 Frequently Asked Questions*, November 2008
- **SC1** *Credit Crisis and Insurance—A Comment on the Role of the Industry*, by Patrick M. Liedtke, November 2008

- **PROGRES** contributes to the exchange of information on studies and initiatives aimed at better understanding the challenges in the fields of insurance regulation, supervision as well as other legal aspects.
- **Risk Management** summarises The Geneva Association's initiatives in the field of risk management and is open to contributions from any institution or company wishing to exchange information.
- **Insurance Economics** which serves as an information and liaison bulletin to promote contacts between economists at universities and in insurance and financial services companies with an interest in risk and insurance economics.
- **Four Pillars** provides information on research and publications in the field of social security, insurance, savings and employment.
- **Health and Ageing** brings together facts and figures linked to health issues for people aged 50-80 and productive ageing, to try to find solutions for the future financing of health.
- **World Fire Statistics.**
- **General Information.**

Journals

(published by Palgrave Macmillan for The Geneva Association)

- **The Geneva Papers on Risk and Insurance—Issues and Practice**
This prestigious journal, published quarterly, leads its field, publishing papers which both improve the scientific knowledge of the insurance industry and stimulate constructive dialogue between the industry and its economic and social partners.
- **The Geneva Risk and Insurance Review** is an international journal published in annual volumes of two issues. Its purpose is to support and encourage research in the economics of risk, uncertainty, insurance and related institutions by providing a forum for the scholarly exchange of findings and opinions.

As a wave of ageing baby-boomers is reaching retirement, variable annuities (VAs) fulfil a compelling social need for certainty of income in retirement. Questions surrounding the sustainability of current state pension systems and the shifting of responsibility for income security in retirement to the individual have added to this need. As a result, the market for VAs has increased significantly since their inception with sales, in 2011 reaching nearly \$160bn in the U.S.

Whilst VAs share many of the features of other life insurance products, they can be more complex and require more sophisticated risk management tools. As a result, they have become an area of discussion between the industry and regulators in the development of a global regulatory architecture to tackle systemic risk.

The Geneva Association has published this report on variable annuities to inform those discussions by providing a clear analysis of the functioning of VA products and the activities of insurers in providing them.

This is the sixth report in The Geneva Associations series on Insurance and Financial Stability. For a copy of previous reports, please refer to our website, http://www.genevaassociation.org/Home/Financial_Stability.aspx