AFIR 2000

AN INTERNATIONAL SURVEY OF
ASSET-LIABILITY SOLVENCY
MANAGEMENT FOR LIFE INSURERS

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Abstract

This paper looks at asset-liability risk management techniques currently in use in life insurance companies in various countries around the world in the context of solvency regulation. Section 1 outlines typical asset-liability matching problems faced by life insurers. Section 2 defines the techniques commonly used to manage these problems and Section 3 documents the regulations, professional actuarial guidance and standard actuarial practice in place in the countries examined.

Keywords

Asset-liability management; international; solvency; dynamic solvency testing; stochastic; matching; resilience
1. TYPICAL REAL-WORLD ALM PROBLEMS

An insurer's solvency becomes threatened when assets and liabilities are poorly matched and there is a change in financial conditions. This is because the mismatch results in assets and liabilities not moving in step. To take an example, if a company had assets of 1 million all invested in equities valued at market prices, and guaranteed liabilities of 900,000, then an equity market crash of 20% would result in asset values falling to 800,000. In conjunction with liabilities being valued at the same 900,000, this would result in the company being insolvent.

More complicated forms of such asset-liability mismatching which have been seen recently are:

■ Assets invested in bonds with a shorter term than the liabilities (this is a typical situation in Europe). Here, solvency comes under stress when interest rates on bonds fall causing a decrease in the maximum allowed valuation rate of interest on the liabilities. In this situation, the value of the liabilities can increase by more than the value of the assets.

■ The same problem of assets which are shorter than liabilities can instead be viewed as the potential problem of reinvesting the asset proceeds at the end of their term at a rate lower than that anticipated in calculating the liabilities.

■ Products that provide guaranteed returns on future premiums. It may not be possible for companies to achieve the guaranteed rates on the investment of future premiums at the time that they are received, as future bond returns cannot be guaranteed (without the use of derivatives). This potential mismatch is made worse when policyholders have the option to increase their premiums at the original guaranteed rate, a situation found in, inter alia, Finland.

■ Guaranteed returns on future policy maturity benefits. An example here might be the UK’s guaranteed annuity options, where the fund at retirement can be used to buy a pension annuity on the open market. As an additional feature, the product allows the policyholder to choose to convert to the same company’s annuity at guaranteed rates written into the original contract. At the time these products were being marketed, interest rates were much higher than those built into the guaranteed rates. Companies did not expect the guaranteed rate to provide better value than open market rates. However, during the late 1990s, bond returns have fallen so that the guaranteed premium rate was much better value than could be obtained on the open market and most retirees now exercise the option. The exercise of these options has to be anticipated in the reserves of pre-retirement policies, giving rise to large increases in reserves on all business that provides these guarantees. On June 18th 1999, the Financial Times reported an estimate of the additional reserve required to meet these guarantees of £10 billion.

■ Options for borrowers to redeem their loans early, without penalty. If interest rates fall, this will give rise to losses for the lenders, as borrowers will redeem their
loans in order to take out loans on the new, lower rates. In the Danish market, fixed rate mortgage loans are commonly used to back life insurance liabilities. However, the conditions of such loans allow redemption at par at any time. When interest rates fall below the rate on the loan, most borrowers redeem their existing loans and take out new loans at the lower rate. In this way, the term of such loan assets can be considerably shorter than expected.

- Currency mismatch, where guaranteed liabilities are expressed in one currency but the assets are in another currency.

- Options and other derivative instruments can increase the risk of insolvency if insurers fail to understand their impact under different scenarios. Equally though, derivatives can also be used to manage the mismatch position of the insurer (if permitted by the regulator), thereby improving the solvency position.

These examples show that solvency can come under pressure from asset-liability mismatching. They also show that asset-liability mismatching has a wide variety of forms. As markets become more sophisticated, that variety is increasing. However, effective management of the asset-liability position can greatly reduce the risks involved.
2. ASSET-LIABILITY MANAGEMENT TECHNIQUES

2.1 Resilience Testing

Resilience testing examines the ability of the company to withstand large, instantaneous changes in asset values and yields at a particular point in time. The test involves assuming a one-off major change (or "shock") to the value of assets (it could be a shock fall or a shock rise) and calculating the effect that this would have on the liabilities. Account is taken of the resulting effect on asset yields and of the actions available to management, such as changes to bonus rates.

It is usual to examine a small number of possible combinations of asset value and yield shocks. The resilience reserve is the additional reserve required before the shocks in order to leave the company in a solvent position after each of the assumed shocks. Resilience testing can be carried out with reference to a company's "Policyholders Reasonable Expectations ("PRE") Reserves", as well as the more usual statutory solvency reserves.

Typically, a resilience test will involve subjecting the liabilities to a number of different adverse asset scenarios. The resilience reserve must be sufficient to cover the most onerous scenario test, which will differ from company to company depending on the asset liability profile. Adverse scenarios might take the following forms:

- a fall in equity/property values combined with an increase in fixed interest yields;
- a fall in equity/property values combined with a fall in fixed interest yields;
- a rise in equity/property values combined with a fall in fixed interest yields;

Falls in asset values will lead to corresponding increases in the asset yields, thereby increasing the valuation interest rate (and vice versa). Indeed, in some countries the scenarios are expressed in terms of changes in yields rather than asset values.

Another issue which must be considered when applying resilience scenarios is the degree to which companies can "re-hypothecate" assets to liabilities when determining the post-scenario reserves. In many cases it might be possible to achieve lower minimum reserves by adjusting the notional asset mix backing particular liabilities, whilst maintaining the overall asset mix of the fund.

Resilience testing only tests the ability of the company to withstand point-in-time shocks. It does not test the ability of the company to withstand long-term downturns in asset values or movements in yields. Further, it only makes partial allowance for the ability of the company's management to alter strategy to cope with unexpected movements in asset values and yields. Most importantly, the test focuses on the interaction between assets and liabilities, and is therefore to some degree tailored to the specifics of the individual company.
2.2 Cash Flow Projections

Cash flow projections can be used to examine the profile and interaction of the cash inflows and outflows from the company's in force and future new business.

At the most basic level, cash flows are projected based on sample policies which give a good representation of the in force portfolio, with investment returns being calculated at a fixed rate on liabilities. Claim rates would be based on best estimate rates (e.g. surrenders and deaths) and on the profile of the business (e.g. maturities and retirements). This technique allows the company to anticipate periods of net cash outflow and to reserve accordingly. It can also be used to examine the company's bonus and charging structures, albeit at a basic level.

Further increases in sophistication can be gained by projecting the cash-flow for each individual asset, allowing for reinvestment, and/or bringing in a stochastic model of investment returns (see Section 2.5 below).

2.3 Dynamic Solvency Testing

Dynamic Solvency Testing ("DST") is a method of examining the robustness of the company over time to various future asset scenarios. It involves examining the ability of the company to meet contractual payments and/or PRE under a small number of deterministic asset scenarios, making allowance for related areas such as expense inflation and the possible follow-on effect on surrender rates, and taking full account of the likely actions of management under the particular conditions. DST is a useful tool in examining the effectiveness of particular investment and bonus strategies with respect to future solvency, and also provides an indication of the effectiveness of a company's cash flow matching strategy. An estimate of future new business may be included, although this is not usual.

DST is a key part of the US solvency regulations, which are discussed in detail in Section 3.2.2. Insurers are required to examine future solvency under a minimum of seven interest rate scenarios, as follows:
TABLE 2.1
US Asset Adequacy Testing: Minimum Required Interest Rate Scenario Analysis

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description of Interest Rate Scenario</th>
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<tbody>
<tr>
<td>1</td>
<td>Level</td>
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<tr>
<td>2</td>
<td>Uniformly increasing 5% over 10 years and then level</td>
</tr>
<tr>
<td>3</td>
<td>Uniformly increasing 5% over 5 years, then uniformly decreasing 5% over next 5 years and then level</td>
</tr>
<tr>
<td>4</td>
<td>A 3% pop-up and then level</td>
</tr>
<tr>
<td>5</td>
<td>Uniformly decreasing 5% over 10 years and then level</td>
</tr>
<tr>
<td>6</td>
<td>Uniformly decreasing 5% over 5 years, then uniformly increasing 5% over the next 5 years and then level</td>
</tr>
<tr>
<td>7</td>
<td>A 3% pop-down and then level</td>
</tr>
</tbody>
</table>

These scenarios cover a wide range of economic possibilities. They are designed to test most possible patterns of asset-liability mismatches, including the effects of embedded options in the products.

DST is also a component of the Financial Condition Report (or its equivalent) for many other countries, as described in section 2.5 below.

2.4 Stochastic Asset-Liability Modelling

Stochastic asset-liability modelling involves projecting assets and liabilities under a large number of equally probable, randomly generated asset scenarios. Its uses can be quite varied, and include:

- the development of probability distributions with regard to
  - statutory solvency
  - ability to meet contractual payments
  - ability to meet PRE;

- the calculation of Economic Cost of Ruin ("ECOR"), being the probability-weighted severity of insolvency;

- the examination of the resilience of a management strategy to high impact, low probability economic scenarios;

- the analysis of relative risks associated with different lines of business, and the associated levels of desired risk-based capital;

- the analysis of the impact of embedded options in product structures.
Stochastic modelling is usually carried out by projecting future asset scenarios using a model of financial markets and economic indicators which incorporates a random element. Typically the model will define a set of means and standard deviations for each asset class, as well as certain interactions between asset classes. Fluctuations around the means will be randomly generated based on the defined standard deviations. Cash flows and liabilities are then linked to the scenarios through a set of rules relating to, *inter alia*, bonus strategy, investment policy, persistency, reserving, interest rates etc. The net cash flows and liabilities can then be projected for each scenario. Probability measures are estimated by the proportion of scenarios which give a particular result, for example the probability of insolvency would be estimated by the proportion of scenarios which result in an insolvent position at any time over the projection period. To get accurate measures of these probabilities requires a large number of scenarios, and typically for a stochastic investigation to produce meaningful results, significant computing power would be needed.

2.5 Financial Condition Report

The Financial Condition Report ("FCR") is a report prepared by the Actuary of a life office that contains the results of various investigations into the financial health of the company. It is a required report in Australia, and is recommended practice in certain other countries.

While the specific contents of the report will vary between countries, in general the report will contain commentary on the following aspects of the company:

- background information on the company
- the statutory solvency position of the company as at the date of the report
- the Actuary's assessment of PRE, with reference to the historical development of the company
- the anticipated future solvency of the company, with specific reference to any projections that have been performed, such as Dynamic Solvency Testing described above
- an assessment of recent experience as compared to that assumed in previous FCRs.

While the prime purpose of the FCR is to inform the directors of the financial health of the company, it is usual for the FCR to be made available to the regulators. It therefore provides the regulator with a valuable insight into the current and future solvency of the company.
3. SOLVENCY, CAPITAL ADEQUACY AND ASSET-LIABILITY MONITORING

3.1 International Summary

This section looks at the statutory requirements for asset-liability management in various countries around the world. Such requirements may be phrased in terms of solvency, capital adequacy or more general asset-liability monitoring. However, these are essentially variations on the same theme. The section also comments on best practice in asset-liability management. Section 3.3 summarises banking solvency capital requirements.

As we look at solvency monitoring regimes around the world, we can observe varying degrees of development or detail according to local market conditions, the needs of the regulators and the age of the regulations.

In Section 3.2 below, we outline the regulatory regimes for some of the countries examined. A wide range of regulatory complexity can be seen across the countries presented, with some requiring a large volume of information to be presented to the regulator, but allowing a good deal of freedom with regards to investment policy and product features (e.g. Australia), and others having very prescriptive policies with regards to reserving and investment (e.g. many EU countries). It should be recognised that the complexity of regulation in this area will in part be driven by the nature of the products being sold.

Table 3.1 summarises the degree to which each of the monitoring techniques described in Section 2 are used in the countries analysed.

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<td>Australia</td>
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<td>Singapore</td>
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<td>South Africa</td>
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<td>Spain</td>
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</table>
As can be seen in Table 3.1, many EU countries use far fewer of the different types of asset-liability and solvency management techniques. This is in part due to the nature of the products available and the history of product development in these countries, but also reflects a significantly greater level of prescription. On the other hand, those countries that use a wide range of these techniques typically have a much greater degree of discretion in the areas of product design and asset backing. The evidence is that these countries have a much broader range of products available to the public and typically display more innovation in meeting the demands and requirements of customers. They can also compete more fully with alternative savings and investment vehicles.

Somewhat paradoxically, greater prescription on the part of the regulator can actually lead to a higher risk of insolvency as companies are forced to take on higher mismatch risks in order to meet guarantees. This is apparent in many European markets, where certain strong companies have been able to offer high interest rate or bonus guarantees to customers backed by large capital reserves. Financially weaker companies have been forced to offer similar guarantees to remain competitive, but have not been able to match these with appropriate assets due to regulatory restrictions. For example, if liabilities had a significantly longer duration than the available bonds then equities might give a better match to these liabilities than bonds. However, the use of equities might be restricted by the regulator. The mismatch resulting from the use of bonds has often not been fully understood until it has threatened solvency.

Alternatively, restrictions on investment in equities have forced insurers in other countries to invest only in low-risk low-yielding assets such as bonds. This can make life products less attractive savings vehicles than unit trust and mutual funds, which can gain from strong equity markets. An example is in the US, where regulators have attempted to distinguish between protection business, such as life insurance business, and savings and investment business, such as mutual funds. Solvency requirements were designed to encourage life insurers to invest predominantly in safer fixed-interest
assets, rather than in equities. This was justified on the grounds that a high investment return is a secondary requirement for life insurance products as they are not competing in the savings market. However recently US insurers have been the subjects of action by policyholders claiming that life insurance policies were sold on the basis of their being a competitive savings vehicle. Further, the premiums paid by policyholders are dependent on past and expected future investment returns. The reduced investment returns resulting from the above-mentioned restrictions on investment policy ultimately feed back as higher premiums. As a result, life policies may not be as good a deal as they could be for policyholders.

3.2 Monitoring by Country

This section outlines the types of asset-liability monitoring undertaken by regulators in a cross-section of territories around the world.

3.2.1 Australia

The supervision of life insurance companies in Australia is carried out by the Australian Prudential Regulation Authority ("APRA"). The Life Insurance Act 1995 sets out two levels of minimum capital requirement: the Solvency requirement, and the Capital Adequacy requirement.

The **solvency** standard is assessed for each statutory fund\(^1\) and represents a minimum capital requirement. If APRA believes that the solvency requirement is not covered then it may direct the company to take certain courses of action. As a further step APRA may petition a court for the company to be brought under judicial management. After further investigation or on the advice of the judicial manager, the court may ultimately order the company to be wound up.

The **capital adequacy** standard represents the minimum capital requirement to enable a company to operate in accordance with the Life Insurance Act 1995 and in the interests of the policy owners in an unrestricted manner. If the APRA believes that a statutory fund can not meet its capital adequacy requirement it may take similar action as for a fund that can not meet its solvency requirement.

APRA is entrusted with considerable responsibilities including the responsibility to:

- give directions if the solvency or capital adequacy provisions are contravened;
- require the provision of financial statements, statistical returns, reports on reinsurance and a financial condition report at regular intervals.

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\(^1\) Assets relating to policyholder funds are required to be kept separate from shareholders’ funds. Further, assets backing unit-linked liabilities must be kept separate from those backing non-linked liabilities. Each separate fund of policyholder assets is known as a Statutory Fund.
Each company must appoint an actuary (the "appointed actuary"). The appointed actuary has a right to any information needed to fulfil his or her duties and to attend directors' meetings where issues relevant to his duties are discussed. For most companies the appointed actuary is an employee of the company and is generally the most senior actuary in the company.

The appointed actuary has the same duty as the auditor to report, contravention of the Life Insurance Act (actual or probable) which could significantly damage policyholders' interests.

The appointed actuary's main duty is to investigate the financial condition of the life company and produce a written Financial Condition Report, at least annually, including statements on the valuation of policy liabilities and the solvency and capital adequacy requirements. The report is a private and confidential report to the Board. A copy is also provided to APRA. The report is not available to the general public or to policyholders.

Specific regulatory requirements on ALM

Surplus. There is no minimum surplus requirement in excess of the capital adequacy requirement (see below). However, as the capital adequacy requirement must be met at all times, most actuaries will require their directors to hold a level of "target surplus" above the capital adequacy level. The amount of this target surplus is not regulated.

Statutory Capital. The Act requires each life company to have a minimum amount of statutory capital. This requirement is in addition to the requirement that statutory funds are solvent and have adequate capital as discussed below, although the requirements do interact to some degree.

A life company limited by shares must have A$10 million in share capital. It must also have assets outside the statutory funds that exceed the total amount of its liabilities by A$5 million. Similar limits apply to mutual life offices.

Distributions of profit or capital are not allowed if the statutory fund would be left insolvent as a result. Distributions of shareholders' profits that result in the fund becoming capital inadequate are not possible without the APRA's approval.

Solvency and Capital Adequacy Standards. The Life Insurance Actuarial Standards Board ("LIASB") has the responsibility under the Life Insurance Act 1995 to make actuarial standards with respect to solvency and capital adequacy requirements, which an appointed actuary must then comply with.

The LIASB is appointed by the Treasurer (the government member responsible for financial matters) and all but one of its members must be actuaries.
The solvency requirement focuses on whether a statutory fund can meet its liabilities in a situation where the company is wound up. The assumptions and methodology used to determine the solvency requirement are prescriptive in nature and are meant to provide an objective comparison between different statutory funds.

The capital adequacy requirement focuses on whether a life company has sufficient capital in its statutory funds to enable it to trade without restrictions. The determination of the capital adequacy requirement is less prescriptive in nature and allows the appointed actuary to take account of the particular circumstances of the statutory fund. Generally the capital adequacy requirement would be higher than the solvency requirement (it is not permitted to be less) for most companies.

**Determination of Solvency and Capital Adequacy Requirements.** The method by which each requirement is determined is summarised as follows:

- A base liability is calculated as the value of future benefits and expenses less premiums. This liability includes risk margins and may take advantage of policy discretions. The solvency risk margins are prescribed while guidance is provided on the range from which the capital adequacy risk margins must be selected. The policy discretions relate to future bonus rates, termination values, increases in charges and the review of premium rates. These base liabilities are aggregated for each related product group.

- This aggregate liability is set to a minimum of the termination value for each related product group. For solvency purposes the termination value is the lowest level the company would be obliged to use. For capital adequacy purposes this value would be the current termination value. The values are then summed for the whole statutory fund.

- For solvency purposes an expense reserve is then included equal to one year's non-commission related acquisition costs, reduced by tax relief. This represents the fixed costs that would continue for a period after closing the statutory fund to new business. The solvency amount is then set to a minimum of the current termination value.

The amount calculated by the above steps represents an amount to cover liability risks. Assets risks are now considered. Two reserves are established as follows.

- A resilience reserve is established as a measure of the ability of the statutory fund to survive a shock change in the economic environment. Allowance is also included for the revaluation of liabilities in this adverse scenario. The reserve allows for the risk of assets not being matched to liabilities.

- A reserve is established for inadmissible assets to cover situations where investment assets are concentrated or where the regulatory capital of related companies is valued. For the solvency standard this reserve also includes a
component for assets whose value would differ were the company in a run-off position.

- The capital adequacy requirement also includes a new business reserve that covers the expected capital usage, on a solvency basis, of budgeted new business for the next three years.

- The solvency requirement must be no less than the policy liability for the statutory fund and the capital adequacy requirement must be no less than the solvency requirement.

**Professional Guidance**

All appointed actuaries and actuarial members of the LIASB must be members of the Institute of Actuaries of Australia (IAA). The IAA is a professional body that, amongst other things, provides members with professional standards and guidance notes. The IAA provides additional guidance to members on the interpretation of the Act and the LIASB standards. The IAA has a disciplinary code that would be applied to actuaries who ignored professional standards or mandatory guidance notes.

**Best Practice**

With the introduction of the Life Insurance Act 1995, and the consequent changes to capital requirements for life insurance offices (more onerous than those previously applied), most life insurance companies have moved toward greater matching of assets and liabilities. Hence there is generally little need for stochastic asset-liability modelling, and indeed few companies devote significant resources towards such studies.

### 3.2.2 Canada

Life insurance companies in Canada are supervised by the Office of the Superintendent of Financial Institutions ("OSFI") which has its own staff of actuaries. Each company must appoint a Fellow of the Canadian Institute of Actuaries ("CIA") to the office of actuary (the "Appointed Actuary").

The role and responsibilities of the Appointed Actuary are set out the Insurance Companies Act and OSFI requires the Appointed Actuary to conform to the professional actuarial standards of practice promulgated by the CIA. The professional standards are contained in the CIA Recommendations, Valuation Technique Papers (VTPs) and the paper on Provision for Adverse Deviations (PAD Paper). The annual OSFI letter to Appointed Actuaries provides additional guidance on valuation considerations, tests to be performed, and reporting requirements.

The Appointed Actuary’s duties include:
the valuation of the actuarial and other policy liabilities at the end of each financial year. Such valuation must be in accordance with generally accepted actuarial practice. The basis for valuing assets and liabilities are the same basis as required for Canadian GAAP accounting; statutory accounting does not differ from general purpose accounting;

- the preparation and filing of a statement of opinion on the adequacy of in-force insurance liabilities;

- the preparation of a report to the directors of the company or the chief agent of a branch on the financial position and on the expected future financial condition;

- the preparation of a report on the fairness and equity of the method of allocating investment income and losses and expenses; and

- the duty to report, at any time, any matters having a material adverse effect on the financial condition of the company.

Specific regulatory requirements on ALM

There is no specific matching requirement, but the actuarial liabilities must make due allowance for any mismatching.

For insurance liabilities, this is achieved through selection of an appropriate interest rate that allows for mismatch. The Appointed Actuary must explicitly describe the interest rates used in the valuation. Details on the interest assumptions must include a separation between expected experience and the margin for adverse deviations. Interest rates should be based on the expected cash flows from actual assets allocated to the various blocks of business. The relationship between the valuation interest assumption and the net investment income of the assets must be discussed. The Appointed Actuary must identify all reductions from the effective asset yield including margins for asset default risk (C-1), administrative expenses, investment expenses, mismatch risk (C-3) and adverse deviations.

For annuities, this is achieved through cash flow testing, specifically a Cash Flow Valuation Method (CFVM) which includes scenario testing to be performed in accordance with VTP Number 9.

In his report, the Appointed Actuary must discuss the procedure used to match assets and liabilities, including the assumptions used in developing cash flows, the allowance for expenses, and the frequency of the matching process. Descriptions should be provided on the sensitivity studies undertaken to measure the effect of changes in market interest rates, and shifts in the yield curve, the controls in place to ensure the appropriateness of the type, duration, quality and marketability of the assets held and the provision made for the assets/liability mismatch risk. The CIA provides guidance to the actuaries on these subjects.
The Appointed Actuary must also show the projected net cash flows for at least 10 years from the valuation date, give a breakdown of assets used to back each business segment and surplus, discuss the use of any derivative instruments in the matching process, provide details on the company’s use of deferred gains\(^1\) and comment on whether the company actively trades assets.

**Future Financial Condition**

The Superintendent directs that the expected future financial condition report, the Dynamic Capital Adequacy Testing ("DCAT"), be prepared in compliance with the CIA standards, and filed with OSFI. The DCAT examines the effect of various plausible adverse scenarios on the company’s forecast capital adequacy and it is the Appointed Actuary’s primary tool for investigating the company’s financial condition.

The financial condition is satisfactory if the company is able to meet all future obligations under the base scenario and all plausible scenarios and, under the base scenario it meets the minimum regulatory capital requirement.

The scenarios consist of a base scenario and several plausible adverse scenarios. Each scenario takes into account the in-force policies and the policies assumed to be sold during the forecast period (typically 5 years) and, the insurance and the non-insurance operations. The base scenario is a realistic set of assumptions usually consistent with the company’s business plan. A plausible scenario is a scenario of adverse, but plausible assumptions about matters to which the company’s financial condition is sensitive. As a minimum, three adverse plausible scenarios posing the greatest risk for the company require testing and reporting annually.

Although the CIA does not suggest a list of scenarios to test, it provides a list of risks to consider. The risk categories for a life insurer include: mortality, morbidity, persistency, cash flow mismatch (C-3), deterioration of asset values (C-1), new business, expense, reinsurance, government and political action and off balance sheet risk.

The CIA has suggested some generic examples of generalised economic integrated scenarios:

- severe economic adversity, with rapidly rising interest and inflation rates;
- deflationary economic scenario;
- claims experience – deterioration of the mean;
- very adverse fluctuation in claims experience;
- a liquidity crisis for the company;

\(^1\) Canadian reporting rules require that realised gains on investments be amortised (i.e. deferred) over a fixed period, rather than recognised immediately. This is to maintain consistency with the treatment of unrealised gains, which are smoothed rather than marked-to-market.
- loss or deterioration of a major profitable line of business; and
- loss or significant decline in value of major asset category.

**Best practice**

In practice, various methods are used to manage the mismatch risk. Management of the mismatch risk includes the quantification of the potential loss and the evaluation of the company’s exposure to interest rate risk qualitatively. The company should conduct numerical scenario-based analysis of the dollar exposure and review its practices and capabilities in all areas that impact interest rate risk management.

Annuity business tends to be backed by fixed interest assets similar to the underlying annuity guarantees. Life insurance business tends to be backed by more varied assets, including equity and real estate in the larger companies. Most Canadian companies manage and monitor their annuity mismatch risk more carefully than their life insurance liability risk. Reasons for this include the inability to adequately match very long-tailed insurance liabilities with available assets, practical difficulties in projecting equity returns where equity assets support insurance liabilities, and the ability of the bonus or interest crediting mechanism in participating business (and to a lesser extent, universal life business) to vary with varying interest results.

### 3.2.3 Denmark

Legislation in Denmark directs that at least 50% of the guaranteed liabilities should be held in bonds or mortgage bonds. There is a maximum on the proportion of liabilities that can be invested in foreign equities (although we understand that currently this limit is rarely reached).

Assets are generally recorded at book values (amortised cost for bonds). We understand that asset valuation rules and other statutory solvency rules do not require any adjustment to the value of mortgage bonds to allow for the risk of early pre-payment. The main exception to this relates to real estate where the value is determined by reference to actual rental income and an assumed rental yield.

The maximum valuation rate of interest that may be used to value single premium annuities in payment is the “endogen” rate, which is the average expected return (based on amortised yields) on the existing bond portfolio over the next year. We understand that there is no specific requirement for matching by term. However, late in 1999, a rule has been proposed linking the maximum valuation rate of interest to the return available on the 25-year 7% government bond that matures in 2024. The maximum valuation rate of interest before tax is 95% of the yield on this bond, minus around 0.5%.

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2 The mortgages securitised in these bonds may be redeemed at par without penalty. Such redemptions are significant when interest rates fall and borrowers can effect new mortgages at a lower interest rate than the existing mortgage.
Solvency capital is required to be maintained according to the EU rules. However, there are local requirements to maintain the bonus equalisation reserve (bonusopsamling, undistributed surplus from prior years that is available to smooth distributable profits between calendar years) greater than a minimum of 2% of policy reserves. This represents the supervisory intervention limit.

There is a legal requirement for the appointed actuary to produce a long-term forecast (referred to as a “budget”) for at least 15 years, in addition to a short, 5-year, budget. The short-term budget is reported to the supervisor, although the long-term budget may be kept confidential. The budget must, according to actuarial guidance, forecast investment income according to the same rules set by the Supervisor, as govern benefit illustrations given to policyholders. These budgets reflect realistic returns, and should allow for the pre-payment risk mentioned above.

Using models set up to provide the 15-year budget, we understand that companies undertake sensitivity testing along the lines of DST. We understand that some stochastic modelling is carried out using simple models and other simplifying approaches.

3.2.4 France

As in many Continental European countries, technical reserves are calculated using the original tariff basis. Reserves are therefore calculated using the technical/guaranteed interest at issue. To date, controls have been focused on limiting the maximum technical interest rate at issue. However, the French Insurance Code requires an additional reserve for interest guarantees.

Specific regulatory requirements on ALM

An additional reserve known as the "reserve for financial risks" is required in the event that 80% of the accounting return in a given year is less than the cost of guarantees for the year. In these circumstances, a new prospective reserve must be calculated using an assumed future investment return equal to 80% of that observed in the calendar year under consideration. This test, and the reserve recalculation, is applied at the total portfolio level (i.e. companies can cross-subsidise between products). Furthermore, the test only recognises problems after they have occurred when the returns have fallen below the guarantees, and forces companies to capitalise future losses on the basis that the experience of the current year continues. It does, however, encourage companies to limit excessive equity exposure (equities provide low income and unrealised losses must be reserved - these factors can increase the risk of needing the additional reserve for financial risks).

As the test only recognises a problem after it has occurred, the actuarial community does not consider it to be particularly effective. Indeed, we understand that the regulators are considering its replacement with other tests.

Best Practice
Most companies have ALM units that prepare projections of assets, liabilities and their interactions. These projections are used in investigating future investment returns, and in assessing the cost of guarantees and future bonuses. There is no regulatory requirement to undertake these analyses but they are common industry practice (and indeed, they are now indirectly required for the purpose of testing the need for the reserve for financial risks).

**Recent Developments**

Three recent developments indicate that the requirement to provide dynamic financial analysis is being formalised and that the regulators are anxious to ensure that all companies undertake the necessary investigations on ALM.

- Since 1998, companies have been required to provide a solvency report to the board of Directors at the end of each year. The report must discuss the adequacy of reserves, solvency margin coverage and the conditions under which liabilities are at risk of not being met. The report must also include a discussion of the ALM tools that the company uses. The analysis required is not prescribed in regulations and companies have discretion over the content of the report. The requirements suggest that a substantial amount of dynamic solvency projections are required to test solvency on a prospective basis but we understand that many companies have limited the content in the first year of implementation. However, we expect that companies will develop the content over time to include a full prospective analysis. Interestingly, the insurance regulators do not have access to this report as it is for the exclusive use of the directors and auditors; we understand that the regulators are anxious to obtain access to this report and that the regulations may be changed in this respect.

- Companies are required to supply quarterly information on assets to the regulators (market and book values by type). In August 1999, new regulations were published which require that this quarterly reporting be enhanced significantly. The new requirements are in a general form at the current time and the exact content of the reporting has yet to be specified. However, it appears that a form of resilience test involving simulations of changes in assets and liabilities in the event of movements in interest rates and stock markets are required. Information on the liquidity of assets and liabilities will also be required (in particular surrender risks). Furthermore, the report must include comparisons under different scenarios (not yet defined).

- The regulators undertook a survey of life insurance companies at the end of 1998 to determine the effect of implementing new valuation methods for liabilities. The regulators undertook this survey in order to assess the extent of problems with interest rate guarantees. The results have not yet been made public. Companies were required to estimate the effect of recalculating their liabilities on a conservative basis (assuming, for example, only dividend income on equities and assuming that reinvestment in bonds would be at a yield equal to 60% of the
current yield). This might suggest that the authorities are considering a move towards a prospective valuation on a prudent basis.

3.2.5 Norway

Norwegian regulations follow the EU rules, in particular those in the First and Third Life Directives relating to minimum solvency requirements and asset and liability valuation. In addition, no more than 35% of required guaranteed reserves may be backed by equities.

Norwegian life companies have to satisfy two solvency capital requirements: one based on the First Life Directive, the other (following the “BISC rules”) based on the Basle Accord for bank solvency capital (see Section 3.3). The BISC rules require shareholder capital to be no less than 8% of weighted assets, where the weighting for government guaranteed bonds is nil and the weighting for equities is 100%. Clearly, the BISC rules take no account of the nature or term of the liabilities.

There exists also a general requirement to not accept more risk than can be borne by the company’s resources.

There is no actuarial guidance specific to asset-liability risk management.

Norwegian companies have cash-flow projection systems that are mainly used deterministically. Some companies perform resilience testing founded on simple stochastic investigations. The regulator requires information about asset-liability risk to be recorded in the valuation actuary’s report each year, and some companies report the results of their resilience tests in response.

3.2.6 Singapore

The supervision of life insurance companies in Singapore is carried out by the Insurance Department of the Monetary Authority of Singapore (“MAS”).

Each company must appoint an actuary (the “Appointed Actuary”). The Appointed Actuary’s duties are described in the insurance regulations. The major duties are:

- Statutory Valuation - Valuation of the policyholder liabilities
- Premium Rates - Appropriateness of premium rates
- Distribution of surplus - Approving the yearly distribution of surplus among shareholders and policyholders
- Investment Policy - Assisting the management of the insurer to formulate a suitable investment policy, taking into account the term of the policyholder liabilities and the availability of appropriate assets.
- Dynamic Solvency Testing - Annual assessment of the financial soundness of the insurer by conducting solvency testing of the financial condition of the insurance funds under various conditions.
Report to the board of directors – Annual report as to the current and future financial condition of the insurer.

Each company must submit its statutory returns annually to the MAS. Certain of the returns must be submitted each quarter, including the balance sheet and fund revenue account. The valuation bases for assets and of liabilities are set out in the insurance regulations. Assets in the non-linked fund must be valued at the lower of book and market value, while assets in the linked fund must be valued at market value. Liabilities are required to be determined on at least the minimum basis as described in the insurance regulations. For non-linked business this may be summarised as a prospective net level premium reserve adjusted for a (limited) acquisition expense allowance. The linked liabilities are in general valued as the value of the underlying units. All policyholder liabilities must be certified by the Appointed Actuary.

There are no prescribed resilience (mismatching) reserve requirements.

Insurers have to comply with prescribed investment limits in determining the admitted value of the assets of the non-linked life insurance funds (and general insurance business). While the investment limits serve as a broad framework to enhance the quality of insurance fund assets, insurers are also required to exercise prudence in their investments. Equities are limited to 45% of total assets while there is no limit for secure domestic bonds or deposits.

Foreign currency-denominated fixed income assets that are fully hedged to the Singapore Dollar are deemed to be synthetic Singapore Dollars subject to the hedge and the related foreign-currency assets satisfying certain conditions. The assets in aggregate should not exceed 10% of the insurance funds, the hedge is entered into with an institution approved by the MAS; and the hedge contract will mature within 12 months of the reporting date.

**Dynamic Solvency Testing and Financial Condition Report**

The MAS has developed guidelines for the performance of Dynamic Solvency Testing including scope, general process, factors to be considered, forecast period, modelling techniques, the frequency of testing, the contents of the report to the MAS and quality assurance.

Dynamic solvency testing forms a significant part of the financial condition report and examines the future solvency of the company on a range of scenarios.

The prescribed contents of the Actuary’s Financial Condition Report includes the Actuary’s assessment and recommendation:

- General assessment of the results of the projections and the implications for the financial condition of the fund. The actuary’s comments should also include:
— The ability of the fund to meet future statutory reserve and statutory company
and fund solvency margin requirements
— Detailed comments on the 5-year projection
— High level comments on the 30-year projections

■ Highlights of results
■ Disclosures
■ Recommendations
■ Management’s reaction to the recommendation

For the base scenario the investment income assumption is based on the expected
inflation rate, the real return from each asset class and the company’s investment
strategy.

No specific alternative scenarios are specified in the guidelines of the MAS, but are
left to the selection of the appointed actuary. We are not aware of any companies who
use stochastic methods to generate future investment returns.

3.2.7  South Africa

The supervision of life insurance companies in South Africa is carried out by the
Financial Services Board (“FSB”), an independent institution established to oversee
the South African financial services industry in the public interest. Each company
must appoint a statutory actuary, who is required to report to the FSB on the solvency
of the company and various other matters.

The statutory actuary must submit an annual return to the FSB including a valuation of
its assets and liabilities. Currently the valuation of liabilities has to be done on both a
“financial soundness” basis and a more traditional net premium type basis. However,
the latter basis is likely to be phased out in the near future (our comments below are
therefore restricted to the financial soundness basis.)

The financial soundness basis for valuing assets and liabilities is set out in the Long
Term Insurance Act, with further detail provided in professional guidance note
(PGN104) issued by the Actuarial Society of South Africa (ASSA). Assets and
liabilities must be valued on bases that are mutually consistent.

Liabilities are composed of two tiers. The first tier is the “financial soundness
reserve”, which is a prospective valuation based on best estimate assumptions as to
future experience, increased by margins prescribed in PGN104 (and also possibly
increased by further margins at the discretion of the statutory actuary) and taking into
account the reasonable expectations of policyholders. This liability is used for profit
reporting and is intended to prudently recognise profit over the term of a contract.
The second tier liability is the capital adequacy requirement (CAR). The CAR is intended to be an estimate of the additional capital required by a company to meet “fairly substantial” deviations in the parameters affecting the life assurer's business and is calculated according to certain formulae set out in PGN104. Dividends may only be paid by the company if assets are at least equal to the sum of the financial soundness reserves and the CAR.

Specific regulatory requirements on ALM

There are no specific requirements in respect of the matching of assets and liabilities, other than a general requirement that the statutory actuary is satisfied that the assets are proper and suitable having regard to the nature of the liabilities. However, allowance is made in the CAR for the mismatching of assets and liabilities by the inclusion of a resilience reserve. The resilience reserve is calculated as the additional assets required to cover the financial soundness liabilities following prescribed investment scenarios. The two scenarios considered are:

(a) A fall in equity market values of 20% to 30% (depending upon current dividend yields); a fall in property values of 15% and an increase in fixed interest yields of 3%.

(b) A reduction in real investment returns of 2%.

3.2.8 Spain

The supervision of the activity of insurance companies and pension funds in Spain is the responsibility of the Dirección General de Seguros ("DGS"), an executive body reportable to the Secretary of State for Economic Affairs.

Insurance companies are also subject to a specific set of accounting standards, rules and disclosures (Plan General Contable de Compañías de Seguros). According to these rules, both fixed income and equity securities are usually valued at the lower of cost (amorised, if applicable) or market, with a few exceptions. Companies must submit a quarterly report to DGS with detailed financial statements and other information, including all individual invested assets, grouped by asset type, at par value, cost, market value, and related reserve.

There is no explicit requirement for insurance companies to have an "appointed actuary".

Specific regulatory requirements on ALM

Capital adequacy and solvency of life insurance industry members in particular is also the subject of specific regulation. The DGS is in charge of ensuring that industry participants meet the various standards. This is usually carried out by means of examination of quarterly reports.
The Spanish Parliament recently passed a thorough review of the legal framework of the insurance industry in two pieces of legislation, Orden 23/12/1998 and Reglamento 20/11/1998. In particular, one of the various motivations for the law has been the enforcement of a detailed set of asset and liability management disclosures and requirements. The aim of the regulator is to ensure life insurer solvency not only via traditional capital ratios but also introducing a range of legally enforceable ALM techniques and controls.

Broadly, the law sets the following requirements for asset and liability management:

- Mathematical reserves must generally be calculated using the technical interest rate specified in the product technical notes. Since Reglamento 1995, strict upper limits on technical interest rates for product design have been periodically reset by DGS following the decrease of market interest rates. For existing blocks of business at the end of 1998, this upper limit is applicable except where investment returns on assigned assets fall below technical interest rates.

- For new business, following new regulations, mathematical reserves must be calculated using a discount rate not higher than 60% of a weighted average of the preceding three years’ yield on government bonds maturing in more than five years. The weights are 50% for the year immediately preceding the current year, 30% for the previous one and 20% for the one before. This is in line with the Third European Life Directive.

- However, if a set of assets has been specifically assigned to certain reserves, the actual yield to maturity on the assigned portfolio may be used as the basis for reserve calculation purposes as long as investments are deemed “adequate”.

- “Adequacy” of investments is in general terms understood as either the coincidence of asset and liability cash-flows, or the matching of specific “key-rate” durations of assets and liabilities.

   — Cash-flow matching in statutory terms implies that:

   - The present value of cash inflows is equal or higher than the present value of outflows

   - Cash inflows precede outflows and are of equal or higher value, or

   - The capitalised accumulated balance (compounding inflows and outflows using a reinvestment rate equal to the technical reserve rate explained above) is always positive on a monthly basis, or

   - If negative balances occur, the negative amount should not be higher than the sum of the outflows paid in the last three months. The end-of-year balance, additionally, may not be higher than 12.5% of annual outflows.
Negative balances must be capitalised adding a 50% penalty to the reinvestment rate.

- Assigned assets, if cash-flow matching is used, must be fixed income securities graded BBB or better, bank deposits, cash equivalents, or hedge-oriented derivatives. Issuers of these securities must be independent from the insurance company.

- Reserves, if cash-flow matching is used, are calculated using the actual yield of the asset portfolio multiplied by the applicable risk factor: 95% for AAA and AA bond grades, 92% for A bond grades, and 89% for BBB bond grades.

- “Key-rate duration” matching in statutory terms implies that:
  
  - The present value of assigned assets must be equal to or higher than the present value of liabilities.
  
  - Effective duration of assets must be equivalent to effective duration of liabilities (difference must be lower than 1%)
  
  - Effective key-rate durations of assets and liabilities, calculated as per the term of the first and last cash-flow plus a number of intermediate terms higher than two and not distant to each other in more than two years, must be equivalent (difference lower than 1%)

  - Assigned assets can belong to the categories listed above as acceptable for cash-flow matching or equities. The amount of equities must be less than the present value of obligations due in more than 10 years, and cannot be more than 25% of total reserves. Selected equities must belong to the same rating grades accepted for bonds, must be traded frequently (80% of market working days), and be “reasonably” diversified

  - Reserves are calculated as in cash-flow matching but applying higher corrections via risk factors: 93%, 90%, 87% for each rating group.

  ■ In general terms (i.e. not only for assigned portfolios) usage of derivatives is allowed for hedging purposes only. Limits are set to counterparty risk.

### 3.2.9 United Kingdom

The supervision of life insurance companies in the United Kingdom is now largely carried out by the Financial Services Authority ("FSA") which is advised on actuarial matters by the Government Actuary's Department ("GAD"). Each company must appoint an actuary (the "appointed actuary").
Each company must submit an annual return to the FSA including a valuation of its assets and liabilities. The bases for valuing assets and liabilities are set out in regulations (which have been amplified by prudential guidance notes issued by the FSA). Liabilities must be determined in accordance with regulations that generally follow the Third Life Directive of the European Union and concentrate on general principles rather than detailed prescription. The appointed actuary must certify the adequacy of the liabilities arising under inforce insurance policies.

The role and responsibilities of the appointed actuary is set out in professional guidance notes (GNs) issued by the UK actuarial profession. The main guidance notes are mandatory and compliance must be described in the annual return. Any non-compliance must be disclosed.

**Specific regulatory requirements on ALM**

Liabilities in respect of policy benefits linked to certain assets must be matched as closely as possible by the corresponding assets; this follows the requirements of the Third Life Directive. There are no other specific matching requirements, rather the mathematical reserves must make due allowance for any mismatching. The specific regulation 75 is:

> The determination of the amount of long term liabilities shall take into account the nature and term of the assets representing those liabilities and the value placed upon them and shall include prudent provision against the effects of possible future changes in the value of the assets on-

(a) the ability of the company to meet its obligations arising under the contracts for long term business as they arise, and

(b) the adequacy of the assets to meet the liabilities as determined in accordance with regulations 65 to 74 above.

Sub-paragraph a) is interpreted in GNs as requiring a study of cash-flow matching. This is not a major issue for most companies because of the nature of most UK business although it may be for some types of business.

Sub-paragraph b) is of much greater significance. It is interpreted as requiring that the mathematical reserve should be adequate to support significant changes in asset values and interest rates at the valuation date whilst still satisfying the valuation regulations (except regulation 75) i.e. to test the resilience of the published valuation to changes in financial conditions. The range of changes to be considered is not specified by either regulations or GNs. However the GAD has indicated from time to time the investment scenarios which it considers appropriate and these have become de facto standards. At present the following three scenarios are prescribed (these are currently under review) as (in simplified form):
- a reduction in fixed-interest yields by 20% combined with a fall in value of equities of 10%.
- a reduction in fixed-interest yields by 10% combined with a fall in equity values of 10% to 25% (depending on the P/E ratio and gilt yields), and
- a rise in fixed-interest yields of 3 percentage points combined with a fall in equity values of 25%.

The annual return requires considerable disclosure as to the effect of these scenarios on the values of the assets and liabilities of the company so as to derive the required resilience reserve.

Professional Guidance

Professional actuarial guidance also recommends, but does not require, that the appointed actuary produces an annual financial condition report which consider the future solvency position of the company. Almost all actuaries now produce such a report. It is not made available to the FSA or GAD.

A significant part of the financial condition report will be dynamic solvency testing which will examine the future solvency of the company on a range of scenarios. These will include changes in future financial conditions and so will consider the ALM position.

Some companies use stochastic methods to generate future investment scenarios but the majority will use deterministic projections. No specific scenarios are specified in the GNs. These are left to the judgement of the appointed actuary.

Best Practice

A small number of companies in the UK carry out stochastic asset-liability modelling in order to gain a better understanding of their business. This approach has come in to more prominence recently with the reduction in yields available on bonds, which has lead to certain policy guarantees coming into the money. Best practice in this area would also take into account the effects of derivatives on the model results.

3.2.10 United States

The supervision of life insurance companies in the United States is on a state-by-state basis, albeit with some assistance provided via the National Association of Insurance Commissioners ("NAIC"). Life insurers are required to file their products, and file detailed financial statements in prescribed form, separately with each state in which they write business.

Each state has a minimum capital and surplus requirement for licensing purposes. In addition, as part of the statutory statement, a certain minimum solvency level is quoted, based on a formula established by the NAIC, known as Risk Based Capital.
When capital and surplus as a percentage of RBC falls below certain levels, regulatory action is triggered.

The NAIC RBC requirement for a particular company is calculated by applying various factors to the company's reported asset and liability balances and other statistical data. These factors have a theoretical foundation based on actuarial research of industry data.

The NAIC's RBC for Life and/or Health Insurers Model Act puts forward a series of levels which would require regulatory action for companies with capital and surplus to RBC ratios that fall below certain levels.

The basis for valuing assets and liabilities in the annual returns to the regulators generally does not leave a great deal of room for discretion. Assets are generally held at market values, although there are important exceptions such as amply secured bonds not in default where amortised cost is used so that assets are written up or down (i.e., a premium amortised or a discount accrued) in order that the statement value at maturity will equal the maturity value. Because a typical U.S. insurance company's asset portfolio is characterised by large holdings of such bonds, this means a considerable amount of the assets will be at "book value" rather than "market value."

Moreover, the RBC formula limits the types of assets held by life insurers, since higher RBC is needed for more "volatile" assets such as equities and property. There are also specific limits on holding equities and property on a state-by-state basis. In the light of this, life insurers tend to hold large proportions of assets in fixed interest securities, representing a mix of Treasuries, corporate bonds and mortgage-backed securities.

On the liabilities side, the interest rate and mortality assumptions and methodology used to calculate minimum reserves are fairly explicit in law. Acceptable reserve methodologies and bases are determined as of the policy issue date by the state valuation laws then in effect. While specific valuation requirements can vary from state to state, all states have developed some form of the Standard Valuation Law ("SVL"), which was developed by the NAIC to provide uniformity. The SVL is amended from time to time, but it has consistently defined minimum reserves in terms of a modified net premium valuation.

Although the basic reserve calculations are fairly explicit in law, there is increasing discretion being allowed to the "valuation actuary" in setting up additional reserves. Thus, the mood is changing in the U.S. from viewing reserves as "cookbook" items and towards the view that the actuary must seriously consider whether these liabilities make good and sufficient provisions for all unmatured obligations of the company guaranteed under the terms of its policies. Indeed, the valuation actuary may now set up additional reserves in the light of any specific Asset/Liability analysis — something that has been the practice for many years in the U.K.

In addition to the constraint of regulatory solvency requirements, the importance of the independent rating agencies in the U.S. cannot be underestimated. Independent rating
agencies generally view themselves as monitoring insurers on behalf of insureds and insurance buyers. Unlike regulators, rating agencies are not required to use any prescribed formula to determine risk-based or minimum capital, and they use their own formula to determine similar amounts that they perceive to be appropriate for each particular insurer. Because a life insurer's ratings can have a major impact on the public perception, and hence on new business sales and in force persistency, the capital requirements of the independent rating agencies are a major constraint on the financial operations of life insurers in the U.S.

Specific regulatory requirements on ALM

In 1975, the NAIC began requiring that a statement of actuarial opinion as to reserves and related actuarial items be included in the annual statement filed by life insurers. The form and content of this actuarial opinion, as specified in the instructions to the annual statement, dealt specifically with reserves and did not specifically address the adequacy of the aspects supporting these reserves to meet the obligations of the company.

In December 1990, the NAIC amended the SVL and, in June 1991, the NAIC adopted the Model Regulation. These actions had the effect of moving the requirement for the statement of actuarial opinion from the annual statement instructions into the model law itself. In addition, and more significantly, companies were now required to name an appointed actuary and statements of actuarial opinion as to reserve adequacy are required to be based on asset adequacy analysis. The asset adequacy analysis required by the regulation must conform to the standard of practice promulgated from time to time by the Actuarial Standards Board (see below). This analysis includes cash flow testing under a minimum of seven prescribed interest rate scenarios. There are, however, no regulatory or professional standards which identify precisely the number of scenarios that should be tested nor the number of scenarios that a company must pass in order that reserves are deemed adequate.

Professional Guidance

The American Academy of Actuaries, through the Actuarial Standards Board, issues actuarial standards of practice, a number of which apply to financial reporting. Although standards of practice issued by the American Academy represent guidance and recommendations on professional conduct, members of the American Academy not following such guidance and recommendations can be subject to disciplinary proceedings.

Actuarial Standards of Practice No. 7 ("Performing Cash Flow Testing for Insurers") identifies recommended practices and considerations regarding cash flow analysis, including general guidance on how to perform cash flow analysis.

Actuarial Standard of Practice No. 14 ("When to do Cash Flow Testing for Life and Health Insurance Companies") gives guidance to the actuary in determining whether or
not to perform cash flow testing as part of forming a professional opinion or recommendation, such as reserve testing.

Specific guidance to actuaries in filling out the Statement of Actuarial Opinion is given in Actuarial Standard of Practice No. 22 ("Statutory Statement of Opinion Based on Asset Adequacy Analysis by Appointed Actuaries for Life or Health Insurers").

**Best Practice**

Many companies in the U.S. now take cash flow testing well beyond the minimum requirements of the 1991 SVL. Indeed, sophisticated financial modelling is now probably used by all of the major life insurers in the U.S. for true ALM purposes.

Measures of the price sensitivity to interest rate changes are critical to a life insurer’s risk management process. In this regard, the concepts of effective duration and convexity are critical.

In the 1980s, ALM in the U.S. did indeed focus on looking at duration and convexity. Both measures need to be considered in tandem: while matching the duration of assets and liabilities will make sure you are protected from small interest rate changes, it is important to look at convexity to cover against the large changes.

Due to the inherent option in the liabilities, the market value of liabilities does not decline under rising interest rates as much as it would if these options were not available. Similarly, if market rates fall, the value of the liabilities increases more than it would otherwise because the options provide valuable downside protection. These ingredients combine to give rise to a market value profile that has a convex shape, i.e., positive convexity. On the other hand, in the case of both callable bonds and mortgage pass-throughs, both of which are commonly held to back insurance liabilities, the implicit options written by the insurer to the issuer lead to a concave-shaped market value profile of assets, i.e., negative convexity.

Thus, U.S. life insurers are often in the position of writing options on their liabilities and also writing options on their assets. With the market value of surplus then defined as the market value of assets less the market value of liabilities, companies can be left in a “short straddle” position, which will produce profits in a steady market but poses risk in a volatile market.

Much of ALM work in the 1980s focused on understanding the nature and implications of duration and convexity mismatch risk. In recent years, life insurers have become much more proactive in looking more at what potential tools are available to fine-tune duration and convexity, e.g., derivatives.

Today, life insurers are relatively sophisticated at managing interest rate risk, and now the primary ALM question is: how can I maximise my return given certain duration/convexity constraints? This has led to the use of the Asset/Liability Management Efficient Frontier ("ALMEF") in order to examine different investment
strategies in terms of “risk” and “reward”, and recommendations for an investment strategy are made on the basis of such.

3.3 Comparison to Banks

In many countries banking solvency requirements are based on the Basle Accord. This section focuses on banking solvency requirements in the UK, but many of the observations will apply to other countries as well.

There is little in the banking capital requirements which looks at the interaction between assets and liabilities. In particular, there is no requirement to hold capital to cover mismatches between assets and liabilities such as using short term deposit money to write fixed rate mortgages. This is possibly due to the much shorter term nature of banking liabilities, which means there may be much less uncertainty regarding the ability of assets to meet liabilities. Any modelling of asset risks is generally confined to very short term modelling (e.g. 90 day outlooks) which covers short term fluctuations in markets. This type of modelling does not require a view on the longer term means and variances, and therefore might be seen as more defensible.

Banks are required to hold minimum capital of 8% of risk-weighted assets (“RWA”). RWA is calculated for both credit risk and market risk. Credit risk weightings range from 0% for cash, gold and “Zone A” government and central bank securities, to 100% for claims on the non-bank private sector and “Zone B” government and bank securities. Trading asset values are then adjusted for market risk based on the bank’s own internal model, which must be approved by the regulator.

There are three tiers of allowable capital, as follows:

- Tier 1: Permanent share capital, reserves and retained profit and loss;
- Tier 2: Subordinated perpetual debt, general provisions (limited), revaluation reserves and subordinated term debt;
- Tier 3: Short term subordinated debt.

Certain deductions must be made from the above capital:

- Tier 1: Goodwill and current year’s unpublished losses;
- Total Capital: Investments in subsidiaries outside the scope of capital adequacy requirements and capital instruments issued by other banks.

Tier 2 capital cannot be greater than Tier 1 capital, and there are also limits on the composition of Tier 2 capital.

The credit risk weightings are seen as highly prescriptive, especially as they do not differentiate between quality of asset for private sector debt. There are proposals in place to broaden the range of risk weightings to take this into account, based on rating agencies’ assessments, although the resulting system will still be prescribed. There are also suggestions that companies should be allowed to use their own internal systems
for monitoring credit risk to set the capital requirements, much in the same way as is done for market risk.

It is in the areas of market risk and asset-liability interactions in particular where life insurance regulations currently differ from banking regulations. However, the calls to allow banks to use their own internal credit risk models illustrates that the banking industry recognises the need for a more flexible approach to solvency and capital, which reflects each company's individual circumstances. This is becoming increasingly important as banks diversify into other areas of the financial services industry.