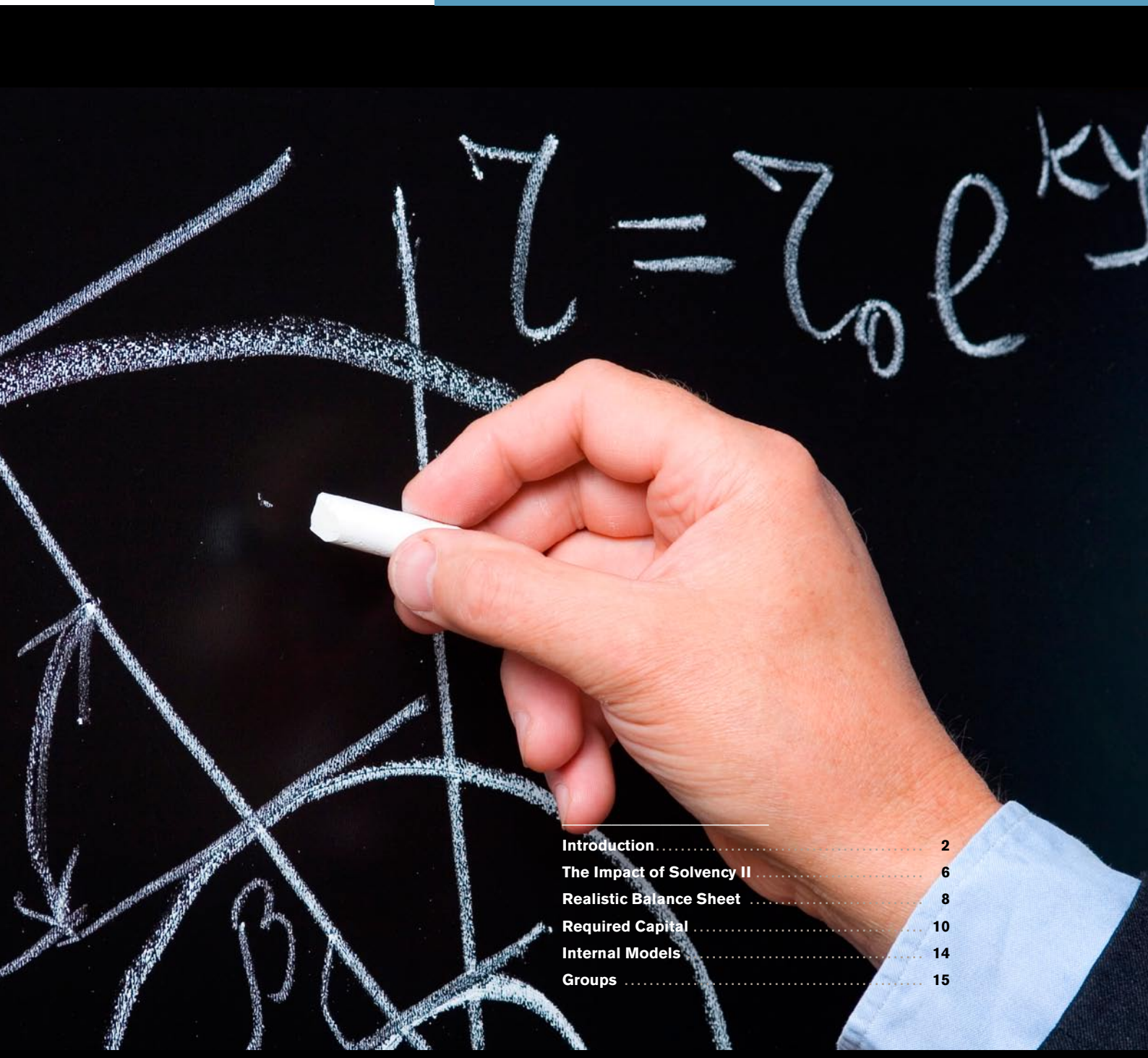
Milliman

Implications for Insurers of Solvency II



SPRING 2007

Introduction

Solvency II is the name given to the European Union's fundamental and wide-ranging review to establish a solvency system that better matches the risks of insurers. It reflects a trend throughout the EU towards the convergence of the economic and regulatory management of insurance companies. Solvency II is based on the realization that ultimately, companies that are profitable and well-managed are those most likely to remain solvent.

The move from the formulaic Solvency I system to the realistic and risk-based Solvency II system is one of the most fundamental changes to take place in European insurance in the last 20 years. It will bring significant new requirements for insurers, and we expect it to lead to important changes in the way insurance business is done and in the landscape of the European insurance market. Definition of the new system is now in an advanced state. In this paper we give an overview of the current expected form of Solvency II and discuss some of the key implications and issues arising.

What is driving Solvency II?

Risk awareness and risk management are crucial to economic stability in all countries. Some even joke that the chief risk officer is now more powerful than the chief executive officer. But risk alone is not the primary driver of Solvency II. In Europe, more sophisticated capital requirements have long been needed. Prudence had always been regarded as the leadership virtue of choice, but strength today is more often associated with transparency and realistic assessments. Policyholders, investors, and other users of financial statements need to know how well a company can weather difficulty.

Solvency II is part of a broader movement towards a convergence that is affecting all financial services institutions. For example, the Basel II banking rules, regarding the adequacy of a bank's capital, have provided a point of reference.

Timetable

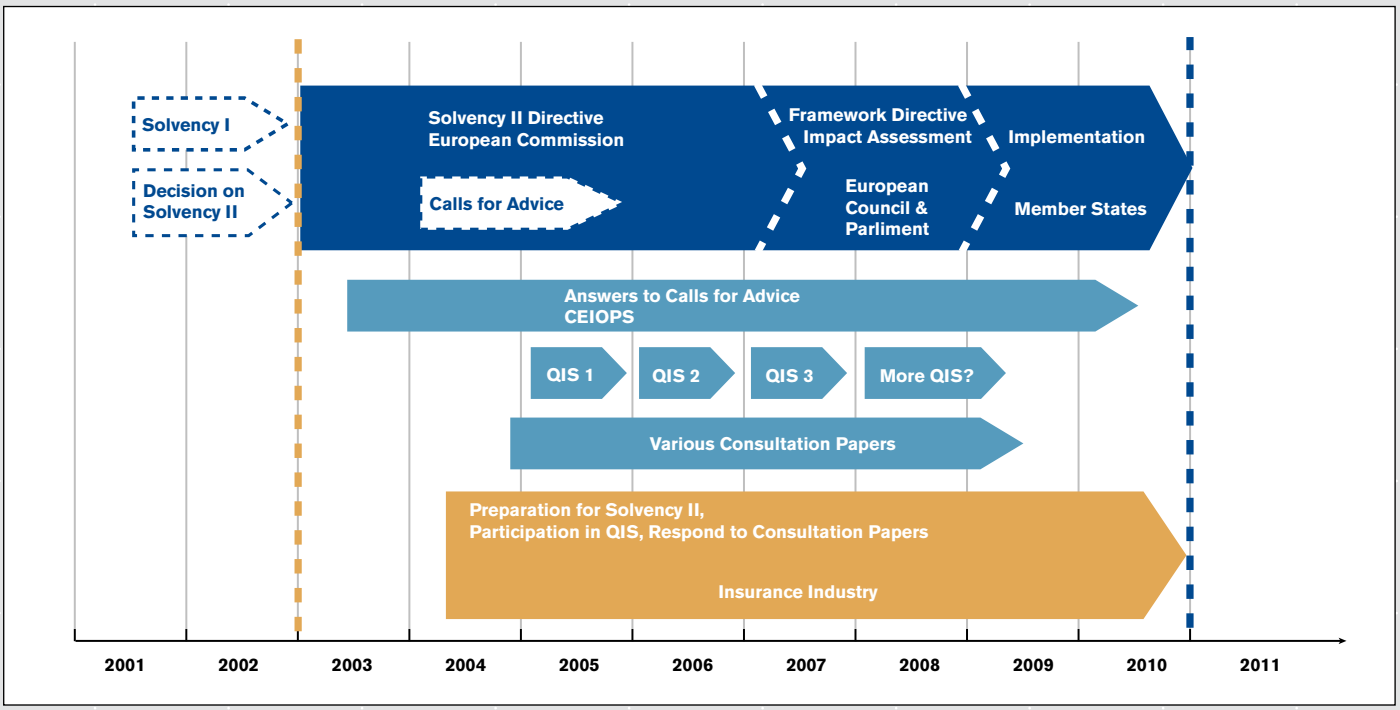
The EC has made three calls for advice (the first being in August 2004) on the direction and structure of Solvency II. The key points identified included a market-value-based approach linked to a capital requirement at a 99.5% level of confidence over a one-year time horizon. In order to assess the likely impact of such a regime, a series of quantitative impact studies has been initiated. Two of these studies (QIS 1 and QIS 2) have been completed and QIS 3 commenced on 2 April 2007.

The timetable for the implementation of the Solvency II system is shown in Figure 1 below. We are already in 2007 and the system is to be fully implemented by end 2010 at the latest. As such there are fewer than four years for undertakings to get ready, and while this may appear to be fairly distant, this is quite definitely not the case. Undertakings will need to fully appreciate the impact that Solvency II will have on their organisation if they are to enter the new regime in an orderly and positive manner. Therefore, preparing now is a very important part of an undertaking's current risk management process.

International context

Certain European countries, most notably the UK and Switzerland, are already further ahead in evolving their solvency systems. In the UK, the regulator is anticipating the arrival of Solvency II and adopted the Individual

Figure 1



Sidebar1

Quantitative Impact Studies

A key step in the development of the Solvency II system will be an Impact Assessment to accompany the Framework Directive. The Impact Assessment itself will be heavily reliant on the results from the quantitative impact studies.

The first study (QIS 1) looked at the level of prudence in technical provisions (benchmarked against three confidence levels: 60th, 75th and 90th percentiles) and an alternative approach to value the risk margin on top of best estimate for unhedgeable risks, e.g., the cost-of-capital approach. The results from QIS 1 on provisions were reported in March 2006. They indicated a broad consistency in the relative size of best estimates to current provisions for non-life entities, but there were some outlier firms and countries. For non-linked life assurance, they indicated that the best estimate of technical provisions plus a risk margin was lower than current bases for most entities.

The second study (QIS 2) was completed in mid-2006, and looked at the impact on individual entities of the possible overall Solvency II framework, covering:

- practicability of calculations, and resource implications
- effect on the level of capital needed by firms
- suitability of approaches for establishing capital requirements

It was also devised to gather information to assist in the further development and calibration of the SCR and MCR.

The results from QIS 2 were reported in October 2006. They indicated that most undertakings remain solvent according to QIS 2 valuation principles, and while the solvency ratio decreases, it remains above 100% for most undertakings in a majority of countries. The key issues emerging from the study have been fed in to CP20 covering the methodology for the Pillar 1 quantitative assessments, and several comments have been implemented in QIS 3.

The third study (QIS 3) is planned to be completed by end June 2007, with the following objectives:

- to obtain further information about the practicability and suitability of the calculations involved
- to obtain quantitative information about the possible impact on the balance sheets and the amount of capital needed
- to assess the suitability of the suggested calibrations and methodology for the calculations of the SCR and MCR
- to test the effect of applying the QIS 3 specification to insurance groups

Capital Adequacy Standards (ICAS) regime, making it effective in 2005. Under ICAS, a company has to assess its capital needs using robust modelling and be prepared to discuss it with the regulator on demand. Meanwhile, Swiss companies are in the process of adhering to their unique solvency regime, since they are not a part of the EU.

Solvency II framework

The framework that is likely to be adopted by the EU Commission will be based on a three-pillar approach as follows:

- Pillar 1 will represent the quantitative assessment of regulatory capital requirements. Capital held by firms should be sufficient to ensure with a high degree of confidence that liabilities can still be met after any adverse events or developments in the next 12 months. The current direction is that the Solvency Capital Requirement (SCR), the key quantitative assessment, will be based on the capital required to ensure solvency at a 99.5% confidence level over one year for market, credit, underwriting, and operational risks. In addition to the SCR there will also be a Minimum Capital Requirement (MCR), which will act as a lower trigger for mandatory supervisory action.
- Pillar 2 is the review process. It will address internal controls and risk management practises, supervisory practises (e.g., on-site visits), supervisory powers, supervisory peer reviews, investment management and ALM rules, and fit and proper criteria. The review process itself may occasionally lead a supervisory authority to apply capital guidance, i.e., an adjustment/capital add-on to the SCR.
- Pillar 3 sets the information disclosure requirements. There will be public disclosures on business overview and performance, governance, and the valuation basis employed for solvency. In addition, there will be non-public disclosures on risk and capital management.

Risk mitigation

Risk mitigation techniques will be reflected in the SCR to allow for their impact on an undertaking's risk profile. These techniques include both traditional and non-traditional risk transfer instruments on the asset side (e.g., financial hedging) and on the liability side (e.g., reinsurance).

The SCR will therefore allow for the effects of risk mitigation through:

- a reduction in requirements commensurate with the extent of the risk transfer
- appropriate treatment of any corresponding risks acquired in the process

Profit-sharing systems used in life insurance can have very important risk mitigation effects. It follows, therefore, that life insurers could often misstate their financial position if the cost of non-guaranteed benefits is completely ignored.

For with-profits life business, the standard formula is expected to take into account the risk absorption ability of future profit sharing by looking at the capital requirements with and without the possibility to vary future profit sharing, with the latter calculation based on reasonable expecta-

tions of the feasibility of varying future bonus rates. This is done on a risk-by-risk basis to reflect the fact that the risk absorption effectiveness of profit sharing may vary according to the risk under consideration.

Fundamentals of Solvency II – A "New World" Balance Sheet

Solvency II will involve a new way of looking at an insurance company's balance sheet as shown in Figure 2 below.

Under the Solvency I balance sheet there is a prudent valuation of assets and liabilities and a formulaic approach to defining minimum required capital.

Under the Solvency II balance sheet there are two fundamental changes:

1. There is a realistic/market-consistent valuation of assets and liabilities that results in a change in the amount of capital available to cover the minimum required capital.
2. The definition of minimum required capital will change to a risk-based system under which the amount of capital is calculated to be sufficient to provide a defined level of confidence that the insurer will remain solvent.

Insurance is by its nature a risk-accepting business, and therefore insurers are inevitably subject to the possibility of losses due to volatility in various aspects of their business activity. The objective of the SCR is to generate a level of capital that enables an insurer to absorb these losses and remain solvent with a prescribed high level of confidence over a specific time horizon.

In order to define the SCR it is necessary to set the following key factors outlined in the Table 1 on page 5.

Figure 2

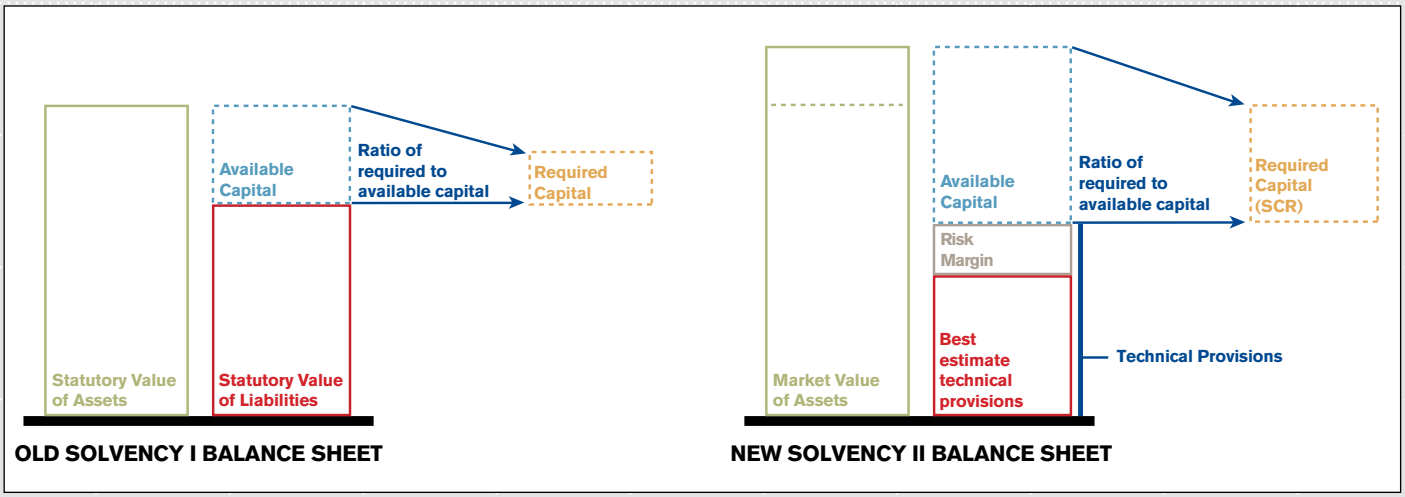


Table 1

Key Factor		Current Proposal
(1)	The confidence level	This is proposed to be 99.5% (i.e., a one-in-200-year risk of insolvency)
(2)	The time horizon	This is proposed to be one year (i.e., over a one-year time horizon assets should be sufficient to cover liabilities up to the confidence level, including technical provisions for all future losses from business written up to the end of the year)
(3)	The key risks of loss to which insurer is exposed	Insurance risks, market risks, credit risks, and operational risks
(4)	The "risk measure"	VaR ("value at risk"), which measures the amount of capital to avoid insolvency at a defined confidence level over a defined time horizon

Sidebar 2

What do we mean by a realistic/market-consistent basis for valuing assets and liabilities?

In the case of assets, this generally corresponds with the market value.

For liabilities, this involves a discounted best estimate valuation of liabilities, i.e., allowing for the time value of money and the expected cash flows. This contrasts with the current valuation bases that typically use prudent estimates of future liability cash-flows, which for life business are discounted at rates below market interest rates, and for non-life business make no allowance for the time value of money.

The implicit prudence in the Solvency I system is replaced in Solvency II by an explicit **risk margin**, which is intended to represent the additional value of the liabilities that would be required to purchase or sell the liabilities in an open market. The definition of this risk margin is a key point in the Solvency II framework and is discussed in more detail below.

An important distinction introduced by Solvency II is between **hedgeable** and non-hedgeable liabilities, with hedgeable liabilities being those that can be replicated by a combination of assets and/or liabilities with observable prices, i.e., they can be marked to market. For non-hedgeable risks, a reference framework of valuation principles needs to be established. Examples of hedgeable risks are market and credit (i.e., typically financial) risk. Underwriting, operational, or run-off risk are (at present) non-hedgeable.

2. THE IMPACT OF SOLVENCY II

Financial strength

The quantitative impact studies have tested possible methodologies among insurers throughout Europe and have allowed a first possible vision of the impact of the above changes. Figure 3 below shows the new balance sheet diagram with the movements in the various items based on the overall results of the second study (QIS 2).

It is worth noting furthermore that in some non-life markets a significant proportion of participants ended up with a ratio of available to required capital less than 100%.

The European insurance market

Solvency II is a very important change to the way European insurers are regulated, the way they prepare their financial statements, and their capital requirements. As such, it has the potential to cause very material changes in the structure of the industry. The following sets out some of the key issues that will arise.

i. Will small insurers survive?

It is recognised that the greater sophistication and complexity of Solvency II will present significant challenges to smaller insurers. With the enlargement of the EU, there are many small firms among the total of around 4,000 EU insurers. Simplifications are being considered for small firms in the area of technical provisions and the SCR. Even with these simplifications, it seems likely that the minimum viable size for an insurer will increase and there will be–over a period of several years–a significant reduction in the number of small firms.

ii. Will there be harmonization in European insurance?

One of the stated key objectives of Solvency II is to achieve a higher degree of harmonisation in the European insurance market than at present. History suggests that this may not be fully achieved. Cultural and structural differences in the different national markets and other non-harmonised systems that affect the insurance market (e.g., the social security and pensions systems and profit-sharing systems) seem likely to lead to differences in how the final directive is implemented in the various national markets.

iii. Will we see the death of embedded value?

Embedded values emerged as a financial reporting tool in the 1980s and 1990s to deal with the lack of realism in statutory insurance company financial reporting. In recent years the embedded value method has evolved to meet a number of criticisms (e.g., lack of transparency and objectivity and failure to allow for the cost of embedded options and guarantees).

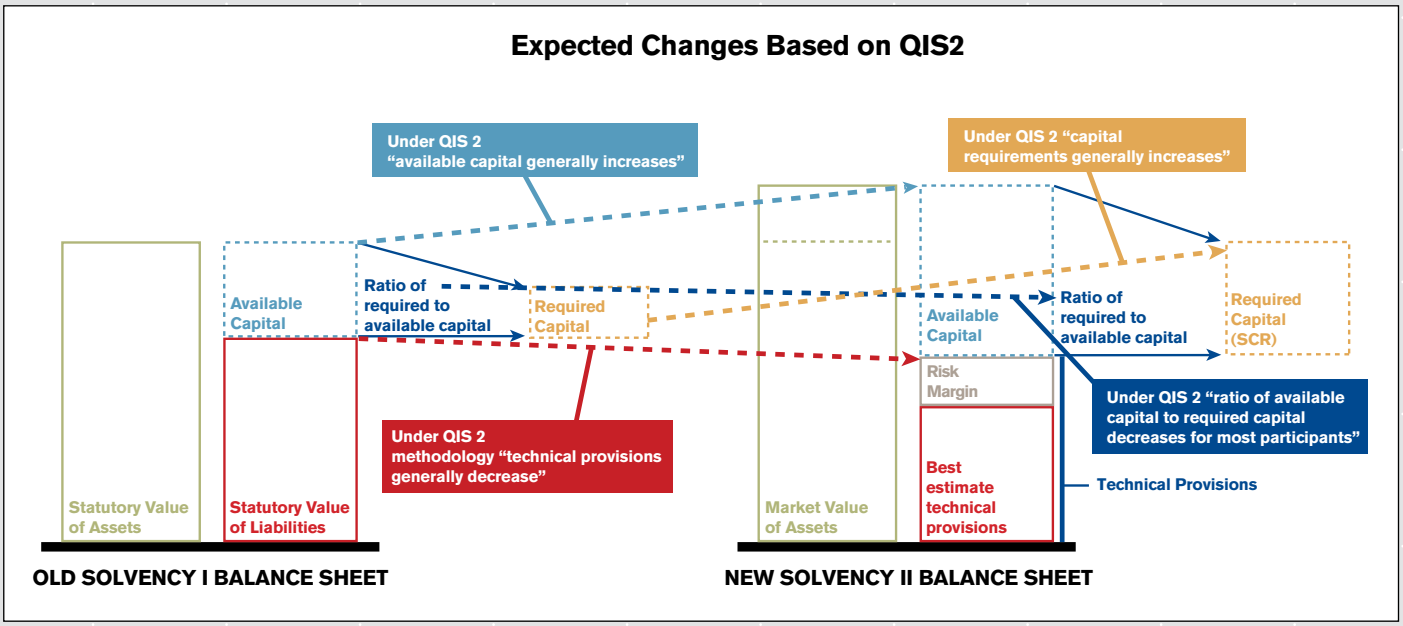
The proposed structure of Solvency II is very similar to a market-consistent embedded value methodology. It therefore seems unlikely that companies will continue to carry out supplementary embedded value reporting and analyses because the local statutory accounts will give a meaningful view of the financial position and earnings of the company.

iv. What will Solvency II mean for non-life reserving?

Non-life reserves under Solvency I are typically calculated on a non-discounted "best estimate" basis. Under Solvency II the emphasis for reserving is to establish reserves on an economic basis, i.e., at levels that would be consistent with trading such reserves in an open market. In the absence of any observable trading prices, this means establishing reserves with an appropriate risk margin over the "best estimate" level on a discounted basis (i.e., allowing for the time value of money).

Reserving under Solvency II should therefore become more realistic and transparent.

Figure 3



v. What will Solvency II mean for IFRS Phase II?

An objective in developing the Solvency II standards has been maintaining consistency with the developments of the International Accounting Standards Board (IASB). The proposed system moves a very significant way towards the type of fair value standard the IASB is aiming for. Nonetheless, some differences of view (e.g., allowance for insurers' own creditworthiness) remain, but it seems unlikely that Solvency II will change on such issues.

Further, if the Solvency II framework is implemented quicker than IFRS Phase II, then there may be much less receptiveness to an alternative reporting standard that is substantially similar but with some differences, and put pressure on the IASB to remain close to the Solvency II structures.

vi. Will risk management become the key insurance competency?

Pillar 2 of the Solvency II system will require risk management to be embedded into insurance company activity. In some cases this will formalise systems already in place, but in others it will be a real change to the way businesses are run. The function responsible for risk must be appropriate to the nature, scale, and complexity of the undertaking and separate from the operational functions.

The implementation costs associated with Solvency II may push some companies to opt for the standard formula approach rather than the use of internal models even though internal modelling may be preferable from a risk management perspective.

vii. How will insurers' attitude to risk mitigation change?

The new system will inevitably encourage risk mitigation activity. Life insurers will have a strong incentive to structure as many of the financial risks as possible as hedgeable in order to reduce risk margins. Hedging (both static and dynamic) is sure to become more widespread and insurers will look for new ways to mitigate risks (e.g., by securitisation of catastrophic mortality or longevity).

Reinsurance as an alternative (and less costly) form of capital is likely to be attractive to smaller and medium-sized insurance companies. If an insurer can reinsure business on attractive terms relative to its own SCR, then such risk transfer techniques may well become popular under Solvency II.

viii. Will there be a shortage of capital?

The results of the quantitative impact studies suggest that both required and available capital will increase and suggest that for certain types of firm, capital may be insufficient. Although some commentators have suggested there could be significant shortfalls in capital, it seems more likely that there will only be small parts of the European insurance industry where capitalisation is weak and the new rules adversely affect the solvency position.

These are likely to be small or medium-sized companies with some underlying business problems (such as onerous financial guarantees) and as such it seems likely that such companies will have difficulty raising additional capital. It is more likely that such entities will be absorbed by other insurers through consolidating mergers and acquisition activity.

ix. Will group structures change?

Large European insurance groups have very complex company structures, often with many subsidiaries in single markets. Being able to use capital efficiently across the group will be a key competitive advantage.

If the rules for groups do not permit full use of capital, it seems inevitable that group structures will simplify and that there will be fewer legal entities, and we may start to see single legal entities being used across different markets becoming much more widespread. Where merging of existing entities may be problematic, these may be put into run-off and new pan-European manufacturing operations set up.

x. Will products change?

All the above changes cannot conceivably leave the product environment unaffected. As the new rules start to become imminent, more and more companies will start to price business on the new rules and to structure products to be optimized to them.

In the life market we expect to see more unbundled and transparent products (as these will lend themselves to risk management and hedging), and we may see changes in with-profits structures to improve their ability to mitigate risks.

In the non-life market we expect to see products priced and structured with more emphasis on capital allocation and the resulting cost of capital.

3. REALISTIC BALANCE SHEET

In this section we discuss how the various items of the realistic balance sheet will be defined.

Realistic valuations

Assets. The main valuation principle for assets is to *mark to market* for traded assets (i.e., market values) and *mark to model* consistent with available market information for all other assets. Non-tradable assets that cannot be *marked to market* should be valued prudently, taking account of increased liquidity and credit risks involved.

Technical provisions. As technical provisions have no observable market prices, i.e., they are (presently) non-hedgeable, their value needs to be modelled as the sum of a best estimate and a risk margin.

Measurement of the best estimate

The best estimate of insurance liabilities is the expected value of future discounted cash flows. Discounting is based on the risk-free yield curve. The effects of legal, medical, social, demographic, and other relevant developments, as well as inflation, should be taken into account. Liabilities are net of reinsurance. No bad debt provisions for reinsurance credit risk are required, unless a reinsurer is in default. Also, the creditworthiness of the insurance company itself should not influence the valuation of its liabilities.

Embedded options, financial guarantees, and management actions must be taken into account when projecting future cash flows. It will not usually be possible to do this on a single deterministic basis, although for small insurers and portfolios, approximations such as closed form formulae (e.g., Black Scholes) may be used. Furthermore, the impact of policyholder behaviour and how this may be influenced by changes in financial conditions should be considered.

The exact way to allow for profit sharing is an important and complex question, especially since the mechanisms used for profit sharing and its legal status vary widely from country to country. Granting discretionary benefits is a special category of management actions that can under certain circumstances act as a risk mitigant.

Approaches to the risk margin

As mentioned above, technical provisions must include a risk margin to cover the risk associated with running off the portfolio or the cost in excess of best estimate if the portfolio is transferred to another insurer. For non-hedgeable liabilities, the risk margin should be determined using a cost-of-capital (CoC) methodology.

The rationale for the CoC approach is that on a going concern basis, insurers will need to satisfy certain solvency requirements from both a statutory viewpoint and a commercial viewpoint in order to attract business. There is a cost associated with the need to maintain enough capital to cover the SCR for the business (in the period until it runs off), which is the difference between the required rate of return and the after-tax investment yield on the assets supporting the SCR.

Work by the Swiss regulator (FOPI) suggests that the approximately 6% observed cost of capital for companies with a BBB credit rating was deemed to be a reasonable estimate. The BBB credit rating is deemed to be broadly equivalent to the 99.5% confidence level over one year on which the SCR is currently expected to be based.

The three steps to calculate the risk margin under a CoC methodology can be summarized as follows:

- Project the SCR for future years until the run-off of the current liability portfolio for each “homogeneous group of risks.”
- Determine the cost of holding future SCRs by multiplying the projected SCR by a CoC factor. QIS 3 requires all participants to assume a CoC factor of 6% above the risk-free rate on the valuation of the risk margin.
- Discount the cost of holding future SCRs at the risk-free rate to get the CoC risk margin.

The main practical difficulty of the CoC method is the projection of future SCRs. A sophisticated approach requires the projection of the risk factors underlying the liabilities until completion of their run-off. Simpler approximations are envisaged, i.e., the use of proxies to the SCR from the second year onwards, e.g., in proportion to the best estimate of the liabilities.

For long-tailed non-life business, the risk margin can be determined using an alternative method such as the percentiles approach, e.g., the risk margin is assessed as the difference between the 75th percentile reserve and the best estimate reserve, where the 75th percentile reserve is the level of reserves expected to be sufficient to meet all liabilities in three out of four cases. The percentile approach must be consistent with the risk margin framework, i.e., the level necessary to achieve transfer or run-off.

To calculate the 75th percentile reserve, sufficient historical data to build a probability distribution is required. Availability and quality of data may be an issue, and the alternative of using market data or other proxies may be inappropriate.

Available capital

The solvency system also needs to define which capital is available to cover the required minimum levels. This involves categorising capital into tiers in an analogous way to Basel II (although with some differences in definition), with the three tiers defined as core capital, supplementary capital, and contingent capital. Various subdivisions exist within the different tiers. Higher quality capital should be better at absorbing losses and perpetual (i.e., not have to be re-paid at any fixed time).

Core Tier 1 capital includes items such as paid-up shareholder's equity and retained earnings. Tier 2 capital can include items such as preference shares and subordinated debt. A distinction is made between Upper Tier 2 capital, which is permanent, and Lower Tier 2 capital, which is dated. Tier 3 capital may provide loss absorption under certain circumstances. It can include contingent capital, like unpaid equity or foundation fund, letters of credit, or supplementary members' calls for mutuals. Recognition of Tier 3 capital will be subject to supervisory approval.

It is proposed that total capital (including all three tiers) will be eligible to cover the SCR, but there will be limitations on the proportion of this that must be covered by Tier 1 capital. The MCR must be covered by Tier 1 and Tier 2 capital and there will be some limitations on the proportion that must come from Tier 1 capital.

4. REQUIRED CAPITAL

Required Capital (SCR) – Standard Formula

A modular approach has been adopted in QIS 3 for the standard formula. In each module, proxies for individual risks are transformed into a capital charge. The capital charges for individual risks are combined to generate an estimate of the SCR. The modular structure of the standard formula approach is shown in Figure 4 below.

The parameters and assumptions used for the calculation of the SCR are intended to reflect a VaR risk measure (calibrated to a confidence level of 99.5% over a time horizon of one year).

To ensure consistency, these calibration objectives have been applied to each individual risk module.

For the aggregation of the individual risk modules to an overall SCR, linear correlation techniques are to be applied. The setting of correlation coefficients is intended to reflect potential dependencies in the tail of the distributions, as well as the stability of any correlation assumptions under stress conditions. While this method of aggregation is not theoretically correct it has been adopted as a convenient approximation.

The modular structure of QIS 3 includes a top-level addition to the basic SCR (BSCR) before arriving at the final result of the standard formula, ie. the capital charge for operational risk (SCR_{op}).

The components of the SCR are discussed in more detail in the following sections of this paper. Nonetheless, in simple terms the SCR is derived from the formula:

$$SCR = BSCR + SCR_{op}$$

Basic SCR

The BSCR to be tested in QIS 3 includes five major risk categories (market, non-life, life, default, and health), and within the major risk modules there are further (sub) risk categories (e.g., for non-life there are the underwriting and CAT risk categories).

Capital charges are calculated for each risk category, and then aggregated in a two-step approach linked to the modular structure:

1. all risks belonging to the same major risk category are combined, e.g., equity, property, interest rate, currency, and spread risks are aggregated using a correlation matrix to produce an overall market risk charge

2. the major risk categories (market, non-life, life, default, and health) are combined using another correlation matrix to arrive at an overall BSCR

Market risk

Market risks can apply to both life and non-life business and so are treated separately from these two. They derive from movements in variables such as equity market levels, interest rates, and exchange rates. The proposed model defines a capital charge for interest rate, equity, property, spread, concentration, and currency risks, with offsets for the mitigating effect of profit sharing. A correlation matrix is defined to reflect the degree to which the different financial risks are linked (for example, QIS3 proposes a 0.75 correlation between equity and property risks).

The interest rate risk charge is determined by applying upward and downward stress tests to current interest rate levels and calculating the impact on the difference between the value of assets and the value of liabilities. For equity risk, a similar stress test (e.g., a 40% drop for European equities) is applied on market levels separately for different global indices and with an offset to allow for the effect of any hedging. Similar approaches are applied for property and currency risks. Concentration and spread risks are dealt with through approaches based on the relevant ratings of the underlying assets.

Life underwriting risk

This is split into biometric risks (mortality; longevity and morbidity/disability), expense risks, lapse risks, catastrophic risks, and revision risks. As with market risks, there is an allowance for the mitigating effect of profit-sharing systems and a correlation matrix is used.

Figure 4

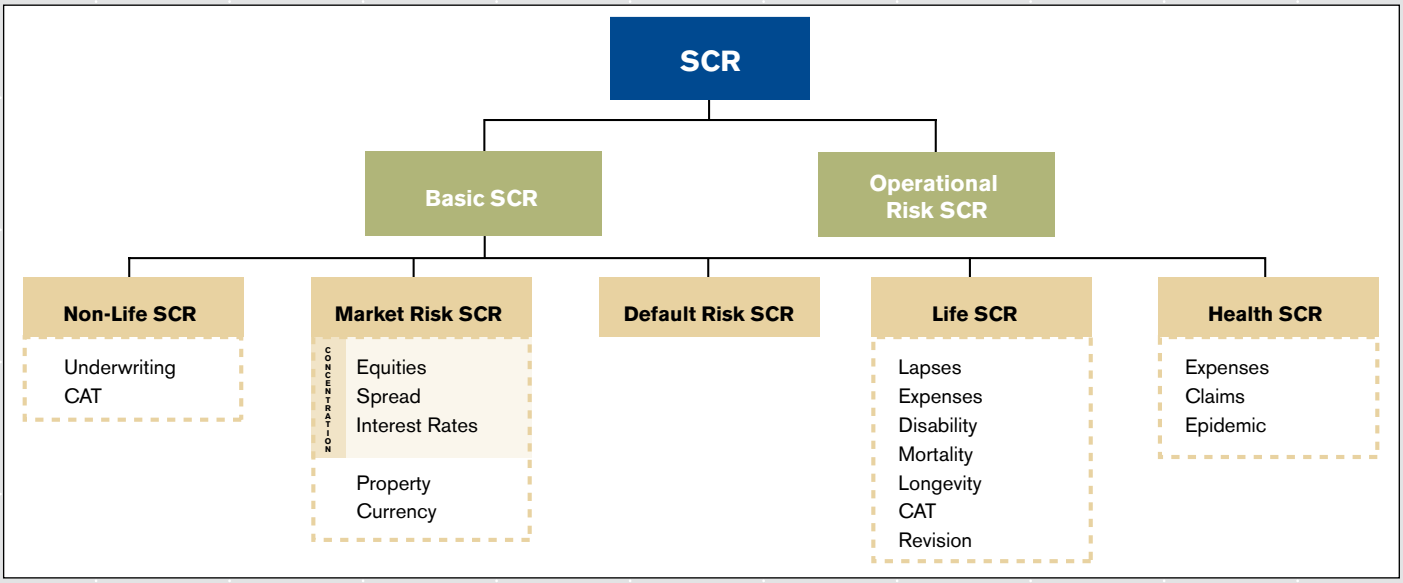


Table 2 below gives some comments on the expected treatments of these different risk categories.

Non-life underwriting risk
The underwriting risk relates to the uncertainty about the results of the insurer's underwriting. This includes uncertainty about:

- the amount and timing of the ultimate claim settlements relating to existing liabilities;
- the volume of business and premium rates at which business will be written;
- the premium rates required to cover the liabilities created by the business written;

Following on from the results of QIS 2, QIS 3 will consider two modules of non-life underwriting risk: combined premium and reserve risk, and catastrophes. It will use a factor-based approach to non-life underwriting risk as the base model, including some simple scenario analysis to take account of catastrophic events. Table 3 on page 12, gives some comments on the expected treatment of these different risk categories.

It should also be noted that under QIS 3, non-life technical provisions for direct insurance (and facultative and proportional reinsurance) are to be determined for 12 lines of business. In addition, non-life technical provisions for non-proportional reinsurance are to be split into 3 lines of business (property, casualty and MAT). In keeping with the resulting segmentation, the standard deviations for reserve risk and premium risk are determined by segment as described in QIS 3. Further, the correlations between the segments are defined via a correlation matrix itself set-out in QIS 3.

Counterparty default risk
Counterparty default risk (credit risk) is the risk of default of a counterparty to risk-mitigating contracts like reinsurance and financial derivatives. The calculation in QIS 3 is based on the "replacement cost" (RC) of each exposure and the corresponding probability of default (PD) of the counterparty.

RC is meant to be a conservative estimate of the replacement cost of the exposure, given default of the counterparty. It is calculated as the difference between gross and net technical provisions plus the extra premium (if any) to be paid minus any recoveries, collateral, or other risk mitigants.

A PD estimate for QIS 3 is derived from external ratings, e.g., an A-rated reinsurer is deemed to have 0.05% probability of default.

Health underwriting risk
This module generates a capital charge for the underwriting risk in health insurance that is practised on a similar technical basis to life assurance.

Table 2

Risk Catagories	Comments
Mortality, Longevity, and Disability and Morbidity Risks	Volatility risk, defined as the risk of random fluctuations, and uncertainty risk, the risk the models used to estimate that mortality rates are misspecified or have misestimated parameters or can change over time, are treated separately. The volatility risk is based on a one-off increase in mortality rates and is reduced by the impact of having a larger portfolio, whereas the uncertainty risk is based on a permanent change in mortality risk and is independent of the size of the portfolio. The treatment of longevity risk and disability and morbidity risks is broadly similar to that of mortality.
Lapse Risk	Lapse risk is defined as the risk of an unanticipated (higher or lower) rate of policy lapses, terminations, changes to paid-up status (cessation of premium payment), and surrenders. The proposed approach is based on a shock to higher and lower levels of lapsation.
Expense Risk	Expense risk is defined as the risk that expenses associated with insurance contracts, or with the undertaking as a whole, are higher than expected. The proposed approach involves looking at a shock to both higher expenses and higher expense inflation.
Catastrophe (CAT) Risk	CAT risks stem from extreme or irregular events that are not sufficiently captured by the charges for the biometric risks, lapse risk, and expense risk. These are one-time shocks from the extreme, adverse tail of the probability distribution that are not adequately represented by extrapolation from more common events and for which it is usually difficult to specify a loss value, and thus an amount of capital to hold. For example, a contagious disease process or a pandemic may affect many persons simultaneously, nullifying the usual assumption of independence among persons. There will be an element to allow for both mortality/disability and to allow for the impact of catastrophic lapse experience (since there is no surrender value floor to the reserve).
Revision Risk	Revision risk captures the risk of adverse variation of an annuity's amount as a result of unanticipated revision of the claims process. This is only intended to cover genuinely reviewable annuities not indexed ones.

The risk is split into three components: expense, claim/mortality/cancellation, and epidemic/accumulation risks. Capital charges are calculated for each health underwriting sub-risk and then combined using a correlation matrix to arrive at an overall capital charge for health underwriting.

Operational risk

Operational risk is the risk of loss arising from inadequate or failed internal processes, people, or systems, or from external events. Operational risk also includes legal risks, but reputation risks and risks arising from strategic decisions do not count as operational risks. It is challenging to set capital requirements for operational risk, primarily due to a lack of data. Insurers vary greatly in terms of their current sophistication in this area. Operational risk poses a serious potential threat to policyholder protection and hence it is an important risk class.

The capital charge for operational risk (while not yet finalised) is determined under QIS 3 using a relatively simple formula using technical provisions and earned premiums as inputs. It should be noted that the structure has changed from that in QIS 2 in that the capital charge is now restricted to 30% of the BSCR.

Minimum capital requirement (MCR)

One key safety measure of the proposed Solvency II system is the MCR, as it defines the level of capital below which ulti-

Table 3

Risk Catagories	Comments
Premium and Reserve Risk	Premium risk is the risk that expenses plus the volume of losses (incurred and to be incurred) for claims (paid amounts and provisions at the end of the period) is higher than the premiums received (or if allowance is made elsewhere for expected profits, that the profitability will be less than expected). Premium risk relates to policies to be written (including renewals) during the period and to unexpired risks on existing contracts. Reserve risk arises from two main sources: first, the absolute level of the claims provisions may be misstated and second, because of the random nature of future claim pay-outs, the actual claims will fluctuate around the statistical mean value. In QIS 3, the calculation of the combined premium and reserve risk is determined as a function of a volume measure and the standard deviation of the loss ratio for the overall portfolio in a two stage process as follows: 1. For each individual line of business, standard deviations and volume measures for both premium risk and reserve risk are determined. 2. The standard deviations and volume measures for the premium risk and reserve risk in the individual lines of business are aggregated to derive an overall volume measure and an overall standard deviation for input into the calculation of the capital charge. For QIS 3, loss ratios (rather than combined ratios, as in QIS 2) are used because they are deemed to provide a more objective basis for the measurement of volatility, and because this lessens the burden on undertakings with respect to data collection.
Catastrophe (CAT) Risk	CAT risks stem from extreme or irregular events that are not sufficiently captured by the charges for premium and reserve risk. For modelling non-life CAT risk in QIS 3, regional CAT scenarios are considered that are specified by a local regulator (e.g., in the UK, a major flood in the London area, resulting in an estimated insurance industry loss of £15bn). In addition, a list of European (trans-regional) scenarios will be prescribed. For each of the prescribed trans-regional scenarios, the participants have to estimate the cost (i.e., the effect on the net value of assets and liabilities), subject to a materiality threshold of 25% of the most severe scenario. For regional scenarios, the calculation of the CAT cost follows the specification set by the local regulator (this could either be a scenario- or market-loss-based approach). The combination of regional CAT costs is also to be prescribed by the local regulator. The overall CAT cost is then determined using a root mean square approach.

mate supervisory action is triggered. In addition to this safety measure, a fundamental criterion under Solvency II is that at any time, a sufficient amount of eligible assets should be available to cover technical provisions, the MCR, and the SCR.

It is therefore a safety net that should be an auditable, robust, and simple requirement. The MCR needs to allow a clear decision as to when a regulator should intervene in a company's affairs and that cannot be disputed after the event (e.g., in a legal case in a national court).

The MCR to be tested under QIS 3 uses a modular approach that aims to provide simple, robust treatments for the main risks that insurers are exposed to.

The calibration of the MCR will be adjusted through further studies taking into account as a benchmark the current Solvency I requirements. It may turn out that the MCR is simply set as a proportion of the SCR, e.g. 50%.

The structure of the formula based MCR in QIS 3 is shown in Figure 5 below.

The gross MCR is initially calculated as the aggregate of the results for the market risk, non-life underwriting, life underwriting, and special (health underwriting) risks. It should be noted that there is no explicit credit or operational risk components.

The basic MCR (BMCR) is calculated as the gross MCR less the reduction for profit sharing (RPS). The RPS reflects the loss reduction potential of future non-guaranteed bonuses (under life business).

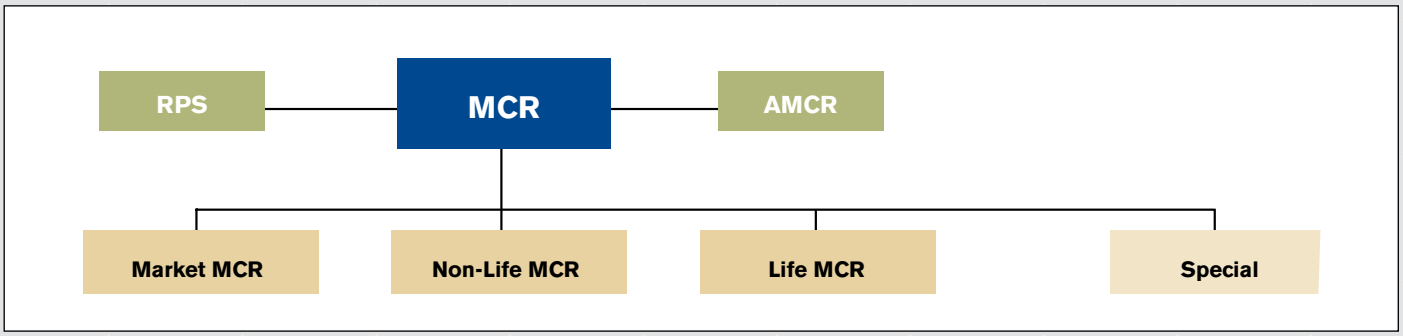
The placeholder absolute MCR (AMCR) for the purposes of QIS 3 is €1million.

The resulting MCR is the greater of the BMCR and the AMCR.

Transitional MCR

QIS 3 also tests various other measures, e.g. one third of the SCR according to the standard formula, to assist in the design of transitional arrangements relating to the MCR.

Figure 5



5. INTERNAL MODELS

Full internal models

The supervisory objectives of basing the SCR on the internal risk modelling of an undertaking as an alternative to the standard formula approach are:

- better risk management, which also improves policyholder protection
- continual upgrading and encouragement of innovation in risk management methodology
- improved risk sensitivity of the SCR, especially for undertakings with non-standard risk profiles

The potential benefits of basing the SCR on the internal risk modelling of an undertaking as an alternative to the standard formula approach are:

- higher competitiveness through better risk management and hence lower costs of capital
- more adequate modelling of non-standard, especially non-linear, contracts
- more effective Pillar 2 discussion and familiarity of the supervisor with more detailed exposure data than is generally available in accounting records
- realisation of cost efficiencies through re-use of risk modelling infrastructure for discussion with supervisors, rating agencies, analysts, and shareholders

It is expected that three tests will have to be passed by internal models on an ongoing basis to be accepted by regulators:

1. ***Use test.*** Is the actuarial model genuinely relevant for and used within risk management? The board of directors needs to document and communicate its strategic goals of risk management (risk strategy), which is an integral, consistent part of an undertaking's business strategy. The risk strategy shall document how the actuarial internal model is used to achieve these goals. The objectives should be broken down hierarchically to the responsible business unit. If there is not a centralised risk management function and the single model is used for more than one legal entity in a group, the qualitative review of it may be undertaken on a group basis.
2. ***Calibration test.*** Is the SCR computed by the undertaking a fair, unbiased estimate of the risk as measured by the common SCR target criterion? CEIOPS's calibration solution requires undertakings to quantify the relation between their own internal economic capital calibrations and the Solvency II SCR calibration objectives, in line with the general Solvency II goal of making the degree of prudence in both valuation and capital buffers explicit. Without this re-scaling requirement, it will be difficult for the Solvency II SCR calibration objective to establish itself as an industry benchmark among the capital benchmarks defined by rating agencies.
3. ***Statistical quality test.*** Are the data and methodology underlying both internal and regulatory applications sound and sufficiently reliable to support both satisfactorily? An undertaking should be able to justify its model choices to its supervisor.

The practical implications of considering statistical quality, use, and calibration requirements separately require a response to the following issues:

- how to achieve comparability of the SCR in a sector that uses a multitude of risk measures (e.g., VaR and TailVaR) for risk management purposes
- how to assess the bias of an SCR estimate that is defined in terms of events well beyond normal experiences (the 200-year-event loss in the case of 99.5% VaR)
- how to assess that a model is realistic, reliable, and actually used in the daily risk management of the insurer
- how to optimize the resources needed for the validation of internal models by both supervisors and undertakings

For QIS 3, participants are invited to complete this part of the study at their discretion. They are also encouraged to comment on the reasons for material differences between their internal model estimates and the results of the standard formula modelling, particularly where they suspect that the latter fail to reflect the real drivers of risk.

Partial internal models will also be permitted under certain well-defined circumstances, e.g., to ease the transition from the standard formula to "full" internal models. Of necessity, partial internal models must be consistent with the SCR standard formula, and this means that their use needs to satisfactorily address the following issues:

- which parts of the SCR standard formula are affected by the use of the internal model
- how their replacement by internal SCR estimates impacts the rest of the standard formula
- how the general consistency and confidence level is maintained

6. GROUPS

Group SCR Data

QIS 3 contains a specification on how insurance groups may calculate and report their SCR on a group data basis. It should be noted, however, that this specification does not necessarily reflect final solutions for Solvency II. It is also worth pointing out that the feasibility of the proposed solution is dependent on very effective collaboration and consensus among different regulators involved in regulating an insurance group.

The main objectives of the group questions in QIS 3 are to gather information on:

- size and source of group diversification benefits resulting from the application of the standard formula at group level
- principle of transferability in a group context and its impact in terms of absolute amounts
- size and nature of group-specific risks
- difficulties experienced by participants in carrying out the calculations specified and any other relevant issues

Capital

Required group capital is to be calculated by applying the SCR standard formula to the group as a whole, but adjusted for non-transferability of assets between group entities. Available capital is to be calculated according to the specifications for solo entities.

Diversification

Application of the standard SCR formula to a group as though it were a single entity will result in diversification benefits. The QIS 3 specification allows for diversification subject to certain adjustments to take account of transferability.

Transferability

Surplus capital in one group entity may only count towards available group capital to the extent that it is freely transferable to cover losses in other parts of the group.

Restrictions on transferability exist where assets are:

- required to meet the solo capital requirements of an individual group entity
- allocated for a specific purpose, e.g., with-profit funds
- financed by subordinated debt or minority interests
- located in non-EEA or cross-sector entities
- required to meet local taxation, transaction costs, etc.

Group-specific risks

A group may create its own specific risks, e.g., contagion, legal, reputation, complexity, conflicts, concentrations, and multiple gearing risks. None of these risks is covered by the standard formula, but should as far as possible be addressed in the Pillar 1 required capital calculation. QIS 3 therefore requires participants to explain how they have addressed and quantified such risks.

Technical specification

The SCR structure at a group level is very similar to the solo entity structure, save that it has an additional module to deal with other risks, i.e., participations in (re)insurance entities in third countries, participations in other financial sectors, and participations in EEA (re)insurers accounted for at equity value.

It is envisaged that calculations are carried out on consolidated group data at the required level of a given sub-module.

Formulae are proposed to combine sub-module risk charges by group entity to allow for diversification effects.

Milliman

For further information please contact your usual Milliman consultant at one of our European offices listed here. Alternatively, you are welcome to contact the authors directly:

Amsterdam

Milliman
Postbus 75215
1070 AE Amsterdam
The Netherlands
(+) 31 (0)61 014 9938 tel

Henny Verheugen
henny.verheugen@milliman.com

London

Milliman
Finsbury Tower
103-105 Bunhill Row
London EC1Y 8LZ
UK
(+) 44 (0) 20 7847 1500 tel
(+) 44 (0) 20 7847 1501 fax

Neil Cantle
neil.cantle@milliman.com

Tanya Fick
tanya.fick@milliman.com

Gary Wells
gary.wells@milliman.com

Madrid

Milliman
Edificio Cuzco IV
Paseo de la Castellana, 141 P. 18-20
28046 Madrid
Spain
(+) 34 91 789 3470 tel
(+) 34 91 789 3471 fax

Milan

Milliman
Via Monte di Pietà 21
20121 Milan
Italy
(+) 39 02 86 33 72 14 tel
(+) 39 02 86 33 74 00 fax

Aldo Balestreri
aldo.balestreri@milliman.com

Ed Morgan
ed.morgan@milliman.com

Munich

Milliman
Maximilianstrasse 35a
80539 München
Germany
(+) 49 89 5908 2395 tel
(+) 49 89 5908 1200 fax

Jeff Courchene
jeff.courchene@milliman.com

Warsaw

Milliman
ul. Emilii Plater 53,
11th Floor
00-113 Warsaw
Poland
(+) 48 22 528 6962 tel
(+) 48 22 528 6701 fax

Zürich

Milliman
Lavaterstrasse 65
Ch 8002 Zürich
Switzerland
(+) 41 44 287 80 60 tel
(+) 41 44 287 80 81 fax

Janos Blum
janos.blum@milliman.com