Solvency II: an integrated risk approach for European insurers

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Solvency regulation in the EU is under reform. The Solvency II project will introduce a new solvency regime which will be characterised by an integrated risk approach better taking into account the risks an insurer is facing than the current solvency regime. Security for these risks will have to be held in the form of solvency capital. The work on the design of the future supervisory system was concluded in early 2003. The proposal for a Solvency II Draft Directive is expected to be adopted by the EU Commission in mid-2007. The plan is to implement Solvency II by 2010.

The objectives of Solvency II are to protect policyholders and to establish a measure of solvency that better reflects the risks to which an insurer is exposed than the current Solvency I criteria. Its focus will be on the overall solvency position of an insurer.

According to currently available information, Solvency II will be characterised by the following features:

- it will be based on principles and not on detailed rules.
- the calculation of the solvency position will be based on market-consistently valued parameters.
- the need to explicitly quantify risk interdependencies will create an incentive for insurers to use their own internal models to measure and manage their risk.
- Solvency II aims at consistency across financial sectors, harmonisation of supervisory methods across Europe and convergence in international prudential standard-setting.
- it will be based on a Basel-type three-pillar approach, used in banking, consisting of quantitative requirements (rules for financial resources), qualitative requirements (supervisory review process and risk management) and market discipline (disclosure and transparency).

Any analysis of the impact of Solvency II on the European insurance industry can only be preliminary without the directive being available at this time. This limitation notwithstanding, there is a high probability that

- Solvency II will most likely lead to a more encompassing picture of an insurer’s solvency situation. This is mainly thanks to the market-consistent valuation of assets and liabilities and to making explicit provision for investment risks.
- while Solvency II will most likely not reveal major under- or overcapitalisation of the insurance industry as a whole, the implications for certain individual insurers may be substantial.
- explicitly assigning a risk-based capital charge to underwriting and investment risks may lead to price increases and/or to changes in product design: in non-life insurance, this may affect products with above-average loss volatility, such as property covers; in life insurance, options and guarantees, in particular, may be reconsidered.
- major impact will come from charges for investment risks. They will most probably prompt insurers to reduce their exposure to stock markets.
Solvency II will reinforce insurers’ focus on risk/return fundamentals.

Solvency II will be a particular challenge for insurers which in the past have insufficiently or inadequately taken the underlying characteristics of their risks into account. This may be the case particularly in life insurance, where traditional actuarial practices have often not extended to the valuation and assessment of product guarantee and option features. Generally, Solvency II will reinforce insurers’ focus on risk/return fundamentals and will increase professionalism regarding risk-adequate pricing and risk and capital management in the insurance sector.

Effective policyholder protection requires that the Solvency II framework reflects economic principles: particularly that it recognises diversification, allows internal models, gives appropriate credit for reinsurance and other risk mitigation techniques (financial hedges, such as derivatives and insurance-linked securities) and reinforces trust in market mechanisms by relying on increased transparency.

Due to lower stock market exposure, the link between non-life insurance capacity and the ups and downs of the stock markets will weaken. This may reduce the swings of price cycles.

Risk transfer tools (reinsurance, hedging and securitisation) will be treated more consistently by the supervisory authorities, better reflecting their effect on risk reduction. This will lead to changes in cession and hedging behaviour and further promote the use of innovative risk management tools.

The requirement of market-consistent reserve valuation will increase transparency and enhance the understanding of reserving risks. This will lead to more appropriate reserving.

Economic principles are crucial for Solvency II.
In March 2003, the European Commission Services prepared a note on the design of a future prudential supervisory system in the EU.¹ It represented a milestone in the Solvency II project, which was initiated in 2001 to investigate the need for a revision of the current EU solvency system. The proposed design foresees a paradigm shift of EU solvency calculation: the underwriting-risk-focused solvency approach is to be replaced by an integrated risk approach taking into account all risks an insurer is facing. This sigma gives a review of the current EU solvency models, the goals and design of the Solvency II project, and discusses the impact the Solvency II reform might have on the European insurance industry.

### Historical development of EU solvency capital requirements

#### The first EU solvency rules

In Europe, solvency regulation was set out in two directives² in 1973 and 1979. It required insurers to establish a capital buffer to cope with the uncertainty of the insurance business. The importance of solvency regulation increased when markets were opened up under the third generation of EU insurance directives, enacted in mid-1994, which abolished price and product control throughout the EU. The goal of solvency control was to enable supervisory authorities to detect problem cases amongst insurers at an early stage, and thus to better protect policyholders. Designed as a common minimum standard, EU member states were free to impose stricter regulations.

#### Solvency I – the current EU solvency regime

Solvency regulation underwent only little amendment until the Solvency I Directives were adopted in February 2002. The Solvency I regulation has been binding as of accounting year 2004.³ The legislation left the solvency calculation unchanged, it only adjusted some components to better reflect the actual situation (e.g., higher minimum guarantee fund, increased threshold in the non-life required solvency margin calculation, composition of available capital). It strengthened supervision by demanding that solvency requirements be fulfilled at all times (not only at the time the financial statements are drawn up), and it stipulated extended intervention rights on the part of the insurance supervisory authorities. (The following box provides information on the Solvency I calculation).

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³ Member states may opt for a transition period until accounting year 2007.
Solvency calculation under Solvency I

Solvency I requires insurers to hold capital funds equal to the required solvency margin or the minimum guarantee fund, whichever is the higher.

**Non-life insurance solvency margin**

For non-life insurance, the required solvency margin is defined as the higher of the premium and the claims index, which are calculated using the following formulas:

- **premium index** = \((18\% \times \text{first EUR 50m gross premiums} + 16\% \times \text{remaining gross premiums}) \times \text{retention rate}\)
- **claims index** = \((26\% \times \text{first EUR 35m gross claims} + 23\% \times \text{remaining gross claims}) \times \text{retention rate}\)

Retention rate = net claims ÷ gross claims, three-year average, (but not less than 50%)

In liability insurance except MTPL, and in marine and aviation, a factor of 1.5 is applied to the indexes.

**Life insurance solvency margin**

For life insurance, the required solvency margin is calculated as:

- \(4\% \times \text{gross mathematical provisions} \times \text{retention rate mathematical provisions} + 3‰ \times \text{capital at risk} \times \text{retention rate capital at risk}\)

Retention rate mathematical provisions = net provisions ÷ gross provisions (but not less than 85%)

Retention rate capital at risk = net capital at risk ÷ gross capital at risk (but not less than 50%)

**Minimum guarantee fund**

The minimum guarantee fund was set at one third of the required solvency margin, subject to a minimum of EUR 2 to 3m, depending on the line of business.

The minimum guarantee fund and premium and claims thresholds are subject to annual review. They will be adjusted should the European consumer price index have changed by more than 5% since the last adjustment.

**Investment risk is dealt with by means of investment rules.**

In addition to the solvency regulations, the EU defined investment guidelines governing how technical reserves are invested by imposing restrictions on the asset classes in which insurers are allowed to invest and the maximum share they are allowed to hold in each. The investment regulations reflect the fact that asset risks are not captured in the Solvency I capital requirements.

**Regulatory action if available capital is lower than solvency requirements.**

According to the EU directives, the available capital funds are calculated as the assets of the insurer free of any foreseeable liabilities, less any intangible items. If the available capital funds fell short of the solvency requirements, regulators could impose various corrective measures on the non-compliant insurer.

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4 The average claims experience of the past three financial years is to be taken into account. For insurers writing mainly credit default, storm, hail or frost risks, the last seven financial years have to be taken into account.

5 For unit-linked business this figure is 1%.

6 For pure term assurance with a maximum term of three years, the fraction is set at 1‰. For policies with a term of more than three, but not more than five years, the fraction is 1.5‰.

7 Capital (or sum) at risk is the maximum amount of risk to the insurer; in endowment insurance this is the difference between the death benefit and the reserve already formed, whereas for term and accident policies, the sum at risk equals the sum insured.
The strengths of the Solvency I framework are its simplicity and robustness. Furthermore, its results can be compared across companies. However, these benefits gloss over some weaknesses:

- valuation of assets and liabilities (including technical provisions) is not based on a market-consistent approach.
- solvency requirements depend on parameters that are inadequate proxies for the underlying underwriting risk – premiums or claims in non-life and mathematical reserves and capital at risk in life insurance.
- risks other than underwriting are not or only partially accounted for. For example, investment risk is not included in the required solvency margins, but is dealt with by regulations on investment of technical provisions.
- no allowance is made for diversification, certain forms of risk transfer, and dependencies between assets and liabilities.
- credit for reinsurance is limited and does not adequately take into account risk transfer and reinsurers’ credit quality.

Hence, no allowance is made for the company’s specific risk profile. Solvency I is therefore regarded as an interim solution on the way to a solvency regulation which more adequately reflects the risks an insurer is actually facing.

Overview of the design of Solvency II

Objectives and main features of Solvency II

In 2001, the EU Commission initiated the Solvency II project in order to review the European framework for prudential supervision of insurance companies. Currently, the EU Commission has started to draft the Solvency II Directive. The final draft should be ready in early 2007. Its adoption by the EU Commission is expected for mid-2007. It then has to be adopted by the EU parliament and the Council of Ministers. Implementation is scheduled to be completed by 2010.

The objectives of Solvency II are as follows:

- to protect policyholders;
- to establish a solvency capital requirement that is better matched to the risks of an insurance company;
- to avoid undue complexity;
- to reflect market developments;
- to establish principles and not be excessively prescriptive;
- to avoid unnecessary overcapitalisation.
The project was divided into two phases. In the first phase, the general design of the new solvency system was discussed. The second phase is dedicated to elaborating the detailed design of Solvency II. The work on phase I was concluded in early 2003, and in April 2003 the broad lines for the new supervisory regime were welcomed by the European Commission’s Insurance Committee. The framework contains the following main features:

- assessment of the overall solvency of the insurance company,
- Basel-type three-pillar approach, adapted to insurance;⁸
- risk-sensitive approach, providing insurers with an incentive to measure and manage their risks (including recognition of internal models);
- two-level approach to capital requirements:
  1) Solvency Capital Requirement based on the economic capital needed at a certain ruin probability, and
  2) a more easily calculated lower, absolute Minimum Capital Requirement;
- consistency across financial sectors;
- more efficient supervision of insurance groups and financial conglomerates;
- harmonisation of quantitative and qualitative supervisory methods;
- incorporation of international developments with the aim of promoting further convergence in prudential standard-setting, particularly with the International Association of Insurance Supervisors (IAIS), the International Association of Actuaries (IAA) and the International Accounting Standards Board (IASB).⁹

The core of Solvency II – its three-pillar structure

The new EU solvency system will be based on a three-pillar structure organised as follows:

![Figure 1: The three-pillar structure of Solvency II](image)

1st pillar | 2nd pillar | 3rd pillar
---|---|---
Quantitative requirements | Qualitative requirements | Market discipline
- Basics for the calculation of technical provisions | - Principles of internal control and risk management | - Disclosure
- Minimum Capital Requirement | - Supervisory review process | - Transparency
- Solvency Capital Requirement | - Investment rules |  

⁸ For an overview of the Basel II banking supervision, see next chapter.
Pillar I – quantitative requirements: rules on financial resources

The first pillar will comprise rules on financial resources – prudential rules on technical provisions, investments and capital requirements.

Rules for valuing technical provisions will be a central component of pillar I, as the amount of reserves will have a major impact on the solvency requirements. At the time this sigma was finished, no decision had yet been taken on the details of these rules. Solvency II aims to harmonise methods for calculating technical provisions and to achieve congruency with developments in the International Financial Reporting Standards (IFRS). However, should IFRS accounting standards not be ready by the time Solvency II is introduced or not be suited for solvency purposes, a different accounting principle could be set up. CEIOPS¹⁰ recommends “that the valuation of insurance liabilities should be based on the expected present value of cash flows ([..] “best estimate”), together with an explicit risk margin”.¹¹

The envisaged introduction of a market-consistent valuation of assets and liabilities is one of the major differences between Solvency II and Solvency I. It will fundamentally impact the outcome of the solvency calculation.

Based on market-consistently valued assets and liabilities, capital requirements will be calculated. Solvency II envisages two levels of capital requirements:

- the Minimum Capital Requirement (MCR) designates the “level of capital below which an insurance undertaking’s operations present an unacceptable risk to policyholders. If an undertaking’s available capital falls below the Minimum Capital Requirement, ultimate supervisory action should be triggered”.¹² “The Minimum Capital Requirement should be a simple, robust and objective measure.”¹³

- the Solvency Capital Requirement (SCR) “should deliver a level of capital that enables an insurance undertaking to absorb significant unforeseen losses and gives reasonable assurance to policyholders that payments will be made as they fall due. It should reflect the amount of capital required to meet all obligations over a specified time horizon to a defined confidence level.”¹⁴ Thus, all significant, quantifiable risks to which an insurer is exposed (underwriting, investment, credit, operational, and liquidity risk) should be factored into its calculation.

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¹⁰ CEIOPS is the Committee of European Insurance and Occupational Pensions Supervisors. CEIOPS is composed of high-level representatives from the insurance and occupational pensions supervisory authorities of the European Union Member States. For more information on the role CEIOPS has in the Solvency II process, see box at the end of the chapter.

¹¹ CEIOPS (2005), p. 17.

¹² Working definition stated in CEIOPS (2005), p. 70.

¹³ CEIOPS (2005), p. 70.

The Solvency Capital Requirement will be calculated by applying either the standard approach or the insurer’s own internal risk model, which has to be validated and approved by the supervisory authorities. So far no Solvency II standard model has been adopted. The option of using in-house risk models should allow insurers to calculate their solvency capital in a way that reflects their actual risk profiles. In-house models are generally expected to result in a lower Solvency Capital Requirement than the standard model.

The calculation of the Solvency Capital Requirement will be based on modelling of risks and their interdependencies using balance-sheet data which reflect the economic value of the insurer. In this respect, “the intention should be to implement accounting rules which are compatible with the likely outcome of IASB work. In areas where the supervisors’ need for information is not fulfilled by IASB financial statements, adjustment or additions may be necessary. Current accounting rules could be used as a basis […] insofar [as] they are in line with foreseen IASB developments”.¹⁵

To calculate the Solvency Capital Requirement, a risk measure and a confidence level have to be defined. A risk measure is a function that assigns an amount of capital to a distribution of economic profit and loss. Commonly used risk measures are value at risk (VaR) and expected shortfall (ES), also referred to as tail value at risk (TailVaR or TVaR).

The risk measure VaR 1% is defined as the difference between the adverse result that is exceeded in only 1 out of 100 years and the expected result (see Figure 2). Thus, VaR is a threshold which is only breached with the very low probability of 1%. ES 1% is more restrictive – it adds to the value at risk the expected extra loss under the condition that the specified threshold is breached. Hence it also considers the distribution in the tail. Using expected shortfall as a risk measure would shift the focus onto the consequences of a potential default, rather than focussing simply on the probability of insolvency.

“CEIOPS strongly appreciates TailVaR for supervisory purposes and a risk-sensitive measurement”.¹⁶ From a technical and economic point of view, expected shortfall is preferred because it satisfies the properties of a coherent risk measure, whereas VaR does not.¹⁷ However, CEIOPS acknowledges that “depending on the risk characteristics of the portfolio, VaR may be calibrated to deliver approximately the same degree of prudence as the concept of TailVaR”.¹⁸ As a working hypothesis, CEIOPS considers a VaR level of 99.5%, which is equivalent to a 0.5% target default probability, and specifies a time horizon of one year as a general basis for the Solvency Capital Requirement. However, the appropriate risk measure, confidence level and time period are still open, as the final Solvency Capital Requirement framework will only be decided in the months to come.

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¹⁷ Coherent risk measures are a subset of more general risk measures which possess the useful properties: subadditivity, monotonicity, positive homogeneity and translation invariance. For further explanation see Fishburn (1982).
The current proposal on eligible assets envisages that “assets covering technical provisions, the Minimum Capital Requirement and the Solvency Capital Requirement should secure the safety, yield and marketability of the undertaking’s investments”.¹⁹ In this context, regulation should be “based on a combination of overall eligibility criteria, or principles, and/or a list of eligible asset classes”.²⁰ However, “a minority of CEIOPS members support an approach based only on principles.”²¹

Pillar II – qualitative requirements: supervisory review process and risk management

The second pillar will provide principles for the supervisory review process and for insurers’ internal control and risk management. The former encompasses harmonisation of the supervisory review processes at EU level, coordination in times of crisis, rights and duties of the supervisory authorities, principles on transparency and accountability of the supervisory authorities and a peer review process. The latter sets out principles for internal control systems and for sound risk management. Key elements are the control of internal risk models, the use of stress tests, governance processes and fit and proper criteria for the senior management, and quality of risk mitigation (including reinsurance). Furthermore, risks which cannot be quantified in pillar I should be assessed qualitatively in pillar II.

¹⁹ CEIOPS (2005), p. 72.
²⁰ CEIOPS (2005), pp. 72.
The Chief Risk Officer Forum's position on allowance for diversification²²

The Chief Risk Officer (CRO) Forum²³ acknowledges that risk management is a core need for insurers. Solvency II will highlight its importance by encouraging explicit modelling of risks and risk interdependencies and setting up principles for risk management. Risk diversification is a key component of risk management. The lack of diversification is one of the major drivers of insurance default. Therefore, recognition of diversification is crucial when setting up solvency capital requirements. The CRO Forum identifies four levels of diversification benefits:

- within risk types,
- across risk types,
- across entities, within a given geography,
- across entities, across geographies or regulatory jurisdictions.

While diversification within and across risk types is generally accepted by regulators, diversification across entities within a given geography and across geographies is not commonly recognised. This creates barriers to best practice risk management and increases the price of protection for policyholders or in some cases leads to non-insurability. To reward sound risk management practice, the CRO Forum postulates:

- diversification effects must be recognised when risk factors, their dependencies and the company’s exposure to them are identifiable, supported by empirical evidence, scientific research or expert opinion of causal linkages, actively considered in business decision-making, and where capital/risk mobility does not impose barriers to the diversification effects being realisable.
- capital mobility and risk transfer should be recognised if financial resources are available to back policyholders’ and other creditors’ claims with sufficient value and as they fall due.
- capital requirements at the solo entity level should reflect the diversification effects within that entity and the formalised support, where present, provided by transferability of capital between a group and the solo entity, or an external party and the solo entity.
- capital requirements for an insurance group must be assessed separately from those of the solo entities within that group and should reflect the diversification effects specific to that group and the capital implications of both group legal structure and any intra-group agreements.

Pillar III will reinforce market mechanisms and risk-based supervision.

Pillar III – market discipline: disclosure and transparency

The third pillar will build on disclosure and transparency to reinforce market mechanisms and risk-based supervision. The goal is to give policyholders, investors, rating agencies and any other interested parties a comprehensive picture of an insurer’s risks, as this information should have a disciplining effect on corporate management. Disclosure requirements will depend very much on the measures implemented in pillars I and II. So far, no pillar III reporting requirements have been defined, but they will most probably rely strongly on the Basel II approach applied in the banking sector and the accounting work done by IASB.

It has not yet been decided whether or not certain supervisory information will be made public, because publication of a company’s tight solvency position could aggravate the situation of the insurer concerned. On the other hand, this information may be important for (potential) policyholders to make informed choices.

How does the consultation process work? The Lamfalussy approach

Currently, consultation on the detailed design of the Solvency II framework is still going on. The process is divided into four levels:

- **Level 1:** Directives and regulations setting out a framework of overarching principles. The Council of Ministers and the European Parliament adopt the framework legislation under the auspices of the European Commission.
- **Level 2:** Technical measures implementing the principles of the Level 1 directive/regulation. The Commission prepares the detailed technical implementing measures based on the input from CEIOPS and adopts them following consultation with the European Insurance and Occupational Pensions Committee (EIOPC).
- **Level 3:** CEIOPS in consultation with the Consultative Panel — consisting of experts from the industry and consumers — provides consistent guidance on level 2 measures. CEIOPS is composed of high-level representatives from the insurance and occupational pension supervisory authorities of EU member states.
- **Level 4:** The European Commission enforces the effective and consistent application, modification and updating of Community law in EU member states.

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The following chapter describes how Solvency II fits into the context of existing and proposed solvency assessment models in the insurance and banking sector.

Table 1
Overview of solvency models

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<td>CEIOPS proposal</td>
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<td>Enhanced Capital Requirements non-life insurers</td>
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CEIOPS = Committee of European Insurance and Occupational Pensions Supervisors, GDV = German insurance association, CEA = Comité Européen des Assurances, ESA = European Standard Approach, RBC = Risk Based Capital, APRA = Australian supervisory authority, IAA = International Association of Actuaries

Sources: Swiss Federal Office of Private Insurance, Swiss Re Economic Research & Consulting

The models used or proposed are either multi-risk-factor-based or models that comprehensively quantify risks and their interdependencies combined with scenario testing (see Table 1). In the EU, a single-risk-factor-based model (Solvency I) is still applied. Recent years have seen a shift towards more sophisticated solvency models to reflect improvements in modelling capacity and increasing awareness that insurers face a multitude of risks.

Solvency II will most likely fall into the categories “multi-risk-factor-based models” – with respect to the standard model (CEIOPS, GDV and CEA proposal) – and “models which comprehensively quantify risks and their interdependencies” (internal models, CEA proposal). Scenario testing would be applicable to both standard and internal models. Currently, multi-risk-factor-based models are widely used, as they combine risk focus with a simple, standardised calculation method. However, particularly in Europe, there is a clear trend to create incentives for insurers to implement their own internal models for calculating their solvency requirements. In the following, selected solvency regimes are presented and compared with the Solvency II framework.
Basel II and Solvency II compared

Basel II is the entirety of the capital requirements for the banking sector. Solvency II is in many ways similar to Basel II: both projects are based on a three-pillar approach encompassing quantitative and qualitative requirements and market discipline. Sound risk management processes, transparency and efficient regulatory reviews are key. Both will, at least in part, permit internal models for determining the required capital.

However, the different business models of banks and insurers entail also significant differences between Solvency II and Basel II. The objective of Basel II is to reinforce the soundness and stability of the international banking system. In the insurance industry, the main driver of regulation is consumer protection. Solvency II consequently targets all insurers, Basel II is primarily directed at internationally active banks. Whereas Basel II applies separate models for investment, credit and operational risks centring on creditworthiness, Solvency II focuses on risk-based portfolio analysis by applying an integrated approach, taking into account dependencies between risk categories. Furthermore, Basel II assumes a standard level of diversification and concentrates on the asset side, while Solvency II improves recognition of risk diversification and the assessment of capital adequacy by applying economic principles to both assets and liabilities. Solvency II will thus permit statements on the default probability of the entire insurance company, taking into account the economic capital of the company as a whole.

United Kingdom: Enhanced Capital Requirements and Individual Capital Adequacy Standards

In the UK, a risk-oriented insurance supervision system was introduced in January 2005. It requires that "a firm must at all times maintain overall financial resources [...] to ensure that there is no significant risk that its liabilities cannot be met as they fall due".²⁵ Furthermore, it expects insurers to identify and understand the risks within their business, identify an appropriate control environment to manage those risks, and monitor the enforcement of the controls. The regulators use the insurers’ Enhanced Capital Requirement calculation and Individual Capital Assessment to decide on the final level of capital the insurer is required to hold.

Enhanced Capital Requirements

All life insurers are required to hold capital of at least the Solvency I minimum guarantee fund, or the Solvency I required solvency margin plus the resilience capital requirement²⁶, whichever amount is higher. Insurers with technical provisions for with-profit products of £ 500m or more in addition have to apply a “twin peaks” approach. “The ‘twin peak’ approach requires life firms to make a

²⁵ Financial Services Authority (FSA), “Integrated Prudential sourcebook”, (2006), Paragraph 1.2.22R.
²⁶ "The purpose of the resilience capital requirement is to cover adverse deviation from: 1) the value of life insurance liabilities; 2) the value of assets held to cover life insurance liabilities; and 3) the value of assets held to cover the resilience capital requirement; arising from the effects of market risk for equities, real estate and fixed interest securities”. FSA, “Integrated Prudential sourcebook”, (2006), Paragraph 4.2.11G.
‘realistic’ assessment of their with-profits liabilities, to determine whether they need to hold additional capital on top of the mathematical reserves to cover expected discretionary bonus payments”.²⁷ The “twin peaks” approach calls for two calculations:

- mathematical reserves, plus EU Solvency I requirement, plus resilience capital requirement and
- a “realistic” present value of (a) expected future contractual liabilities, plus (b) projected “fair” discretionary bonus payments plus a Risk Capital Margin which is defined by a set of stress tests for investment, credit and persistency risks.²⁸

The difference between the latter and the former is the so-called with-profits insurance capital component which insurers must hold. The sum of the with-profits insurance capital component, required EU solvency margin and resilience capital requirement is called the Enhanced Capital Requirement. Capital in the amount of the Enhanced Capital Requirement has to be held if this exceeds the minimum capital requirements applying to all life insurers.

Non-life insurance: multi-risk approach

Non-life insurers are required to hold capital sufficient to meet the higher of the:

- Minimum Capital Requirement. This corresponds to the capital requirements set out in the European Solvency I non-life Directive; and the
- Enhanced Capital Requirement, which is a more risk-sensitive calculation. It is defined as the sum of an asset- and of an insurance-related capital requirement less the insurer’s equalisation provisions.

Individual Capital Adequacy Standards

In addition to the Enhanced Capital Requirements, both life and non-life insurers are required to self-assess capital requirements for their risk profiles. Guidance on how this is done is outlined in the Individual Capital Adequacy Standards (ICAS)²⁹. Internal models are used for the calculation. The models and their results are subject to review by the FSA, which then advises the insurer of their view of the required capital.

Switzerland: Swiss Solvency Test

In May 2003, the Swiss Federal Office of Private Insurers together with the Swiss insurance industry launched the Swiss Solvency Test (SST) project with the aim of elaborating a risk-oriented supervision framework. The initial conceptual work was completed in December 2003 and further refined up to May 2004. It was followed by field-test runs with Swiss insurers. The Insurance Supervision Act became legally binding as of 2006. By 2008, all insurers must perform the SST calculations. After a transition period of five years the solvency targets have to be met by 1 January 2011.

²⁹ see FSA, “Integrated Prudential sourcebook”, (2006), Paragraph 2.3.
The objectives of the SST are policyholder protection, promotion of a risk culture, strengthening of the market through competition, and capital requirements which reflect risks. The new system is principle-based and in its main points compatible with the anticipated EU Solvency II reform: the SST is based on market-consistently valued assets and liabilities and it likewise relies on a three-pillar structure. There are minimum capital and target capital requirements. The standard model explicitly quantifies risk interdependencies. The risk measure is expected shortfall for a one-year period.

Thus, the SST standard model is set up like an internal model with explicitly quantified risk interdependencies. The standard approach comprises a mix of predefined and company-specific scenarios for investment, credit and underwriting risks. The capital requirements resulting from the solvency calculation and scenario testing are aggregated and determine the target capital. Insurers are encouraged to certify their internal models and to use them in place of the standard model for target capital calculation. The responsibility for target capital calculation lies with the management. All assumptions and calculations have to be documented in the SST report.

United States: Risk Based Capital (RBC) system

In 1994, the US insurance supervisory authorities introduced the Risk Based Capital (RBC) system. It is a rules-based regime, ie the required analyses are exactly defined. Insurers have to hold capital equal to at least their RBC requirement. The RBC calculations include asset risks stemming from stock, bond and real estate holdings, credit risk, underwriting risks (loss reserves and paid claims risks), and risk from affiliates. All these risk categories are considered to be independent of each other, except the asset risk for affiliates, which is treated as fully correlated with the aggregate of the other risks. Total RBC required is therefore less than the sum of its components.

In US Property & Casualty (P&C) insurance, RBC requirements are dominated by underwriting risk, due to the reserve risk stemming from liability and other long-tail business (see category R4 in Figure 3). The second largest risk component is underwriting risk related to business written (category R5). After deduction of the covariance effect, the RBC requirement accounted for 44% of net premiums earned for the overall P&C market in 2003. The risks considered for life insurers differ slightly from their P&C counterparts. The biggest risk in life insurance is the “other asset” risk, stemming from investments in stocks, bonds, mortgages and real estate (category C1). In 2003, overall RBC requirements for life insurers – after correction for covariance effects – were 8% of net technical provisions. Since the RBC rules were gradually introduced, their impact was not felt on a market level. Financial impairments were less frequent after the introduction of the RBC system.

30 The basic formula is: Total RBC = capital for asset risk of affiliates + √(capital for risk category 1)^2 + ... + (capital for risk category n)^2
What are the differences between Solvency II and US RBC?
Solvency II will be a principle-based approach whereas RBC is rules-based. Solvency II will rely on market-consistently valued assets and liabilities, whereas RBC is based on US statutory accounting rules, which do not reflect the market value of assets and liabilities. Furthermore, RBC does not account for possible mismatches between assets and liabilities, whereas Solvency II will do. Contrary to Solvency II, RBC does not explicitly define a maximum default probability level. Its implicit default probability level differs between risk components, for many of them it is 5% over a multi-year period. The so-called RBC “covariance adjustment” assumes independency of most different risk categories – under Solvency II risk interdependencies are expected to be explicitly modelled. In contrast to Solvency II, calculation of required capital is solely based on a multi-risk-factor-based approach in the RBC model, it does not allow internal models and has no scenario tests. RBC also has no explicit equivalent to pillars II and III in Solvency II.

Source: NAIC

RBC and Solvency II in comparison
Both available and required capital will likely increase in response to Solvency II. Solvency II will be based on market-consistently valued assets and liabilities. This will influence the calculation of both the capital required as a safeguard for the company’s risks (required capital) and the capital available for backing the requirements (available capital). Required capital will likely be higher than under Solvency I, because Solvency II will call for capital charges to be assigned to all risks an insurance company is facing. Available capital will also rise, because the value of assets will increase when they are carried at market values, while technical provisions will be lower, as they will be discounted and as implicit safety margins formerly included in technical provisions will be accounted for in the equity capital.³¹

What the SST model calculations show
Currently, it is not clear whether the required or the available capital will undergo the greater increase in relative terms. In the absence of specific rules for calculating the Solvency II capital requirement, the SST standard model is used in the following to illustrate the potential impact of risk-adequate capital requirements on the average insurer under Solvency II. For this reason, the 2004 version of the SST standard model is applied to a sample non-life and a sample life insurer.³³

Non-life insurance
The sample non-life insurer is assumed to write premiums of CHF 1.6bn from motor liability, motor own damage and property insurance. The move from statutory valuation under Solvency I rules to market valuation under the SST would increment total assets from CHF 2500m to CHF 2610m, an increase of 4% (see Table 2). On the liabilities side, technical provisions would shrink by 14% or CHF 270m due to the discounting effect and the release of safety margins. Consequently, equity would rise by 127%, to CHF 680m.

Table 2
Balance sheet of the sample non-life insurer, in CHFm

<table>
<thead>
<tr>
<th></th>
<th>Statutory</th>
<th>Close-to-market</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real estate</td>
<td>302</td>
<td>332</td>
<td>+10%</td>
</tr>
<tr>
<td>Bonds</td>
<td>1 996</td>
<td>2 056</td>
<td>+3%</td>
</tr>
<tr>
<td>Shares</td>
<td>202</td>
<td>222</td>
<td>+10%</td>
</tr>
<tr>
<td>Total</td>
<td>2 500</td>
<td>2 610</td>
<td>+4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Statutory</th>
<th>Close-to-market</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td>300</td>
<td>680</td>
<td>+127%</td>
</tr>
<tr>
<td>Technical provisions</td>
<td>2 000</td>
<td>1 730</td>
<td>–14%</td>
</tr>
<tr>
<td>Other liabilities</td>
<td>200</td>
<td>200</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>2 500</td>
<td>2 610</td>
<td>+4%</td>
</tr>
</tbody>
</table>

Source: Bâloise

³¹ For non-life insurance, this holds true with high probability. In life insurance, technical provisions may also increase, if the discount rate applied under Solvency II is lower than the rate used before and if more realistic mortality assumptions are applied to annuity business.

³² The 2004 version of the SST is stricter than the 2005 version, which allows expected underwriting and investment results to be deducted from the required capital.

³³ Examples by courtesy of Bâloise (non-life insurance company, presented at the Euroforum conference, held 19–20 April 2005 in Zurich) and Swiss Life (life insurance company).
How do capital requirements change?
The SST standard model calculation results in a solvency capital requirement of 32% of written premiums (see Figure 4). This is split almost evenly between underwriting risk (17% of premiums) and investment, scenario, credit and run-off risks (15%). The SST capital charge for the underwriting risk is nearly the same as required by the current Solvency I premium index (18% for the first EUR 50m of premiums, 16% thereafter). The available capital increases from 26% to 43% of premiums or CHF 680m. The increase in required capital outweighs the improvement in available capital. Consequently, the sample insurer’s capital adequacy ratio (available capital divided by required capital) decreases from 160% under Solvency I to 134% in the SST environment.

<table>
<thead>
<tr>
<th>Requirement Type</th>
<th>% of Premiums</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural catastrophe pool</td>
<td></td>
</tr>
<tr>
<td>Motor hail cumulation</td>
<td></td>
</tr>
<tr>
<td>Single big losses</td>
<td></td>
</tr>
<tr>
<td>Normal (small) losses</td>
<td></td>
</tr>
<tr>
<td>Reserve changes previous years</td>
<td></td>
</tr>
<tr>
<td>Discounting</td>
<td></td>
</tr>
<tr>
<td>Diversification effects</td>
<td></td>
</tr>
<tr>
<td>Underwriting risks</td>
<td></td>
</tr>
<tr>
<td>Investment risks</td>
<td></td>
</tr>
<tr>
<td>Contribution scenarios [1]</td>
<td></td>
</tr>
<tr>
<td>Credit risks</td>
<td></td>
</tr>
<tr>
<td>Risk margin (run-off)</td>
<td></td>
</tr>
<tr>
<td>Diversification effects</td>
<td></td>
</tr>
<tr>
<td>Required capital</td>
<td></td>
</tr>
<tr>
<td>Available capital</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4
SST solvency capital requirements for sample non-life insurer

[1] Scenarios: nine historical financial scenarios (reflecting changes in share price, interest rate, exchange rate), under-reserving, bus accident, stadium accident, hail, dam liability, industrial catastrophe, pandemic, financial distress, reinsurers’ default, terrorism.
The assumed shortfall probability is 1%.

Sources: Bâloise, Swiss Re Economic Research & Consulting

Appendix I provides the detailed figures used for the calculation.
The findings for the sample life insurer point to a more pronounced deterioration of the capital adequacy ratio than for the sample non-life insurer. Table 3 shows the balance sheet of the sample life insurer. Like in the non-life example, market valuation increases the value of total assets and reduces the value of technical provisions. Under the SST, equity is valued at three times the statutory valuation. The percentage changes in the sample life insurer’s assets are not the same as for the sample non-life insurer, because assets were purchased at different points in time.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Statutory</th>
<th>Close-to-market</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real estate</td>
<td>101</td>
<td>121</td>
<td>+20%</td>
</tr>
<tr>
<td>Bonds</td>
<td>645</td>
<td>661</td>
<td>+2%</td>
</tr>
<tr>
<td>Shares</td>
<td>103</td>
<td>106</td>
<td>+3%</td>
</tr>
<tr>
<td>Other assets</td>
<td>151</td>
<td>154</td>
<td>+2%</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1042</td>
<td>+4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Statutory</th>
<th>Close-to-market</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td>39</td>
<td>120</td>
<td>+208%</td>
</tr>
<tr>
<td>Technical provisions</td>
<td>911</td>
<td>879</td>
<td>-4%</td>
</tr>
<tr>
<td>Other liabilities</td>
<td>50</td>
<td>43</td>
<td>-14%</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1042</td>
<td>+4%</td>
</tr>
</tbody>
</table>

Source: Swiss Life

The insurance portfolio is worth CHF 102m in premiums. It consists of 35% individual business (3% mortality premiums, 22% endowment, 10% annuity) and 65% group business (2% mortality premiums, 62% endowment with defined contribution and 1% annuity with defined benefit). The capital required to back the expected shortfall from underwriting activities would account for 2.9% of technical provisions. It would be loaded by another 7.9% for the additional investment, scenario, credit and run-off risks (see Figure 5 and Appendix I). Total required capital would amount to CHF 98m or 11% of technical provisions. This is almost three times the capital requirement under Solvency I. Available capital, however, would increase by only 2.1 times to CHF 120m. Correspondingly, the sample insurer’s capital adequacy ratio of 122% under the SST would be lower than under Solvency I (152%).
Conclusion from the sample calculations

The model calculations for both life and non-life insurer show that the application of the SST standard model leads to a reduction in the capital adequacy ratio compared to Solvency I. This may also hold true for the industry as a whole, as found in the SST 2005 test run: the majority of companies had a lower capital adequacy ratio under SST than under Solvency I (see Figure 6). The main reason for this is that the SST takes into account the overall risk environment of an insurance company and not just underwriting risk proxies as Solvency I does. Therefore, not surprisingly, the SST results have shown that no inferences can be drawn from the statutory Solvency I results as to the economic and the risk situation of an insurer.

The Solvency II standard model may be designed according to similar principles as the SST. In that case, the insurance industry’s capital adequacy ratio under the Solvency II standard model will most likely be lower than under Solvency I. The case is less clear-cut for insurers using internal models.

Sources: Swiss Life, Swiss Re Economic Research & Consulting
In general, the impact of a risk-based solvency system on the entire insurance industry’s solvency position should not be too pronounced. At least available figures indicate that even today insurers hold more capital than required by Solvency I.³⁵ For some insurers, however, the new solvency regime may have a major impact on the capital they need to hold. Especially the investment risk, peak risks, insufficient diversification, reserving, disability and surrender risks may put pressure on capital requirements. Insurers with a high exposure to these risks may be confronted with higher capital requirements, while insurers with a conservative investment strategy and a less exposed product structure may need less capital.

³⁵ This view is also confirmed by FitchRatings: “Fitch does not expect to make many ratings adjustments as a direct result of the new Solvency [II] regime. This is because many rated insurers already hold capital in excess of their current Solvency I regulatory requirements.” FitchRatings, “Solvency II – What is Happening?”, (2005), p. 1.
Even though the overall industry’s solvency position may not change significantly under Solvency II, the adoption of an integrated risk approach is a fundamental change compared to the current Solvency I regime. The question therefore arises as to what the impact on insurers’ products, investments and the market structure will be. This chapter addresses the following five major questions confronting the European insurance market in the context of Solvency II:

1. Will explicit accounting for the different underwriting risks influence insurance prices and product design?
2. Will taking investment risk into consideration influence investment return and insurance prices?
3. How will Solvency II affect risk transfer tools?
4. Will there be an impact on reserving?
5. Is the corporate landscape going to change?

“Take the messages with a grain of salt”

The subsequent discussion of the questions above is hypothetical in nature. Therefore it is important to bear in mind the following:

- the detailed specifications of Solvency II – including eg the design of the standard model – are still under discussion. This uncertainty makes it difficult to quantify the expected changes. Experience with other risk-based solvency regimes, mainly the Swiss Solvency Test (SST), has been drawn upon to substantiate the argumentation.
- both Solvency I and Solvency II represent only minimum solvency standards. EU members have the right to impose stricter requirements. Also, insurers usually have a stronger capital backing in practice (even though some insurers may only have followed Solvency I principles). Comparing minimum standards can give only partial answers to the question of how solvency requirements will impact insurers. Furthermore, the comparison of Solvency II with Solvency I is biased, as the latter was not based on economic principles.
- most of the expected changes will take place gradually, starting before the introduction of Solvency II. Field tests of the new solvency calculation will make insurers aware of their deficiencies and will prompt them to implement the necessary changes in the run-up to Solvency II.
1. Will explicit accounting for the different underwriting risks influence insurance prices and product design?

While Solvency I does not adequately take into account the different underwriting risks, Solvency II does. This will make transparent which products or product features are relevant for an insurer’s solvency position and which are not.³⁶ From an underwriting perspective, products with the following features may need to be backed with more capital:
- products with a high volatility of claims
- long-term products and products with guarantees and options exposed to changes in underwriting risks.

**Products with a high volatility of claims**
Solvency II will require adequate capital backing for the volatility of claims. To assess which lines of business may exhibit above-average volatility, the loss ratios of five non-life lines of business (property, liability, motor, accident, other) in four insurance markets – France, Germany, Italy, and the United Kingdom – were used to calculate the expected shortfall in individual lines of business.³⁷ Figure 7 shows that the capital required to provide for unexpected claims fluctuations ranges from 116% of motor claims in France to 197% in UK property. The expected shortfall of claims exceeds the overall non-life average in the German property and accident, the French property and liability, the UK property, and the Italian property and accident insurance lines. The residual line “other” is also above average in all countries.³⁸ Due to the higher volatility, these lines are expected to be subject to higher capital charges under Solvency II. On the other hand, motor and liability insurance can be expected to need less solvency capital due to their below-average volatility. This analysis shows that particularly catastrophe-prone lines such as property may face extra capital charges. Higher capital charges may lead to price increases or adjustments in the product design. Whether such adjustments will take place, however, cannot be concluded, as insurers may already hold more capital for these lines. Furthermore, the calculation is distorted by
- the time lag between premiums and claims payments in long-tail business, which makes it possible to smooth the loss ratio. Especially in liability insurance, the low volatility of the loss ratio underestimates the actual risk.
- catastrophic events which occurred more often in the sample period than could be assumed from their expected return period. This overstates the risk exposure mainly in property insurance.
- the isolated line-of-business view: Riskier lines may help to diversify the portfolio and hence to lower the overall exposure.

³⁶ The analyses in this section are based on the assumption that, on average, industry capital adequacy ratios are sufficient under Solvency II. Therefore, only the relative divergence between the different lines and product features within the non-life and life sectors is investigated.
³⁷ For the detailed calculation refer to Appendix II: Historical expected shortfall of European non-life business lines.
³⁸ The line “other” includes inter alia credit, aviation and marine.
The expected shortfall of the entire non-life portfolio in any country is lower than the mean of the shortfalls of the individual lines of business, because holding a diversified portfolio reduces the overall risk. This diversification effect ranges from 11% of average non-life claims in Germany and Italy to 14% in the United Kingdom.³⁹

The vertical line is the mean of the expected shortfalls of the five lines of the respective market without taking diversification benefits into account. Calculation was based on direct loss ratios, except for the UK where net loss ratios were used. Average claims: 7 years for property, 3 years for the other lines of business.

Sources: Supervisory authorities, Swiss Re

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Long-term products and products with guarantee and option features exposed to changes in underwriting risks

While in non-life insurance the volatility of expected losses accounts for a major part of the underwriting risk, capital charges to assure guarantees and options over the policy term define a major risk factor in life insurance.⁴⁰ This is because life products often provide cover for a long time span; for example, longevity products can easily run for 30 years or more. Health and disability contracts are often also concluded for long periods.

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³⁹ It should be noted that this diversification effect was derived exclusively from the low historical volatility of total non-life losses.

⁴⁰ Often guarantees and options hold both underwriting and investment risks. In this section only underwriting risks are analysed. Risks arising out of investment are discussed in the subsequent section.
Insured risk characteristics may change unexpectedly over the policy term. For example, unexpected improvements in life expectancy may require insurers to pay annuities for a longer time period than expected using the mortality tables valid at conclusion of the contract. Insurers can adapt new policies sold to the new insights, but the vast majority of in-force business will have to be fulfilled based on old and possibly outdated underwriting risk assumptions. Adverse changes in the underwriting risk may therefore pose a risk to an insurer’s solvency. Under Solvency II, capital has to be held for unexpected changes in underwriting risk characteristics. Longer-term products have a higher likelihood of such changes happening. Therefore, long-term products with underwriting guarantees may become more expensive or their product features may be changed if this risk was not priced into the original premium.

Options may also harbour underwriting risks. Product features such as options to increase death benefits or to waive premiums require assumptions to be made on how they will be exercised. If a higher portion of policyholders than expected takes advantage of an option, the portfolio mix may change adversely, eg in the case of cancellation rights: “good” risks may tend to exercise this option more than the average. Also, for example, the option to increase death benefits without medical examination, eg upon marriage, may be particularly attractive to “bad” risks. Often, traditional actuarial practices have not extended to assessing and putting a value on such product features. Solvency II will require market-consistent valuation of and an explicit capital charge to be made for risks emanating from options. This is contrary to Solvency I requirements, which do not factor these risks into capital calculation. Products with options containing a significant underwriting risk can thus be expected to become more expensive under Solvency II than under Solvency I. Also, the design of option may change. As mentioned earlier, whether prices or design will actually be adjusted depends very much on how these options have been allowed for in current pricing.

How can insurers remove capital-intensive elements from their products?
In the case of in-force business, insurers can offer their policyholders incentives to convert their existing policies into contracts which better reflect the new risk environment. Or they may decide to close the relevant portfolio for new business (run-off) or to sell it. Going forward, besides adjusting prices for new business to reflect the costliness of a risk, insurers can also modify the product design to eliminate capital-intensive elements. The following measures may be considered:
- review profit sharing arrangements and the need for options and long-term guarantees;
- introduce loss participation schemes in which the policyholder also bears part of the loss;
introduce terms and conditions which allow for adjustment; for example, indexation of premiums to inflation or regular review of the annuity conversion rate;

- mitigate risks by offering combined risk products, by extending the risk base to benefit from better diversification, by hedging risks, by passing them on to the reinsurers, or by using securitisation.

Risk-adequate capitalisation of underwriting risks under Solvency II is likely to lead to fewer guarantees and options being offered and to a greater variety of risk sharing with the policyholder.

2. Will taking investment risk into consideration influence investment return and insurance prices?

The potentially greatest and most obvious impact of Solvency II will come from the introduction of a capital requirement for investment risks. Solvency I deals with investment risk only in the form of rules for the investment of asset-backing technical provisions. Capital charges for investment risks may encourage insurers to take less investment risks than under Solvency I, ie they may reduce the share of stocks and real estate in their portfolio and increase the proportion of high-rated bonds in order to reduce capital requirements. This would lower investment results. Also, if insurers did not change their investment strategy, the additional capital charges imposed by Solvency II would reduce the overall profit. Investment risks are particularly important in long-term lines of business, such as in life or liability insurance. In practice, the potential change in prices or product design will depend on the extent to which insurers have already incorporated investment risks.

Life insurance products with long duration and investment guarantees may become more expensive

European life insurers often guarantee interest rates on endowment policies or conversion rates on annuity policies. Such policies can easily run for 30 years or more. During this time, financial market conditions can change substantially. In Germany for example, bond yields dropped to almost 3% in 2005, from around 8% in the early 1990s (see Figure 8). Guaranteed interest rates of new policies have been adapted to the decline in bond yields. However, insurers still have interest-rate guarantees of above 3% in their portfolios from business written in past years. Today, insurers are finding it difficult to earn the investment income necessary to pay for such guarantees. Most insurers failed to hedge the guarantees they had granted, because they did not expect interest rates to drop so low and because long-term hedges were expensive and not readily available.
In a risk-based solvency framework, allowance has to be made for the impact of assets having a shorter term than liabilities. Therefore, insurers will have to hold capital for the risk of unexpected financial market developments impairing their ability to meet their guarantee and option promises over the entire policy term, which cannot be hedged otherwise.

The solvency capital required for unhedged investment risks as well as potential hedges — eg interest rate options such as floors or swaptions — may be quite expensive.⁴¹ As a consequence, premiums for products with guarantees and options may increase compared to the situation under Solvency I, where such features are not included in the solvency margin calculation. Again, insurers might offer their policyholders incentives to convert their existing contracts, or they may close the portfolio or sell it. In new products, insurers may either charge a higher price for these features or they may change the product design eg by offering more products in which the policyholder bears the investment risk, for example unit-linked products, or by introducing terms and conditions allowing for adjustment over the policy term.

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⁴¹ Swaptions can cost 0.5%–1% of the investment amount swapped. Solvency capital requirements may be in the same range.
Less pronounced cycles in non-life insurance

Non-life insurance exhibits price and result cycles emanating from changes in claims incurred and price changes in financial markets: lower interest rates reduce the discount effect of long-tail losses, and lower stock market prices curtail investment results as well as available risk capital. Figure 9 compares underwriting, investment and overall results for the big four European non-life insurance markets France, Germany, Italy and the UK. Until 2000, insurers could afford to post negative underwriting results because investment returns were high. Regulation did not punish such behaviour, because the solvency capital calculation did not explicitly take the investment-risk exposure into account. With the stock market meltdown as of 2000, investment results dipped and premiums had to be raised to improve underwriting results and to shore up overall profitability.

Sources: Supervisory authorities

Solvency II will punish “cash-flow underwriting”.

Such cycles, resulting from changes in the financial markets, are expected to be dampened because Solvency II will explicitly account for investment risk in the required capital. Applying the expected shortfall calculation to the above markets shows that the capital requirement for investment risk can be considerable: In 2000, insurers in the top four European non-life insurance markets had almost 40% of their portfolio invested in stocks. To cover for expected shortfall, this would have required extra solvency capital amounting to almost half of the value of their stock-market investments, corresponding to an additional risk capital charge of 1.4% of total investments.⁴²

⁴² Assumptions for calculation of the expected shortfall: stock market price changes are normally distributed, yearly standard deviation of stock market returns is 17%, shortfall probability is 1%, cost of capital rate is 8%. Investment risk for holding other risky assets and default risks are disregarded.
3. How will Solvency II affect risk transfer tools?

Solvency II is expected to treat all risk-mitigating instruments such as reinsurance, hedging and securitisation, in a consistent manner. For these to be accepted as risk-mitigation tools, Solvency II requires that the insurer quantifies their actual contribution to risk reduction. Part of this proof will be delivered by the suppliers of these solutions, eg reinsurers, banks and other financial intermediaries. However, ultimate responsibility lies with the insurer itself. Solvency II is likely to accept a wider spectrum of risk-hedging and risk-transfer instruments than Solvency I, which permits only a uniform capital reduction for the use of reinsurance. The new options will give insurers an incentive to optimise their risk-transfer tools and may consequently intensify competition among providers of the various solutions.

Reinsurance provides capital for underwriting risks and new business

Reinsurance is primarily a means of reducing an insurer’s underwriting risk, allowing it to expand the scope of its business. The cost of transferring risk to a reinsurer is lower than the solvency capital cost the insurer would bear if it retained the risk in its portfolio, because reinsurers benefit from a better risk diversification than the primary insurer. The risk mitigation effect and the cost saving can be illustrated for the property business of the six insurance markets UK, Germany, France, Italy, the US and Japan. However, it must be borne in mind that this analysis on a market level underestimates the potential savings achievable through reinsurance, as individual insurers likely experience a higher volatility in their portfolios than the overall market.

The comparison assumes that reinsurers absorb all expected catastrophe losses via catastrophe excess of loss (Cat XL) reinsurance contracts. Lower and upper limits (attachment and exit points) of the Cat XL contracts were set at market-practice levels.⁴³

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⁴³ The covers for atmospheric perils (windstorms, hail) are designed for events occurring every 5–10 years (attachment point) up to 50–100 years (exit point), the covers for earthquakes are for return periods from 15–30 years up to 150–300 years.
Premiums Expected shortfall [1] Reduction in direct direct net expected shortfall
direct figures USDbn USDbn % of direct

UK [2] 22.8 20.9 7.8 –63%
Germany 14.2 5.7 3.0 –47%
France 14.9 15.5 7.3 –53%
Italy 5.4 3.9 1.3 –67%
USA 72.7 98.8 69.0 –30%
Japan 10.5 24.8 17.1 –31%
Total 140.5 169.7 105.5 –38%

% of direct

Capital savings of direct insurers –64.1 –38%
Reinsurers’ capital required [1] 30.3 18%
Net capital savings of all re/insurers –33.8 –20%

Expected shortfalls are calculated on the basis of Swiss Re’s market-wide loss-frequency curves.
For a description of the methodology see Swiss Re, “Natural catastrophes and reinsurance”, 2003.

Source: Swiss Re

The sample Cat XL contracts would have reduced the required capital in the entire insurance industry by at least 20%.

The Cat XL contracts would have reduced the loss-ratio volatility of direct insurers’ net portfolios and thereby lowered their capital requirements. Table 4 shows that the expected shortfall at the 1% default probability level would have decreased by 38% from USD 169.7bn to USD 105.5bn in all six countries together. In contrast, reinsurers would have needed only capital (the expected shortfall from the assumed Cat XL contracts) in the amount of USD 30.3bn. The insurance industry as a whole would thus have saved USD 33.8bn in capital, 20% of the amount required without any reinsurance.⁴⁴ This saving represents the economic value added by reinsurers. Diversification across countries enlarges the risk basis, reduces capital requirements and, consequently, leads to lower insurance premiums. The savings are shared among the reinsurers, direct insurers and policyholders.

Solvency II may recognise reinsurance in terms of the risk reduction it entails for the buyer. The impact of Solvency II on reinsurance-buying behaviour is difficult to predict. Non-proportional reinsurance might become more important particularly for well-capitalised insurance companies, as it reduces expected shortfall for less premiums ceded than does proportional reinsurance. For weaker-capitalised companies, proportional cessions may increase as insurers attempt to benefit from the reinsurers’ better diversification base and stronger capital standing. To sum up, the trend is for reinsurance to be bought more on the basis of economic risk/return considerations. However, this prediction is based on the assumption that solvency calculation makes adequate allowance for reinsurance.

⁴⁴ In practice the saving would be even higher, as reinsurers hold more contracts than just the six sample Cat XLs, a fact which further reduces their portfolios’ volatility and capital requirements. A minor part of the capital saving will be eaten up by the capital required under Solvency II to cover the credit risk that reinsurers pose.
Hedging can eliminate many investment risks

Solvency II will introduce capital charges for investment risks. Insurers could almost entirely avoid investment risks by investing in the “replicating” portfolio. A replicating portfolio is the bundle of financial market investments which in theory perfectly match the expected claims payment cash flows in terms of size and maturity. For simple claims cash flows, it consists of a number of zero-coupon government bonds with different face values and maturities. If an insurance company’s investments were just the replicating portfolio, its profit and loss account items and its capital would not be affected by changes in interest rates: any change in interest rates would instantaneously alter the value of the replicating portfolio by the same amount as the present value of the claims payment liabilities. The fact that actual claims payments usually differ from the expected ones will be considered in the capital charge for underwriting risks under Solvency II. The replicating portfolio approach suffers from financial markets not providing enough government bonds to hedge all insurers’ liabilities, both in terms of duration and market liquidity. Insurers therefore need substitutes (for instance corporate bonds), which besides benefits like higher coupons, come along with a higher credit risk, increased volatility or other disadvantages.

Minimising investment risks might become the preferred option for an insurance company, because, in general, differences in investment strategy were found to have a neutral effect on the economic value of an insurer: a high price-to-book ratio was instead achieved by a “combination of high underwriting profit margins, premium growth and scale of operations.”

Investment risk is especially important for life insurers, because a replicating portfolio is not always available to match the long duration of many life policies. Whereas an almost perfect hedge against the investment risk of single-premium life policies is to invest the risk-premium part in a bond with the same maturity as the life policy, the hedge for policies with annual premium calls for either a strategy based on forward contracts which do not exist for long maturities or a rolling investment strategy that goes hand in hand with reinvestment risks. One tool for hedging the reinvestment risk of eg fixed-annual-premium endowment policies with guaranteed sum insured would be a series of options on swaps (swaptions). The problem is that the swaptions market for longer maturities is not very liquid and that there is some counterparty credit risk involved. In addition, swaptions are expensive: they can easily eat up 0.5% to 1% of the investment amount to be swapped.

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45 Where claims payments do not depend on interest rates or other financial market variables.
46 For further information see Swiss Re, “The economics of insurance – how insurers create value for shareholders”, (2001).
48 The hedge would not be perfect because possible policy lapses would require payment before maturity.
49 At the start of the policies, the insurance company would buy a series of swaptions, one for each expected premium inflow date. The notional amount is the corresponding premium flow. Each option lasts from the start of the policies until the date of the premium flow. The swaption gives the right to enter a swap which pays the fixed guaranteed interest rate and accepts the variable interest rates which can be achieved by investing the premiums in the underlying short-term papers such as LIBOR or EURIBOR. If interest rates fall, the insurance company exercises the swaptions and enters the swap agreements to get the fixed-interest income. If interest rates rise, the swaptions become worthless – the purchase cost of the swaptions is lost – and the insurance company earns the higher investment income.
There are also other – albeit imperfect – hedges available against underwriting risks, such as buying stocks of pharmaceutical corporations against longevity risks, selling short cat bonds or buying construction or oil industry stocks against natural catastrophes (e.g., in the Gulf of Mexico). Prices of these stocks are expected to go up and cat bond prices to fall in the wake of the hedged event. But such hedges can fail: the pharmaceutical industry may not benefit from longevity (if the additional years of life do not go hand in hand with increased pharmaceutical sales), the cat bond may be not triggered, or there may be no reconstruction demand surge nor oil price hike after the natural catastrophe. Furthermore, the cat bond market is not big and liquid enough yet to allow such hedges on a large scale.

Hedging – as well as capital charges for investment risks – will reduce investment returns offered by life insurance policies in addition to the risk-free yield. This may make life insurance less attractive as an investment tool, because policyholders can achieve the same investment return without buying insurance. As a consequence, the focus in life insurance may shift from investment-type to risk-transfer-oriented life policies. Policies where the investment risk is borne by the policyholder may also gain in importance. Both aspects may lead to the emergence of new products.

Securitisation permits transfer and financing of peak risk

Insurance-linked securities (ILS) were launched in the mid-1990s with the first cat bonds transferring natural catastrophe risks to the capital markets. Risks include windstorms and earthquakes, mainly in the US, Europe and Japan. More recently, ILS have also been issued to cover extreme mortality risk and industrial accidents. The basic structure is as follows: investors pay in capital, which is held in a bankruptcy-remote Special Purpose Vehicle (SPV). The SPV invests in government bonds. As long as there is no catastrophe to trigger the bond, investors receive interest plus a risk premium. If the bond is not triggered before maturity, the capital is returned to investors. If, however, a major catastrophe triggers the bond, interest and capital are used to pay insurance claims, resulting in a loss to investors.

Cat bonds are increasingly based on parametric triggers, such as wind speeds or earthquake magnitudes, measured at different locations and weighted according to the size of the insurance portfolio at these locations. From 1997 to 2005, more than USD 10bn of cat bonds were issued. The outstanding notional amount of USD 5.6bn in March 2006 is equivalent to about 5% of the global property cat reinsurance capacity. The risk-premium equivalent of cat bonds is treated like reinsurance premiums and thus reduces insurers’ solvency capital burden. ILS generally insure against high-severity, low-frequency events. Thus, to date, only one cat bond is thought to have been triggered.

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50 See also Swiss Re, “Natural catastrophes and reinsurance”, (2003).
51 When parametric triggers are used, the allowance is reduced to reflect “basis risk”, i.e., the mismatch between payments made based on the trigger and a company’s actual losses.
52 KAMP Re 2005 Ltd. is currently trading at a steep discount in the secondary market, a reflection of investors’ belief that Katrina has triggered a loss in the bond. Since this bond has an indemnity trigger, it will take some time to determine whether a triggering event has actually occurred.
Since 1997 an additional amount of USD 12bn of life ILS has been issued to finance in-force or new life business. About half of the volume issued is in the form of embedded-value bonds. These ILS promise investors the cash flows from a defined insurance portfolio, thus converting expected future income from in-force policies into capital.

4. Will there be an impact on reserving?

Technical provisions are the biggest liability item on an insurer’s balance sheet. Under Solvency II the reserving risk, ie the risk that technical provisions will not be sufficient, has to be backed up with capital. To date, technical provisions have not been part of non-life solvency requirements. In life insurance, they are taken into account by aligning the capital requirement to the mathematical reserves and capital at risk. The need to factor reserves into the solvency calculation according to their risk makes it necessary to estimate the expected value and volatility of future insurance payments. The method for determining the expected value under Solvency II has not yet been decided. There are still many open questions such as:

- how to treat embedded options, guarantees and policyholders’ surrender options?
- how should policyholders’ and management’s expected behaviour be accounted for in participating policies?
- should a prudent safety margin be included – if so, how much should it be?

What the SST field test showed

In the SST, all liabilities and assets are determined in a market-consistent fashion. Technical provisions are accounted as discounted best estimates plus a risk margin. Best-estimate provisions are the expected value of liabilities, taking into account all information from financial markets and underwriting. The risk margin is the cost of capital needed to cover risks during the whole portfolio run-off. It is the additional amount required by a willing buyer in an arms-length transaction to assume the liabilities.

The SST field test 2005 showed that market-consistent technical provisions were in the range of 70%–100% of statutory reserves for a majority of participants (see Figure 10). Market-consistent valuation of technical provisions thus revealed substantial amounts of hidden reserves, particularly among non-life insurers. These reserves are considered to be equity capital in the economic approach.
Market-consistent valuation of reserves will enhance the transparency of reserving and therefore facilitate understanding of the reserve risks. This will encourage more adequate reserving on the one hand, and possibly reduce cyclicality in technical provisions on the other. However, it may also have an impact on products with a potentially high volatility of technical provisions and a high run-off margin, e.g., most liability products. These products may increase in price or have to be redesigned.

### 5. Is the corporate landscape going to change?

The Solvency II requirement to introduce an enterprise-wide risk-oriented framework and the associated focus on product design and risk transfer strategies are also likely to have an influence on the insurance market structure. It might increase pressure on insurers to concentrate on their core competencies. As a result, the insurers’ value chain may break apart, and some companies whose profitability is inadequate for the size and complexity of their portfolio may disappear.

Currently, most insurers have an integrated business model, i.e., product design, distribution, claims handling, asset and capital management are all handled within the same company (see Figure 11).
The cost transparency ensuing from Solvency II is likely to induce insurers to review their overall cost structures with a view to improving overall efficiency. As a consequence, some insurers may decide to outsource or offshore their back office, capital and asset management, and possibly claims settlement to specialists. Solvency II would thus reinforce the outsourcing and offshoring trends observed in recent years.

One of the objectives of Solvency II is for insurers to have an enterprise-wide risk management organisation in place. This is likely to require adaptation of organisational structures and processes; on the other hand, it calls for a data base which represents the economic value of assets and liabilities and makes it possible to calculate the size of risks and their interdependencies. Furthermore, IT systems are needed to run the capital requirement calculation and the designated scenarios. Setting up and maintaining the models is another field which might demand considerable resources under Solvency II. The SST field test has shown that the cost tends to increase with augmenting complexity of the portfolio; however, the circumstance that the standard approach implemented is based on an internal model was not reported to lead to undue intricacy.

As a consequence of the data, IT and risk management expertise required in a Solvency II framework, insurers could decide to focus more on their core competencies and no longer pursue an integrated business model. The decision appears to centre around whether to be a product provider or to focus on distribution. It could make sense for an insurer with strong risk management skills but a weak distribution network to focus on product design and risk transfer and to withdraw from distributing policies. For an insurer with a strong selling network it could pay off to specialise on distributing policies, while leaving product design and risk transfer to other insurers or reinsurers. A company of this type would then come to resemble an insurance broker. Solvency II can be expected to foster new commission schemes, the use of alternative distribution channels such as the internet or direct marketing, the emergence of specialised distribution companies that sell brand and white-labelled products and of a market for run-off business and securitisation.
Internationally operating insurers will also have to review their group structure to optimally balance the number of subsidiaries and branches, since Solvency II will require solvency calculation at entity level. A company with a large network of subsidiaries may need to dedicate considerable resources to performing the calculation and reporting. Furthermore, if diversification across entities is not permitted and full capital mobility is not possible, capital requirements may be distorted upwards for companies with an extensive network of subsidiaries. The associated cost may lead to subsidiaries being transformed into branch offices and thus to a more concentrated corporate organisation.

Small insurers will have to cope with the fact that certain costs associated with Solvency II are not fully scalable. However, a less complex investment portfolio, a relatively simple product structure and regional concentration with a branch structure may reduce the cost of solvency calculation.

Generally, Solvency II will be a particular challenge for insurers which in the past have done business without adequately taking into account the underlying characteristics of their risks. This may be the case particularly in life insurance, where traditional actuarial practices have often not extended to assessing and putting a value on product guarantee and option features. Solvency II will reinforce insurers’ focus on risk/return fundamentals, which means achieving high underwriting profit margins, posting premium growth and optimal scales of operation. Companies which fail to generate economic value will become candidates for takeover. Even though consolidation may pick up, it should be noted that Solvency II will only be a catalyst, accelerating already ongoing trends.

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53 See Swiss Re sigma No 3/2005, “Insurers’ cost of capital and economic value creation”.
Benefits of Solvency II

Solvency II will foster a holistic and forward-looking appreciation of risk within the European insurance community and will enhance the functioning of market forces by increasing transparency and disclosure. Overall, Solvency II will lead to a more transparent, professional and thus more secure insurance market.

Solvency II will allow the unambiguous identification of the risks an insurer is facing, as the risk associated with each line of non-life and life business, major catastrophes, investment and credit positions can be named and quantified. In addition, the capital-saving effect of diversification and risk transfer will also be measurable. All this information enables the management of an insurance company to keep control over its overall risk exposure while steering its underwriting, investment and risk-transfer processes. Solvency II therefore eliminates false incentives to take risks (for instance investment risks, credit risks, catastrophe-prone underwriting risks) which were not charged for heavily enough by Solvency I. Consequently, the major benefit of Solvency II for the insurance industry is its enforcement of risk-adequate pricing of insurance products. Solvency II may therefore also foster product innovation that brings together customised products with manageable risk features. Hence, Solvency II will reinforce insurers’ focus on economic value creation, which is inevitably linked to strong risk management.

Challenges of Solvency II

Solvency II will on the other hand also require insurers to compile the various information needed for calculating risk-adequate solvency requirements, and to update this information continuously in line with the changing risk environment. This will cause expense and call for continuous learning and strict enforcement of a risk/return focus within the insurance company.

But learning is not only a matter for insurers, it is also crucial for the supervisory authorities. Failure to ensure a harmonised regulatory framework based on economic principles may shift relative prices and thus create false incentives. This may be the case especially if prudence margins are added to economic values. One example might be adding a risk margin which is set at an arbitrary confidence level to best estimates of reserves. Also, systemic risks may emerge if incentives for insurers to implement their own internal risk models are not strong enough and the standard model fails to properly allow for risks and their interdependencies.

Prerequisites for Solvency II becoming a success story

So, for Solvency II to meet the objective of a healthy insurance sector, it is important that the framework consistently reflects economic principles, recognises diversification, allows internal models, gives appropriate credit for reinsurance and other risk mitigation techniques, and puts trust in market mechanisms by relying on increased transparency. Only then can it avoid making the cost of regulation outweigh its potential benefits.
### Appendix I: Sample insurers according to Swiss Solvency Test 2004

#### Expected shortfall of sample non-life insurer

<table>
<thead>
<tr>
<th>Risks</th>
<th>CHFm</th>
<th>% of premiums</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural catastrophe pool</td>
<td>147</td>
<td>9%</td>
</tr>
<tr>
<td>Motor diversification effect</td>
<td>154</td>
<td>10%</td>
</tr>
<tr>
<td>Total catastrophes</td>
<td>185</td>
<td>12%</td>
</tr>
<tr>
<td>Large single losses</td>
<td>243</td>
<td>15%</td>
</tr>
<tr>
<td>Normal (small) losses</td>
<td>73</td>
<td>5%</td>
</tr>
<tr>
<td>Diversification effect</td>
<td>−227</td>
<td>−14%</td>
</tr>
<tr>
<td>Total current year</td>
<td>274</td>
<td>17%</td>
</tr>
<tr>
<td>Reserve changes from previous years</td>
<td>144</td>
<td>9%</td>
</tr>
<tr>
<td>Diversification effect</td>
<td>−123</td>
<td>−8%</td>
</tr>
<tr>
<td>Discounting</td>
<td>−22</td>
<td>−1%</td>
</tr>
<tr>
<td>Expected shortfall UW</td>
<td>273</td>
<td>17%</td>
</tr>
<tr>
<td>Investment risks</td>
<td>215</td>
<td>13%</td>
</tr>
<tr>
<td>Diversification effect</td>
<td>−156</td>
<td>−10%</td>
</tr>
<tr>
<td>Expected shortfall UW + investment</td>
<td>332</td>
<td>21%</td>
</tr>
<tr>
<td>Contribution scenarios [1]</td>
<td>93</td>
<td>6%</td>
</tr>
<tr>
<td>Credit risks</td>
<td>45</td>
<td>3%</td>
</tr>
<tr>
<td>Risk margin (run-off)</td>
<td>37</td>
<td>2%</td>
</tr>
<tr>
<td>Required capital</td>
<td>507</td>
<td>32%</td>
</tr>
<tr>
<td>Available capital SST</td>
<td>680</td>
<td>43%</td>
</tr>
<tr>
<td>Solvency margin SST</td>
<td>134%</td>
<td></td>
</tr>
</tbody>
</table>

#### Expected shortfall of sample life insurer

<table>
<thead>
<tr>
<th>Risks</th>
<th>CHFm</th>
<th>% of technical provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>2.1</td>
<td>0.2%</td>
</tr>
<tr>
<td>Longevity</td>
<td>3.6</td>
<td>0.4%</td>
</tr>
<tr>
<td>Disability</td>
<td>13.4</td>
<td>1.5%</td>
</tr>
<tr>
<td>Reactivation</td>
<td>6.3</td>
<td>0.7%</td>
</tr>
<tr>
<td>Surrender</td>
<td>12.4</td>
<td>1.4%</td>
</tr>
<tr>
<td>Annuity conversion option</td>
<td>3.5</td>
<td>0.4%</td>
</tr>
<tr>
<td>Diversification effect</td>
<td>−14.8</td>
<td>−1.6%</td>
</tr>
<tr>
<td>Expected shortfall UW</td>
<td>26.5</td>
<td>2.9%</td>
</tr>
<tr>
<td>Investment risks</td>
<td>61.4</td>
<td>6.7%</td>
</tr>
<tr>
<td>Diversification effect</td>
<td>−19.7</td>
<td>−2.2%</td>
</tr>
<tr>
<td>Expected shortfall UW + investment</td>
<td>68.2</td>
<td>7.5%</td>
</tr>
<tr>
<td>Contribution scenarios [2]</td>
<td>5.1</td>
<td>0.6%</td>
</tr>
<tr>
<td>Credit risks</td>
<td>7.5</td>
<td>0.8%</td>
</tr>
<tr>
<td>Risk margin (run-off)</td>
<td>17.3</td>
<td>1.9%</td>
</tr>
<tr>
<td>Required capital</td>
<td>98.1</td>
<td>10.8%</td>
</tr>
<tr>
<td>Available capital SST</td>
<td>120</td>
<td>13.2%</td>
</tr>
<tr>
<td>Solvency margin SST</td>
<td>122%</td>
<td></td>
</tr>
</tbody>
</table>

#### Solvency I

<table>
<thead>
<tr>
<th>Risks</th>
<th>CHFm</th>
<th>% of technical provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvency requirement</td>
<td>256</td>
<td>16%</td>
</tr>
<tr>
<td>Solvency capital</td>
<td>410</td>
<td>26%</td>
</tr>
<tr>
<td>Solvency margin</td>
<td>160%</td>
<td></td>
</tr>
</tbody>
</table>

### Notes
- **UW** = underwriting; 1% shortfall probability
- SST as of 2004, no deduction of underwriting and investment result from target capital allowed
- **[1]** Scenarios: nine historical financial scenarios (reflecting changes in share price, interest rate, exchange rate), under-reserving, bus accident, stadium accident, hail, dam liability, industrial catastrophe, pandemic, financial distress, reinsurers’ default, terrorism
- **[2]** Scenarios: nine historical financial scenarios (reflecting changes in share price, interest rate, exchange rate), longevity, disability, pandemic, financial distress, reinsurers’ default, terrorism

Source: Bâloise
### Historical expected shortfall of European non-life business lines

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Germany</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property</td>
<td>12%</td>
<td>9.60</td>
<td>9.88</td>
<td>142%</td>
</tr>
<tr>
<td>Liability</td>
<td>5%</td>
<td>5.26</td>
<td>5.34</td>
<td>117%</td>
</tr>
<tr>
<td>Motor</td>
<td>5%</td>
<td>21.61</td>
<td>21.98</td>
<td>122%</td>
</tr>
<tr>
<td>Accident</td>
<td>6%</td>
<td>2.37</td>
<td>2.43</td>
<td>130%</td>
</tr>
<tr>
<td>Other</td>
<td>13%</td>
<td>11.20</td>
<td>11.80</td>
<td>143%</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>49.95</td>
<td>51.43</td>
<td>128%</td>
</tr>
<tr>
<td>Diversification</td>
<td>–3.76</td>
<td>–4.53</td>
<td>–11%</td>
<td></td>
</tr>
<tr>
<td>Non-life</td>
<td>4%</td>
<td>46.18</td>
<td>46.89</td>
<td>117%</td>
</tr>
<tr>
<td><strong>France</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property</td>
<td>22%</td>
<td>12.67</td>
<td>13.50</td>
<td>174%</td>
</tr>
<tr>
<td>Liability</td>
<td>14%</td>
<td>2.96</td>
<td>3.11</td>
<td>163%</td>
</tr>
<tr>
<td>Motor</td>
<td>4%</td>
<td>15.66</td>
<td>15.86</td>
<td>116%</td>
</tr>
<tr>
<td>Bodily injury</td>
<td>4%</td>
<td>6.16</td>
<td>6.25</td>
<td>126%</td>
</tr>
<tr>
<td>Other</td>
<td>13%</td>
<td>10.54</td>
<td>11.11</td>
<td>156%</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>47.99</td>
<td>49.83</td>
<td>142%</td>
</tr>
<tr>
<td>Diversification</td>
<td>–3.79</td>
<td>–4.63</td>
<td>–13%</td>
<td></td>
</tr>
<tr>
<td>Non-life</td>
<td>7%</td>
<td>44.19</td>
<td>45.20</td>
<td>129%</td>
</tr>
<tr>
<td><strong>United Kingdom</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property</td>
<td>17%</td>
<td>16.80</td>
<td>17.85</td>
<td>197%</td>
</tr>
<tr>
<td>Liability</td>
<td>10%</td>
<td>9.59</td>
<td>9.92</td>
<td>161%</td>
</tr>
<tr>
<td>Motor</td>
<td>9%</td>
<td>19.12</td>
<td>19.72</td>
<td>132%</td>
</tr>
<tr>
<td>Accident</td>
<td>10%</td>
<td>6.82</td>
<td>7.06</td>
<td>141%</td>
</tr>
<tr>
<td>Other</td>
<td>20%</td>
<td>22.25</td>
<td>23.67</td>
<td>197%</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>74.58</td>
<td>78.22</td>
<td>163%</td>
</tr>
<tr>
<td>Diversification</td>
<td>–5.80</td>
<td>–6.93</td>
<td>–14%</td>
<td></td>
</tr>
<tr>
<td>Non-life</td>
<td>11%</td>
<td>68.78</td>
<td>71.29</td>
<td>149%</td>
</tr>
<tr>
<td><strong>Italy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property</td>
<td>13%</td>
<td>4.17</td>
<td>4.36</td>
<td>185%</td>
</tr>
<tr>
<td>Liability</td>
<td>13%</td>
<td>3.38</td>
<td>3.53</td>
<td>141%</td>
</tr>
<tr>
<td>Motor</td>
<td>6%</td>
<td>21.20</td>
<td>21.67</td>
<td>141%</td>
</tr>
<tr>
<td>Accident</td>
<td>12%</td>
<td>2.50</td>
<td>2.61</td>
<td>180%</td>
</tr>
<tr>
<td>Other</td>
<td>10%</td>
<td>3.55</td>
<td>3.67</td>
<td>148%</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>34.80</td>
<td>35.86</td>
<td>148%</td>
</tr>
<tr>
<td>Diversification</td>
<td>–2.39</td>
<td>–2.79</td>
<td>–11%</td>
<td></td>
</tr>
<tr>
<td>Non-life</td>
<td>6%</td>
<td>32.42</td>
<td>33.05</td>
<td>136%</td>
</tr>
</tbody>
</table>

Assumed shortfall probability of 1%.

[2] Calculation based on direct loss ratios, except for the UK where net loss ratios were used.

Average claims: 7 years for property, 3 years for the other lines of business.

A lognormal distribution is assumed because it can capture the fact that claims distributions tend to be positively skewed, i.e. that there are more big claims than under a normal distribution. If claims were distributed normally, expected shortfall would on average be about one third of the values derived from the lognormal distribution.

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