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SUMMARY ON THE SWISS SOLVENCY TEST

In 2003 the FOPI (Federal Office of Private Insurance in Switzerland) set out a new directive concerning the SST (Swiss Solvency Test). The conceptual work was finished by the end of 2003, and followed by a first field test in early 2004 run by a few selected life and non-life companies. In 2005 a second, extended field test will be conducted open for all Swiss insurance companies. It is envisaged that the SST will become effective as of 1 January 2006 as a part of the new insurance supervision act.

The goal of the SST is to ensure that the receivables of policyholders are protected. Up to now this goal has been achieved with a combination of measures, such as a required solvency margin or constraints on investments. In particular, the current definition of solvency capital (e.g., 4% of mathematical reserves for life insurance) is not appropriate since companies writing similar business often have quite different levels of reserves. This puts prudent insurers at a competitive disadvantage as they have more capital locked in the mathematical reserves and in addition are subject to higher solvency requirements than their competitors.

This has led the FOPI to propose a risk-based solvency standard, which is based on the actual risks run by the companies. It puts the responsibility on the companies to investigate their own risk situation. In this way, transparency and competition will be enhanced, as companies are rewarded for better managing their risks. The proposal, which is described in more detail in the 'White Paper of the Swiss Solvency Test' [2], can be summarised as protecting insurance customers by ensuring that each insurance company has sufficient capital available. Sufficient means that even in an unlikely situation (e.g. one with a probability of 1%), there is (on average) enough capital to allow the assets and liabilities of the company to be transferred to a third party. There must then still be sufficient assets to cover the liability and the future capital costs of that third party. This leads to the concept of the target capital, which will be discussed further in this note.

Adoption of these proposals will have a number of significant impacts on the insurance market in Switzerland and on the regulator. It will accelerate the transition to a more risk-aware culture, which has been underway for some years now. Furthermore as the sophistication of companies' risk-management techniques improves, an equivalent advance in sophistication of the regulator will be required.

CONCEPT – KEY ELEMENTS OF THE SST

The key elements of the SST are the marking-to-market valuation of assets and liabilities including embedded options and guarantees. Of particular interest is the calculation of the minimal capital needed in order that the probability of default is below a certain level within one year. The calculation of this so-called *target capital* is based on a hybrid analytical-scenario approach where stochastic models are supplemented with scenarios and both results are aggregated. The determination of the target capital contains also a credit risk charge and a risk margin, which are explained in more detail further in this note. The SST can be described as follows:

- Relevant risks are market, credit and insurance risks.
- Assets and liabilities are valued market-consistently.
- The market consistent value of insurance liabilities is based on best-estimate cash flows.
- Options and guarantees must be valued too.
- There are standard models for market, credit and insurance risks.
- Market and insurance risk within the standard model are measured using the expected shortfall of the change in risk-bearing capital over one year.
- There are scenarios to take into account rare events or risks not covered by the standard models.
- The results of the standard models and the evaluation of the scenarios are aggregated to determine the target capital.
- In case of financial distress of an insurer, policyholders are protected by a risk margin.
- Upon approval by the regulator, internal models can be used for the calculation of the target capital.
- There must be a SST report documenting the calculations and assumptions.
- Reinsurance can be taken into account fully if actual risk-transfer has been calculated.
- Operational risks have to be described qualitatively, but do not have to be quantified.
- The SST encourages companies to use internal models, provided they satisfy certain regulatory requirements.

COMPATIBILITY WITH SOLVENCY II

In order for Swiss companies not to be at a competitive disadvantage to insurers domiciled in EU member countries, it is an aim of the supervisor for the SST to be compatible with the future European Solvency II framework. This entails in particular that both, a minimal solvency level and target capital, have to be calculated

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[2] (www.bpv.admin.ch/de/pdf/white_paper_sst.pdf→)

and that internal models (provided they satisfy regulatory requirements) can be used for target capital calculation.

The new Solvency II regime consists, in analogy with the Basel II framework in the banking industry, of three pillars; see for instance the document 'A Global Framework for Insurer Solvency Assessment' obtainable from the download section of the International Actuarial Association.

Pillar 1: Minimum capital requirements
Pillar 2: Supervisory review of capital adequacy
Pillar 3: Public disclosure

Pillar 1 consists of the statutory requirements, Solvency I and others. The statutory valuation is based on implicit prudent margins, but there is no explicit valuation of options and guarantees and no explicit consideration of specific risks. While Solvency I calculations are not risk sensitive, they are not model-dependent and thus more objective.

The target capital, as determined by the SST, belongs squarely within Pillar 2. It is a review of the economic capital adequacy of a company, based on economic risk, with financial and insurance risks considered explicitly (including options and guarantees).

However, Solvency II compatibility does not mean that the SST will only be introduced when Solvency II is in force. Rather, risk-based solvency requirements will be introduced now within Pillar 2. This will give companies time for the transition as well as lessen the effects of a sudden transition to a risk-based framework. The SST will remain within Pillar 2 as long as the target capital requirement within Solvency II stays within Pillar 2.

RISK-BEARING AND TARGET CAPITAL

The *risk-bearing capital* is defined as the difference between the market value of assets and the market value of the liabilities,

$$C(t) := A(t) - L(t)$$

where t denotes the valuation date,
e.g. 31 December 2003.
The *target capital* is made up of 4 building blocks:
– analytic part
– scenario aggregation
– credit risk charge
– risk margin

TARGET CAPITAL:
THE ANALYTIC PART DEFINITION

The *analytic part* TC_a *of the target capital* is defined through

$$TC_a := \mathrm{ES}_\alpha(C(1)-C(0)),$$

whereby ES_α denotes the *expected shortfall at confidence level* $1-\alpha$.[3]

Recall the definition of the two widely used risk measures *value at risk* (VaR_α) and *expected shortfall* (ES_α) at some confidence level $1-\alpha$:

$$\mathrm{VaR}_\alpha(X) := \inf\{ x \mid P[X > x] \leq 1-\alpha \}$$
$$\mathrm{ES}_\alpha(X) := \mathbf{E}[X \mid X > \mathrm{VaR}_\alpha(X)],$$

whereby X is an arbitrary (real) random variable.

Let X be a random variable. Then we use the notation $X \sim N(\mu, \sigma^2)$ to express that X has a normal distribution with mean value μ and variance σ^2.

EXAMPLE: let $X \sim N(\mu, \sigma^2)$. Then

$$\mathrm{VaR}_\alpha(X) = \mu + \sigma q_\alpha$$

and

$$\mathrm{ES}_\alpha(X) = \mu + \sigma \frac{\varphi(q_\alpha)}{1-\alpha} \qquad (1)$$

Here, q_α denotes the α-quantile of an $N(0,1)$-variable and φ its density function.

ASSUMPTION: It is assumed that

$$C(t) = f(Z(t))$$

for some time-independent function f.
Here $Z = (Z^i)_{1 \leq i \leq d}$ is the vector of risk factors.

The goal is to approximate $C(t) - C(t\text{-}1)$. Let therefore $X(t) := Z(t) - Z(t\text{-}1)$ denote the vector of risk factor changes. Then by use of the Taylor approximation

$$\begin{aligned} C(t) &= f(Z(t)) \\ &= f(Z(t-1) + X(t)) \\ &\approx C(t-1) + \nabla f(Z(t-1)) \cdot X(t) \end{aligned}$$

Hence,

$$C(t) - C(t-1) \approx \nabla f \cdot X(t) \qquad (2)$$

The gradient $\nabla f = (\partial f / \partial z_1, \ldots, \partial f / \partial z_d)^1 = \nabla f(Z(t-1))$ is called *vector of sensitivities*.
Its components are approximated by difference quotients, that is

$$\frac{\partial f}{\partial z_i}(Z(t\text{-}1)) \approx \frac{f(Z(t\text{-}1) + \zeta_i e_i) - f(Z(t\text{-}1))}{\zeta_i} \qquad (3)$$

for ζ_i small enough, where e_i denotes the i-th basis vector of the canonical basis in R^d.

[3] To be more precisely: Assume that A(t) and L(t) are discounted to time t = 0, otherwise one should consider C(1)/(1+R(0,1))-C(0) instead of C(1)-C(0).

ASSUMPTION:
Market and insurance risk factor changes are multivariate normally distributed with mean vector 0 and covariance matrix Σ.

By the above assumption on the distribution of $X(t)$, for the right hand side of equation (2)

$$\nabla f \cdot X(t) \sim N(0, \sigma^2)$$

with $\sigma^2 = (\nabla f)^T \Sigma (\nabla f)$. Hence, by means of equation (1), the approximation

$$TC_a \approx \sqrt{(\nabla f)^T \Sigma (\nabla f)} \cdot \frac{\varphi(q_\alpha)}{1-\alpha}$$

is applied whereby ∇f is computed using (3) for some well-defined risk factor moves ζ_i.
The covariance matrix Σ of the risk factors can be written as

$$\Sigma = \Delta R \Delta$$

where Δ is the diagonal matrix $\mathrm{diag}(\sigma_1, \ldots, \sigma_d)$ in which the σ_1 are the standard deviations of the risk factor changes and $R := [\rho_{ij}]$, $\rho_{ij} := \mathrm{Corr}(X_i, X_j)$. The matrices R and Δ uniquely determine the multivariate normal distribution of the risk factor changes X.

Within the SST, 23 market and 6 insurance risk factors are considered. The correlations and standard deviations of the risk factors are estimated and provided by the FOPI.

The *delta-normal approach* as described above has its limitations, among them the poor coverage of extreme events by normal distributions and the bad understanding of the non-linear behaviour of f due to linearisation and approximation. Therefore, the definition of the target capital is extended by aggregation of extreme scenarios, see below.

TARGET CAPITAL: SCENARIO AGGREGATION
In addition to the determination of the analytic part of the target capital, one also has to evaluate some prescribed scenarios as well as some company specific scenarios which better capture the specific risk of the company. The results of the standard models are combined with the evaluations of the scenarios using an aggregation method. The aggregation consists, loosely speaking, of calculating a weighted mean of the normal situation (captured by the standard models) and special situations (described by the scenarios).

CREDIT RISK CHARGE
The target capital after scenario aggregation will be complemented by a credit risk charge. The credit risk charge reflects all credit risks except reinsurers' default risk and credit spread risk.

In order to limit the possibility for arbitrage of credit risk from the banking to the insurance sector (and the reverse), credit risk quantification follows as closely as possible the one used by the banking regulator. Therefore, a credit risk charge is calculated using an approach compatible to Basel II. This charge is then added to the target capital resulting from the standard model after scenario aggregation.

THE STANDARD MODEL
The standard model within the SST to quantify credit risk is the Basel II standardised approach. This approach can be implemented quite easily and without much extra effort.

INTERNAL MODELS
Internal models for credit risk have to be calibrated to the same risk measure as used by Basel II, namely the Value at Risk on the 99.9% quantile. Possibilities for internal models are for instance
– Basel II Internal Ratings-based approach (Foundation)
– Basel II Internal Ratings-based approach (Advanced)
– Credit risk portfolio model

If a company intends to use a portfolio model, it is prerequisite that all the credit risks within the scope of Basel II are captured. This means in particular that all the requirements of Basel II to use the internal ratings-based approaches need to be satisfied.

RISK MARGIN
The ultimate target capital finally includes a risk margin. The risk margin of an insurance portfolio is defined as the hypothetical cost of regulatory capital necessary to run-off all the insurance liabilities, following financial distress of the company. For the regulator it is imperative that in the case of insolvency, the rightful claimants are protected. Policyholders are best served if a third party can take over the assets and liabilities of their initial insurer. The FOPI argues that a third party will only be willing to do this if the cost of setting up the regulatory capital that would be required is covered by the portfolio.