Introduction to the SST

Schweizer Solvenz Test
Test suisse de solvabilité
Proba di solvibilità svizzera
瑞士偿付能力测试

Federal Office of Private Insurance
Brussels, 22 December 2005

Timeline of the SST Development

2003

Herbert Lüthy becomes new director of FOPI (Federal Office of Private Insurance) in Fall 2002, reorientation to prudential supervision

Start of Swiss Solvency Test project Mai 2003 with participation of industry, actuarial and insurance association, consulting companies and others, conceptual work finished end of 2003

2004

Up to Mai 2004, development of first version of the standard model

Field test 2004 with 10 insurers, supported by consulting companies

2005

Adaptations and improvements on the standard model and the methodology of the SST

Field test 2005 with 45 insurers covering approx 90% of the market

2006

Insurance supervision act to be implemented 1.1. 2006

Further development underway on requirements on internal models and group effects

Field test 2006, mandatory for all large life & nonlife companies

2007

Small companies, reinsurers and groups prepare for full SST calculations in 2008+

Field test 2007, mandatory for all large life & nonlife companies

2008

As of 2008 all companies have to implement the SST, as of 2011 target capital requirement will be in force

SST

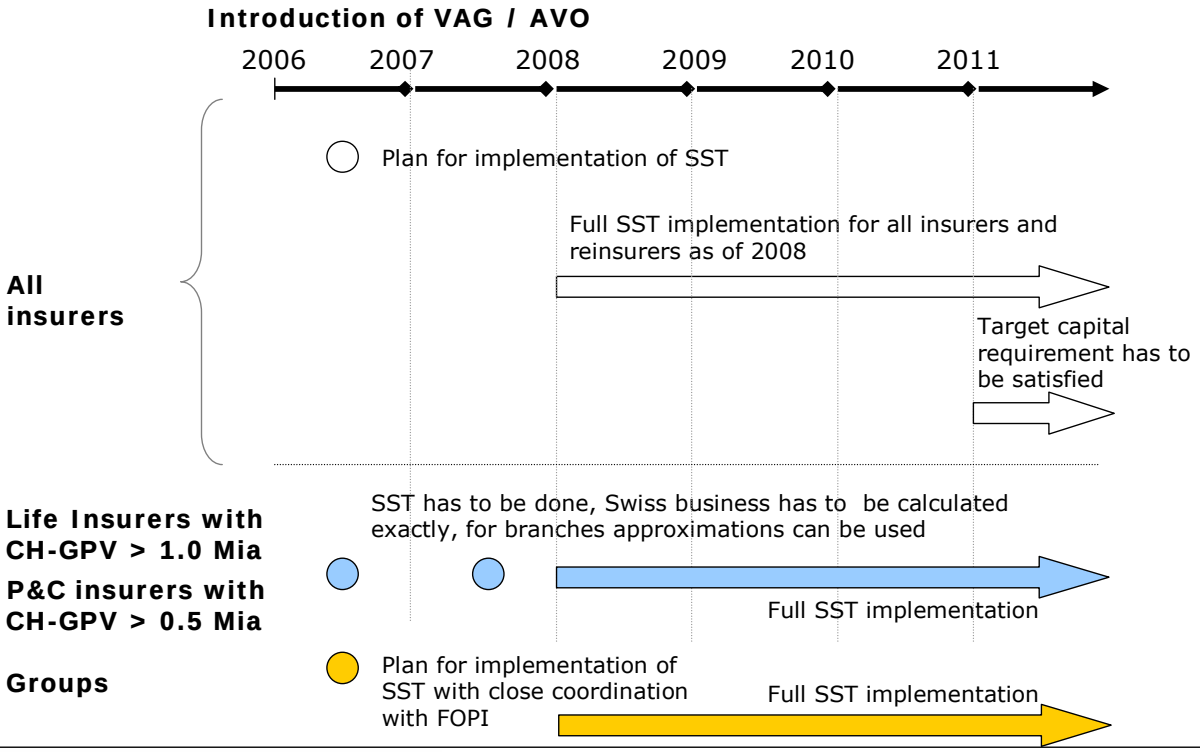
The SST is compulsory for

- Life, nonlife and health insurers supervised by FOPI;
- Reinsurers;
- Insurance groups;
- Captives which are ‚reinsurer' like.

For life and nonlife companies, standard models are supplied.

Groups, reinsurers, captives, companies with substantial business written in foreign branches and companies for which the standard models are not appropriate have to use internal models for the SST

Transition Period



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  - SCR
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- Internal Models
- Group Aspects

Requirements of the SST

Basic requirements of a risk-based solvency system:

- Requirements and definitions have to follow from regulatory purpose (e.g. what is the risk margin for, what purpose does the solvency capital requirement (SCR) have, etc.)
- If internal models are to be used, the solvency system should be defined by underlying principles
- Building blocks have to fit together (SCR has to be linked to risk margin to avoid double counting of risks, the valuation of assets and liabilities has to be consistent, …)
- If the solvency system has to be embedded within insurance companies, it has to be founded on economic principles
- A nontransparent mix of quantification of risks, limited eligibility of capital, limits and implicit safety margins which would make interpretation of SCR impossible should be avoided

Requirements of the SST

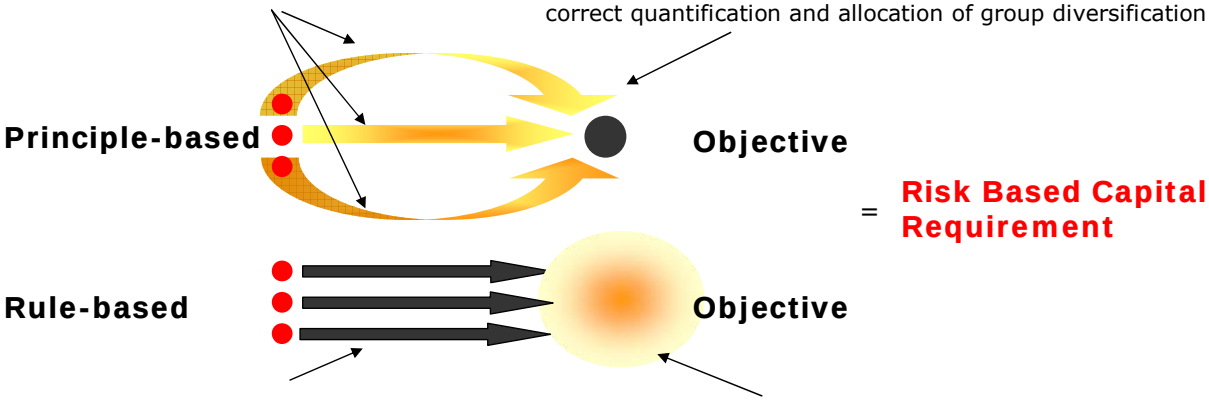
As simple as possible, as complex as necessary	Reliance on internal models for complex companies (e.g. groups, reinsurers,…), use of a standard model for small to mid-sized companies that is risk sensitive and rewards risk management
Incentivizes risk management	Clearly stated principles, responsibility of adherence to principles on senior management, avoid rules and limits which can be arbitraged against
Requirements follow from regulatory intentions	Avoid/minimize effects of legacy regulation (e.g. limits on investment, inconsistent valuation rules, …)
Minimizing unintended consequences	Market value margin type risk margin, SCR as pure one-year risk, no implicit prudence margins
Solvency 2 and International Compatibility	Market consistent valuation of assets and liabilities, total balance sheet approach
Economic View	Allows for reinsurance, ALM, hedging to be taken into account via a risk-specific standard model and by an internal model
Capturing all relevant risks and risk mitigations	Allows for group diversification given fungibility restrictions, taking into account all relevant intra-group risk and capital transfer instruments
Capturing group effects	

Implications of Principles vs Rules

Principle-based standards describe the objective sought in general terms and require interpretation according to the circumstance.

Companies tailor approach such that clearly stated objective is attained

Objective can be attained if companies interpret principles faithfully. The objective is defined by a (theoretically) correct quantification and allocation of group diversification

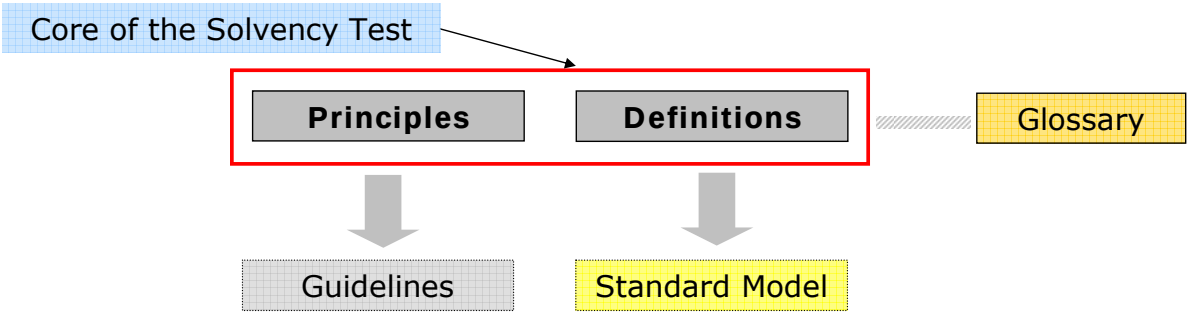


Rule based approach does not allow truly company specific risk assessment

Attained result depends on how well rules capture the specific situation of the insurer

The SST Concept: Principle-Based

The more laws and order are made prominent, the more thieves and robbers there will be, Lao-tzu



The SST is defined not by the Standard Model but by underlying principles

- Principles define concisely the objectives
- Definition of terms and concepts so that meaning and possible interpretation of principles become clear
- Guidelines help in interpretation
- Standard Model allows use of Solvency Test also by small companies

The SST Concept: Principle-Based

Defines Output

1. All assets and liabilities are valued market consistently
2. Risks considered are market, credit and insurance risks
3. Risk-bearing capital is defined as the difference of the market consistent value of assets less the market consistent value of liabilities, plus the market value margin
4. Target capital is defined as the sum of the Expected Shortfall of change of risk-bearing capital within one year at the 99 % confidence level plus the market value margin
5. The market value margin is defined as the cost of the present value of future required regulatory capital for the run-off of the portfolio of assets and liabilities
6. Under the SST, an insurer's capital adequacy is defined if its target capital is less than its risk bearing capital
7. The scope of SST is legal entity and group / conglomerate level domiciled in Switzerland
8. Scenarios defined by the regulator as well as company specific scenarios have to be evaluated and, if relevant, aggregated within the target capital calculation

The SST Concept: Principle-Based

Defines How-to

9. **All relevant probabilistic states have to be modeled probabilistically**
10. **Partial and full internal models can and should be used. If the SST standard model is not applicable, then a partial or full internal model has to be used**
11. **The internal model has to be integrated into the core processes within the company**

Transparency

12. **SST Report to supervisor such that a knowledgeable 3rd party can understand the results**
13. **Disclosure of methodology of internal model such that a knowledgeable 3rd party can get a reasonably good impression on methodology and design decisions**

Responsibility

14. **Senior Management is responsible for adherence to principles**

The SST Concept: The SST in a Nutshell

Expected Shortfall

$$TC = ES[\Delta RBC] + MVM$$

Target Capital

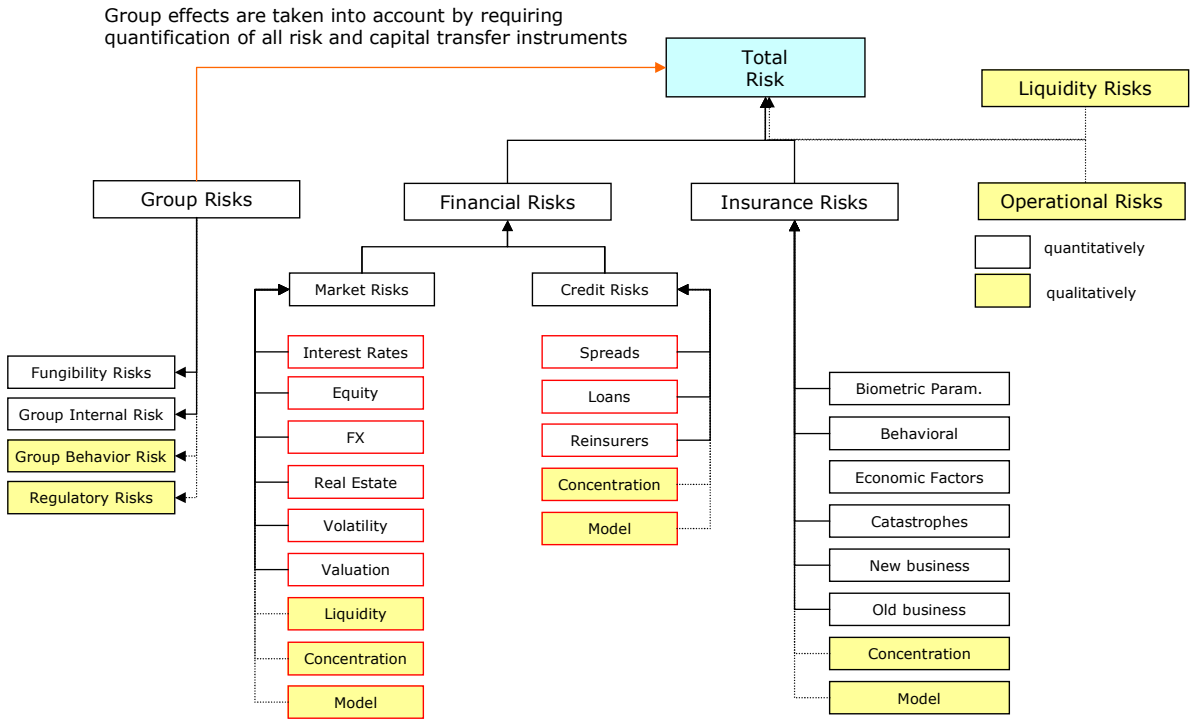
Change of Risk-Bearing Capital

Covers risks emanating during a one-year time horizon ~ SCR

Market Value Margin

Market value margin should be sufficient to allow a run-off or portfolio transfer

The SST Concept: Risk Classification



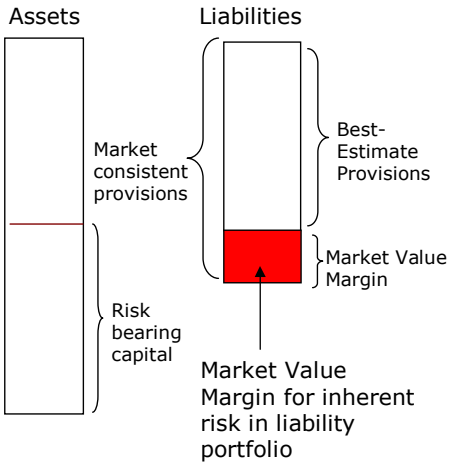
The SST Concept: The economic view

Market Consistent

Wherever possible, **market-consistent valuation** is based on observable market prices (marking to market)

If such values are not available, a market-consistent value is determined by examining comparable market values, taking account of liquidity and other product-specific features, or on a model basis (marking to model)

Market-consistent means that up to date values are used for all parameters



Best-estimate = Expected value of liabilities, taking into account all up to date information from financial market and from insurance.

All relevant options and guarantees have to be valued.

No explicit or implicit margins

Discounting with risk-free interest rate

Valuation of policyholder-options: Assume realistic behavior of policy holders, but option exercise depends on financial market parameters

One approach to value options is using replicating portfolio of traded financial instruments

The SST Concept: Market Value Margin

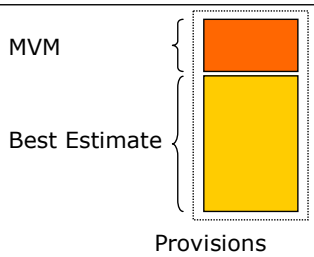
Market Value Margin: to cover policyholders against risks emanating beyond 1 year

- SCR: To cover risks which emanate during a 1-year time horizon
- Market Value Margin: To cover cost of capital to cover risks during the whole run-off of the portfolio

There should not be double-counting between SCR and Market Value Margin

Possible Approaches:

- **Statutory:** Taking undiscounted reserves, using prudent assumptions, adding a simple factor on best-estimate etc.
- **Quantile:** Taking e.g. the 75% quantile of the ultimate loss distribution of the liabilities: Used by APRA for P&C liabilities, discussed within Solvency 2.



- **Market Value Margin:** the additional amount on top of the best estimate which is required by a willing buyer in an arms-length transaction to assume the liabilities the loss reserves are held to meet: Discussed within Fair Value Accounting, used within the SST.

The SST Concept: Market Value Margin

Definition: The market value margin is the smallest amount of capital which is necessary in addition to the best-estimate of the liabilities, so that a buyer would be willing to take over the portfolio of assets and liabilities.

Idea: A buyer (or a run-off company) needs to put up regulatory capital during the run-off period of the portfolio of assets and liabilities

→ a potential buyer needs to be compensated for the cost of having to put up regulatory capital

Market Value Margin = cost of the present value of future regulatory risk capital associated with the portfolio of assets and liabilities

Problem: How to determine future regulatory capital requirement during the run-off of the portfolio of assets and liabilities?

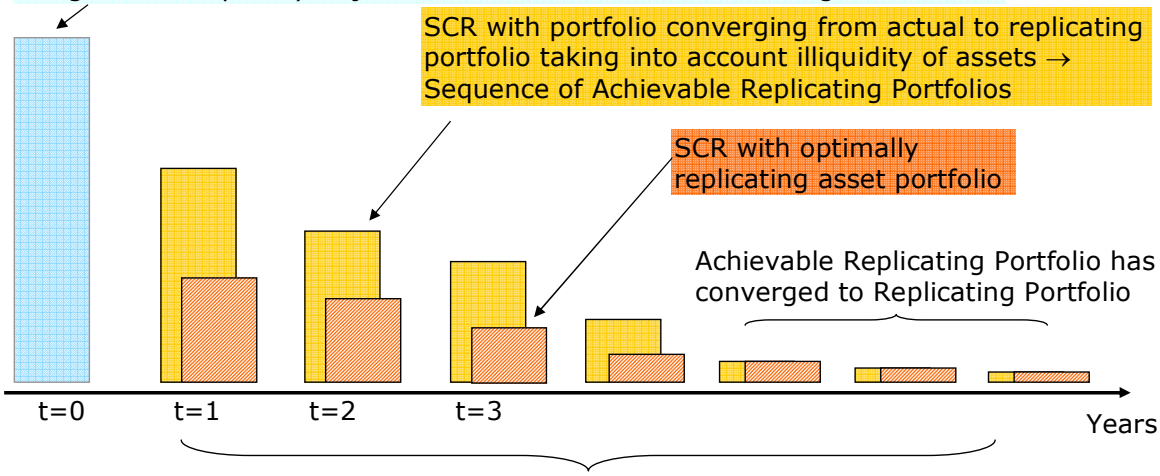
-> Assumptions on the evolution of the asset portfolio are necessary

The SST Concept: Market Value Margin

$$MVM = CoC \cdot \sum_{t \geq 1} SCR(t)$$

CoC: 6% over risk free

ES at t=0 does not enter calculation of the market value margin necessary at t=0 → risks taken into account for 1-year risk capital and market value margin are completely disjoint and there is no double-counting



SCR: 1-Period (e.g. 1 year) risk capital = Expected Shortfall of risk-bearing capital

Future SCR entering calculation of MVM at t=0

The SST Concept: Market Value Margin

Experiences from Field Tests:

- Companies were able to determine the MVM
- The results were stable, although there were some (easily identifiable) outliers
- The magnitude of the MVM corresponds to the expectations:
  - higher for companies with large insurance risk component and long duration of liabilities (e.g. life companies writing risk products)
  - smaller for companies with large proportion of market risk (life companies writing savings products) or short durations of liabilities (some P&C companies)

SST Concept: Risk Bearing Capital

Capital needs to be risk-bearing also in case of financial distress

Risk Bearing Capital: Core Capital + Lower and Upper Additional Capital:

Core Capital:

- Excludes dividends, own shares, immaterial assets, latent real estate tax
- Loans which can be converted into share capital of the company and similar innovative financial instruments can be used as core capital given regulatory approval
- Supervisory approval should be required before such capital can be repurchased/redeemed or otherwise reduced in amount.

Lower Additional Capital: Hybrid capital with fixed maturity date of at least 5 years

Upper Additional Capital: Hybrid capital without maturity date (e.g. perpetual subordinated loans)

Limits:

- Lower Additional Capital up to 50% of core capital
- Additional Capital up to 100% of core capital

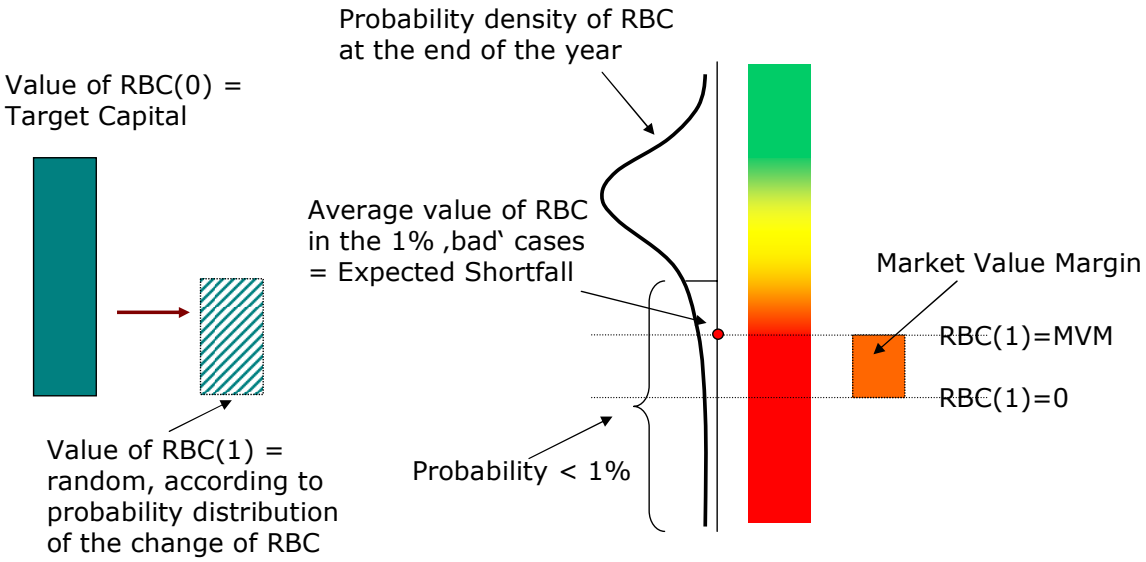
Fixed limits make no sense for a truly risk based framework

For companies, using the standard model, limits are in place as the standard model does not cover all risk-relevant features of different forms of capital.

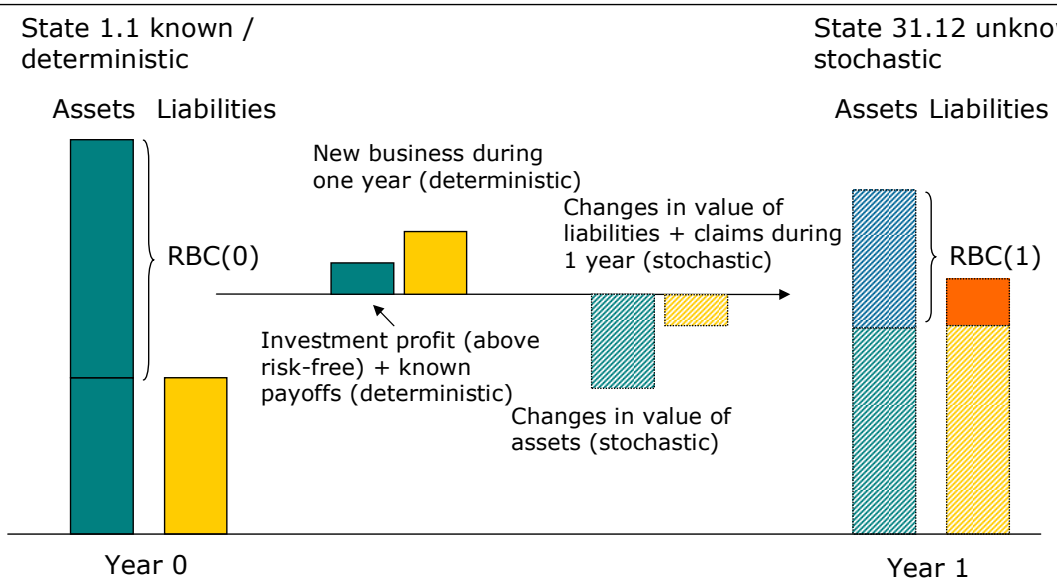
Companies using internal models can ask FOPI for change in limits. Requirement for a change is that the internal models capture the relevant features of capital, e.g. its availability in case of financial distress etc.

The SST Concept: Risk Bearing Capital

Target capital is defined such, that when RBC(0)=target capital at the begin of the year, then – even in case of a bad financial result with P<1% - at the end of the year there is on average still enough risk bearing capital to cover the market value margin, i.e. RBC(1)≥ Market Value Margin



Change in Risk Bearing Capital



The SST requires the quantification of the randomness of risk bearing capital in one year (the probability distribution of RBC). From this follows the determination of target capital

RBC(0) should be such that at the end of the year, even when a large loss with P<1% occurs, the insurer's available RBC covers (on average) still the market value margin

Work Load

Result of the Field test: Total Work Load in Person Months (PM)

	Initally for Fieldtest	Subsequently
Small Companies	1-2 PM	< 1 PM
Small to Mid-Sized Companies	2 - 3 PM	< 2 PM
Mid-Sized Companies	9 - 15 PM	4 - 8 PM
Large Companies, Groups	12 - 24 PM	< 12 PM

Split for field test on average:

- 20% - 30% for internal education, communication
- 30% - 40% for developing valuation methodology, preperational work (data, IT),…
- 20% - 30% for actual calculation

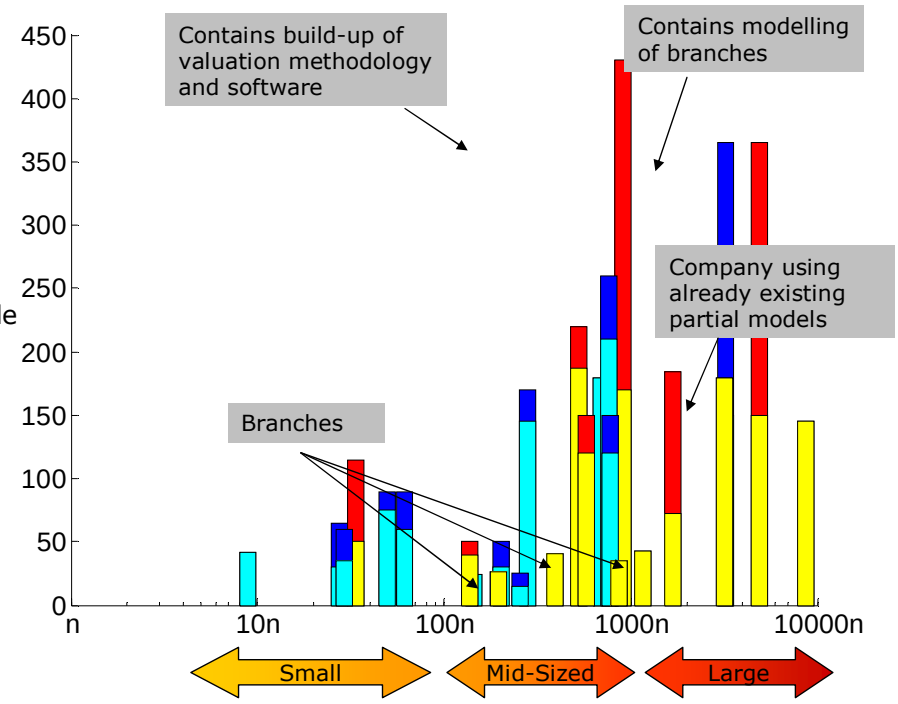
Based on initial feedback from a part of the field test participant

Work Load

Total workload for life and nonlife companies, split into work for field test 2005 (initial) and estimates for work for SST during later years

Y-axis: person days of work

X-axis: logarithmic scale for size of company (assets)



Life initial
Life later
Nonlife initial
Nonlife later

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  - Nonlife Risk
    - Current Year Risk
    - Previous Year Risk
  - Life Risk
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The SST Concept: General Framework

Standard Models for insurance risk:

Nonlife: Split into small and large claims and catastrophes

Life: biometric and policy holder behavior risk modeled using multivariate normal approach

Mix of predefined and company specific scenarios

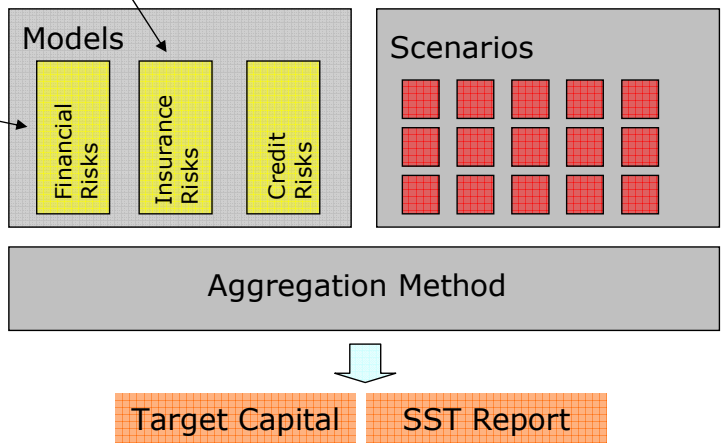
Scenarios add approx. 15% (median) to capital requirement.

Credit risk of reinsurers' default modeled using a scenario (adding btw.) 0.01% and 7% to capital requirement

Credit risk calculated using Basel II or portfolio model (e.g. credit metrics)

Asset-Liability Model using covariance approach

Aggregation by weighted average of different distribution functions (weight = probability of scenarios occurring



The SST Concept: Standard Models

- Financial Market Risk
  - For many companies this is the most important risk (up to 80% of total target capital emanating from financial market risk)
  - Needs to be modeled with particular care
  - Most relevant are interest rate risk, real estate risk, spread risk, equity risk
  - Financial market risk model does take into account assets and liabilities simultaneously
- Credit Risk
  - Credit risk is becoming more important as companies go out of equity and into corporate bonds
  - Many smaller and mid-sized companies do not yet have much experience in modeling credit risk
- Insurance Risk (Life)
  - For many life companies with predominantly savings product, pure life insurance risk is not too important
  - Life insurance risk is substantial for companies selling more risk products / disability
  - Model needs to capture optionalities and policyholder behavior
- Insurance Risk (Nonlife)
  - Premium-, reserving- and cat risk are important
  - A broad consensus on modeling exists among actuaries

More information under:

www.sav-ausbildung.ch

The SST Concept: Standard Models

Aims of SST for standard models:

- Should give incentives for proper risk management;
- should correspond to the ideas of the users:
  - CIO/CFO for market and credit risk, life actuaries for life standard modes and P&C actuaries for nonlife standard model;
  - Only then will SST be integrated in internal processes of companies;
- should not give uneconomic incentives;
- should allow adequate mapping of reinsurance programs;
- should not be too conservative as not to disadvantage small companies.

Standard Model: Market Risk

Financial market risk often dominates for insurers → adequate modeling of interest rate-, equity-,.. risks is key

Interest rate risk can not be captured solely by a duration number

Financial instruments have to be segmented sufficiently fine else arbitrage opportunities might be created

Regulatory requirements shouldn't force companies to disinvest totally from certain investment classes (e.g. shares, private equity)

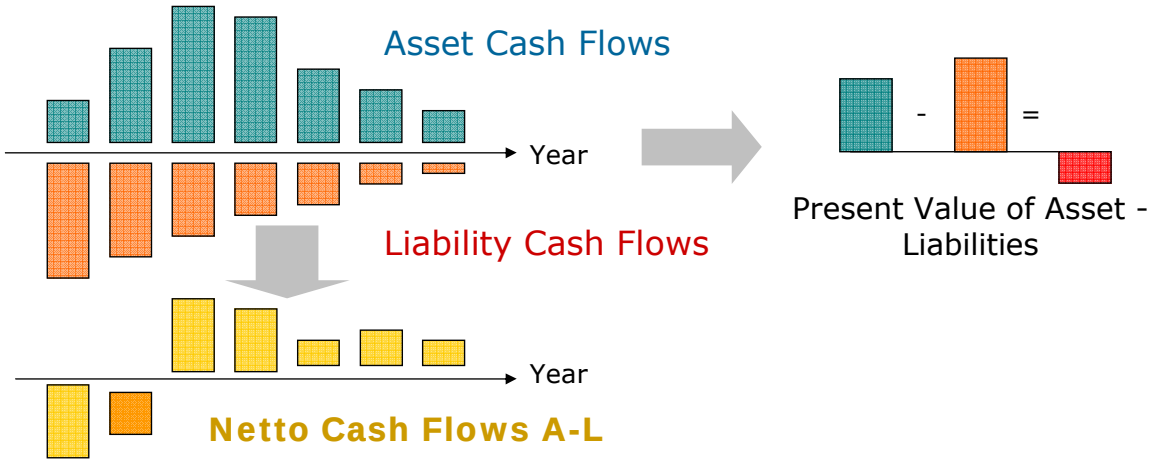
For SST, RiskMetrics type model with given risk factors and associated volatilities and correlation matrix is used together with scenarios

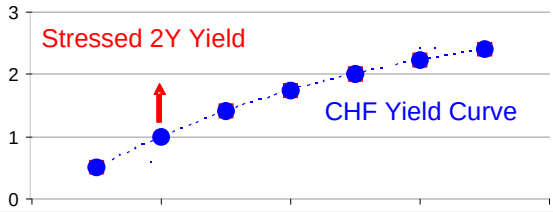
Scenarios

- Historical
  - Share crash (1987)
  - Nikkei crash (1989)
  - European FX-crisis (1992)
  - US i.r. crisis (1994)
  - Russia crisis / LTCM (1998)
  - Share crash (2000/2001)
- Default of Reinsurer
- Financial Distress
  - Equity drop
  - Lapse = 25%
  - New business = -75%
- Deflation

Standard Model: Cash Flow Based

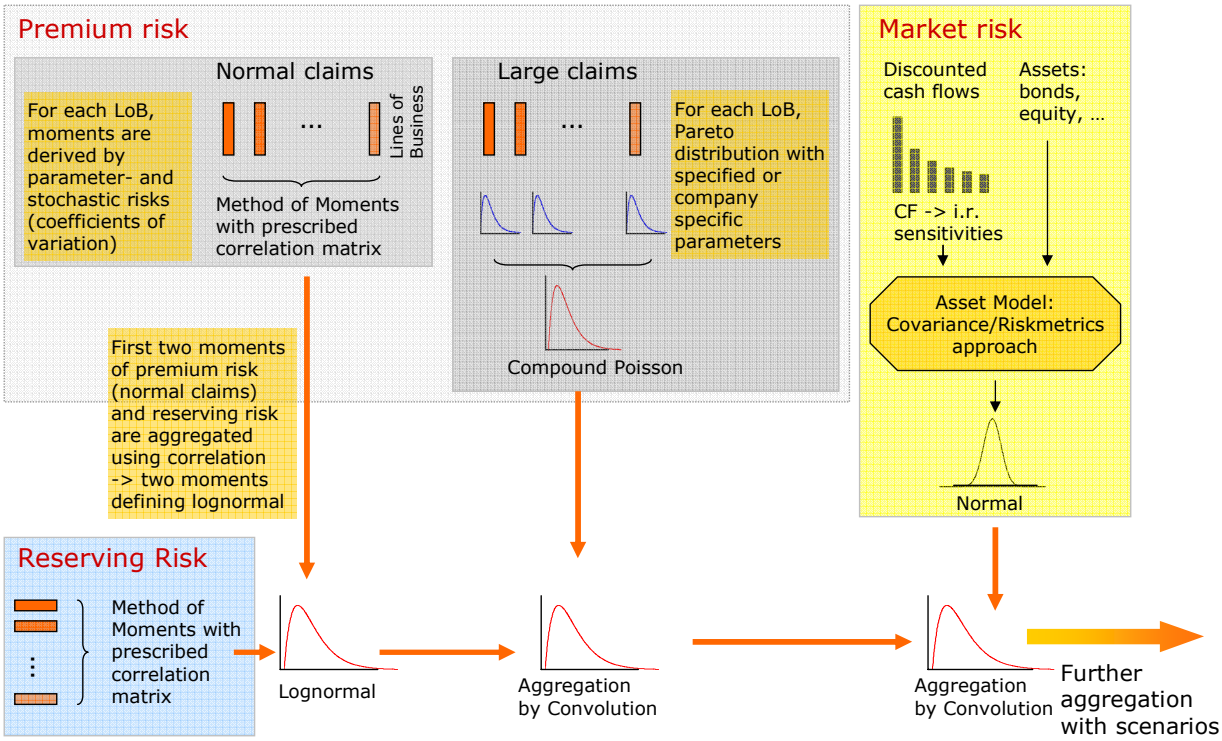
Example: Sensitivity to 2 Year CHF Yield





Change of present value of net cash flow (assets-liabilities) due to change in the 2 year CHF yield

Standard Model: Nonlife



Standard Model: Nonlife

- SST standard model for nonlife risks corresponds closely to internal models used by nonlife actuaries:
  - Split into normal, large and catastrophic claims;
  - Split into reserving risk and current year risk;
  - uses probability distributions for severity and number of claims;
- It allows easy quantification of most reinsurance contracts which is especially important for small and mid-sized nonlife companies;
- For companies without sufficient internal historical data (e.g. for cash-flow patterns of different Lines of Business, data is supplied by FOPI.

Standard Model: Life

Assumptions: The risk factors are normally distributed with given volatilities. The change of risk bearing capital in function of the risk factors is linear → The distribution over all risk factors is again (multivariate) normal distributed

Risk Factors:	Volatility	
	Indiv.	Group
•Mortality	5%	5%
•Longevity (trend)	10%	10%
•Disability	10%	20%
•Reactivation	10%	10%
•Lapse	25%	25%
•Option Exercise	10%	10%

Volatility: Describes changes of risk factors within one year due to parameter-uncertainty

Stochastic risk will be included using company specific data if relevant

The volatilities have been set during discussions with specialist and represent a best-guess

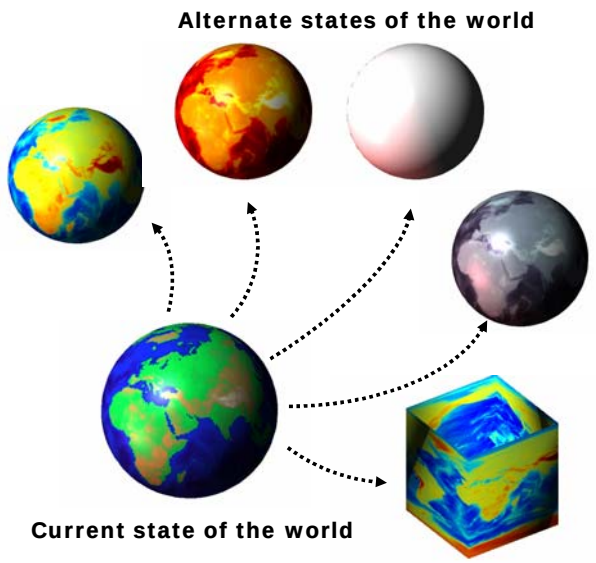
Standard Model: Life

- The model is simple and transparent: the company has to determine sensitivities with respect to life insurance risk factors and then can use correlation matrix and volatilities to arrive at distribution for life insurance risk The normality assumption allows easy aggregation with market risk
- The standard model for life risks is adequate for companies writing standard products without substantial optionalities and where risk bearing capital changes linearly w.r.t. risk factors
- For companies where risk bearing capital depends nonlinearly on risk factors, an internal model is likely the only adequate way of measuring risk
    - These companies need to model life risks using market consistent internal models, e.g. by generating arbitrage free market risk scenarios
    - Simplifications can be made if conservative

The SST Concept: Scenarios

"Ersatz experience is a better guide to the future than the real past and present", Hermann Kahn in *On Thermonuclear War*

Scenarios can be seen as thought experiments about possible future states of the world. Scenarios are not forecasts, in that they need not predict the future development, but rather should illuminate possible but perhaps extreme situations. Scenarios are also different from sensitivity analysis where the impact of a (small) change of a single variable is evaluated.



The SST Concept: Scenarios

Each company has to evaluate a number of predefined and company specific scenarios

The evaluation of a scenario is not just a loss number but should encompass:

- Losses for different lines of business;
- Effects on different legal entities (e.g. branches, subsidiaries);
- Impact on the credit rating;
- Impact on fungibility of capital;
- Group-internal capital transfers necessary;
- Strategy of the company to deal with effects of loss event;
- Assessment of likelihood of the scenario;
- And other impact the company deems to be relevant.

The SST Concept: Scenarios

Historical Scenarios: Stock Market Crash 1987, Nikkei Crash 1989, European Currency Crisis 1992, US Interest Rates 1994, Russia / LTCM 1998, Stock Market Crash 2000

Financial Distress: Increase of i.r., lapse, no new business, downgrading of company,…

Deflation: decrease of i.r.

Pandemic: Flu Pandemic with given parameters (e.g. number of death, sick-days, etc.)

Longevity

Reserving: Provisions have to be increased by 10%

Hail (Swiss specific): Given footprints

Default of Reinsurer: Reinsurer to which most business has been ceded defaults

Industrial Accident: Accident at chemical plant

Personal Accident: large accident during company outing or mass panic in soccer stadium

Anti-selection for Health Insurers: all insured with age < 45 lapse

Collapse of a dam (Swiss specific)

Terrorism

Global Scenarios (for groups&reinsurers)

Property Cats (earthquake, windstorm)

Special Line Cats: Aviation (2 planes collide, marine event, energy event, credit&surety event

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Internal Models: Challenge

When allowing internal models for target capital calculation, the problems a regulator faces are:

- How to ensure that the results are comparable between different companies
- How to ensure, that a company is not punished if it models risks more conscientiously than its peers
- How to be able to distinguish between acceptable and not acceptable models
- How to be certain that a model is deeply embedded within a company

Acceptable Models : The Scientific Method

A regulator should see to it that the scientific method works within the company

The scientific method also has implication for the embedding of a model within the company

- Transparency within the company: Documentation on different levels, openness regarding results of the model
- Interdisciplinary development process: An internal model is at the intersection of several disciplines (mathematics, economy, physics, sociology,…). Interdisciplinary approach reduces risk of sterile formalism, oversimplification, etc.
- Know-how: There needs to be deep knowledge about risks and risk management on different levels of the company
- Testing of models, experiments, falsifications: Testing using historical data where possible, assessment of limits of models, assessing boundary of applicability,…
- Skepticism and continual challenging of models: Models should be continually challenged. Regular internal and external audit of both model and implementation. External audit of processes and appropriate 'culture' of company. Ideally publication of methodology and presentation both internal and externally

Acceptable and Unacceptable Models

Acceptable Models

- Clearly stated and understood assumptions
- Clear on idealizations and simplifications
- Transparent on which effects are neglected
- All relevant risk factors are taken into account
- The model relies not purely on historical data but aims to model the future risks using theory, scenarios, expert opinion etc.
- The model is tested
- The model is regularly challenged, and compared against industry best-practice
- …

Unacceptable Models

- Theory is misapplied
- Pure statistics, no explanation
- Hidden and unclear assumptions
- Too many simplifications
- The model is not tested against the real world
- Inappropriate or stale parameters
- The model is not sufficiently understood within the company
- …

Internal Models

Even worse than having a bad model is having any kind of model – good or bad – and not understanding it

If internal models are used for regulatory purposes, it will be unacceptable if the model is not understood within the company

There needs to be

- deep and detailed knowledge by the persons tasked with the upkeep and improvement of the model
- Knowledge on the underlying assumptions, methodology and limitations by the CRO, appointed actuary etc.
- Sufficient knowledge to be able to interpret the results and awareness of the limitations by senior management and the board

Senior management is responsible for internal models and the review process. The review of internal modes will be based on 4 pillars

- Internal Review;
- External Review;
- Review by the Supervisor;
- Public Transparency.

The regulator is responsible for ascertaining that the review process is appropriate

Companies using internal models have to disclose publicly the methodology, valuation framework, embedding in the risk management processes etc.

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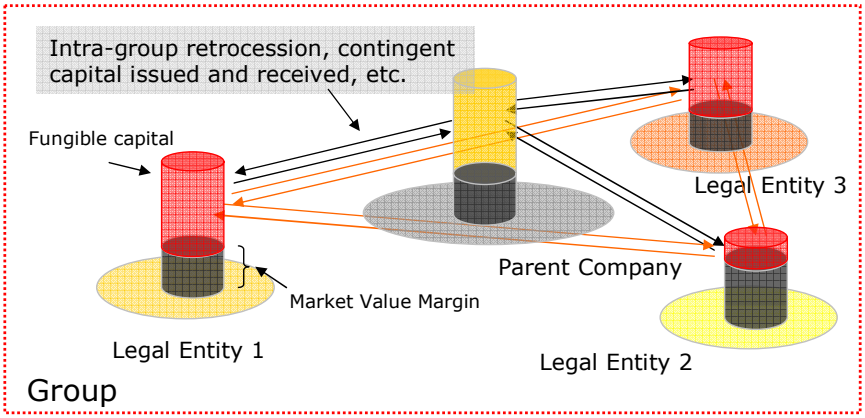
Group Effects

Group effects have to be captured consistently: for group capital requirements and for subsidiaries which are part of a group

-> all formal, legally binding capital and risk transfer instruments are taken into account



Internal models of groups will have to be able to model different legal entities of a group and all relevant risk and capital transfer instruments

Intra-Group Capital and Risk Transfer Instruments:

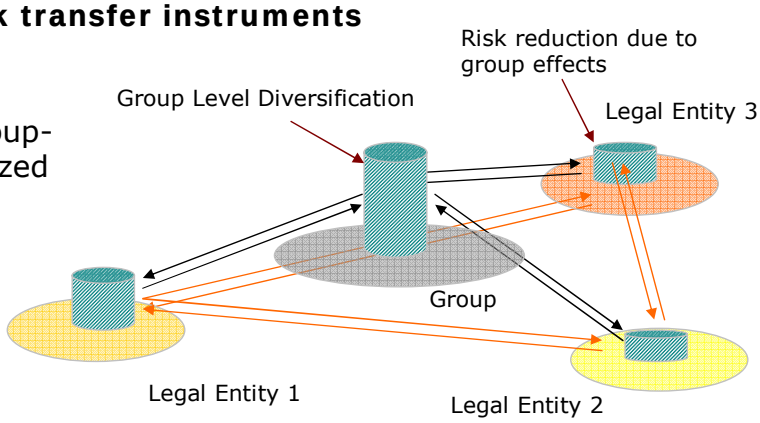
- Intra-group Retrocession
- Guarantees
- Participations
- Dividends
- Loans
- Issuance of surplus notes
- securitization of future cash flows / earnings
- sale / liquidation of a business

Group Effects

A group is defined not only by its legal structure but also by its web of intra-group capital and risk transfer instruments

Intra-group risk and capital transfer instruments allow group-level diversification to be realized and allocated to legal entities

Limited fungibility of capital due to regulatory restrictions have to be considered



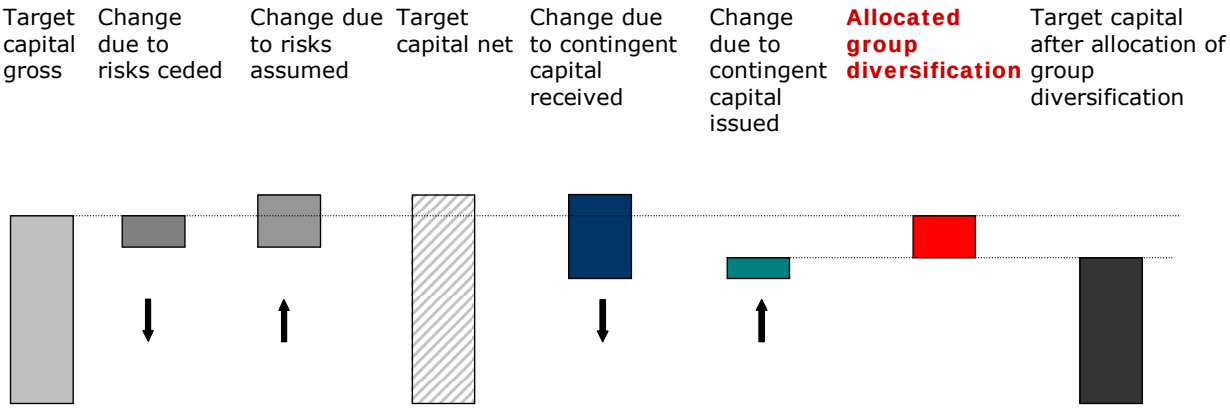
Intra-Group Capital and Risk Transfer Instruments:

- Intra-group Retrocession
- Guarantees
- Participations
- Dividends
- Loans
- Issuance of surplus notes
- securitization of future cash flows / earnings
- sale / liquidation of a business

Capital and risk transfer instruments can only be considered if they are legally binding and acceptable to the regulators involved

Group Diversification

Within the SST, group diversification is the effect, legally enforceable group risk and capital transfer instruments have on required and available capital



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