Supervisory Framework for Risk Assessment and Risk-based Solvency

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

Philipp Keller (Philipp.Keller@bpv.admin.ch)
Federal Office of Private Insurance
FSI, 10 August 2006

Contents

Global Regulatory Tendencies

Reliance on investment profits

Acceptance of negative technical results to obtain cash to invest in market

Risk management often no issue

Some fixed rules, limits, prudence

Self-regulation

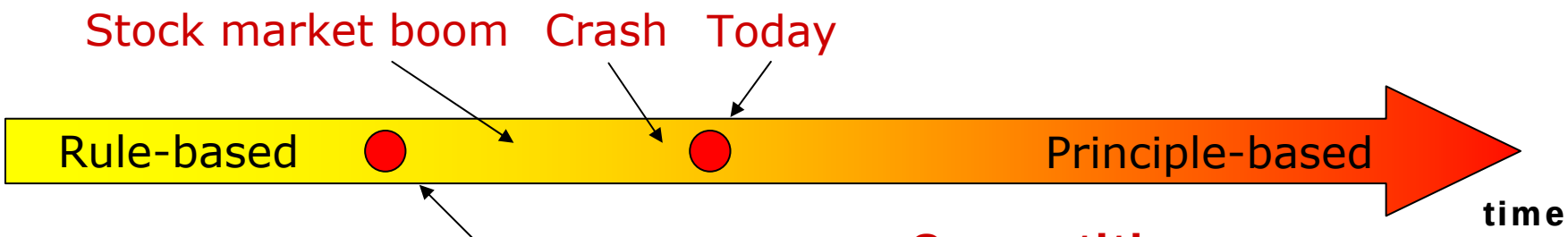
Still some loss making long-tail business in the books (life and non-life)

Smaller investment profits

Scarce capital

Explicit requirements on risk management, risk-based capital requirements, transparency

Strengthening of supervision



Cartels

Build-up of hidden reserves

Liberalization

international expansion

Competition

Possibly more volatile results, better ALM, possibly different business models

Global Regulatory Tendencies

There are costs and risks to a program of action, but they are far less than the long-range risks and costs of comfortable inaction

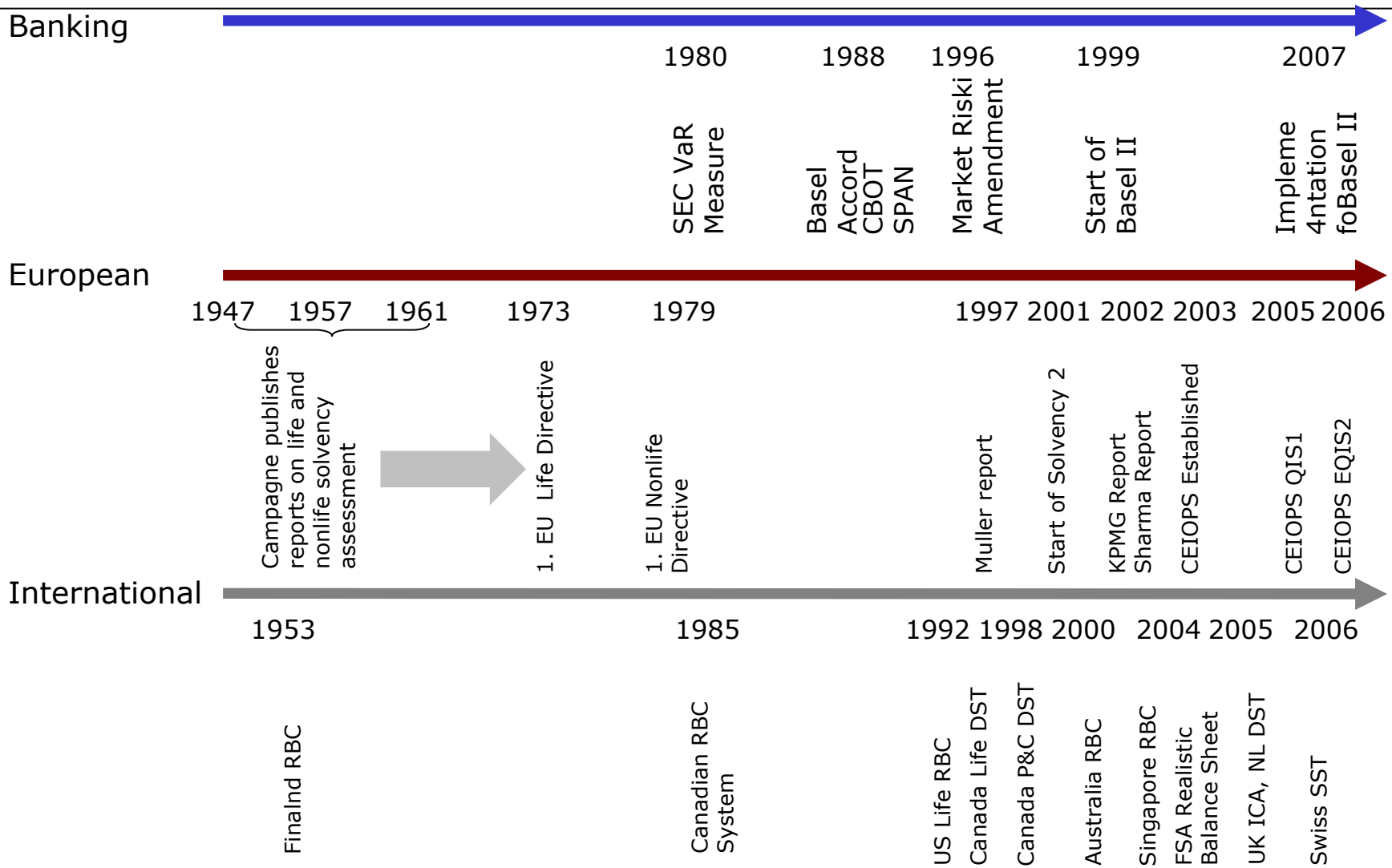
John F. Kennedy

In the past, insurance supervisors but also insurance companies were not sufficiently aware of economic reality

- The valuation of assets and liabilities were not adequate for an analysis of risk
- The artificial smoothing of results often made companies and supervisors inclined to comfortable inaction
- An adequate risk quantification was perceived by some to be too complex and too onerous

The financial crisis of 2000/2001 has shown to all that the insurance industry was more exposed than previously thought and both insurers and regulators saw the need for a more adequate, risk based supervisory framework → many regulators (UK, NL, CH,…) and the EU have started initiatives to develop more risk based supervisory models

Regulatory Initiatives



Contents

- Global Regulatory Trends
- Prudential Supervision and Risk Management
  - Risk Management
  - Prudential Supervision
- Risk Based Solvency Models
- Swiss Solvency Test
- Internal Models
- Group Effects
- Appendix

Prudential Supervision

Prudential Supervision aims to systematically evaluate the risk profile and the risk bearing capacity of the supervised entities.

Finnish Financial Supervisory Authority

What prudential supervision is about is helping protect other people from the failure of the institution by trying to ensure the institution is adequately run. An adequately-run institution needs to know why it's in business. It need s to have a strategy and some idea of where its revenues will come from. It needs to know what kind of risks it faces and, preferably, to try to measure them. It needs to know what kinds of risks it wants to face and take measures to eliminate the rest. And it needs to have some way of telling how much capital it needs to deliver an acceptable risk-adjusted return to shareholders

Howard Davis, Chairman, Financial Services Authority, UK

Prudential supervision is not only about quantifying insurers' risks, but to give incentives so that the companies themselves manage their risks appropriately, i.e. have an adequate risk management and corporate governance

Risk Management

Wir müssen wissen. Wir werden wissen.

David Hilbert

Risk management is responsible for identifying, assessing, analyzing, quantifying and then transferring, mitigating or accepting of risk

For risk management to be effective, there needs to be a risk culture such that senior management wants to know and risk management is able to tell the "truth" about the risks

Senior management and the board have to ensure that there is a honest dialog and transparency regarding risks within the company

Risk management is not solely about control but about confronting issues and uncomfortable truths openly and honestly

A risk based supervisory framework should be such that it fosters a climate in the market where an appropriate risk culture and risk management is rewarded

→ principles instead of rules

→ responsibility with senior management

→ transparency and trust in market and in regulator

Prudential Supervision: Pitfalls to Avoid

A regulator has to be careful not to give incentives for secondary risk management of supervisors

> Secondary Risk Management: the preoccupation of risk managers with managing their own risks. This can lead to a culture of risk aversion. Symptoms are that disclaimer paragraphs become longer than the expert opinion, a proliferation of risks which are considered in order to be able to cover all bases, the perception that all risk are unacceptable and a preoccupation with residual, ill-defined risk.
>
> (based on 'The Risk Management of Everything: Rethinking the politics of uncertainty', Michael Power, Demos 2004)

Symptoms of secondary risk management in supervision:

- The insistence on limits on investments and products
- The fear of transparency, allowing comfortable inaction
- An obsession with formalities rather than substance
- The fear and rejection of all things new and unconventional

Secondary risk management has to be fought with transparency: of the economic state of the companies but also of the regulatory requirements and a continuing, public engagement of the supervisors with all stakeholders

Principles vs Rules

".. in designing Solvency 2 our principal aim should be to incentivise insurance firms to use, and reward them for using, modern risk management practices appropriate to the size and nature of their business."

Speech by John Tiner, Chief Executive, FSA, ABI conference on Solvency II and IASB Phase II, 6 April 2006

A risk based solvency system has to rely on principles rather than rules if it has to give incentives for risk management

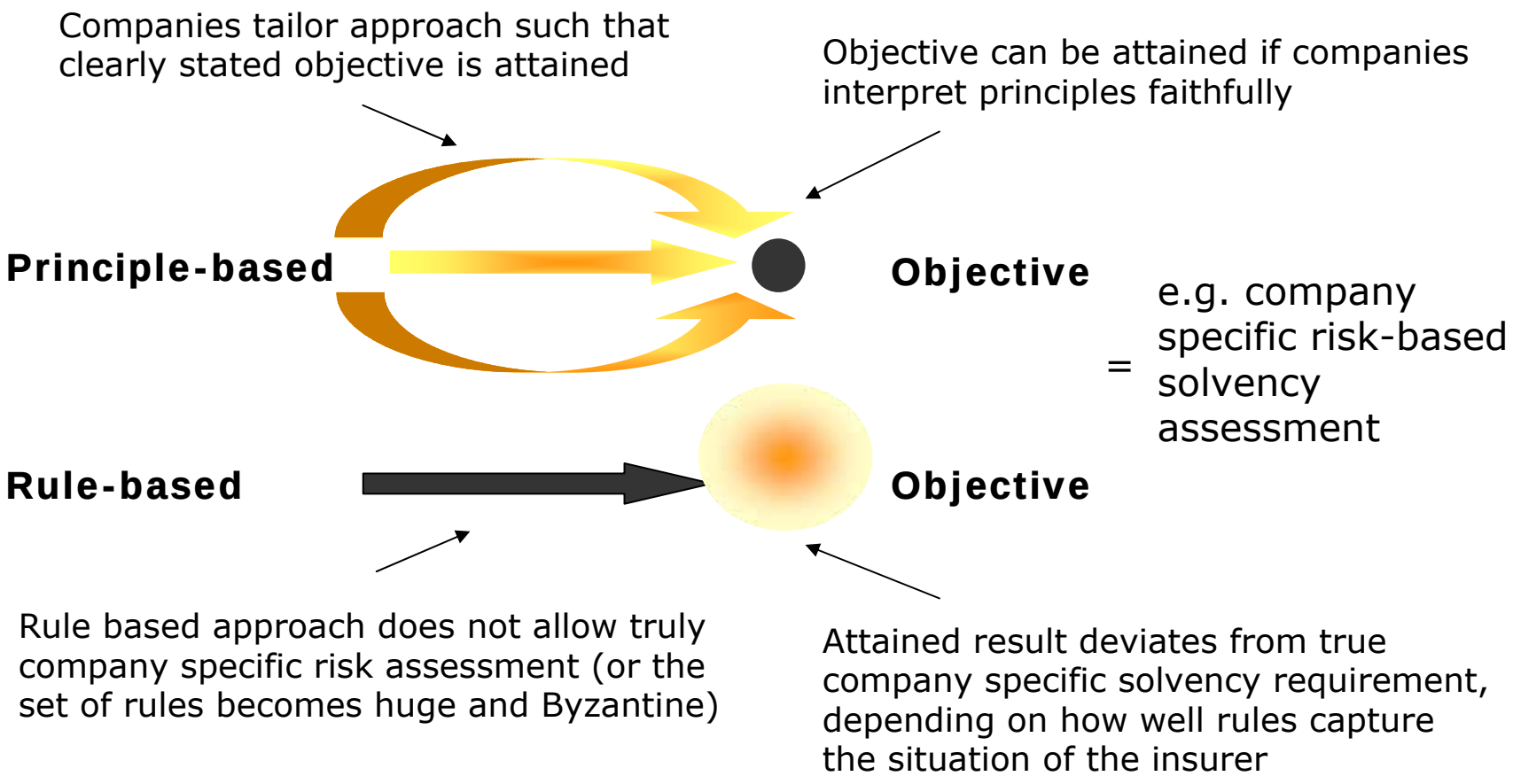
Principle-based standards describe the objective sought in general terms and require interpretation according to the circumstance

A rule-based approach is not be possible if internal models will be used for regulatory purposes

A principle based approach however only works if there is a responsibility culture and not with a compliance culture

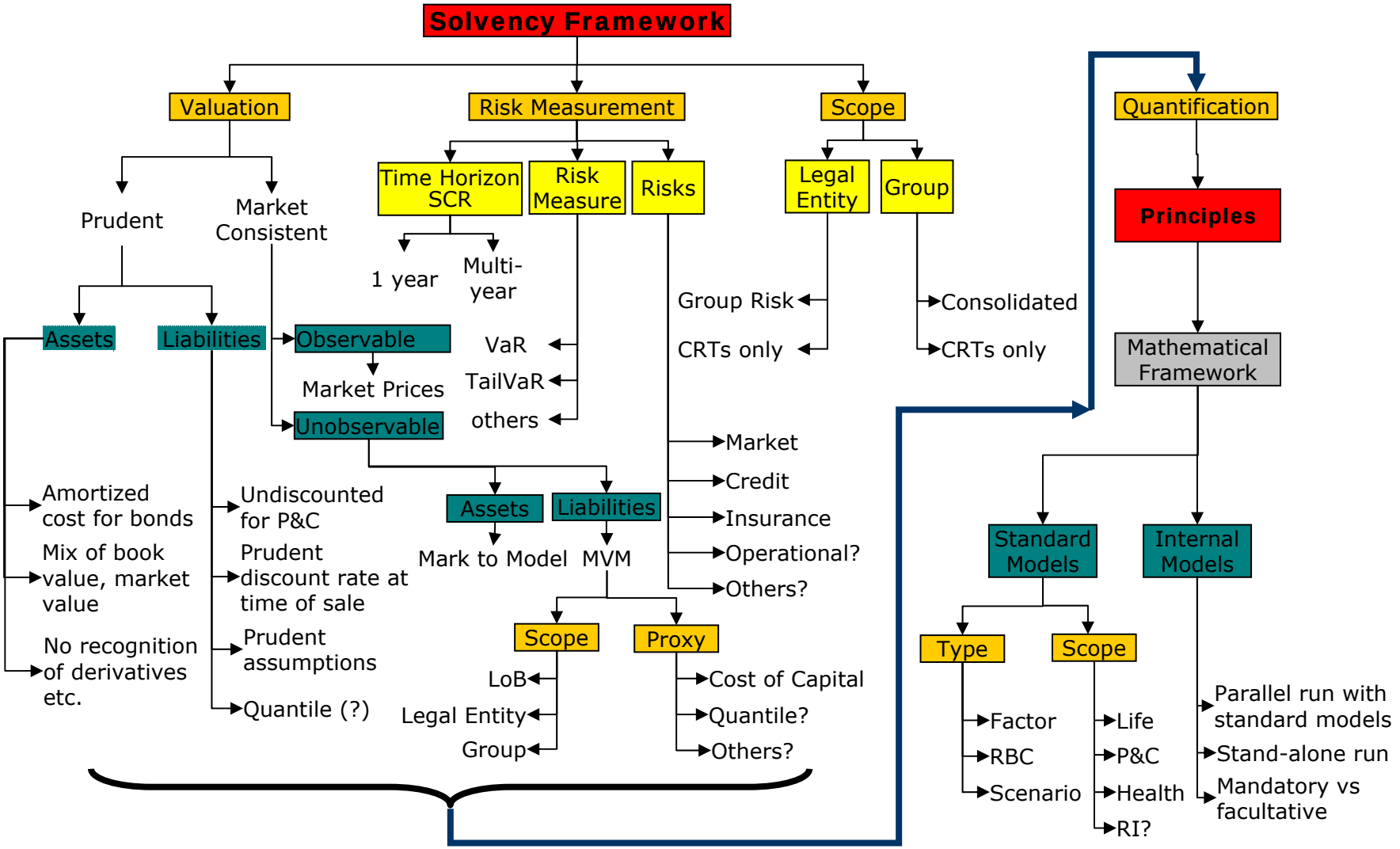
Principles vs Rules for Risk-Based Solvency

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



Contents

Risk Based Solvency Frameworks



Risk Based Solvency Frameworks

There are some unique challenges when developing regulatory capital models:

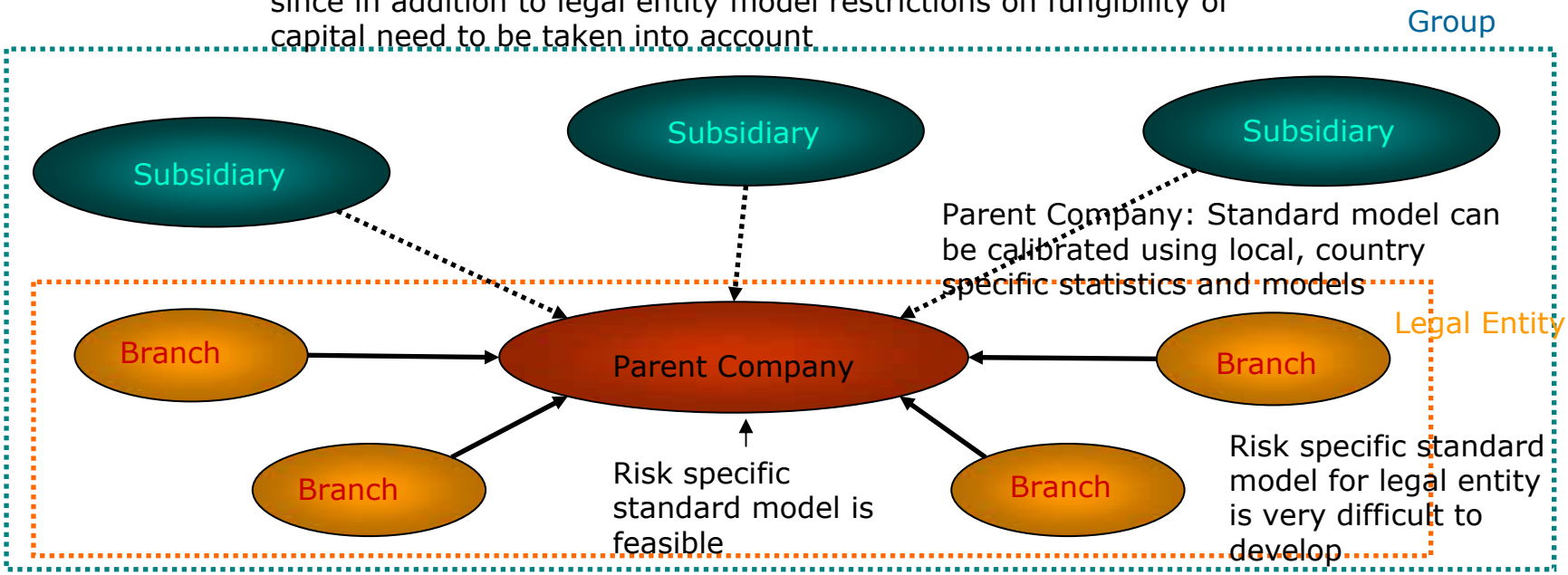
- They need to be applicable to a wide range of companies
- They should be flexible in order to allow adaptation to new risks
- They should be close to companies' internal models
- Their underlying principles should be transparent
- They should be easily recalibrated if risk factors change (e.g. financial market risk)
- They should not be so complex as to inhibit use of internal models
- They should not be so simple as to not allow the use of partial model as a stepping stone for smaller companies to full internal models

The art of defining a regulatory capital model is to find an optimal solution fitted to the specific insurance market

Scope of Regulatory Models

Subsidiaries: Can be in all parts of the world, home country regulator cannot calibrate easily (if at all) a standard model to different risk profiles. Mix of legal entity risk to risks emanating from subsidiaries is widely varying from group to group. Capital flow between subsidiaries and parent is restricted.

Risk specific standard model for group is extremely difficult to develop since in addition to legal entity model restrictions on fungibility of capital need to be taken into account



Branches: Can be in all parts of the world, home country regulator cannot calibrate easily (if at all) a standard model to different risk profile. Mix of parent country risk to risks emanating from branches is widely varying from company to company

Capital can flow (nearly) freely between branches and parent company and legal entity can be considered to be one risk-entity. Diversification between parent and branches.

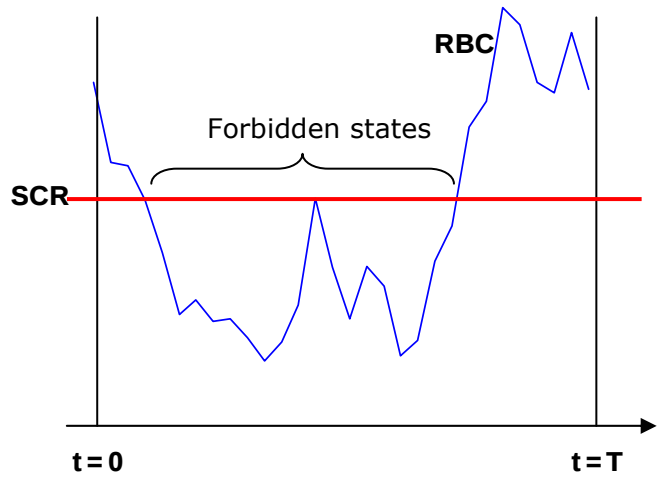
Time Horizon

The time horizon of 1 year used by most internal models and supervisory frameworks is not natural but a compromise:

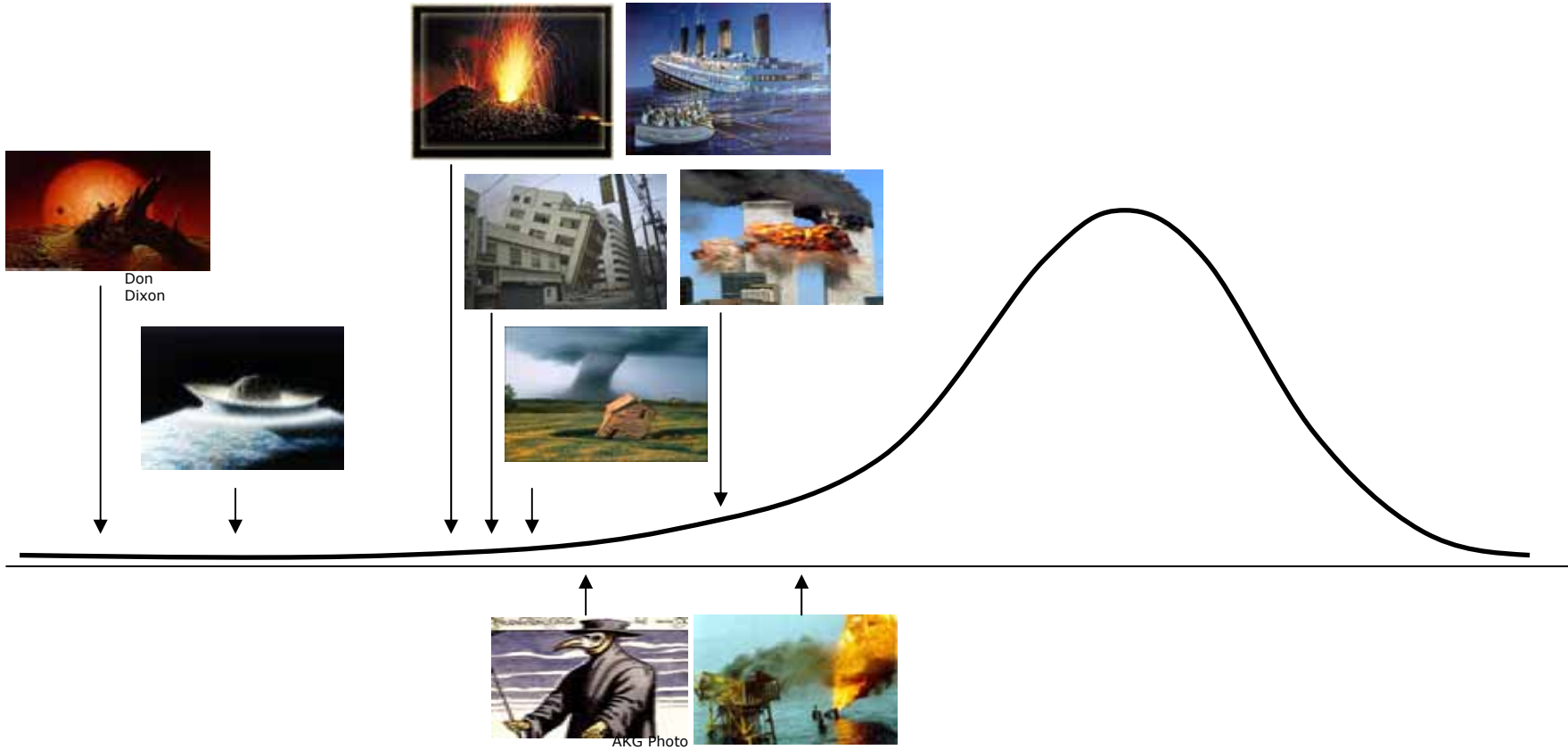
- A time horizon of one year is short enough that asset and business strategy need not necessarily be modeled: assume that asset and liability composition at the end of one year is more or less as at the beginning of the year
- Since solvability requirements (in theory) have to be fulfilled at each point in time a time horizon of one year is short enough so that satisfying the solvency requirement only at the end of each year is a reasonable approximation to a continuous model

However, the are also disadvantages to a one year time horizon:

- Diversification over time is limited
- During one year many things can happen (strategies can change, assets rebalanced etc. → SST requires to do a recalculation if risk situation has changed substantially

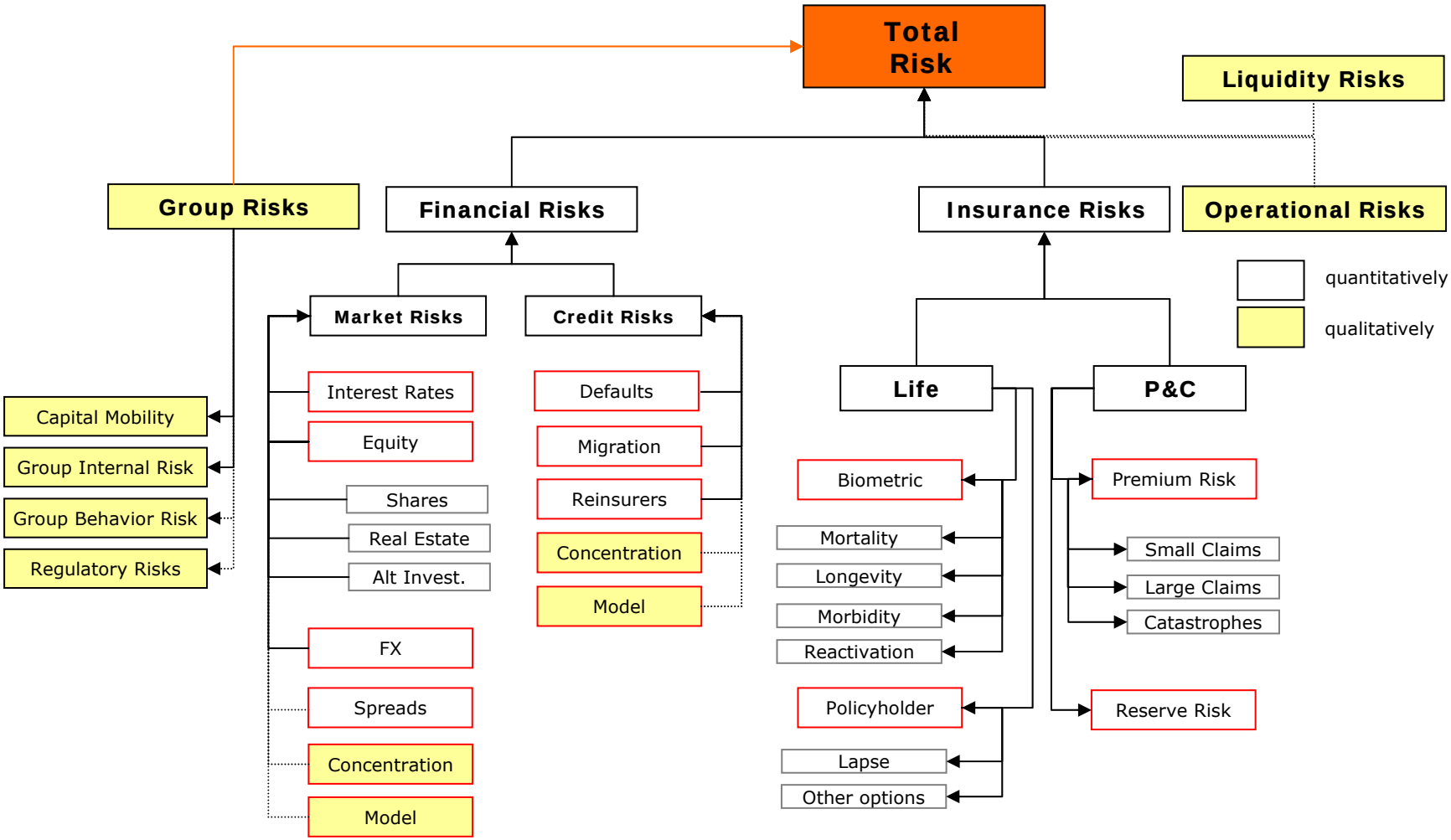


Risk: Regulatory Treatment of Risks



Irrelevant for Capital Requirements **Relevant for Regulatory Risk Capital** **Relevant for Reserving**

Risk: Classification (Example SST)



Risk Measures: Expected Shortfall vs VaR

The Expected Shortfall of a random variable X to the confidence level 1-α (ESα) is given by

$$ES_\alpha[X] = 1/\alpha \cdot E[\max(X - VaR_\alpha[X], 0)] + VaR_\alpha[X]$$

Expected Shortfall is a coherent risk measure

Shareholder: Only default or non-default is relevant not how bad the state of the insurer is in case of default as shareholders have a put-option on the insurer

(Merton) ⟶ Value-at-Risk might be appropriate

Policy Holder: In case of default, it matters how much capital is left ⟶ Expected Shortfall is more appropriate than VAR

From the perspective of an insurance regulator, Expected Shortfall has advantages compared to Value at Risk

For an insurer, Expected Shortfall has advantage of being coherent:

- Allocation of risk and risk management of subunits is possible
- ES_α is easier to explain to management:
  - $ES_{1\%}$=average one-in-a-hundred-years loss
  - $VaR_{1\%}$ = the loss that is in 99-out-of-a-100-years not exceeded

The Importance of Being Consistent

con·sis·tent (k&n-'sis-t&nt): marked by harmony, regularity, or steady continuity **:** free from variation or contradiction

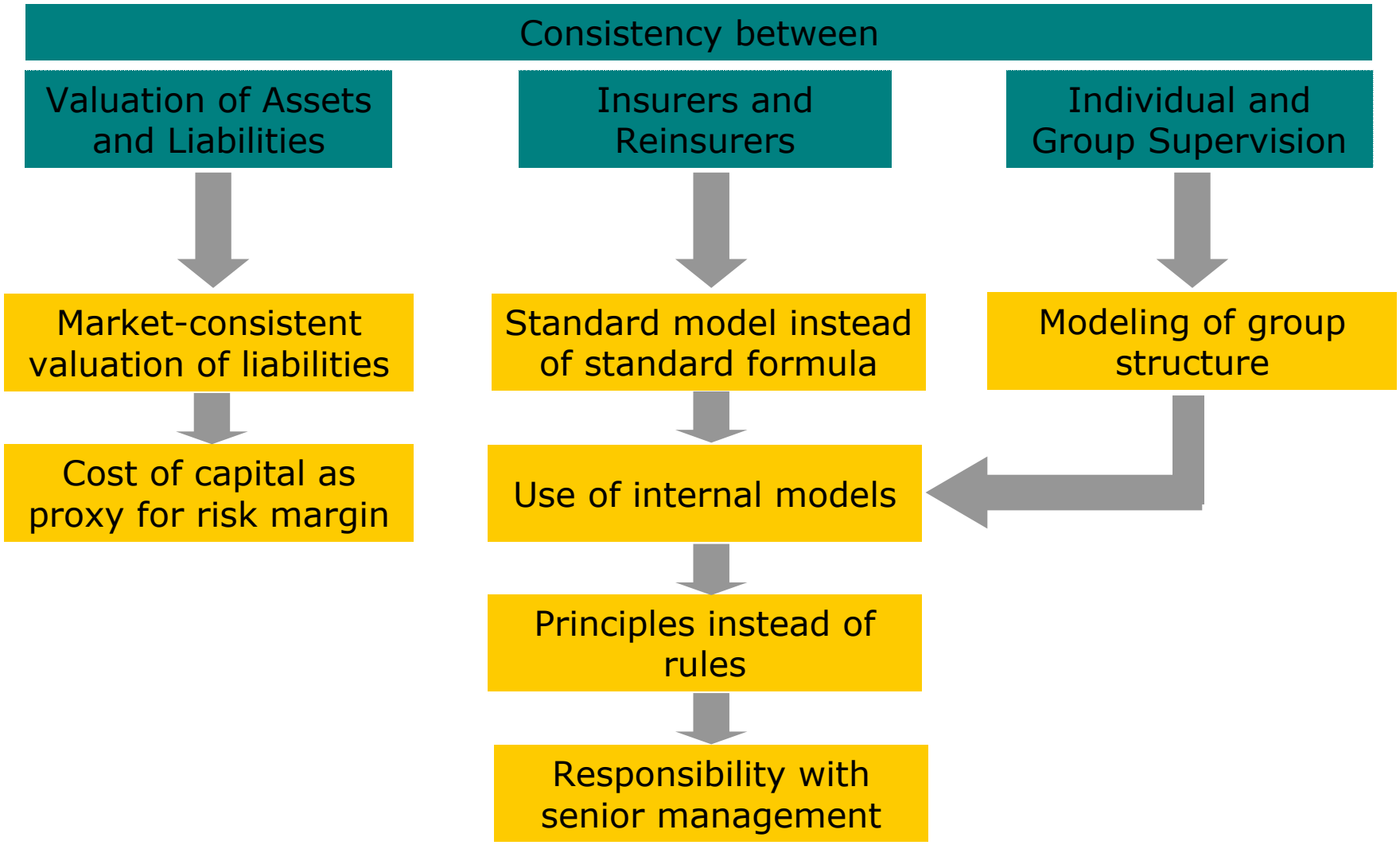
Merriam-Webster Online Dictionary

The consistency of a regulatory system is key, else:

- results are intransparent, prudence will be implicit
- a layer of economically irrelevant arbitrage instruments will be developed to exploit regulatory inconsistencies

Without consistency across	**Examples**
• **capital requirements of companies:** no level playing field	Solvency 1
• **valuation of assets and liabilities:** Artificial volatility	Solvency 1, IFRS Phase 1, many statutory valuation systems
• **valuation and risk quantification:** Model is mathematically not sound	
• **insurers and reinsurers:** Regulatory arbitrage	Old Swiss supervision act
• **individual and group level solvency tests:** Regulatory arbitrage	
• **different jurisdictions:** regulatory arbitrage, economic inefficiencies	Within Europe, Europe ~ US,…

Implications from Consistency Requirements



Consistency across Valuation and Risk

Most capital and solvency models consist of two main parts:

- **A valuation V(.) is a mapping from the space of financial instruments (assets and liabilities) in R:**

  V: A * L $\rightarrow$ R, where A * L is the space of all assets and liabilities

- **A risk measure rm(.) of a random variable (e.g. VaR, TVaR,…)**

$$AC(t) = V(A(t))-V(L(t)),\ t=0,1$$

$$SCR = rm(\ AC(1) - AC(0)\ )$$

Available capital (risk bearing capital) at time t=1: random variable

Available capital at time t=0: known

Standard models and internal models should be consistent across valuation and risk quantification

Consistency across Insurers and Reinsurers

- Capital and valuation requirements for insurers and reinsurers should be the same
- The risk transfer from insurer to reinsurer has to be adequately captured
  - Many smaller companies transfer a substantial part of their risks to reinsurers. Not taking this into account in the capital requirement would put these companies at a disadvantage

  → The standard model should be able to adequately capture the risk transfer

  - A simple standard formula or standard model is not able to capture most reinsurance solutions used (e.g. XL, Stop Loss, multi-year covers, etc.)

  → The risk transfer has to be captured either by a sufficiently complex standard model or by internal models

Valuation

Actuaries of the Past

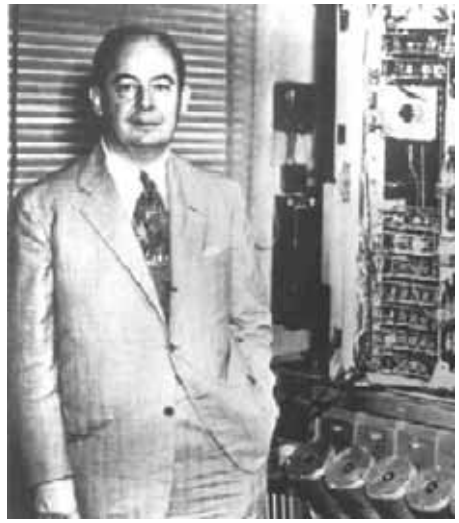
Coyle & Sharpe © Mal Sharpe

Prediction of future asset returns and banking conjectured gambling profits by using high discount rates for the valuation of liabilities

Injection of ambiguity into the predictions by using 'prudent' parameters

Never going back to past predictions and forever using parameters used in the past

Actuaries of the Future



John von Neumann

Using recognized mathematical and financial models

Having transparency on prudence by using an explicit risk margin

Regularly reassessing and updating the valuation and using most recent information

Requirements on the Valuation

Requirements on a appropriate valuation from a regulatory perspective:

- Consistency across assets and liabilities and across products: Without consistency, arbitrage and pure 'valuation' volatility will result (e.g. a IFRS phase 2 situation)
- Uniqueness: There should not be choice in the sense that one can switch a valuation scheme arbitrarily (e.g. amortized cost or market value for bonds, discounting or not discounting liabilities)
- Codifiability: The valuation scheme must be such that it can be codified (e.g. via principles or rules or a mix thereof)
- Approximates observable prices: A valuation scheme should not result in prices which are far off observation, at least for a reasonably efficient market
- Accepted and used by market participants: Without acceptance by the market (not only by actuaries!), the valuation can not become embedded within the companies

Valuation: The economic view

How to measure risks?

Accounting risk or economic risk?

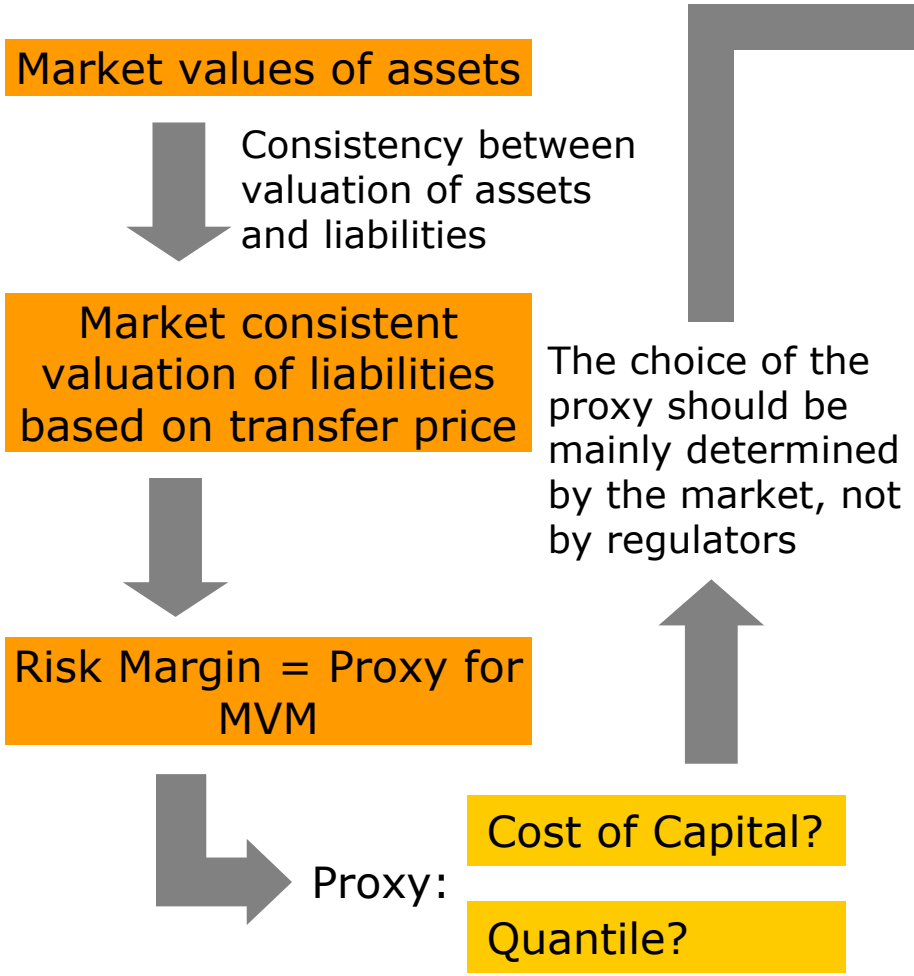
> *Reported earnings follow the rules and principles of accounting. The results do not always create measures consistent with underlying economics. However, corporate management's performance is generally measured by accounting income, not underlying economics. Therefore, risk management strategies are directed at accounting, rather than economic performance.*
>
> Enron in-house risk-management handbook

For a risk-based solvency system, risks need to be measured objectively and consistently → economic risk rather than accounting risk

→ Market Consistent Valuation of Assets and Liabilities

Market Consistent Valuation

Logical consequences of using market values for assets:



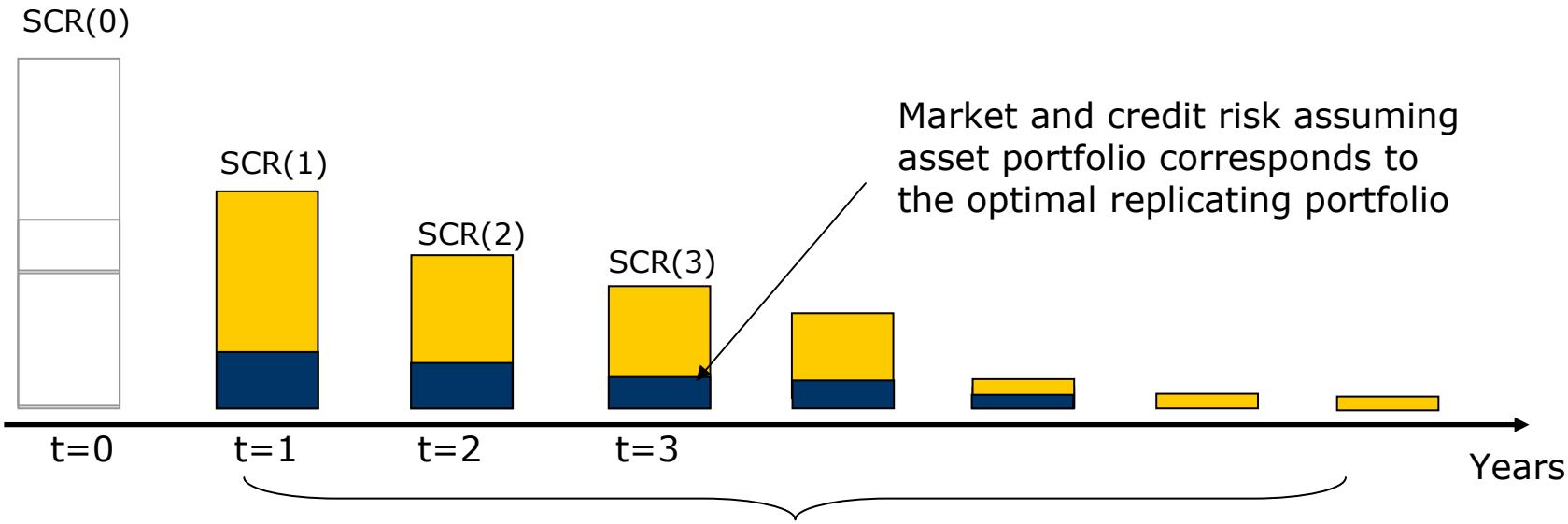
For valuation, M&A, EEV, portfolio transfers, etc. the cost of capital approach is used predominately → CoC is a proxy for the MVM by definition

CoC applied for regulatory purposes: 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

Proxy for the Market Value Margin = the present value of future regulatory risk capital costs associated with the portfolio of liabilities

Market Consistent Valuation

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



Future SCR entering calculation of MVM at t=0

→ no double-counting of risks

Premium risk

Reserve risk

Market and credit risk

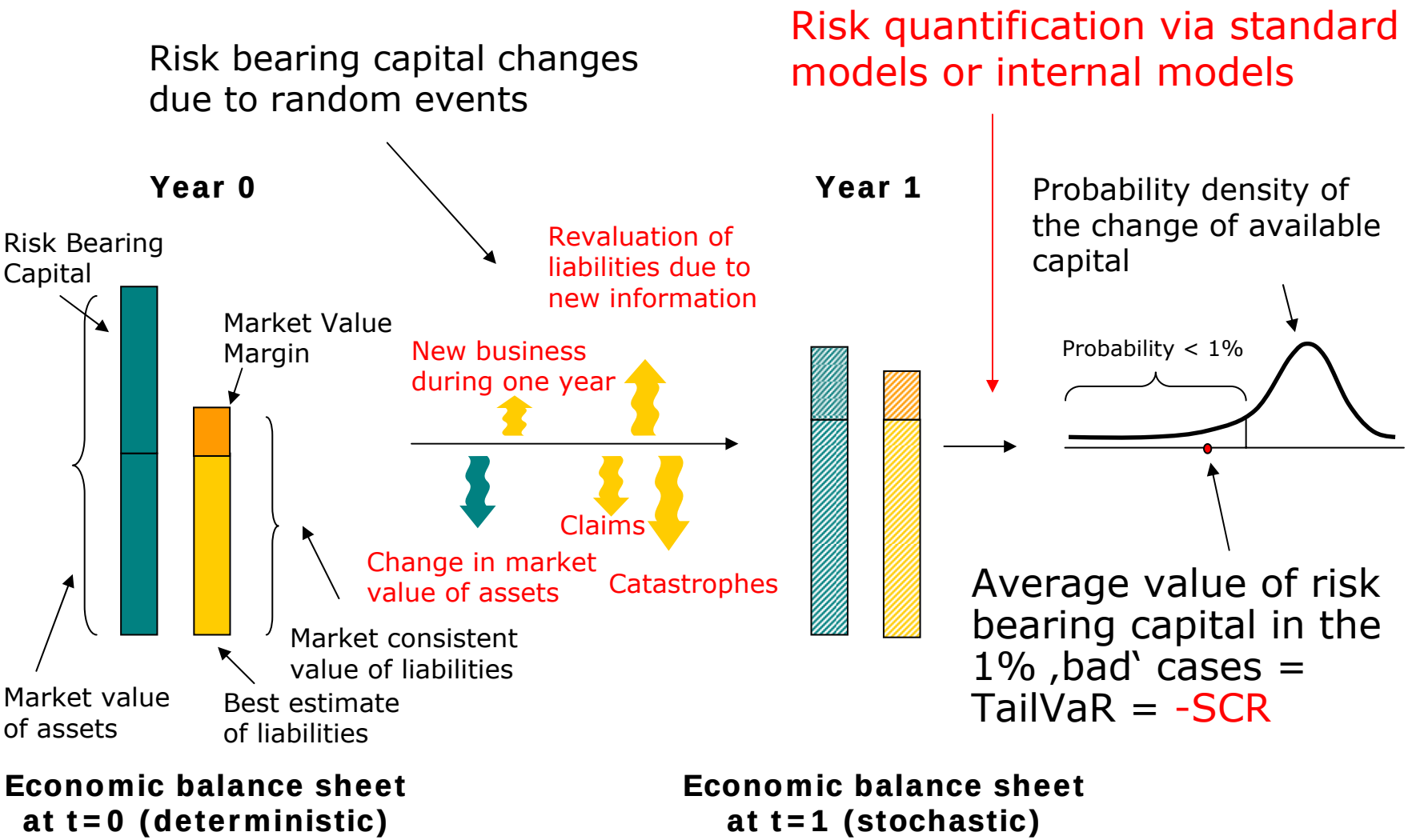
Note: This approach for calculation of the cost of capital margin assumes that the portfolio transfer occurs at the end of year 0, hence SCR(0) does not enter into the calculation

Market Consistent Valuation: Definition

Advantages of the Cost of Capital Margin Approach:

- The CoCM is defined as a proxy for the MVM, therefore it fits into a market consistent valuation framework
- It can be defined consistently for both life and P&C companies
- It allows a range of calculation methods, from very sophisticated to simplified
- It is congruent to the margins used by many companies internally (e.g. for pricing, for EEV,…)
- It forces companies to think about long term risk and capital requirements
- For supervisors, the Cost of Capital approach is easy to review

Risk as Change of Risk Bearing Capital



Regulatory Models: Typology

Factor Models: Linear combination of volume measures

$$C = a_1 * v_1 + a_2 * v_2 + \cdots + a_n * v_n$$

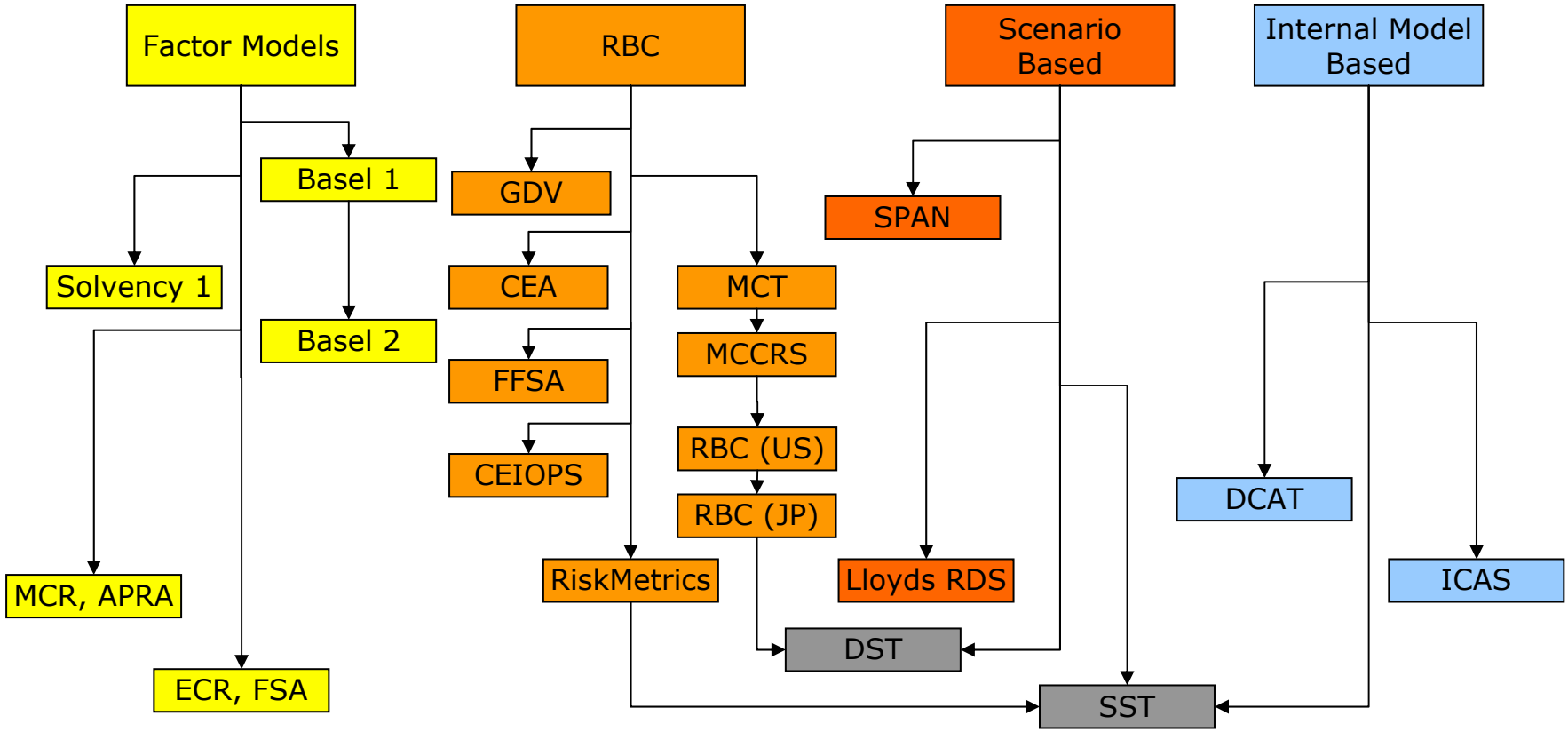
RBC Models: Combination of risk charges C1,C2,…

$$C = C_1 + \sqrt{C_2^2 + (C_3 + C_4)^2}$$

Scenario Based:

$$C = f(S_1, \ldots, S_n)$$

Internal Model Based:



Standard Formulae vs. Standard Models

Standard Formula: A simple formula which uses easily obtainable accounting or other values to arrive at a (more or less good) proxy for necessary economic capital (SCR). If the calculation can be done by a HR manager, then it is a standard formula.

Example: Solvency 1, GDV model

Standard Model: An algorithm or a description of a sequence of calculation steps ending the desired results and allowing company specific adaptations. If the user needs know-how of the underlying model and risks and expert judgment, it is a standard model.

Example: Internal Models, ICA, SST

Standard Formula

Pros

- Simple
- Easy to check
- Very little work needed
- The way of calculation is comparable

Cons

- Not risk sensitive
- Not company specific
- Often allows arbitraging against
- Gives no incentive for risk management
- Underlying assumptions often not clear
- Partial internal model are difficult to integrate
- Financial and reinsurance risk mitigation can not be captured adequately
- Introduces systemic risk

Standard Model

Pros

- Incentivizes risk management
- Result is company specific
- Financial and reinsurance risk mitigation fully reflected
- The results are comparable
- Underlying assumptions are clear
- Result is more than just a number

Cons

- More work intensive
- Needs educated users

Risk Based Solvency Frameworks

There are some unique challenges when developing regulatory capital models:

- They need to be applicable to a wide range of companies
- They should be flexible in order to allow adaptation to new risks
- They should be close to companies' internal models
- Their underlying principles should be transparent
- They should be easily recalibrated if risk factors change (e.g. financial market risk)
- They should not be so complex as to inhibit use of internal models
- They should not be so simple as to not allow the use of partial model as a stepping stone for smaller companies to full internal models

The art of defining a regulatory capital model is to find an optimal solution fitted to the specific insurance market

Risk Based Supervision

Necessary skill-set of supervisors

Rule Based System:

- Generalists
- Verification of compliance
- Limited need for creativity and conceptual thinking
- Little need for technical know-how
- Staff predominantly with legal/economic background

Principle Based System:

- Specialized know-how + ability to see the big picture
- Creativity
- Ability for conceptual thinking
- Ability to challenge insurers
- Communication skills
- Staff predominantly with mathematical/hard science background

The shift from a rule based to a principle based solvency system constitutes a big cultural change for the industry and also for supervisors. Ideally, risk-based and market-conduct supervision should be completely segregated since often the aims are conflicting

FOPI increased staff with mathematical background by approx. 150 % during the last 2 years in order to be able to implement the new risk based supervision

Contents

- Global Regulatory Trends
- Risk Management
- Risk Based Solvency Models
- Swiss Solvency Test
  - Principles
  - Standard Models
  - Scenarios
  - Experiences from the Field Tests
- Internal Models
- Group Effects
- Appendix

Swiss Insurance Supervision Act

Old Act

- Rule based
- Product and tariff approval
- Restrictions on products, investments and pricing
- Solvency 1 capital requirements only, no consideration of financial market risks

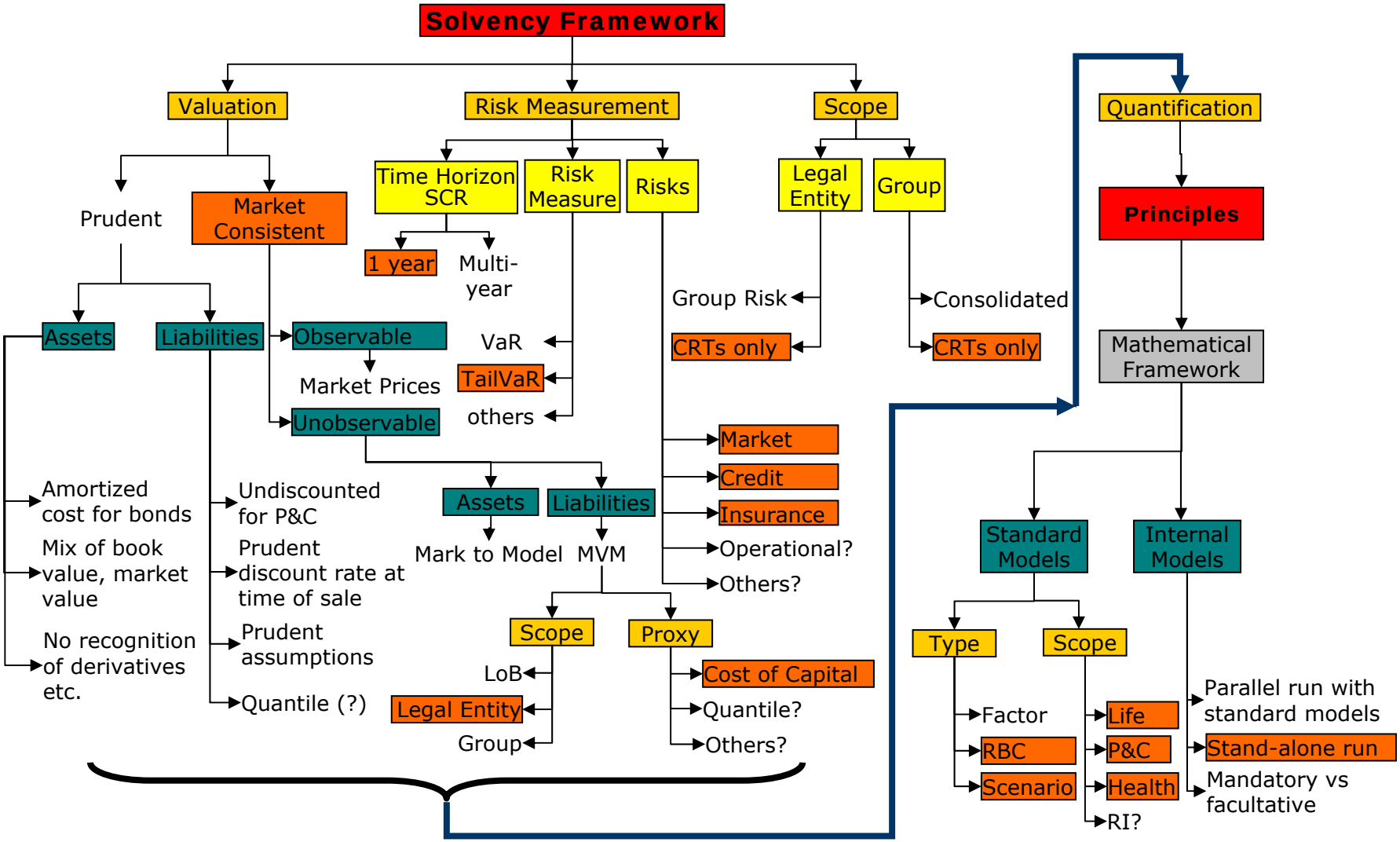
Consequences:

- Overexposure to risky assets
- Underpriced long-term guarantees
- No guidelines by actuarial association due to prescriptive regulatory rules
- Accounting and regulatory arbitrage
- Compliance culture
- Abrogation of responsibility to the regulator
- Gambling on resurrection in case of financial problems
- Often underdeveloped risk management
- Regulatory requirements disconnected from companies internal risk based calculations

New Act (1 January 2006)

- Principle based
- Review of technical provisions
- No restrictions on products (except for some mandatory life and health products)
- Less restrictions on investments
- Dual Solvency 1 and risk-based capital requirements (Swiss Solvency Test, SST)
- Corporate governance and risk management requirements
- Appointed actuary for all insurers and reinsurers
- Supervision of groups and conglomerates
- Consistent requirements for insurers and reinsurers
- Responsibility with senior management

The SST Concept



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 approximated by 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: Standard Models

SST Standard Model: ‚Standard Algorithm' rather than Standard Formula

The standard algorithm is similar to companies' internal model:

- gives incentives for risk management
- corresponds closely to the thinking of the user of the model (e.g. actuaries, investment specialists, CROs,…)
- Allows easy use of partial internal models
- allows easy and consistent mapping of reinsurance (business ceded)

Financial market Risk: RiskMetrics type approach (Covariance matrix of market risk factors)

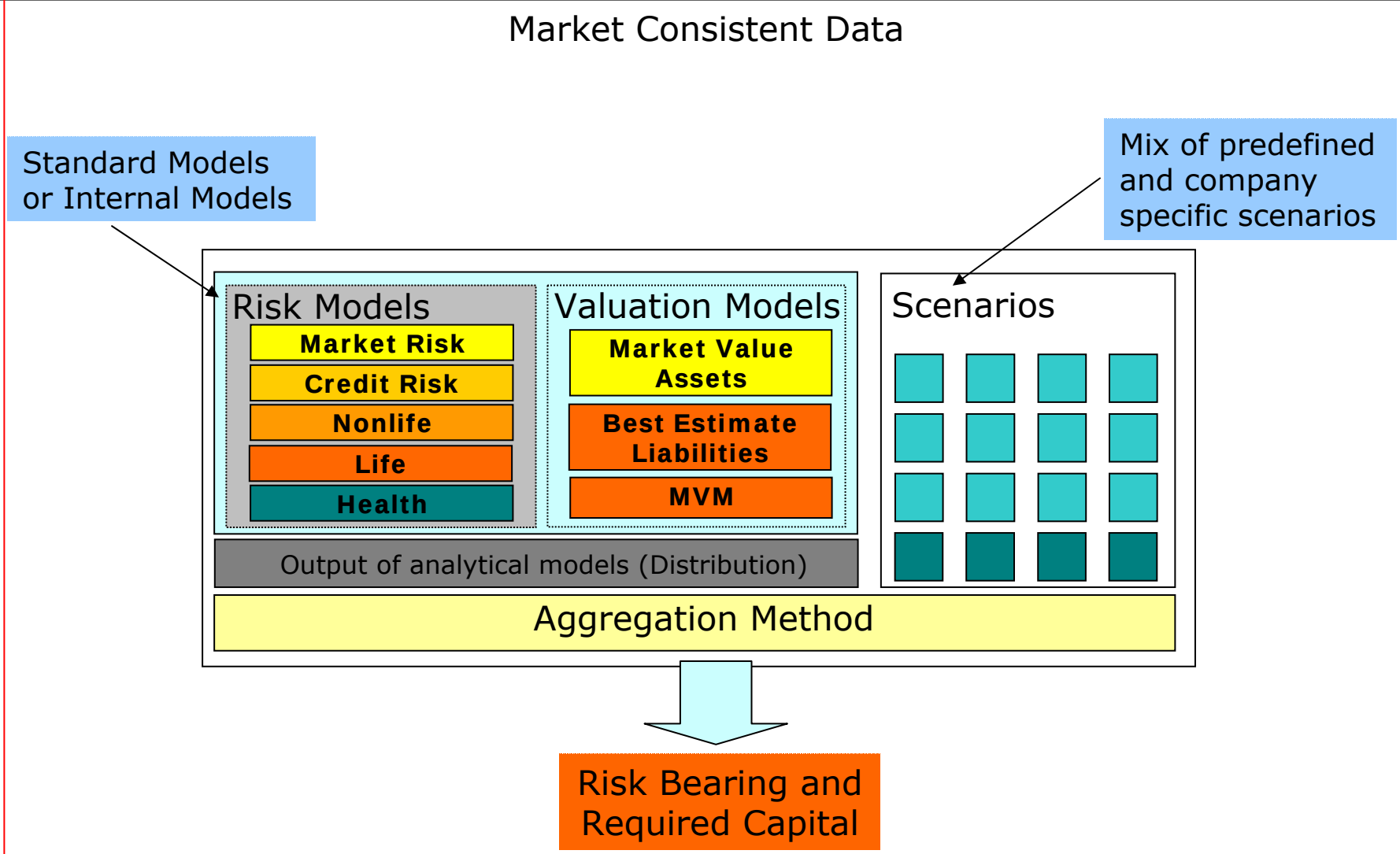
Credit Risk: Basel 2 or Credit risk portfolio models, credit risk of reinsurers via scenario

P&C Insurance Risk: Distribution based (small, large and cat claims)

Life Insurance Risk: Covariance approach for life insurance risk factors

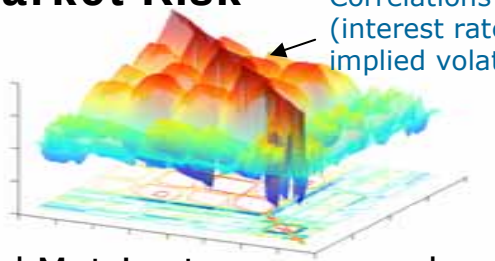
- Companies have to determine sensitivities of assets and liabilities to financial market risk factors
- Analyze life and P&C insurance risk, determine company specific parameters
- Aggregate risk using convolutions etc.

Swiss Solvency Test: General Framework



Swiss Solvency Test: Standard Models

Market Risk

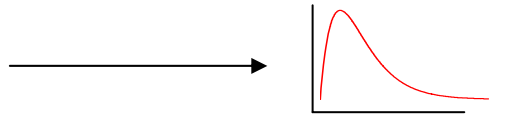


Correlations btw risk factors (interest rates, equity, FX, implied volatilities)

RiskMetrics type approach with ~80 risk factors. Sensitivities w.r.t. risk factors of both assets and liabilities have to be determined

P&C Risk

Insurance Risk
- Premium Risk
  - Small Claims (Gamma Distribution)
  - Large Risk (Lognormal)
  - Catastrophes (Compound Poisson-Pareto)
- Run-off Risk (Lognormal)



Life Risk

Covariance approach for 8 risk factors (mortality, morbidity,…)

Internal models have to be used if substantial embedded options and nonlinearities are in the books → e.g. replicating portfolios, market consistent scenarios,…

Credit Risk

Basel II (standard, advanced or IRB); recalibration to 99% TVaR. Spread risk treated within the market risk model.

Internal Models (CR+, KMV type,…)

Credit risk of default of reinsurers is treated via a scenario

Scenarios

Historical financial market risk scenarios (Crash of 2001/2002, Russia crisis,…)
Predefined scenarios (pandemic, industrial accident, default of reinsurers,…)
Company specific scenarios (at least three, e.g. nuclear meltdown, earthquake in Tokyo,…).
Scenarios have to describe impact of events on all relevant risk factors (e.g. Pandemic leads not only to excess mortality but also to downturn of financial markets).

Swiss Solvency Test: Risks

Risks entering the capital requirement: Market, credit and **insurance risks** which emanate during a 1 year time horizon

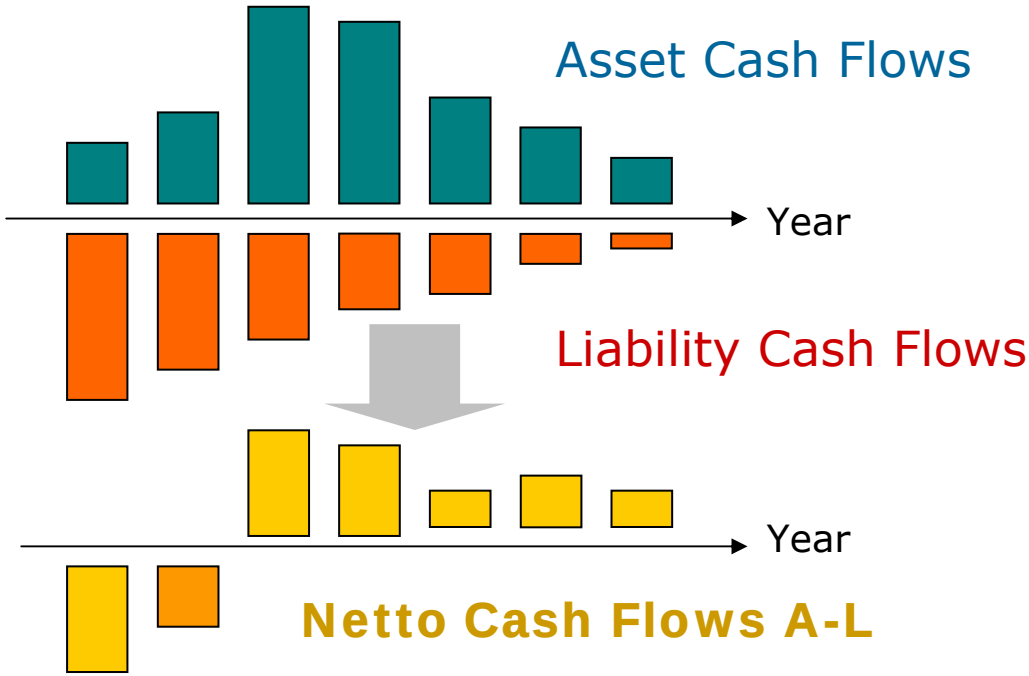
Operational Risk does not enter SST capital requirement:

- As of now, quantification is too subjective for imposing capital requirements
- Capital might not be an optimal measure against operational risks
- A (simple) quantification can lead insurers and supervisors to believe that the risk has been managed
- Operational risk differs from market, credit and insurance risk since there is no upside and capital requirements could lead to a culture of excessive control
- Tendency to concentrate on quantifying easily measurable losses rather than important ones: routine systems error, petty misdemeanors of employees rather then low frequency/high impact events where there are (per definition) few data
- Using high-frequency data and then extrapolate to tail-events (e.g. via assumptions on the loss distribution) needs to be based on a convincing story
- Some risks (operational, reputational risks, etc.) might be better handled qualitatively by what-if scenarios, narrative etc. than by quantification

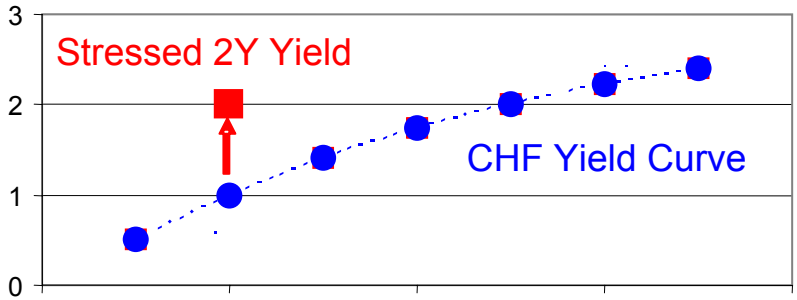
Operational risk is treated qualitatively with the option for supervisors to impose an add-on in case of inadequate operational risk management

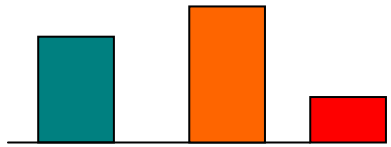
The SST Concept: Cash Flow Based

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



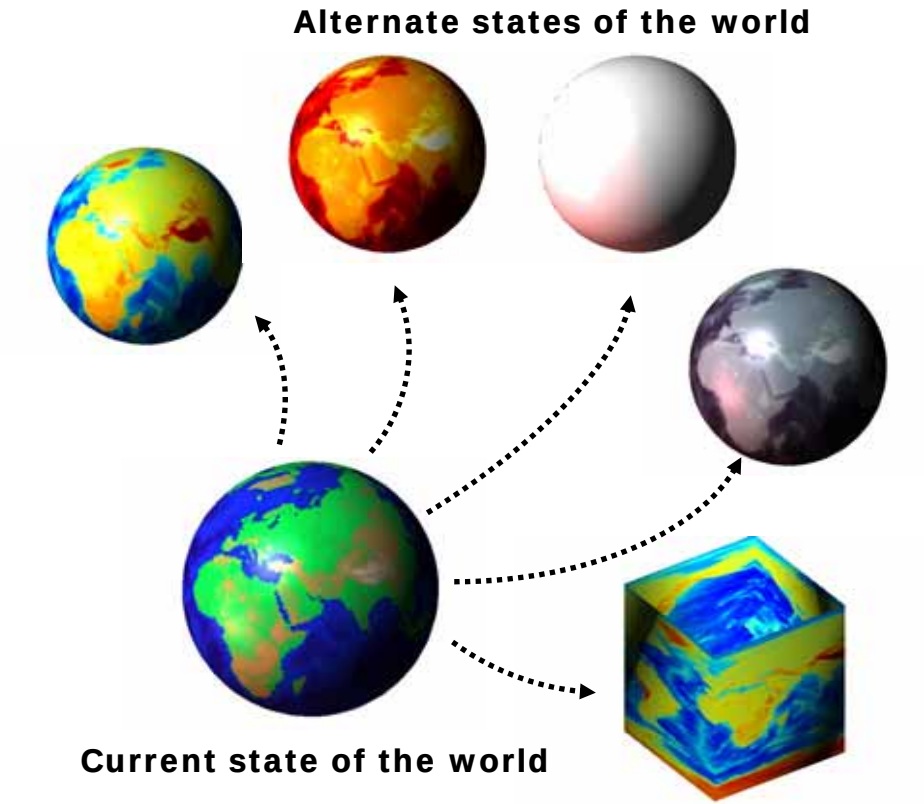


Present Value von Asset - Liabilities

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

The formulation and evaluation of the scenario should not be a compliance exercise but will entail a detailed and comprehensive discussion not only of primary but also of secondary and tertiary effects.

> Example: *A scenario 'Earthquake in Tokyo' should not only specify the financial impact due to loss of life and to the collapse of buildings, but also discuss the implication on the financial markets (e.g. the collapse of the global financial market for a given duration, the effect on global markets of Japan having to rebuild the infrastructure, etc.).*
>
> Example: *A scenario 'Dirty Bomb in European City' should not only specify the financial impact due loss of life but should in addition discuss the impact on real estate prices, airline travel, financial markets, consumer confidence, long term effects on mortality and morbidity, …*

The formulation of the scenario should comprise

a) the event occurring during the following year

b) the effects of the scenario in the future

The SST Concept: Scenarios (Pandemic)

Pandemic

Biometric Effects

Extra mortality corresponds to ≈ a doubling for Europe, an increase by ≈ 60% for North America and by up to 1000% for Asia.

Hospitalization, Bed Days

Based on government study. For risks not in Switzerland, the assumptions for Switzerland can be scaled with the number of inhabitants of the country and the number of projected deaths of the country

Financial Market Effects

- FX rates: Depreciation against the CHF
- Bonds: Decrease of interest rates
- Spreads: Widening
- Share prices: Decrease except for pharmaceuticals

Other Scenarios

Historical Scenarios: Stock Market Crash 1987 and 2001, Nikkei Crash 1989, European Currency Crisis 1992, US Interest Rates 1994,…

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

Deflation: decrease of i.r.

Longevity

Reserving: Provisions have to be increased by 10%

Default of Reinsurer: Industrial Accident: Accident at chemical plant

Collapse of a dam (Swiss specific)

Terrorism

…

+ 3-5 company specific scenarios

Swiss Solvency Test: Experiences

- Most small and mid-sized companies participating in the field tests find the SST useful to gain additional insight into risk situation and will use it internally for quantitative risk management
- Some mid-sized companies want to develop partial and full internal models even though the use of the standard model would be acceptable by the supervisor
- The standard model was doable for small companies (with a workload of 1-2 person months)
- Most companies (irrespective of size) find increased company internal dialogue about risk and risk management very useful

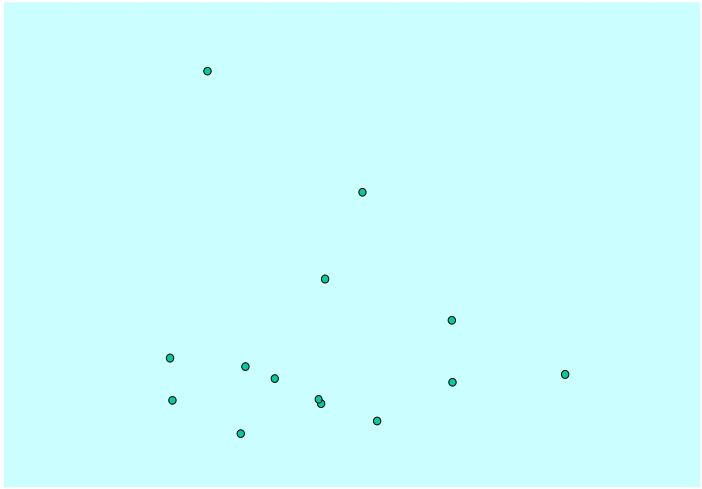
- The Solvency 1 ratio and the economic solvency ratio are only weakly correlated (correlation 0 for P&C, 0.4 for life) → statutory solvency is a bad predictor for economic solvency
- The discussion about the modeling and assumptions with the companies allow the supervisors to gain deep insight into the risk culture of companies → SST is not merely about quantification but much more about the qualitative assessment of insurers
- The analysis of the field tests is public and published on the FOPI webpage (www.bpv.admin.ch)

Results of the Field Tests: Solvency Ratios

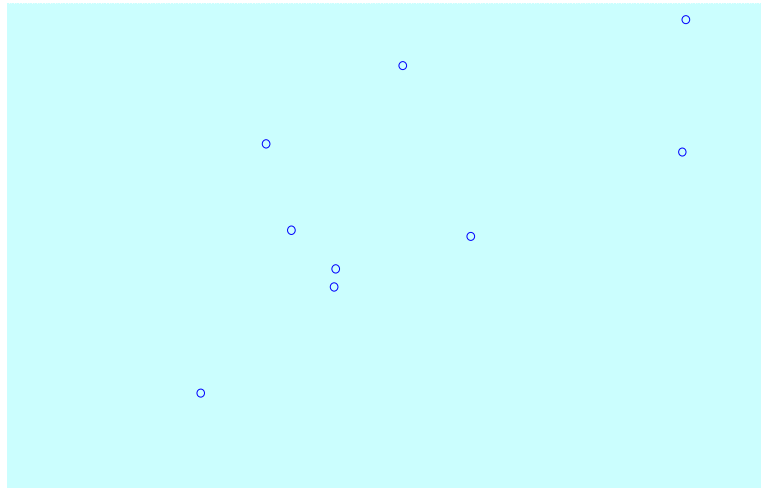
The Statutory Solvency Ratio is only a weak predictor for the SST Solvency Ratio

For nonlife companies, Spearman's Rank Correlation is approx 0 and for life companies Spearman's Rank Correlation is approx 0.5

Nonlife



Life

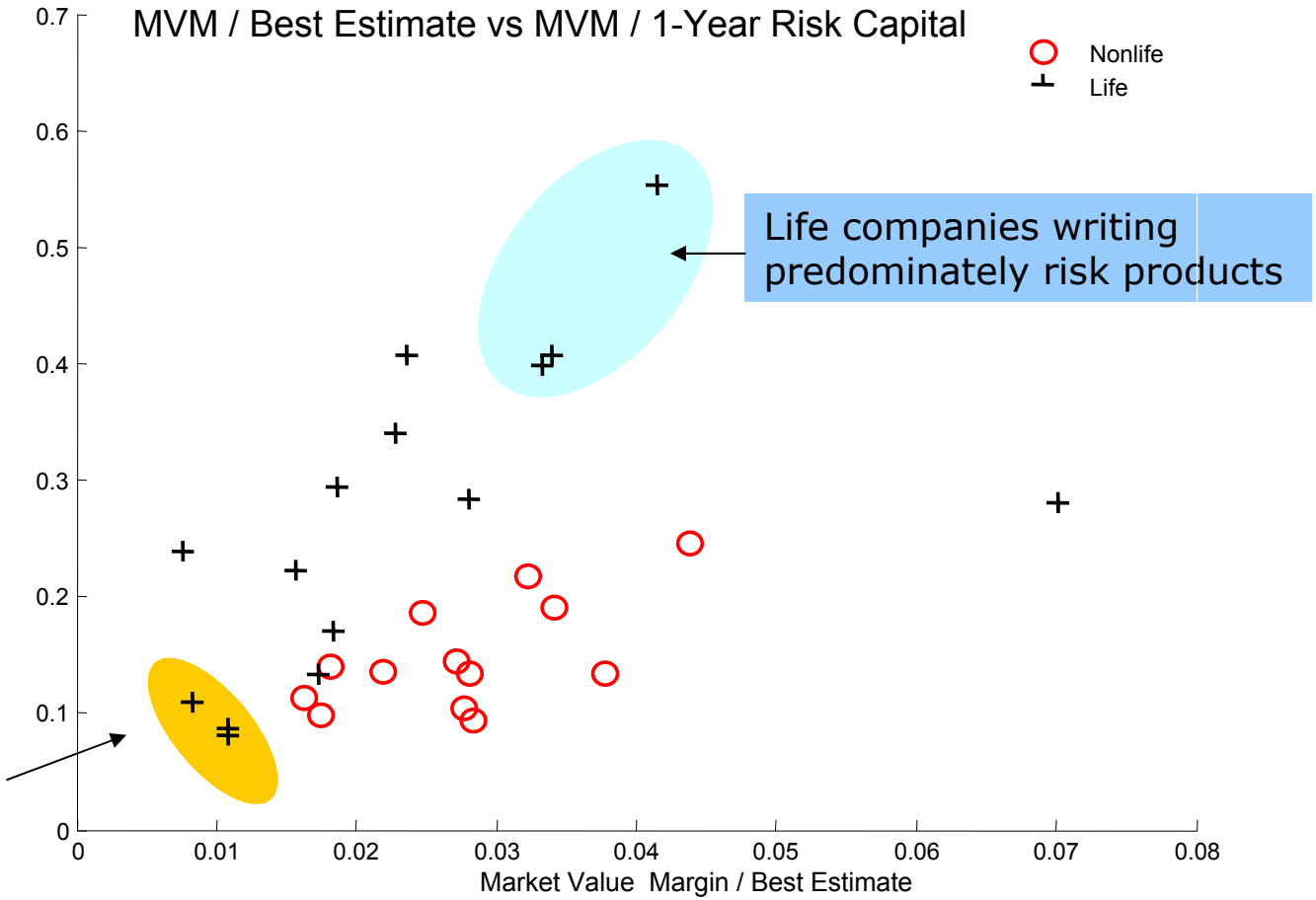


Results of the Field Tests: MVM

Market Value Margin / Best Estimate vs Market Value Margin / ES[RBC], based on provisional data of Field Test 2005

X-axis: MVM divided by best estimate of liabilities

Y-axis: MVM divided by 1-year risk capital (SCR)



Contents

- Global Regulatory Trends
- Risk Management
- Risk Based Solvency Models
- Swiss Solvency Test
- Internal Models
  - Challenges for Supervision
  - Definition
  - Internal Models: Acceptable vs Unacceptable
  - Review
  - Transparency
- Group Effects
- Appendix

Internal Models: Definition

A model is a framework to discuss economic capital

The point of the model is not (solely) the calculation of economic capital but to have a common framework for discussion of risks, of dependencies, of links between different areas of the business etc.

It consists of :

- Methodology: Assumptions, models, mathematics, mapping of the real world to a conceptual framework,…
- Parameters: estimates, mortality tables, claim size estimates,…
- Data: Position data, data on financial instruments, insurance policies,…
- Implementation: Software code, IT platforms, data warehouses,…
- Processes: Testing, back-testing, falsification, plausibilisation, estimation,…

Some supervisors show reluctance for the use of internal models.

However, internal models have been used since the beginning of insurance for valuing technical provision.

The difference of calculating provisions to an internal model used for economic capital calculation is only that the former is often done without a formalized algorithmic process.

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

Internal models for the SST have to be used by:

- Reinsurers (~20)
- Captives (those which have to do the SST) (~10-15)
- Groups and conglomerates (10-15)
- Legal entities with substantial amount of business written by foreign branches (~10-15)
- Insurers, for which the SST standard model is not applicable (?)
- Life insurers writing substantial options and guarantees linked to financial market (in discussion) (~5-10)

Some small and mid-sized companies already indicated that they will develop partial- and full internal models in order for the SST calculations to be better integrated within the companies' processes

In addition, the determination of technical provisions is done via a internal model

Internal Models: Challenge

For some type of insurers, models are often assumption driven: Up to 90% of the economic capital requirement due to insurance risks emanates from assumptions and only 10% from historical data:

- models can often not be back-tested;
- The review has to rely less on formalized requirements as for VaR market risk engines;
- The assessment of models has to rely more on experience, comparison with similar models and embedding of the model within the company

The regulatory review of models will rely heavily on discussions with quants and actuaries, assessment of company's know-how of the model and its limitations and public transparency

There are limits on what a regulator can demand from internal models of insurers and reinsurers:

- Model verification is impossible
- Falsification is in many cases unpractical
- The scientific method cannot be formalized. There can be no set of guidelines codifying the model approval process
- We need to accept that some properties of a model cannot be ‚proven' statistically (e.g. some dependency structures, some parameters)
- Models can, however, be persuasive

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: Review

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.

Internal Models: Public Transparency

A little light dispels a lot of darkness.
Rabbi Schneur Zalman

The public disclosure requirements on internal models should be principles based. The amount of information to be disclosed should be based on the principle that a knowledgeable person can get a reasonably good impression on the basic methodology of the internal models as well as on the major design decisions. In particular a description of the following main features should be provided:

- valuation methods (for assets and liabilities);
- risk measure;
- criteria for the choice of parameters and distribution functions;
- major scenarios and risk factors and the assumptions on their dependencies;
- aggregation methods;
- embedding into the company's risk management processes;
- scope of the model and which relevant risks are not quantified.

Internal Models: Future Development

Current State

Group level model with consolidated view. No modeling of restricted fungibility of capital.	Explicit modeling of intra- and extra-group capital and risk transfer instruments	Ability of following losses and events from origin through the whole group	Optimization of group structure and web of capital and risk transfer instrument to allow down-streaming of group diversification to legal entities
Risks segregated wrt main reporting lines only	Risks segregation possible wrt to multiple dimensions (e.g. legal entities, LoBs,…)		
Risks quantified using instantaneous shocks of market risk factors.	Financial market risks quantified via replicating portfolio approach	Consistent treatment of valuation and risk using economic scenarios (scenarios over scenarios)	
Embedded options quantified using pure historical experience	Modeling of embedded options using recognized financial models	Modeling and optimization of insurers options and strategy	
Main risk factors (market, credit, insurance,…) aggregated using correlation assumptions	Replacement of correlations btw risk classes with more adequate dependency structures	Modeling of underlying risk factors instead of ad-hoc risk classes. Dependency btw risk classes emerges naturally via dependency btw underlying risk factors	
Financial market risk using one year calibration	Modeling of long-term behavior of financial market risk factors	Multi-year modeling of asset allocation and business strategy	

Contents

- Global Regulatory Trends
- Risk Management
- Risk Based Solvency Models
- Swiss Solvency Test
- Internal Models
- Group Effects
  - Group Level Diversification
  - Consistency across Individual and Group Requirements
  - Consolidated View
  - Group vs. Solo Requirements
  - Swiss Approach
- Appendix

Group Effects

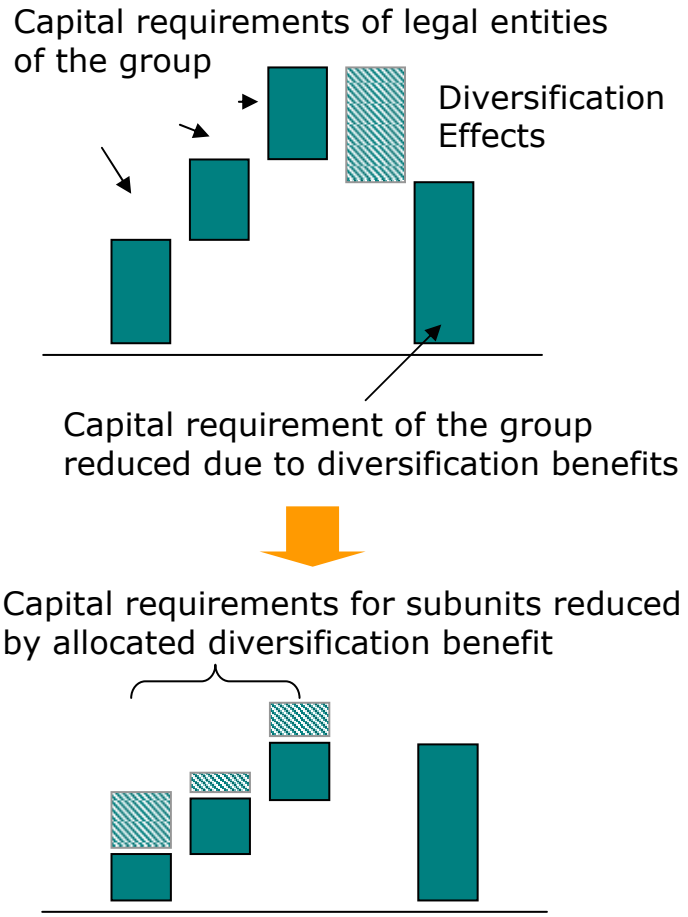
What is diversification?

Consider two portfolios A and B. Let R(A) and R(B) be the risk capital necessary for portfolio A and B respectively. Assume R(.) is a risk measure. Then, if R(A+B) < R(A)+R(B), i.e. if the necessary risk capital for the combined portfolio is less than the sum of the risk capitals necessary for portfolio A and B, there is diversification between portfolio A and B

Note that diversification depends not only on the portfolios A and B but also on the risk measure R(.)

For groups, diversification relates to the fact that the sum of the solvency requirement of all subsidiaries of the group (considered as stand-alone companies) is higher than the total group capital (if the group is considered consolidated)

To allocate this diversification benefit to the subsidiaries is questionable: A consolidated group capital requirement is not necessarily a realistic requirement, and the allocation method needs to be specified



Consistency across Individual and Groups

Conflicting or competing capital requirements between different jurisdictions (cross-border effects), and between legal entity- and group-level are a considerable risk

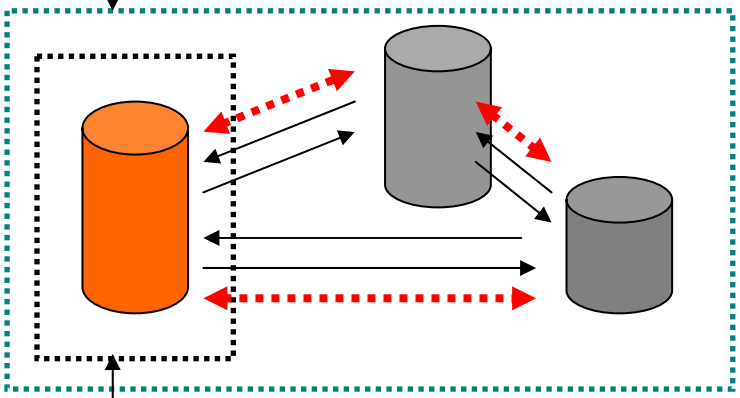
- If requirements for groups and legal entities are inconsistent, then in case of a parent company owning subsidiaries it will experience the situation of having two contradictory capital requirements: One for the group and one for individual solvency
- Groups will have to develop different models for group level solvency requirements and for individual level requirements for the different subsidiaries. Different models will make embedding within companies questionable

How to achieve consistency between individual and group level requirements?

Group vs. Individual Supervision

Two Methodologically Consistent Frameworks for Group and Individual Requirements:

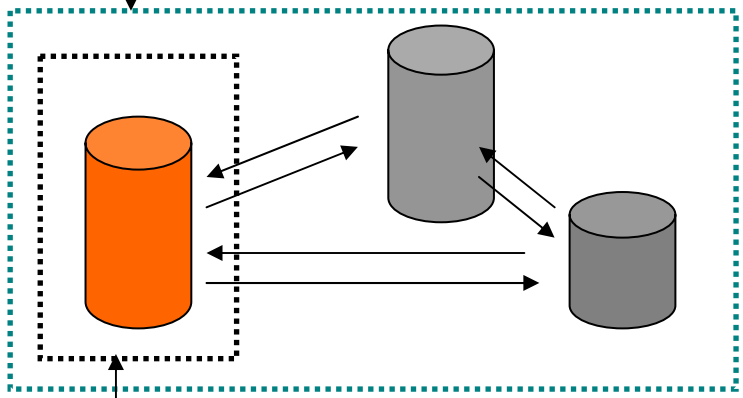
Group Test: Assumes unrestricted capital transfer between the legal entities of the group even if no formal risk and capital transfer instruments are in place → **consolidated calculation**



Individual Test: Assumes unrestricted capital transfer in case of financial distress in the rest of the group even if no formal capital and risk transfer instruments are in place → **group risk**

Swiss Approach

Group Test: Assumes capital transfer only via formal capital and risk transfer instruments



Individual Test: Assumes capital transfer only via formal risk and capital transfer instruments

Formal capital and risk transfer instruments

Assumed unlimited capital transfer

Swiss Approach for Groups

- For a parent company, the group level solvency requirement equals the individual solvency requirement
- The value of a subsidiary for the parent company is the economic value (independent of regulatory or accounting conventions the subsidiary is domiciled in)
- The risk of a subsidiary for the parent is defined as the potential change of the economic value of the subsidiary within one year
- The option of a parent company to let a subsidiary go into run-off is taken into account ($\rightarrow$ the value of a subsidiary for the parent company is never less than 0)

Allocation of Diversification:

A parent company benefits endogenously from group level diversification by taking into account the dependency structure between the risks in its subsidiaries and the risks of the parent company

A parent company can down-stream group level diversification via capital and risk transfer instruments (e.g. intra-group retrocessions, guarantees, etc.).

Contents

- Global Regulatory Trends
- Risk Management
- Risk Based Solvency Models
- Swiss Solvency Test
- Internal Models
- Group Effects
- Appendix
  - IAIS Cornerstones
  - CRO Forum Principles for Financial Risk Mitigation
  - CRO Forum Principles for the Use of Internal Models
  - Definition of Market Consistent Valuation

Cornerstones IAIS

- Cornerstone I: the solvency regime addresses the robustness of the insurer to meet its liabilities both short term and over a longer time span.

- Cornerstone II: the solvency regime is sensitive to risk, and is explicit as to which risks, individually and in combination, lead to a regulatory financial requirement and how they are reflected in the requirement.

- Cornerstone III: the solvency regime is explicit on how, for each of the risks that attract a financial requirement, individually and in combination, prudence is reflected in these requirements.

- Cornerstone IV: the solvency regime requires a valuation methodology which makes optimal use of and is consistent with information provided by the financial markets and generally available data on insurance technical risks.

Towards a common structure and common standards for the assessment of insurer solvency, IAIS, Draft Version, Oct. 2005

Cornerstones IAIS

- Cornerstone V: the solvency regime includes the definition of technical provisions. Technical provisions have to be prudent, reliable, and objective and allow comparison across insurers worldwide. Technical provisions include an explicit risk margin.
- Cornerstone VI: the solvency regime requires the determination of a ´best estimate´ of the costs of meeting the obligations arising from the insurance portfolio, taking into account the time value of money, determined by reference to the relevant risk free interest rates on the financial markets
- Cornerstone VII: the solvency regime establishes a range of solvency control levels and the supervisory instruments associated with each of the control levels.
- Cornerstone VIII: the solvency regime allows a set of standardised and more advanced approaches to determine the solvency requirements, and includes the use of internal models if appropriate.

Towards a common structure and common standards for the assessment of insurer solvency, IAIS, Draft Version, Oct. 2005

Risk Mitigation: CRO Forum Principles

Principle 1: Provide the right incentives

Solvency II should provide incentives for sound risk mitigation strategies.

Principle 2: Sound risk management framework is a precondition

A precondition for the use of financial instruments for risk mitigation is a sound risk management framework for the company.

Principle 3: Focus on the process, not the instrument

The admissibility of financial instruments for risk mitigation should be based upon the soundness of the risk hedging process. Restrictions on the use of financial instruments for risk mitigation cannot follow a "one size fits all" approach (e.g. a list of admissible and inadmissible financial instruments).

Principle 4: Equal yardsticks for qualifying financial instruments

Qualifying financial instruments used for risk mitigation purposes should receive full and unrestricted capital credit under Pillar I of Solvency II. The credit given for financial instruments used for risk mitigation under Pillar I, should be based on the documented and evaluated economic effect on both the valuation of assets and liabilities and the determination of the MCR and SCR.

Financial Risk Mitigation in Insurance - Time for Change, The Chief Risk Officer Forum, Risk Mitigation Working Group

Risk Mitigation: CRO Forum Principles

Principle 5: Supersede legacy rules

Determination of capital requirements for solvency purposes under Pillar I of Solvency II or under Solvency I should be based entirely on economic principles if the insurance company can demonstrate that it has a sound risk management framework (Principle 2) and that it is using financial instruments for risk mitigation satisfying the requirements of Principles 3 and 4.

Principle 6: Consistent treatment in statutory accounting

Under the statutory accounting regime, the asset valuation rules in respect of financial instruments used for risk mitigation purposes must be consistent with the valuation rules in respect of the liabilities they are designed to hedge.

Financial Risk Mitigation in Insurance - Time for Change, The Chief Risk Officer Forum, Risk Mitigation Working Group

Internal Models: CRO Forum Principles

A set of principles which according to the CROF internal models need to satisfy to be acceptable for regulators for use of regulatory capital calculation.

Principle 1: SCR should be set to ensure a **standardised likelihood** of **economic loss** to policyholders.

1.1 SCR should be based on the **economic value** of **liabilities** and the insurer's risk profile, and should be **independent** of **accounting liabilities.**

1.2 The level at which the **MCR** is set should **not interfere** with the operation of the **SCR**, and should strike a balance between being linked to the economic value of liabilities and their risk in a transparent manner, and allowing for continuous monitoring and the need for a legally certain trigger for intervention.

Principle 2: Internal models need to be based on the adverse movement in the **Economic Value of (Assets Liabilities)**, calibrated to a target annualised **99.5% probability of solvency.**

2.1 Economic Value defined as "The present value of future cash flows, valued in such a way as to be consistent with current market prices where these are available and reliable" – for unhedgeable, undiversifiable risks, a market value margin (MVM) should be applied to the best estimate cash flows in order to obtain the price that a willing, rational and well-diversified counterparty would charge for taking on the risk.

2.2 Modelling approaches based on longer time horizons or alternative risk measures (e.g. TailVaR) should be admissible, as long as the calibration approach used is consistent with an annualised 0.5% probability of economic insolvency.

Chief Risk Officer Forum Principles for Regulatory Admissibility of Internal Models', June 2005

Internal Models: CRO Forum Principles

Principle 3: All **material risks that can affect the balance sheet should be explicitly modelled.**

3.1 All sources of **market risk** need to be **modelled probabilistically** with embedded options and guarantees, management actions and policyholder behaviour explicitly modelled where material through simulation modelling, and inter-risk dependencies explicitly modelled and parameterised.

3.2 All sources of **credit risk** (investment credit risk, reinsurer / derivative counterparty risk, credit insurance risk) must be **modelled probabilistically** and **aligned with the principles of Basel II**, taking account of default risk, migration risk and spread risk.

3.3 **Insurance risk** modelling approaches should be **tailored to the type and magnitude of the risk**:

- **Life and health risks should** include parameter (level and trend), process and calamity risk, the modelling of which should take into account scientific analysis, expert opinion and analysis of historical experience.
- **Non-Life risk** should cover both **premium risks** and **reserve risks** – modelling should be appropriate for the nature of the risk under consideration – e.g. frequency-severity methodologies for large losses and perils and the modelling of non-proportional reinsurance, scientific / expert-opinion driven scenarios for weather, geological and environmental risks etc.

3.4 **Operational risk** to be incorporated in a manner aligned with the principles of **Basel II**

3.5 **Risk aggregation** to explicitly account of **inter-risk dependencies**, estimated based on tail dependencies

Chief Risk Officer Forum Principles for Regulatory Admissibility of Internal Models', June 2005

Internal Models: CRO Forum Principles

Principle 4: Implementation of the **internal risk model** must be such that it is used as part of **'business as usual'**

4.1 Full risk calculations with the risk model itself assessed and refined at least on an annual basis, with calculation updates computed at least quarterly

4.2 Comprehensive documentation, formal internal sign-off and regulatory sign-off processes in place

4.3 The internal risk model must be used for capital allocation and as an input into performance measurement, and consequently management compensation

4.4 Validation and reconciliation of data carried out by independent 3rd party

Chief Risk Officer Forum Principles for Regulatory Admissibility of Internal Models', June 2005

Market Consistent Valuation: Definition

The valuation of a company's (or person's) financial claims and obligations is said to be market consistent, if it is based on and is consistent with the public financial markets‘ participants' assessment of value and risk, which is derived directly or indirectly from the observed prices at which instruments are traded in these public financial markets.

The understanding of some elements is key to the definition:

The **prices** that underlie the assessments are those that are achieved in public markets. The public aspect is critical in order to get close to an "efficient arbitrage free market". In particular the market participants must have the opportunity to exploit any price inefficiencies at any time.

The price observed might not directly imply the required value: obviously transaction and other costs have to be considered, but also the price observed represents the instrument's value for the seller and a purchaser, which might differ for a third party, because some risks, rights or obligations impact the third party differently. Assume, for example, a bond investor's claim on a bond issuer. The bond investor will value the credit risk of the issuer, because she considers the possibility that the issuer fails on its obligation. The corresponding default option is held by the owner of the institution that issued the bond. Consequently, the bond issuing debtor will have to add the value of its own credit risk to the market value of the bond, when valuing this obligation for its own balance sheet. (A good test is the accounting principle that double entries have to match; in other words, accounting itself cannot create value.)

Market Consistent Valuation: Definition

Consistency means that a knowledgeable person, knowing how to assess financial claims and obligations, would transact her assets and liabilities neither at higher nor lower prices than those achievable in the public financial markets. The knowledge that might be needed comprises the ability to discern the various risks that might or might not be valued by the public financial markets.

Assessment in the definition refers to all quantitative and qualitative methods known to analyse financial market prices.

If the public financial market does not value a claim or an obligation or a part / component of it then the value assigned to it will be intrinsic, i.e. depending on legal entity specific factors. The above is the definition of market consistency and some explanation for how to interpret it. It will be the accountant's or actuary's task to apply the definitions to the valuation of the various assets and liabilities that are found in a financial institution. The most prominent example for an insurance company is of course an insurance contract.

The result of such an analysis would reveal that an insurance contract's value consists of the "risk neutral" expected value of the conditionally expected cashflows, conditional on all future financial market prices. The cashflows to consider comprise all "inflows" and "outflows", i.e. all contractually agreed premium income, all claims payments and expenses, fees and costs for any resources required to manage and administer the contractual obligations. In particular, among the costs are those for the resource used to buffer risk. Whereas the conditionally expected cashflows can be replicated for the difference between the actual cashflows and the conditionally expected cashflows one needs risk capital, the cost of which has to be recognized in the valuation.

Definition by Hans Peter Würmli

Market Value Margin: Further Information

The Swiss Experience with Market Consistent Technical Provisions - the Cost of Capital Approach, Federal Office of Private Insurance, March 28, 2006

A Primer for Calculating the Swiss Solvency Test "Cost of Capital" for a Market Value Margin, Federal Office of Private Insurance, 26. April 2006

A market cost of capital approach to market value margins discussion paper, The Chief Risk Officer Forum, 17 March 2006

CEA Document on Cost of Capital, Comité Européen des Assurance, 21 April 2006

Risk Based Supervision: Further Information

Benchmarking Study of Internal Models, Chief Risk Officer Forum, Damir Filipovic and Daniel Rost, 2005

CEA Working Document on the Standard Approach for Calculating the Solvency Capital Requirement, Comité Européen des Assurance, 2005

Financial Assessment Framework Consultation Paper, Dutch National Bank, 21 October 2004

Financial Risk Mitigation in Insurance – Time for Change, The Chief Risk Officer Forum Risk Mitigation Working Group, 2006

A Framework for Incorporating Diversification in the Solvency Assessment of Insurers, The Chief Risk Officer Forum, 10 June 2005

The IAIS Common Structure for the Assessment of Insurer Solvency (Draft), International Association of Insurance Supervisors, 2006

Solvency Assessment Models Compared, Comité Européen des Assurance and Mercer Oliver Wyman, 2005

Solvency II – Building Blocks for the Solvency II Project, Comité Européen des Assurance, 2005

Solvency II: a new framework for prudential regulation of insurance in the EU: A discussion paper, HM Treasury, February 2006

Towards a common structure and common standards for the assessment of insurer solvency, International Association of Insurance Supervisors, 2006

White Paper of the Swiss Solvency Test, Federal Office of Private Insurance, 2004