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Proxies & Simplifications for the Risk Margin

Simplifications & Proxies in the Market
Consistent Valuation of Technical Provisions

Thorsten Pfeiffer
Eltsville, December 5, 2008



The SST Group Structure Model

Table of Content

- Principles of Cost-of-Capital approach
- Parameters, Assumptions, Simplifications
- Risk Margin in a Nutshell
 - Importance, Drivers, Data, Benchmarking, Diversification
- Examples, Role of FOPI
 - Non-Life, Life



Risk-Based Solvency Frameworks

The main purpose of risk-based solvency - and of risk management - is to achieve *transparency* on the insurers' exposure to risk.

Control and mitigation of risk are objectives which are better achieved via *transparency*.

The core of a solvency framework are the *underlying principles*, not the standard models or regulators' technical documents.

Internal models must be assessed with reference to *the solvency framework* not with reference to the standard model.

Incorporating implicit prudence via valuation, restrictions on eligibility of capital, investments, and risk transfers will

- make the system less transparent and
- lead to the *transfer* of insurers' risk management and *responsibility* to the supervisor.

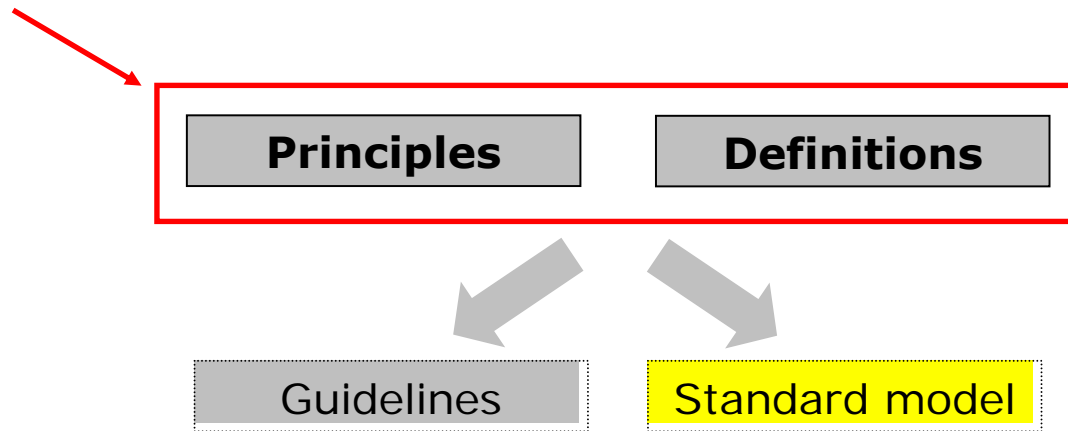
Which is true for the whole is valid for any single part (e.g. risk margin)



SST is Based on Principles

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

Core of SST



SST is defined by principles, but not by the standard model or FOPI's technical publications.

The standard model or FOPI's technical publications can only be used if appropriate.

There is no legal or magical right to use the standard model or blindly apply FOPI's technical publications.



SST: Today's Choice of Principles...

1. All assets and liabilities are valued market consistently

2. 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

3. SST Report to supervisor such that a knowledgeable 3rd party can understand the results

Market Consistent Valuation for Liabilities

Di tutto sappiamo il prezzo, di niente il valore,
Nietzsche, „Michelangelo“

Market Consistent Value of Liabilities: Best Estimate + MVM:

= market value (if it exists); or

= value of a replicating portfolio of traded financial instruments + cost of capital for the remaining basis risk

But how??

- *Capital*: company's own specific or regulatory?
- *Cost of Capital rate*: own specific or regulatory?
- *Diversification*: own specific portfolio or fictitious buyer's?
- *Risks*: own specific portfolio or fictitious buyer's?
- *Company Policy*: own specific or fictitious buyer's?
- *Assumptions*: like own best estimate or other fictitious?

→ Depends on specific Solvency Framework (e.g. regulators)

Market Consistent Valuation for Liabilities

Di tutto sappiamo il prezzo, di niente il valore,
Nietzsche, „Michelangelo“, ZH

Market Consistent Value of Liabilities: Best Estimate + MVM:

= market value (if it exists); or

= value of a replicating portfolio of traded financial instruments + cost of capital for the remaining basis risk

But how??

- *Capital:* regulatory
- *Cost of Capital rate:* regulatory
- *Diversification:* own specific portfolio
- *Risks:* own specific portfolio, non-hedgeable
- *Company Policy:* own specific
- *Assumptions:* consistent with own best estimate

→ As pointed out in the SST-Guideline



Next two slides only formulas ...

Mathematics of Market Consistent Valuation

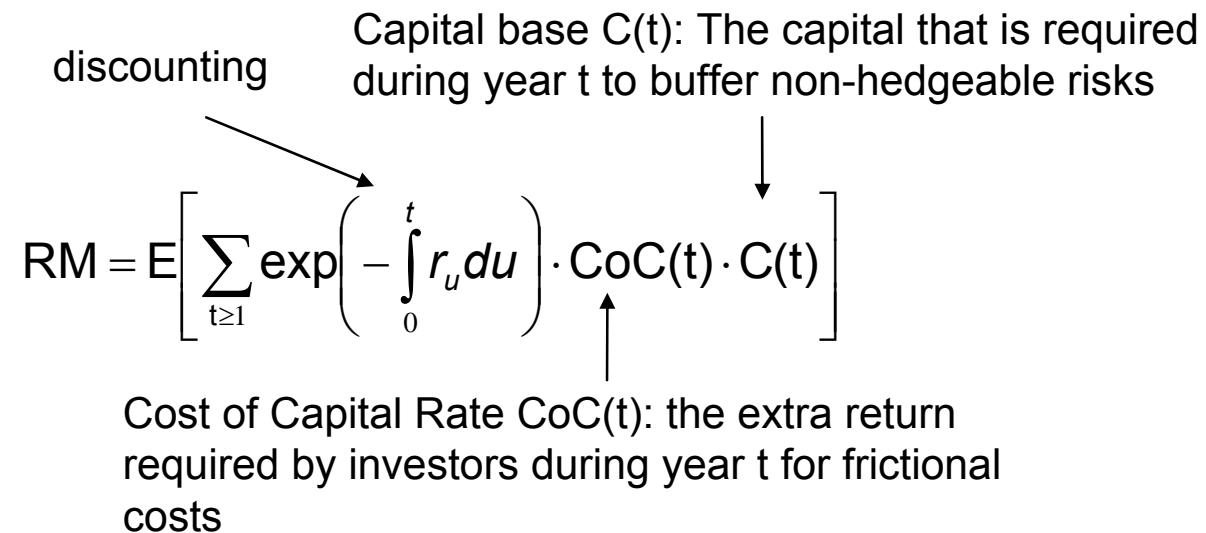
In the SST, the risk margin is defined as the expected cost of capital needed to support non-hedgeable risks until the termination of the last contract / liability

discounting

Capital base $C(t)$: The capital that is required during year t to buffer non-hedgeable risks

$$RM = E \left[\sum_{t \geq 1} \exp \left(- \int_0^t r_u du \right) \cdot \text{CoC}(t) \cdot C(t) \right]$$

Cost of Capital Rate $\text{CoC}(t)$: the extra return required by investors during year t for frictional costs



As seen from time t , $C(t+1)$, $C(t+2)$, and $\text{CoC}(t+1)$, $\text{CoC}(t+2), \dots$ are random variables, hence CoCM is actually an expectation

Mathematics of Market Consistent Valuation

There are some misunderstandings concerning the risk margin in the SST. In reality, both the Cost of Capital Rate $CoC(t)$ and the Capital base $C(t)$ are *random variables*, in practice *simplifications* are used

General formulation

$$RM = E \left[\sum_{t \geq t_0} \exp \left(- \int_0^t r_u du \right) \cdot CoC(t) \cdot C(t) \right]$$

Non stochastic discounting

$$RM = E \left[\sum_{t \geq t_0} B(0, t) \cdot CoC(t) \cdot C(t) \right]$$

Independence of CoC rate and capitalization in time

$$RM = \sum_{t \geq t_0} B(0, t) \cdot E[CoC(t) \cdot C(t)]$$

Taking long term average of CoC rate

$$RM = \sum_{t \geq t_0} B(0, t) \cdot E[CoC(t)] E[C(t)]$$

$$RM = E[E[CoC(t)]] \cdot \sum_{t \geq t_0} B(0, t) \cdot E[C(t)]$$

$$RM = 6\% \cdot \sum_{t \geq 1} B(0, t) \cdot E[SCR(t)]$$

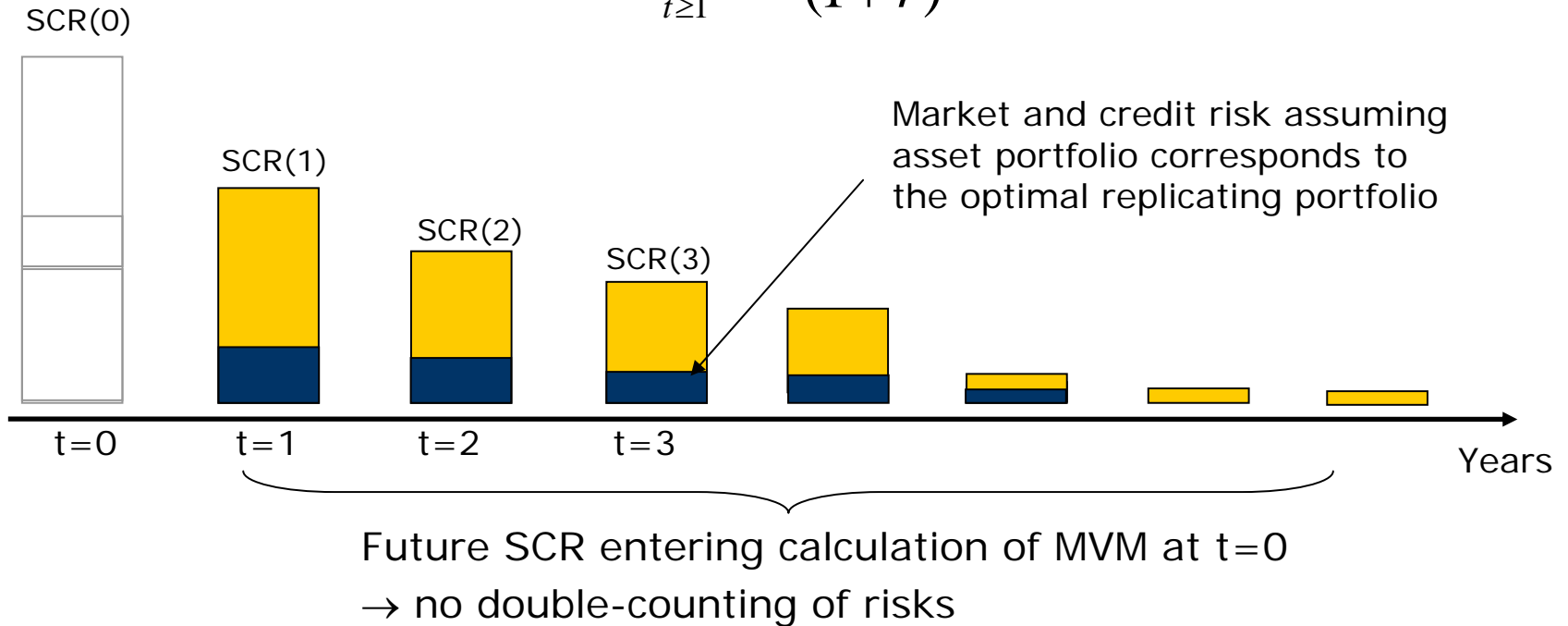
The SST risk margin already contains a number of simplifications, the major one being:




- The 6% cost of capital rate is taken to be a long-term average
- Corresponding approx. to BBB-level in CH
- The regulatory capital SCR is taken as a capital base rather than the company's own capital
- Regulatory capital is easier to be assessed by regulators



Market Consistent Valuation

$$MVM(1) = \sum_{t \geq 1} \frac{CoC \cdot SCR(t)}{(1+r)^t}$$



-  Premium risk
-  Reserve risk
-  Market and credit risk

Note: This approach for calculation of the cost of capital margin charges CoC starting at the end of year 0, hence SCR(0) does not enter into the calculation, a *simplification* to avoid circularity



Risk Margin in a Nutshell...

A company doing the SST needs to...

- Perform n single SSTs for n future years
 - given the information today
 - where n is *expected* life time of the liabilities in years and
- Show future SSTs are consistent with current SST
 - difference: measuring non-hedgeable risk only
- Identify hedgeable / non-hedgeable risk *first*
 - using replication techniques
 - instruments from deep & liquid markets only
 - detailed description of the replicating portfolio in the *SST-report*



SST: Today's Choice of Principles...

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Financial risks

Non financial risks

Hedgeable risks

- 10 years cash flow in CHF, deterministic
- 10 years interest rate option
- 5 years share index option
- Rational lapse behavior

- securitized insurance risks

Value of the replicating portfolio

Non-hedgeable risks

- 50 years cash flow in CHF, deterministic
- 50 years interest rate option
- 30 years share index option

- 10 years cash flows in CHF, stochastic
- underwriting risks: mortality, fluctuation in loss amounts
- Real lapse behavior

Costs of capital approach

Fundamentals: Deep and Liquid Markets

Price is what you pay, value is what you get,
Warren Buffet

- The *Bank for International Settlement* defines a deep and liquid market as follows:
- A *liquid* market is a market where participants can rapidly execute large-volume transactions with a small impact on prices.
- *Depth* denotes either the volume of trades possible without affecting prevailing market prices, or the amount of orders on the order-books of market-makers at a given time.
 - In a deep and liquid market, agents – buyers and sellers – constantly trade and thereby define prices for securities
 - Observed prices are an emergent property and can be seen as the consensus assessment of the security's value by many buyers and sellers
 - Observed prices can not be identified with objective values of the securities. Each buyer and seller has a specific, personal assessment of value for herself of the security. It is only in the interplay of many buyers and sellers that a consensus opinion emerges at which a transaction can take place



Risk Margin in a Nutshell...

- “Perform n single SSTs for n future years“

⇒ valuation is linked to SST risk via MVM

⇒ we need to know how

⇒ SST “usual” risk works out

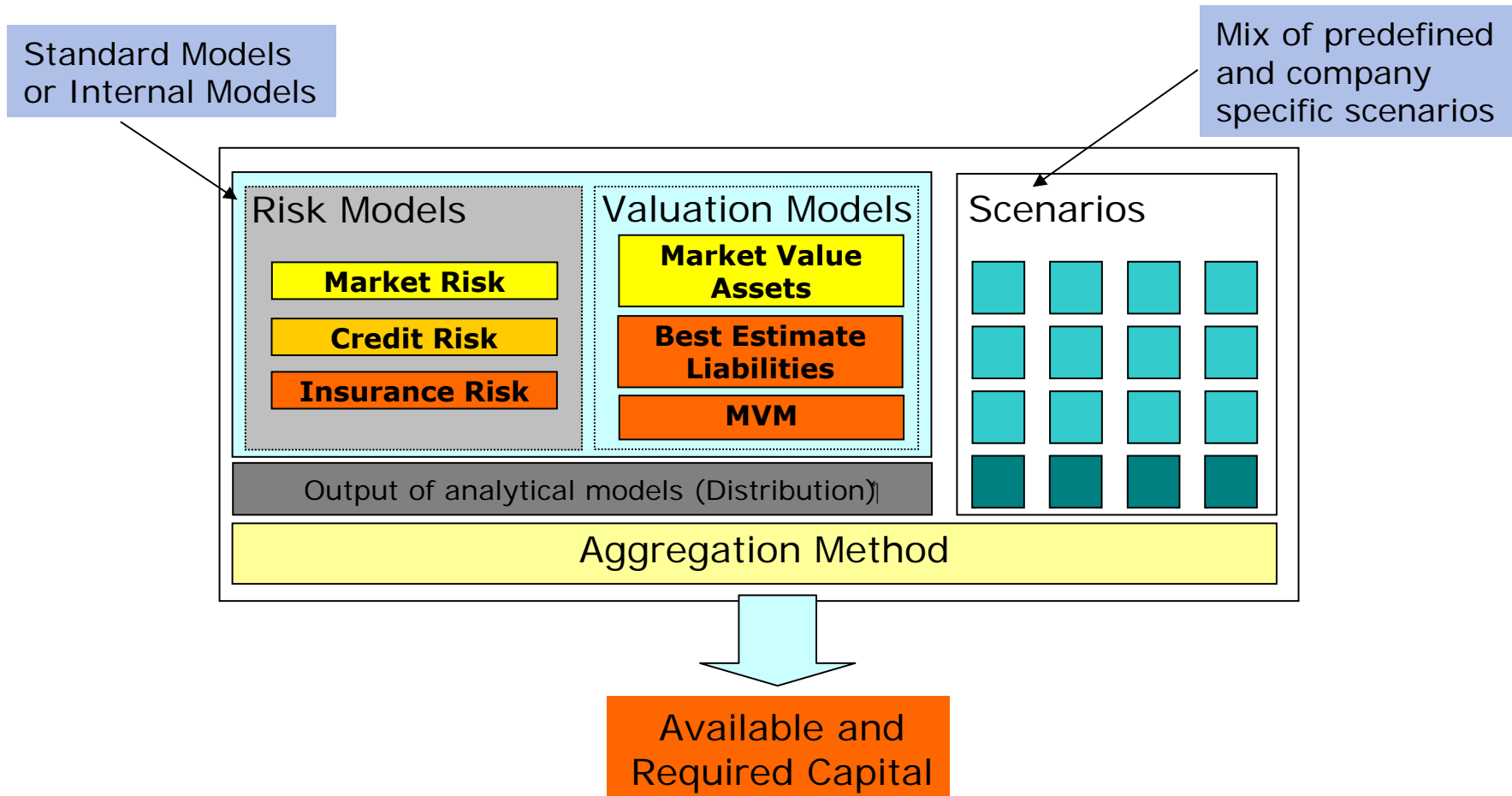
⇒ SST “usual” diversification works out

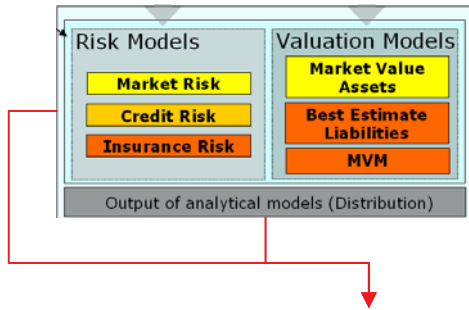
⇒ non-hedgeable risk works out under the SST



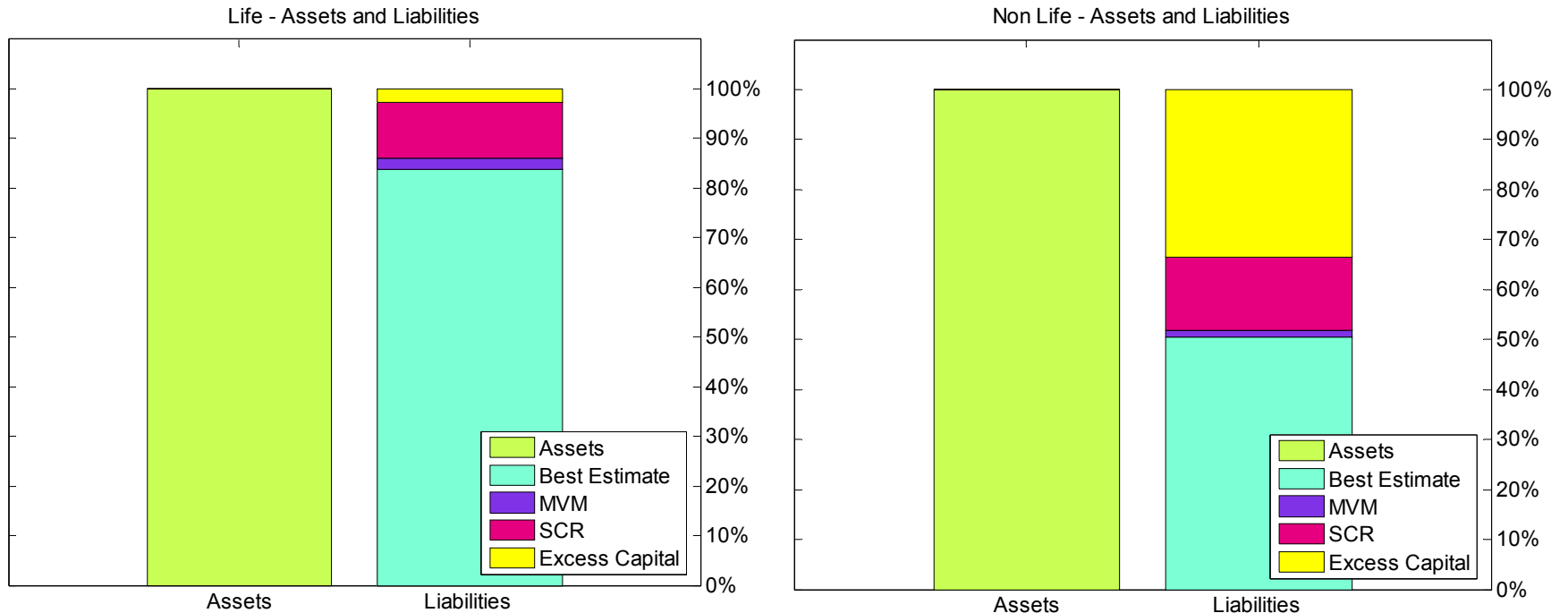
The SST Concept: General Framework

Market Consistent Data

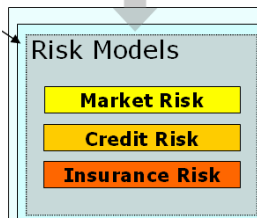




Public results 2007

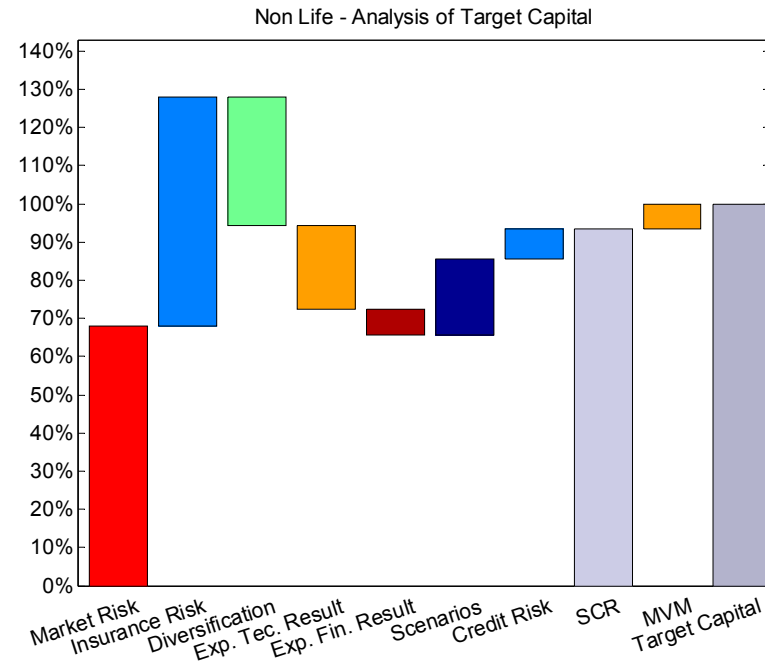
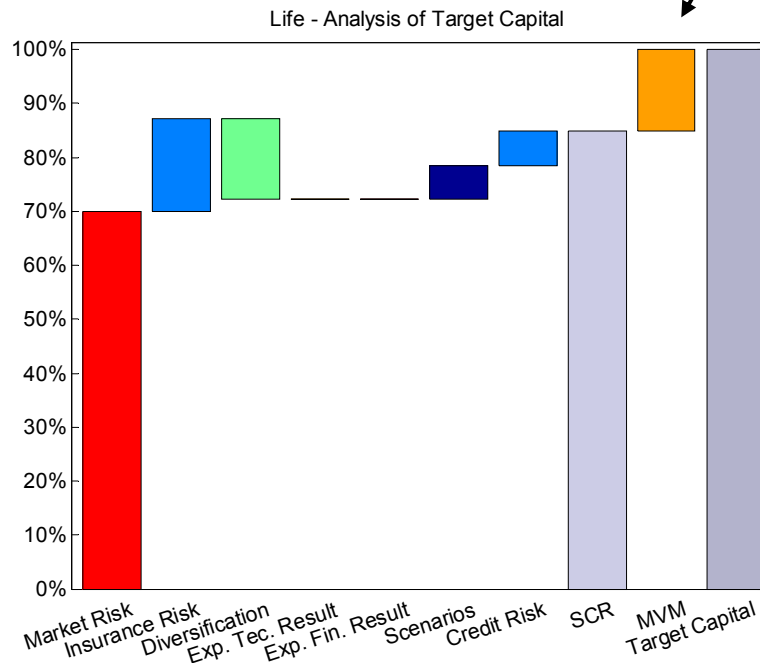


MVM looks small here: how important is it anyway?



Public results 2007

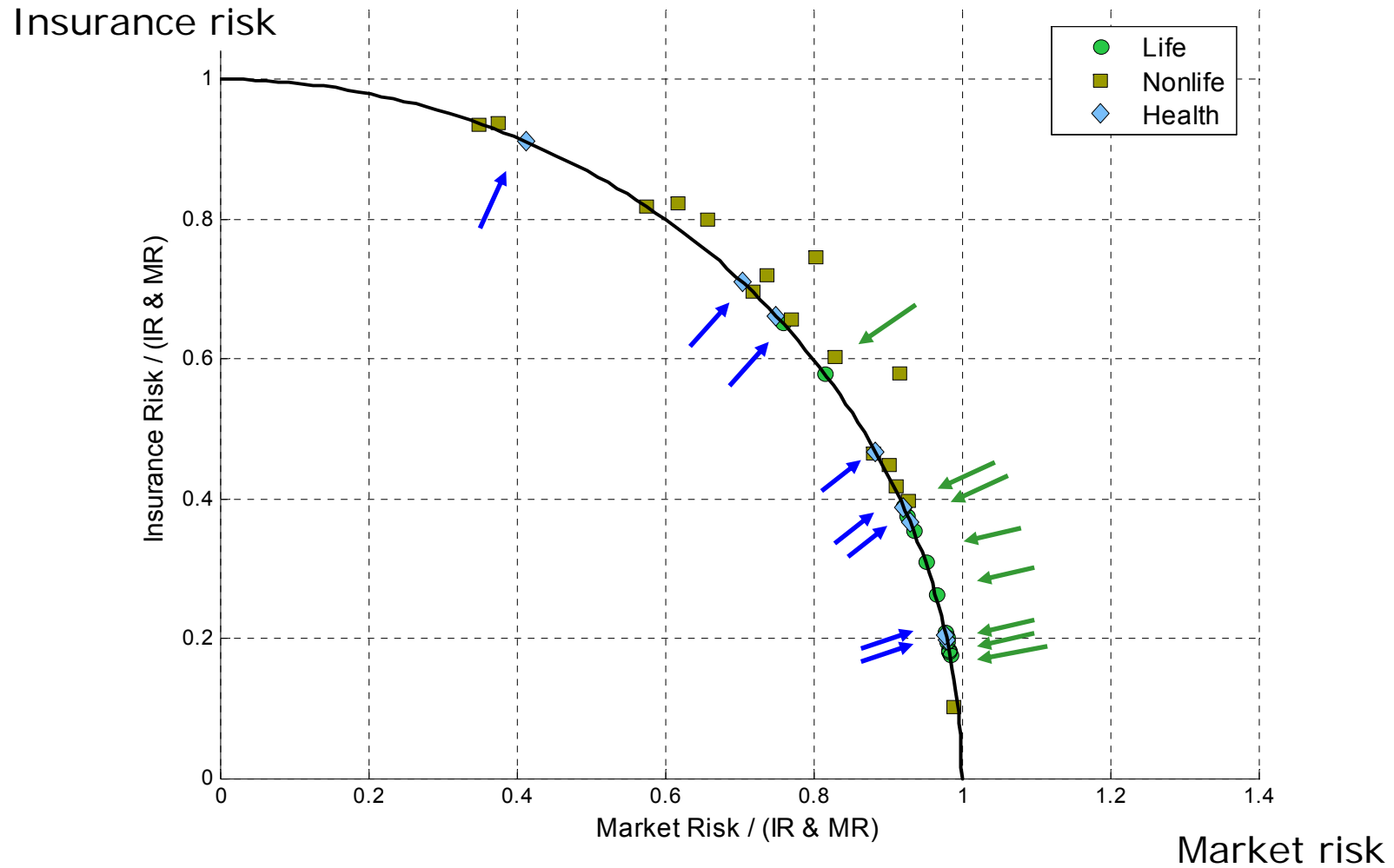
MVM: in the SST part of the *Target Capital*



$$\text{Diversification}(M, I) := \text{ES}(\Delta\text{RBC}(M, I)) - \text{ES}(\Delta\text{RBC}(M)) - \text{ES}(\Delta\text{RBC}(I))$$



Market and Insurance Risks





Impacts of SST-Scenarios are aggregated via mix of df (if not already captured by analytical ΔRBC)

Industrial



Pandemic



Accident:
works outing

Health: anti selection

Hail



disability; longevity,
lapses

Daily allowance

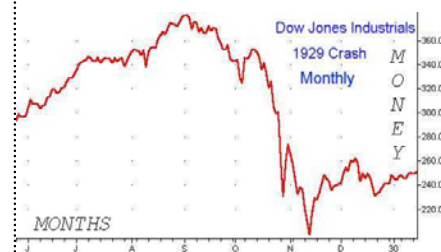


Claims provisions:
+10%

Failure of
reinsurance

Financial Distress

Financial Market



Terror

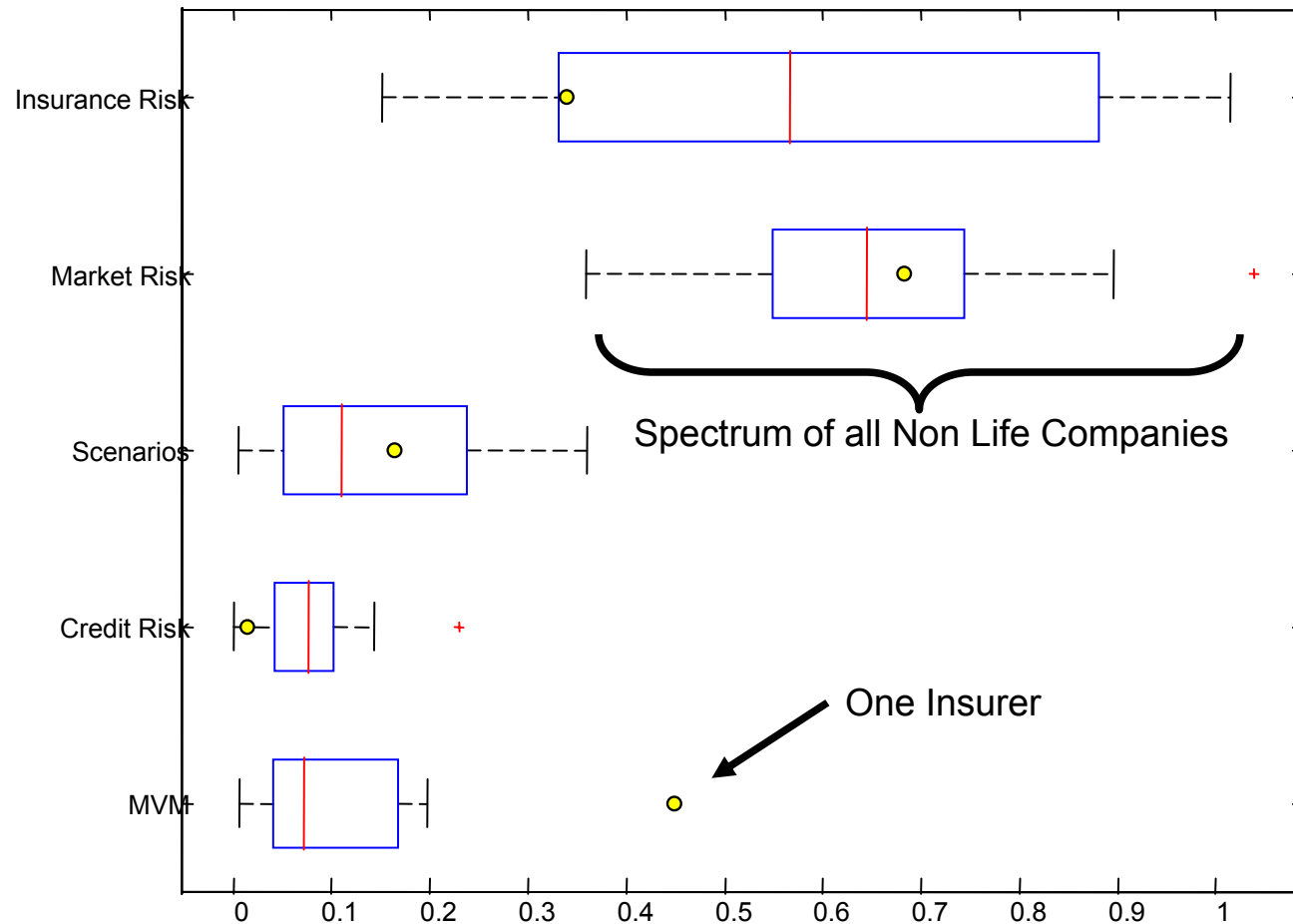


Standard Model: Non-Life Insurance Risks

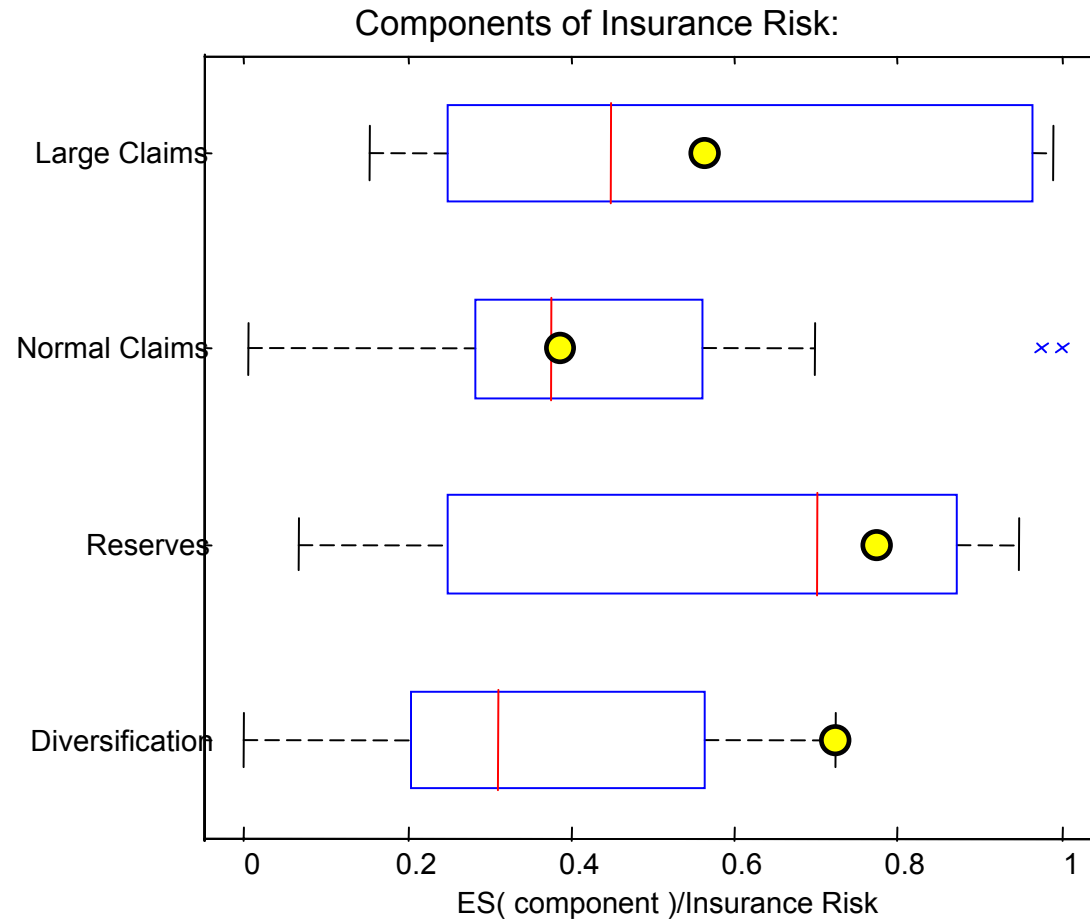


Target Capital Benchmarking

Components of Target Capital Non Life Companies:

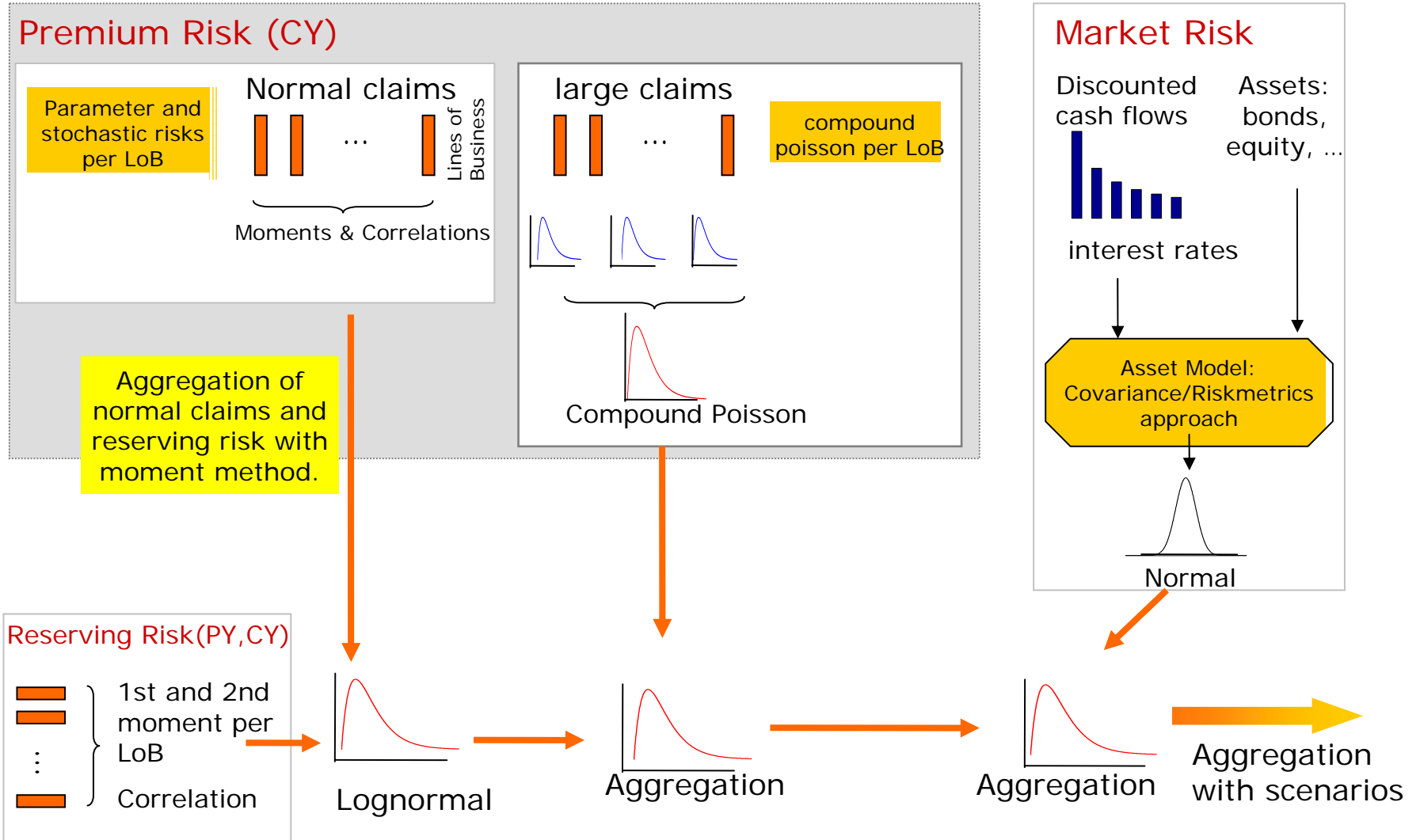


Non-Life Insurance Risk Benchmarking





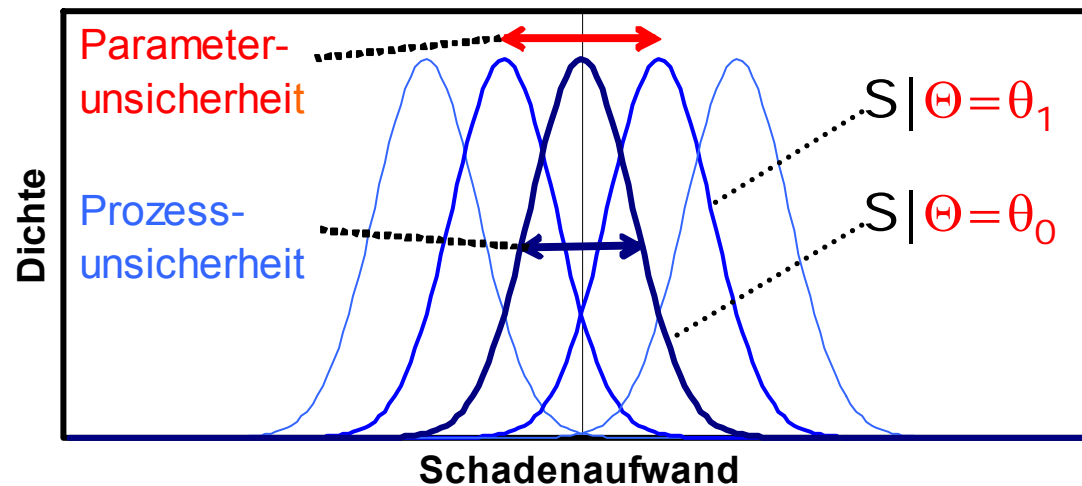
SST Standard Models: Non-Life Insurance



Reserving Risk splits into Process Risk and Parameter Risk

In General

$$\text{Var}(S) = \underbrace{E[\text{Var}(S|\Theta)]}_{\text{Process Risk}} + \underbrace{\text{Var}(E[S|\Theta])}_{\text{Parameter Risk}}$$



Apply this to annual incurred claims S :
$$S = \sum_{j=1}^N Y_j$$



Risk Margin for Non-Life companies

Hedging non-life cash flows (almost) impossible

- *stochastic* cash flows, driven by (non-hedgeable) insurance risk
- *expected* cash flows (usually) not a problem, duration not too long, no complicated embedded options

Usually no premium risk

- are there really no multi-year contracts in your portfolio?

Measure impact of relevant SST-scenarios

- some companies add a flat loading derived from current SST (debatable *simplification*, must be justified in the *SST-report*)

Credit risk through reinsurance remains

- best estimate reserves apparently a good proxy but
- depends on the nature and complexity of the reinsurance program (need detailed description and justification in the *SST-report*)
- standard SST assumption: no diversification between credit and other risks



Risk Margin for Non-Life companies

Reserving Risk

- apparently natural proxy: best estimate liability $L(k)$
- $ES(R(k)) = L(k) / L(0) * ES(R(0))$
- thus: $ES(R(0)) / L(0)$ equals $ES(R(k)) / L(k)$ for all k

Lognormal assumption of $ES(R(k))$ (standard model)

- conclusion: coefficient of variation $VK(k)$ constant over time!!
- need good justification or better modeling
- reserve risk split into parameter and process (stochastic) risk
- no diversification allowed for from fictitious buyer's portfolio
- how does diversification between LoBs develop over time?
- comparison to development patterns necessary

Companies are / will be asked for better modeling

- Responsibility of the company to come up with solutions (e.g. better proxies)
- FOPI's role: getting convinced, challenge companies, giving feedback, accept or reject proposed solutions



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Principle Based Supervision: how we see ourselves

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

Principle Based System:

- Specialized know-how + ability to see big picture
- Creativity
- Ability for conceptual thinking
- Ability to challenge insurers
- Communication skills

FOPi increased staff with mathematical background by approx. 300% between 2005 and 2008 in order to be able to implement the new risk based supervision

Principle Based Supervision: how we see our counterparts

Actuaries of the Past

Pharmacist rather than actuary

Looking for numerical recipes and push-the-button solutions

Expects others (e.g. regulators, auditors, etc.) to provide all the solutions he needs

Tends to shift responsibility to others

Actuaries of the Future

Using recognized mathematical and financial models or invents them

Having transparency on prudence by using an explicit risk margin which he can explain to others

Regularly reassessing and updating the valuation and using most recent information, sharing it with regulators

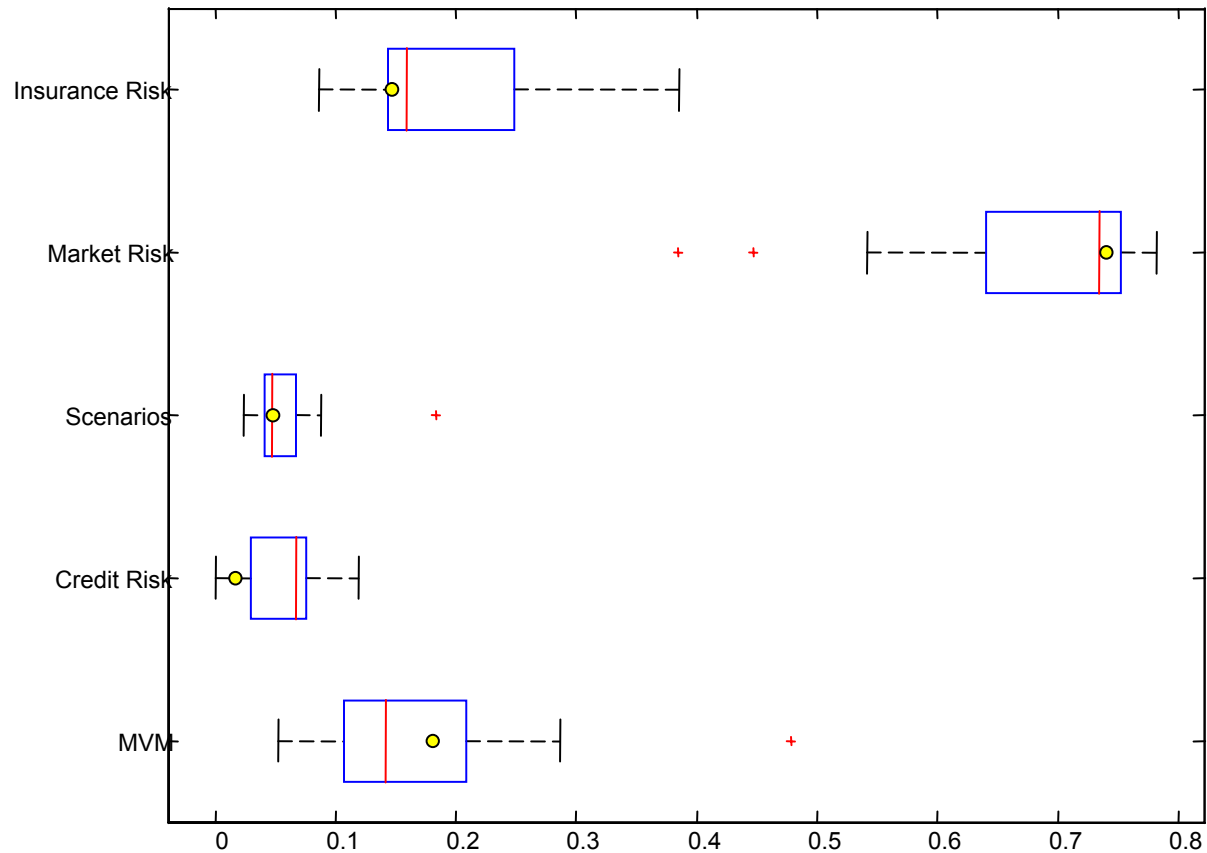


Standard Model: Life Insurance Risks



Target Capital Benchmarking (Life)

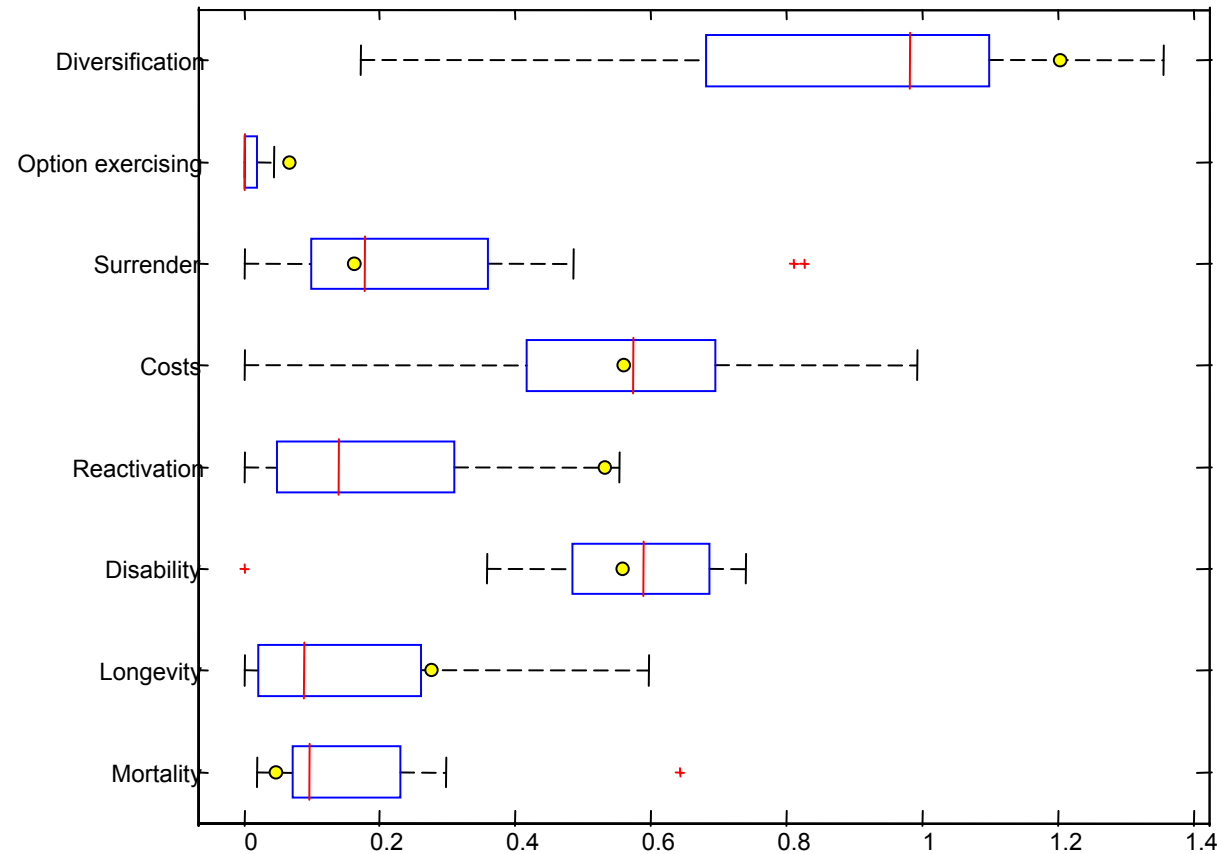
Components of Target Capital Life Companies:





Life Insurance Risk Benchmarking

Components of Insurance Risk: Single (Life)





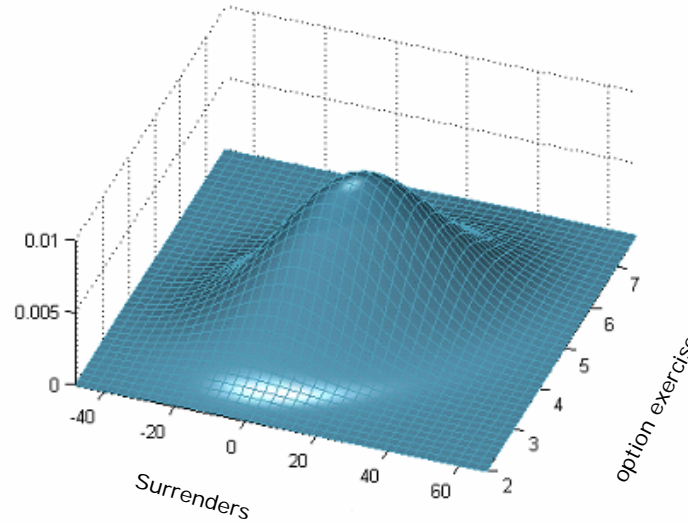
SST Standard Models: Life Insurance

Analytical Model:

Risk Factors:

Measure impact on both term & annuity portfolio

- Mortality
- Longevity
- Morbidity
- Recovery rates
- Surrenders
- Option exercise
- Costs



		Nicht BVG						
		Sterblich-keit q_x	Langlebig-keit λ_{x}	Invalidität i_x	Reakti- vierungsrate	Kosten	Storno	Options- ausübung
Nicht BVG	Sterblichkeit (q)	1	0	0	0	0	0	0
	Langlebigkeit (lambda)	0	1	0	0	0	0	0
	Invalidität	0	0	1	0	0	0	0
	Reaktivierungsrate	0	0	0	1	0	0	0
	Kosten	0	0	0	0	1	0	0
	Storno	0	0	0	0	0	1	0.75
	Optionsausübung	0	0	0	0	0	0.75	1

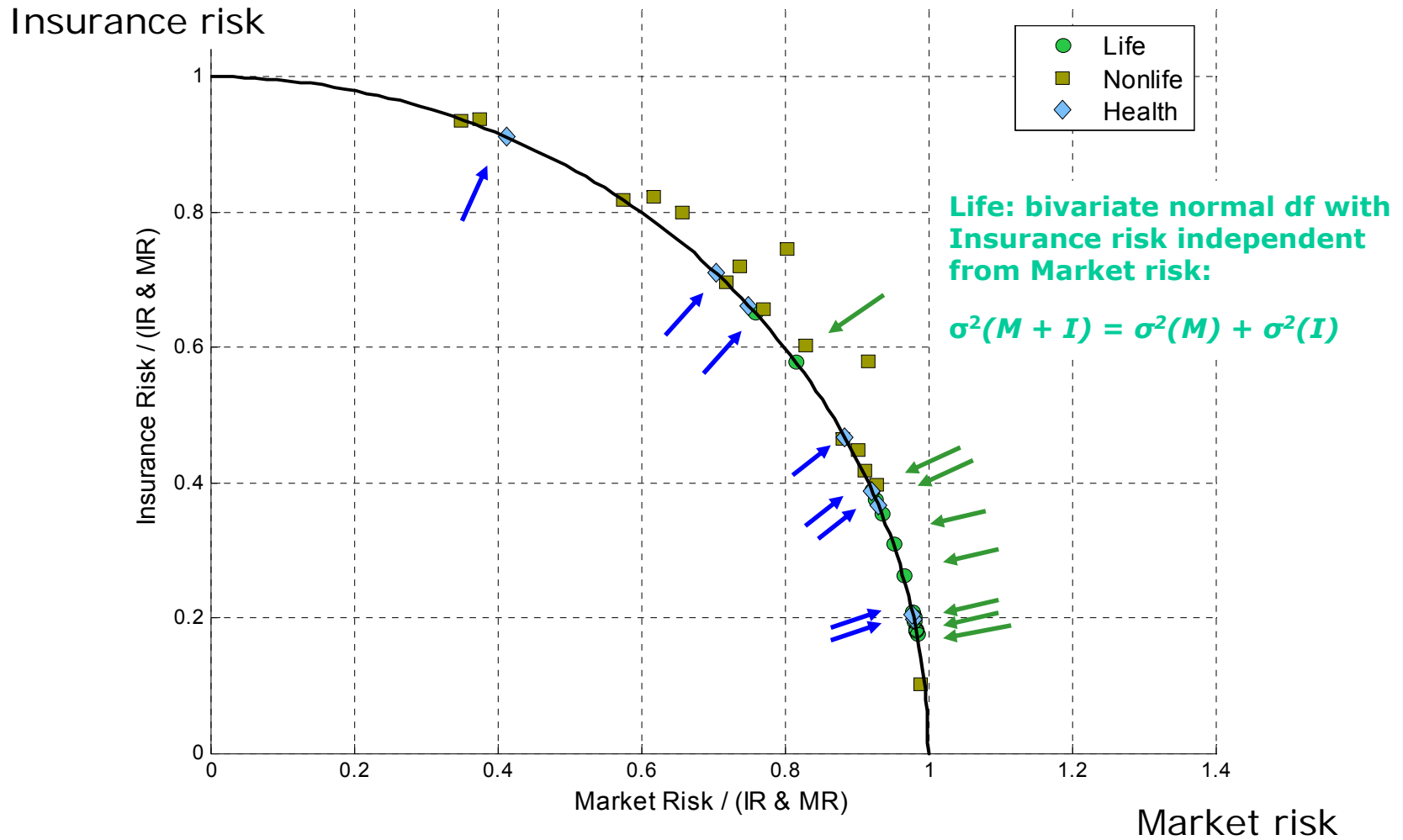


Standard Model: Life Insurance Risks

- Assumptions:
 - Changes of risk factors are multivariate normally distributed
 - Specified covariance (by FOPI)
 - Change in RBC linear on change of risk factors
 - Life model → ΔRBC normal distribution with zero mean and given volatility
 - Biometric risks are assumed to be *independent* to market risk factors



Market and Insurance Risks





“Life” Scenarios:

- Pandemic (Spanish Flu 1918 translated to current year)
- Disability scenario (short term increase + systemic increase)
- Mortality: long term changes (impact on both term & annuity)
(to take into account of systemic over- or underestimation)
- Longevity (impact on both term & annuity portfolio)
- Lapse scenario (combined with interest rate increase)
- + Scenarios defined by companies



MVM for Life companies: example

Complete hedge of Life Liabilities usually not possible

- duration too long, markets not liquid enough, many embedded options, almost no instruments for vola hedging, etc.
- define optimal replicating portfolio (ORP), description in the *SST-report*
- replicating best estimate liabilities, no *special* “run-off assumptions” allowed for
- no fictitious buyer’s behaviour allowed for

Run a pro forma SST for current year based on ORP

- determine $ES'(M(0))$ of non-hedgeable market risk
- measure impact of SST-scenarios on non-hedgeable risks
- usually credit risk remains or even higher (more corporate bonds, swaps etc.)
- describe results in the *SST-report*

Life Insurance risk likely to be a driver of MVM

- risk factors usually do not correspond to LoBs
- how to allocate to LoBs?

MVM for Life companies: example

Allocating Life Insurance risk

- identify suitable LoBs (e.g. split of portfolio)
- use capital allocation principle to allocate $ES(I(0))$ to LoBs
- there are lots, but Euler principle (probably) well-known
- (*pp 256, Quantitative Risk Man.; McNeil, Frey, Embrechts*)
- project $ES(I(k))$ per LoB, different proxies per LoB
- saving product: sum assured $s(k)$ (but why is this good?)
- death risk: death benefit $d(k)$
- disability: claims number $m(k)$ (but why is this a good proxy?)

Non-hedgeable market risk, Credit Risk

- $ES'(M(k))$, credit risk develop like best estimates $L(k)$
- but why is this a good proxy?

Real Life Example (randomized numbers)

Life: Market Value Margin ("Minimalbetrag")

Life Insurance Company

Cost of capital (spread over risk free) sp 6,0%

Risk Margin (sum of costs of capital) Mio. CHF 329,3

Maturity	01.01.2008	01.01.2009	01.01.2010	01.01.2011	01.01.2012	01.01.2013	01.01.2014	01.01.2015
Time-to-maturity	0	1	2	3	4	5	6	7
riskfree spot rates / yield curve [CHF]		2,977%	2,625%	2,661%	2,724%	2,820%	2,872%	2,926%
Discount factor	1	0,971	0,949	0,924	0,898	0,870	0,844	0,817
riskfree spot rates / yield curve [USD]		3,290%	3,095%	3,077%	3,329%	3,511%	3,641%	3,876%
Discount factor	1	0,968	0,941	0,913	0,877	0,841	0,807	0,766

Proxies:

Best estimate liabilities BEL

Nominal values CHF		386	357	474	219	438	180	157
Nominal values USD		94	225	271	135	138	216	162
Time-t-values (BE in CHF)	10,194	9,976	9,510	8,865	8,746	8,418	8,208	8,161
scaling factor	1	0,9787	0,9330	0,8696	0,8580	0,8258	0,8052	0,8006

For savings products: sums assured

Total sums assured	414	337	324	269	201	182	194	172
scaling factor	1	0,8160	0,7840	0,6496	0,4851	0,4412	0,4686	0,4166

For mortality risk products: death benefits

Total death benefits	270	320	320	186	233	275	182	222
scaling factor	1	1,1851	1,1856	0,6871	0,8603	1,0167	0,6752	0,8209

For disability risk products: expected claims

number of expected claims	392	387	507	400	261	470	341	297
scaling factor	1	0,9871	1,2931	1,0196	0,6647	1,1976	0,8694	0,7571

SCR at beginning of future years (std)

	2,6652							
non-hedgeable market risk	57	56	53	50	49	47	46	46
Trend insurance risk: savings products	57	46,9	45,0	37,3	27,9	25,3	26,9	23,9
Trend insurance risk: mortality risk products	1	0,7	0,7	0,4	0,5	0,6	0,4	0,5
Trend insurance risk: disability risk products	11	10,6	13,8	10,9	7,1	12,8	9,3	8,1
Stochastic insurance risk	3	3,0	3,0	1,7	2,2	2,5	1,7	2,1
SCR non-hedgeable market & insurance (without scen)	239	215	214	186	162	163	157	150
SCR non-hedgeable market & insurance (including scen)	455	411	407	354	308	311	300	286
credit risk	75	73,0	69,6	64,9	64,0	61,6	60,1	59,7



Any Questions??



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