Munich Re Seminar on Solvency II
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Agenda

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1. Introduction
2. Solvency II is not only Pillar I
3. Solvency II balance sheet & economic valuation
4. Standard formula under QIS 5
5. Improvement of Solvency Ratio
6. Impact of Solvency II on the insurance industry

1. INTRODUCTION

Where have we come from?
Where are we going?

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Solvency I (actual)

- Established 1973 (P/C) resp. 1979 (Life),
- Rule-based,
- Capital based on ratios of premiums, claims; liabilities,
- Available solvency capital derived from accounting data,
- Underlying liability valuation not consistent between member states, but usually includes margins for prudence,
- Some EU member states have introduced additional tests.

Solvency II

- Principle-based,
- Capital requirements based on probability models of risk. All prudential margins classified as capital, not liabilities,
- Prescribed liability valuation methodology including market-consistent liability and a margin for cost of capital,
- Comprehensive, avoids the need for member states to impose additional rules.

Source: Smith, Solvency II and the CRO Forum, PRAGUE, APRIL 23-27, 2007

Main objectives of Solvency II

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1. Overall goal**: consumer protection**
2. To create a **harmonised supervisory system** throughout Europe based on the actual risk situation of each insurance company
3. To extend the existing quantitative supervisory system through development of companies' own internal risk-management models and processes
4. To add a qualitative aspect to the supervisory system through internal risk-management system requirements
5. Alignment with international developments (Basel II, IFRS, …)

Paradigm change
from a quantitative to a qualitative, principle-driven approach

Solvency II uses the "three-pillar approach" found in Basel II

Solvency II

… will be mandatory for all insurance companies in the EU

Risk category	Quantitative	Qualitative	Transparency
▪ Underwriting risk ▪ Market/ALM risk ▪ Counterparty default risk ▪ Operational risk	**Risk capital requirements**	**Risk governance and process requirements**	**Reporting requirements**

... and provides motivation to introduce internal models

Realistic reflection of the total exposure of the insurance company

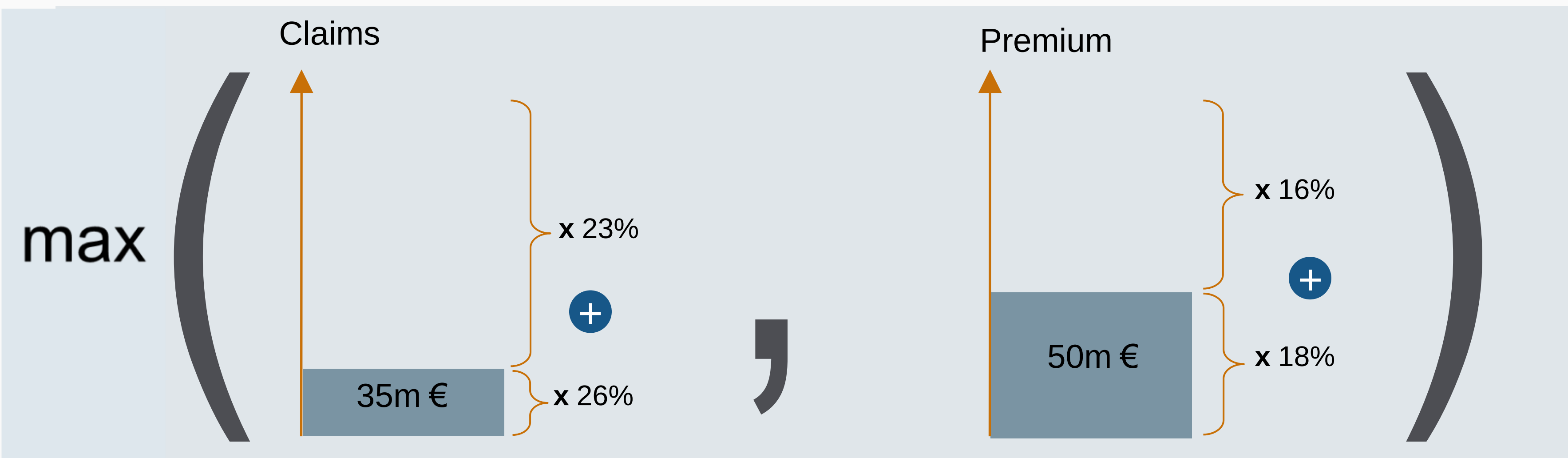
How should risk be measured?

"It's better to be vaguely right than to be precisely wrong."

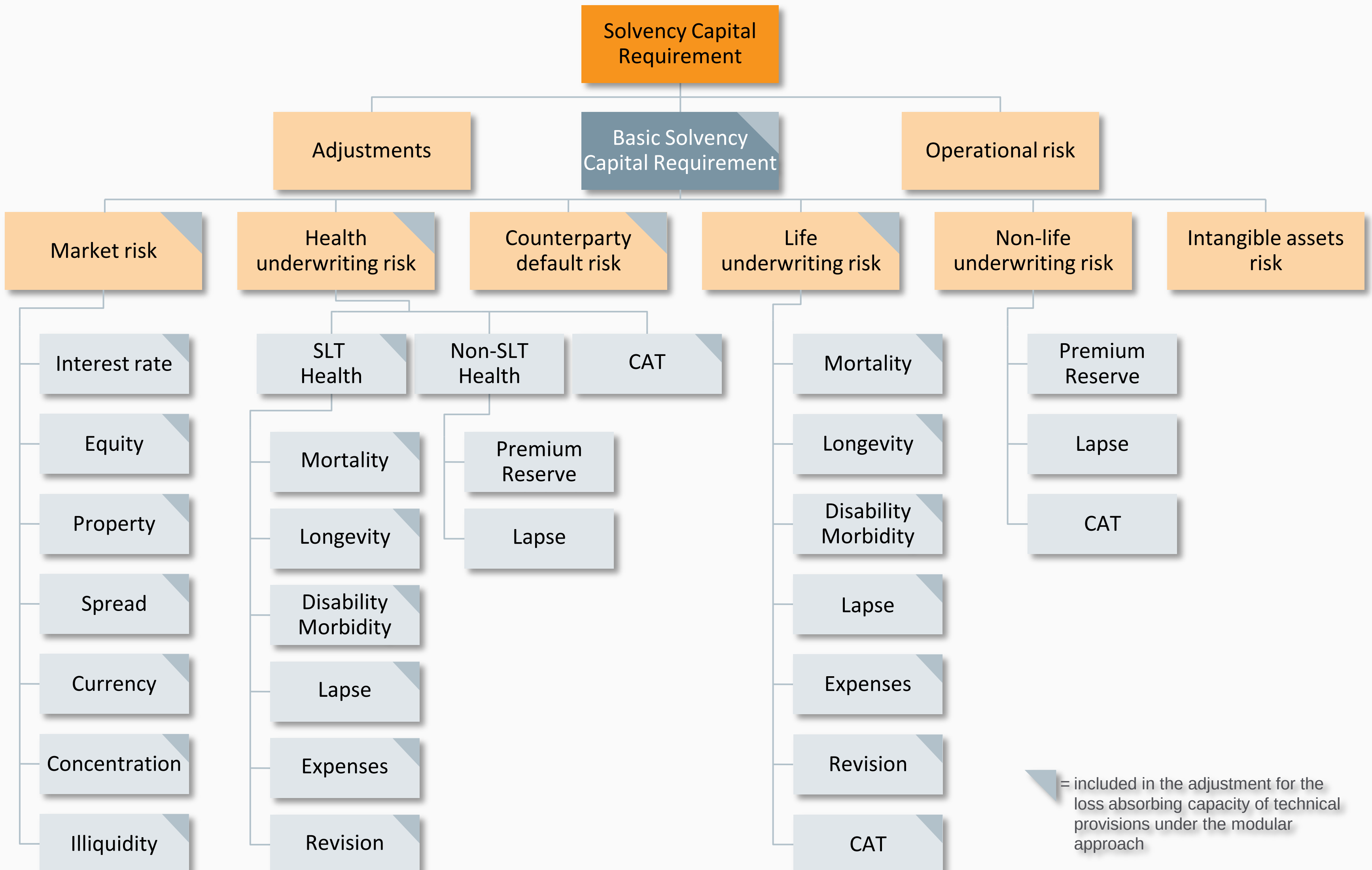
Karl R. Popper (1902 – 1994)

Solvency I
Non-Life formula for capital requirement

max (retention rate, 50%) x

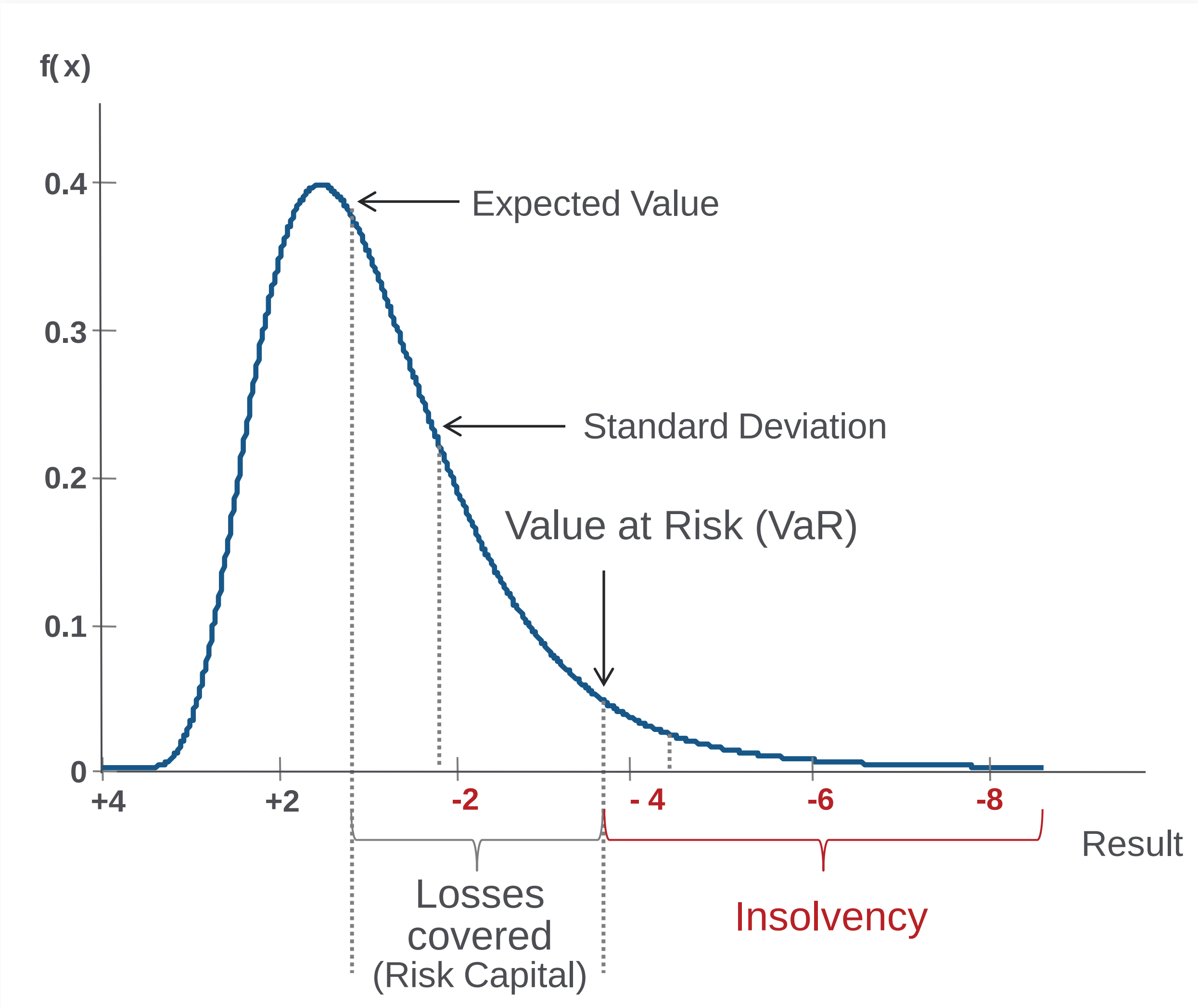


Risk segments in Solvency II and breakdown of the capital requirement according to QIS 5 specification



Source: European Commission

Risk measure: 99.5% Value-at-Risk



The basic solvency capital requirement is calibrated using a Value-at-Risk measure with a confidence level of 99.5% over a one-year period

→ ruin once in 200 years.

Solvency II balance sheet

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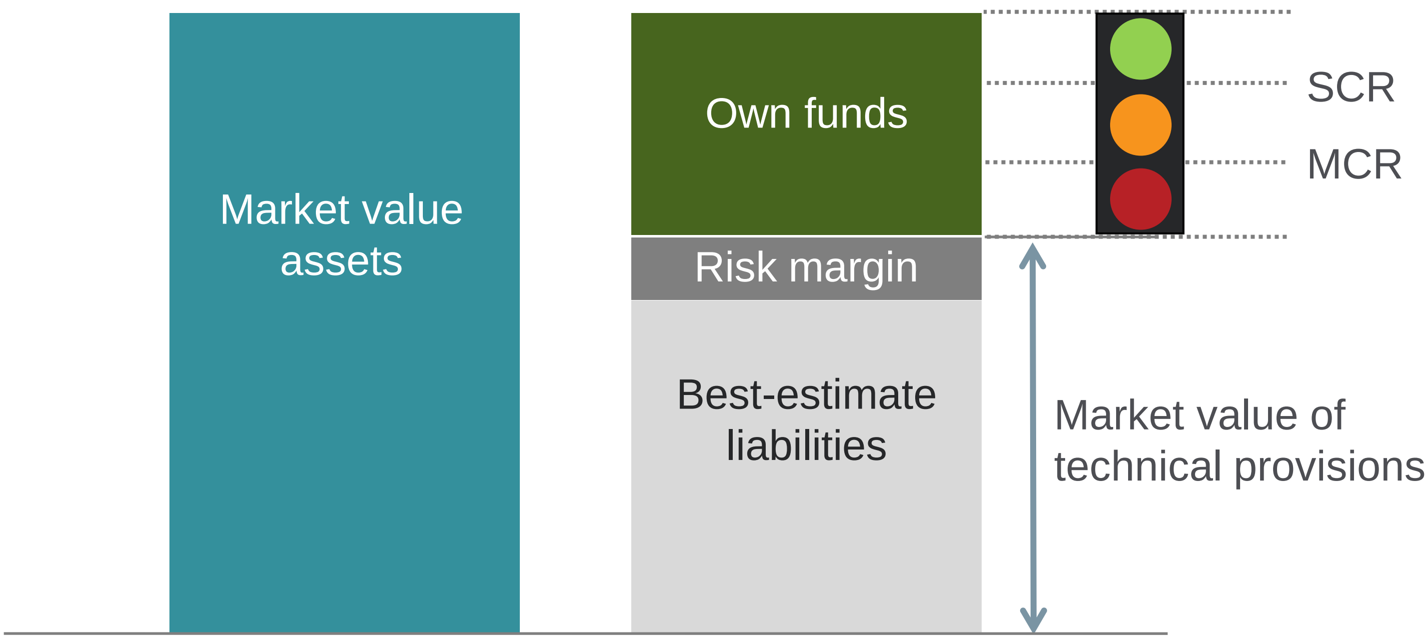
Solvency II balance sheet



SCR = Solvency capital requirement; MCR = Minimum capital requirement

Economic / market-consistent valuation of assets and liabilities

Determination of the Solvency Ratio

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What are **data sources** for a market consistent approach?

Solvency II balance sheet

- Comparability
- IFRS-Standards
- Mark-to-market
- Mark-to-model

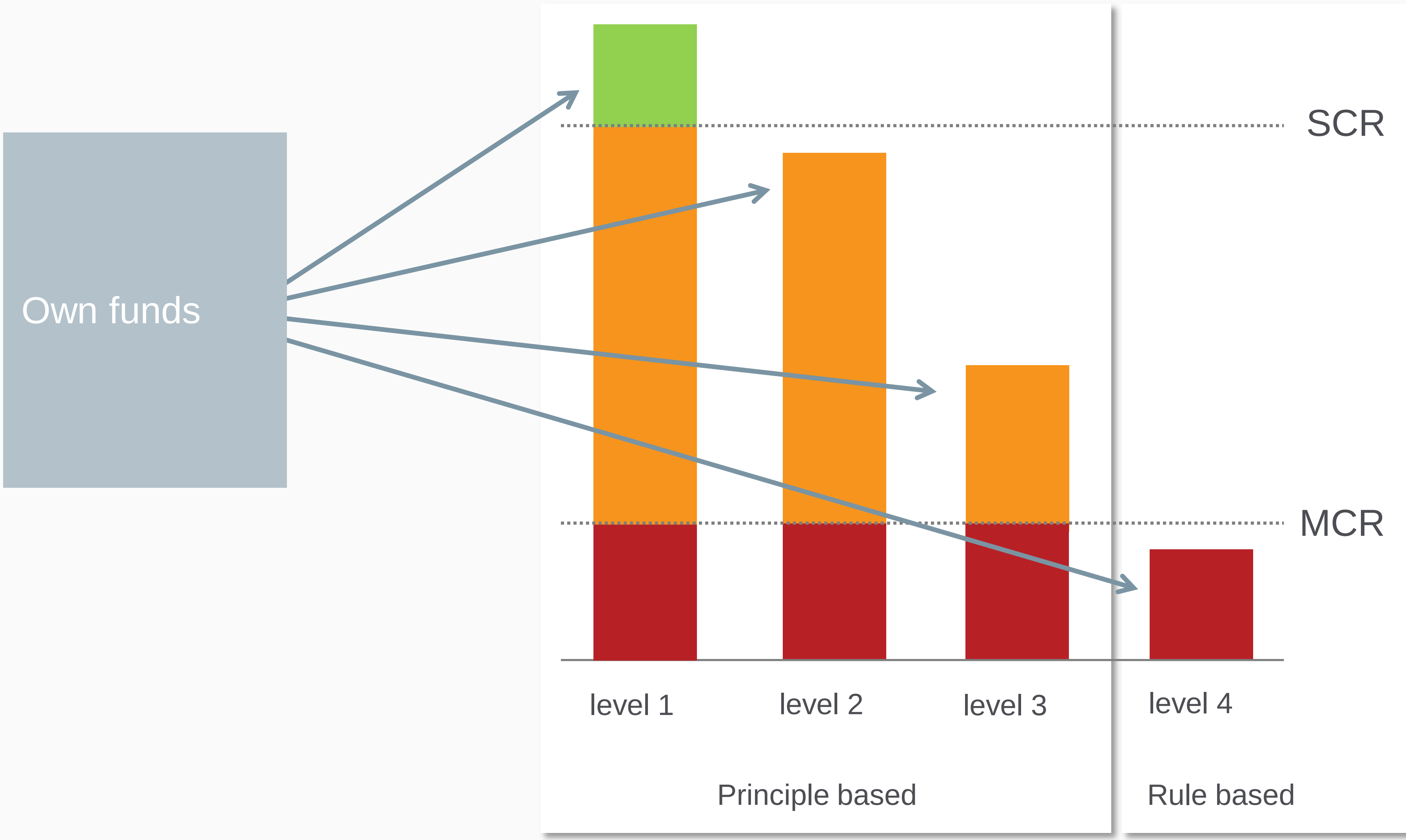
$$\text{Solvency Ratio} = \frac{\text{Own Funds}}{\text{Solvency Capital Requirement (SCR)}} \quad \text{should be} > 1.$$

Underwriting
Market
Credit
Operational

Stochastic risk model / Standard formula

- Statistics
- Experience based

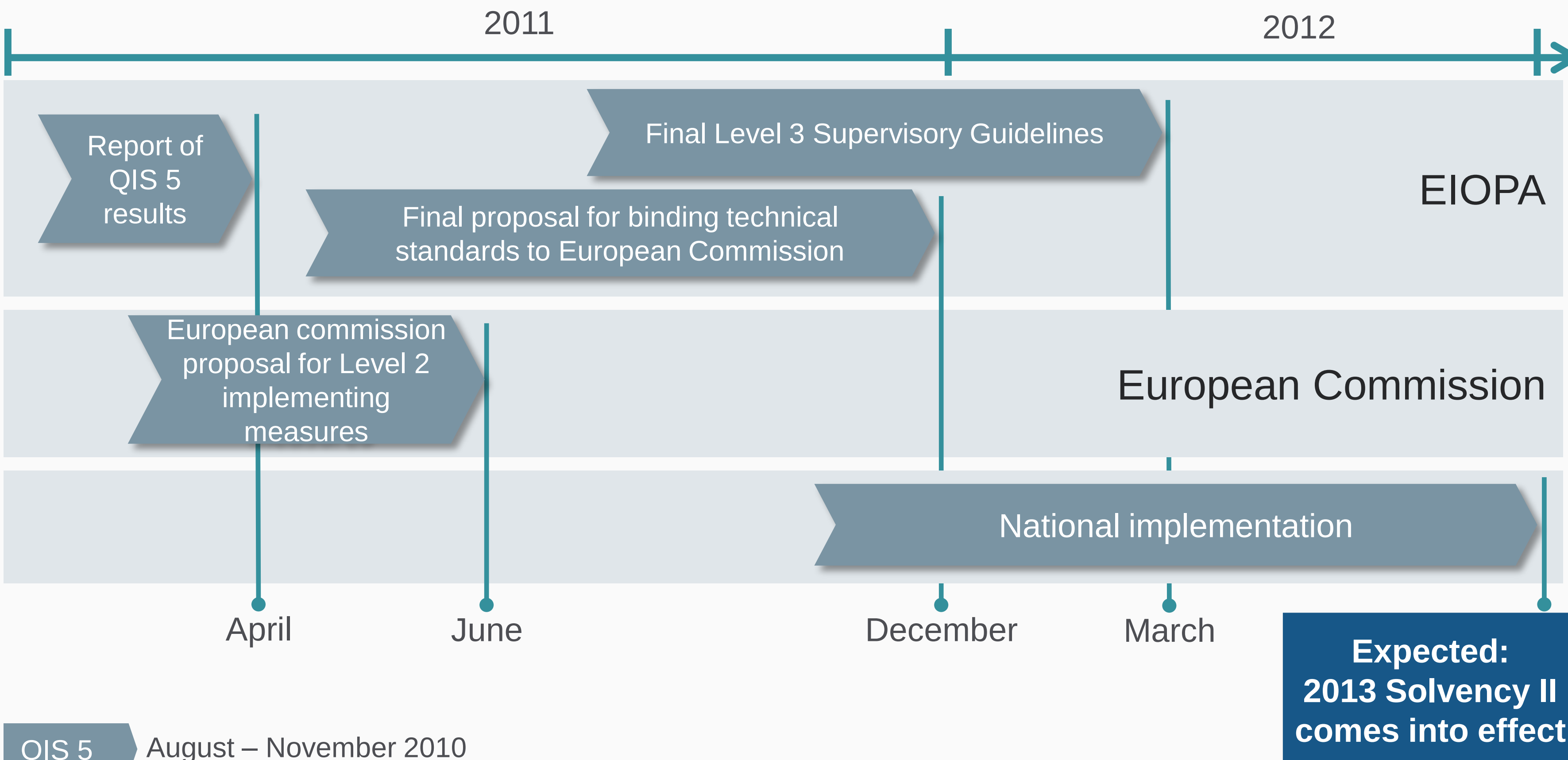
Supervisor's intervention ladder



Supervisory process
Supervisor's intervention ladder

Level 1	Level 2	Level 3	Level 4
Solvency ratio > 100%	e.g. solvency ratio between 80%-100%	e.g. solvency ratio between 50%-80%	Own funds < MCR
Going concern & new business	Going concern and new business	Going concern, maybe restriction on new business	Run-off or even closure of the company
Yearly review of solvency ratio	Notice from the supervisor and soft measures: e.g. structured plan to achieve the SCR within six months	Notice from the supervisor and hard measures: e.g. ▪ capital measures ▪ limitation of dividend payment ▪ change in executive board	Extreme measures: e.g. emergency plan to be presented within a month to restore the MCR immediately

Timeline of Solvency II project



QIS 5 August – November 2010

QIS Quantitative Impact Study
EIOPA European Insurance and Occupational Pensions Authority

Uncertainty in the Solvency II timeline
Omnibus II Directive

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Overview

Proposal for Omnibus II Directive published in Jan 2011*

Contents:

- Several amendments to the level 1 Directive
(Illiquidity premium, standard formula, equivalence of third-country solvency regimes, etc.)
- Responsibility and authority of EIOPA – binding mediation power
- Transitional measures to Solvency II framework
(Length of the transitional period, phasing of that period, transitional requirements)

Problems

- May interfere with Level 1 Directive and Level 2 Implementing Measures
(New legal instruments, delegated acts and implementing technical standards)
- May delay the adoption of Level 2 and Level 3 until late 2011 or 2012

*Proposal for a directive of the European Parliament and of the Council amending Directives 2003/71/EC and 2009/138/EC in respect of the powers of the EIOPA and the European Securities and Markets Authority

2. SOLVENCY II IS NOT ONLY PILLAR 1

Governance system: selected risk management measures to ensure the underwriting process conforms to Solvency II

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Principles-based Solvency II framework

Management is "fit and proper"

Management responsibility for business and risk strategy

Proportionality

Governance requirements:

- transparent structures
- clear segregation of duties
- documented policies
- regular reviews

ICS: internal control system and compliance function

Risk management system

- quantitative requirements
- risk management function
- contingency plans
- (partial) internal model

ORSA

Actuarial function

Outsourcing

Internal audit

Regular information, documentation and reports

ORSA (Own Risk and Solvency Assessment): interlinking of risk strategy, process control and reporting

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ORSA is the entirety of the processes and procedures employed to identify, assess, monitor, manage and report the short and long-term risks that a (re)insurance undertaking faces or may face and to determine the own funds necessary **to cover the overall solvency needs at all times**.

Business strategy: qualitative (e.g. service leadership) and quantitative (e.g. growth)

in regular planning cycles

areas covered by ICS and internal audit

Risk identification → Risk analysis → Risk monitoring → Risk management → Risk report

Risk strategy: qualitative (principles) and quantitative (limits) with medium-term perspective

in regular planning cycles

Art. 50 of the draft Directive – Report on solvency and financial condition

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Public disclosure on an annual basis – description of:

- the business and performance of the company
- the governance system and assessment of its adequacy for the risk profile
- each risk category, risk exposure, concentration, mitigation and sensitivity
- evaluation methods used for assets and technical provisions
- capital management (own funds, MCR, SCR)
- non-compliance with the MCR / significant non-compliance with the SCR during the reporting period even if subsequently resolved, with explanation of its origin, consequences and remedial action
- Capital add-ons

3. SOLVENCY II BALANCE SHEET & ECONOMIC VALUATION

Technical Provisions

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- The value of technical provisions = Best estimate + Risk margin

- Insurance and reinsurance obligations segmentation: as a minimum by line of business (LoB)
- The distinction between life and non-life insurance obligations should be based on the nature of the underlying risk:
  - Insurance obligations of business that is pursued on a similar technical basis to that of life insurance should be considered as life insurance obligations, even if they are non-life insurance from a legal perspective.
  - Insurance obligations of business that is not pursued on a similar technical basis to that of life insurance should be considered as non-life insurance obligations, even if they are life insurance from a legal perspective.
  - *In particular, annuities stemming from non-life insurance contracts (for example for motor vehicle liability insurance) are life insurance obligations.*

- **Substance over form principle**: The choice between life or non-life actuarial methodologies should be based on the nature of the liabilities being valued and from the identification of risks which materially affect the underlying cash-flows.

Best Estimate

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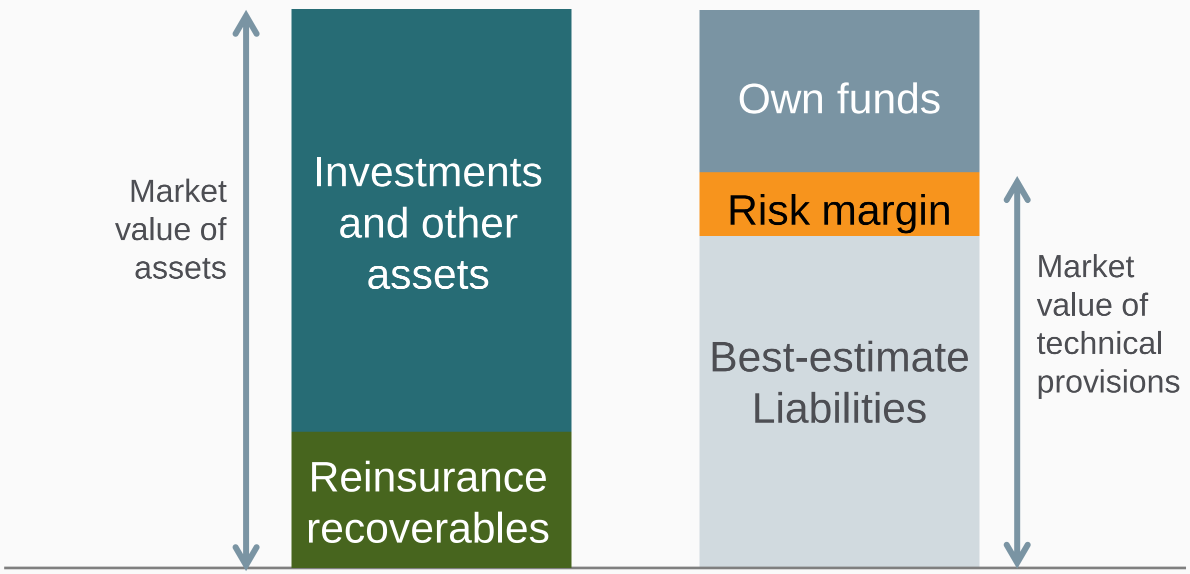
- The best estimate should correspond to the probability weighted average of future cash-flows taking account of the time value of money.

- The best estimate should be calculated gross of reinsurance.
- Recoverables from reinsurance should be calculated separately.



Note:
BE Liabilities should be calculated gross of reinsurance whilst Risk margin is calculated net of reinsurance.

Non-life Insurance Obligations

Separate calculation of best estimate for provisions for:

- Claims outstanding
  - The cash-flow projections relating to claim events having occurred before or at the valuation date – whether the claims arising from these events have been reported or not (i.e. all incurred but not settled claims).
- Premium provisions
  - The expected present value of future in- and out-going cash-flows
    - future premiums;
    - future claims events;
    - administration expenses (claims, in-force policies).

- **The cash in-flows could exceed the cash outflows leading to a negative best estimate. This is acceptable and undertakings are not required to set to zero the value of the best estimate.**

Best Estimate
Example

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Technical provisions

(Figures in '000 EUR)

	accounting basis	BE provisions
Unearned premium reserve (UPR)	284,3	550,3
Provision for claims outstanding	781,9	765,3
Other	53,8	0,0
Total	**1.120,0**	**1.315,6**
Risk margin		**111,8**
Total BE + RM		**1.427,4**

*BE UPR ~ combined ratio * UPR*

BE of PCO calculation:

	acounting basis	discounted value
paid in year 1	574,3	566,0
paid in year 2	207,6	199,3
total	**781,9**	**765,3**

Economic Balance Sheet
Example

Economic balance sheet *'000 EUR*

	accounting basis	QIS5 valuation
Assets	**11.289,9**	**11.289,9**
Liabilities	**4.228,9**	**4.424,5**
TP (BE + RM)	1.120,0	1.315,6
others	3.108,9	3.108,9
Own funds	**7.061,0**	**6.865,4**
Share capital	11.500,0	11.500,0
Profits	-4.439,0	-4.439,0
Reconciliation reserve		-195,6

- In this case the increase of Best estimate of Technical provisions decreases available Own funds.

Risk margin (1/4)

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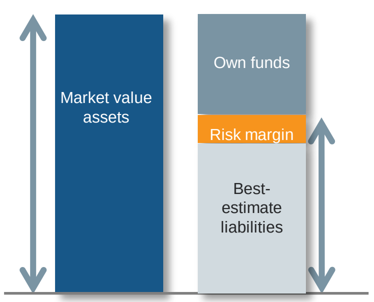
The calculation of the risk margin is based on a transfer scenario

Assumptions:

- The whole portfolio of insurance and reinsurance obligations of the undertaking (original undertaking) is taken over by another insurance or reinsurance undertaking (reference undertaking).
- The reference undertaking does not have any insurance or reinsurance obligations and any own funds before the transfer takes place.
- The calculation of the risk margin should be based on the assumption that the reference undertaking at time t = 0 (when the transfer takes place) will capitalise itself to the required level of eligible own funds.

$$CoCM = CoC \cdot \sum_{t \geq 0} \frac{SCR_{RU}(t)}{(1 + r_{t+1})^{t+1}}$$

CoCM	=	*risk margin*
$SCR_{RU(t)}$	=	*SCR for year t as calculated for the reference undertaking*
r_t	=	*risk-free rate for maturity t*
CoC	=	*Cost-of-Capital rate*



Own funds = MV assets – MV liabilities

Risk margin (2/4)

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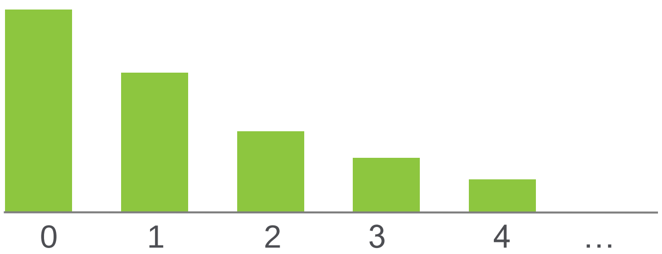
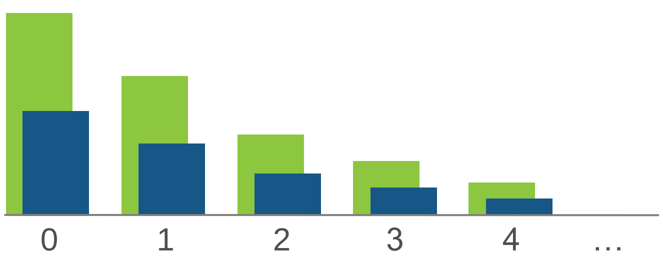
Steps to calculate the Risk Margin under a Cost-of-Capital approach

Step 1:



SCR for future years until run-off of the current liability portfolio.

Step 2:



Determine the cost of holding future SCRs, by multiplying the projected SCR by the $CoC_{Factor} = 6\%$

Step 3:

$$\text{Risk Margin} = CoCM = CoC \cdot \sum_{t \geq 0} \frac{SCR_{RU}(t)}{(1+r_{t+1})^{t+1}}$$

Discount the cost of holding future SCRs at the risk-free rate for maturity *t* to get the risk margin.

The Cost-of-Capital rate accounts for the spread over and above the risk free rate.

Calculation based on the SCR, using the relevant risk-modules of the BSCR.

Relevant risk-modules for the calculation:

- Underwriting risk
- Unavoidable market risk
- Operational risk
- Counterparty default risk wrt reinsurance

Diversification is taken into account between lines of business.

RU: Reference undertaking

Risk margin (3/4)

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The risk margin can be calculated using several simplifications

- run a full calculation of all future solvency capital requirements
- approximate the individual risks or sub-risks within some or all modules and sub-modules to be used for the calculation of future SCRs
- approximate the whole SCR for each future year (e.g. using a proportional approach)
- estimate all future SCRs “at once” (e.g. using a modified duration approach)
- approximate the risk margin by calculating it as a percentage of the best estimate

Diversification should be taken into account

Risk margin (4/4)
Example

- Assume an undertaking in run-off (i.e. no future premium imcome),
- Full claims settlement after 1 year
- Best estimate of liabilities = 200
- Assume $SCR_{RU(0)}$ = 100 which are invested at the risk-free rate r_1 = 3%.
- By QIS 5 definition CoC = 6% (spread above r_1)
- Risk margin = 100 * 6% = 6
- Best estimate of technical provisions = 200 + 6
- At the end of year 1
  - the undertaking will settle claims of 200 (expected value),
  - the remainder amount of 6 can be released from the technical provisions,
  - the provider of the capital $SCR_{RU(0)}$ receives a return of 6 (risk margin) plus another 3 from the risk-free investment.

Own funds (1/6)
Classification

Basic Own Funds

- Excess of assets over liabilities
- Subordinated liabilities
- Reduced by adjustments for:
  - restricted reserves
  - participations in financial/credit institutions
  - ring-fenced funds
  - net deferred tax asset

Tier 1	Tier 2	Tier 3

Ancillary Own Funds (prior supervisory approval)

- "Off balance sheet" items which can be called up to absorb losses
  - Unpaid share capital or initial fund that has not been called up
  - Letters of credit or guarantees
  - Any other legally binding commitments received by (re)insurance undertakings

	Tier 2	Tier 3

Own funds (2/6)
Criterias for classification into Tiers 1-3

Criteria	Tier 1	Tier 2	Tier 3
Subordination	Deeply subordinated	Must rank after the claims of all policyholders, beneficiaries and non-subordinated creditors	Must rank after the claims of all policyholders, beneficiaries and non-subordinated creditors
Loss absorbency	Immediately available to absorb losses Absorbs losses at least on SCR breaches Should not cause or accelerate insolvency	Not necessarily immediately available to absorb losses Should not cause or accelerate insolvency	Should not cause or accelerate insolvency
Sufficient duration	Undated or minimum 10 years maturity at issue. Contractually locked in or replaced at least equivalently on breach of SCR	Undated or minimum five years maturity at issue. Contractually locked in or replaced at least equivalently on breach of SCR	Undated or minimum three years maturity at issue. Contractually locked in or replaced at least equivalently on breach of SCR

Own funds (3/6)
Criterias for classification into Tiers 1-3

Criteria	Tier 1	Tier 2	Tier 3
Free from incentives to redeem	Only redeemable at the option of the insurer or reinsurance undertaking;	Only redeemable at the option of the insurer or reinsurance undertaking; moderate incentives to redeem permissible	Incentives to redeem are permissible
No mandatory fixed charges	Suspension of redemption provided and coupons/dividends can be cancelled in case of breach of SCR	Suspension of redemption provided and coupons/dividends can be deferred in case of breach of SCR	Suspension of redemption provided in case of breach of SCR. Deferral of coupons/ dividends on breach of MCR
No encumbrances	Unconnected with other transactions and no restrictions, charges or guarantees	Unconnected with other transactions and no restrictions, charges or guarantees	Unconnected with other transactions and no restrictions, charges or guarantees

Own Funds (4/6)
Tiering and Tier 1 basic own funds items

Tiering system was first used in the banking sector:

Tier 1 = capital of highest quality
Tier 2 and Tier 3 = capital of lower quality

The following lists of basic fund items that might qualify for the different Tiers reflect the status of QIS5 and are not meant to be comprehensive.

The following basic own funds items should be classified into **Tier 1** provided they meet the Tier 1 criteria mentioned above :

- Called up and paid in common equity (excl. own shares held by the undertaking)
- Initial fund for mutual undertakings (excl. those items held by the undertaking)
- Share premium account
- Reserves (retained earnings, reconciliation reserve, …)
- Other paid in capital instruments (preference shares, subordinated liabilities)

Own Funds (5/6)
Tier 2 and 3 basic own funds items

The following basic own funds items should be classified into **Tier 2** provided they meet the Tier 2 criteria mentioned above:

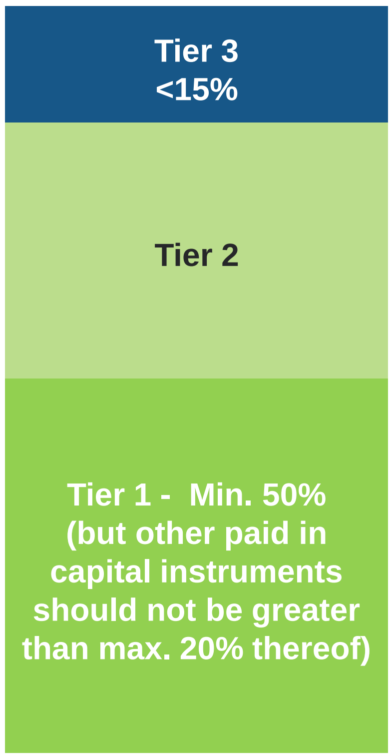
- Called up ordinary share capital
- In respect of restricted reserves: Own funds in excess of amounts being used to cover related risks
- Other called up capital instruments that absorb losses first
- Other paid in capital instruments, incl. preference shares, subordinated liabilities and subordinated mutual members accounts that do not meet the criteria for Tier 1

The following basic own funds items should be classified into **Tier 3** that is not classified as Tier 1 or Tier 2, but meets the Tier 3 criteria mentioned above

- Net deferred tax assets
- Other capital instruments, incl. preference shares, subordinated liabilities and subordinated mutual members accounts

Own funds (6/6)
Eligibility of own funds

Requirement for SCR



Requirement for MCR:

Tier 1 (basic & ancillary) + Tier 2 (only basic) ≥ MCR; of Tier 1 min. 80%

4. STANDARD FORMULA UNDER QIS5

What is it about?

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Timeline and objectives

- From August 2010 to November 2010 – Report published 14 March 2011
- Structure and calibration of the standard formula
- Group issues and internal models

Content

- Use of **one year VaR** at 99.5% as risk measure
- **Cost of Capital approach** for calculating risk margin over best estimate liabilities for non-hedgeable risks
- **Modular structure** of the Solvency Capital Requirement calculation
- **Scenario based approaches**
  (e.g. market risks) driven by prescribed scenario and guidelines on possible calculation methods
- **Recognition of risk absorbing effects**
- **Classification of own funds** with tiering system
- Allowance of risk **diversification effects**

Breakdown of the solvency capital requirement (SCR)

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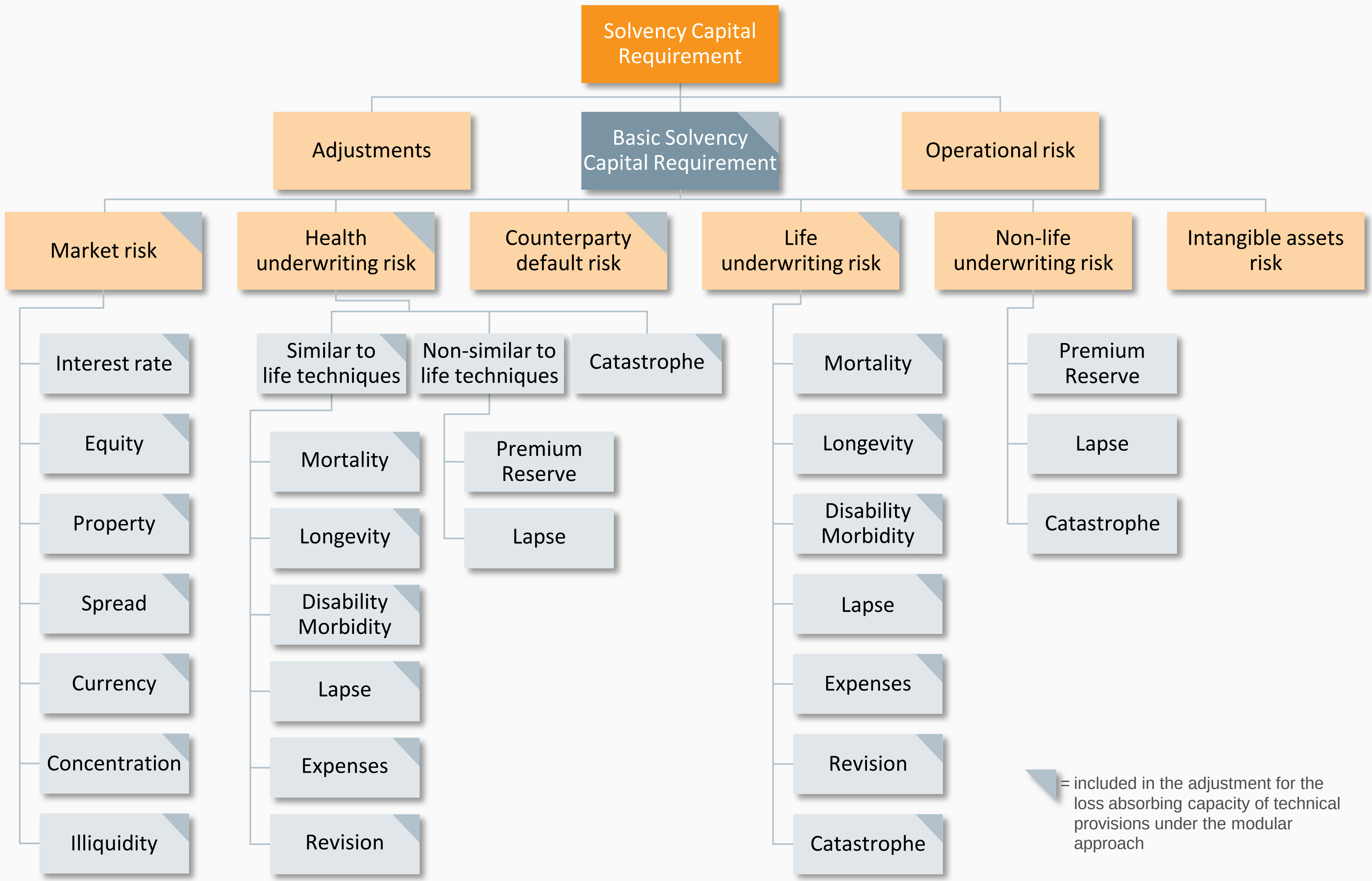

Source: European Commission

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4.1 NON-LIFE UNDERWRITING RISK

Breakdown of the solvency capital requirement (SCR)

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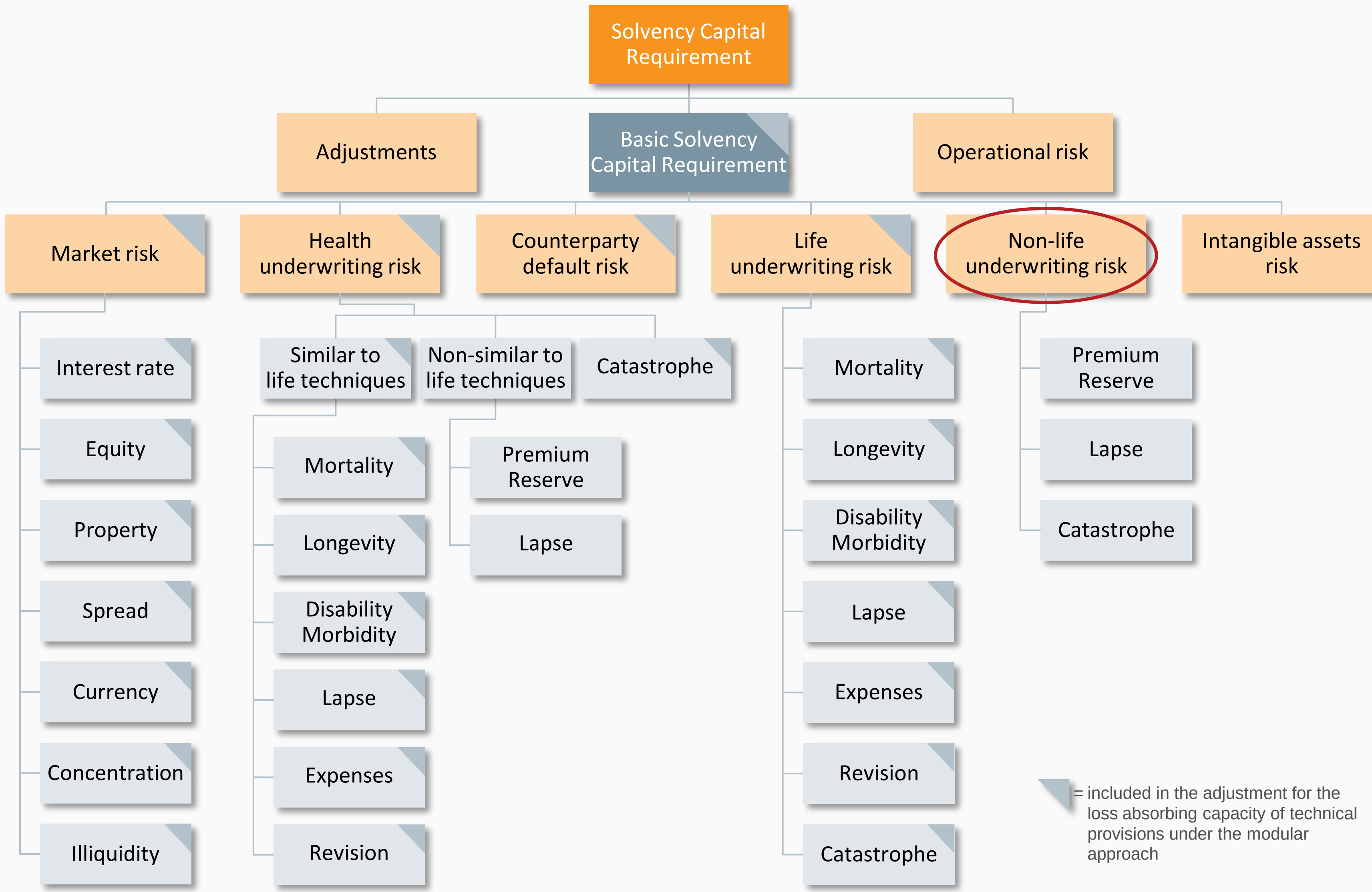

Source: European Commission

QIS5 – calculation of $SCR_{\text{Non-life}}$

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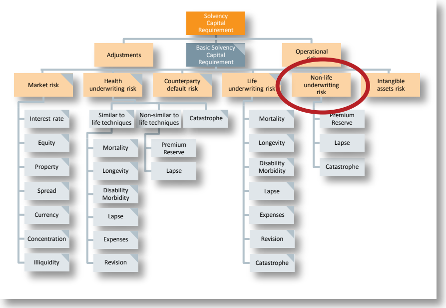
Capital charge for non-life underwriting risk

Derived by combining the capital charges for the non-life sub-risks using a correlation matrix as follows:

$$SCR_{Non\text{-}life} = \sqrt{\sum_{r \times c} CorrNL_{r,c} \cdot NL_r \cdot NL_c}$$

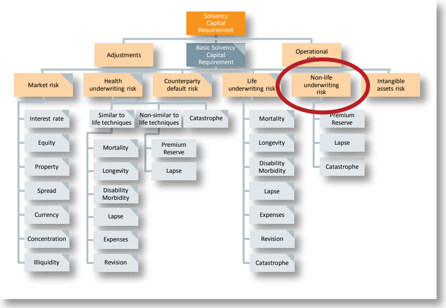
$CorrNL=$	NL_{pr}	NL_{lapse}	NL_{CAT}
NL_{pr}	1		
NL_{lapse}	0	1	
NL_{CAT}	0.25	0	1



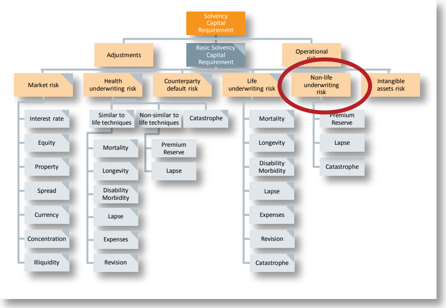
QIS5 – Calculation of the premium and reserve risk NL_{pr} (1/9)

Segmentation in following LoBs

LoB number	
1	Motor, third-party liability
2	Motor, other classes
3	Marine, aviation, transport (MAT)
4	Fire and other property damage
5	Third-party liability
6	Credit and suretyship
7	Legal expenses
8	Assistance
9	Miscellaneous
10	Non-proportional reinsurance – property
11	Non-proportional reinsurance – casualty
12	Non-proportional reinsurance – MAT



QIS5 – Calculation of the premium and reserve risk NL_{pr} (2/9)



Geographical segmentation

Central & Western Asia
Eastern Asia
South and South-Eastern Asia
Oceania
Northern Africa
Southern Africa
Eastern Europe
Northern Europe
Southern Europe
Western Europe
Northern America excl. USA
Caribbean & Central America
Eastern South America
Northern, southern, western South America
North-east US
South-east US
Mid-west US
Western US

QIS5 – Calculation of the premium and reserve risk NL_{pr} (3/9)

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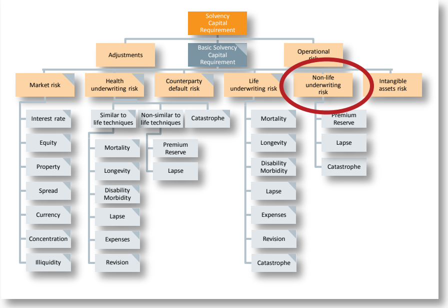
Capital charge for premium and reserve risk

$$NL_{pr} = \rho(\sigma) \bullet V$$

V	Volume measure
ρ(σ)	A function of the standard deviation (~ 3 σ)



QIS5 – Calculation of the premium and reserve risk NL_{pr} (4/9)

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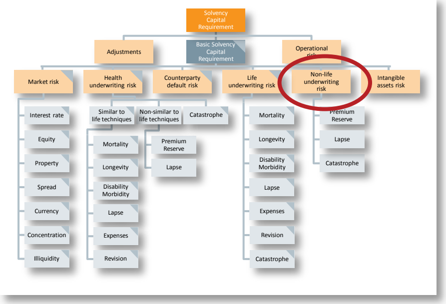


Volume measure for premium risk

$$V_{(prem,lob)} = \max(P_{lob}^{t,written}; P_{lob}^{t,earned}; P_{lob}^{t-1,written}) + P_{lob}^{PP}$$

Volume measure for reserve risk

(Best estimate for claims outstanding for each LoB)

$$V_{(res,lob)} = PCO_{lob}$$

Geographical diversification

$$DIV_{lob} = \frac{\sum_j \left(V_{(prem,j,lob)} + V_{(res,j,lob)}\right)^2}{\left(\sum_j \left(V_{(prem,j,lob)} + V_{(res,j,lob)}\right)\right)^2}$$

, *j denotes the geographical segments*

Overall volume measure

$$V = \sum_{Lob} V_{lob}$$, where

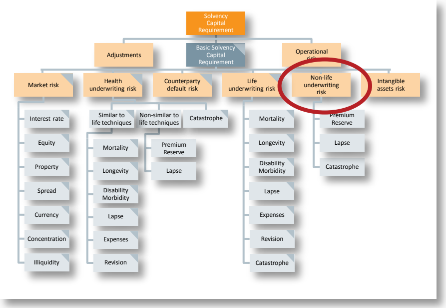
$$V_{lob} = \left(V_{lob}^{prem} + V_{lob}^{res}\right) \cdot (0.75 + 0.25 \cdot DIV_{lob})$$

QIS5 – Calculation of the premium and reserve risk NL_{pr} (5/9)

Geographical diversification

$$DIV_{lob} = \frac{\sum_j \left(V_{(prem,j,lob)} + V_{(res,j,lob)}\right)^2}{\left(\sum_j \left(V_{(prem,j,lob)} + V_{(res,j,lob)}\right)\right)^2}$$, *j denotes the geographical segments*

$$V_{lob} = \left(V_{lob}^{prem} + V_{lob}^{res}\right) \cdot \left(0.75 + 0.25 \cdot DIV_{lob}\right)$$



For simplicity assume $V_{res,j,lob} = 0$. For abbreviation set $V_j = V_{prem,j,lob}$.

<u>1st case:</u> n geographical segments of the same volume $V_1 = V_2 = \ldots = V_n$

➔ $DIV_{lob} = 1/n$ ➔ $V_{lob} = n\, V_j * (0.75 + 0.25 / n)$

➔ The **benefit** from geographical diversification is **less than 25%.**

<u>2nd case:</u> 2 geographical segments with volumes $V_2 = 1/n * V_1$ (V_1 n-times larger)

➔ $DIV_{lob} = 1 - 1/n$

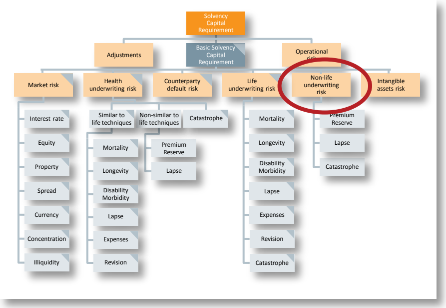
➔ **The more heterogenous** the segments are (in terms of volume), **the less the benefit** from diversification.

QIS5 – Calculation of the premium and reserve risk NL_{pr} (6/9)

Net of reinsurance standard deviation for premium risk

Market-wide estimate of the standard deviation for premium risk per LOB

LoB	
Motor, third-party liability	$10\% \cdot NP_{lob}$
Motor, other classes	$7\% \cdot NP_{lob}$
Marine, aviation, transport (MAT)	$17\% \cdot NP_{lob}$
Fire and other property damage	$10\% \cdot NP_{lob}$
Third-party liability	$15\% \cdot NP_{lob}$
Credit and suretyship	$21.5\% \cdot NP_{lob}$
Legal expenses	$6.5\% \cdot NP_{lob}$
Assistance	$5\% \cdot NP_{lob}$
Miscellaneous	$13\% \cdot NP_{lob}$
Non-proportional reinsurance – property	$17.5\% \cdot NP_{lob}$
Non-proportional reinsurance – casualty	$17\% \cdot NP_{lob}$
Non-proportional reinsurance – MAT	$16\% \cdot NP_{lob}$



The adjustment factor for non-proportional reinsurance NP_{lob} *of a line of* business allows to take into account the risk-mitigating effect of particular per risk excess of loss reinsurance.

QIS5 – Calculation of the premium and reserve risk NL_{pr} (7/9)

Net of reinsurance standard deviation for premium risk

Adjustment factor for non-proportional reinsurance NP_{lob}

$$NP_{lob} = \sqrt{\frac{1+\left(\Omega_{lob}^{net}/M_{lob}^{net}\right)^2}{1+\left(\Omega_{lob}^{gross}/M_{lob}^{gross}\right)^2}}$$

where

$$M_{lob}^{net} = M_{lob}^{gross}\cdot\left[1-F_{m+\sigma^2,\sigma}(a+b)+F_{m+\sigma^2,\sigma}(a)\right]$$
$$+a\cdot\left[F_{m,\sigma}(a+b)-F_{m,\sigma}(a)\right]-b\cdot\left[1-F_{m,\sigma}(a+b)\right]$$

$$\Omega_{lob}^{net} = \begin{pmatrix} \left(\left(\Omega_{lob}^{gross}\right)^2+\left(M_{lob}^{gross}\right)^2\right)\cdot\left[1-F_{m+2\sigma^2,\sigma}(a+b)+F_{m+2\sigma^2,\sigma}(a)\right] \\ +a^2\cdot\left[F_{m,\sigma}(a+b)-F_{m,\sigma}(a)\right] \\ -2b\cdot M_{lob}^{gross}\cdot\left[1-F_{m+\sigma^2,\sigma}(a+b)\right]+b^2\cdot\left[1-F_{m,\sigma}(a+b)\right]-\left(M_{lob}^{net}\right)^2 \end{pmatrix}^{1/2}$$

$$\sigma = \sqrt{\ln\left(1+\left(\frac{\Omega_{lob}^{gross}}{M_{lob}^{gross}}\right)^2\right)}$$

$$m = \ln M_{lob}^{gross} - \frac{\sigma^2}{2}$$

$$M_{lob}^{gross} = \begin{cases} \widetilde{M}_{lob}^{gross} & \text{if } S \geq 1 \\ S\cdot\widetilde{M}_{lob}^{gross} & \text{otherwise} \end{cases}$$

$$\Omega_{lob}^{gross} = \begin{cases} \widetilde{\Omega}_{lob}^{gross} & \text{if } S \geq 1 \\ S\cdot\widetilde{\Omega}_{lob}^{gross} & \text{otherwise} \end{cases}$$

and

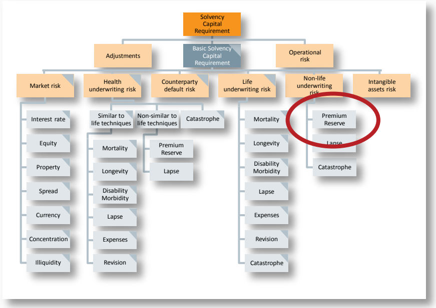
$$S = \sqrt{\frac{n\cdot\sigma^2_{(prem,gross,lob)}\cdot V^2_{(prem,gross,lob)}}{N\cdot\left(\left(\widetilde{\Omega}_{lob}^{gross}\right)^2+\left(\widetilde{M}_{lob}^{gross}\right)^2\right)}}$$

QIS5 – Calculation of the premium and reserve risk NL_{pr} (8/9)

Munich RE

- Adjustment ratio is based on frequency-severity approach which is intensively used in reinsurance impact studies
  - A global frequency-severity model, not only for large claims, but also for all claims for a given line of business
  - Independence between claims frequency and severity which is generally accepted - the assumptions are:
    - Frequency N of all claims: $N \longrightarrow Poisson(\lambda)$
    - Severity X for single claim gross: $X \longrightarrow Lognormal(\mu, \sigma)$
- Frequency has no impact on volatility reduction - no need to calibrate the factor and no assumption on frequency is requested
- Lognormal distribution for a single claim severity is rather conservative

Source: QIS5 Technical Specifications (Annex N) at www.eiopa.europa .eu



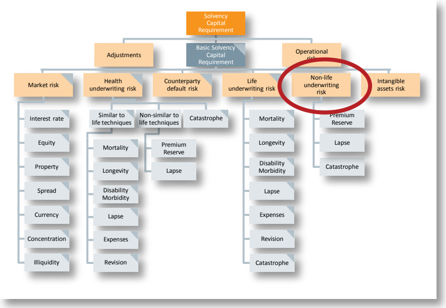
QIS5 – Calculation of the premium and reserve risk NL_{pr} (9/9)

Munich RE

Net of reinsurance standard deviation for reserve risk

Market-wide estimate of the standard deviation for reserve risk per LOB

LOB =	1	2	3	4	5	6	7	8	9	10	11	12
$\sigma_{(res,lob)}$	9.5%	10%	14%	11%	11%	19%	9%	11%	15%	20%	20%	20%



Standard deviation for premium and reserve risk

$$\sigma_{(lob)} = \frac{\sqrt{\left(\sigma_{(prem,\,lob)} V_{(prem,\,lob)}\right)^2 + 2\alpha\sigma_{(prem,\,lob)}\sigma_{(res.lob)} V_{(prem,\,lob)} V_{(res.lob)} + \left(\sigma_{(res,\,lob)} V_{(res,\,lob)}\right)^2}}{V_{(prem,\,lob)} + V_{(res,\,lob)}}$$

$$\alpha = 0.5$$

Munich RE

Insurers should calculate their catastrophe scenarios using standardised scenarios (method 1) or a factor based approach (method 2) or a combination of both

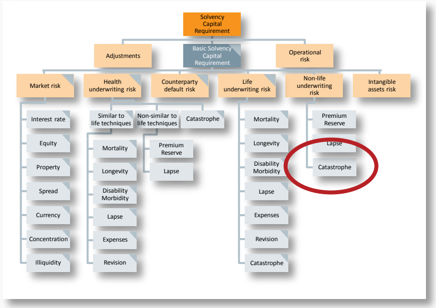
Method 1 should be used for all exposures where possible

Method 2 only where the application of method 1 is not possible, in particular:

- Nat cat exposures outside of the European Economic Area
- Miscellaneous insurance business
- Non-proportional insurance business

Source:

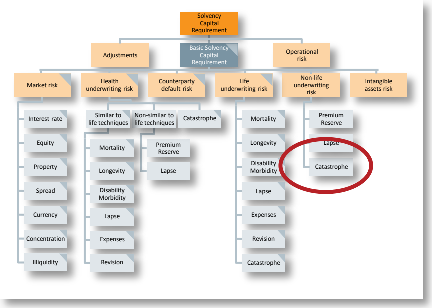
QIS5 Technical Specifications (SCR.9.4) at www.eiopa.europa.eu



QIS5 – Calculation of the non-life CAT risk NL_{CAT} (2/8)

Munich RE

The capital charges of the standardised scenarios (method 1) or the factor based approach (method 2) need to be aggregated to obtain the total capital charge



Capital charge for CAT risk

NL_CAT_1 = CAT capital requirement under method 1

NL_CAT_2 = CAT capital requirement under method 2

$$NL\_CAT = \sqrt{(NL\_CAT_1)^2 + (NL\_CAT_2)^2})$$

Aggregation of capital requirements for method 1 (nat cat/man made)

$$NL\_CAT_1 = \sqrt{(NL\_CAT_{1Nat\_cat})^2 + (NL\_CAT_{1Man\_made})^2})$$

CorrNL=	*Nat cat*	*Man made*
Nat cat	1	
Man made	0	1

QIS5 – Calculation of the non-life CAT risk NL_{CAT} (3/8)

Munich RE

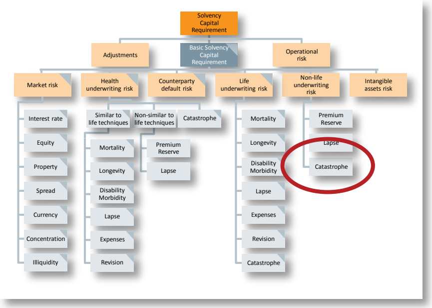
Method 1: standardised scenarios (natural catastrophes)

Regional scenarios for nat cat & man made

Scenarios for perils:

- Windstorm
- Flood
- Earthquake
- Hail
- Subsidence

- Capital requirement is calculated for each peril and country separately
- Aggregation at first by countries then by perils
- For each zone (CRESTA, post-code) undertaking's exposure are required (total insured value) for each LoB affected by the peril



QIS5 – Calculation of the non-life CAT risk NL_{CAT} (4/8)

Munich RE

Method 1: example of flood

$$WTIV_{ZONE} = F_{ZONE} * TIV_{ZONE}$$

$$CAT_{Flood\_ctry} = Q_{CTRY} \sqrt{\sum_{rxc} AGG_{r,c} * WTIV_{ZONE,r} * WTIV_{ZONE,c}}$$

where

- $WTIV_{ZONE}$ – geographically weighted total insured value by zone
- F_{ZONE} – predetermined relativity factors for each zone by country
- TIV_{ZONE} – exposure (total insured value) for each zone (CRESTA)
- CAT_{Flood_ctry} – capital requirement for flood and the country
- Q_{CTRY} – predetermined country factor (1 in 200 years for each country)
- $AGG_{r,c}$ – aggregation matrix for the country between the zones

Multiple events: subsequent losses for windstorm, flood and hail – capital requirement calculated as maximum from A and B type events

A – one large event and additionally one smaller event

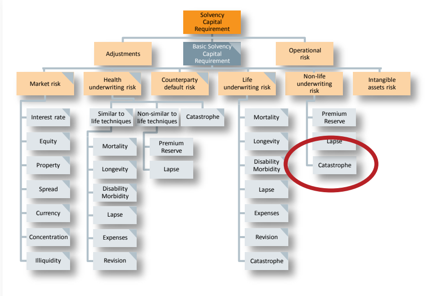
B – two moderate events

QIS5 – Calculation of the non-life CAT risk NL_{CAT} (5/8)

Method 1: standardised scenarios (man-made catastrophes)

The same events for all undertakings – no differentiation between countries or zones

- Events:
  - Motor
  - Fire
  - Marine
  - Aviation
  - Liability
  - Credit & Suretyship
  - Terrorism
- Aggregation capital requirements from above events with the independence assumption



QIS5 – Calculation of the non-life CAT risk NL_{CAT} (6/8)

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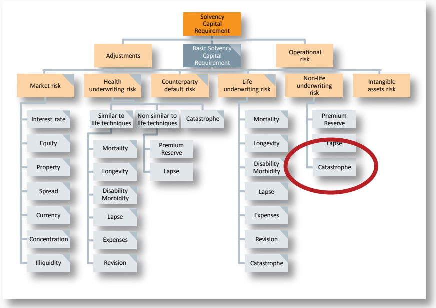


Method 1: Man made example for fire (Option 1)

$$CAT_{Fire} = P * x$$

where

- P – sum insured of the largest known concentration of exposures under the fire & other damages LoB in a 150m radius
- x – proportion of damages caused by the scenarios (100%)

Method 1: Man made example for fire (Option 2 - simplification)

$$CAT_{Fire} = Max\left(LSR, \sum_{sub-lines} SI_x * F_x \right)$$

where

- SI_x – sum insured by sub-line of business (residential, commercial and industrial)
- LSR – single largest risk across all sub-lines
- F_x – market wide factors for each sub line

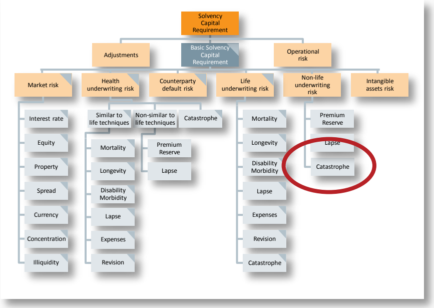
QIS5 – Calculation of the non-life CAT risk NL_{CAT} (7/8)

Munich RE

Method 2: factor based approach

$$NL_{CAT} = \sqrt{\left(\left(\sqrt{\sum_{t=1,2,3,5}(c_t \times P_t)^2} + c_{11} \times P_{11}\right)^2 + \sum_{t=4,7,8,9,10,13}(c_t \times P_t)^2 + (c_6 \times P_6 + c_{12} \times P_{12})^2\right)}$$

- For each event (storm, flood, earthquake, hail…) the affected LoBs (t=1,…,12) are given with predetermined factors
- Capital requirement based on the estimate of the gross written premium in the individual LoB during the forthcoming year



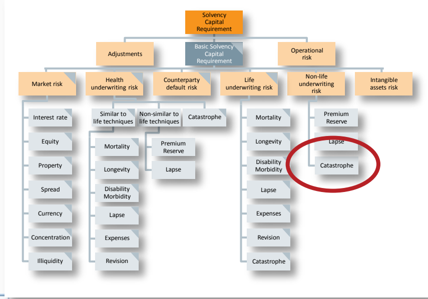
Example

Events	Lines of business affected	Gross Factor c_t
Storm	Fire and property; Motor, other classes	175%
Flood	Fire and property; Motor, other classes	113%

QIS5 – Calculation of the non-life CAT risk NL_{CAT} (8/8)

Munich RE

- CEIOPS provides helper tabs (see below)
- National supervisors need to provide guidance, e.g., in case of missing exposure data at CRESTA level



Number of vehicles insured per country (annualized basis)

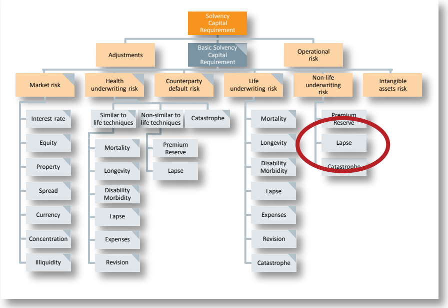
Highest sum insured offered. For example if unlimited, undertakings should type in "unlimited" or a monetary amount.

Once inputs have been entered, press 'Calculate' button to calculate the gross motor CAT charge

	A	B	C	D	E	F	G	H	I	J	K	L
3											Calculate	Motor Cat Charge 27,9
6							scenario loss		chosen loss			
7			Exposure (vehicle years) - $VY_{country}$	Highest sum insured offered - $LIM_{country}$	limit 'failure' rate	base frequency	freq (local)	freq (green c)	freq (local)	freq (green c)		
8												
9	Austria	AT			6%	0,000000	0,000000	0,000000	0,0000		Fixed parameters	
10	Belgium	BE			6%	0,000000	0,000000	0,000000	0,0000			
11	Bulgaria	BG			6%	0,000000	0,000000	0,000000	0,0000		275	€m total
12	Switzerland	CH			6%	0,000000	0,000000	0,000000	0,0000			
13	Cyprus	CY			0%	0,000000	0,000000	0,000000	0,0000		20	year return period
14	Czech Republic	CZ			6%	0,000000	0,000000	0,000000	0,0000			
15	Germany	DE			6%	0,000000	0,000000	0,000000	0,0000		300	m vehicles
16	Denmark	DK			6%	0,000000	0,000000	0,000000	0,0000			
17	Estonia	EE			6%	0,000000	0,000000	0,000000	0,0000		2,0	alpha
18	Spain	ES			6%	0,000000	0,000000	0,000000	0,0000			
19	Finland	FI			6%	0,000000	0,000000	0,000000	0,0000		6%	limit failure
20	France	FR			6%	0,000000	0,000000	0,000000	0,0000			
21	Greece	GR			6%	0,000000	0,000000	0,000000	0,0000			
22	Hungary	HU			6%	0,000000	0,000000	0,000000	0,0000		0,000171	per million vehciles per annum
23	Ireland	IE			6%	0,000000	0,000000	0,000000	0,0000			
24	Iceland	IS			0%	0,000000	0,000000	0,000000	0,0000		Results	
25	Italy	IT			6%	0,000000	0,000000	0,000000	0,0000		#DIV/0!	no limits
26	Lithuania	LT			6%	0,000000	0,000000	0,000000	0,0000			
27	Luxembourg	LU			6%	0,000000	0,000000	0,000000	0,0000		27,9	limited
28	Latvia	LV			6%	0,000000	0,000000	0,000000	0,0000			

QIS5 – Calculation of the non-life lapse risk NL_{lapse} (1/2)

Non-life insurance contracts can include policyholder options that influence the obligations, e.g. options to terminate a contract before the end of the previously agreed insurance period or options to renew contracts according to previously agreed conditions. Where such policyholder options are included in a non-life insurance contract, the calculation of premium provisions is based on assumptions about the exercise rates of these options. Lapse risk is the risk that these assumptions turn out to be wrong or need to be changed.

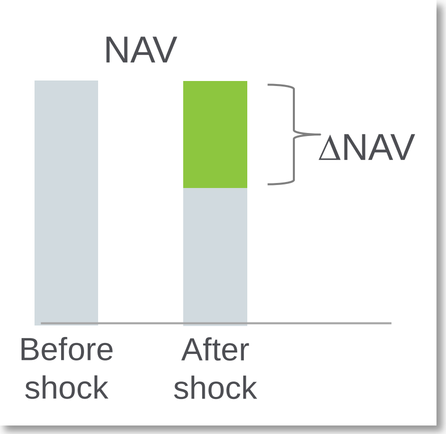


The capital requirement for lapse risk should be calculated as follows:

$$NL_{lapse} = \max(Lapse_{down}; Lapse_{up}; Lapse_{mass})$$

The capital requirement for the risk of a permanent change of the rates of lapsation is determined by the maximum of the corresponding capital requirement.

NL_{lapse}	=	Capital requirement for lapse risk
$Lapse_{down}$	=	Capital requirement for the risk of a permanent decrease of the rates of lapsation
$Lapse_{up}$	=	Capital requirement for the risk of a permanent increase of the rates of lapsation
$Lapse_{mass}$	=	Capital requirement for the risk of a mass lapse event



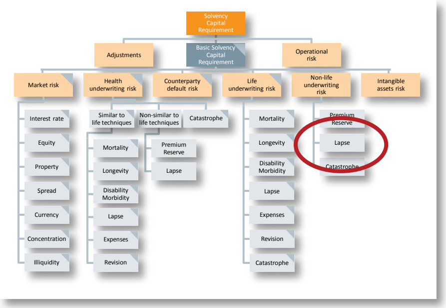
QIS5 – Calculation of the non-life lapse risk NL_{lapse} (2/2)

Munich RE

Permanent decrease of the rates of lapsation:

$Lapseshock_{down}$ = **Reduction of 50%** in the assumed option take-up rates in all future years for all policies adversely affected by such risk. Affected by the reduction are options to fully or partly terminate, decrease, restrict or suspend the insurance cover. Where an option allows the full or partial establishment, renewal, increase, extension or resumption of insurance cover, the 50% reduction should be applied to the rate that the option is not taken up.

The shock should not change the rate to which the reduction is applied to by more than 20% in absolute terms.



Permanent increase of the rates of lapsation:

$$Lapse_{up} = \Delta NAV \mid lapseshock_{up}$$

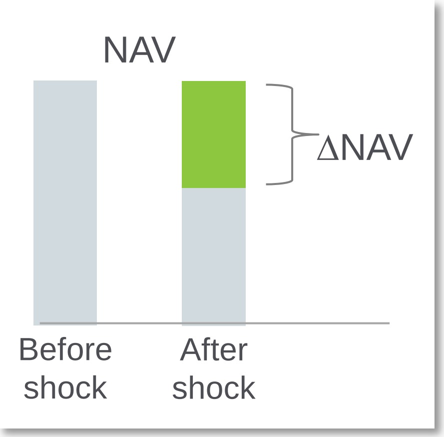
$Lapseshock_{up}$ = **Increase of 50%** in the assumed option take-up rates in all future years for all policies adversely affected by such risk. Affected by the increase are options to fully or partly terminate, decrease, restrict or suspend the insurance cover. Where an option allows the full or partial establishment, renewal, increase, extension or resumption of insurance cover, the 50% increase should be applied to the rate that the option is not taken up.

The shocked rate should not exceed 100%.

Risk of a mass lapse event:

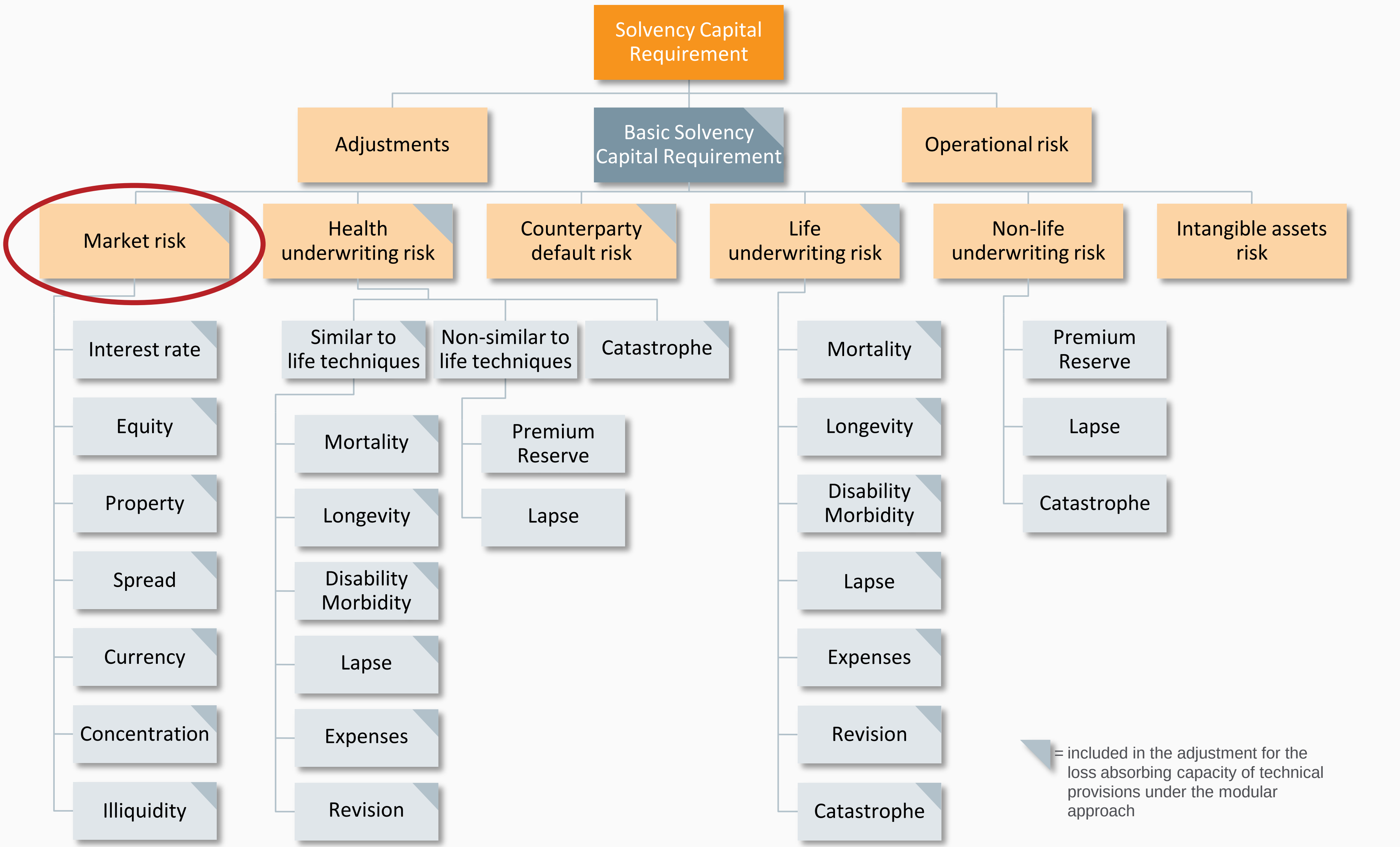
$$Lapse_{mass} = \Delta NAV \mid lapseshock_{mass}$$

$Lapseshock_{mass}$ = the surrender of **30%** of the insurance policies with a **negative best estimate** for premium provision



4.2 MARKET RISK

SCR$_{market}$ – Market risk



Source: European Commission

SCR_{market} – Market risk

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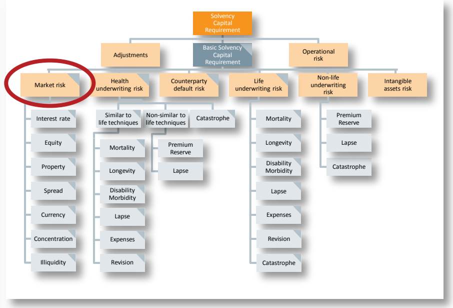
Capital charge for market risk

The market subrisk-modules should be combined to an overall charge SCR_{mkt} for market risk using a correlation matrix as follows:

$CorrMkt_{r,c}$ = the cells of the correlation matrix CorrMkt

Mk_r, Mkt_c = Capital charges for the individual market risks under the interest rate stress according to the rows and columns of the correlation matrix CorrMkt.

$$SCR_{mkt} = \max \sqrt{\sum_{rxc} CorrMkt_{r,c} \cdot Mkt_r \cdot Mkt_c}$$



r,c: Values of the correlation matrices (rows and columns)

SCR$_{market}$ – Market risk

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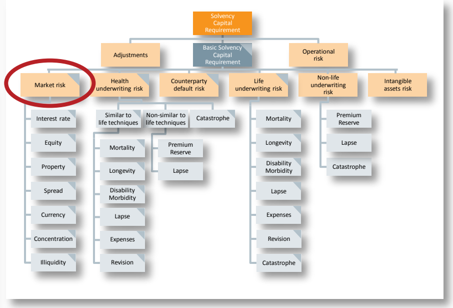
Capital charge for market risk

The capital charge for market risk is calculated by taking into account up- and downward shocks.

The two stress testing scenarios are based on different correlation matrices.

The standard formula for market risk is determined as the maximum of the upward or the downward tested capital charge.



Capital charge for market risk

$$SCR_{mkt} = \max\left(\sqrt{\sum_{rxc} CorrMktUp_{r,c} \cdot Mkt_{Up,r} \cdot Mkt_{Up,c}} \,;\, \sqrt{\sum_{rxc} CorrMktDown_{r,c} \cdot Mkt_{Down,r} \cdot Mkt_{Down,c}} \right)$$

Capital charge for market risk including risk absorbing effect of technical provisions

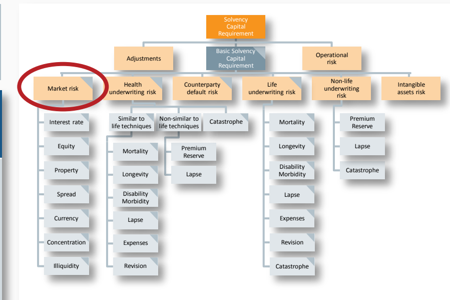
$$nSCR_{mkt} = \max\left(\sqrt{\sum_{rxc} CorrMktUp_{r,c} \cdot nMkt_{Up,r} \cdot nMkt_{Up,c}} \,;\, \sqrt{\sum_{rxc} CorrMktDown_{r,c} \cdot nMkt_{Down,r} \cdot nMkt_{Down,c}} \right)$$

SCR_{market} – Market risk Correlation matrices

Munich RE

Correlation matrix for market risk shock

Correlation Market Risk	Interest	Equity	Property	Spread	Currency	Concentration	Illiquidity premium
Interest	1						
Equity	**A**	1					
Property	**A**	0.75	1				
Spread	**A**	0.75	0.50	1			
Currency	0.25	0.25	0.25	0.25	1		
Concentration	0	0	0	0	0	1	
Illiquidity premium	0	0	0	-0.50	0	0	1



The factor **A** shall be equal to 0 if the capital requirement for interest rate risk is derived from the capital requirement for the risk of an **increase** in the interest rate term structure including the loss absorbing capacity of technical provisions.
For the risk of a **decrease**, the factor **A** shall be equal to 0.5.

Mkt_{int} – Interest rate risk (1/3)

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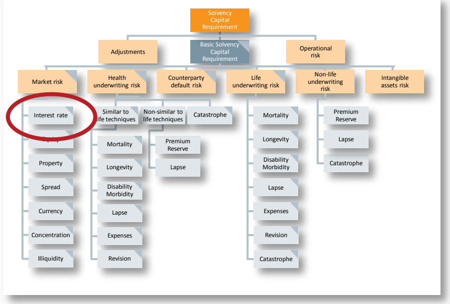
Calculation

The altered term structures are derived by multiplying the current interest rate curve by $(1+s_{up})$ and $(1+s_{down})$, where both the upward stress $s_{up}(t)$ and the downward stress $s_{down}(t)$ for individual maturities t are specified as follows:

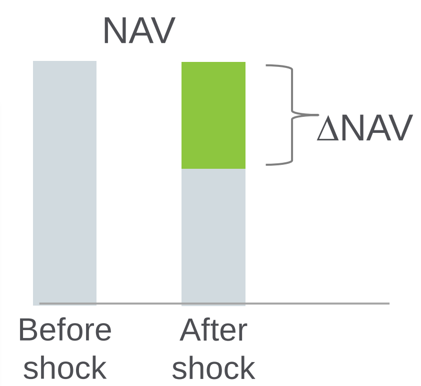


Maturity t (years)	0.25	0.5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30
relative change $s_{up}(t)$	70%	70%	70%	70%	64%	59%	55%	52%	49%	47%	44%	42%	39%	37%	35%	34%	33%	31%	30%	29%	27%	26%	26%	26%	26%	26%	26%	25%
relative change $s_{down}(t)$	-75%	-75%	-75%	-65%	-56%	-50%	-46%	-42%	-39%	-36%	-33%	-31%	-30%	-29%	-28%	-28%	-27%	-28%	-28%	-28%	-29%	-29%	-29%	-30%	-30%	-30%	-30%	-30%
	Note that for maturities greater than 30 years a stress of +25%/-30% should be maintained																											

The capital charge for interest rate risk is determined as the result of two predefined scenarios

$$\text{Mkt}_{\text{int}} = \max\left(Mkt_{\text{int}}^{up}; Mkt_{\text{int}}^{down}; 0\right)$$

The capital requirement for interest rate risk is calculated depending on which of the capital requirement figures calculated for the interest rate upward and downward shocks is higher.



Mkt_{int} – Interest rate risk (2/3)
How to calculate ΔNAV? (Upward shock)

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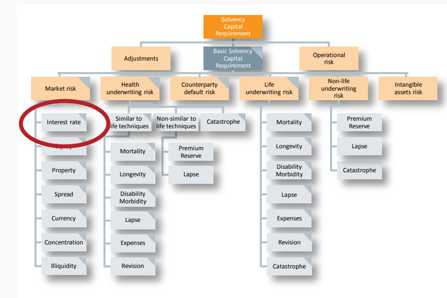
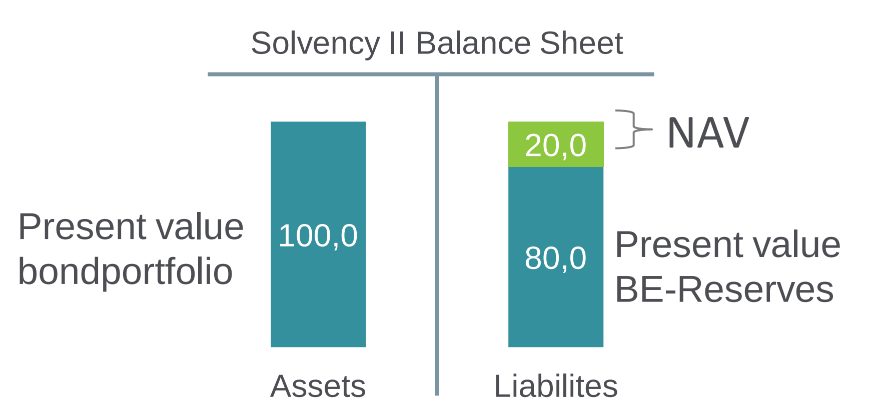
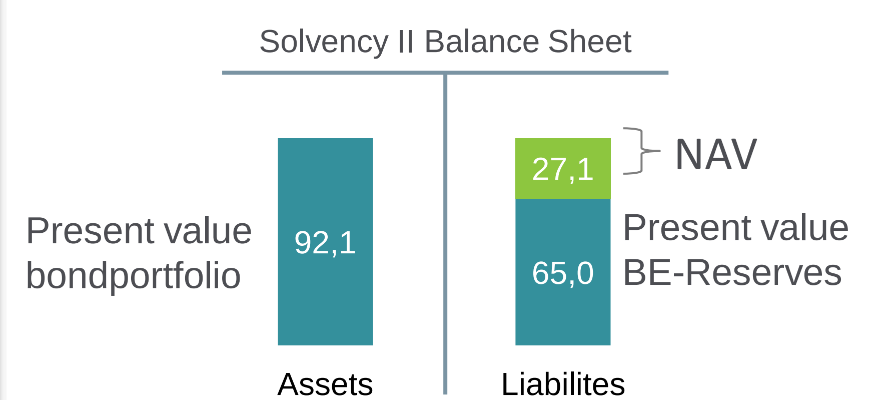
Assumptions:

- Interest rate of the bond portfolio before shock: 4%
- Duration assets: 5 years
- Duration liabilities: 15 years
- Shocks upward: 5/15 years: 55%/33%





Before shock



After upward shock

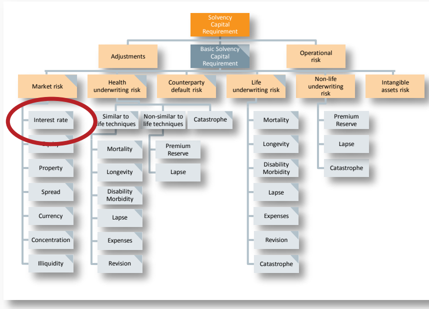
$$\Delta NAV = \max(0; NAV_{\text{before shock}} - NAV_{\text{after shock}}) = \max(0\ ;\ 20 - 27{,}1) = 0$$

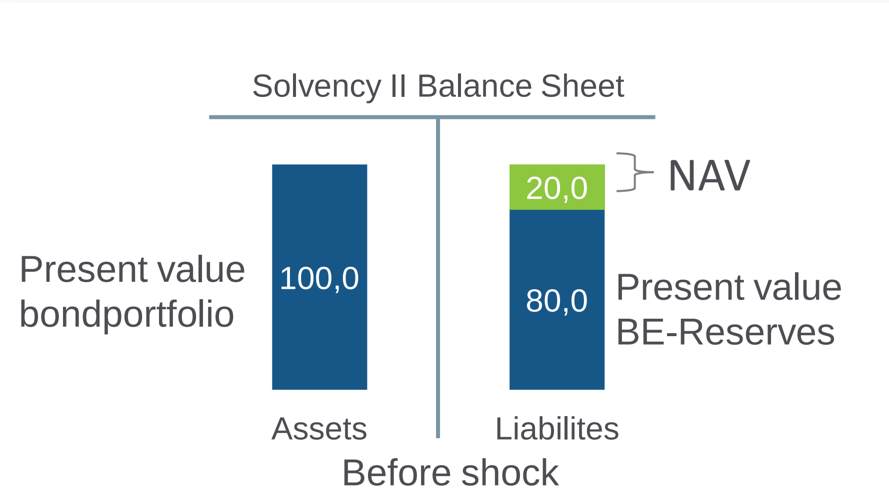
Mkt_{int} – Interest rate risk (3/3)
How to calculate ΔNAV? (Downward shock)

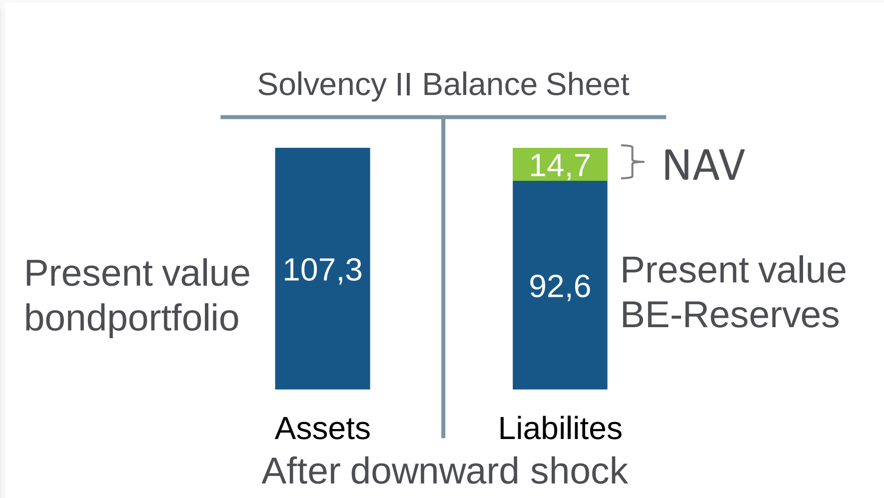
Munich RE

Assumptions:

- Interest rate of the bond portfolio before shock: 4%
- Duration assets: 5 years
- Duration liabilities: 15 years
- Shocks downward: 5/15 years: -46%/-27%







$$\Delta NAV = \max(0; NAV_{\text{before shock}} - NAV_{\text{after shock}}) = \max(0 ; 20 - 14{,}7) = 5{,}3$$

Mkt_{prop} – Property risk (1/1)

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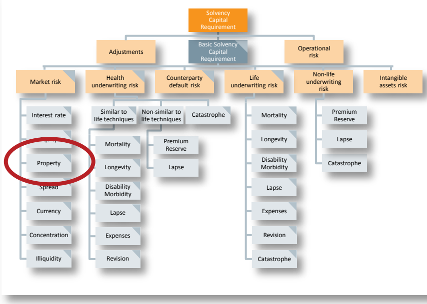
Property risk arises as a result of sensitivity of assets, liabilities and financial investments to the level or volatility of market prices of property

The following investments shall be treated as property and their risks considered accordingly in the property risk sub-module:

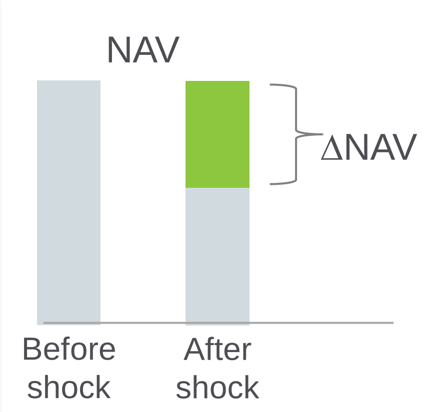
- land, buildings and immovable-property rights;
- direct or indirect participations in real estate companies that generate periodic income or which are otherwise intended for investment purposes;
- property investment for the own use of the insurance undertaking



The capital charge is determined as a result of a predefined scenario

The property shock is the immediate effect on the net value of asset and liabilities expected in the event of an instantaneous **decrease of 25 %** in the value of investments in real estate, taking account of all the participant's individual direct and indirect exposures to property prices.

$$Mkt_{prop} = \max\left(\Delta NAV \middle| \text{property shock}; 0\right)$$



Mkt_{eq} – Equity risk (1/2)

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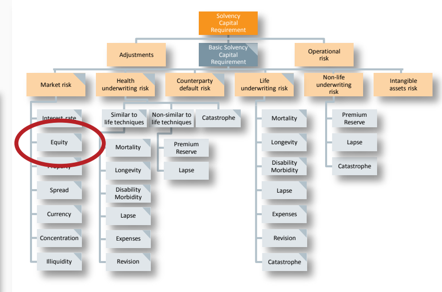
Equity risk arises from level or volatility of market prices for equities

Exposure to equity risk refers to all assets and liabilities whose value is sensitive to changes in equity prices.



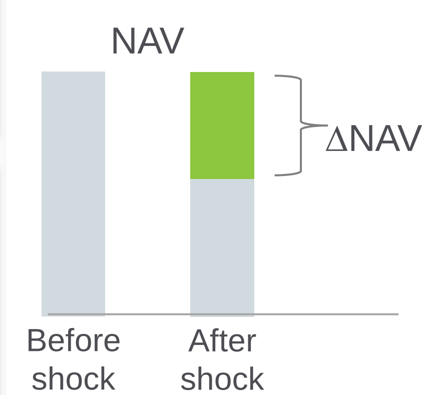
The capital charge is determined as a result of predefined scenarios

$$Mkt_{eq,i} = \max(\Delta NAV | \text{equity shock}_i; 0)$$

	Global	*Other*
Equity shock$_i$	30%	40%

Note that the stresses above take account of a YE09 symmetric adjuster to equity of -9%, so changing them from their **base level of 39% and 49%.**

For the determination of this capital charge, all equities and equity type exposures have to be taken into account, including private equity as well as certain types of alternative investments, excluding equity owned in an undertaking part of the same group in which case the approach for the treatment of participations applies.



Mkt_{eq} – Equity risk (2/2)

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Calculation of the capital charge

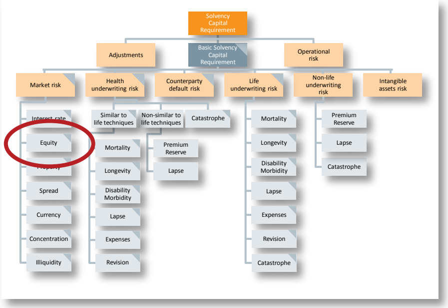
$$Mkt_{eq} = \sqrt{\sum_{r \times c} CorrIndex_{r \times c} \cdot Mkt_r \cdot Mkt_c}$$

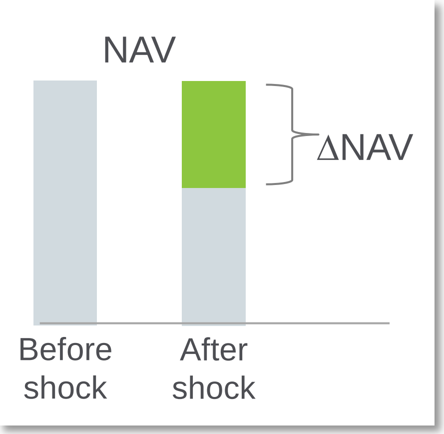
$CorrIndex_{rxc}$ = *The cells of the correlation matrix* $Corr_{Eq}$

Mkt_r, Mkt_c = Capital charges for equity level risk per individual index according to the rows and columns of correlation matrix *CorrIndex*

CorrIndex	Global	Other
Global	1	
Other	0.75	1

“Global” comprises equity listed in EEA or OECD countries, the equity index “Other” comprises equity listed only in emerging markets, non-listed equity, hedge funds and any other alternative investments not included elsewhere in the market risk calibration





rxc: Values of the correlation matrices (rows and columns)

Mkt_{sp} – Spread risk (1/4)
Bonds

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Calculation of the spread risk

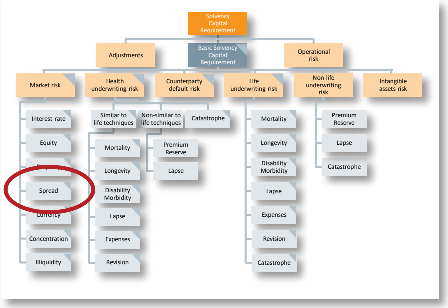
$$Mkt_{sp} = Mkt_{sp}^{bonds} + Mkt_{sp}^{struct} + Mkt_{sp}^{cd}$$

Where:

Mkt_{sp}^{bonds} : is the capital charge for spread risk of bonds

Mkt_{sp}^{struct} : is the capital charge for spread risk of structured credit products

Mkt_{sp}^{cd} : is the capital charge for credit derivatives



Calculation of the spread risk for bonds

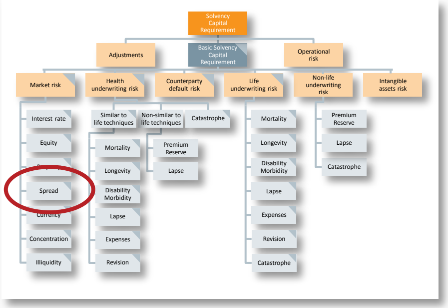
The capital charge for spread risk of bonds is determined as follows:

$$Mkt_{sp}^{bonds} = \max\left(\Delta NAV \mid \sum_i MV_i \cdot duration_i \cdot F^{up}\left(rating_i\right);0\right)$$

Bonds	F_{up}	Duration Floor	Duration Cap
AAA	0.9%	1	36
AA	1.1%	1	29
A	1.4%	1	23
BBB	2.5%	1	13
BB	4.5%	1	10
B or lower	7.5%	1	8
Unrated	3.0%	1	12

Mkt_{sp} – Spread risk (2/4)
Bonds

Spread risk is the part of risk that reflects the change in value of net assets due to a move in the yield on an asset relative to the risk-free term structure.



The following input information is required:

MV_i	=	the credit risk exposure i as determined by reference to market values (exposure at default)
$rating_i$	=	for corporate bonds, the external rating of credit risk exposure i
$duration_i$	=	for corporate bonds, the duration of credit risk exposure i
$attach_i$	=	for structured credit products, the attachment point of the tranche held
$detach_i$	=	for structured credit products, the detachment point of the tranche held
$tenure_i$	=	for structured credit products, the average tenure of the assets securitised
$ratingdist_i$	=	for structured credit products, a vector of the rating of the rating distribution in the asset pool securitised

Mkt_{sp} – Spread risk (3/4) Structured products

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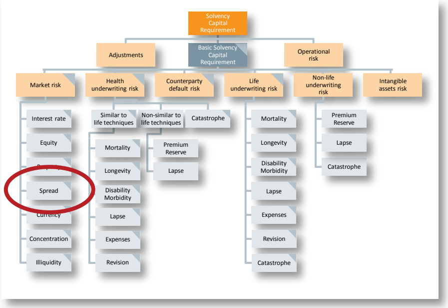
Calculation of the spread risk for structured products

The capital charge for spread risk of structured products is determined as follows:

$$Mkt_{sp,underlying}^{struct} = \max\left(\Delta NAV \,|\, \sum_i MV_i \frac{G\left(ratingdist_i; tenure_i\right) - attach_i}{detach_i - attach_i}; 0 \right)$$

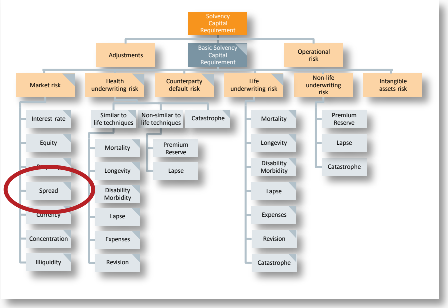
$$Mkt_{sp,direct}^{struct} = \max\left(\Delta NAV \,|\, \sum_i MV_i \cdot duration_i \cdot F^{up}\left(rating_i\right); 0 \right)$$



Structured Products	F_{up}	Duration Floor	Duration Cap
AAA	0.9%	1	36
AA	1.1%	1	29
A	1.4%	1	23
BBB	2.5%	1	13
BB	6.75%	1	10
B or lower	11.25%	1	8
Unrated	3.0%	1	12

$G(ratingdist_i, tenure_i)$	AAA	AA	A	BBB	BB	B	CCC or lower	Unrated
[0-2[years	0.4%	0.9%	2.8%	5.3%	14.6%	31.1%	52.7%	6.3%
[2-4[years	0.8%	1.7%	4.9%	9.6%	23.9%	44.8%	66.6%	11.4%
[4-6[years	1.2%	2.8%	6.5%	13.1%	30.1%	51.2%	70.7%	15.7%
[6-8[years	1.8%	4.1%	8.4%	16.4%	35.3%	55.0%	72.6%	19.6%
8+ years	2.4%	5.3%	10.3%	19.6%	39.3%	57.8%	73.5%	23.5%

Mkt_{sp} – Spread risk (4/4)
Credit derivatives



The function for determining the risk capital for credit derivatives is determined as follows:

$$Mkt^{cd}_{sp,upward} = \max\left(\Delta NAV \middle| \text{upward spread shock on credit derivatives}; 0\right)$$

$$Mkt^{cd}_{sp,downward} = \max\left(\Delta NAV \middle| \text{downward spread shock on credit derivatives}; 0\right)$$

Credit derivatives	Widening of the spreads (in absolute terms)	Decrease of the spreads (in relative terms)
AAA	+130 bp	-75%
AA	+150 bp	-75%
A	+260 bp	-75%
BBB	+450 bp	-75%
BB	+840 bp	-75%
B or lower	+1620 bp	-75%
Unrated	+500 bp	-75%

Mkt$_{fx}$ – Currency risk (1/1)

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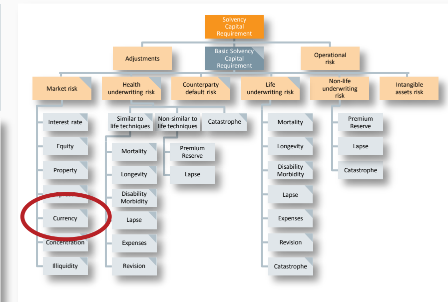


Currency risk arises from changes in the level or volatility of currency exchange rates

The capital charge for currency risk is determined as the result of two predefined scenarios:

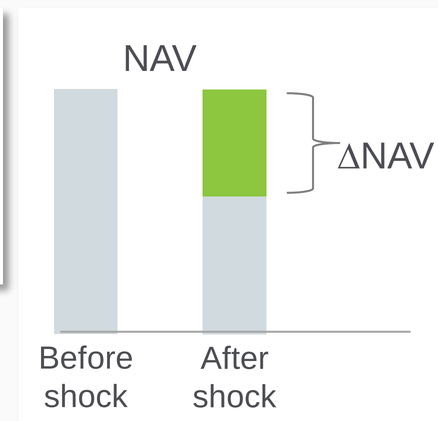
$$Mkt_{fx,C}^{up} = \max\left(\Delta NAV \middle| fx_{upwardshock};0\right)$$

$$Mkt_{fx,C}^{down} = \max\left(\Delta NAV \middle| fx_{downwardshock};0\right)$$

$$Mkt_{fx} = \max(Mkt_{fx}^{down};Mkt_{fx}^{up};0)$$

All of the participant's individual currency positions and its investment policy (e.g. hedging arrangements, gearing etc.) should be taken into account.

The charge is set at a **25% change**, rise and fall respectively in value of all other currencies against the local currency in which the undertaking prepares its local regulatory accounts.



Mkt_{conc} – Concentration risk (1/1)

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Calculation of the concentration risk

The calculation is performed in three steps: (a) excess exposure, (b) risk concentration capital requirement per 'name', (c) aggregation.

$$(a) \qquad XS_i = \max\left(0; \frac{E_i}{Assets_{xl}} - CT\right)$$

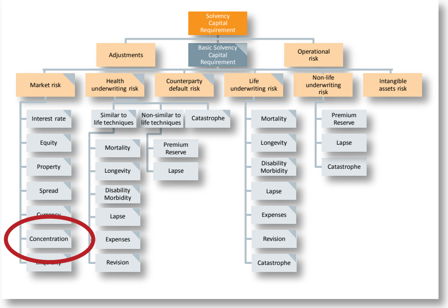
Concentration threshold (CT) is set as follows	
AA-AAA	3%
A	3%
BBB	1.5%
BB or lower	1.5%

Rating$_i$	Credit Quality Step	g_i
AAA	1A	0.12
AA	1B	0.12
A	2	0.21
BBB	3	0.27
BB or lower	4–6	0.73

$$(b) \qquad Conc_i = \Delta NAV \,|\, \text{concentration shock} \qquad\qquad Conc_i = Assets \cdot XS_i \cdot g_i$$

The capital requirement for financial concentration risk is determined assuming no correlation among the requirements for each counterparty i.

$$(c) \qquad Mkt_{conc} = \sqrt{\sum_i \left(Conc_i^2\right)}$$



Mkt_{ip} – Illiquidity premium risk (1/1)

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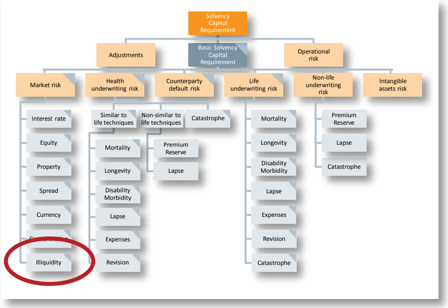
Illiquidity premium risk arises from the risk of increase of the value of technical provisions due to a decrease in the illiquidity premium.



As the illiquidity premium observed in the financial markets is recognised in the calculation of technical provisions, the market risk module should capture the illiquidity premium risk.

The effect of an increase of the illiquidity premium is captured in the calibration of the spread risk module.

Mkt_{ip} = Capital requirement for illiquidity premium risk

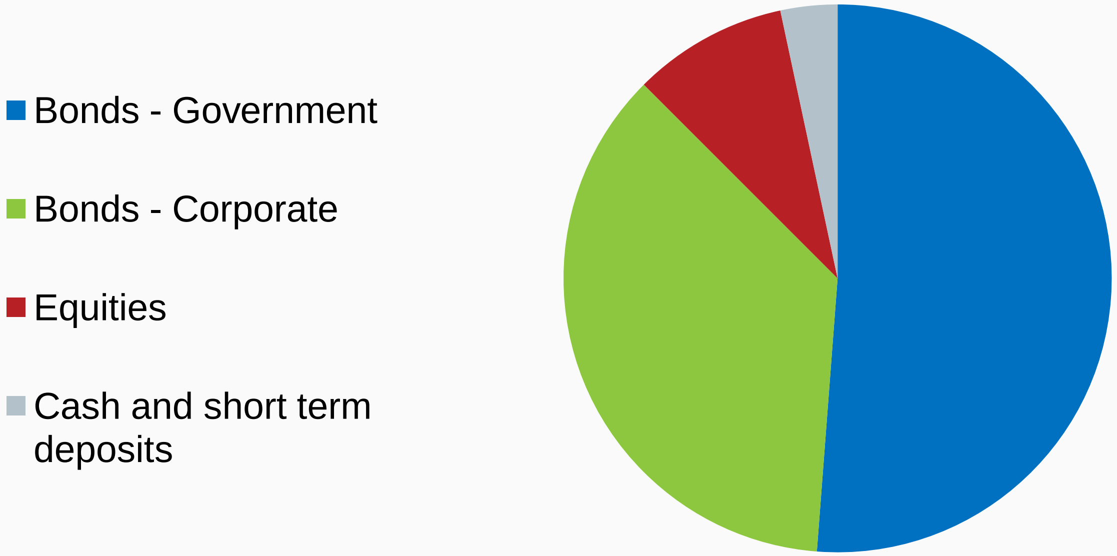
The capital requirement for illiquidity premium risk is determined as the result of a pre-defined scenario:

$$Mkt_{ip} = \max\left(\Delta NAV \middle| \text{illiquidity premium shock}; 0\right)$$

The illiquidity premium shock is the immediate effect on the net value of asset and liabilities expected in the event of a **65% fall** in the value of the illiquidity premium observed in the financial markets. The 65% fall is restricted to the illiquidity premium that is used for the calculation of technical provisions.

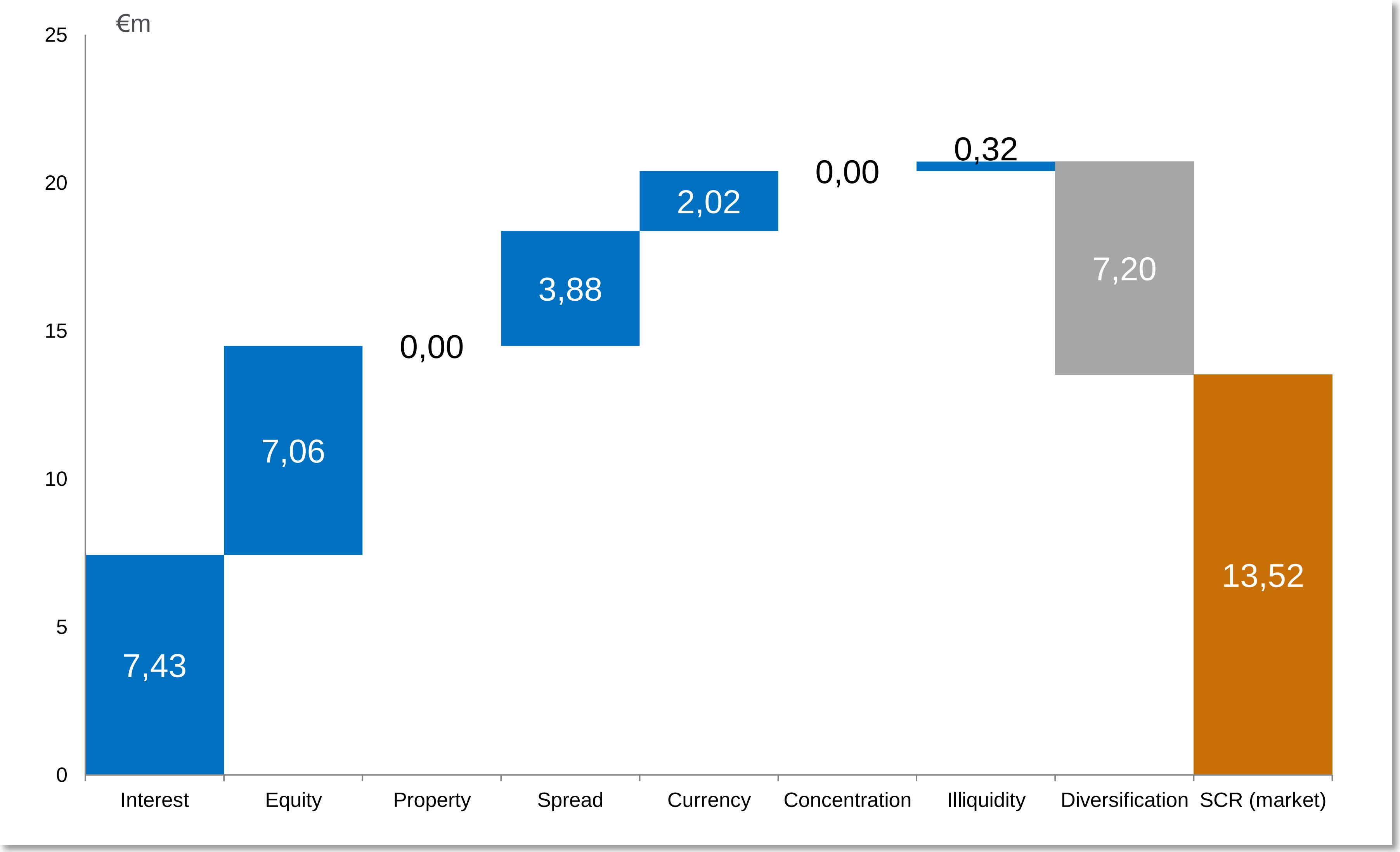
Case study: Asset allocation

Asset allocation	*'000 EUR*	*%*
Bonds - Government	131.680	51,2%
Bonds - Corporate	93.323	36,3%
Equities	23.520	9,1%
Cash and short term deposits	8.631	3,4%
Total	257.153	100,0%



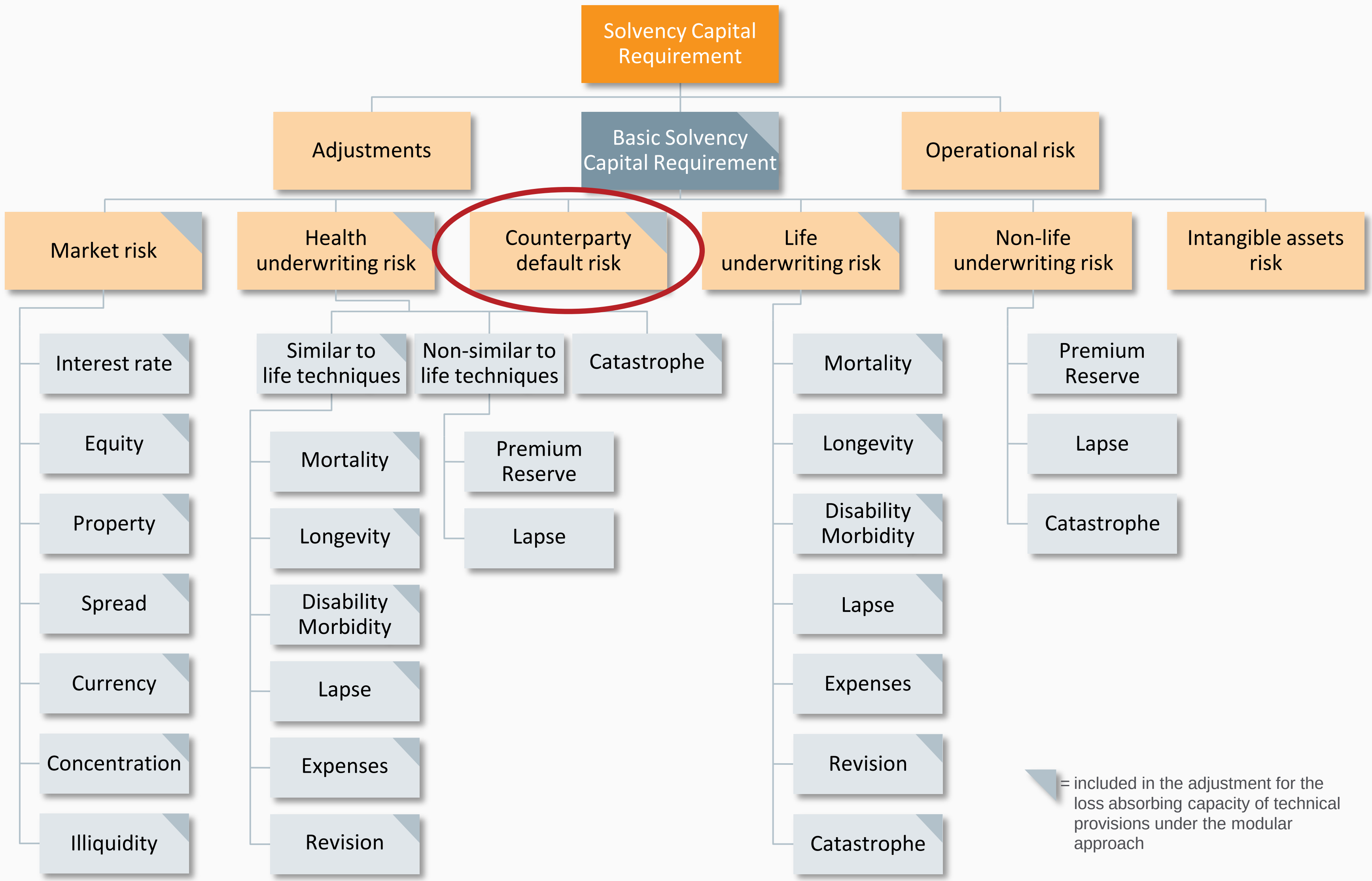
Case study: Breakdown of market SCR

Munich RE



4.3 COUNTERPARTY DEFAULT RISK

$SCR_{default}$ – Counterparty default risk(1/7)

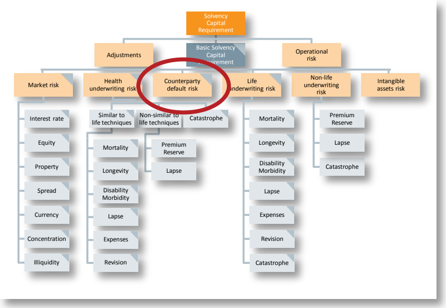


Source: European Commission

$\text{SCR}_{\text{default}}$ – Counterparty default risk (2/7) Aggregation

Munich RE

The counterparty default risk module should reflect possible losses due to unexpected default, or deterioration in the credit standing, of the counterparties and debtors of companies over the forthcoming twelve months.



Diversification is recognized in the counterparty default risk module

$$SCR_{def} = \sqrt{SCR_{def,1}^2 + 1.5 \cdot SCR_{def,1} \cdot SCR_{def,2} + SCR_{def,2}^2}$$

SCR_{def} = Capital requirement for counterparty default risk

$\text{SCR}_{\text{def,1}}$ = Capital requirement for counterparty default risk of type 1 exposures

$\text{SCR}_{\text{def,2}}$ = Capital requirement for counterparty default risk of type 2 exposures

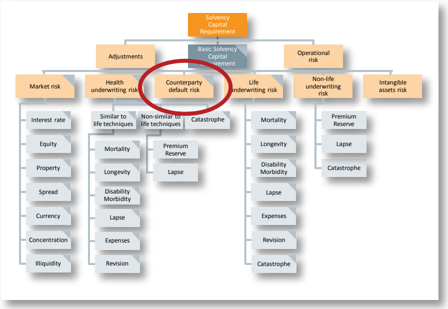
$SCR_{default}$ – Counterparty default risk (3/7)
Type 1 exposures

Munich RE

The class of type 1 exposures covers the exposures which may not be diversified and where the counterparty is likely to be rated.

The class should consist of exposures in relation to

- **reinsurance arrangements**,
- **securitisations** and **derivatives**,
- any other **risk mitigating contracts**,
- **cash at bank**,
- **deposits** with ceding institutions
- **capital, initial funds, letters of credit** as well as any other commitments received by the undertaking which have been called up but are unpaid
- **guarantees, letters of credit, letters of comfort** which the undertaking has provided as well as any other commitments which the undertaking has provided and which depend on the credit standing of a counterparty.



$$SCR_{def,1} = \begin{cases} 3 \cdot \sqrt{V} & if \quad \sqrt{V} \le 5\% \cdot \sum_i LGD_i \\ \min\left(\sum_i LGD_i ; 5 \cdot \sqrt{V}\right) & else \end{cases}$$

LGD_i = Loss-given-default for type 1 exposure of counterparty I

V = Variance of the loss distribution of the type 1 exposures

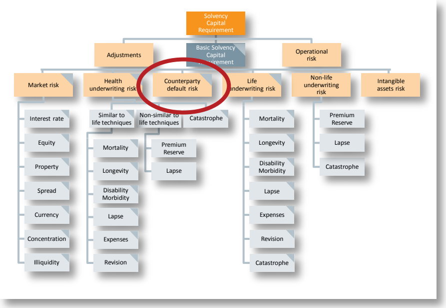
$SCR_{default}$ – Counterparty default risk (4/7)
Type 1 exposures – reinsurance

Munich RE

For a reinsurance arrangement or securitisation i, the loss-given-default LGDi should be calculated as follows:

$Recoverables_i$	=	Best estimate recoverables from the reinsurance contract (or SPV) i plus any other debtors arising out of the reinsurance arrangement or SPV securitisation
$RM_{re,i}$	=	Risk mitigating effect on underwriting risk of the reinsurance arrangement or SPV securitisation i
$Collateral_i$	=	Risk-adjusted value of collateral in relation to the reinsurance arrangement or SPV securitisation i.

$$LGD_i = \max\left(50\% \cdot \left(Recoverables_i + RM_{re,i} - Collateral_i\right);0\right)$$



$SCR_{default}$ – Counterparty default risk (5/7)
Type 1 exposures

Munich RE

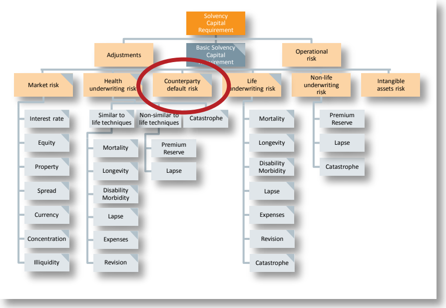
Conditions

The probability of default is **based on the rating** of the respective counterparty. The probabilities in relation to the rating are set as follows:

$Rating_i$	Credit Quality Step	p_i
AAA	1	0.002%
AA		0.01%
A	2	0.05%
BBB	3	0.24%
BB	4	1.20%
B	5	4.175%
CCC or lower	6	4.175%

For **unrated** counterparties that are under-takings that will be subject to Solvency II and that would meet their MCR, the probability of default, depending on the solvency ratio is determined as follows:

Solvency ratio	p_i
>200%	0.025%
>175%	0.050%
>150%	0.1%
>125%	0.2%
>100%	0.5%
>90%	1%
>80%	2%
≤80%	4.175%



For unrated counterparties that are undertakings that will be subject to Solvency II and that would not meet their MCR, the probability of default used in the calculation should be 4.175%.

For other unrated counterparties, the probability of default should be 4.175%.

In cases where more than one rating is available for a counterparty, the second-highest rating should be used.

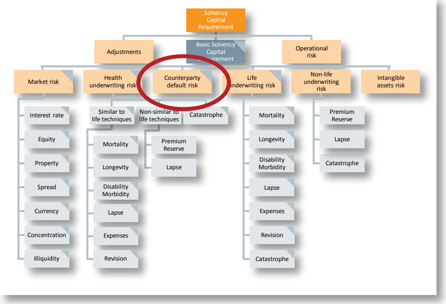
$SCR_{default}$ – Counterparty default risk (6/7)
Type 2 exposures

Munich RE

The class of type 2 exposures covers the exposures which are usually diversified and where the counterparty is likely to be unrated.

The class of type 2 exposure should consist of all exposures which are in the scope of the module and are not of type 1, in particular

- **receivables** from intermediaries,
- **policyholder debtors, including mortgage loans**,
- **deposits** with ceding institutions, and
- **capital, initial funds, letters of credit** as well as any other commitments received by the undertaking which have been called up but are unpaid, if the number of independent counterparties exceeds 15.



$$SCR_{def,2} = 15\% \cdot E + 90\% \cdot E_{\text{past-due}}$$

E = Sum of the values of type 2 exposures, except for receivables from intermediaries which are due for more than 3 months.

$E_{\text{past-due}}$ = Risk factor for past-due receivables from intermediaries which are due for more than 3 months

$SCR_{default}$ – Counterparty default risk (7/7)

Munich RE

Calculation of the variance of the loss distribution

For the calculation of the variance V of the loss distribution, the following summations of loss-given-default values are relevant. For each rating class j, y_j and z_j are defined as follows:

$$y_j = \sum_i LGD_i \text{ and } z_j = \sum_i \left(LGD_i\right)^2$$

where sums run over all independent counterparties i in the rating class j.
The variance V of the loss distribution is then calculated as follows:

$$V = \sum_j \sum_k u_{j,k} \cdot y_j \cdot y_k + \sum_j v_j \cdot z_j$$

where j and k in the sums run over all rating classes and u_{jk} and v_j are fixed parameters which only depend on the rating classes, with

$$u_{ij} = \frac{p_i\left(1-p_i\right)p_j\left(1-p_j\right)}{\left(1+\gamma\right)\left(p_i+p_j\right)-p_i p_j}$$

$$v_i = \frac{\left(1+2\gamma\right)p_i\left(1-p_i\right)}{2+2\gamma-p_i} \text{ with } \gamma = 0{,}25$$

and where p denotes the probability of default.

Reinsurer default risk (1/2)
Is it worth spreading the risk across several reinsurers?

Munich RE

Risk capital for different rating categories – one RI

# RI companies	Rating	LGD in m€	RC in €
1	AAA	60	804,976
1	AA	60	1,799,910
1	A	60	4,023,916
1	BBB	60	8,807,575
1	CCC	60	60,000,000

Risk capital for different rating categories – three RI

# RI companies	Rating	LGD in m€	RC in €
3	AAA	20 + 20 + 20	623,530
3	AA	20 + 20 + 20	1,394,186
3	A	20 + 20 + 20	3,116,704
3	BBB	20 + 20 + 20	6,820,133
3	CCC	20 + 20 + 20	46,215,949

Spreading the risk across several reinsurers within the same rating category reduces the capital requirement for the default risk.

Reinsurer default risk (2/2)
Is it worth spreading the risk across several reinsurers?

Munich RE

Risk capital for three RI with different rating categories

# RI companies	Rating	LGD in m€	RC in €
3	AAA; AAA; AA	20 + 20 + 20	868,066
3	AAA; AA; AA	20 + 20 + 20	1,127,768
3	AAA; AA; A	20 + 20 + 20	1,708,072
3	AA; AA; A	20 + 20 + 20	1,940,740
3	AA; A; A	20 + 20 + 20	2,521,210
3	A; A; BBB	20 + 20 + 20	4,290,800
3	A; A; CCC	20 + 20 + 20	20,717,387

Spreading the risk across several reinsurers of lower rating categories increases the capital requirement for the default risk.

4.4 INTANGIBLE ASSET RISK

SCR$_{intangible}$ – Intangible asset risk

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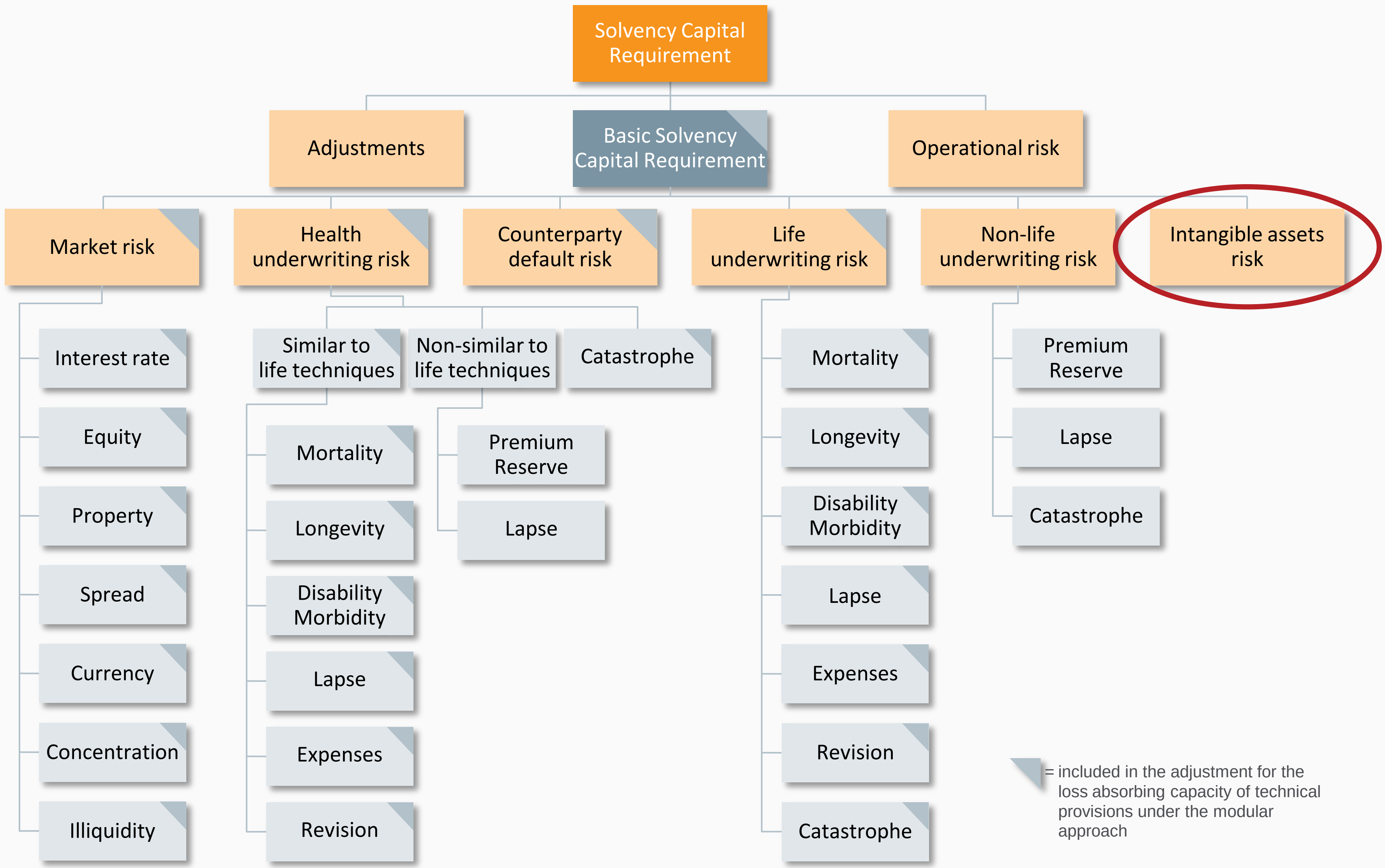

Source: European Commission

$SCR_{intangible}$ – Intangible asset risk

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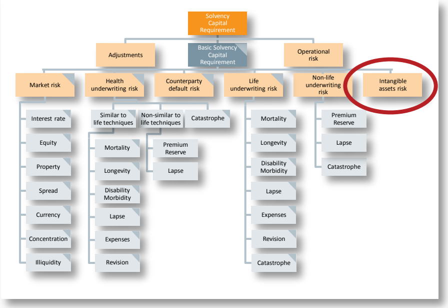
Intangible assets are exposed to two risks:

- Market risks
- Internal risks



Intangible assets are exposed to two risks:

- Market risks, as for other balance sheet items, derived from the decrease of prices in the active market, and also from unexpected lack of liquidity of the relevant active market, that may result in an additional impact on prices, even impeding any transaction.
- Internal risks, inherent to the specific nature of these elements (e.g. linked to either failures or unfavourable deviations in the process of finalization of the intangible asset, or any other features in such a manner that future benefits are no longer expected from the intangible asset or its amount is reduced; risks linked to the commercialization of the intangible asset, triggered by a deterioration of the public image of the undertaking).

The output for this module is the capital requirement for intangible assets, denoted as

$SCR_{intangible}$ = Solvency Capital Requirement for intangible asset risk

IA = Value of intangible assets

$$SCR_{intangible} = 0{,}8 \cdot IA$$

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4.5 OPERATIONAL RISK

SCR_{op} – Operational risk

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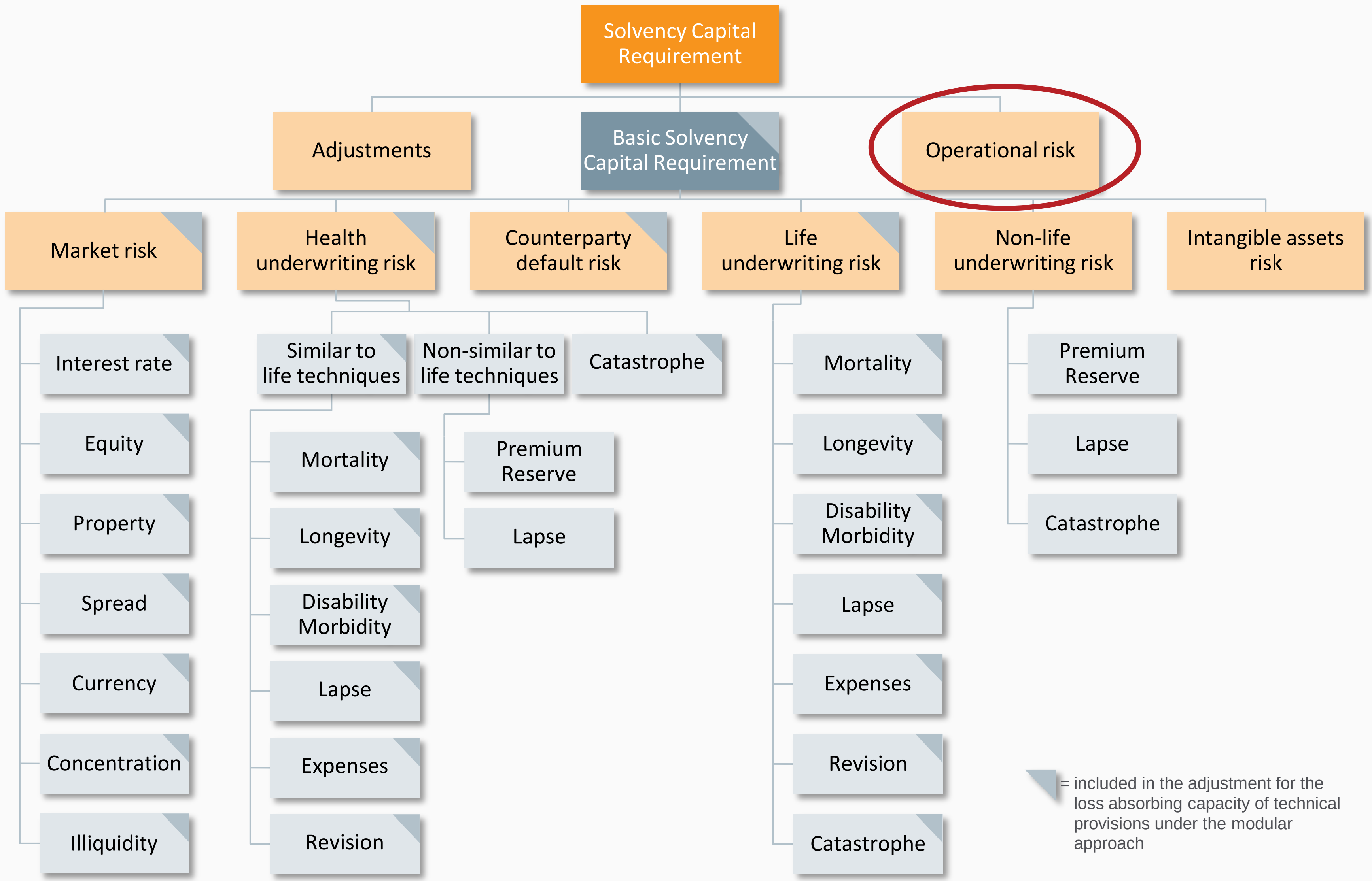


Source: European Commission

SCR_{op} – Operational risk

Munich RE

Capital charge for operational risk

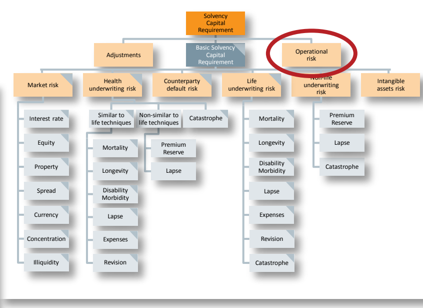
$$SCR_{Op} = Min(30\% \cdot BSCR; Op)$$

$$Op = Max(Op_{\text{Premiums}}; Op_{\text{Provisions}})$$

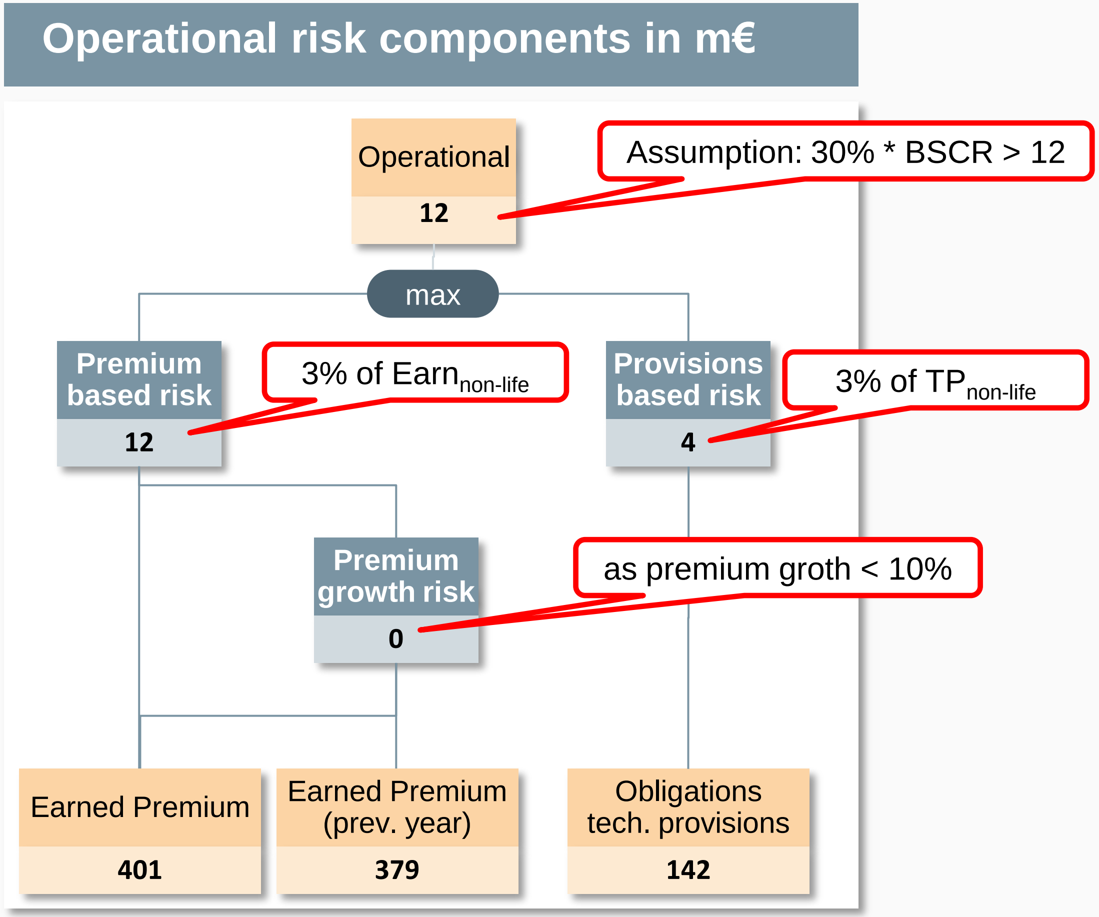
$$Op_{\text{Premiums}}^{non-life} = 3\% \cdot Earn_{\text{non-life}} + max\left[0; 3\% \cdot \left(Earn_{\text{non-life}} - 110\% \cdot pEarn_{\text{non-life}}\right)\right]$$

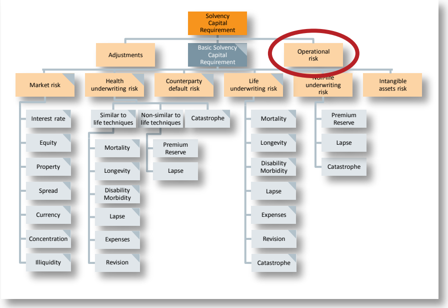
$$Op_{\text{Provisions}} = 3\% \cdot max\left[0; TP_{\text{non-life}}\right]$$

Op	= Basic operational risk charge for all business other than life insurance where the investment risk is borne by the policyholders
$Earn_{\text{non-life}}$	= Earned premium during the previous year for non-life insurance obligations
$pEarn_{\text{non-life}}$	= Earned premium during the 12 months prior to the previous 12 months or non-life insurance obligations, without deducting ceded to reinsurance
$TP_{\text{non-life}}$	= Total non-life insurance obligations (does not include the risk margin and should be gross of reinsurance)



SCR_{op} – Operational risk Example (Non-life)





4.6 ADJUSTMENTS FOR LOSS-ABSORBING CAPACITY

Adjustments for loss absorbing capacity
Two classes

(1) Adjustment for loss absorbency of technical provisions

- reflects the potential compensation of unexpected losses through a decrease in technical provisions
- by accounting for the risk mitigating effect due to a reduction of future discretionary benefits.
- Usually less or even irrelevant for non-life insurance companies

(2) Adjustment for loss absorbency of deferred taxes

- reflects the potential compensation of unexpected losses through a decrease in deferred tax liabilites or an increase of deferred tax assets.

Adjustments for loss absorbing capacity
Deferred taxes assets and liabilities

- Deferred tax assests (DTA) and deferred tax liabilities (DTL) are tax benefits, resp. tax burdens due to differences in respect of
  - the inclusion of or
  - the valuation of

  assets, resp. liabilities between
  - the Solvency II balance sheet and
  - the tax balance sheet
- which differences are expected to be released with tax effect in future accounting periods.

Adjustments for loss absorbing capacity of deferred taxes – Calculation I

1. Assume an instantaneous loss to the undertaking of the amount

   $$SCR_{Shock} = BSCR + Adj_{TP} + SCR_{OP}$$

   where

   Adj_{TP} = Adjustment through reduced technical provisions for future discretionary benefits.

2. Revalue all positions of both balance sheets (for S II and tax purposes)

3. Determine the changes

   $$\Delta\, DTA = DTA_{\text{before shock}} - DTA_{\text{after shock}}$$ and

   $$\Delta\, DTL = DTL_{\text{before shock}} - DTL_{\text{after shock}}$$

Adjustments for loss absorbing capacity of deferred taxes – Calculation II

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4. The Adjustment for loss absorbence of deferred taxes is then given by

   $$Adj_{DT} = \Delta\, DTL - \Delta\, DTA$$

   and should be negative (< 0).

   But: In case of an increase of the

   $$\text{net } DTA = DTA - DTL$$

   after the shock, the undertaking should take into account

   - the magnitude SCR_{Shock} of the loss and
   - its impact of the undertaking‘s financial situation

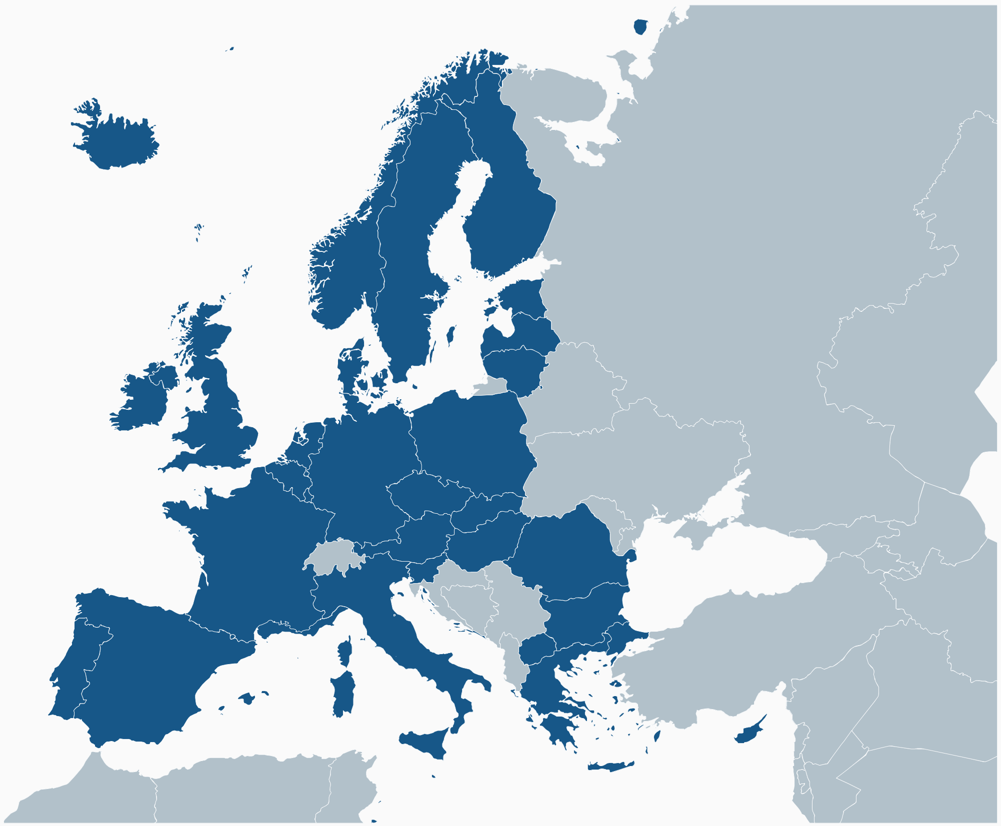
   when assessing whether the realisation of the DTA is probable in a feasible and reasonable timeframe:

   - How many periods can losses be carried forward?
   - Can one expect the undertaking‘s expected future income will suffice to be off-set against the losses?

5. QIS5 RESULTS

Participation

Participation of 2,520 insurance undertakings of all 30 EEA member countries



Participation rate: 68%

- 1,284 P&C-insurers 51.0%
- 610 Life-Insurers 24.2%
- 336 Composite 13.4%
- 111 Reinsurers 4.4%
- 175 Captives 7.0%

Size:

- small 60.0%
- medium 31.4%
- large 8.6%

Source: EIOPA Report on fifth Quantitative Impact Study (QIS5) for Solvency II

SCR – Diversified basic solvency capital requirement (BSCR)

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	Life (solo)	Non-life (solo)
Market risk	67,4%	32,8%
Counterparty risk	7,7%	7,0%
Life underwriting risk	23,7%	0,5%
Health underwriting risk	1,0%	7,0%
Non-life underwriting risk	0,0%	52,4%
Intangible	0,1%	0,4%
BSCR	100,0%	100,0%

Market risk clearly dominates for life, whereas underwriting risk is the largest component for non-life in the BSCR.

Source: Annexes to the EIOPA Report on QIS5

SCR - Underwriting risk composition (Non-life)

Munich RE

	Non-life	Reinsurance	Composite	Captive
Premium/reserve risk	75%	62%	65%	37%
Catastrophe risk	44%	61%	54%	79%
Lapse risk	1%	0%	1%	0%
Diversification effects	–20%	-23%	-20%	-16%

The premium/reserve risk was generally the largest component in the non-life underwriting module.

The catastrophe risk was on average the main component for captives and comparable to premium/reserve risk for reinsurance companies.

Source: Annexes to the EIOPA Report on QIS5

SCR - Underwriting risk composition (Health)

Munich RE

	Solo	Groups
Health SLT	39%	36%
Health Non-SLT	59%	55%
Health catastrophe risk	11%	9%
Diversification effects	–8%	-10%

Health Non-SLT (= non-similar to life techniques) was generally the largest components in the health underwriting module.

Source: EIOPA Report on fifth Quantitative Impact Study (QIS5) for Solvency II

SCR – Underwriting risk composition (Life)

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	Life	Composite
Mortality risk	8%	18%
Longevity risk	41%	19%
Disability risk	9%	4%
Lapse risk	42%	55%
Expenses risk	18%	26%
Revision risk	2%	0%
Catastrophe risk	8%	16%
Diversification effects	–29%	–38%

Lapse, expense and longevity risk were generally the largest components in the life underwriting module.

Source: Annexes to the EIOPA Report on QIS5

SCR - Market risk composition

	Solo	Groups
Interest rate risk	28%	20%
Equity risk	42%	35%
Property risk	12%	14%
Spread risk	30%	43%
Currency risk	10%	13%
Concentration risk	6%	5%
Illiquidity premium	8%	10%
Diversification effects	–36%	–40%

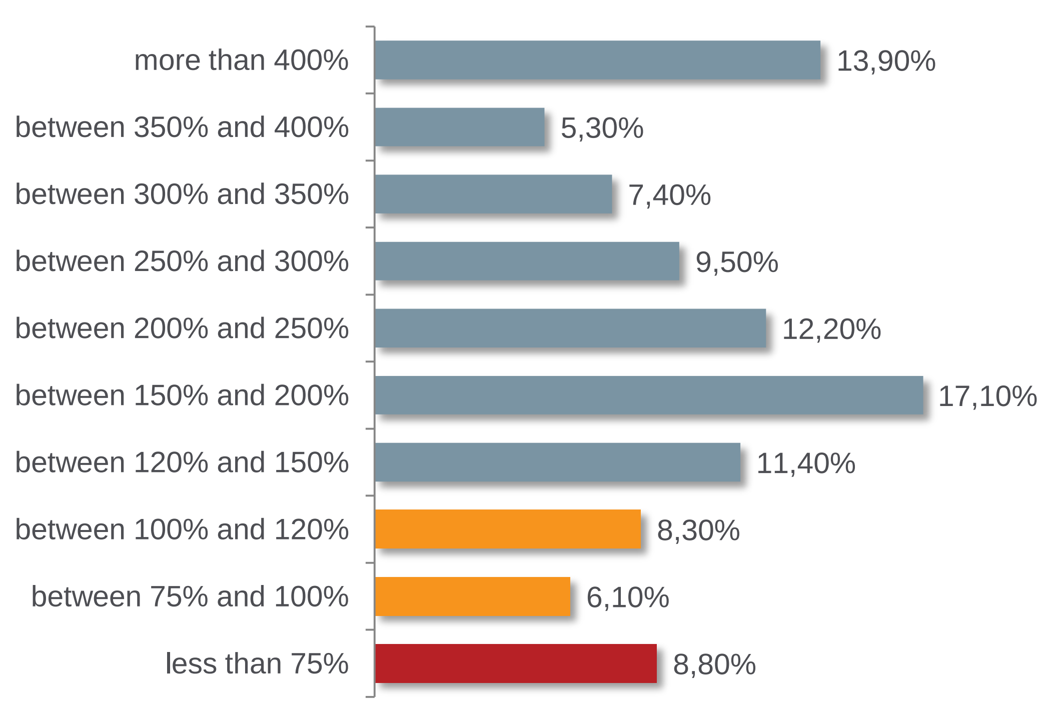
Market risk is mostly driven by equity and spread risk.

Source: EIOPA Report on fifth Quantitative Impact Study (QIS5) for Solvency II

How solvent are European insurers after QIS5?

Munich RE

Solvency ratio market average: 165% (compared to Solvency I: 310%)

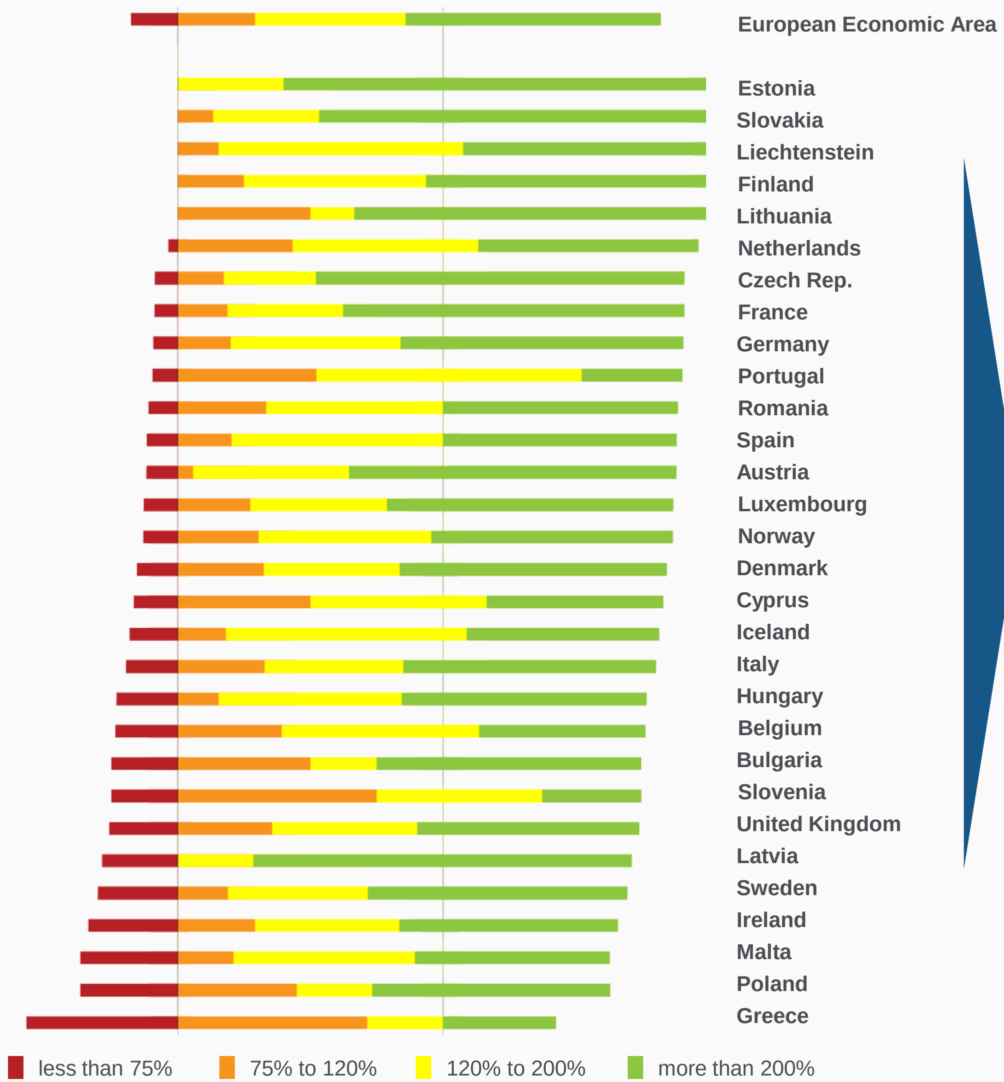


- Solvency ratio market average: 165% (Solvency I: 310%)
- 34.6% of all participating undertakings have solvency ratios below 150%.
- Almost 15% do not meet the SCR.
- 4.7% do not even meet the minimum capital requirement (≈ 40% of the SCR).

How these figures break down to the single markets can be seen in the QIS5 country reports which are currently about to be published.

Source: EIOPA Report on fifth Quantitative Impact Study (QIS5) for Solvency II

Distribution of solvency ratios by country



Source: EIOPA Report on fifth Quantitative Impact Study (QIS5) for Solvency II

- **On country level, between 19% and 80% of participating companies exceeded a solvency ratio of 200%.**
- **In the majority of countries, around 10% of participating companies failed to cover the SCR with a solvency ratio below 100%.**

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5. IMPROVEMENT OF SOLVENCY RATIO

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5.1 REINSURANCE

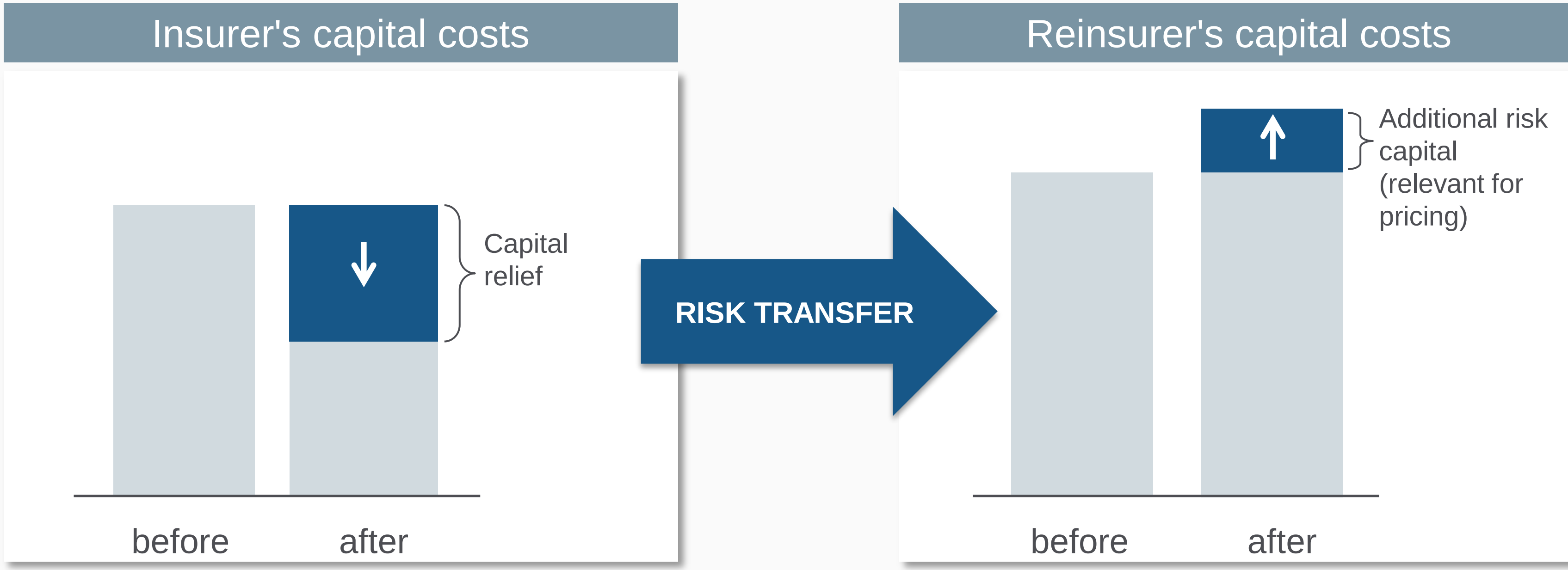
Optimising risk capital – Reinsurance

Munich RE

What kind of role is reinsurance going to play?

- European Commission: "Reinsurance is a key risk management tool in insurance"
- Depends on the risk model
- Tailor-made reinsurance programmes will play increasingly important role
- "Arbitrage" effects between the risk models of the insurer and the reinsurer (diversification)

The role of reinsurance
Optimizing risk capital



Usually diversification for reinsurers is higher than diversification for insurers due to

Number of individual risks	Geographical spread (global business model)	Product / line of business mix

Capital relief for insurer exceeds capital requirement of reinsurer

Win-win situation

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5.2 CASE STUDY

5.2.1 THE SAMPLE COMPANY

A brief description of our sample company (1)

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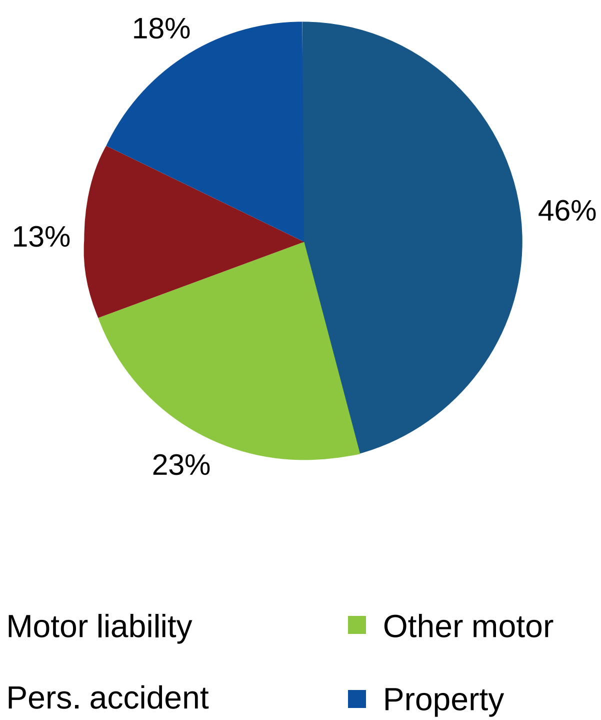
Portfolio composition



- **Total premium: €413m**
  - Motor liability €189m
  - Other motor €97m
  - Personal accident €54m
  - Property €73m
- **Combined ratio: 99.95%**

Economic balance sheet

Munich RE

in m€

	Solvency I		QIS5 valuation
Assets	**313**		**342**
Investments	312		340
Reinsurance	0		1
Other assets	1		2
Liabilities	**201**		**153**
TP Best Estimate			142
Risk Margin			12
Other liabilities			0
Own funds	**112**		**189**
Share capital			112
Reconciliation reserve			77
Adjustments to assets		29	
Adjustments to technical provisions		48	
Other adjustments		0	
Other			0

Alternative reinsurance programmes

Cover of peak risks (PeakRisk)

- Purely non-proportional cover with high attachment points

Non-proportional working cover (NP)

- Purely non-proportional cover with low attachment points

Non-proportional working cover plus 50% MTPL quota share (MTPL50 + NP)

- MTPL: quota cession in MTPL to homogenise the risk profile plus non-proportional cover of net retention with low attachment point
- Other lines: Purely non-proportional cover with low attachment points

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5.2.2 PEAKRISK R/I COVER

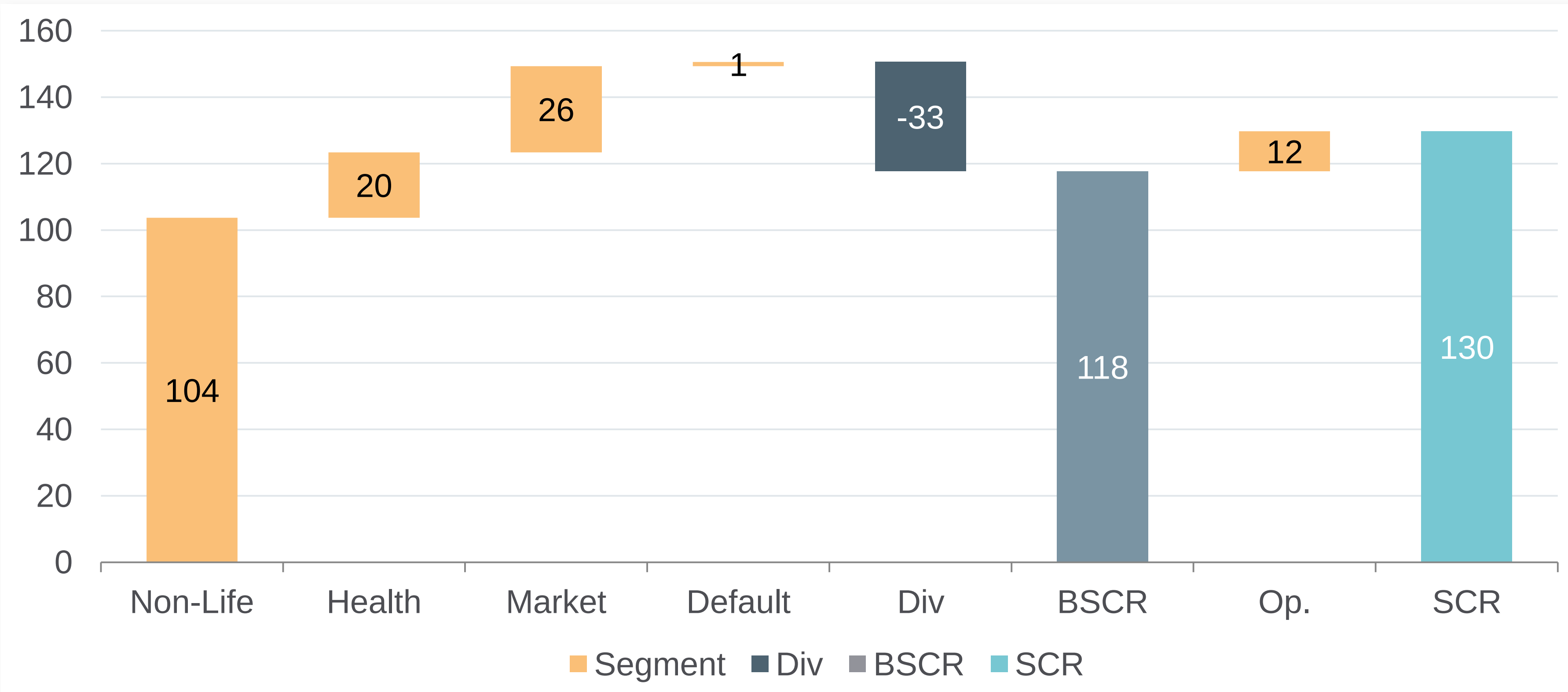
PeakRisk
Reinsurance structure

MTPL:	WXL 95 xs 5	(reinstatements: 9 free)
MOD:	CXL 10 xs 10	(reinstatements: 9 free)
Property:	WCXL 170 xs 10	(reinstatements: 1@100%)
PA:	WXL 1 xs 2	(reinstatements: 2@100%)
	CXL 10 xs 2	(reinstatements: 1@100%)

(Figures in m€)

PeakRisk
SCR split in risk categories

SCR in QIS5 split in risk categories in m€



Non-Life UW risk dominates SCR.

Market risk

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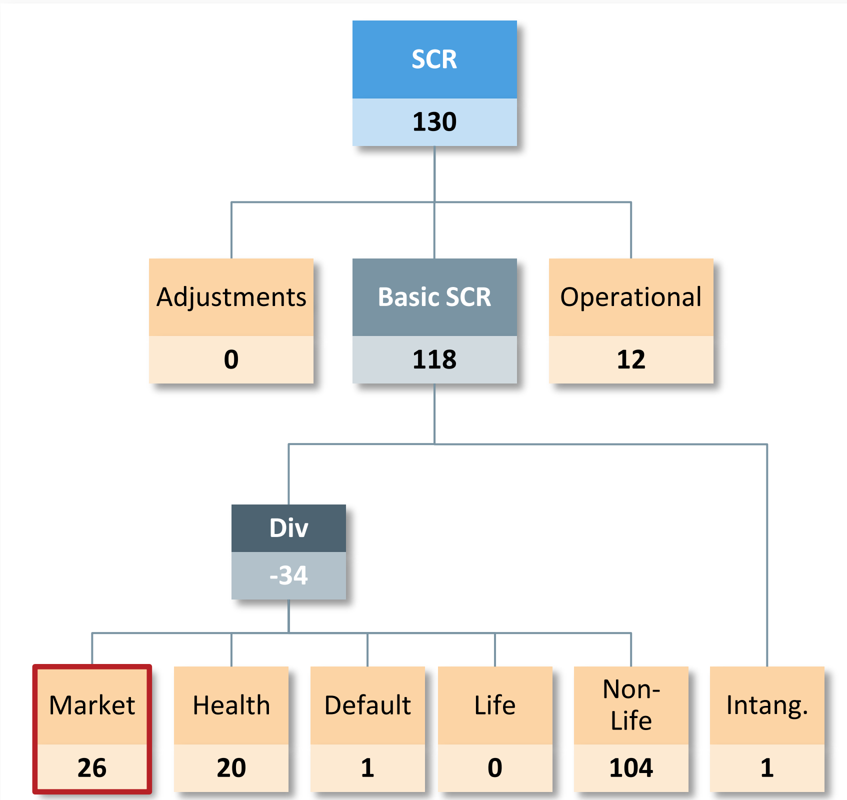
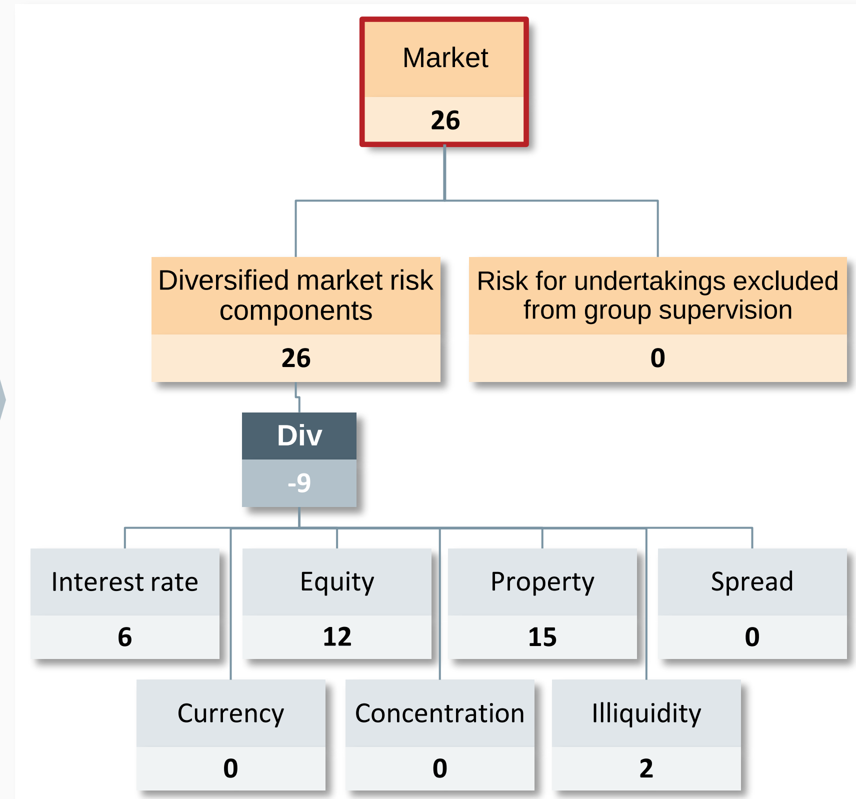
Solvency Capital Requirement in m€



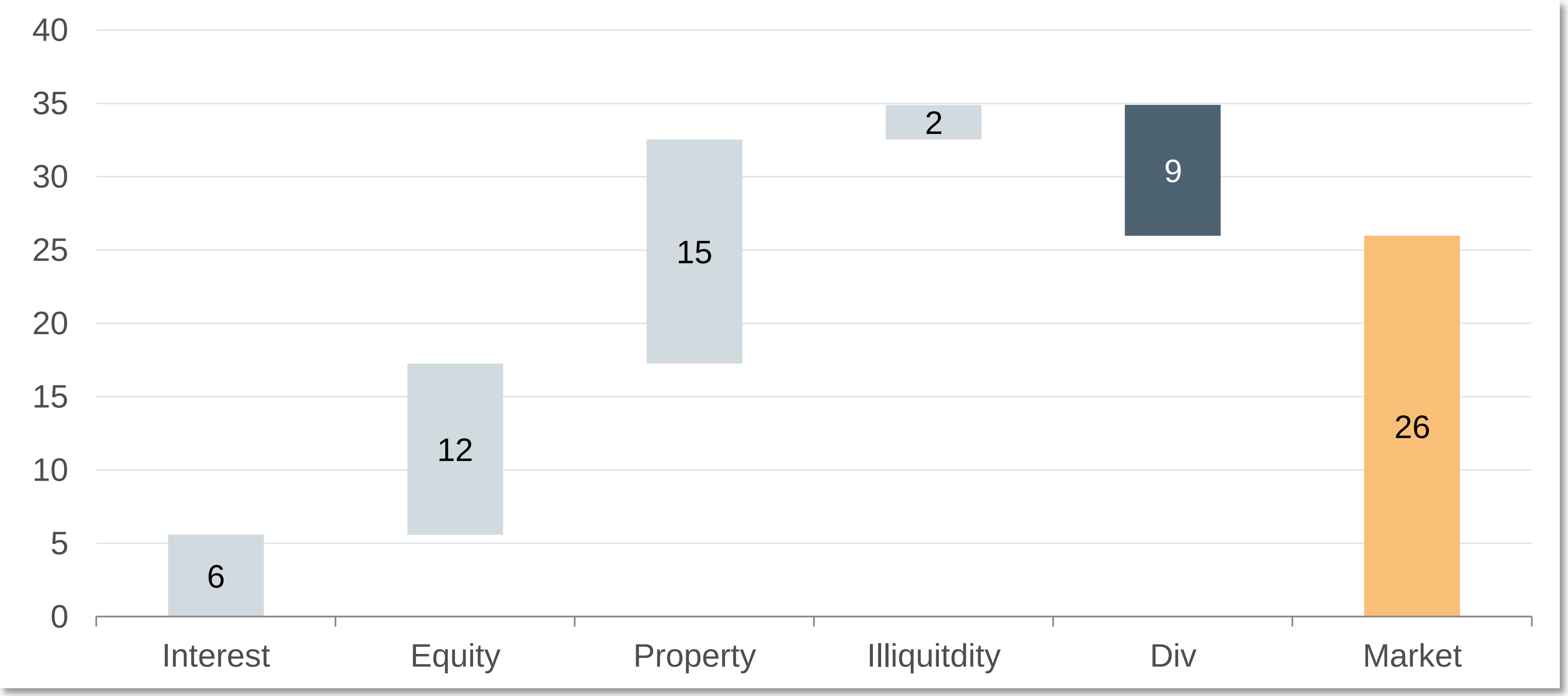
Market risk components in m€



The main drivers in market risk are property risk & equity risk.

SCR split for market risk

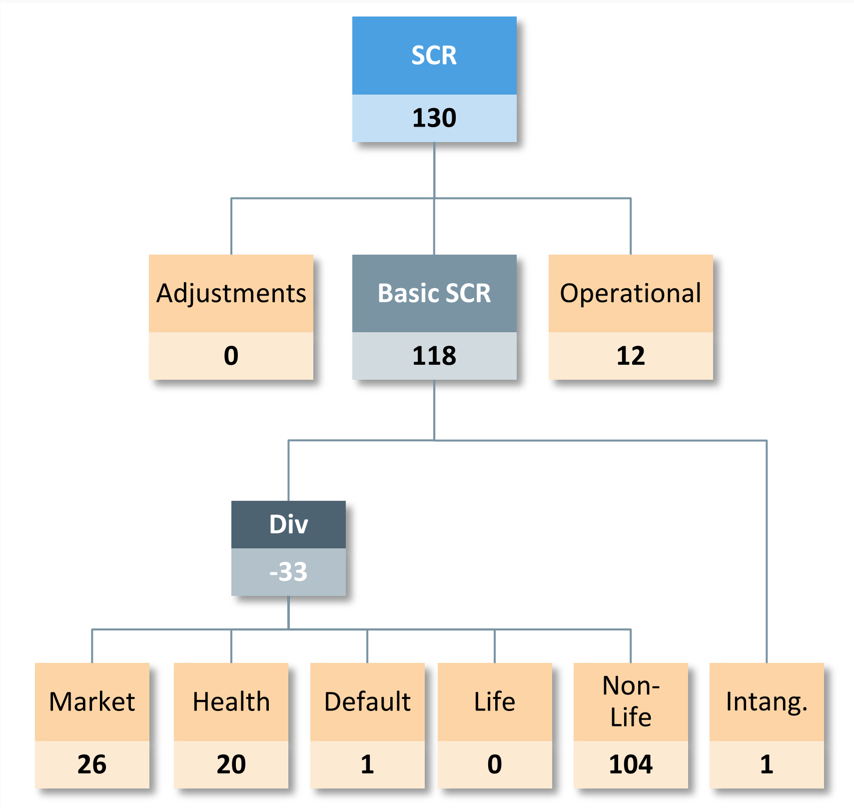
SCR split for market risk in m€



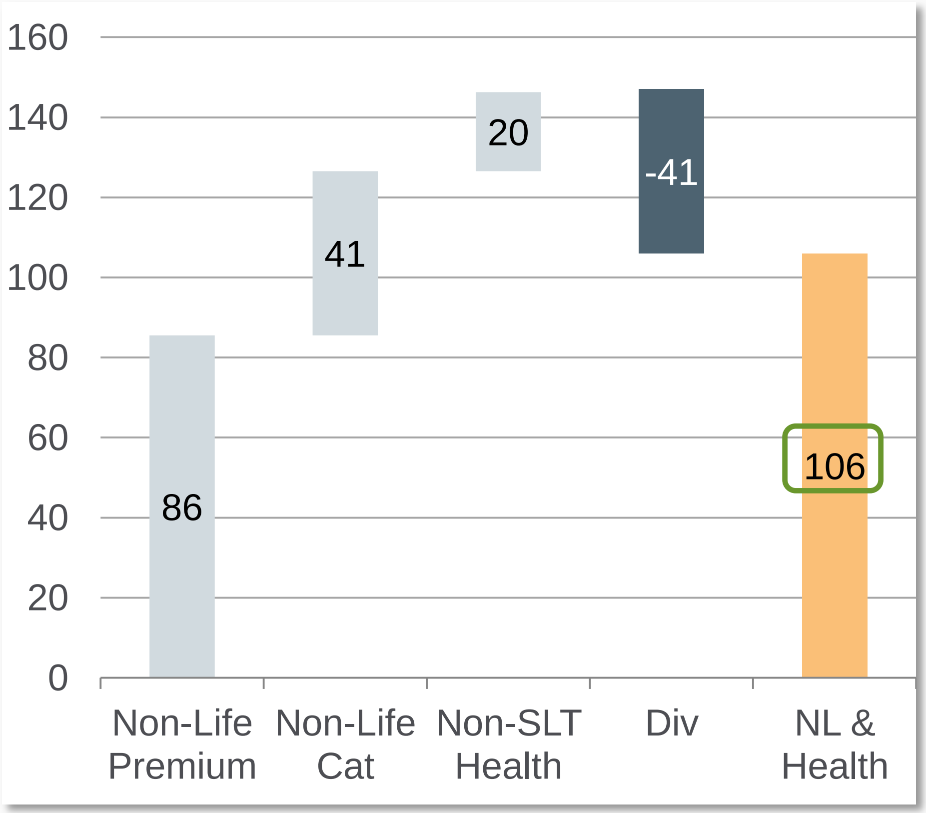
The main drivers in market risk are property risk & equity risk.

PeakRisk
SCR for Non-Life & Health UW risk

SCR (net) in m€



SCR split for UW risk (net) in m€



Non-Life premium and reserve risk dominate the UW risk.

PeakRisk
Gross/net comparison of SCR for UW risk per UW-LoB

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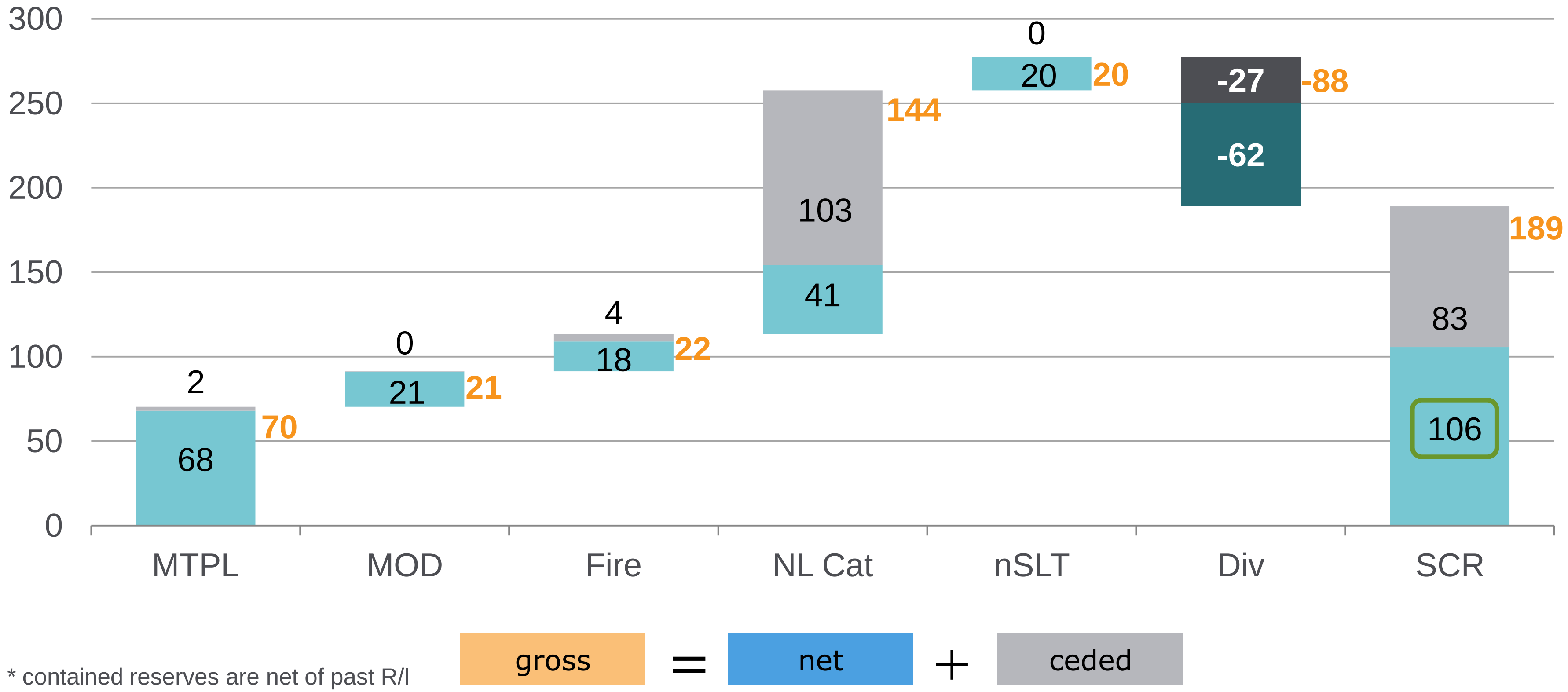
SCR for UW risk per UW-LoB, gross* vs net in m€



* contained reserves are net of past R/I

The PeakRisk reinsurance reduces the NL Cat risk significantly, but its impact on the other risk classes is quite poor. MTPL remains as the predominant risk.

PeakRisk
CAT (Nat Cat & Man-made)

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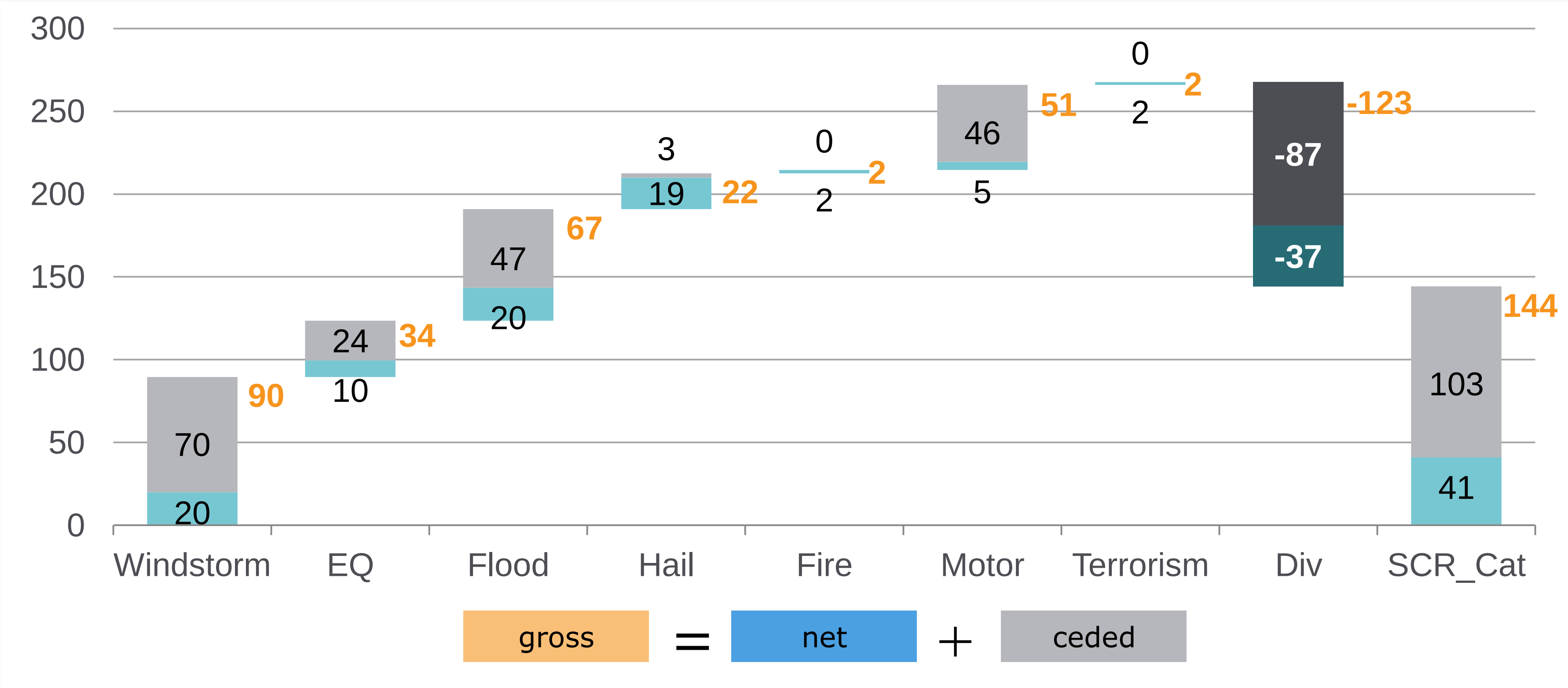
NL CAT, gross vs net in m€



Motor Cat exposure significantly reduced by PeakRisk reinsurance.

5.2.3 NP R/I COVER

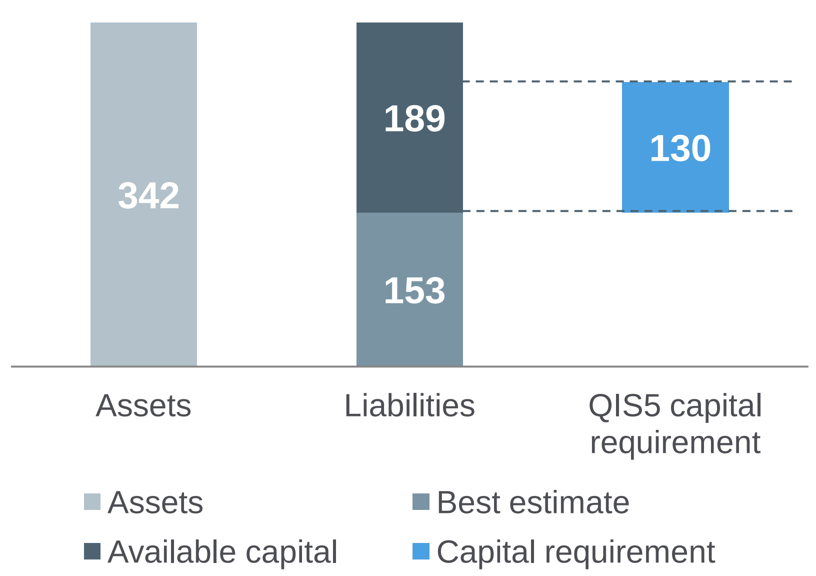
NP
Reinsurance structure

MTPL:	WXL 99 xs 1	(reinstatements: 9 free)
MOD:	CXL 19.5 xs 0.5	(reinstatements: 9 free)
Property:	WCXL 14 xs 1	(reinstatements: 3@100%)
	SL 300% xs 100%	
PA:	WXL 2.8 xs 0.2	(reinstatements: 2@100%)
	CXL 1.4 xs 0.2	(reinstatements: 1@100%)

(Figures in m€)

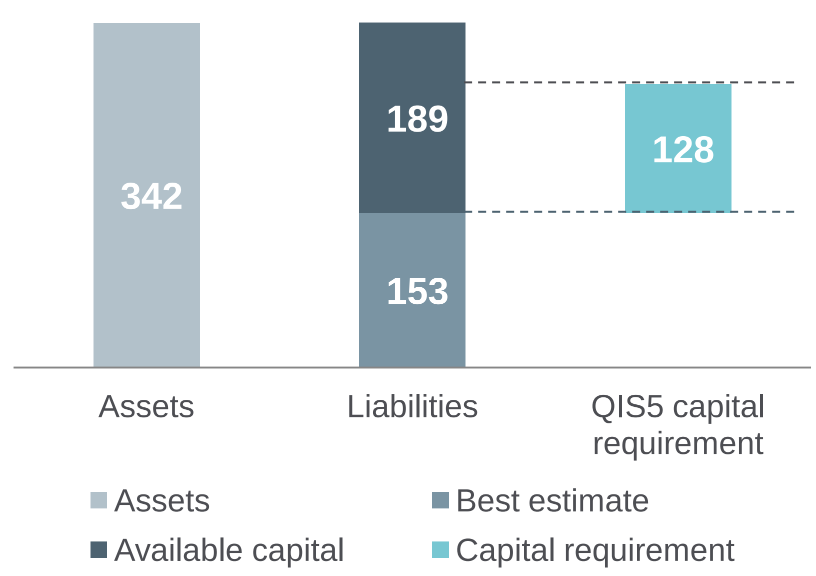
PeakRisk vs. NP
Solvency ratio

PeakRisk (in m€)



Solvency ratio: 189/130 = 146%

NP (in m€)

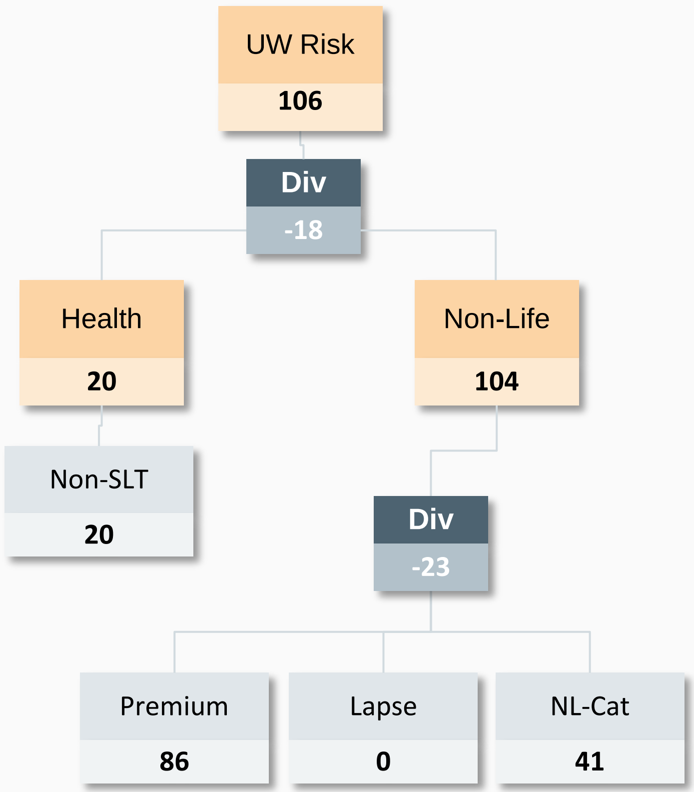


Solvency ratio: 189/128 = 148%

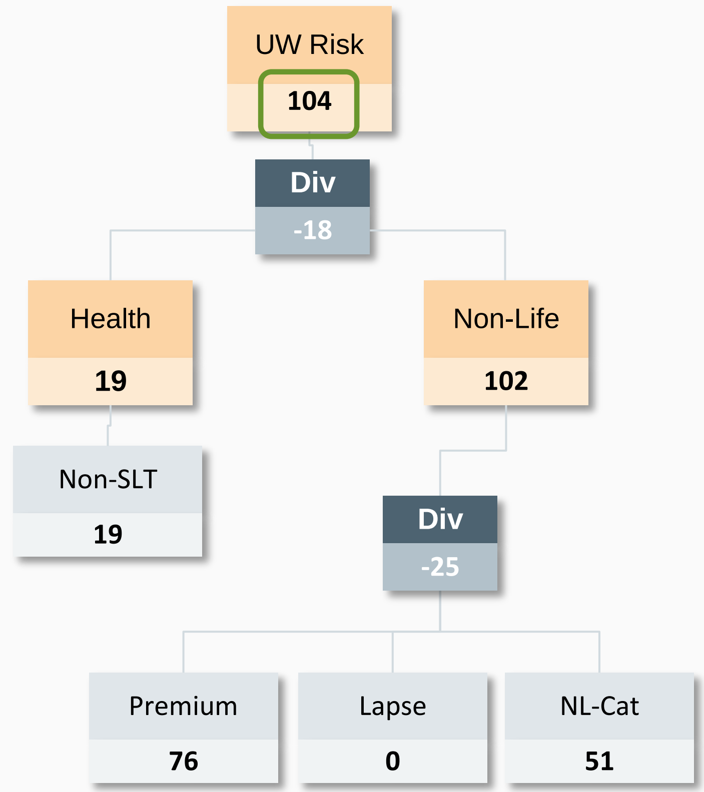
Improvement with alternative R/I structure is marginal.

PeakRisk vs. NP
SCR for Non-Life & Health UW risk

SCR for UW risk (PeakRisk) in m€



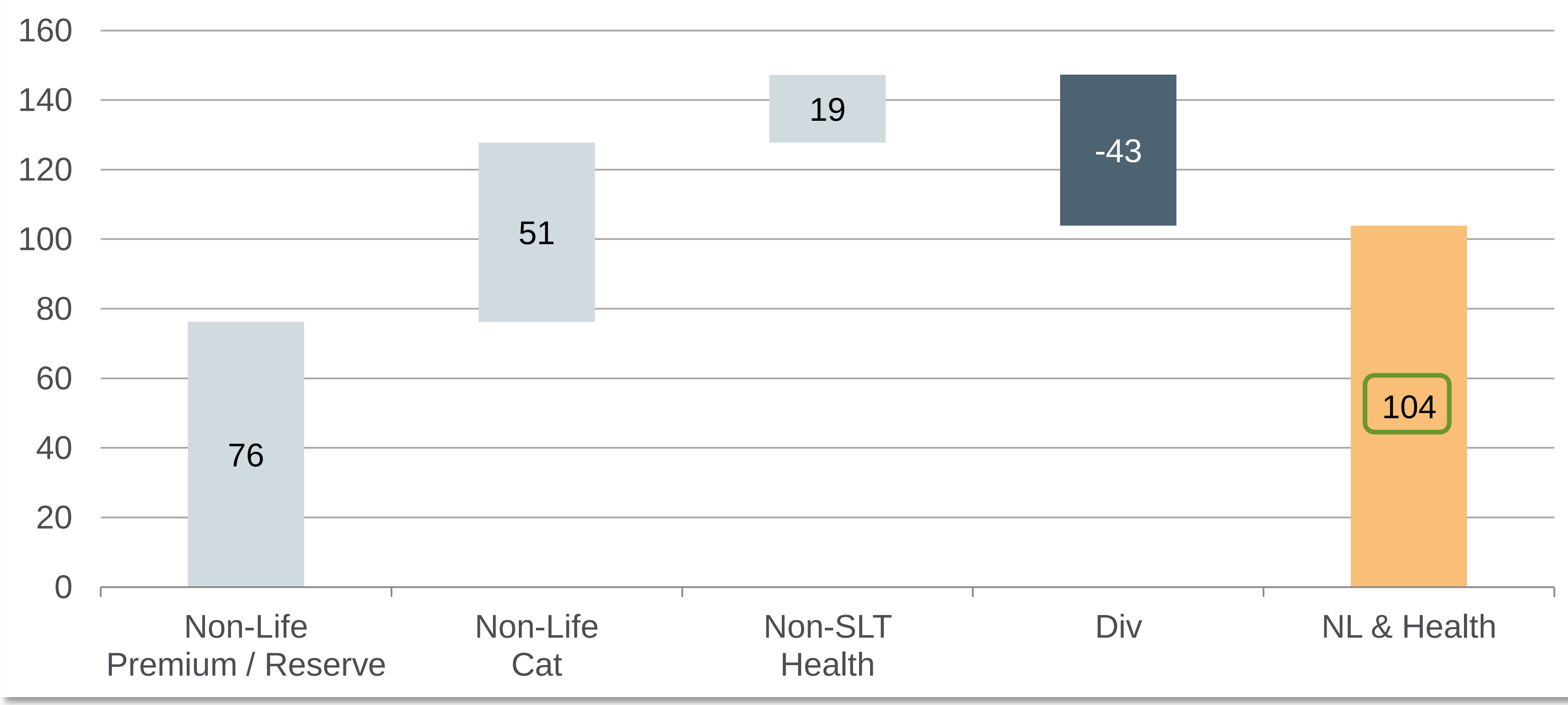
SCR for UW risk (NP) in m€



Premium / Reserve risk reduced, but in total nearly no improvement of underwriting risk as compared to PeakRisk

NP
SCR split for underwriting risk (net)

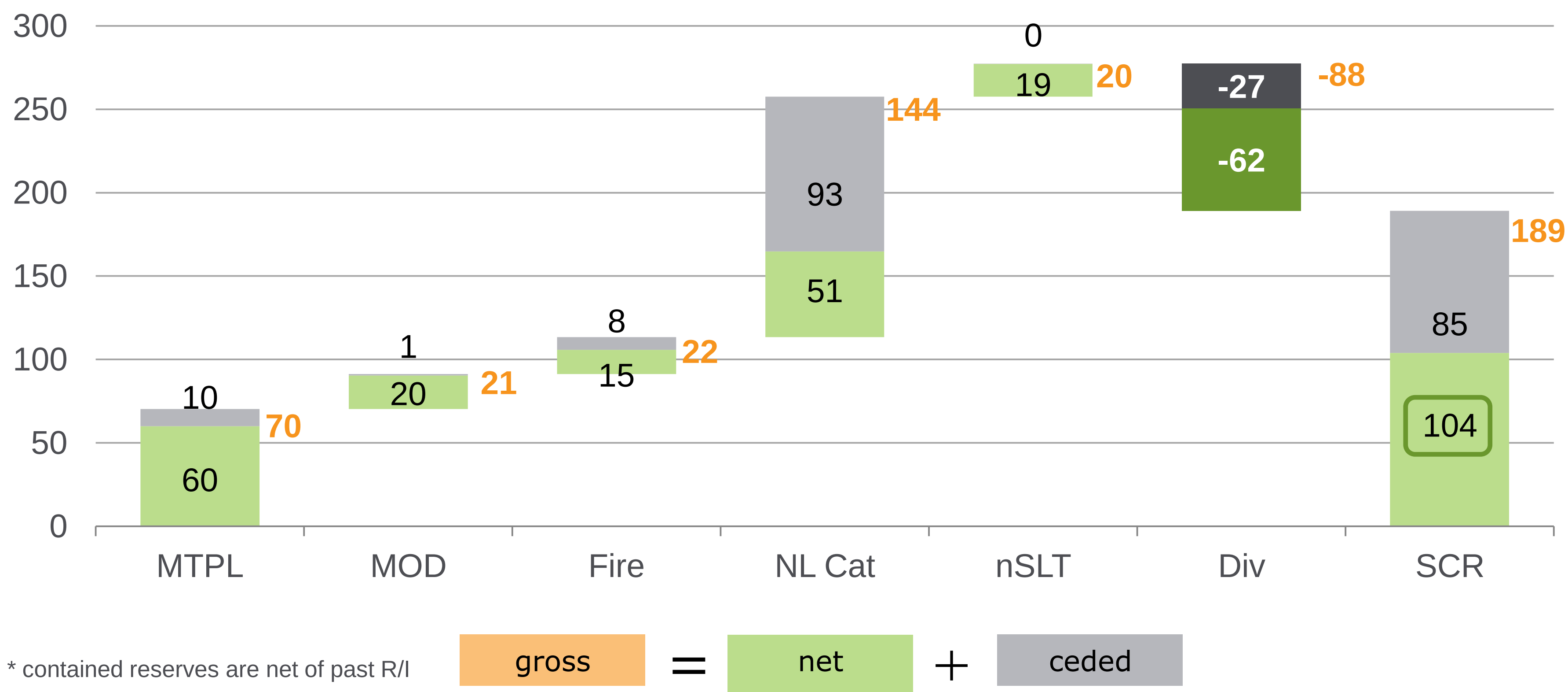
Composition of Non-Life and Health underwriting risk in m€



Non-Life premium/reserve risk still dominates the UW risk.

NP
Gross/net comparison of SCR for UW risk per UW-LoB

SCR for UW risk per UW-LoB, gross* vs net in m€

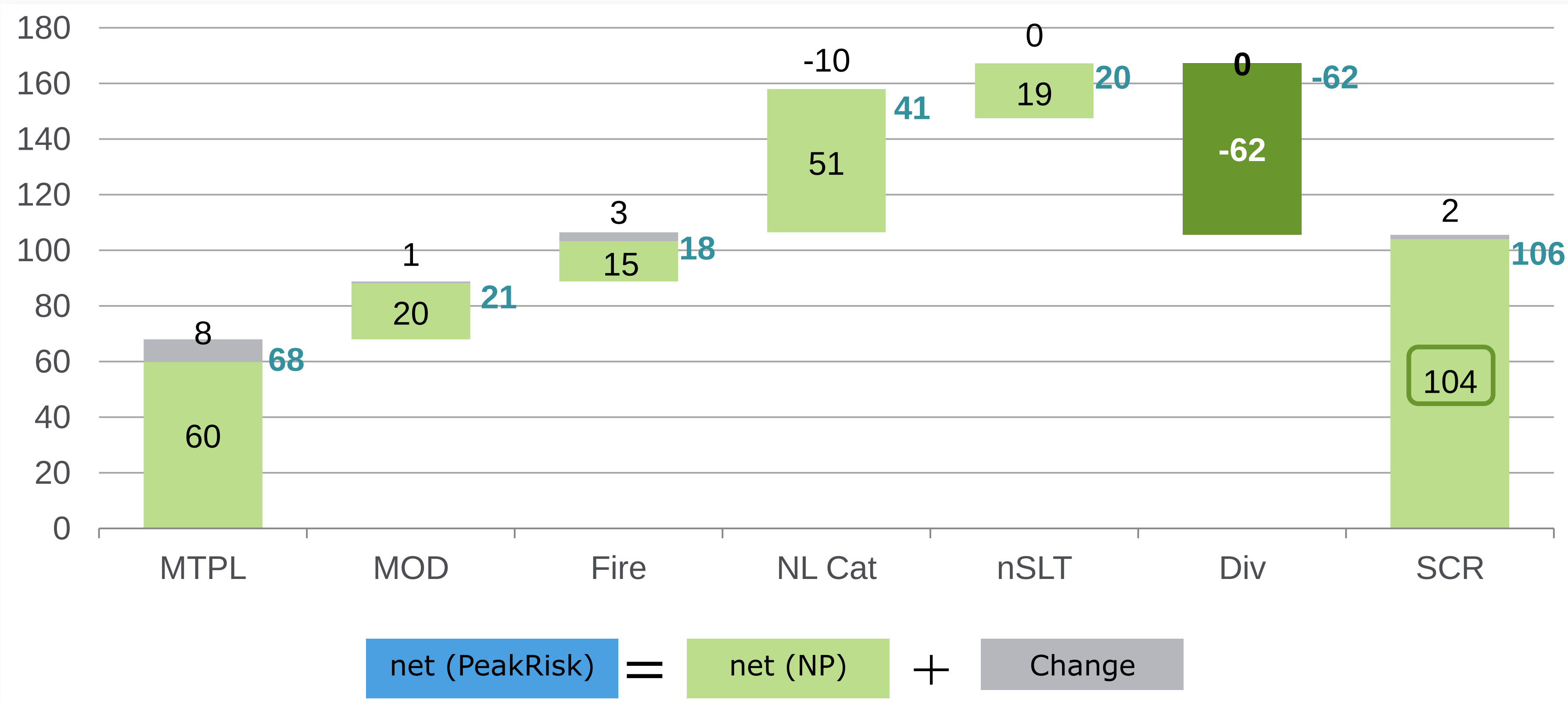


* contained reserves are net of past R/I

MTPL is still main risk in net.

PeakRisk vs. NP
Comparison of net SCR for UW risk per UW-LoB

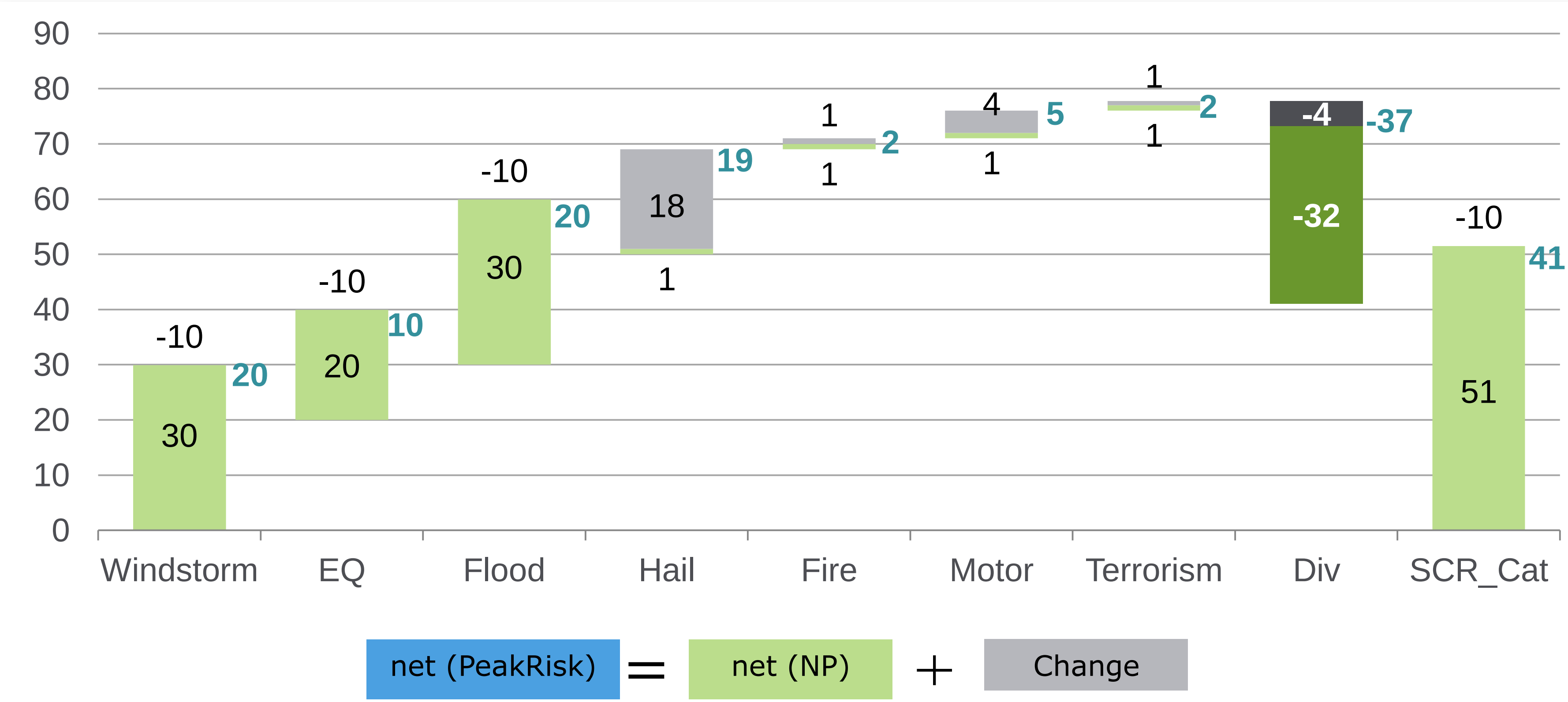
SCR for UW risk per UW-LoB, net (PeakRisk) vs net (NP) in m€



NL Cat is more risky in comparison to PeakRisk reinsurance.

PeakRisk vs. NP
Comparison of net UW risk for Non-life CAT

NL CAT, net (PeakRisk) vs net (NP) in m€



Slight improvement in Motor. Deterioration stems from Property.

5.2.4 MTPL50 + NP R/I COVER

MTPL50 + NP
Reinsurance structure

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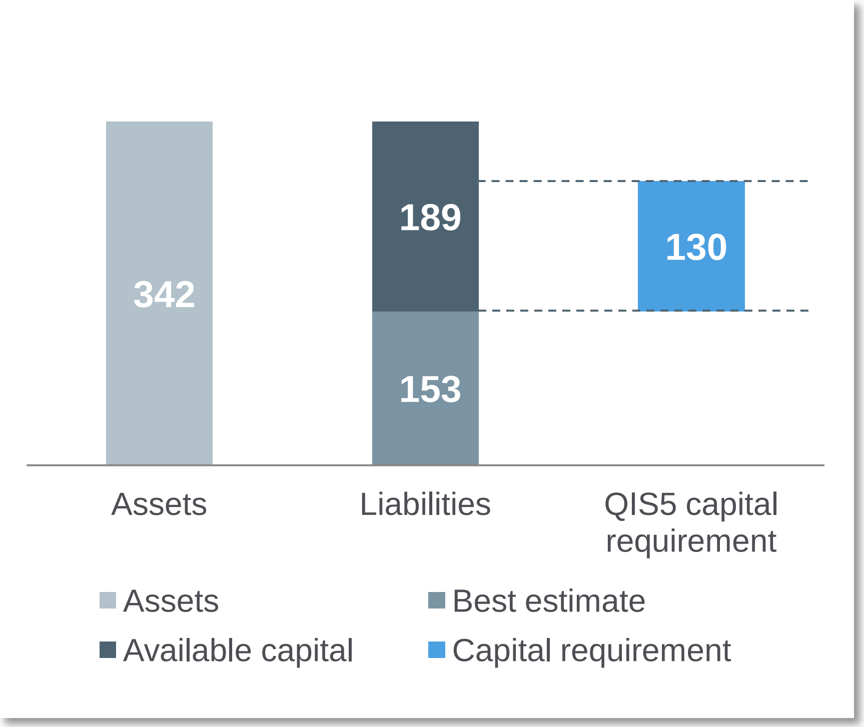
MTPL:	QS 50%	(underwriting year basis)
	WXL 99 xs 1	(reinstatements: 9 free)
MOD:	CXL 19.5 xs 0.5	(reinstatements: 9 free)
Property:	WCXL 14 xs 1	(reinstatements: 3@100%)
	SL 300% xs 100%	
PA:	WXL 2.8 xs 0.2	(reinstatements: 2@100%)
	CXL 1.4 xs 0.2	(reinstatements: 1@100%)

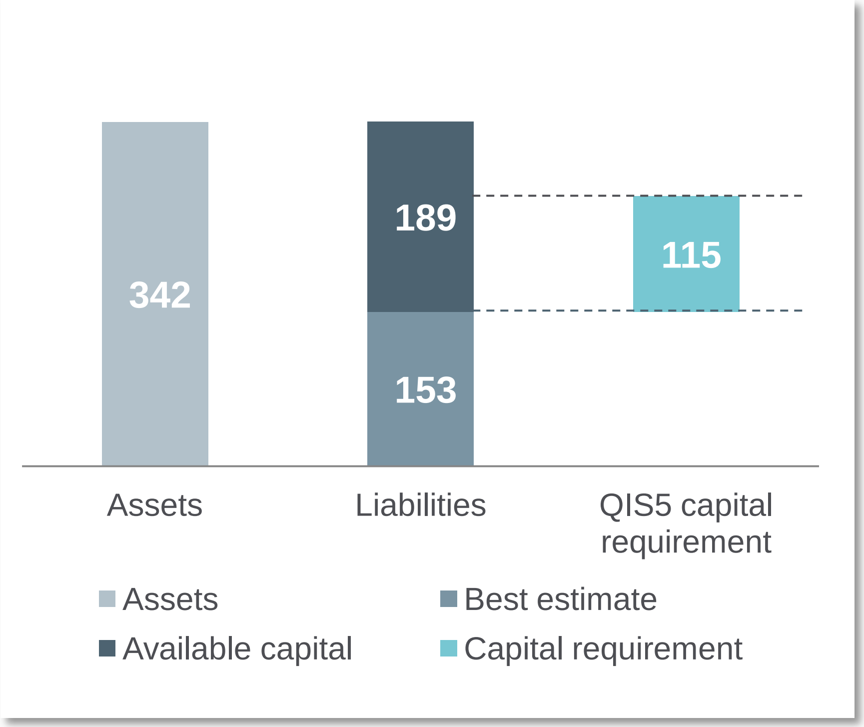
(Figures in m€)

PeakRisk vs. MTPL50 + NP
Solvency ratio

PeakRisk (in m€)



MTPL50 +NP (in m€)



Solvency ratio: 189/130 = 146%

Solvency ratio: 189/115 = 164%

Significant improvement of Solvency Ratio by MTPL quota share.

PeakRisk vs. MTPL50 + NP
SCR for Non-Life & Health UW risk

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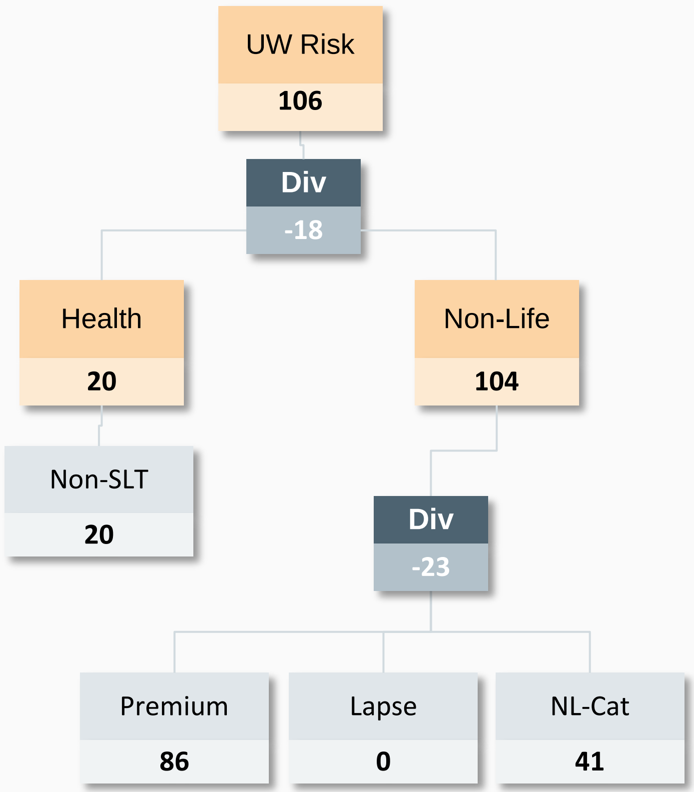
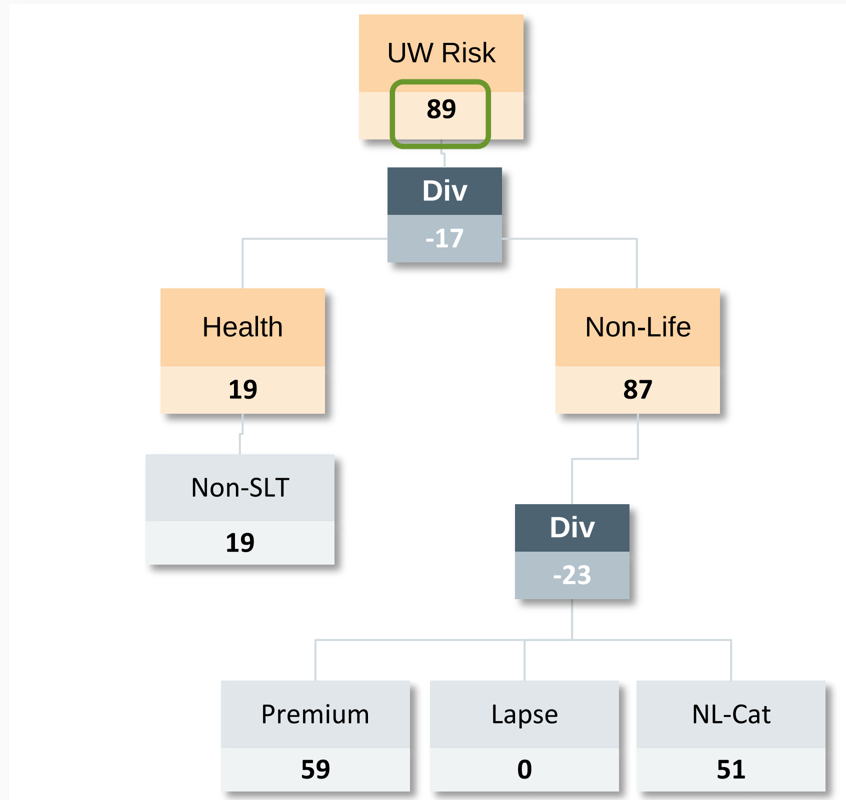
SCR for UW risk (PeakRisk) in m€



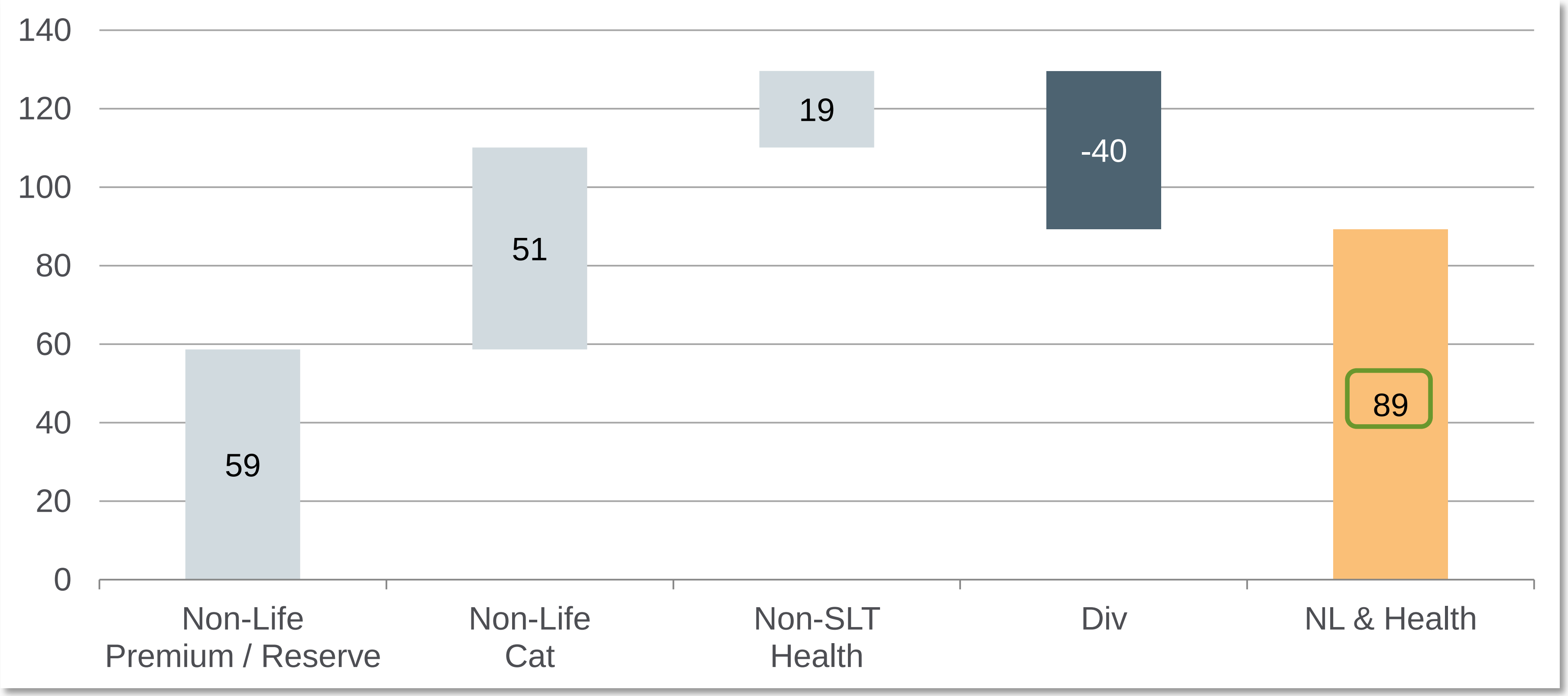
SCR for UW risk (MTPL50 + NP) in m€



Significant reduction of UW risk.

MTPL50 + NP
SCR split for underwriting risk (net)

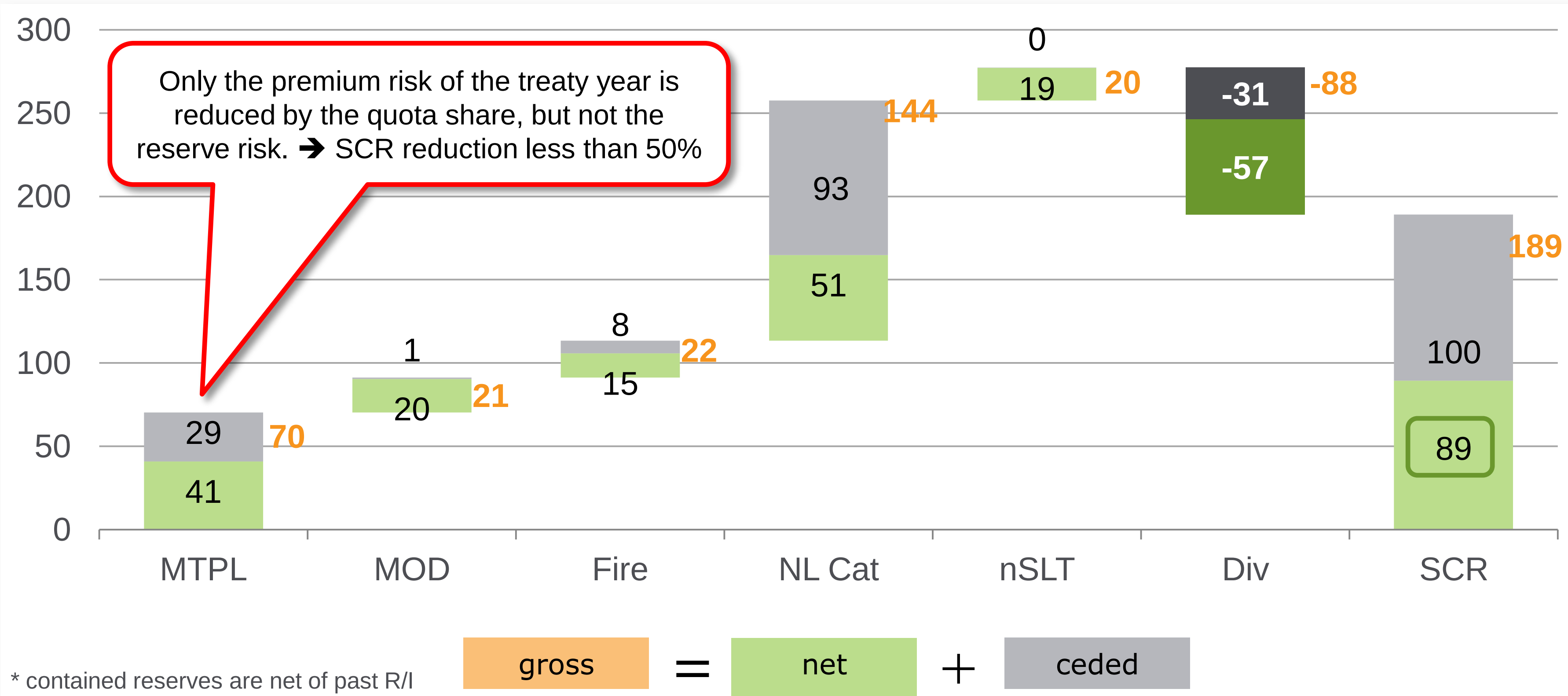
Composition of SCR for Non-Life and Health underwriting risk in m€



Non-Life premium and reserve risk no longer dominates the UW risk.

MTPL50 + NP
Gross/net comparison of SCR for UW risk per UW-LoB

SCR for UW risk per UW-LoB, gross* vs net in m€

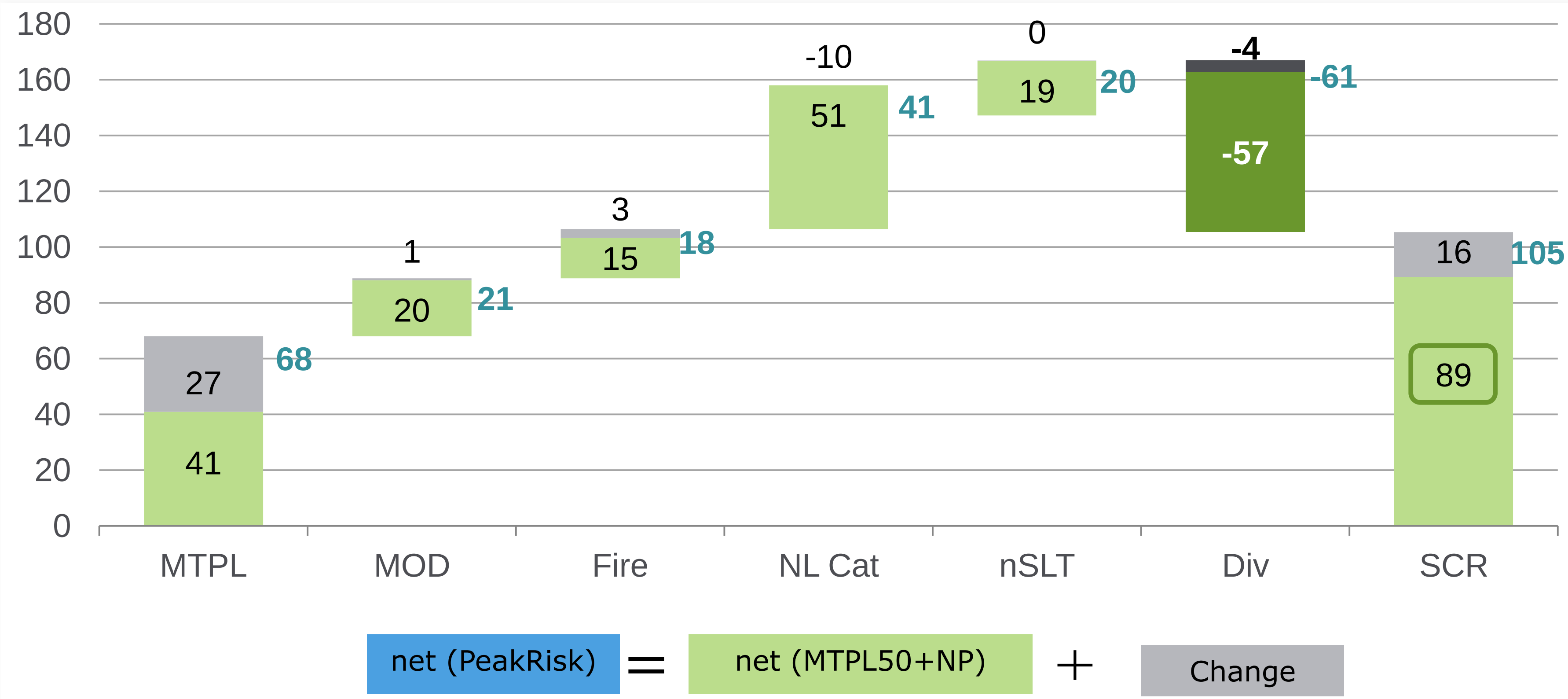


* contained reserves are net of past R/I

MTPL Cat no longer is the main risk driver.

PeakRisk vs. MTPL50 + NP
Comparison of net SCR for UW risk per UW-LoB

SCR for UW risk per UW-LoB, net (PeakRisk) vs net (MTPL50 + NP) in m€



Diversification is improved by MTPL-QS.

Result overview

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Type of Reinsurance	UW SCR	Total SCR	Solvency Ratio
Cover of peak risks (PeakRisk) ▪ Purely non-proportional cover with high attachment points	106	130	146%
Non-proportional working cover (NP) ▪ Purely non-proportional cover with low attachment points	104	128	148%
Non-proportional working cover plus 50% MTPL quota share (MTPL50 + NP) ▪ MTPL: quota cession in MTPL to homogenise the risk profile plus non-proportional cover of net retention with low attachment point ▪ Other lines: Purely non-proportional cover with low attachment points	89	115	164%

(Figures in m€)

MTPL Quota Share yields the desired relief of SCR.

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5.3 OTHER INSTRUMENTS

Reinsurance and funding alternatives: Options in case of capital shortfalls

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Target	Instrument	Condition
De-risking of assets	Re-allocation within investment portfolios: ▪ Sale of participations, ▪ Reduction of equity ratio, ▪ Hedging	Availability of assets → can lower investment return
De-risking of liabilities	▪ Reduction of business volume ▪ Reduction or exit of capital intense lines of business	Limitation of growth perspectives → diversification benefits and of market position
Risk transfer	Reinsurance	Available to all insurer segments
Restructuring available capital	a) Increase core equity b) Increase minorities c) Increase subordinated debt	a) Restricted to stock companies c) Depending on capital market access, especially Tier 1! c) Increasing spread due to more demand and higher volatility

Reinsurance: Effective and available independent of capital market access

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6. POTENTIAL IMPACT OF SOLVENCY II ON THE INSURANCE INDUSTRY

Solvency II will change the insurance sector

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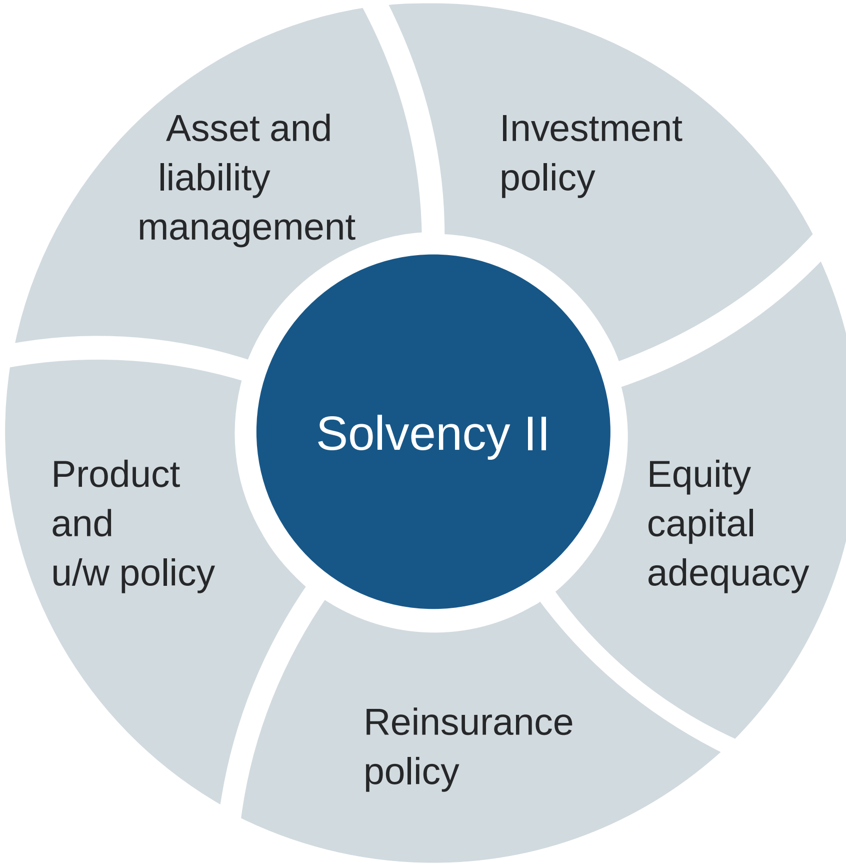
Some general assumptions:

1.	Increase in capital requirement	▪ Identification and evaluation of all relevant risks ▪ Long-term products will require more capital (more volatile) ▪ Consideration of guarantees and options
2.	Available capital will rise	▪ Assets and liabilities will be valued using a "market-value approach" ▪ The available capital will rise but volatility will be higher in time
3.	Risk management & transparency	▪ Better qualitative processes for risk management/control ▪ Use of quantitative models for overall risk-modeling ▪ Value proposition of risk transfer is measurable
4.	Asset risk	▪ An aggressive asset allocation will no longer compensate technical losses – higher risk capital for adventurous asset allocation ▪ Reduction in volatile asset categories
5.	Product adaptations	▪ Current products are put to test (risk-capital intensive?) ▪ New products will appear (less risk-capital intensive)

Solvency II will affect different areas within a company

Risk categories relevant to solvency and risk management (quantitative und qualitative):

- Underwriting
- Market
- Credit default
- Operational



Solvency II the driver of more professional and holistic corporate management.

Business and risk strategy from a risk-capital perspective?

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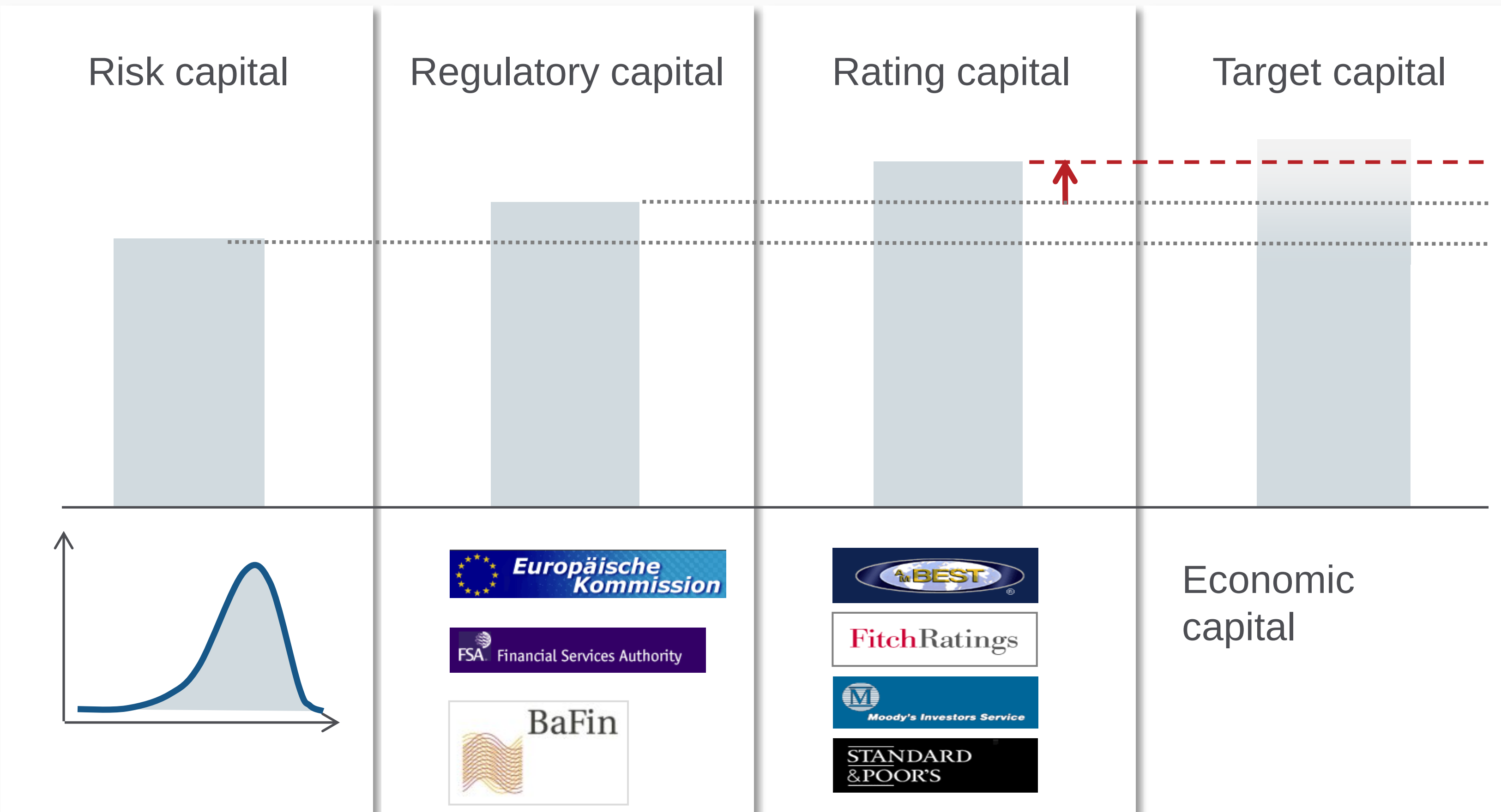
Most international insurers have a financial strength rating that requires higher capitalisation (Solvency II is "theoretically" calibrated to BBB)



Solvency II will be a trigger for value-based management

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Insurers' immediate needs can vary: Solvency II is mandatory, value-based management a matter of choice

Risk control | Extended risk management process

- Recording of risks — External and internal risks
- Risk identification
- Risk assessment
- Basic risk management
  - Avoidance
  - Cession
  - Reduction
  - Retention
- Risk monitoring
- Allocation of risk capital
- Value based production:
  - Products
  - Portfolio mix
  - Investments
- Value-based management

Corporate governance legislation

Solvency II

Value-based management

Solvency II issues for primary insurers:

- Pros and cons of a standard formula and internal models - capital requirement
- Data management/reporting requirements
- Certification by supervisory authority

Solvency II and value-based management issues for primary insurers:

- Approaches to value-based management, granularity
- Adaptation of business model and product portfolio; sales
- Optimising risk transfer

Optimising risk capital will become a competitive factor

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Minimising cost of risk capital

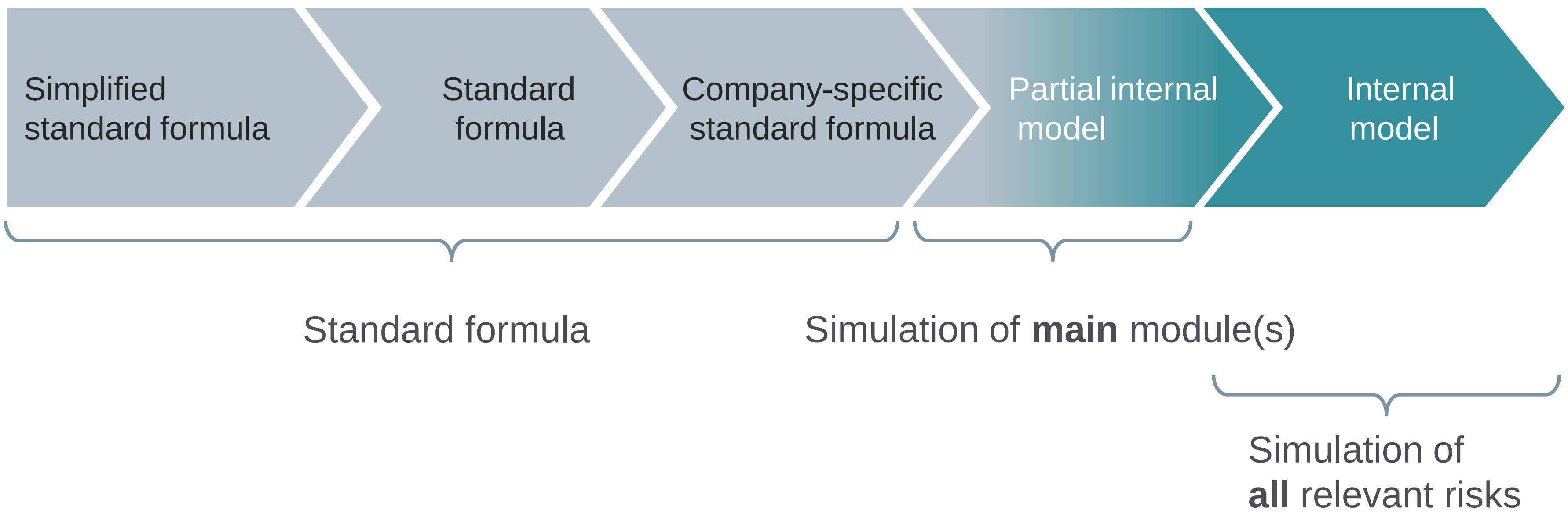
- Diversification (risk segments, perils, regions, portfolio size)
- Asset-liability matching
- Insurance product design
- Reinsurance
- Securitisation
- Portfolio swaps
- Portfolio acquisition/sale
- M&A

Company

- Financial conglomerates
- Big, international insurance companies
- Medium-sized to small insurers
- Niche insurers
- Monoliners
- Reinsurers

Measures expected to be highly diverse, depending on company size and objectives.

The insurer’s model approach follows its business complexity



Standard formula vs. internal model

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Different degrees of complexity and costs

Deterministic models	Stochastic models
Simple and general factor models: ▪ Pre-defined stress tests and scenario calculations ▪ Company-specific factor models ▪ Based on accounting data	Probabilistic stress tests and scenario calculations: ▪ Internal models with stochastic calculations for each risk type ▪ Based on exposure data

Speed and simplicity **Costs and complexity**

Solvency II will have an impact on the insurance industry beyond the boarders of the EEA

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World-wide regulatory trends

Inside EEA

- Large differences in preparedness
  - By market (Rank 1: UK, Germany, Rank 2: France, Austria, Italy, Netherlands, Nordic, Spain)
  - By size (large groups have higher diversification, familiar with rating agencies‘ requirements)
  - Legal form (stock listed insurers are advanced)
  - Indicator: (planned) submission of a (partial) internal model, need to increase own funds
- Still various concerns around Solvency II
  - Inappropriate calibration
  - Extensive workload and expenses related to Pillar 2 and 3 requirements
  - Disproportionate disclosure under Pillar 3
  - Disadvantage for medium size / small insurers and niche players, leading to increased M&A activity
  - Pressure to change products and increase rates

Outside EEA

- Solvency II
- Swiss Solvency Test
- Planned adaptations of Solvency II in Israel, Mexico, Chile, Brazil, Bermuda; adaptations to different degrees
- Adjustments of risk-based capital type regulation (USA, Canada, Asia...)

ERM / Solvency II influence on regulatory reforms worldwide:

1. Increased / more risk based capital requirements
2. More specific consideration of cat risk
3. Consideration of asset and interest risk
4. Stronger focus on qualitative and governance aspects
5. Scenario building, stress tests
6. Incentives for internal models
7. Rating Agencies’ models converge increasingly with Solvency II.

Source: IRM

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THANK YOU FOR YOUR ATTENTION.

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