Deloitte.

Developments in the calibration of the standard formula

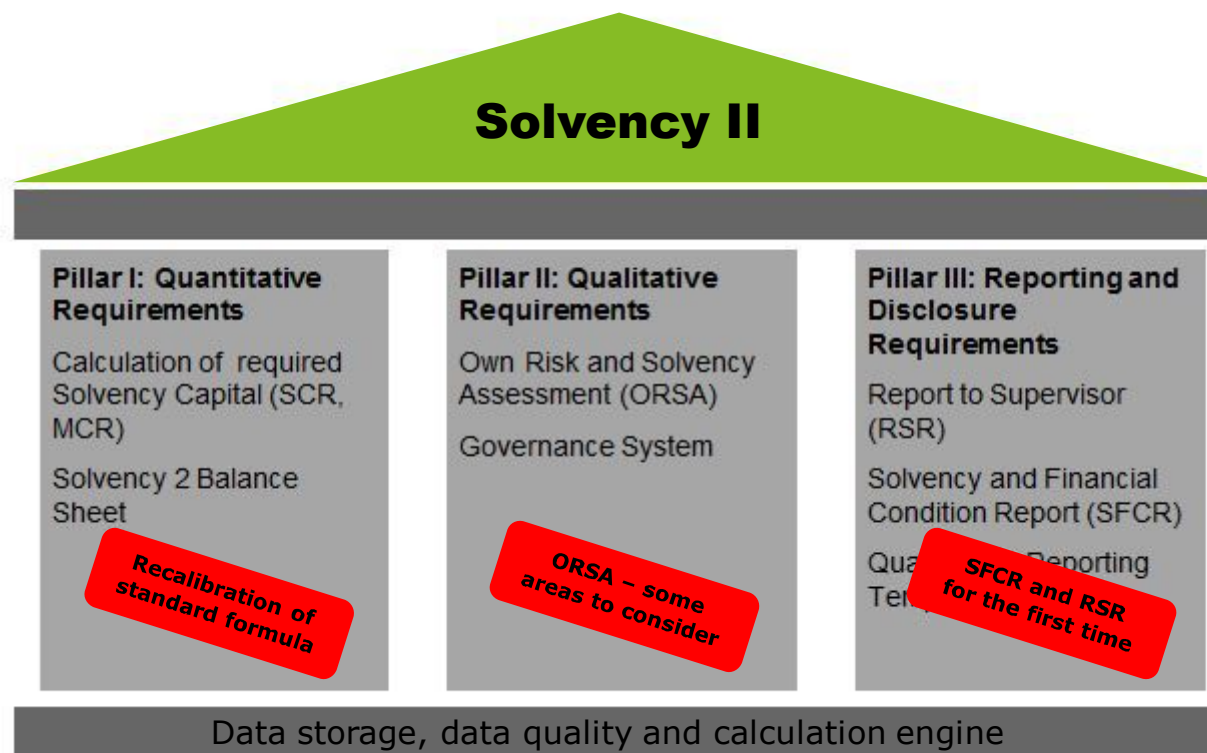Actuarial seminar
7th April 2017

Petr Svojítka
Michal Gerthofer

Recall of Solvency II principles

Three pillars

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Program

Solvency II – current situation and outlook (brief overview of actual topics)

- Current situation and open topics
- Industry's focus points
- EIOPA Stress test 2016

Standard formula review 2018 – closer look on selected areas:

- Mortality and longevity risk
- Interest rate risk

Standard formula calibration and its assessment within ORSA – remarks on calibration of selected sub-modules:

- Interest rate risk
- Spread risk
- Concentration risk

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Current situation and open topics

Overview

SII in force since 1. 1. 2016, in CZ from September 2016, several other countries also delayed; now fully transposed

SII standard formula review 2018 (*covered in following sections*)

RFR – potential change in UFR

- EIOPA is considering changes, industry is against that

Other topics

- Capital markets union (CMU) – focus mainly on long-term investments and increased regulation (SII, PRIIPs, IDD)

- Look-through approach

- Equivalence

Industry's focus points

SFCR (Sovency and Financial Condition Report) and RSR (Report to Supervisor)

Reported for the **first time**

The bulk of **SFCR**s will be **made public** from **20 May 2017**
- **Some companies** from Western Europe (end of financial year at June 2016) already reported SFCR

The **structure** and **headings** of the report **are stipulated** in the **regulation** (Commission Delegated Regulation (EU) 2015/35), however it leaves **most of the disclosure** choices **with the firm**

RSR contents as per SFCR, aimed specifically at supervisor
- More detailed, mainly more confidential information
- Business and risk strategies, financial and non-financial objectives, explanation of the variance to the plan, expected future developments

14 – 20 weeks after financial year-end (**decrease by two weeks each financial year!!!**)

Industry's focus points

SFCR, RSR

Detailed requirements

- **SFCR:** The information to the public must be annually published in a report containing 5 main categories of information

- **RSR:** Information to be produced for prudential control purposes have to allow the supervisory authorities to assess the following elements

1. Business & performance	2. System of Governance	3. Risk profile
4. Valuation for solvency purposes	5. Capital management	

Industry's focus points

Focus points across Europe
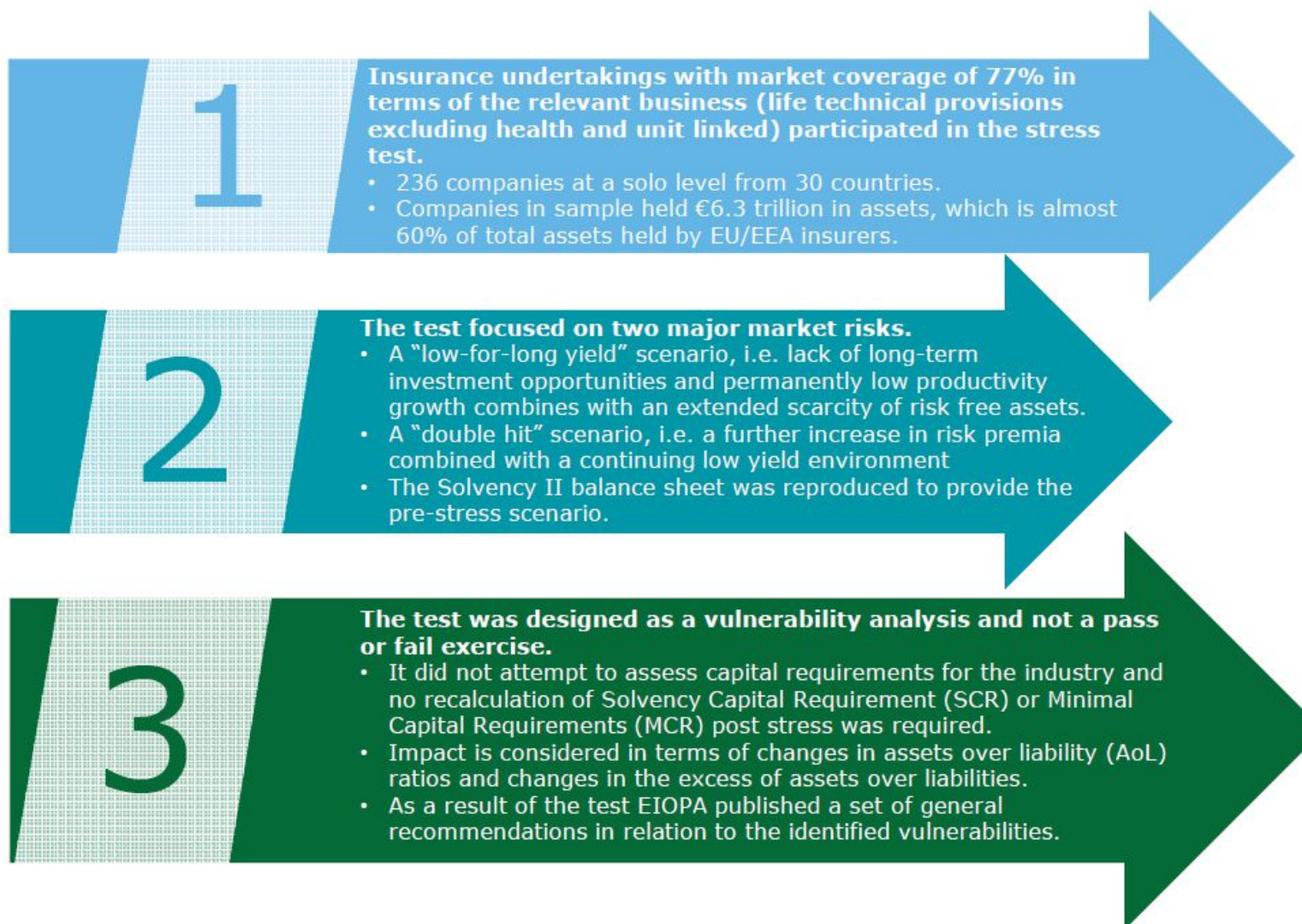
What we observed in other markets

- Capital management and capital optimization
  - Detailed capital management policies
  - Adjustments in product mix
  - Contract boundaries
  - Intra-group reinsurance
  - Unit-matching
  - …
- Automation of SII processes (reporting)
- External audit of SII
  - Required in most countries, often there is no detailed guidance
- Deferred taxes (adj. for loss-absorbing capacity of deferred taxes)
 - Shift to more granular approach

EIOPA Stress test 2016

Assessing vulnerabilities to a combination of market risk adverse scenarios

1 Insurance undertakings with market coverage of 77% in terms of the relevant business (life technical provisions excluding health and unit linked) participated in the stress test.
- 236 companies at a solo level from 30 countries.
- Companies in sample held €6.3 trillion in assets, which is almost 60% of total assets held by EU/EEA insurers.

2 The test focused on two major market risks.
- A "low-for-long yield" scenario, i.e. lack of long-term investment opportunities and permanently low productivity growth combines with an extended scarcity of risk free assets.
- A "double hit" scenario, i.e. a further increase in risk premia combined with a continuing low yield environment
- The Solvency II balance sheet was reproduced to provide the pre-stress scenario.

3 The test was designed as a vulnerability analysis and not a pass or fail exercise.
- It did not attempt to assess capital requirements for the industry and no recalculation of Solvency Capital Requirement (SCR) or Minimal Capital Requirements (MCR) post stress was required.
- Impact is considered in terms of changes in assets over liability (AoL) ratios and changes in the excess of assets over liabilities.
- As a result of the test EIOPA published a set of general recommendations in relation to the identified vulnerabilities.

EIOPA Stress test 2016

Used to highlight the impact of stress scenarios on participant balance sheets
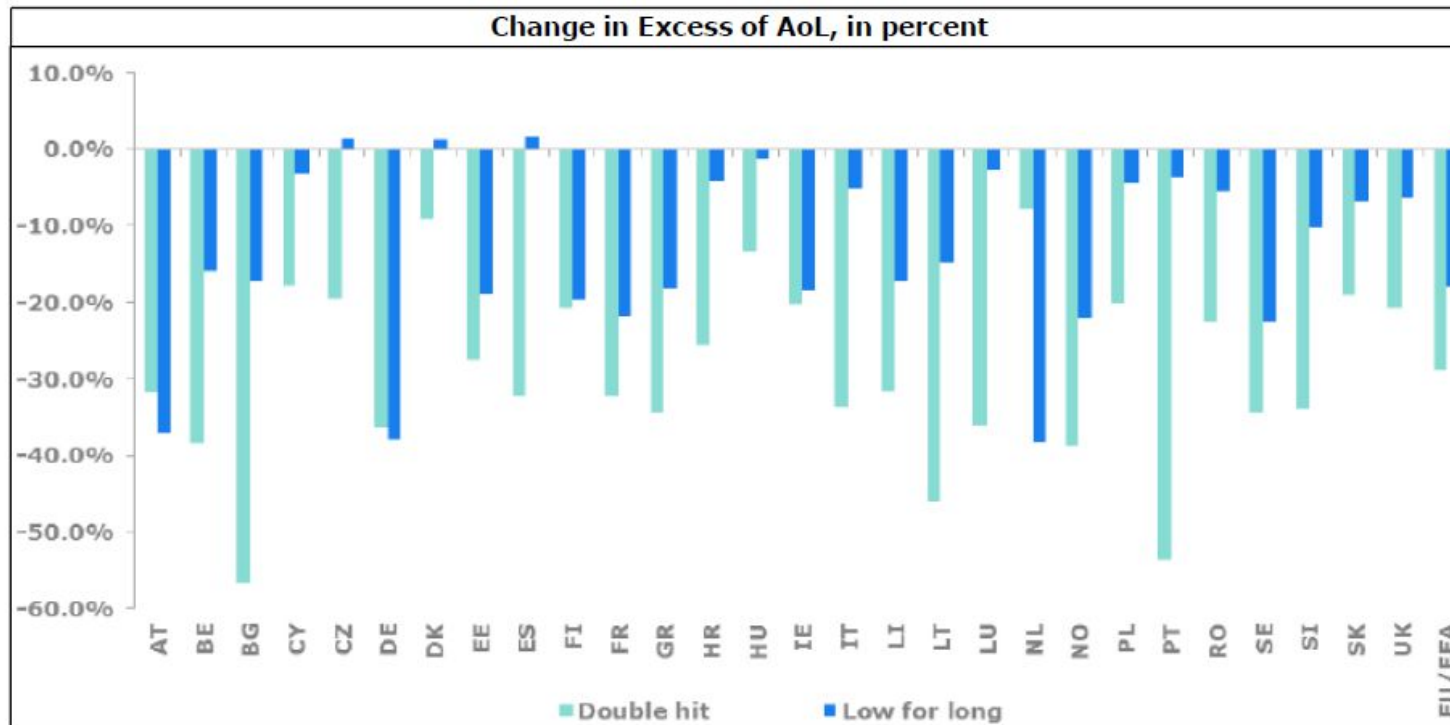
All insurance undertakings in this test had an AoL ratio above 1 before any stress was applied.

- After the application of the "low-for-long scenario" and "double-hit", respectively, 1% and 2% of the undertakings showed an AoL ratio of below 1.

- The overall **percentage change in AoL ratio is**

higher in the "double-hit" scenario. With the "double-hit" seeing losses in AoL over $1/3$ in 66 more undertakings and over $1/2$ in 26 more undertakings than experienced in the "low-for-long" scenario.

- **NL, AT and DE** provide exceptions to this as they felt a **larger impact in the "low-for-long"** scenario.

EIOPA Stress test 2016

EIOPA's Response to the Stress Test Results

1 Vulnerability of the insurance sector to the low interest rate environment highlighted

- EIOPA believe that these vulnerabilities deserve a **supervisory response**.
- In order to ensure a coordinated supervisory response EIOPA issued **Recommendations** in relation to these vulnerabilities and the prospective impact on the EU Insurance sector stability.
- EIOPA will continue to work closely with national competent authorities to ensure **cooperation and coordination** of risk analysis and supervisory actions.

2 Recommendations to the National Supervisory Authorities

These recommendations cover **three main areas**:

1. **Risk management and business model sustainability**
   - Align internal risk management to external risks faced
   - Review behavior of management and policy holders

2. The **modeling of lapses and best estimates**
   - Review clauses of guarantees and continue to asses valuation of technical provisions
   - Request a reduction in maximum guarantees or unsustainable profits offered

3. The impact on **group solvency and group support**
   - Cancel or defer dividend distribution if viability of business model is at risk
   - Ensure vulnerabilities identified at a solo level are dealt with at the group level

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Standard formula review 2018
Review of the methods, assumptions and standard parameters

Review of the **methods, assumptions and standard parameters** used when calculating the Solvency Capital Requirement with the standard formula

- As referred to in **recital (150) of Delegated Acts**

- Till December **2018**

European Commission call for advice to EIOPA on potential **changes** to the **standard formula** in view of the **2018**

- Published in July 2016

- Focus:

  – Proportionate and simplified application of the requirements

  – Removal of unintended inconsistencies

EIOPA **public consultation**

- From December 2016 till March 3, 2017

- Discussion Paper on the review of specific items in the Solvency II Delegated Regulation

EIOPA **partial advice** till **October 2017**

EIOPA **final advice** till **February 2018**
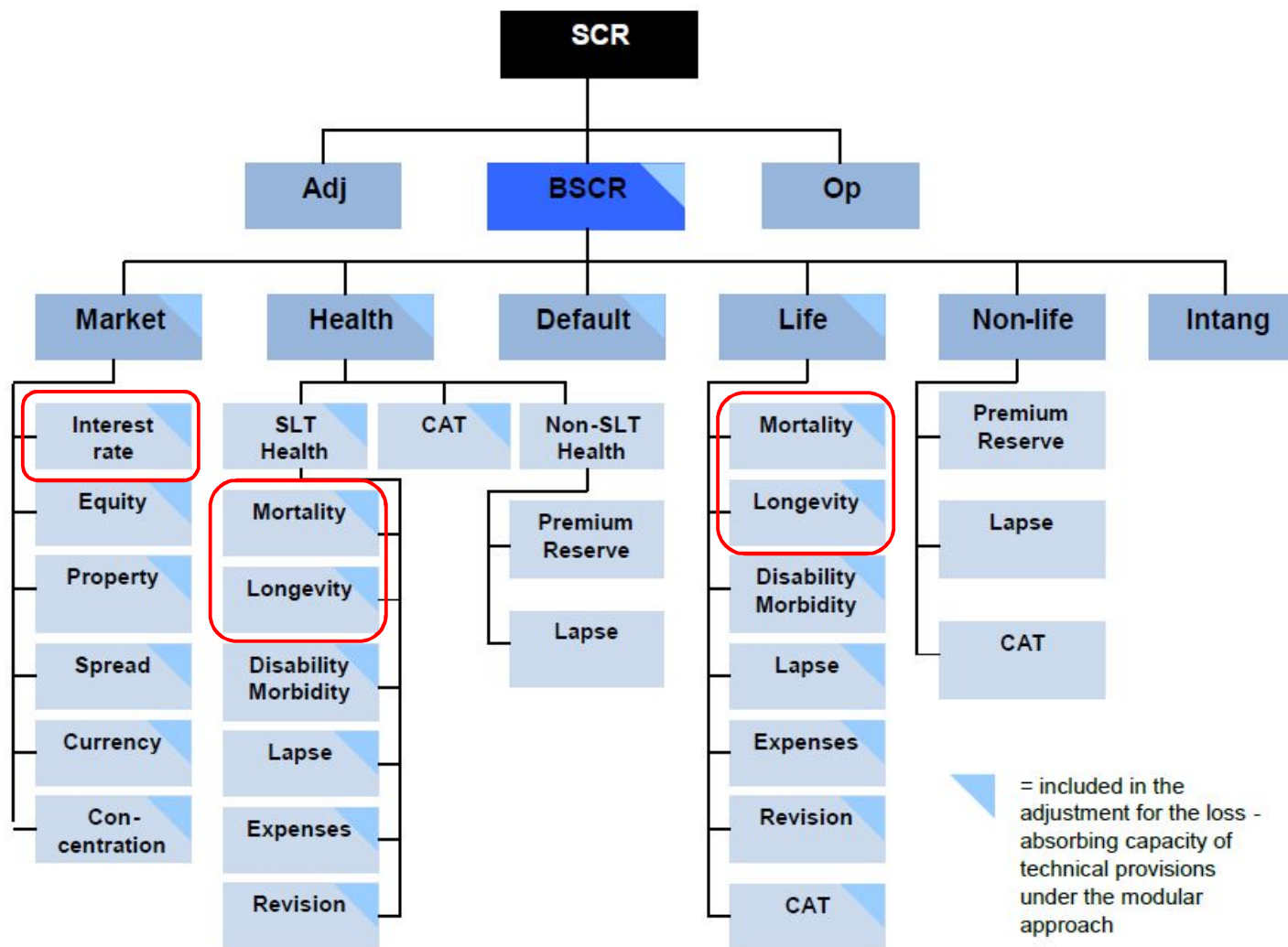
Standard formula review 2018

„Discussion Paper on the review of specific items in the Solvency II Delegated Regulation"

1. Simplified calculation

2. Reducing reliance to external credit ratings in the standard formula

3. Treatment of guarantees, exposures guaranteed by a third party and exposures to regional governments and local authorities (RGLA)

4. Risk-mitigation techniques

5. Volume measure for premium risk

6. Assessment of the appropriateness of standard parameters for non-life premium and reserve risks and for medical expense risk

7. Natural catastrophe risks

8. Man-made catastrophe risk

9. Health catastrophe risk

10. Calibration of the mortality and longevity risk

11. USP (underwriting specific parameters) and GSP (Group specific parameters) on underwriting risks

12. Simplifying the counterparty default risk module

13. Exposures to qualifying central counterparties and derivatives

14. Assumptions of the market concentration risk sub-module

15. Currency risk at group level

16. Look-through approach: simplifications and investment related vehicles

17. Interest rate risk sub-module

18. Loss Absorbing Capacity of Deferred Taxes (LAC DT)

19. Risk margin

20. Comparison of own funds in insurance and banking sectors

21. Capital instruments only eligible as tier 1 up to 20% of total tier 1

Recall

The overall structure of the standard formula

Standard formula review 2018
Mortality and longevity risk

The **current calibration** corresponds to the loss in basic own funds that would result from an **instantaneous permanent increase** (resp. **decrease**) of 15% (resp. 20%) of mortality

Several issues to consider:

- More **granular approaches** (to be detailed in the following slide)
- **Selection of a new model** for recalibration of SF (e.g. Towers Perrin model, multi-population extension by Lee-Li, …)
- **New calibration data** and its handling
  - For instance, estimating the Lee Carter model on European wide data will result in a best estimate uniform European level of mortality and trend which might deviate from current base (cohort) mortality tables used by undertakings

Mortality risk, life expectancy and SCR

- Understanding the uniform SII shocks in terms of life expectancy
- More granular approach can be found in defining a more granular shock level, for instance an instantaneous uniform shock that is depended on the attained age only
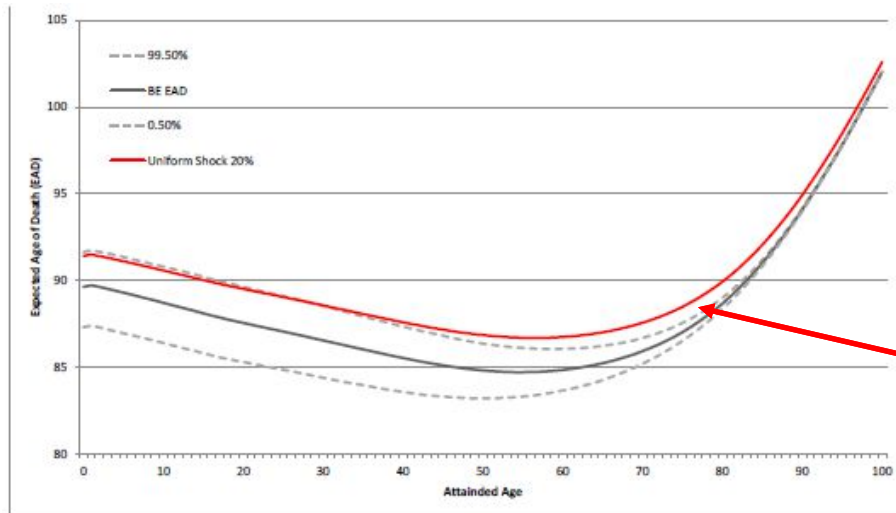
Mortality risk, life expectancy and SCR
Understanding the uniform SII shocks in terms of life expectancy

Expected age of death for an instantaneous decrease od 20% in mortality

$$e_x(t) = \frac{1}{2} + \sum_{k=0}^{\infty} {}_k p_x(t)$$

$$e_x^{shocked}(t) = \frac{1}{2} + \sum_{k=0}^{\infty} \prod_{s=0}^{k} (1 - 0.8 \times q_{x+s}(t+s))$$
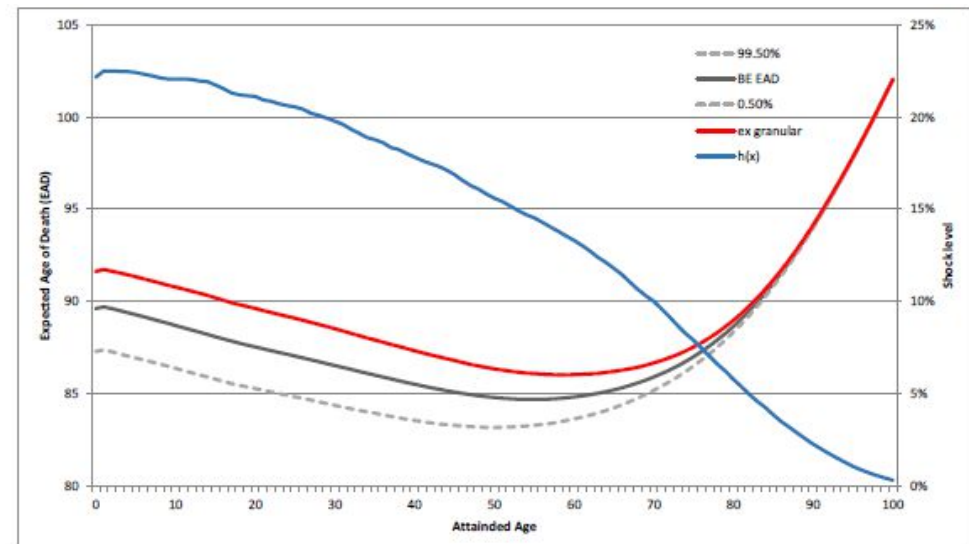
Expected age of death including an attained age depended

$$e_x^{granular}(t) = \frac{1}{2} + \sum_{k=0}^{\infty} \prod_{s=0}^{k} (1 - (1 - h(x)) \times q_{x+s}(t+s))$$

$$e_x^{granular}(t) = e_x^{99,5\%}(t)$$

Although it is **possible to derive the 99.5th** percentile of **the distribution of future mortality rates** when using a stochastic mortality model, these 99.5th percentile mortality rate levels are in general **not suited to calculate the 99.5th percentile** of the distribution of the respective liabilities.

This is due to the fact that liabilities are in general **non-linear transformations** of mortality rates

Standard formula review 2018
Interest rate risk

Calibration of the interest rate risk sub-module **performed** in **2009**

The **interest rates** have **dropped** significantly in the **recent years**

The **changes** in the **calibration methodology** in order to take into account of the **new** interest **rate environment**

Current calibration and setting of SF **does not capture risk** on **99,5% VaR** in low interest rate environment

$$r_t{}^{up} = \max\{r_t\,(1 + s^{up}), r_t + 1\%\}$$

$$r_t{}^{down} = \min\{r_t(1 - s^{down}), r_t\}$$

Standard formula review 2018

Interest rate risk

$$r_t^{up} = \max\{r_t(1 + s^{up}), r_t + 1\%\}$$

$$r_t^{down} = \min\{r_t(1 - s^{down}), r_t\}$$

Maturity in years	Stress factor (increase)	Stress factor (decrease)
1	70%	75%
2	70%	65%
3	64%	56%
4	59%	50%
5	55%	46%
6	52%	42%
7	49%	39%
8	47%	36%
9	44%	33%
10	42%	31%
11	39%	30%
12	37%	29%
13	35%	28%
14	34%	28%
15	33%	27%
16	31%	28%
17	30%	28%
18	29%	28%
19	27%	29%
20	26%	29%
90	20%	20%

Based on **EURO** and **GBP**, **ZCB** and **SWAP** rates from 1979 and 1997 daily observations

Current calibration using **Principal component analysis** and **linear regression**

$$\frac{\Delta r_t}{r_{t-\omega}} = \frac{r_t}{r_{t-\omega}} - 1$$

$$\frac{\widehat{\Delta r_t}}{r_{t-\omega}} = \sum_{i=1}^{4} \hat{\beta}_l T_i$$

T_i the first four components of PCA

Further, complex aggregation of these partial results (distributions) are performed in order to obtain the empirical 99.5 % and 0.5 % quantiles from the distribution liabilities

Standard formula review 2018

Interest rate risk

Alternative mathematical approaches to derive the stressed risk-free curves:

- **An additive stress** could have the following affine form

$$r_t{}^{up,down} = ar_t + b$$

  where a and b depend on the scenario and the corresponding maturity m

- **Interest intensity approach**

$$\rho = \ln(1 + r)$$

  - shocked intensity $\qquad \rho + s$

  - implied shocked factor $\qquad \exp(\rho + s) = (1 + r)e^s$

  - implied shocked rate $\qquad (1 + r)e^s - 1$

  - For small s the implied shocked rate can be approximated by a standard Taylor approximation as follows: $\quad (1 + r)e^s - 1 \approx r + s$

  - Close to 0 the additive stress the stress based on the interest rate intensity should yield similar results

- **Combination of relative** (for high interest rates) and **absolute calibration** (for high interest rates) of interest rate shocks

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ORSA
Interest rate risk

Within ORSA (Own Risk and Solvency Assessment), **company** should **assess,** whether **assumptions** of **SF** are **fulfilled** and use this information within **risk management process**

Current calibration of interest rate is **not suitable** for today´s environment at all (discussed in previous section)

Possible ways:

- In case of assessment of SF assumptions

  - Indicative **difference** caused by **company specific data**, (EURO, GBP -> CZ/ZCB, SWAP) can be seen by **comparing** its **volatilities, quantiles** which could lead to indicative calculations of the impact

- Overall assessment of SF

  - **Indicative calculation** (to be detailed in the following slide)

  - Calculation of **internal model** for interest risk sub-modul to be one step ahead (not required within ORSA)

ORSA

Interest rate risk

Indicative calculation can be **based on setting** tenor specific **stress factors a** and **b** based on particular history of CZ ZCB and SWAP (tenor 2Y, 5Y, 10Y, 15Y) in order **to cover given 99,5% VaR**

$$r_t{}^{up,down} = ar_t + b$$

For example, take history of 10Y CZ ZCB and SWAP

- Set a_{10Y_up}, a_{10Y_down} and b_{10Y_up}, b_{10Y_down} that yearly changes of these yields will be between $r_t{}^{up} - r_t$ and $r_t^{down} - r_t$

Similarly, a_{2Y}, a_{5Y}, a_{10Y}, a_{15Y} and b_{2Y}, b_{5Y}, b_{10Y}, b_{15Y} for up and down must be set and then stress factors for all tenors must be interpolated

- Apply these stress factors in order to derive shocked yield curves

- Final impact could be expressed as difference between BEL with yield stressed according SF and BEL with yield stressed using new stressed factors
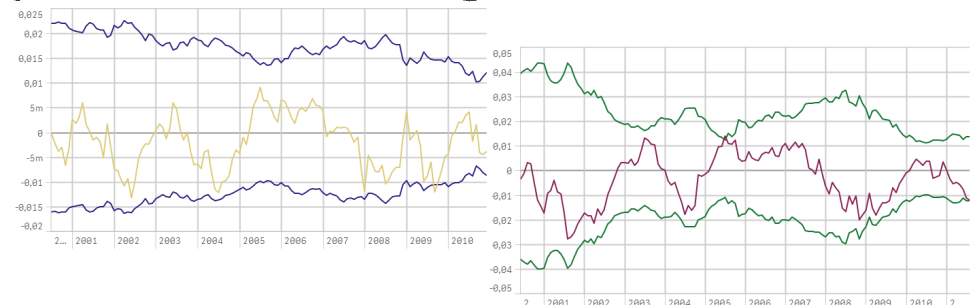
ORSA
Spread risk - bonds

Spread risk 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

Not easy to assess appropriateness due to several issues:

- Calibration is based on **specific index** and its development which is not feasible to replicate for CZ environment

- Process of calibration is **not fully described**

Other possible ways to asses appropriates in case of functional SF calibration on European data

- **Compare volatilities** and **quantiles** of **EURO** spread with **CZ** specific **spreads**

- **Complexity of the task** is given by **company specific portfolio** and **lack** of available **information** and history **for** construction of **relevant** tenor X rating **statistics**
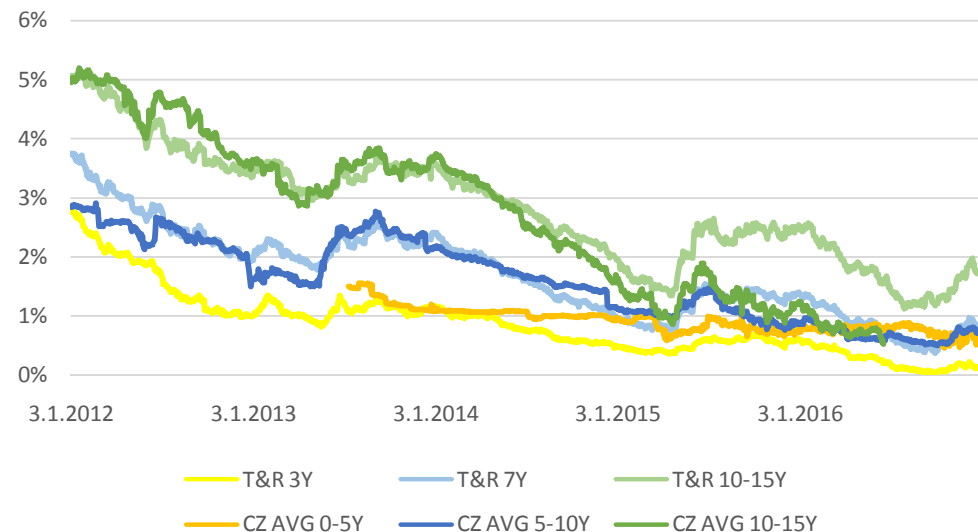
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Spread risk - bonds

Possible way is to **construct sophisticated average yield** curves of **corporate bonds** used in **CZ** for each tenor X rating buckets

Find the comparable **EURO corporate yield** (T&R) in similar granularity

Calculate spreads and then **compare relevant statistics** (upper quantile, volatility) in order to assess and state possible impact of company portfolio and environment

Sometimes, it is very **hard** to **compare even one** statistics which can **vary through all buckets** (tenor X rating)

CZ bonds ratings A and T&R ratting A

Legend: T&R 3Y, T&R 7Y, T&R 10-15Y, CZ AVG 0-5Y, CZ AVG 5-10Y, CZ AVG 10-15Y

ORSA
Concentration risk

The risk dealt with in the **market risk concentration** risk sub-module is restricted to the risk regarding the **accumulation of exposure with the same counterparty**

It **does not include** other types of concentration risk, such as **geographical** or **sector concentrations** of the assets held.

$$XS_i = max\left\{0; \frac{E_i}{Assts_{xl}} - CT\right\}$$

$$Conc_i = Assts_{xl} * XS_i * g + \Delta Liab$$

Calibration is **based** on **historical prices** of selected representative **equities** and standardized **bonds**

– Calculation of 99,5% VaR for well-diversified portfolio

– For each selected name difference between 99,5% VaR of well-diversified portfolio and 99,5% VaR of portfolio where weight of given bond and equity is increased by 1 % (until weight reaches 70 %)

ORSA

Concentration risk

Each **curve** models **difference** between 99,5% VaR of **well-diversified** portfolio and 99,5% VaR of portfolio with varying weight of the **particular name**

Possible way to assess SF assumptions:

- Based on well-known index (CEE) construct well-diversified portfolio which contains names from company portfolio

- Collect history of prices for equity and yields for bonds

- Replicate calibration steps and compare slope of worsening VaR with g function from Solvency II

Worsening of VaR when a well-diversified portfolio (left common point to all curves) is transformed in badly diversified portfolio
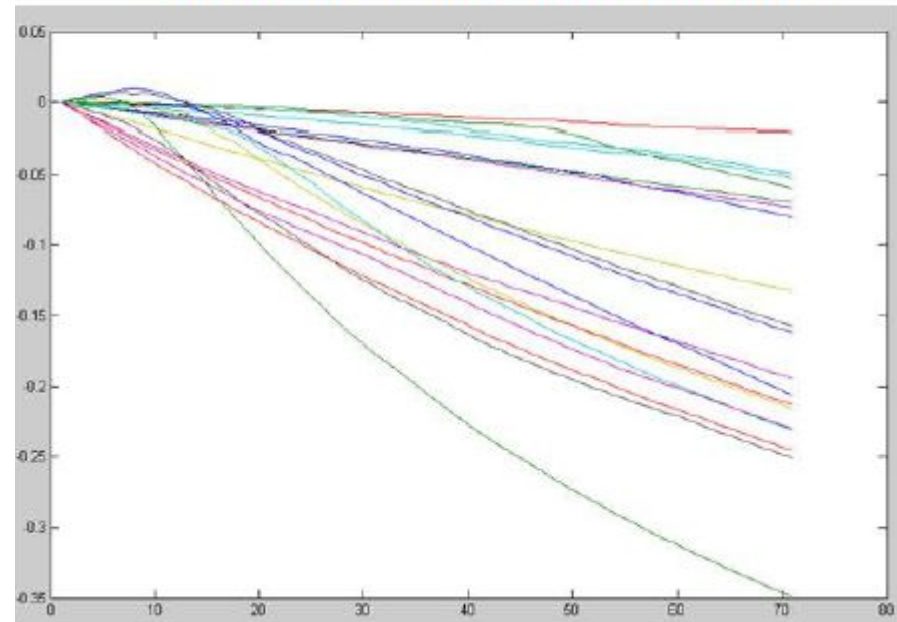
Thank you for your attention

**Manager, Actuarial
and insurance solutions**

Petr Svojítka

**Consultant, Actuarial
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