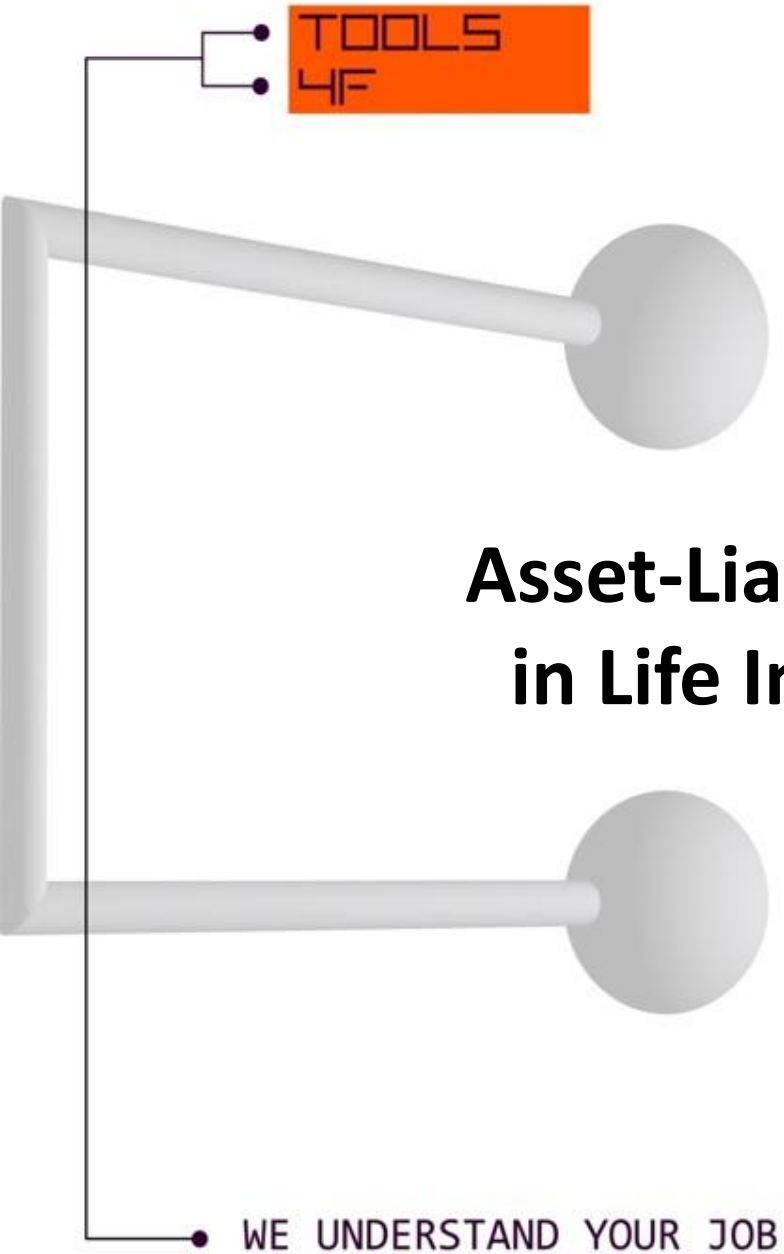

Asset-Liability Management in Life Insurance Business

Milan Sitař

27. 3. 2026

Objectives

- ALM Objectives
- ALM Analyses and Techniques

Milan Sitař

- Ph.D. in Econometrics
  at MFF UK in Prague
- Since 1999 in insurance business:
  - Česká pojišťovna
  - ČSOB pojišťovna
- Senior actuarial expert
- Teacher at Economic University Prague
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Agenda

1. **ALM Objectives in Insurance**

2. **ALM – Basic Market Standard of Practice**
   - Value Management
   - Cash Flow Management

3. **ALM under Different Standards**

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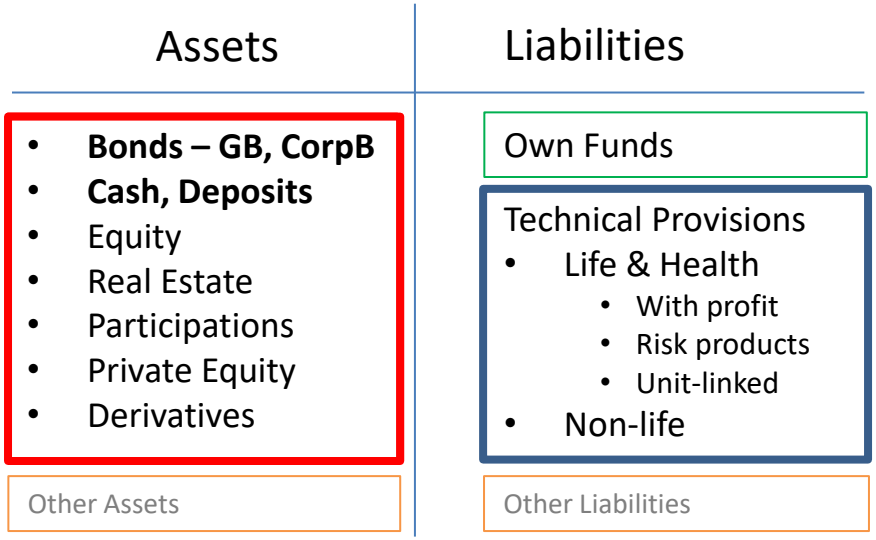
Introduction to ALM

- ALM – what we speak about
  - Liabilities
    - **Technical Provisions**
      - based on sold contracts
      - calculated by actuaries
      - **limited management**
    - Own Funds (= A – L)
    - Others
  - Assets
    - **Investments**
      - Bonds, Depo, Cash > usually 70%–90%
      - Equity, Real Estate, Participations, Private Equity, Derivatives
      - **might be managed** – sold/bought
    - Others



ALM Objectives (1)

- How to adjust and handle the **investment structure** to meet **desired Assets-Liability characteristics**.
  - What characteristics
  - Why them
  - How to calculate them
  - What conclusions we could make out of them
  - Their limitations
  - Managing and Monitoring

- Society of Actuaries ALM definition:

  *ALM is the **ongoing process** of formulating, implementing, monitoring, and revising strategies related to assets and liabilities **to achieve financial objectives**, for a given set of **risk tolerances and constraints**.*

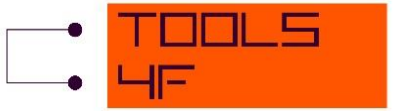
ALM Objectives (2)

- Shareholder objectives
  - Managing the market value of the insurance company
  - Long-term liquidity management (cash flow matching)
  - Return on equity
  - Guide product management to develop products that are manageable from an ALM perspective

- Management objectives (common in CEE)
  - Managing SII ratio
  - Managing the delivery of planned P&L results

Life Insurance Liabilities

- **Life insurance contract** (typical features)
  - Risks covered – death, survival, disability, critical illness, injuries, …
  - **Long-term** contracts
  - Premium – single, regular, ad-hoc
  - **Company cannot unilaterally terminate** (except accident risks)
  - Contracts with different investment options
    - **Contracts with profit-sharing**
      - minimal guaranteed return
      - profit sharing if investment return > guaranteed rate
      - surrender value in case of early termination
      - the insurance company takes the investment risk
    - **Contracts w/o profit-sharing** (pure risk contracts)
      - no surrender value
      - the insurance company takes the investment risk, but it is limited
    - **Unit-linked contracts**
      - no investment return guarantee (the Investment risk is born by the policyholder)



Investments

- Cash
- Deposits (short, long)
- **Bonds:**
  - **Government, Corporate, …**
  - **Zero-coupon vs. coupon (fix, float)**
- Equity
- Real Estate
- Participations
- Private Equity
- Derivatives
- …

Agenda

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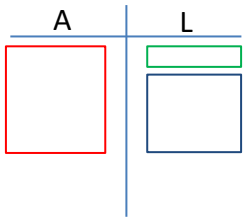
Value Management – Introduction

- What is the shareholders objective?
  - Company value is:
    - increasing
    - stable (within the risk appetite of the shareholder)

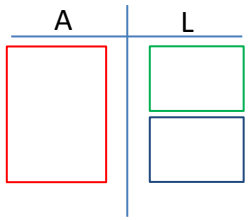
    => from ALM perspective, matching the sensitivity and behaviour of assets and liabilities
  - Where to find the Company value?
    - Own funds = Value of assets – Value of liabilities
    - Different standards = different balance sheets – which is the main one?

Accounting Standard



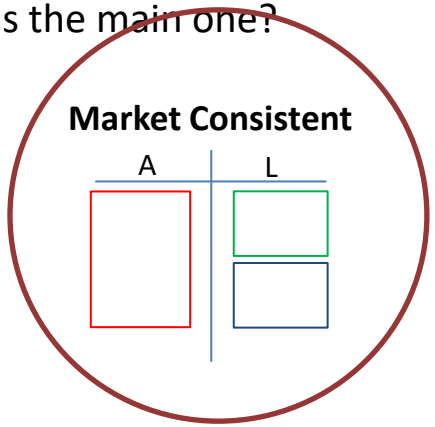
- IFRS
- Value of A and L as in the Standard (e.g. risk adjustment, amortized cost, …)

Regulation (SII)



- Solvency II
- Value of A and L as in the SII Standard (contract boundaries, yield curve (UFR), …)

Market Consistent



- Observable market prices of A and L

Δ A & Δ L Sources

- What drives the changes in A and L?

Δ A sources	Δ L sources
Δ Interest rates	Δ Interest rates
Δ Credit spread	Δ Claims
Δ Illiquidity spread	Δ Expenses
Δ Equity	Δ Lapses
Δ Real Estate	Cat
Δ FX	Op. Risk
…	…

Non-Financial Risks

Δ A sources	Δ L sources
Δ Interest rates	Δ Interest rates
Δ Credit spread	Δ Claims
Δ Illiquidity spread	Δ Expenses
Δ Equity	Δ Lapses
Δ Real Estate	Cat
Δ FX	Op. Risk
…	…

Non-Financial risks
(Ins. Risk, Op. Risk, …)
=>
NOT (main) ALM focus
<u>– liquidity limits</u> based on stress scenarios

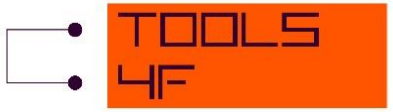
Financial Risks

Δ A sources	Δ L sources
Δ Interest rates	Δ Interest rates
Δ Credit spread	Δ Claims
Δ Illiquidity spread	Δ Expenses
Δ Equity	Δ Lapses
Δ Real Estate	Cat
Δ FX	Op. Risk
…	..

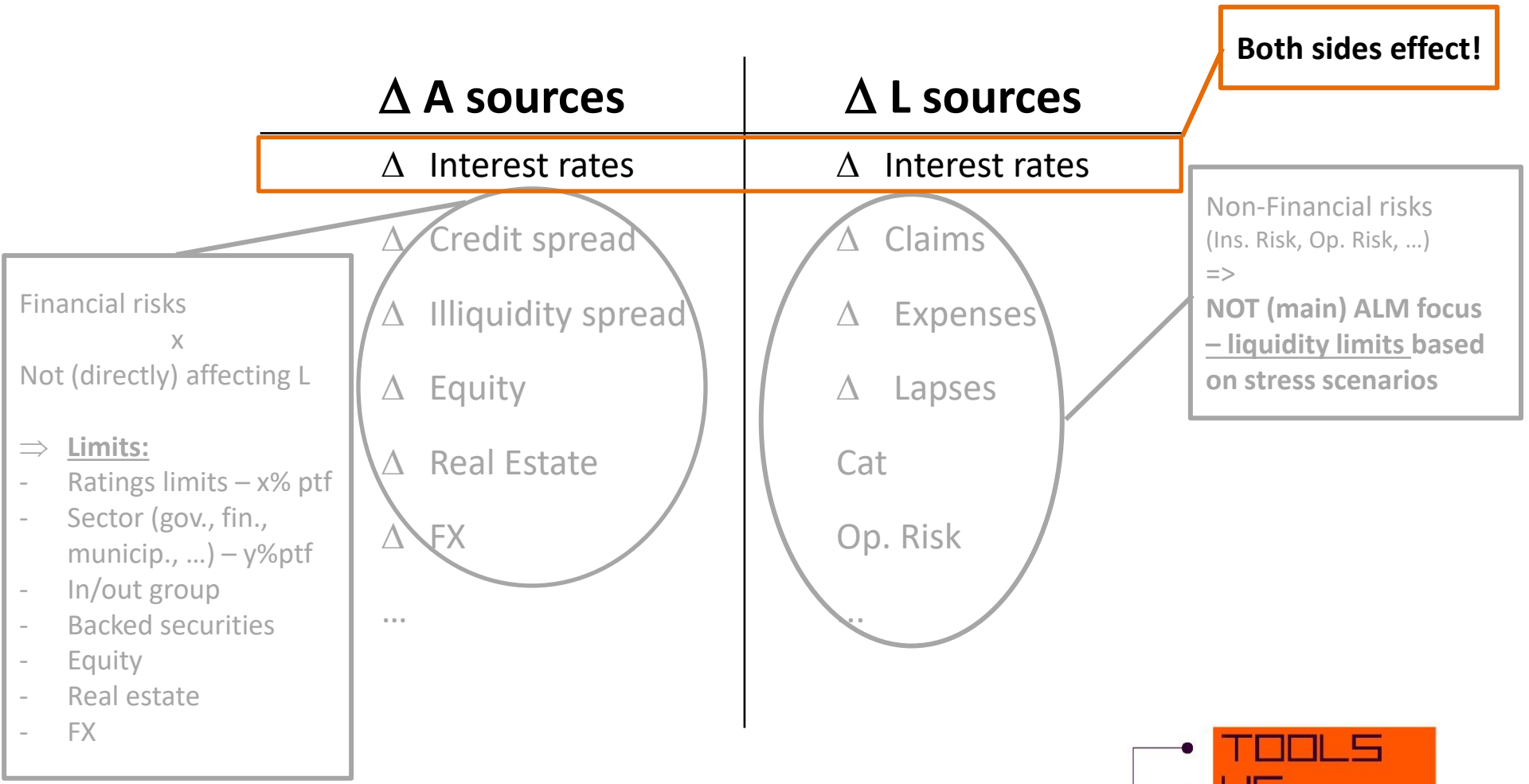
Financial risks
x
Not (directly) affecting L

⇒ **Limits:**
- Ratings limits – x% ptf
- Sector (gov., fin., municip., …) – y%ptf
- In/out group
- Backed securities
- Equity
- Real estate
- FX

Non-Financial risks
(Ins. Risk, Op. Risk, …)
=>
NOT (main) ALM focus – liquidity limits based on stress scenarios



Interest Rate Risk

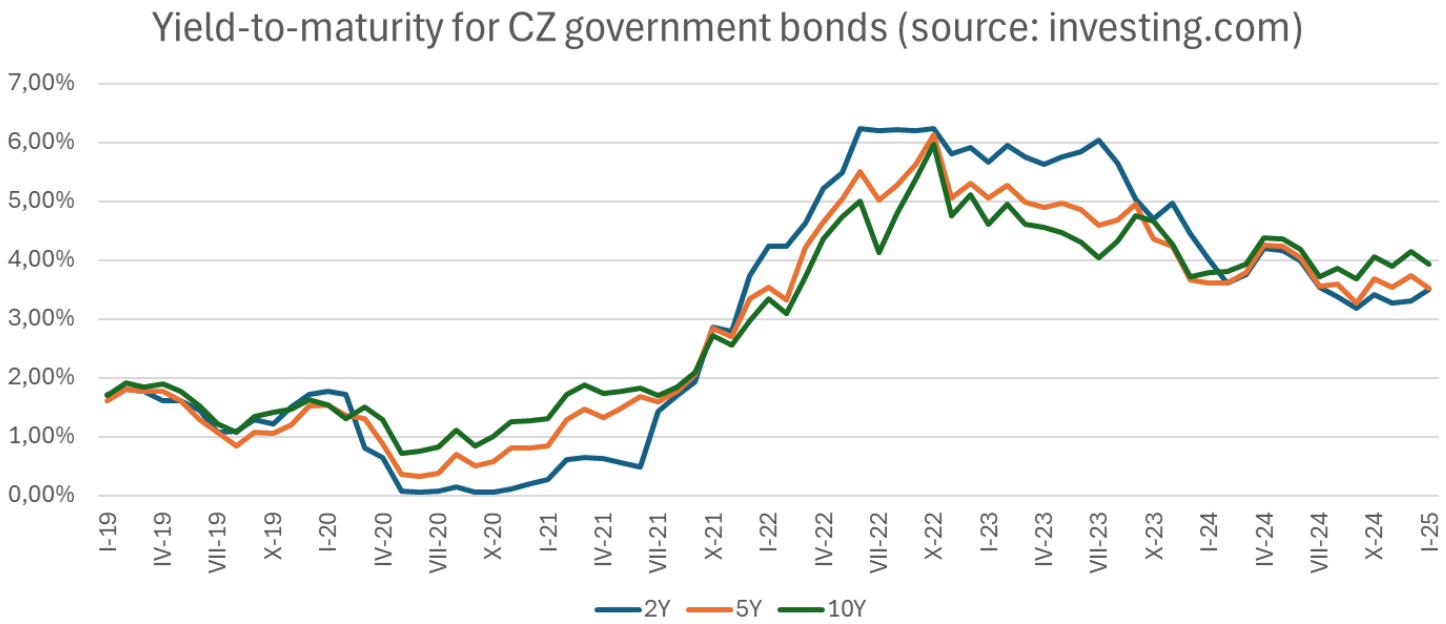


Interest Rate Risk

- Δ (Market) Interest Rates
  - Changes every day and may be significant.
  - No management possibility to affect the market
  - Δ i ➔
    - Δ A ➔ mainly Δ MV bonds (*i* ↑ => MV↓ and vice versa)
    - Δ L ➔ mainly Δ Fair Value (=MV) liabilities
      - discounting
      - profit sharing

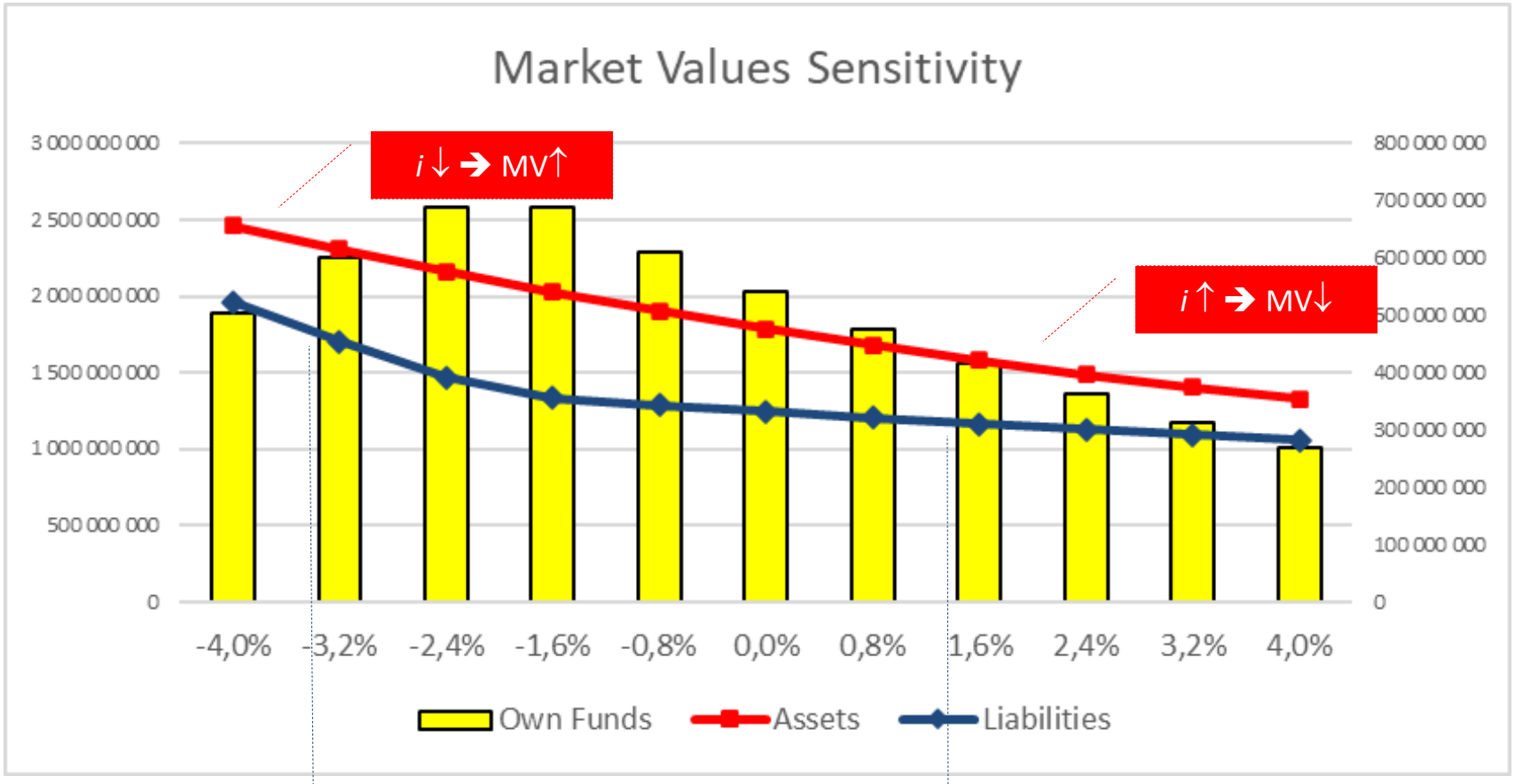
- Yield curve example: Government Bonds - Investing.com

Volatility of interest rates



Maturity	2019	2020	2021	2022	2023	SII Shock Down	SII Shock Up
2Y	3%	-85%	1 504%	34%	-29%	-65%	70%
5Y	-4%	-46%	321%	43%	-28%	-46%	55%
10Y	-10%	-15%	156%	38%	-18%	-31%	42%

Value Management – Life With-Profit products



CF guar. (no PSh)
i ↓ (discount) ➔ FVL ↑

i ↑ discount➔ FVL ↓
CF with PSh➔(*i* ↑ ➔ CF↑) ➔ FVL↑

Possible Solutions – Life With-Profit products

- Buy „similar“ option
  - Buy interest rate option (ptf of IR options – floorlets, swaps, swaptions)
    - ☺ Best hedge
    - ☹ Illiquid
    - ☹ Expensive
    - ☹ Overwhelmed asset management back office (lots of transactions and open positions)
    - ☹ FVTPL ➔ P&L volatility (unless hedge accounting), unwanted taxation

- Change in assets duration (dynamically)
  - ☺ Good hedge for smaller YC shifts
  - ☹ Transaction costs
  - ☹ Capital gains realization ➔ (unwanted) P&L volatility / taxation
  - ☹ Future investment returns may be deteriorated

Practical Notes to Duration

- **Effective duration** (mathematically 1st derivative)
  - applied for both A and L
  - preferred measure of MV sensitivity on interest rates changes
  - numerical calculation is usually used

$$D = -\frac{1}{MV(0)}\frac{MV(+\Delta i)-MV(-\Delta i)}{2\cdot\Delta i} = -\frac{1}{MV(0)}\cdot\lim_{i\to 0}\frac{dMV(i)}{di}$$

  - MV is present value of $CF_t = f(i_1, i_2, \dots, i_t)$, where vector $i_1, i_2, \dots, i_t$ represents term structure of interest rates (yield curve) which can take different shapes. Cash flow in general can be dependent on the yield curve (e.g. life with-profit products)

Practical Notes to Duration

- Note, that in reality
  - the yield curve is **not flat** ⊘ modified / Macaulay durations are by definition calculated using one specific **flat rate** – YtM
  - future **cash flow** $CF_t = f(i_1, i_2, \dots, i_t)$ may **depend on market yield curve** ⊘ modified / Macaulay durations assume independent CF_t

$$MV = \sum_{t=1}^{T} \frac{CF_t}{(1+YtM)^t}$$

$$D_{mod} = -\frac{1}{MV}\frac{dMV(YtM)}{dYtM} = \frac{1}{MV} \cdot \sum_{t=1}^{T} \frac{t \cdot CF_t}{(1+YtM)^{t+1}} = \frac{D_{Mac}}{1+YtM}$$

$$D_{Mac} = \frac{\sum_{t=1}^{T} \frac{t \cdot CF_t}{(1+YtM)^t}}{MV} = \frac{\sum_{t=1}^{T} \frac{t \cdot CF_t}{(1+YtM)^t}}{\sum_{t=1}^{T} \frac{CF_t}{(1+YtM)^t}}$$ … average time to maturity

  - Effective duration, in general, does **not** have the **average time to maturity** interpretation. (only in very specific conditions)
  - In the following, we will use the term duration to mean effective duration

Life With-Profit products

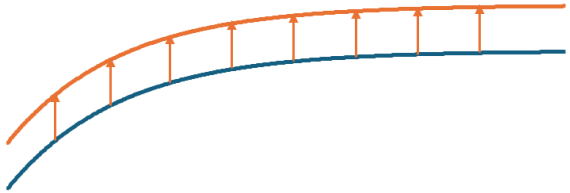
- Durations

Δ interest rate	*Assets*	*Liabilities*	*Duration gap*
-3,2%	**8,23**	**17,96**	**-9,73**
-2,4%	**8,11**	**15,71**	**-7,61**
-1,6%	**7,99**	**8,45**	**-0,46**
-0,8%	**7,87**	**4,35**	**3,52**
0,0%	**7,75**	**4,28**	**3,47**
0,8%	**7,63**	**4,22**	**3,42**
1,6%	**7,52**	**4,15**	**3,36**
2,4%	**7,40**	**4,09**	**3,31**
3,2%	**7,29**	**4,04**	**3,25**

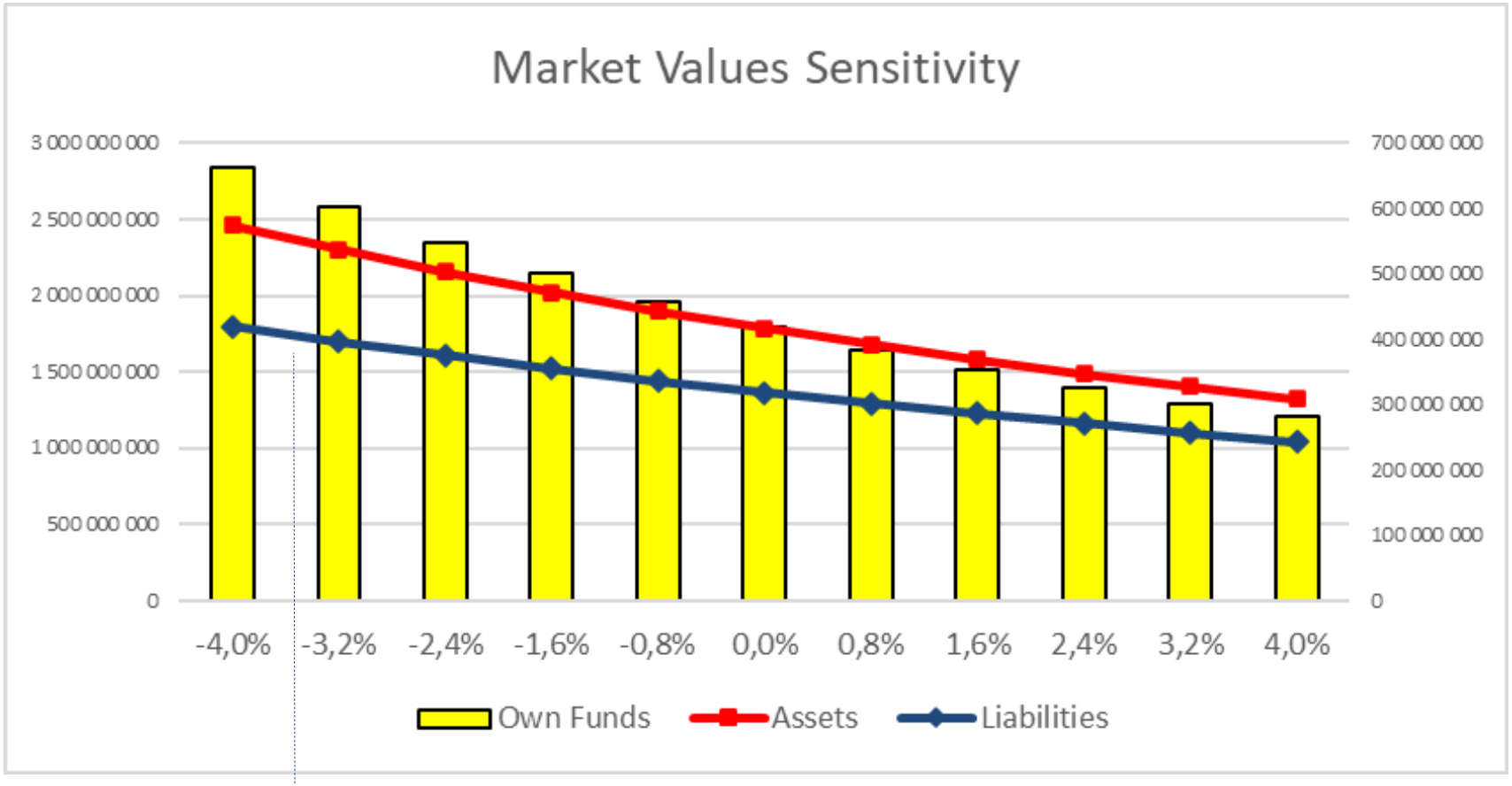
Life With Profit-share

- Limits
  - Duration gap
    - $|D_A - D_L| < limit$
    - Relative changes matching (in % of the MV)
  - Basis Point Value (BPV) or Dollar Duration gap
    - $BPV = MV(i + 0.5bps) - MV(i - 0.5bps) = D \cdot MV \cdot 1bps$
    - Absolute changes matching $|BPV_A - BPV_L| < limit$
  - Other interest rate sensitivity measures:
    - Partial duration: $PD_k = -\frac{MV(i_1,i_2,\dots,i_k+\Delta\boldsymbol{i},\dots,i_n)-MV(i_1,i_2,\dots,i_k-\Delta\boldsymbol{i},\dots,i_n)}{2\cdot\Delta i\cdot MV(i_1,i_2,\dots,i_k,\dots,i_n)}$
    - Key Rate Sensitivity:
      $KRS_k = MV(i_1, i_2, \dots, i_k + 0.5bps, \dots, i_n) - MV(i_1, i_2, \dots, i_k - 0.5bps, \dots, i_n)$

  Specific scenario testing
    - NY7 (2x2 parallel shifts up/down, steepening, flattening, inversion)
    - MDS (Modern Deterministic Scenarios by SoA)
    - NAIC scenarios
    - Internally defined scenarios (crisis 2008, covid-19, SII stress tests, …)



Life Risk products



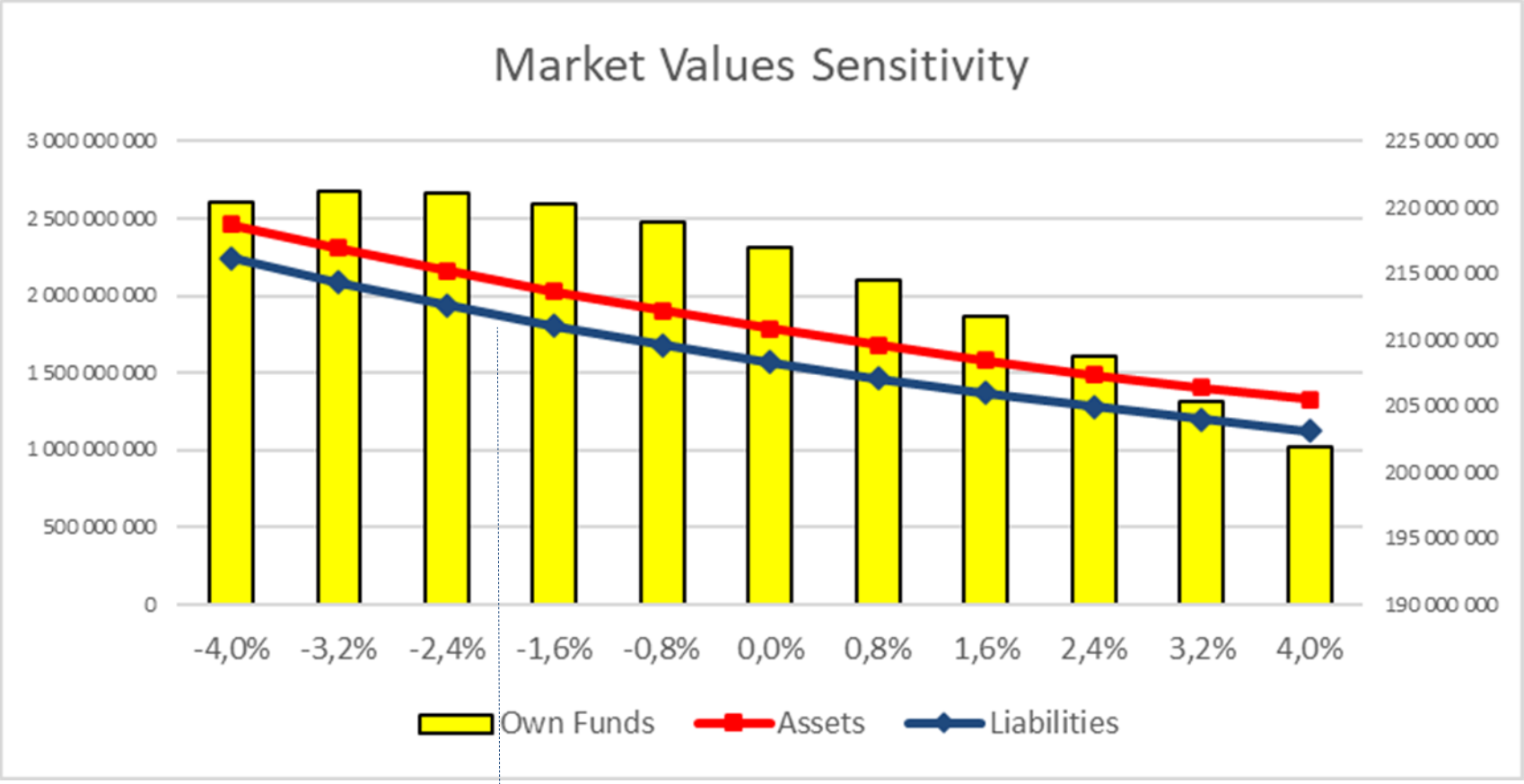
fixed CF
i ↓ (discount) ➔ FVL ↑

Life Risk products

- Durations

Δ interest rate	*Assets*	*Liabilities*	*Duration gap*
-3,2%	**8,23**	**6,91**	**1,31**
-2,4%	**8,11**	**6,88**	**1,23**
-1,6%	**7,99**	**6,84**	**1,14**
-0,8%	**7,87**	**6,81**	**1,06**
0,0%	**7,75**	**6,79**	**0,96**
0,8%	**7,64**	**6,77**	**0,87**
1,6%	**7,52**	**6,75**	**0,77**
2,4%	**7,40**	**6,74**	**0,67**
3,2%	**7,29**	**6,73**	**0,56**

Unit-linked products



discount rates are offset by investment return ➔ FVL const.

Value Management summary

- Life with profit share:
  - Liability = IR option, CF is depending on *i*
  - Dynamical management of investment YC sensitivity (duration, BPV, …) + limits
- Life w/o profit share (pure risk):
  - No IR option = CF is fixed (i.e. not depending on *i*)
  - => similar behaviour as bonds => possible to be matched by bonds
  - OF volatility given by the other drivers than interest rates (insurance risk, op. risk, …)
- Unit-linked
  - U-L fund (replicable) – matched perfectly by the investment strategy chosen by the policyholder
  - Non-replicable (fees, costs) – similar to Life without PSh

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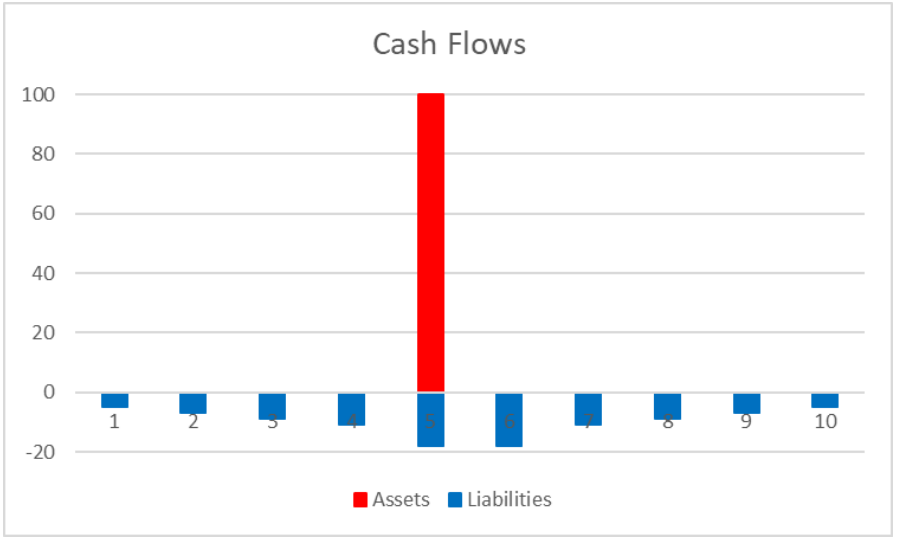
Cash flow management

- Up to now – mgt. of immediate ΔA and ΔL
- Illustrative company situation



  - *i* = 0% flat
  - Assets: 100 pcs of ZC Gov. Bond, 1 unit nominal each, TtM=5Y, $D_A = 5$
  - MVA = MVL = 100; $D_A = D_L = 5$ ➔ Duration gap = 0;

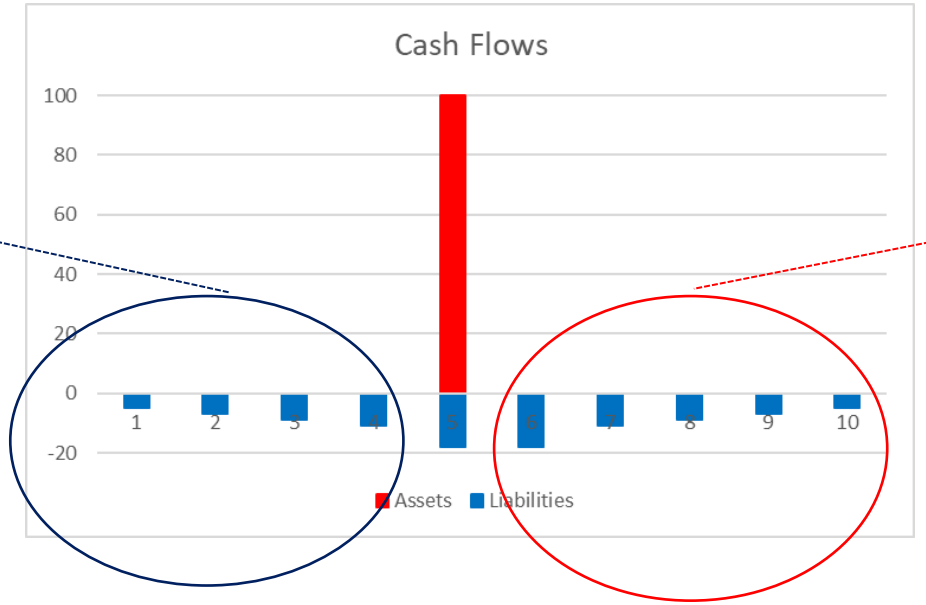
  => we are OK…

- Are we really OK?

Reinvestment Risk

What is the risk?

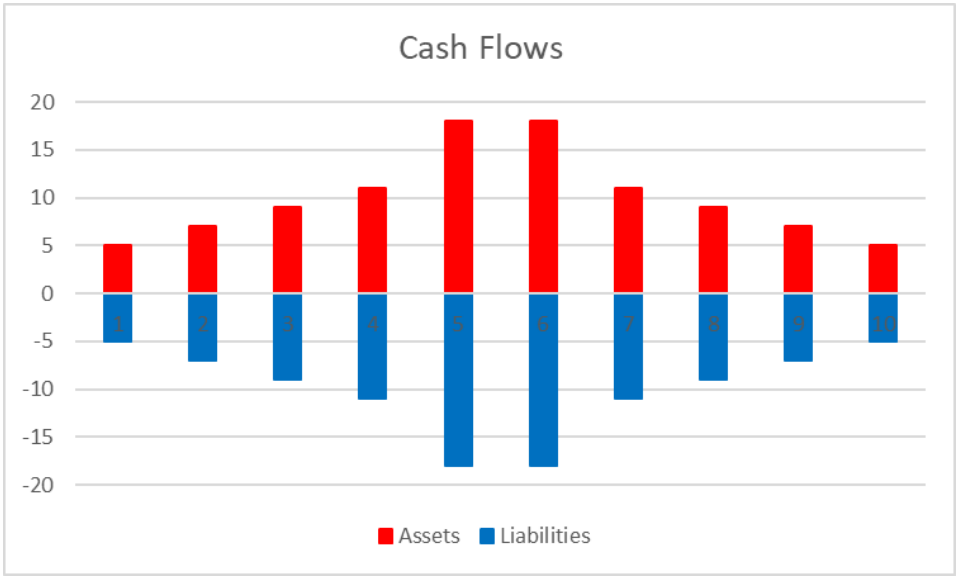
- Several pcs of the GBs will have to be **sold** in 1-5Y.
- **Risk:**
  Future MVs will be **low** ➔ **More** than 50 pcs needs to **be sold**.



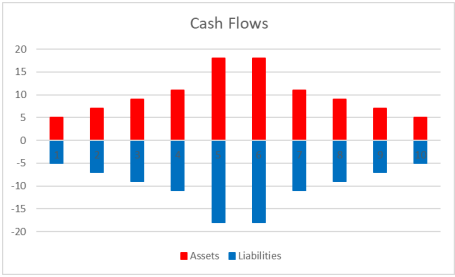
- Reinvestment of the GB after 5Y.
- **Risk:**
  Future MVs will be **high** ➔ Not **enought value** will be obtained from the reinvestment to cover the remaining liabilities.

Objective

- Objective:



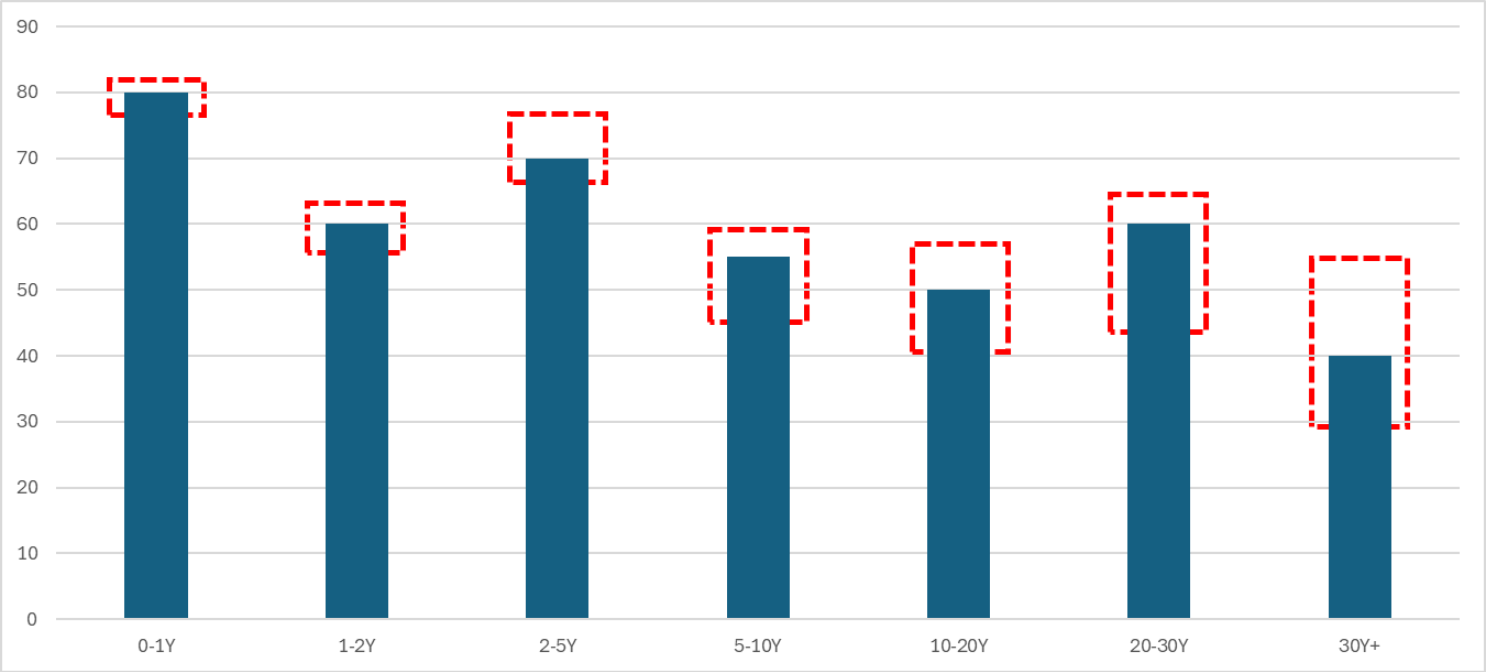
Practical Limitation



- Practical Limitations:
  - Availability of relevant financial instruments
    - Every year
    - Long-term
    - Státní ČR - Patria.cz
  - Insurance liability cash flow volatility
    - Insurance risk
      - risk (e.g. the occurrence of a major bodily injury at MTPL and the resulting liability (RBNS) in the form of an life annuity)
      - uncertainty (e.g. change in lapse parameters in the future – we do not know the probability that the lapse rates will increase/decrease against current estimates)
    - Operational risk
    - Profit sharing
    - …

Solutions

- Limits:
  - Cash flow gaps
    - Usually in buckets (e.g. 0-1Y, 1-2Y, 2-5Y, 5-10Y, 10-20Y, 20-30Y, 30Y+)
    - Stricter on short end



Other Limits

- Main objective:
  - Diversification
  - Avoid unwanted extreme risk positions (according to risk appetite)
- Ratings limits (AAA, AA, A, BBB, NR) – % ptf
- Single name concentrations – % ptf
- Sector (govies, fin. institutions, munic., supranat., …) – % ptf
- Regional (EU, USA, Asia, BRICS, …) – % ptf
- In/out group – % ptf
- Backed securities – % ptf
- Equity, real estate – VaR, RORAC, % ptf
- Illiquid assets – % ptf
- FX – usually limit~0

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Other Balance Sheets (1)

- **Market Consistent Balance Sheet**
  - Market values of assets are in line with observable market prices = market consistent
  - Market/Fair value of liabilities are set by market techniques without any adjustments (e.g. no contract boundaries, market discount curves, etc.)
  - ALM actions might have different (adverse?) impact on the other reporting standards (SII, IFRS)

Suitable for mitigation of volatilities of **market values** of assets and liabilities => **managing market value of the Company.**

  - ALM techniques:
    - Value management
    - Cash flow management
    - ALM in line with Capital management and Capital efficiency management

Other Balance Sheets (2)

- **Regulatory (Solvency II) Balance Sheet**
  - Balance Sheet under Solvency II, **Pillar I**
  - Market values of assets are in line with observable market prices
  - Market/Fair value of liabilities are set by the Standard:
    - Technical provision is a present value of future (liability) cash flows and risk margin
    - Unilateral right of (re)insurer to terminate, reject or amend premiums or benefits is exercised (applied contract boundaries)
    - Discount curve is constructed according to EIOPA regulations (use of UFR, VA)

Managing Solvency Own funds, SCR => **Solvency ratio.**

  - ALM techniques:
    - Value management
    - ALM in line with Capital management and Capital efficiency management

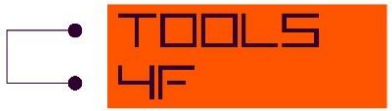
Other Balance Sheets (3)

- **Reporting Balance Sheet**
  - Balance Sheet under IFRS9 and IFRS17
  - Value of A and L according to the Standard – not generally consistent with their market values
    - A – amortised costs, market value (FVTPL, FVTOCI)
    - L – GMM without OCI, GMM with OCI, VFA
      - value of liabilities contains present value of future cash flows, risk adjustment for non-financial risks and contractual service margin
        - Cash flow is within contract boundaries, i.e. till the time when the entity has a practical ability to reassess the risks of policyholders or the portfolio of contracts and, as a result, can set a price or level of benefits that fully reflects those risks
        - Cash flows relating to costs that cannot be directly attributed to insurance contracts are excluded
        - Risk adjustment is different from risk margin
  - Income Statement is usually the main focus, rather than the Balance Sheet
  - Impact on Company's profit, dividend, tax, etc.

Managing the **Income Statement.**

- ALM techniques depend on A and L account. classification

Thank you for your attention!



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