Solvency Testing for an Insurance Company: A glance at the future of ALM

KPMG Seminar

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Contents

Traffic-light model, FTK and Solvency II

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- New European Solvency II regulation for insurance companies is expected around 2010 / 2011 based on trends such as
  - 1. Total balance sheet approach
  - 2. Economic or market value
  - 3. Value at Risk (VaR) approach to determine capital requirements
  - 4. Wide range of risks
  - 5. Capital requirements based on a confidence level on a one year basis
  - 6. Standard versus internal models

- In the perspective of Solvency II, in various countries additional reporting models have been and are being developed such as
  - Swedish Traffic-light model (and new solvency regulation as of 2008)
  - Dutch Financieel ToetsingsKader (FTK)
  - Danish model, UK-FSA model, Swiss Solvency Test (SST), etc.

Traffic-light model, FTK and Solvency II

- Many of these reporting models satisfy the Solvency II trends.
  - Specially, the Traffic-light model and the FTK show strong similarities.

- In this casus we will apply the FTK for insurance companies as an important example of Solvency II and explore ALM consequences.
  - *Dutch regulating authority (DNB):* “The contours of Solvency II correspond to the foundations of the FTK”
  - All calculations done in ORTEC Assets & Liabilities Scenario model (ALS) for insurance companies

- Status FTK in the Netherlands
  - Officially in place (by law) for pension funds as of 01-01-2007
  - Postponed for an indefinite time for insurance companies, awaiting Solvency II and partially also IFRS 4 (valuation of insurance contracts)
  - Nevertheless, regulator can ask (and asks) for FTK results for additional information on true financial and risk position of insurance companies

Traditional balance sheet

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ASSETS				LIABILITIES			
Investments (market value)			1,160,000,000	Surplus			160,000,000
Equities	232,000,000	20%					
Fixed Income	812,000,000	70%		Mathematical reserve (book value)			1,000,000,000
Real Estate	116,000,000	10%		With profits	750,000,000	75%	
				Without profits	250,000,000	25%	
Total			1,160,000,000	**Total**			1,160,000,000

- *Funding ratio end 2005: 116% (400% of legally required solvency)*
- Liabilities pay funeral costs, regular premium paying policies
- Profit sharing
  - Insured amount (funeral costs) increases every year with profit sharing
  - Max(10 year moving average "u-rendement" – 3%, 0)
- Fixed income
  - Duration 4 (Note: 70% x 4 ≈ 3 for total assets)

Valuation of liabilities

- “Market value = Best estimate value + Market Value Margin”
  - MVM is additional charge for unhedgable risk
  - “Mark-to-model” versus “Mark-to-market” approach

- 1. Discount best estimate cash flows with appropriate yield curve
  - Best estimate projections current liabilities with an horizon of 100 years
  - Guaranteed payouts and premiums: Nominal zero coupon yield curve
  - Costs: Real zero coupon yield curve (assumed increase price inflation)
  - Nominal Euro (swap) and real Euro zero coupon curve end 2005

- 2. Market value of profit sharing
  - Because of asymmetric payoff this is an Embedded Option
  - Needs be valued by using option valuation techniques

- 3. Market Value Margin (according to FTK)

Valuation of profit sharing

- Because
  - Precise value is required and
  - Complexity due to increasing insured amount instead of annual payout

  valuation based on risk neutral Monte Carlo simulation techniques.

- Approach
  - 1-factor Hull-White interest rate model
  - “u-rendement” approximated as 7-year par swap rate (max correlation)
  - Model parameters calibrated on market prices of swaptions
  - Short, medium and long term options on 7 year swap rate end 2005
  - Optimal parameters: mean reversion **0.0257** and volatility **0.72%**

- Note: Fast closed form approximations are also used which have been tested against the Monte Carlo results.

Option values - Shocks

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	Intrinsic	Volatility value	Total	Std error
Basic (DNB 31-12-05)	190,702,199	30,565,726	$\boxed{221,267,926}$	0.6%
Rates up	272,038,284	8,222,961	280,261,245	0.4%
Rates down	92,959,781	76,870,854	169,830,634	0.9%
Volatility up	190,702,199	47,844,551	238,546,751	0.7%
Volatility down	190,702,199	15,363,531	206,065,731	0.4%

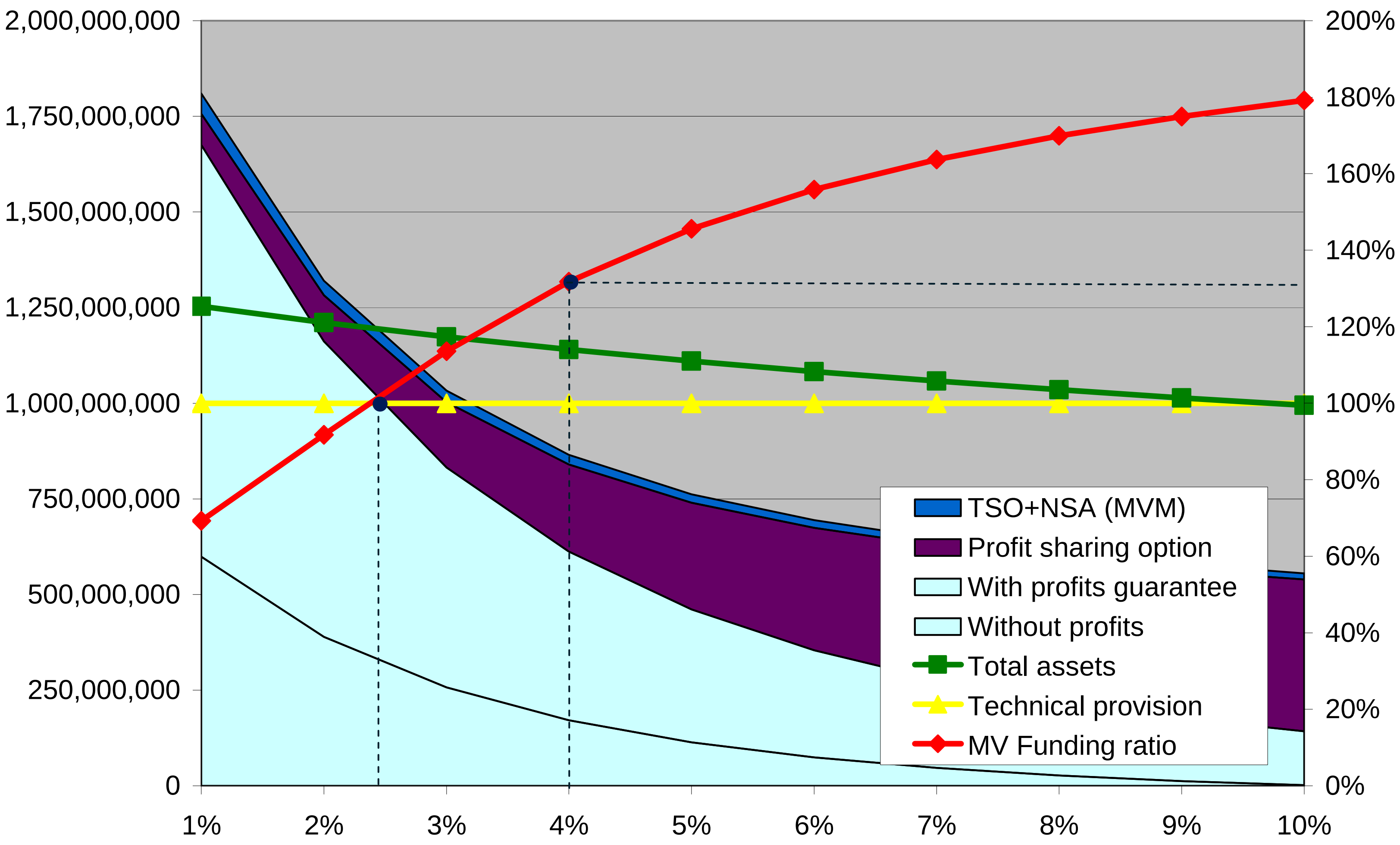
- Curve and volatility shocks according to FTK → standard solvency test
- 500 scenarios / Monte Carlo simulations with an horizon of 100 years
- Intrinsic value is value at zero volatility (requires 1 forward scenario)
- Higher / lower value at high / low interest rates (payoff at high rates)
- Higher / lower value at high / low volatility

Market value balance sheet

ASSETS				LIABILITIES			
Investments (market value)			1,160,000,000	Surplus			263,742,153
Equities	232,000,000	20%					
Fixed Income	812,000,000	70%		Market value liabilities			896,257,847
Real Estate	116,000,000	10%		With profits	687,073,771	77%	
				incl. option	221,267,926		
				Without profits	183,078,387	20%	
				TSO and NSA (MVM)	26,105,690	3%	
Total			1,160,000,000	**Total**			1,160,000,000

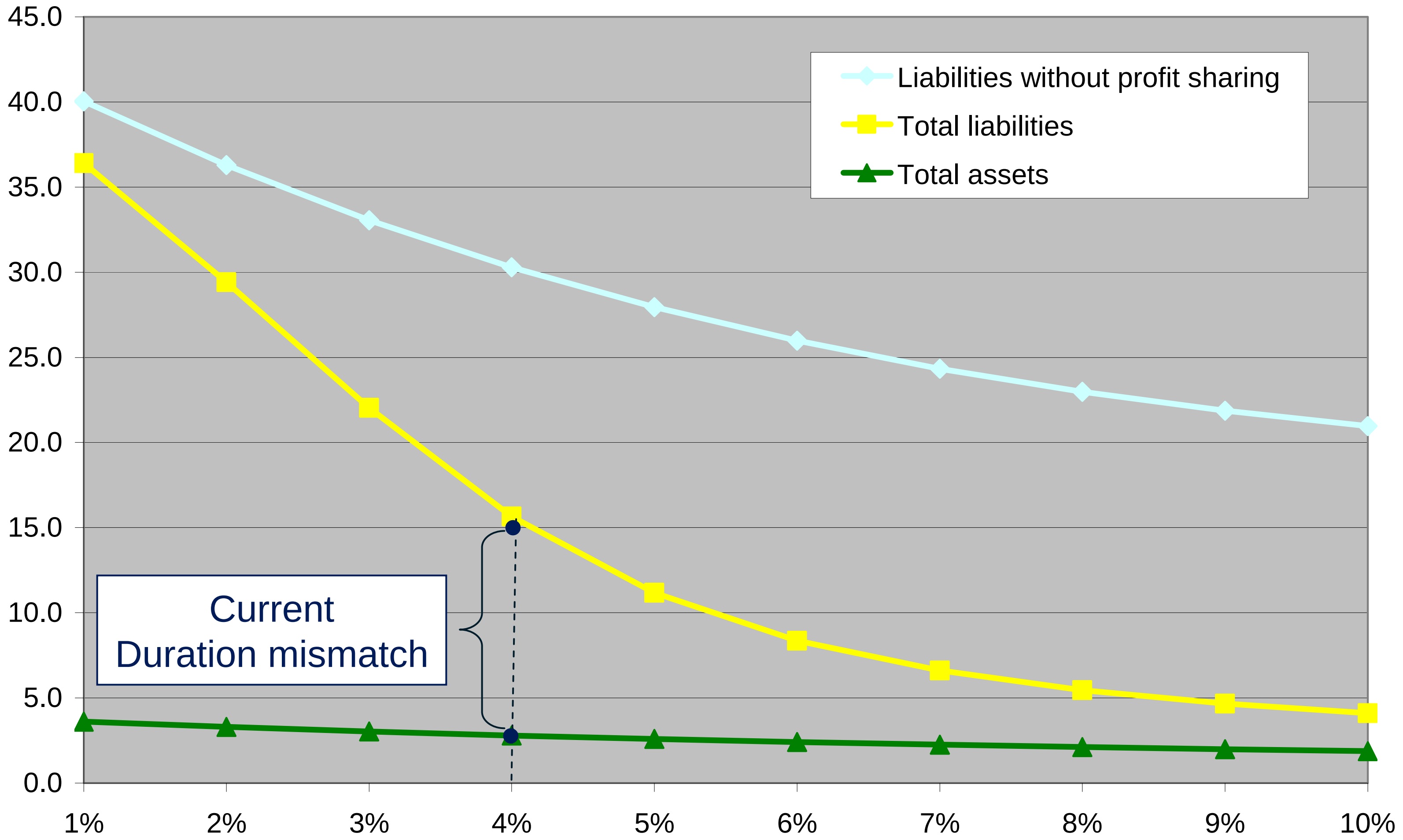
- *Funding ratio increased from 116% to 129%*
- Lower value of liabilities (in this case) because of for example
  - Lower mortality probabilities (best estimate, no prudence)
  - Interest rates above discount rate in technical provision
  - Profit in case of surrender is valued

MV funding ratio – Interest rate risk



- Liabilities strongly convex because of embedded options
- High interest rate sensitivity of funding ratio due to duration and convexity mismatch
- MV funding ratio < 100% in case of a drop in interest rates > than ± 1.5%

Duration and convexity



- Interest rate sensitivity of MV funding ratio caused by duration mismatch
- Profit sharing (option) reduces duration of liabilities
- The convexity can also be seen from the large changes in duration

Standard FTK solvency test

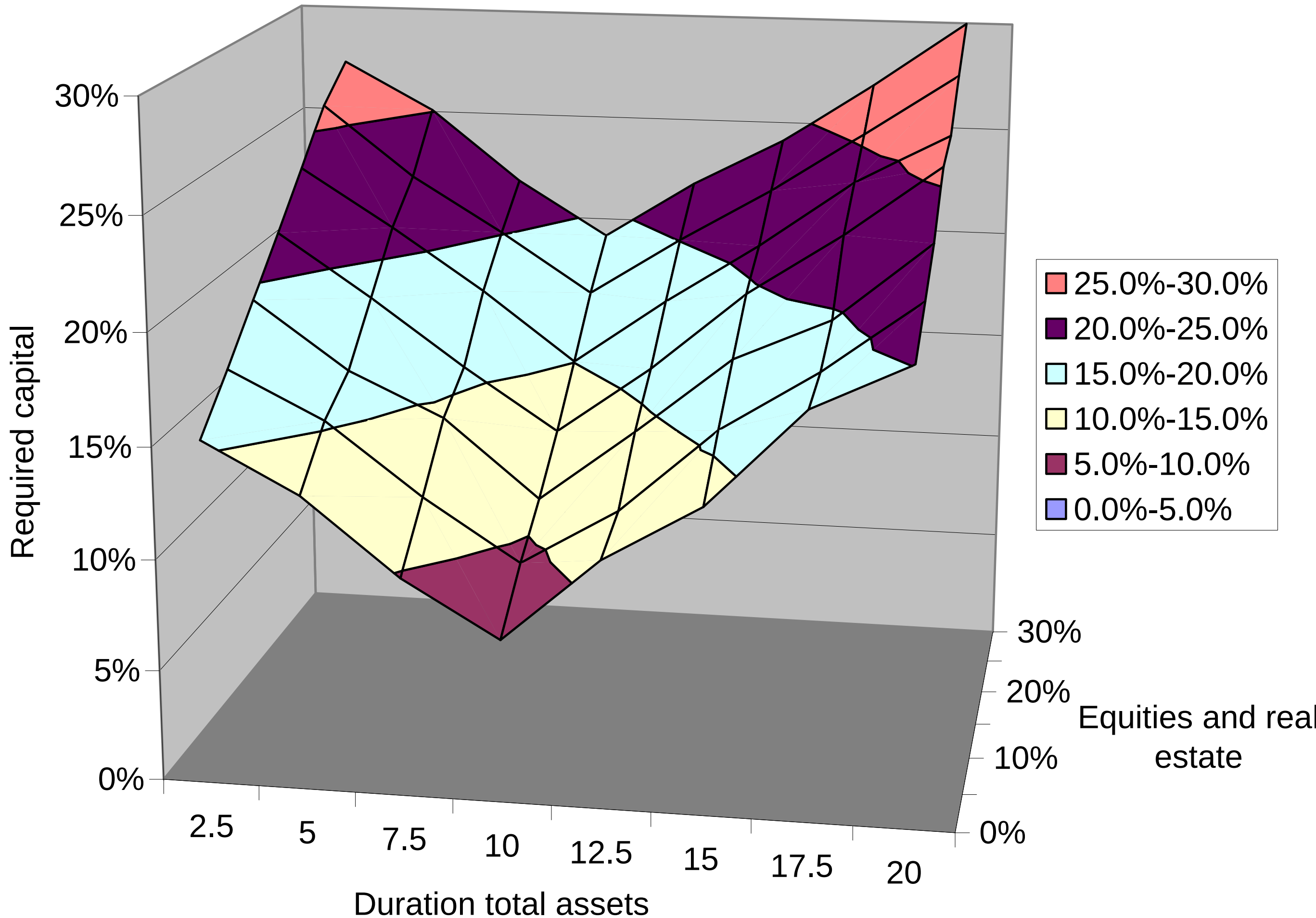
FTK solvency test	Current policy
Market value assets	1,160,000,000
Market value liabilities	896,257,847
Available capital (surplus)	29.4%
Required capital	27.2%
S1. Interest rate risk	13.7%
Volatility risk	2.0%
S2. Equity risk	12.9%
S3. Currency risk	0.0%
S4. Commodity risk	0.0%
S5. Credit risk	0.0%
S6. Technical risk	0.03%
Diversification benefit	-1.5%
Solvency ratio	108.2%

- *Solvency ratio lowered from 400% to 108%*
- FTK required capital more that 6 times the legally required capital
- So, additional available capital is required to compensate for risk
- Interest rate risk and equity risk dominate required capital
- Note: Can be (completely) different in other cases

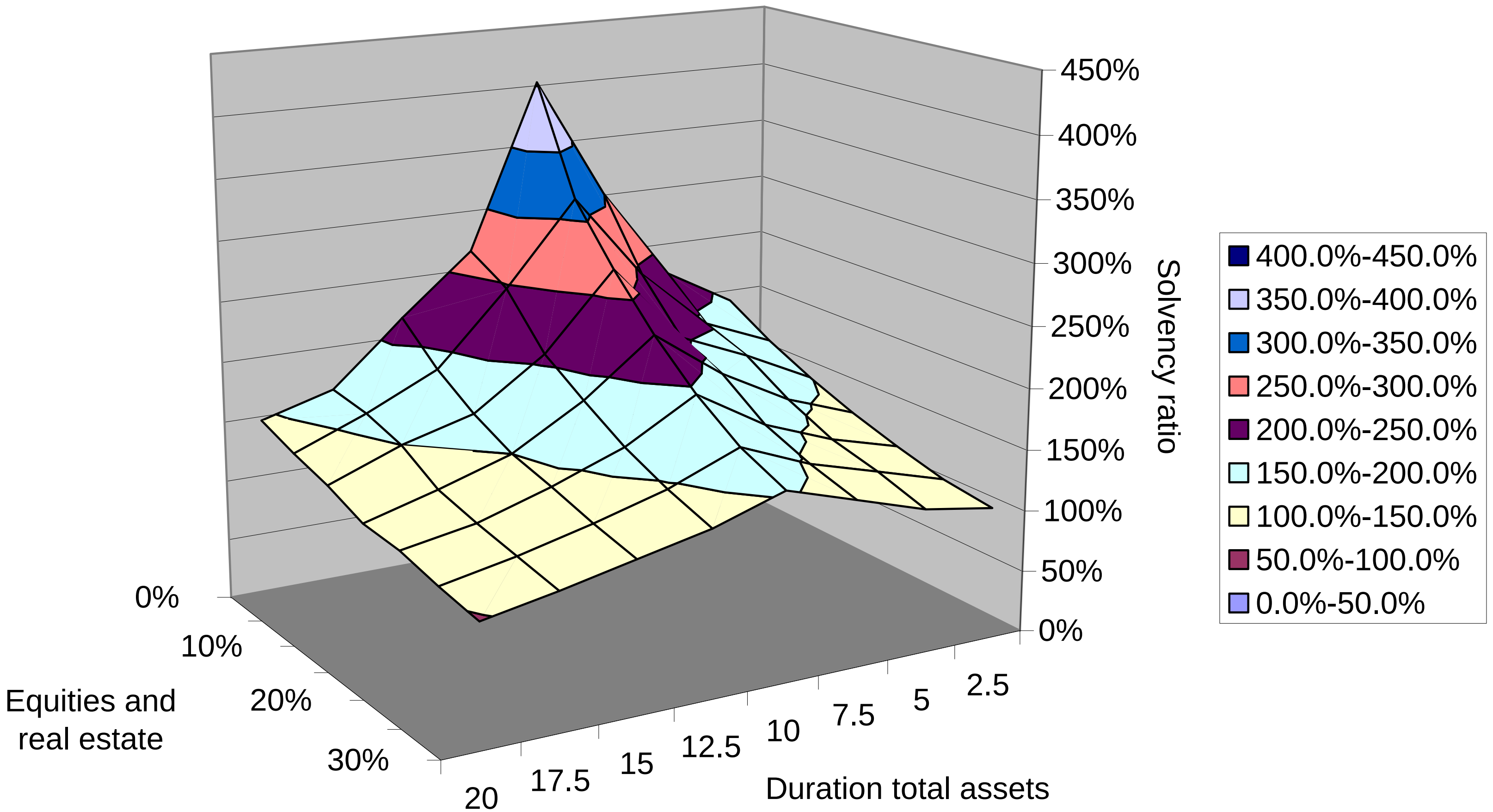
Policy effects - Static

- Vary on investment policy to see how current required capital can be reduced and thereby the solvency ratio can be improved.
- Asset allocation: 0%, 5%, 10%, … , 30% equities and real estate
- Duration total assets: 2.5, 5, 7.5, … , 20

Required FTK capital



Solvency ratio



Observations static

- Better matching is rewarded by lower required capital.
  - Reducing equities and real estate to 0% reduces the required capital.
  - The required capital is lowest at a total asset duration of 10.

- At 0% equities and “optimal” duration of 10, required capital is still around 7%, almost completely consisting of interest rate risk. *The solvency ratio has then increased from 108% back to around 400%.*
  - Asset duration 10 is an approximation of liability interest rate sensitivity

- Further matching will also reduce the expected return. Therefore, also in market consistent ALM, an optimal multi-period risk-return tradeoff is required to determine the optimal strategic policy.

  ➔ dynamic solvency testing

Policy effects - Dynamic

- Calculate risk and return of
  - Current policy
  - Alternative policies in terms of asset allocation and duration

  in stochastic dynamic ALM scenario model.

- 500 real world economic scenario's with an horizon of 10 years

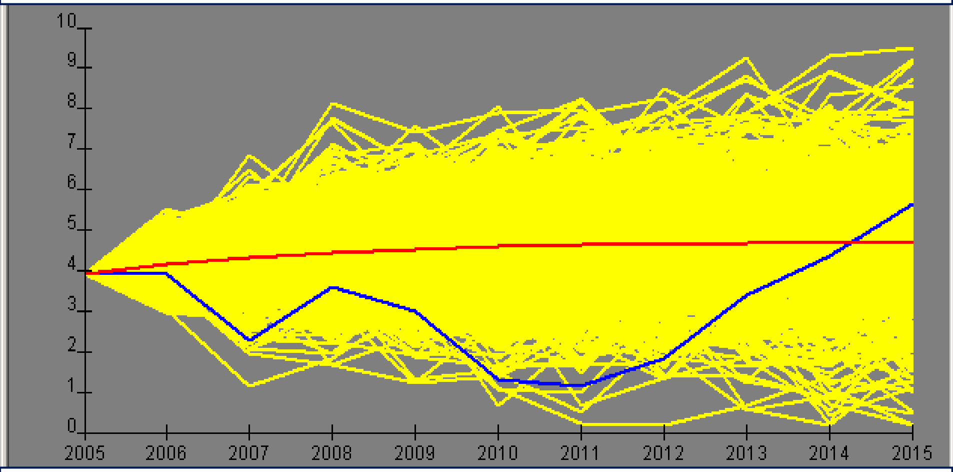
- Going concern: Including new business, taxes, dividends, etc.

- *Risk measure*: Probability of available capital < FTK required capital

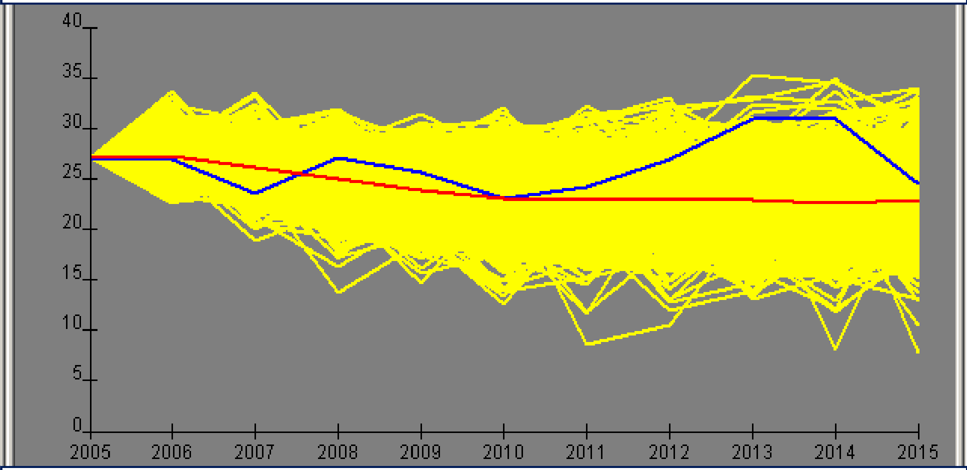
- *Return measure*: Expected MV Funding ratio at end of horizon

Current policy

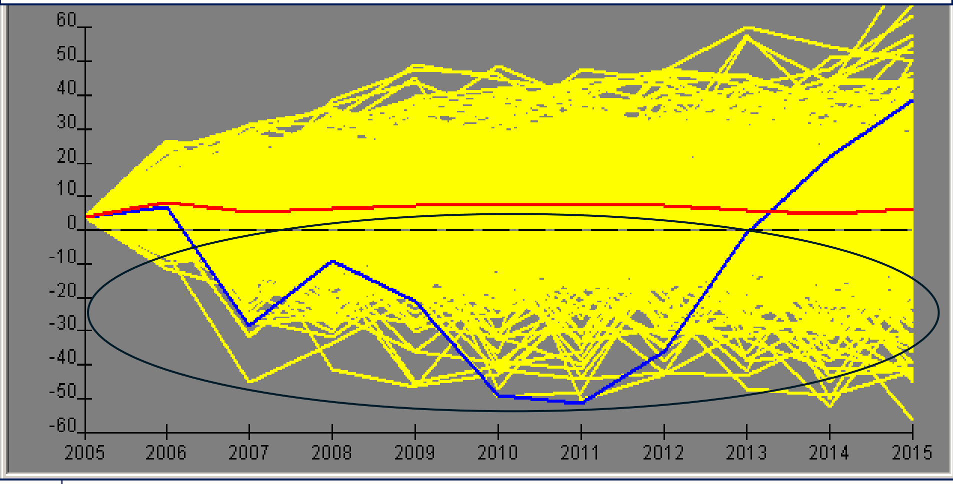
Nominal long zero interest rate (%)



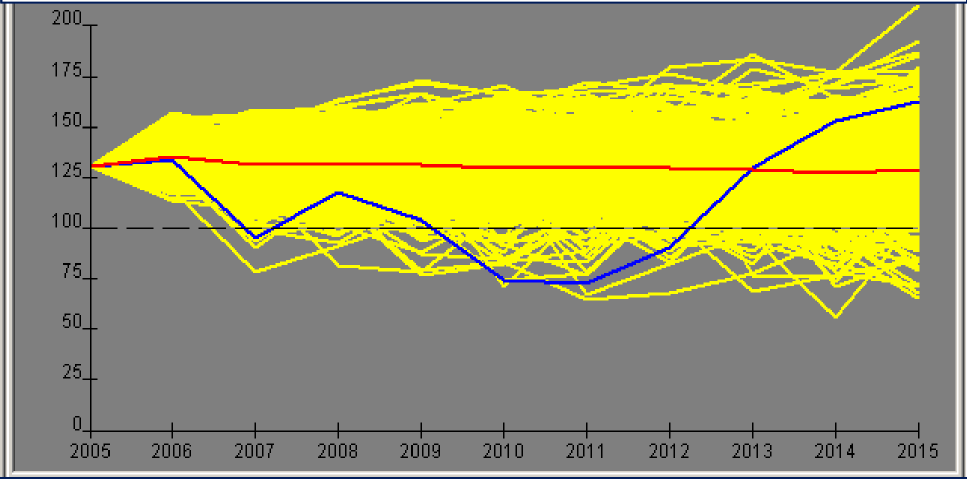
Required capital (% liabilities)



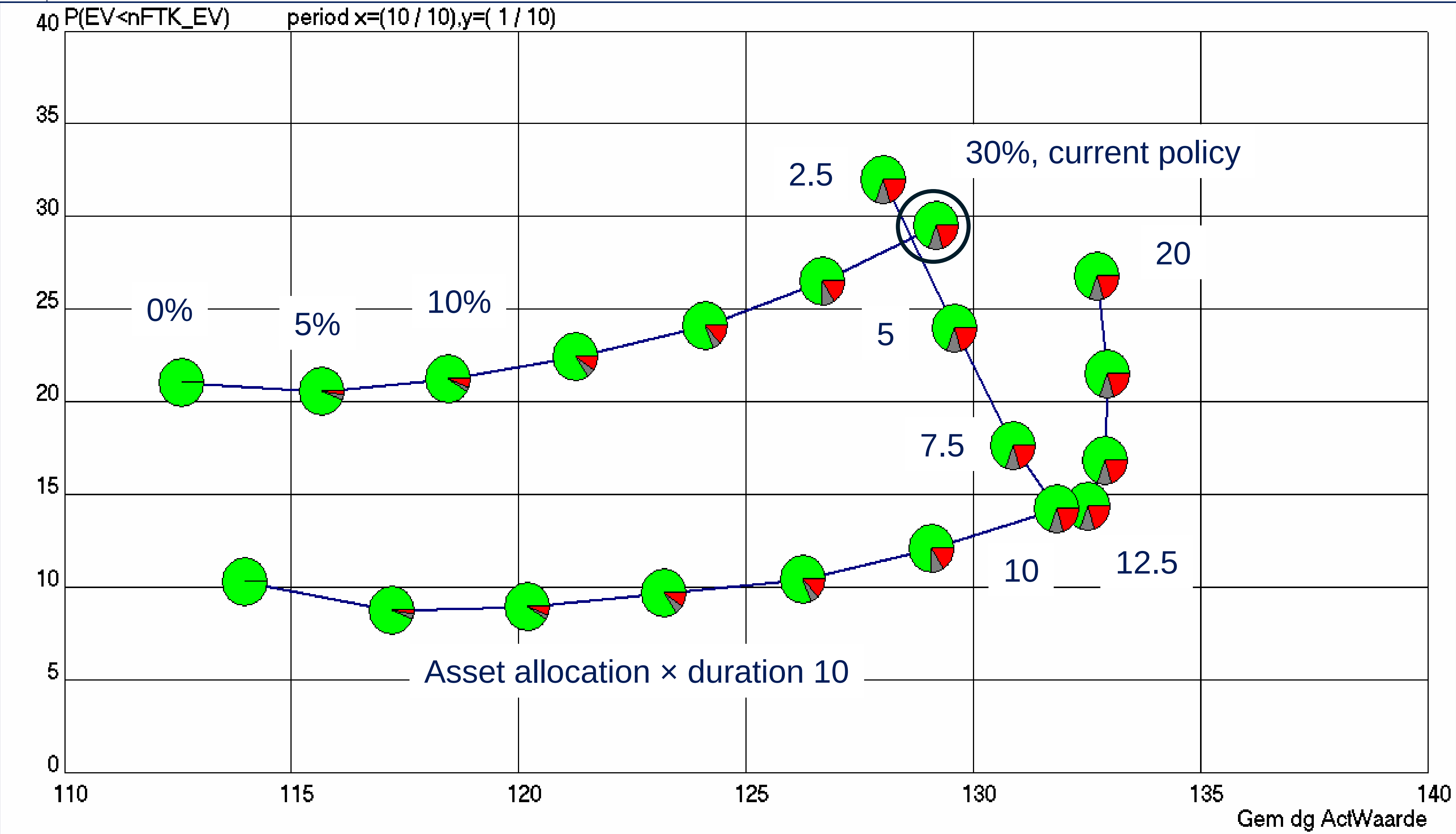
Capital shortage (% liabilities)



MV funding ratio (%)



Alternative policies



Observations dynamic - I

- Required capital is volatile (between 15% and 35% of liabilities) instead of some fixed percentage of around 4%.

- At 108%, now the solvency ratio is still (just) ok but *there is a probability of 30% that there will be (large) FTK capital shortages in the future*.
  - Especially at low interest rate levels
  - Probability of MV Funding ratio < 100% is “only” 3%

- Question: What level of confidence is required in terms of the required capital itself? This is related to
  - Minimum Capital Requirement (MCR, ultimate supervisory measures) versus Solvency Capital Requirement (SCR, absorb unforeseen losses)
  - What actions are needed in case of SCR shortages (“red light”)?

Observations dynamic - II

- Reducing equities to 0% or increasing the duration to 10 results in a similar current required capital (15% versus 19%) but latter is much more efficient (higher return / lower risk). What matters are
  - 1. The level of the <u>required</u> capital (comparable in this case)
  - 2. The level of the <u>available</u> capital
    - 2a. Expected return (better with more equities and a longer duration)
    - 2b. Correlation with required capital (better with a longer duration)

- Even at the combined “minimum risk” policy of 5% to 10% equities and a duration of 10, there is still 9% probability of a capital shortage.
  - Further risk reductions / efficiency gains are possible by using for example partial durations and swaptions.

Final notes

- Market consistent valuation of liabilities and risk based capital measurement have a broad impact on operations of insurers
  - Reporting (IFRS, MCEV)
  - Required solvency (Solvency II)
  - Internal (economic) capital allocation
  - Strategic investment policy (e.g. asset allocation and hedging risks)
  - Product design, development and pricing (e.g. of guarantees)
  - Performance measurement (e.g. risk adjusted return on capital)
  - …
- Need for adequate risk management, financial, economic, actuarial, derivative, etc. models and expertise at insurance companies will further increase
- However, in the end, all for the better of the industry