Market Consistent
Asset and Liability Management

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Market Consistent Valuation of Insurance Contracts
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Market Consistent ALM in General

Two interpretations

- 1. Market Consistent ALM =
  - Valuation of assets and liabilities at market value
  - Simulation and policy evaluation in real world scenarios
  - Search for most efficient and effective strategic policies
  - Topic of this presentation

- 2. Market Consistent ALM =
  - “Value-based ALM”
  - Calculating value / wealth transfers of policies for various stakeholders
  - Simulation and valuation using risk neutral or deflator scenarios
  - Topic of presentation Niels Kortleve

Fair value only? - I

- Past
  - Fair value irrelevant and ignored
  - Valuations based on hardly ever changed long term assumptions
  - Obviously misleading and dangerous
- Today
  - Fair value only
  - If fair value decision makers would be the CEO of Shell or BP,
    and oil prices would be $90 per barrel,
    and break even cost of new oil project would be less than $90 per barrel,
    the fair value decision maker would invest.
- Tomorrow
  - Fair value only?

Fair value only? - II

- Fair value only
  - Fair value solvency and funding ratios
  - → Fair value policy ladders
  - → Extremely volatile contributions, pensions, profits,……..

- But, we know the world is not stationary, at all
  - Investors overreact (behavioral finance)
  - Speculators have enormous impact on the markets (e.g. oil price)
  - Agents frequently are not free in their decision making
    e.g. suppose interest rates drop
  - → Pension funds and insurance companies see their risk budgets shrink,
  - → as a result, will further decrease interest rate sensitivity
  - → as a result, interest rates will further decrease
  - …….

Fair value only? - III

- Rex Tillerson (CEO ExxonMobil)
  - "*It is for people difficult to accept that the oil price of today is irrelevant for the discussion about a project which comes to life 15 or 20 years from today*"
  - Note: duration pension liabilities 15 to 20 years
- Ambachtsheer
  - "*The challenge with both sets of rules is to strike the proper balance between reflecting market-value based realities, and dampening volatility which represents noise rather than signal*"
- Head
  - "*The adoption of a market value leads to volatile funding levels (unless assets and liabilities are closely matched) and volatile contribution requirements (unless long-term assumptions are used or smoothing is applied).*

    The holy grail of an objective methodology and smooth rules is unattainable. Some compromise will still be required"

Fair value only? - The holy grail

First (simple) ideas about the holy grail

- Determine two solvency or funded ratios
  - One based on fair value ← "short term depth meter"
  - One on prudent long term assumptions ← "long term radar"
- Pension funds, insurance companies, etc.
  - Not only specify long term risk constraints (e.g. FTK 2.5% "long term risk limit") but (maybe even more important) short term risk constraints as well
  - Short- and long term risk constraints determine relative importance of
    - long term radar to efficiently realize long term goals
    - short term fair value depth meter to prevent sinking
- Short term risk might be the most important long term risk, but a complete domination of the long term by the short term might be unnecessarily costly

Market Consistent ALM for Insurance Companies

FTK versus Solvency II

- 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

- Although the Dutch FTK for insurance companies has been postponed, in this casus we will regard it as an important example of Solvency II and explore some ALM consequences.
  - *DNB kwartaalbericht September 2005*: “De contouren van Solvency II komen overeen met de grondslagen van het FTK.”

Traditional balance sheet

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

- “Actuele waarde = Verwachtingswaarde + marktconforme opslag“
  - “Market value = Best estimate cashflows + MVM”
  - Mark-to-model” versus “Mark-to-market” approach
- Discount best estimate cashflows 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 (DNB) and real Euro zero coupon curve end 2005
- Plus market value of future profit sharing

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
  - 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

	Intrinsic	Volatility value	Total	Std error
Basic (DNB 31-12-05)	190,702,199	30,565,726	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%

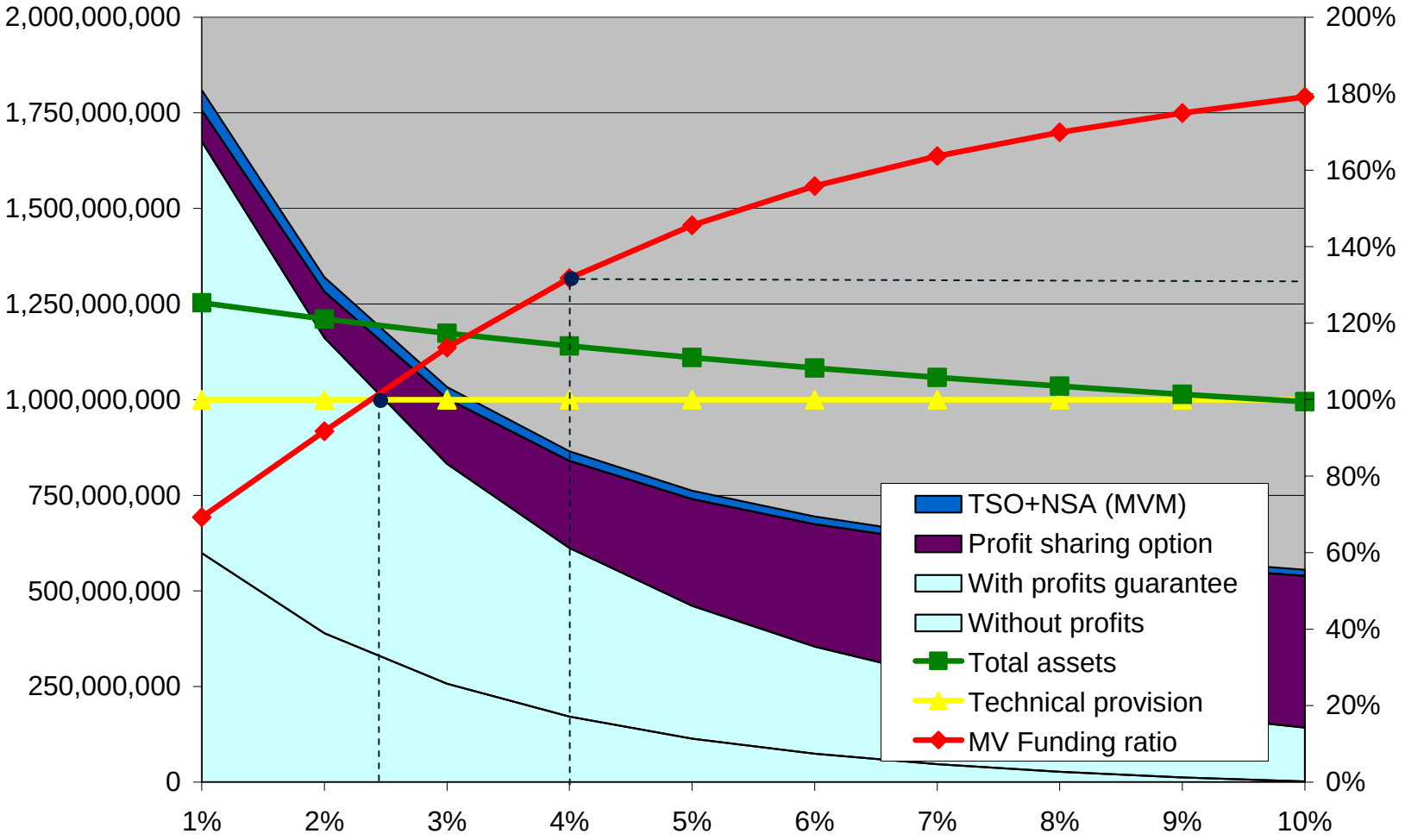
- Curve and volatility shocks according to FTK ➔ standard solvency test
- 500 scenarios / Monte Carlo simulations with an horizon of 100 years
- Intrinsic value is value at zero volatility (requires 1 forward scenario)
- Higher / lower value at high / low interest rates (payoff at high rates)
- Higher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

Standard FTK solvency test

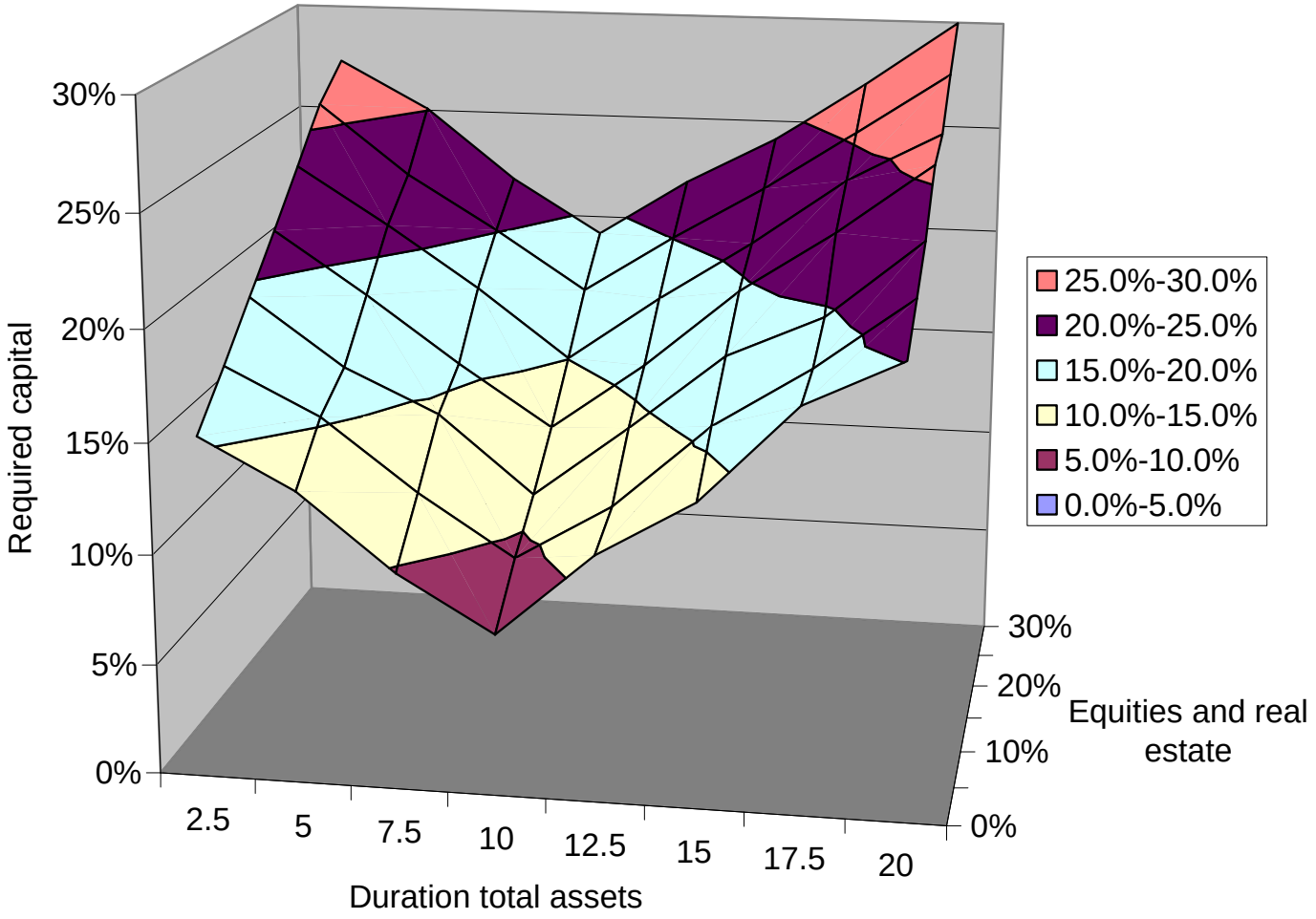
FTK solvency test	Current policy
Market value assets	1,160,000,000
Market value liabilities	896,257,847
Available capital (surplus)	29.4%
Required capital	27.2%
S1. Interest rate risk	13.7%
Volatility risk	2.0%
S2. Equity risk	12.9%
S3. Currency risk	0.0%
S4. Commodity risk	0.0%
S5. Credit risk	0.0%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

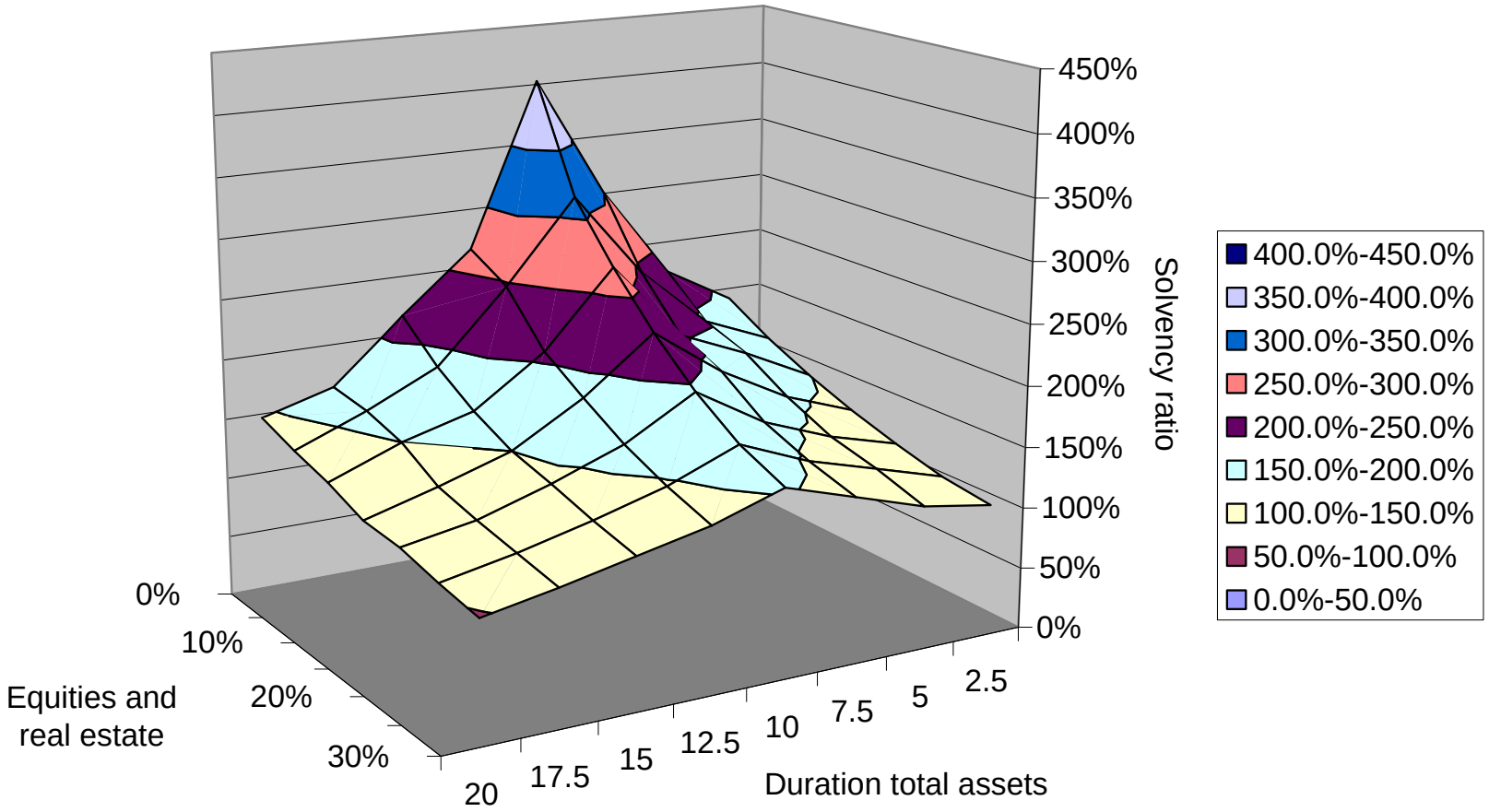
Policy effects - Static

- 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 a dynamic ALM scenario model.

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

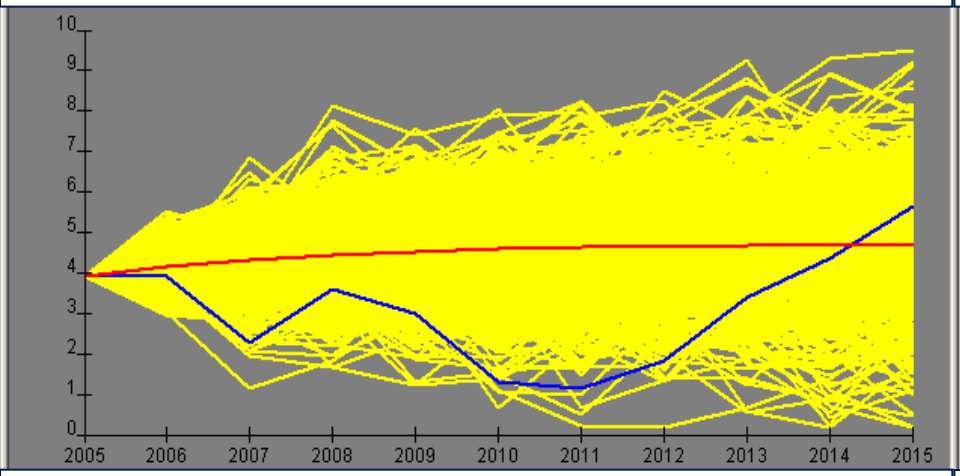
- Going concern: Including new business, taxes, dividends, etc.

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

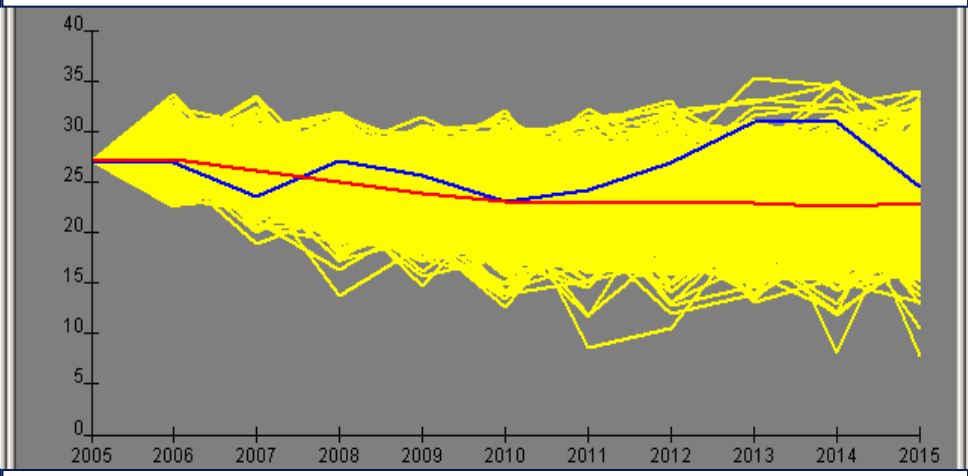
- *Return measure*: Expected MV Funding ratio at end of horizon

Current policy

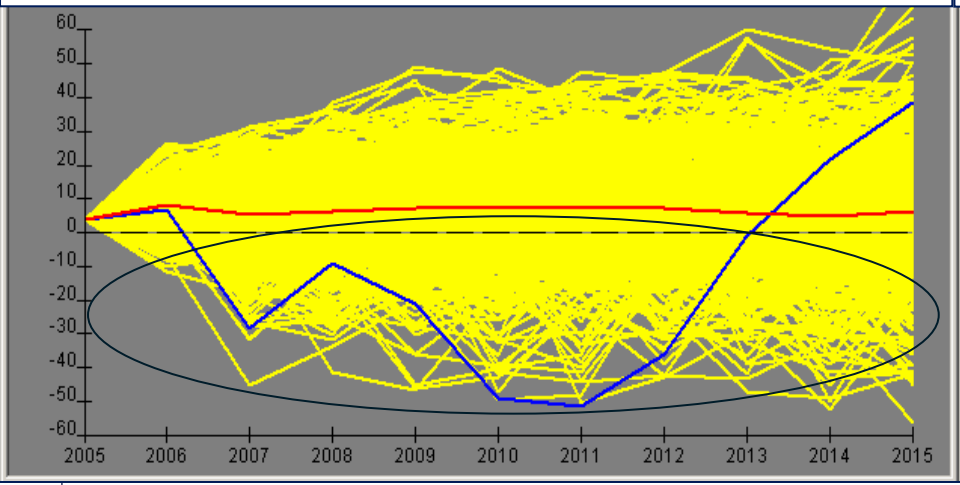
Nominal long zero interest rate (%)



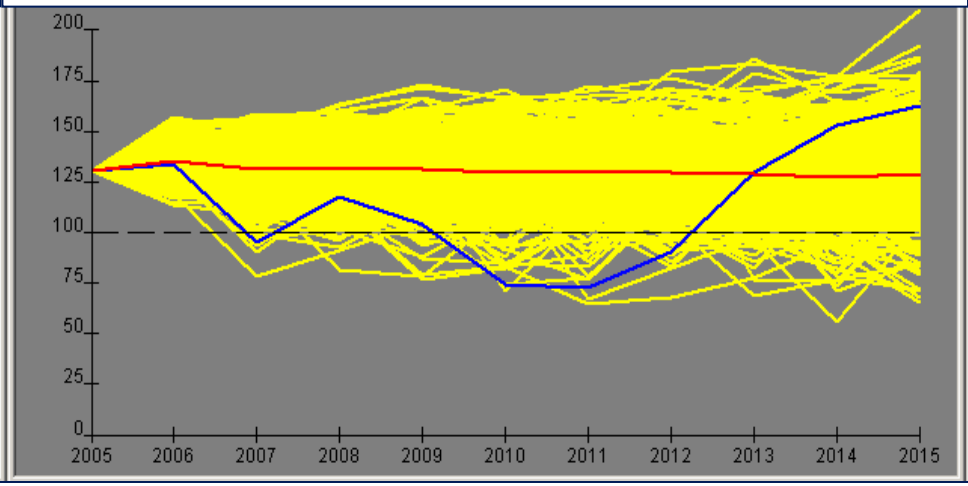
Required capital (% liabilities)



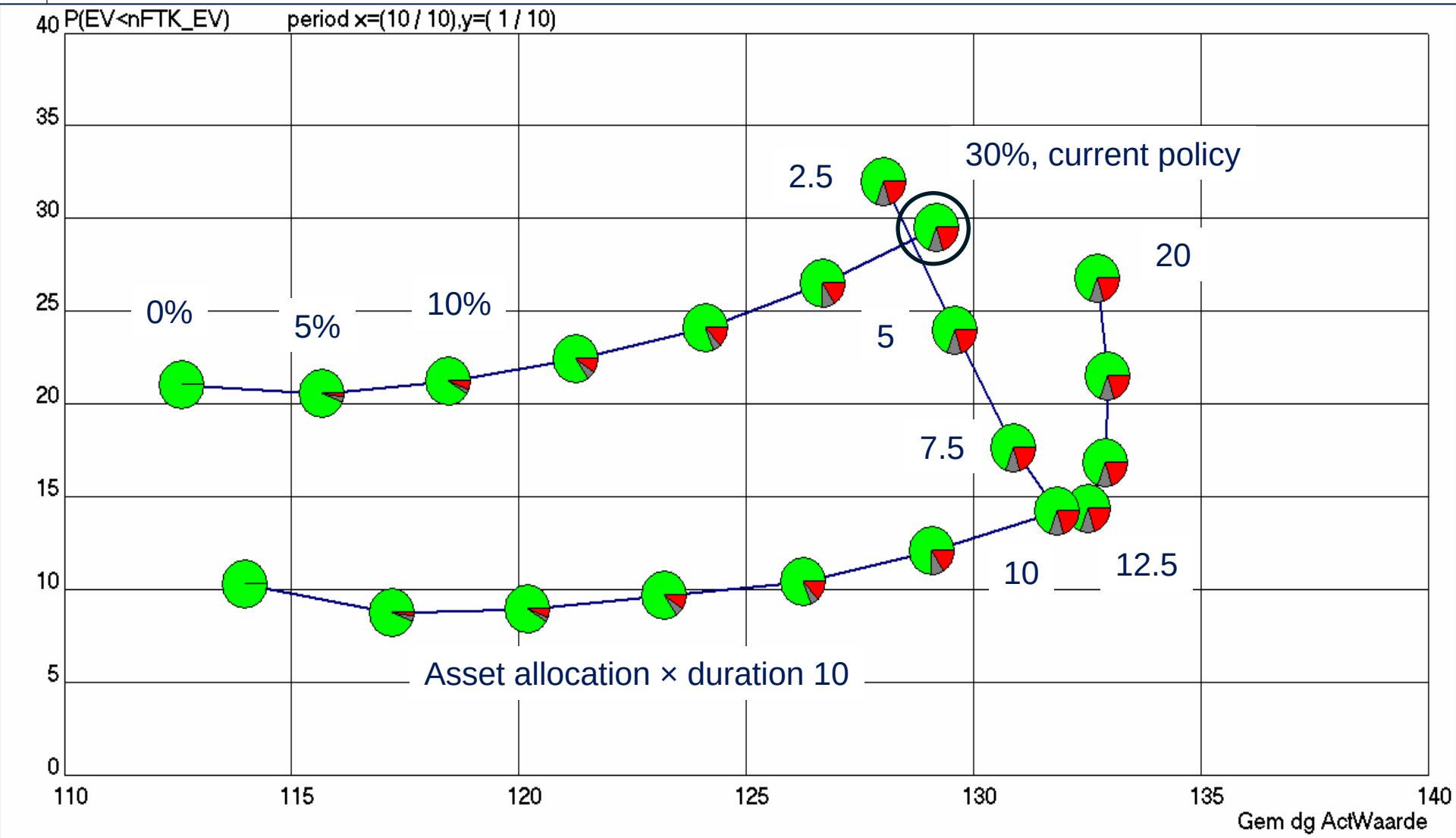
Capital shortage (% liabilities)



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)
  - and “hersteltermijnen” in FTK for pension funds, what actions are needed in case of capital shortages?

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 required capital (comparable in this case)
  - 2. The level of the available 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.

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