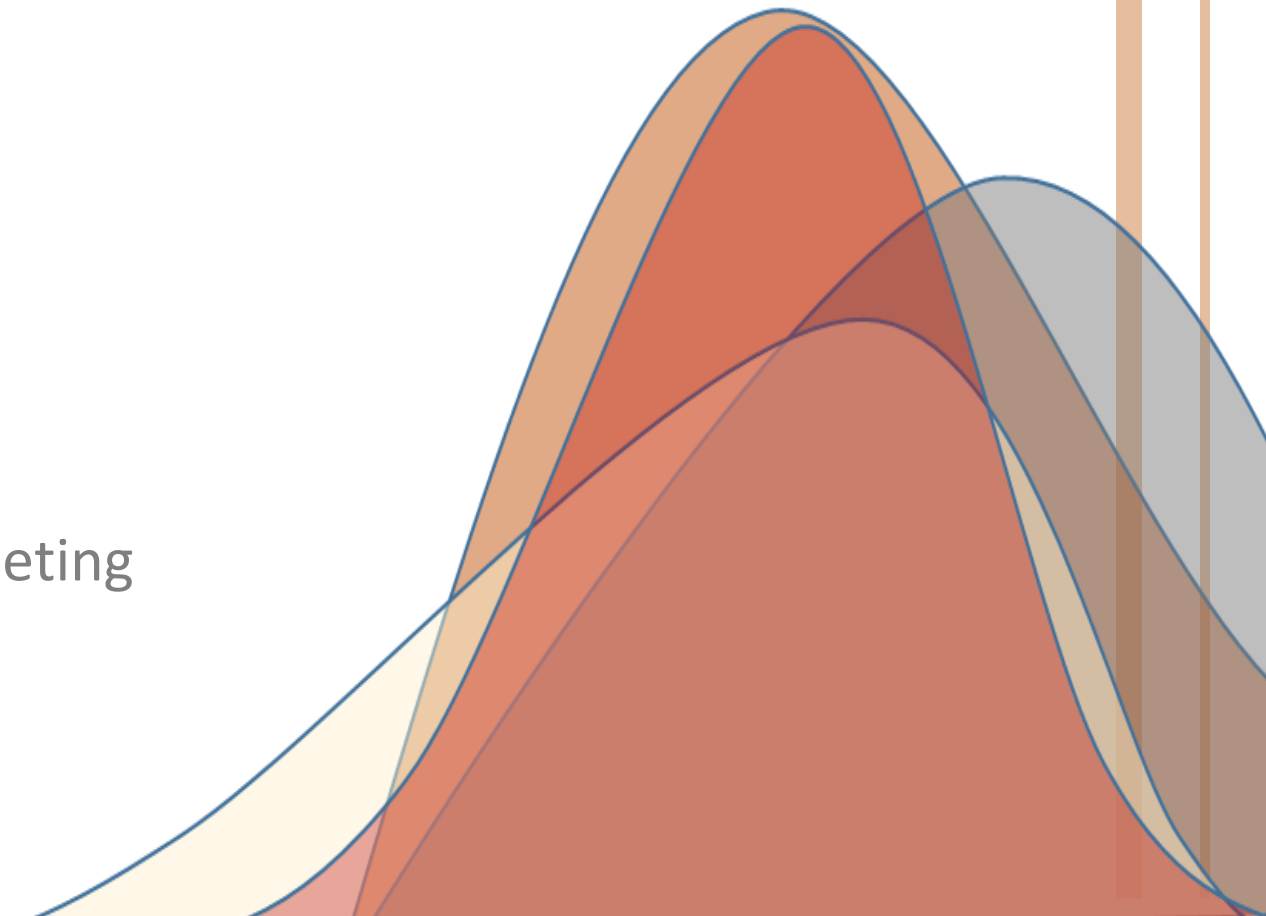
Understanding interest rate risk and its impact for insurers



AAE IC, RMC and Pensions Com. Joint meeting

1st October 2021, Sursee Switzerland

Setting the scene:

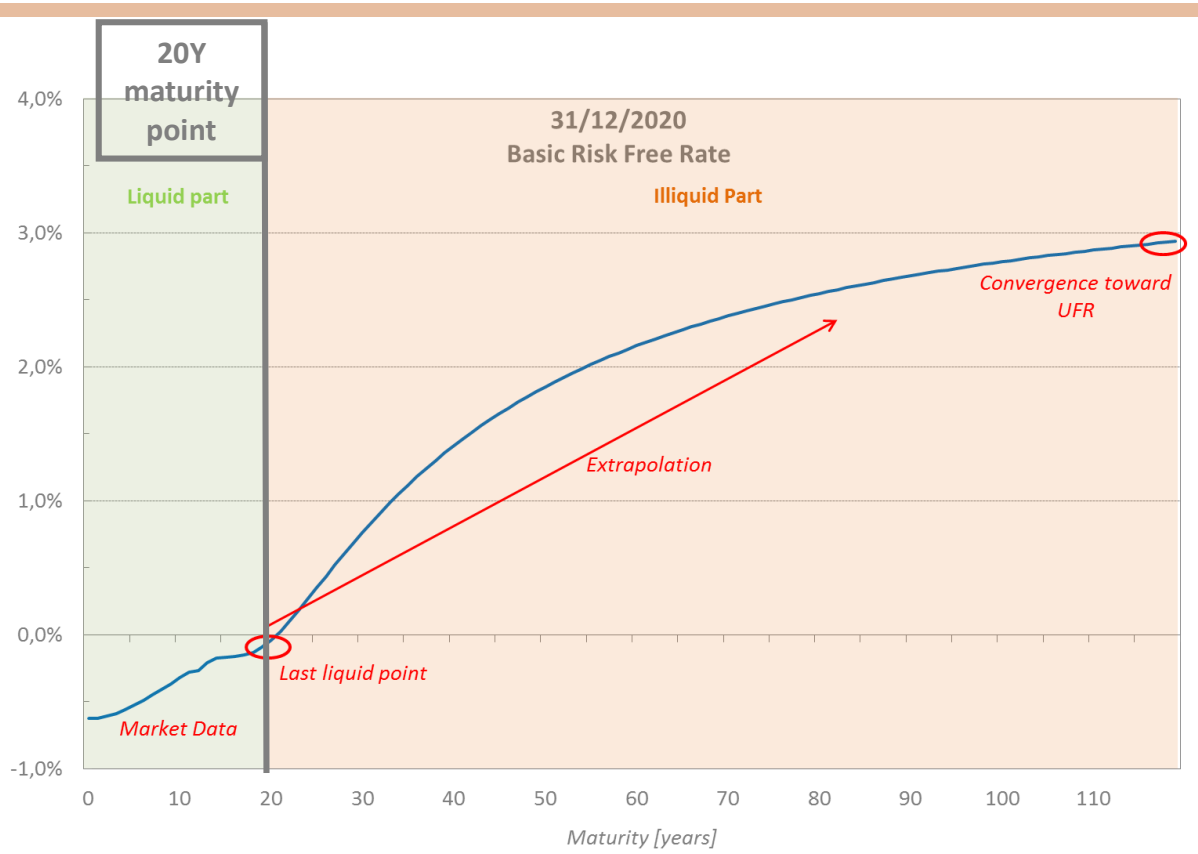
- Interest rate risk for insurers
- Discount rate used in balance sheet valuation

Background on the impact of interest rate risk for insurers

- Insurers are **exposed to interest rate risk** in several ways:
  - Changes in interest rate will affect on the **expected investment return**. Insurers need investment return e.g to pay guarantees, benefits and claims for their customers.
  - Solvency II is based to **market value balance sheet** and its risk profile → interest rates are used also to value liabilities which emphasizes the impact of risk free rate change on insurers own funds
- Insurers, and especially life-insurers have long liabilities towards their customer which requires a **long term business model** balancing well the key policies; underwriting, product offering/pricing, investment strategy, risk appetite- and tolerance and profit sharing.
- Some insurers **hedge interest rest rate risk** in large scale which make their solvency positions less exposed to sudden interest rate movements but might trigger additional liquidity needs. Usually, if the solvency position is stable, insures are more exposed to slower but permanent changes in yield curves (e.g. low for long).
- **Solvency II framework captures interest rate risk**, **but failures to do this for the downward shock in an negative yield environment** as the interest rate down risk goes always towards zero. This model needs urgent correction as EIOPA has rightly pointed out but should be based to realistic findings acknowledging the changes in the risk profile after yields have turned negative.
- **EIOPA publishes** a number of different statistics of the insurance market every year and has been making a lot of clear observations also how interest rate changes have been affecting the industry in history. In general, interest rate sudden changes or turning into negative territory have not brought any severe solvency issues, mainly needs to make changes so that a long term business model can be maintained.

Discount rate curve in Solvency II – the fundamental topic to understand the interest rate risk

- **Yield curve is used to discount future liabilities' cash-flows. The present value of the cash flows gives the economic value of liabilities (the "best estimate").**
- If assets and liabilities have a different sensitivity to interest rates (typically a mismatch between cash inflows and outflows), own funds will be impacted by a change in interest rates, where own funds (approximately) the excess of assets over policyholders' liabilities.
  - Own funds should not be always impacted when their volatility is deemed to be artificial : Omnibus 2 took it into account and proposed ways to solve the issue.
- Matching of assets and liabilities is a very general practice but complex:
  - Long-term liabilities may be difficult to match with equally long-term assets
  - Among long-term liabilities own funds are likely to have the longest term (if not infinite)



- **Solvency 2 promoted market value in order to have understandable and comparable figures among undertakings but practical implementation stumbles in some cases. There is a need to find the good articulation between market value and long-term stable insurance business specific issues.**

Analysing interest rate risk:

- Interest rate risk qualitative analysis
- Euro swap empirical and modelled risk profile
- Example from the Japanese market

THE QUALITATIVE ASSESSMENT ON INTEREST RATE RISK

A qualitative of the interest rate risk profile is needed to set the level of the qualitative risk component. All main triggers to lower or increase the rates needs to be investigated by their historical impact, the possible future impact and the rapidity of that impact. A list of triggers could include:

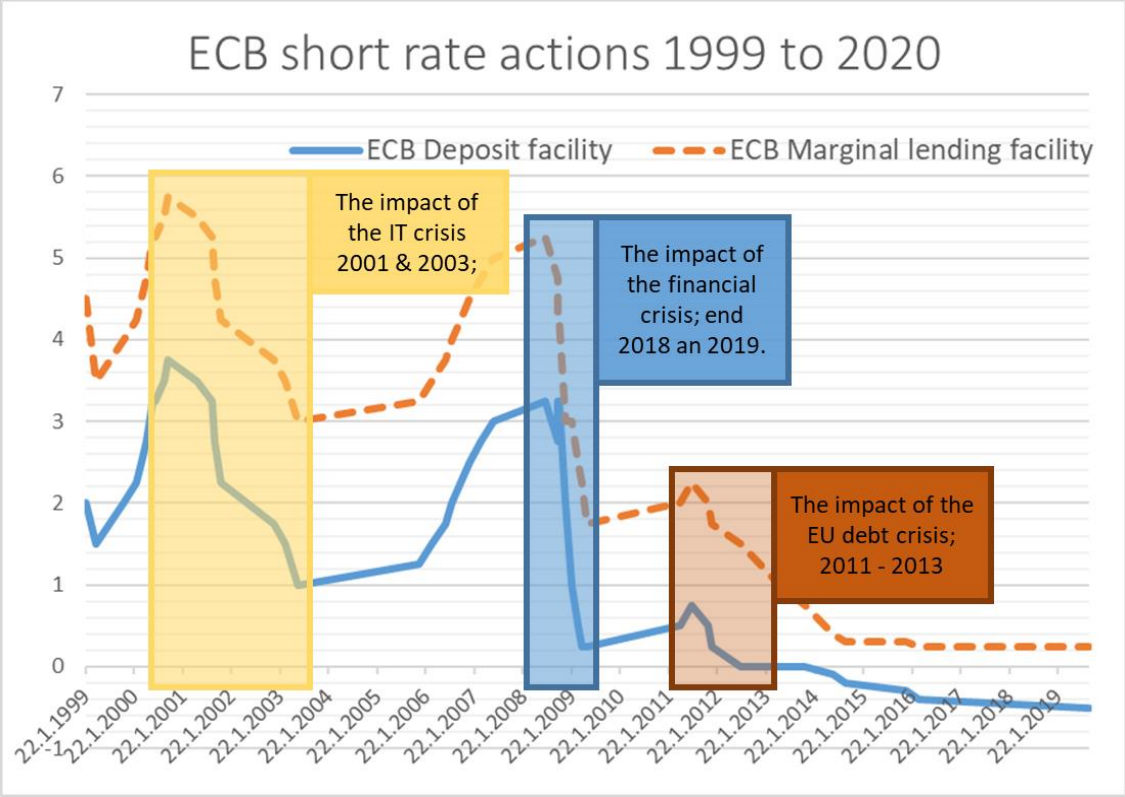
- **ECB actions**
  - The negative interest rates policy by change of the official rates; deposit facility and refinancing rate
  - Quantitative easing
  - Forward guidance, which impacts strongly on the inflation expectation and thus on the maturity premium demand on the long maturities
  - Other ways to control unexpected situations; Stock market crises etc.
- **Investment alternatives for risk free rates**
  - Investing into cash
  - Investing into other highly qualified asset classes (HQLA as published by ECB) that are not strictly linked to the Euro risk free yield, Euro stock index for example
  - Investing into alternative asset classes that are considered liquid (e.g. gold, raw materials)

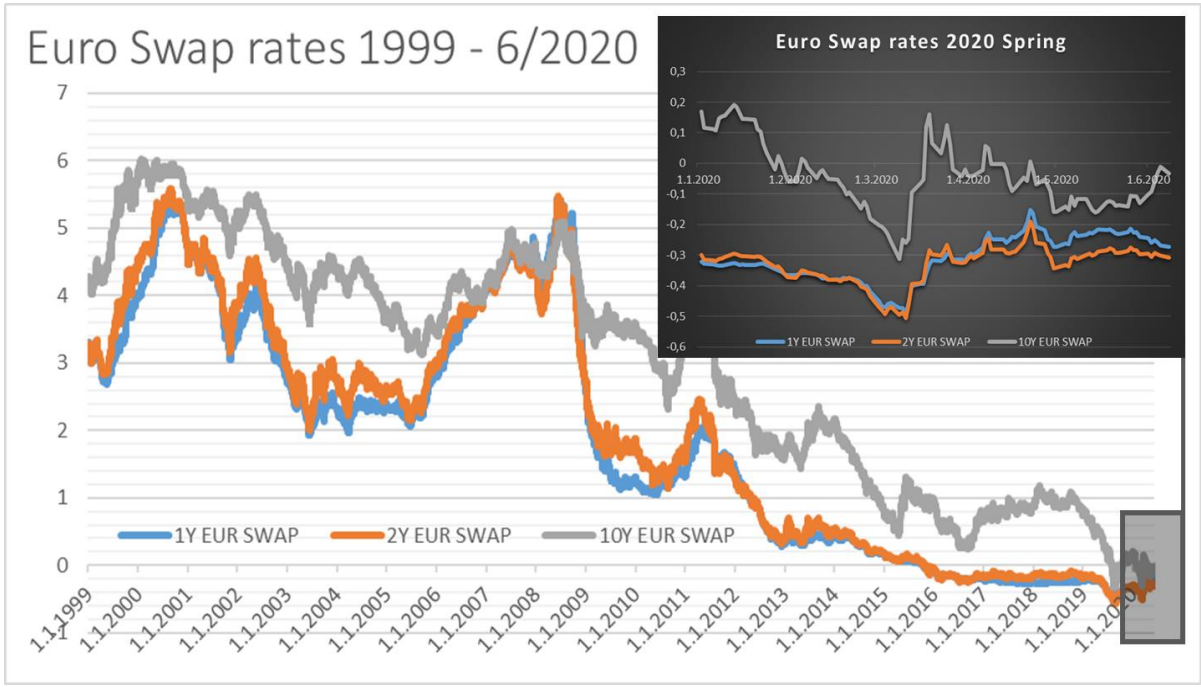
- **The neutral real rate of interest**
- **Euro area Inflation short & long term expectations**
- **The rise of digital currencies**
  - By central banks
  - By private sector providers
- **Changes in how Euro-swaps are used in the market**
  - Individual citizens mortgage payment cap/floor hedges
  - Institutional investors (economic) ALM purposes to hedge (more in sub-section 1.1.3) own funds
  - Insurers to lower their SCR requirement
  - Option pricing purposes
  - Changes in overnight indexes (EONIA old, ESTER new)

- **Convexity bias**, which makes the long forward rates fold down because of the interest rate volatility (delta)
- **New fundamental changes to existing market**

Analysing changes in Euro-Swap levels

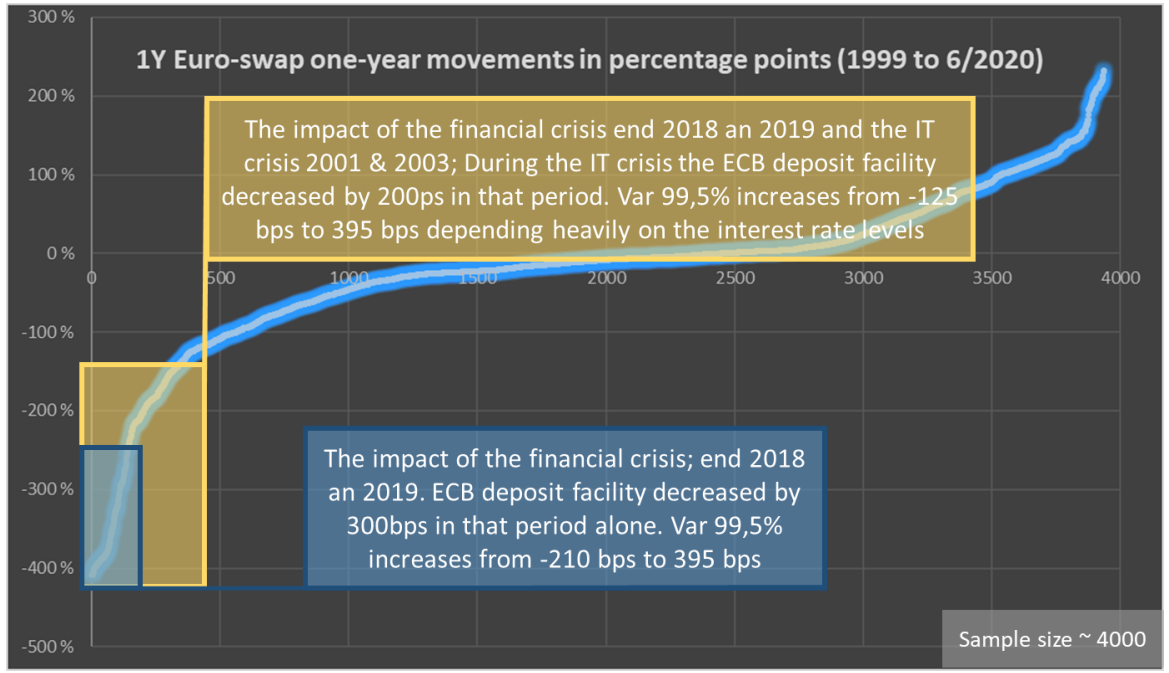
- Euro-swap risk profile can be studied from 1999 looking the one-year changes on different maturity points of the Euro-swap rate.
- As an example also the latest data from the spring 2020 to show the recent developments during the crisis which have been quite modest.





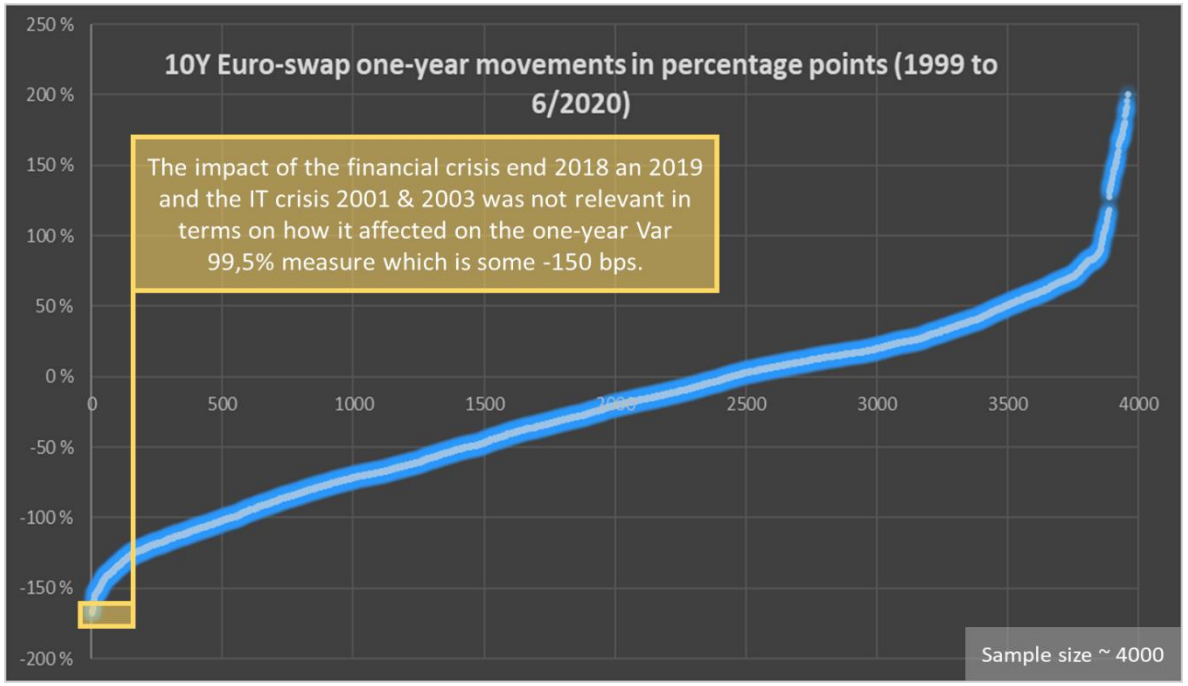
- When investigating the euro-swap rate history it's important to look also how the rates have been changing because of the ECB actions.
- During the different financial crisis; 2001 to 2003, 2008 to 2009 and 2011 to 2013 there has been the biggest changes to the rates, at least in the very short end of the curve.
- In interest rate risk the crisis times are highly interesting but must be looked against the drivers and the absolute level of the interest rates on the times of the crisis.

Analysing changes in Euro-Swap levels



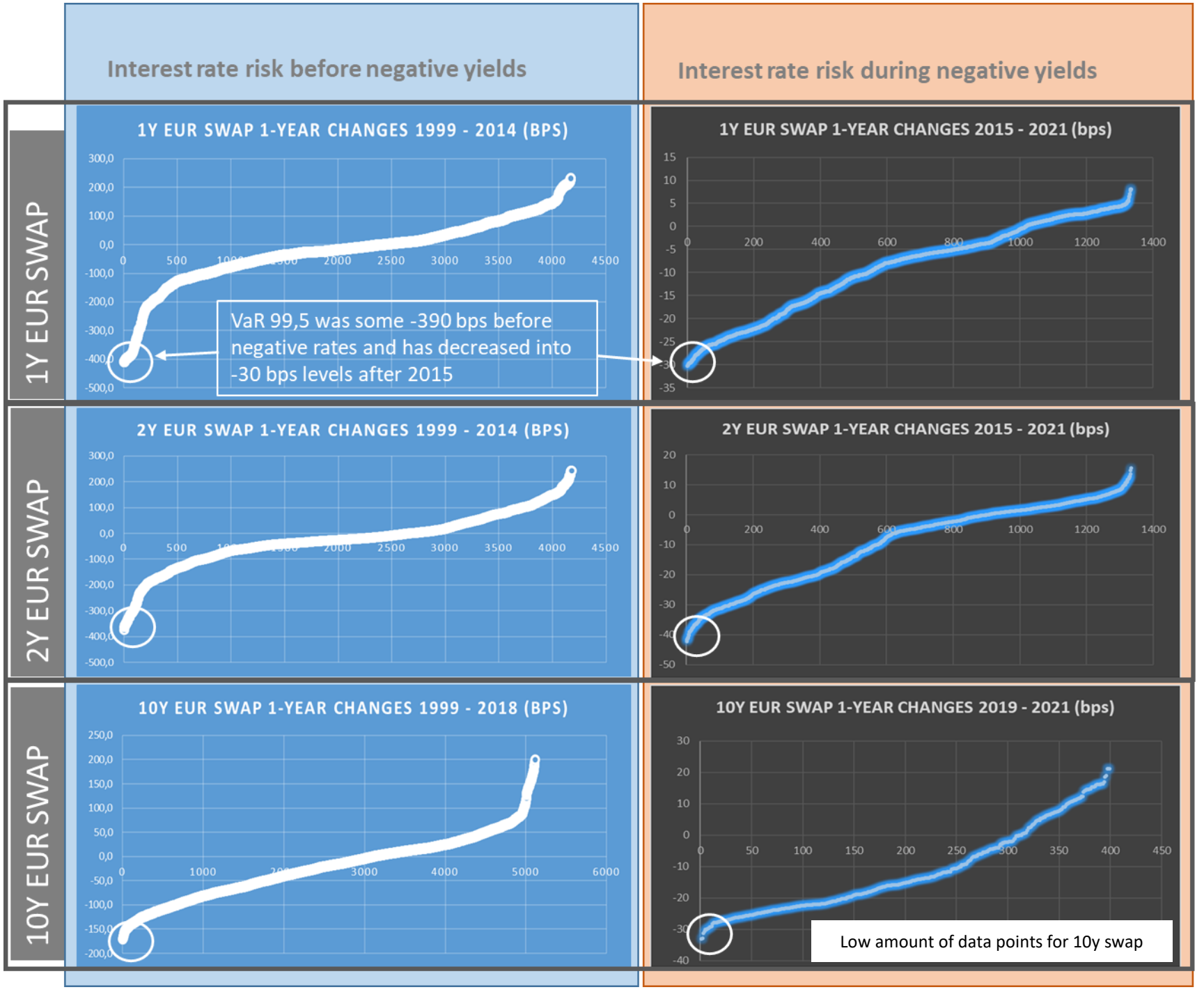
- The biggest one-year changes to euro-swap rates are closely linked to times when ECB has changed their official rates the most; during the financial crisis and the recession from 2001 to 2003.
- The 1-year empirical Var 99,5% is significantly different, even 3-times higher, during times when rates have been higher and ECB actions strong.

- For the 10-year swap rates the times of crisis have not had that much of an impact. The empirical Var 99,5% seems to be around -150bps.



Analysing changes in Euro-Swap levels

- ✓ **Volatility seems to change its regime when interest rates are negative.**
- ✓ **We attribute this to monetary policies and changes in market forces**
- ✓ **30 bps seems to be the accurate 99.5% VaR when rates are negative, even for the 10-year maturity rate which has only couple years of data points.**



Using models to look changes in Euro-Swap levels

Quantile decreases along maturities

Up to 2015 no negative rates observed quantiles are approximatively as observed previously

Short term part of the curve starts to be negative in 2015

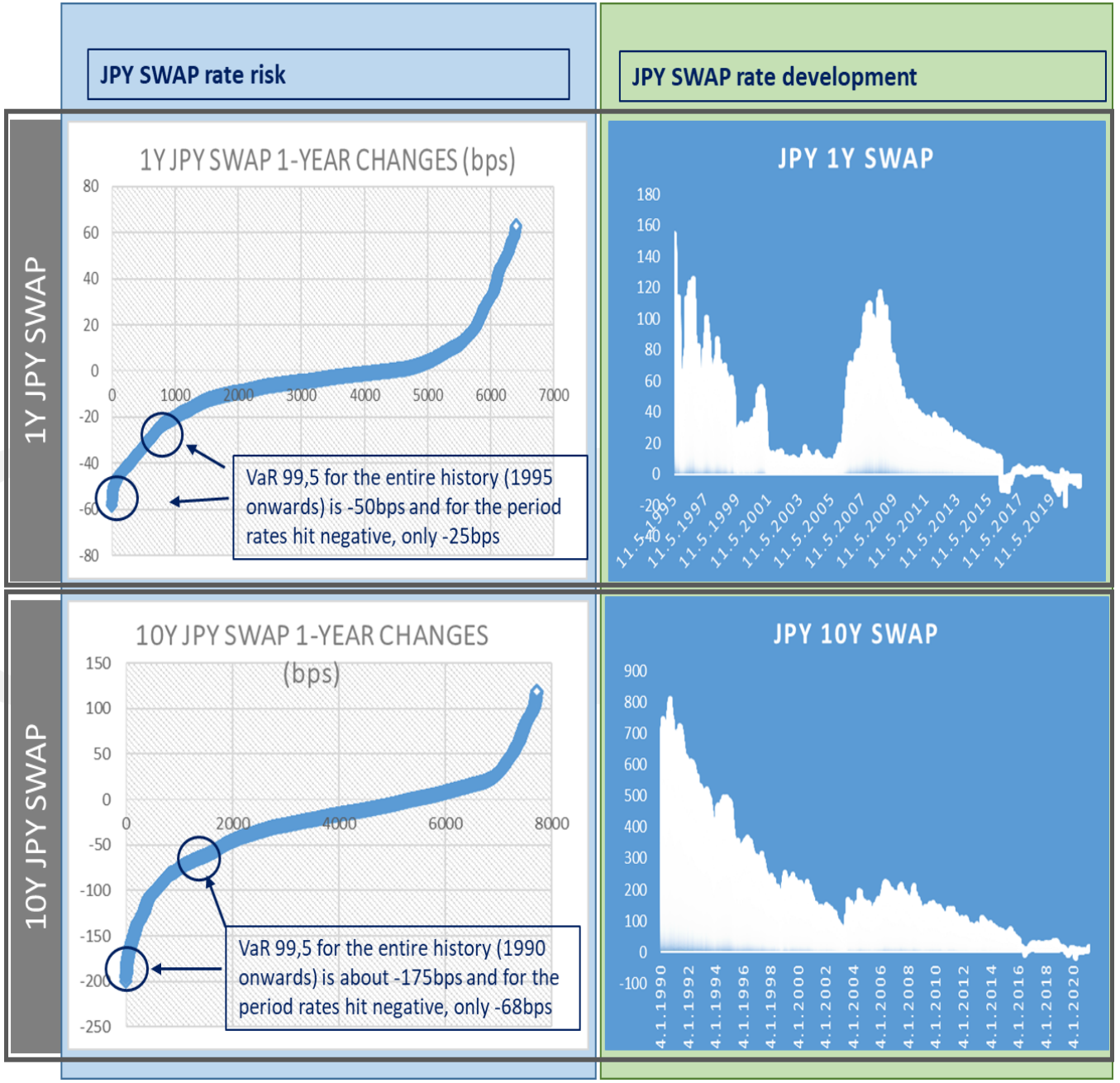
10-year rate is between 0% and 1%, quantile is reduced

Limited number of points, no computations including data before 10 year rate was negative quantile reduced further down toward magnitude observed for short term rates

		EUSA1	EUSA2	EUSA5	EUSA10	EUSA15	EUSA20	EUSA30	EUSA40
Complete Data	Average rate	1,69	1,80	2,23	2,76	3,05	3,16	3,18	1,69
01/1999 to 06/2021	Average change	-0,17	-0,19	-0,21	-0,23	-0,24	-0,24	-0,25	-0,30
	StdDev	0,97	0,87	0,72	0,62	0,60	0,58	0,58	0,58
	Analytical VaR : 3 Stdev	-2,91	-2,62	-2,17	-1,87	-1,79	-1,75	-1,74	-1,74
	Empirical VaR : Percentile 99.5	-3,95	-3,39	-2,12	-1,52	-1,54	-1,61	-1,61	-1,66
Up to Sept 2015	Average rate	2,41	2,56	3,05	3,60	3,88	3,99	3,99	1,99
	Average change	-0,20	-0,22	-0,24	-0,25	-0,26	-0,26	-0,26	-0,39
	StdDev	1,13	1,02	0,82	0,68	0,63	0,61	0,59	0,59
	Analytical VaR : 3 Stdev	-3,40	-3,05	-2,47	-2,04	-1,90	-1,83	-1,78	-1,78
	Empirical VaR : Percentile 99.5	-3,98	-3,45	-2,16	-1,57	-1,56	-1,63	-1,63	-1,69
From Sept 2015	Average rate	-0,29	-0,25	-0,01	0,46	0,77	0,91	0,95	0,93
	Average change	-0,10	-0,11	-0,13	-0,17	-0,19	-0,20	-0,22	-0,23
	StdDev	0,10	0,13	0,29	0,43	0,48	0,51	0,54	0,56
	Analytical VaR : 3 Stdev	-0,31	-0,40	-0,88	-1,28	-1,43	-1,52	-1,61	-1,67
	Empirical VaR : Percentile 99.5	-0,30	-0,40	-0,82	-1,19	-1,32	-1,37	-1,40	-1,43
From Sept 2015 to Jul 2019	Average rate	-0,22	-0,16	0,16	0,73	1,09	1,25	1,31	1,31
	Average change	-0,09	-0,09	-0,07	-0,06	-0,05	-0,05	-0,05	-0,06
	StdDev	0,10	0,13	0,29	0,38	0,41	0,42	0,43	0,45
	Analytical VaR : 3 Stdev	-0,31	-0,40	-0,87	-1,15	-1,22	-1,26	-1,30	-1,34
	Empirical VaR : Percentile 99.5	-0,30	-0,36	-0,66	-0,90	-0,95	-0,99	-1,00	-1,03
From Aug 2019	Average rate	-0,43	-0,43	-0,33	-0,08	0,14	0,24	0,23	0,17
excluding all previous data	Average change	-0,15	-0,12	-0,09	-0,05	-0,04	-0,05	-0,05	-0,05
	StdDev	0,10	0,10	0,14	0,24	0,31	0,35	0,42	0,44
	Analytical VaR : 3 Stdev	-0,29	-0,30	-0,43	-0,72	-0,92	-1,06	-1,26	-1,33
	Empirical VaR : Percentile 99.5	-0,36	-0,29	-0,35	-0,47	-0,55	-0,60	-0,66	-0,67

INTEREST RATE DOWN RISK – CASE STUDY FROM JAPANESE MARKETS

- We can observe a rich data set from the Japanese swap market when looking how the risk free rates have been changing in the history
- Japanese swaps have a history already from early 1990's and especially the short term rate 1Y has been always below 1,5% but stayed below 0,5% after 2010 and dropped negative basically after 2016. With the 10Y rates the levels have been substantially higher in 90's but after that stayed below 2% and also first time hit negative on 2016.
- The 1-year JPY swap rates '1-200-year' (VaR 99,5) one year changes have not been higher than -50bps even if taking into account the entire history. If looking only the period after the 1Y rate hit zero (2016 onwards) this VaR 99,5 measure decreases to -25bps.
- For the 10-year rates this applies quite much more significantly, as the rates have been a lot higher. Therefore the all-history VaR 99,5 is roughly -175bps but becomes a lot lower, into -68bps if looking only the history of low rates (2016 onwards).
- VaR 99,5 can be measured in different ways, in here it is the empirical one year change.



Interest rate risk in Solvency II review:

- Reduction, adaptation, consistency
- AMICE’s proposal
- Back testing

Issues at hand - Introduction

- A change in interest rate may deteriorate undertakings' solvency. Hence the need to account for this risk.
  - A **rise** in interest rate :
    - deteriorates fixed income value
    - increase the discounting factor and reduces the best estimates

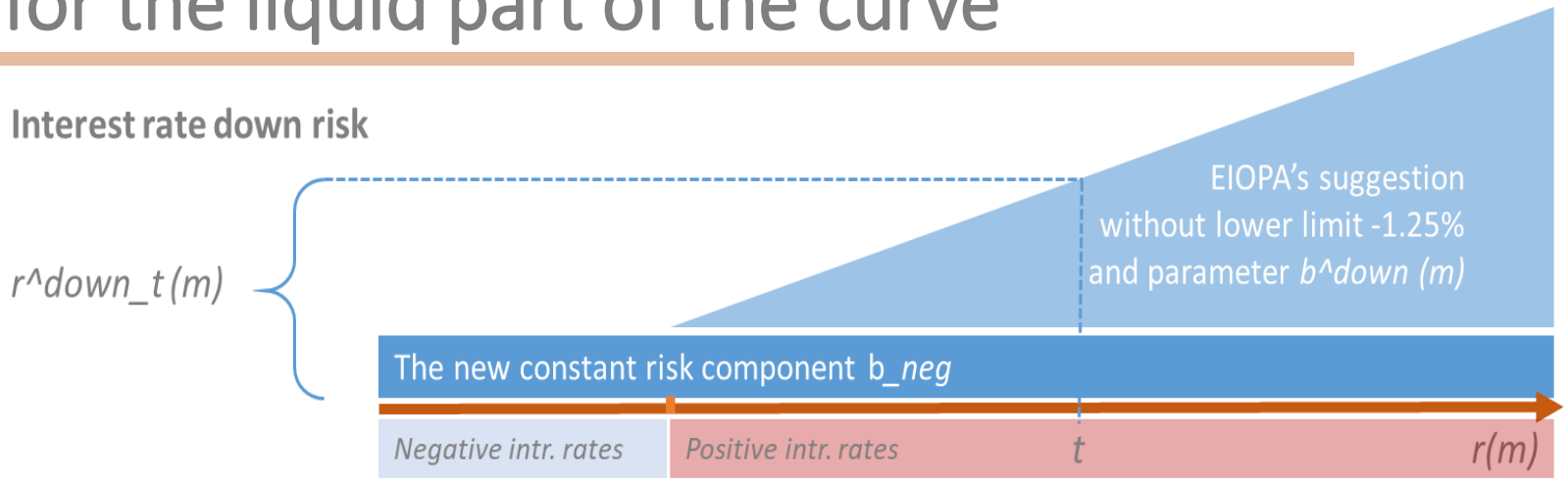
    } two instantaneous effects on own funds. the final outcome will depend on relative sensitivities of fixed income and best estimates

    - rises expected return from assets (through reinvestment rates)
    - rises profit sharing rates when applicable (and increases best estimates)

    } two opposite differed cash-flow effect but instantaneous on best estimates

  - A **decrease** in interest rates
    - improve fixed income value
    - reduce the discounting factor and increases the best estimates
    - decreases return from assets (through reinvestment rates)
    - decreases profit sharing rates except when rates are guaranteed
- **A good measure of the risks** is key for:
  - Supervision and Communication with investors
  - Undertakings' risk taking ability and product offering

AMICE simple proposal – for the liquid part of the curve



EIOPA's Final Opinion on the downward interest rate shock is:

$$r_t^{down}(m) = max\left(r_t\ (m) \times \left(1 - s_m^{down}(\theta_m)\right) - b_m^{down}; -1{,}25\%\right)$$

Considering that interest rates behave differently when negative but should be shocked even if very low, **AMICE has proposed a slight change to the formula:**

$$\boldsymbol{r_t^{down}(m) = r_t\ (m) - max\left(0; r_t\ (m) \times s_m^{down}(\theta_m)\right) - b^{neg}}$$

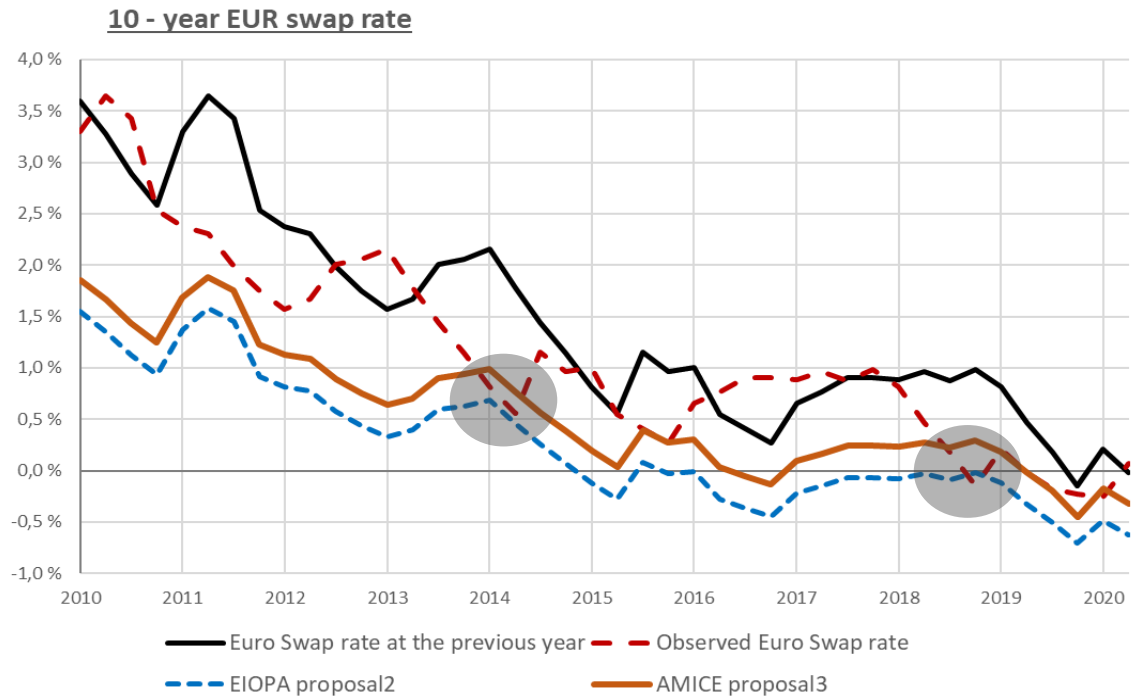
Where b^{neg} is set at 30 bps corresponding to the 99,5% quantile of the 1-year maturity rate when negative rates are observed.

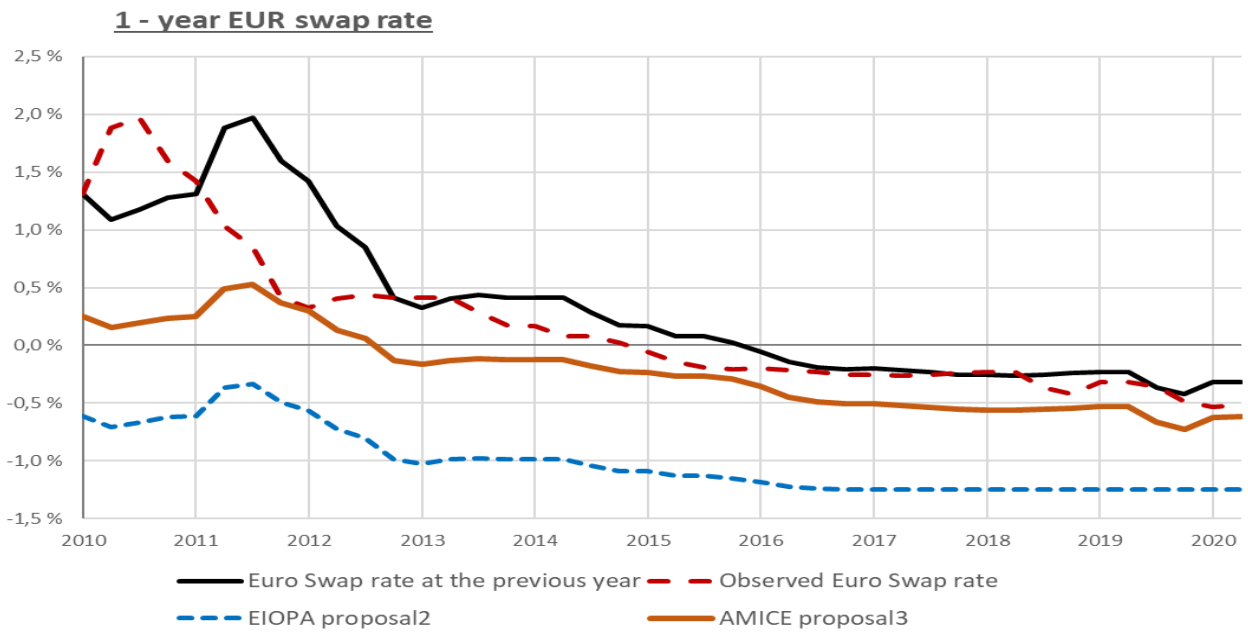
Advantages of this method :

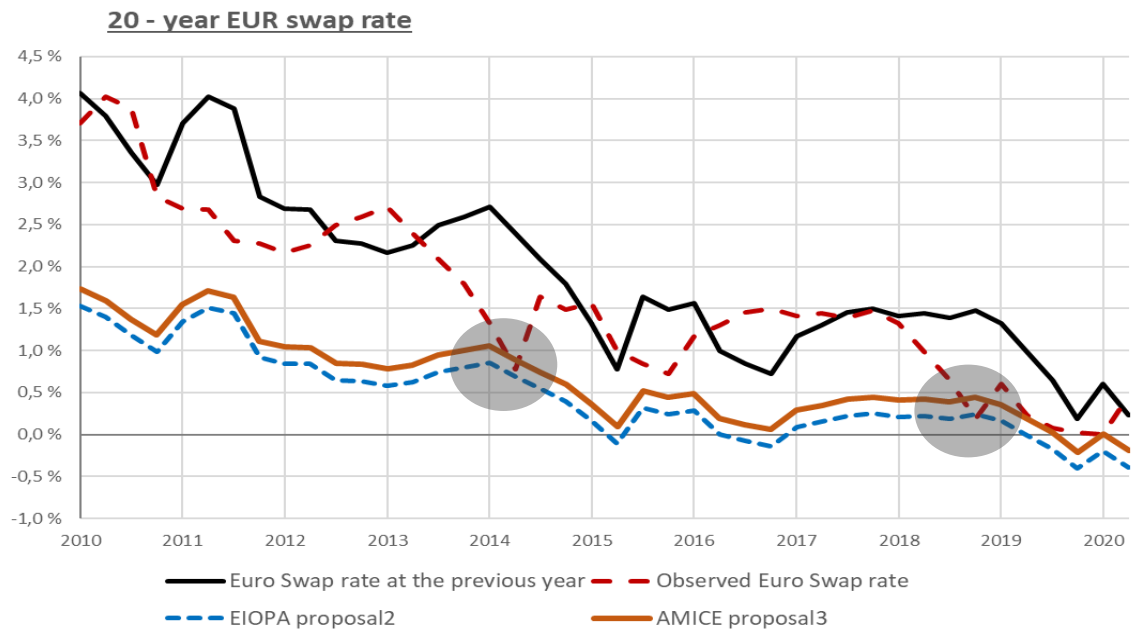
- **The formula remains meaningful even if rates go further down in negative territory.**
- **The formula allows for both reduced shock in the specific regime of negative rates and could be a simplified approach for both negative and positive rates.**

Back-testing of the proposals

- Both EIOPA and AMICE **proposals can be back tested** on how well they would have worked in history. This provides some insight even though the market works a lot differently after yields have turned negative.
- **Back testing has been performed** here by looking at every quartile end how that swap rate has been changing in the following 1-year period and then how both EIOPA and AMICE models have been able to capture the risk
- One can observe that for the **1-year rate** no breaches has been observed and that EIOPA'n model seems to be calibrated in too prudent ways, the realized change in swap rates seems to be a lot less.
- On the **10y and 20Y swap rates** there has been two significant changes what have led to breaches; (1) 2013 EU debt crisis when ECB lowered its deposit and marginal mending facilities and (2) 2019 long swap rates decreasing below zero which resulted also EIOPA's proposal to breach.

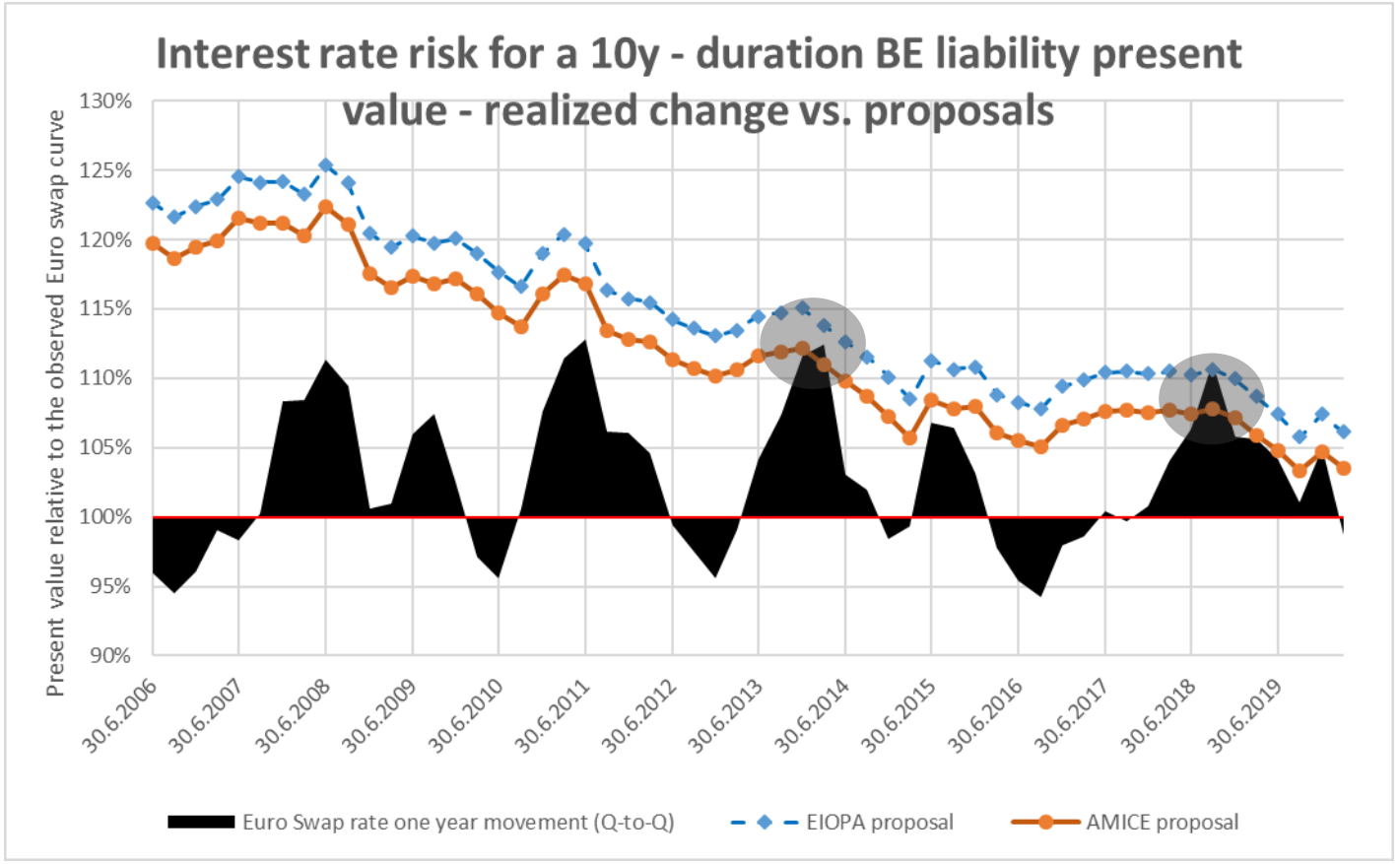




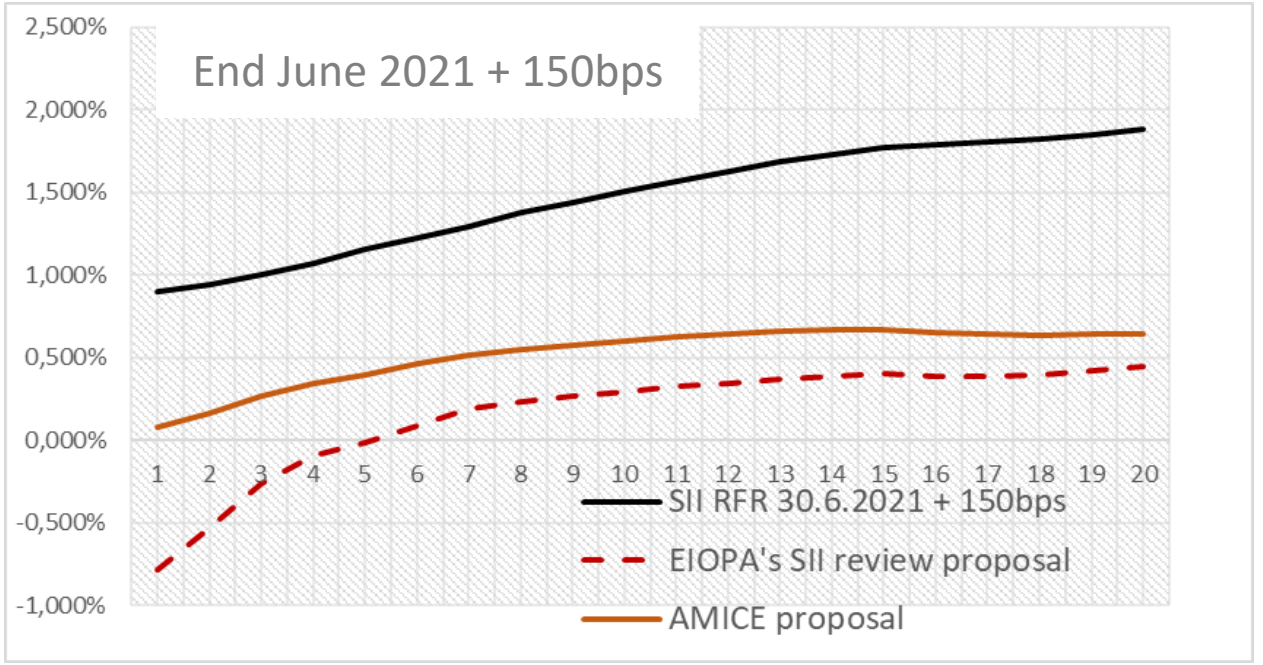


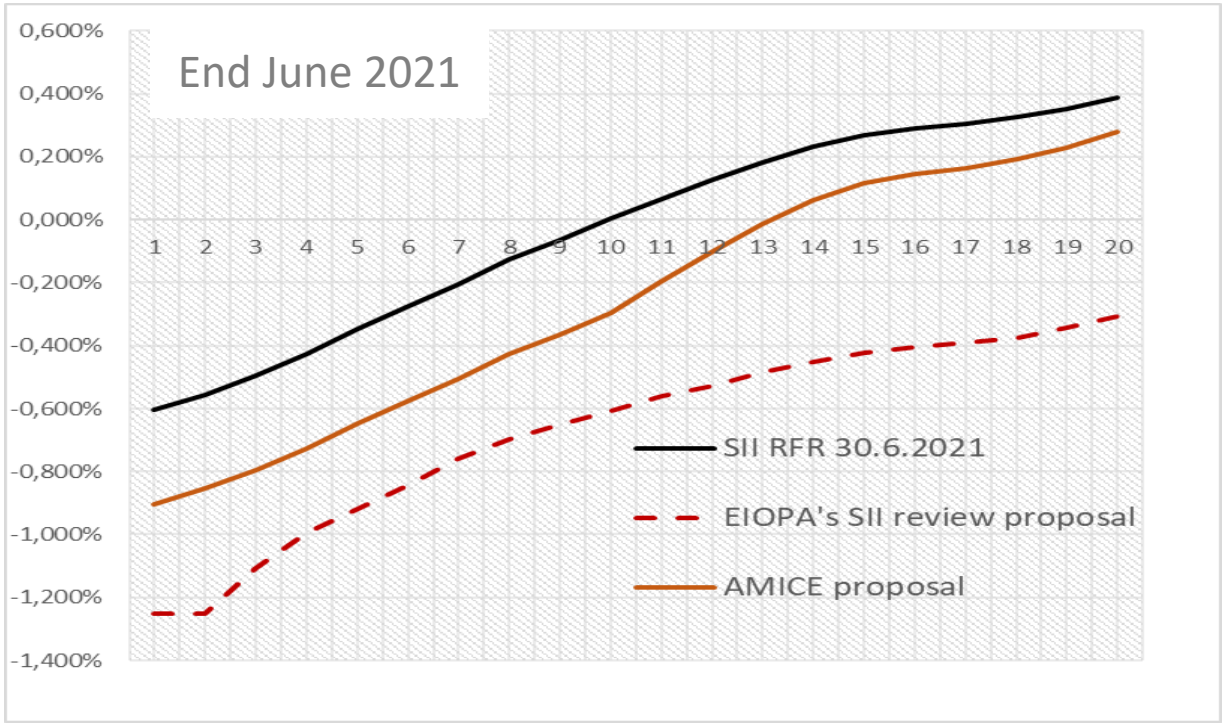
AMICE's proposal – Back-testing of the proposal by looking the best estimate present value changes

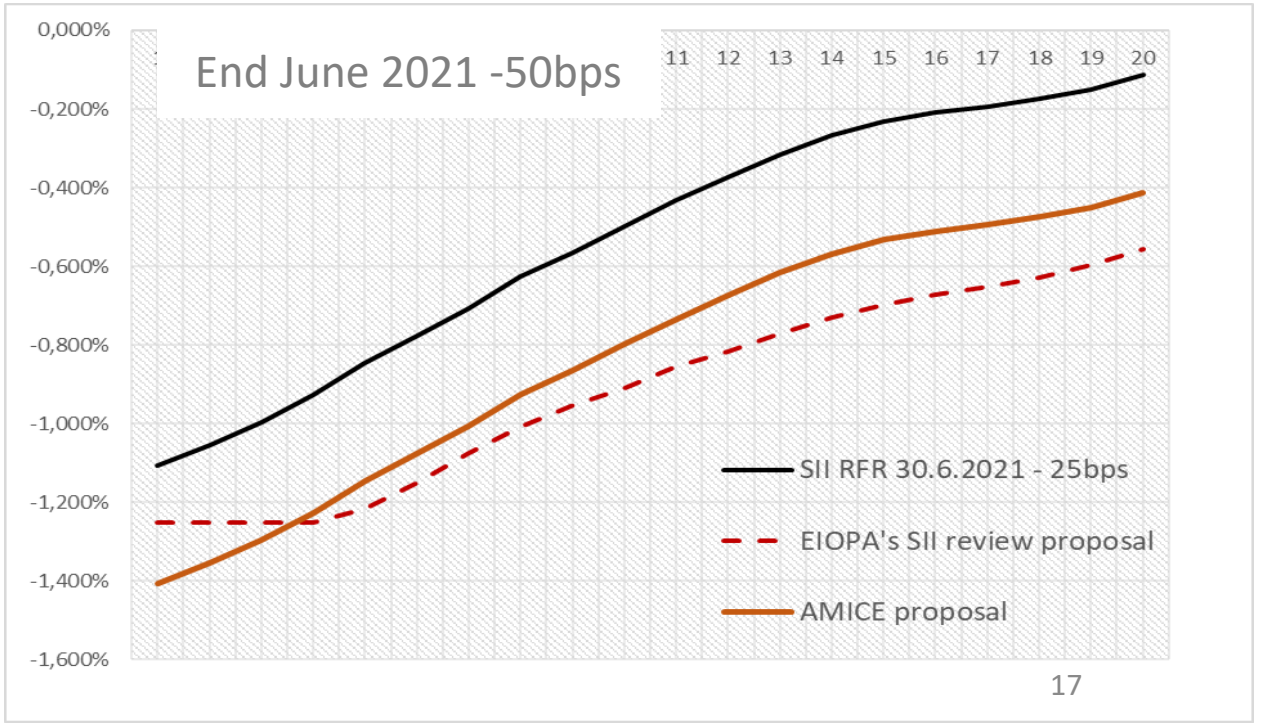
- Both EIOPA and AMICE proposals can be back tested on how well they would have worked in history also by using a different risk measure; the best estimate liability changes in different time steps.
- A 10-year duration liability cashflow has been valued on every quarter by how much rates has been changing in the following 1-year period and then this results is compared on to the EIOPA and AMICE proposals and how well these have been able to capture the risk.
- One can find that two breaches can be found; one during the EU debt crisis (ECB strong actions) and 2019 (long rates turned negative, all models fail)
- Looking the BE liability present value captures well the whole rate curve change and already gives a good insight into the matter. Anyway if taking asset value changes (which reduce the risk), Risk margin (increase the risk, and correlations (reduce the risk) even a more holistic understanding could be achieved.



EIOPA & AMICE proposals end June against +150bps and -50bps sensitivity analysis







THANK YOU!

ANY COMMENTS OR QUESTIONS?