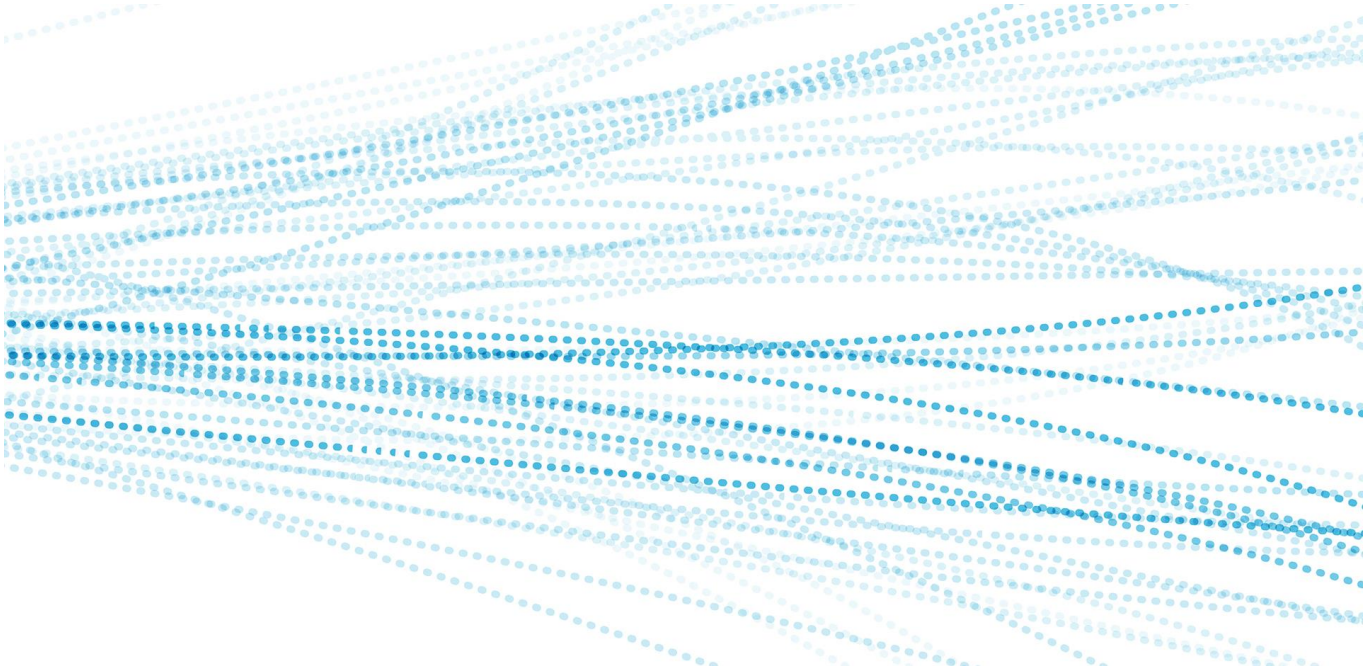

A series of practical papers on Interest Rate Risk Management under Solvency II

Part 2: Impact of the DLT assessment

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Introduction

In the first paper in this series, we explored the implications of EIOPA's alternative methodology for Standard Formula calculations on hedging strategies.[1] Notable among our results was the declining average notional required to hedge Solvency Capital Requirements (SCR) in the scenarios where interest rates decreased, a feature not shared by an Own Fund's hedge target. The primary driver of this behaviour is the increased convexity of the hedging assets as rates decline, with no comparable increase on the liability side. The effect of the Ultimate Forward Rate (UFR) on the level of rates for the extrapolated part of the yield curve is, in turn, the driver for this more muted liability convexity. The dynamics for Own Funds hedging do not show analogous behaviour because the duration mismatch between assets and liabilities compensates for the convexity mismatch.

For this second paper in this series, we turn to exploring the Deep, Liquid, and Transparent (DLT) assessment EIOPA conducted in 2016–2018. Our goals are three-fold. First, we want to update that assessment to include market data over the last couple years. Second, we want to explore how changes in that assessment may impact setting the last-liquid point (LLP) and alternative extrapolation weights. Finally, we will discuss the hedging implications.

[1] https://www.milliman.com/en/insight/part-1-managing-the-standard-formula-scr

What is the DLT assessment?

The market observable interest rates are the basis for the Solvency II risk-free interest rate term structure. EIOPA[2] derives the interest rates based on financial instruments that are traded in DLT markets, where:

- 'deep market' means a market where transactions involving a large quantity of financial instruments can take place without significantly affecting the price of the instruments
- 'liquid market' means a market where financial instruments can readily be converted through a transaction without causing a significant movement in the price
- 'transparent market' means a market where current trade and price information is readily available to the public (either for free or paid), in particular to the insurance or reinsurance undertakings

The DLT assessment analyses whether the individual maturities of the reference instruments can be derived from DLT markets. Only financial instruments which are considered to stem from DLT markets are included in the determination of the EIOPA's Solvency II risk-free interest rate term structure. The interest rates for the missing maturities are currently interpolated or extrapolated using of the Smith-Wilson method.

The DLT assessment has been carried out by EIOPA on a yearly basis starting from 2016. Both the bond market and the interest rate swap market are included in the assessment.

Next to the DLT assessment EIOPA has specified additional criteria that define the LLP on the curve. Since the implementation of Solvency II in 2016, each assessment by EIOPA has resulted in the last liquid term on the Euro interest rate curve being set to the 20-year rate. Terms after this period are extrapolated to the UFR.

Consequently, the DLT assessment is an important driver for the level and shape of the Solvency II risk-free interest rate term structure. First, a shift of the LLP from 20 years to 30 years would take out the extrapolation effect on the 20Y–30Y range and hence, given the current economic circumstance, lower this part of the curve. Second, adding/removing extra intermediate liquid terms on the curve will reduce the impact of interpolation. The impact of the first is significantly higher than the latter, hence this will be our focus area.

In its review of the Solvency II framework EIOPA[3] has proposed several alternatives to the current interest rate term structure:

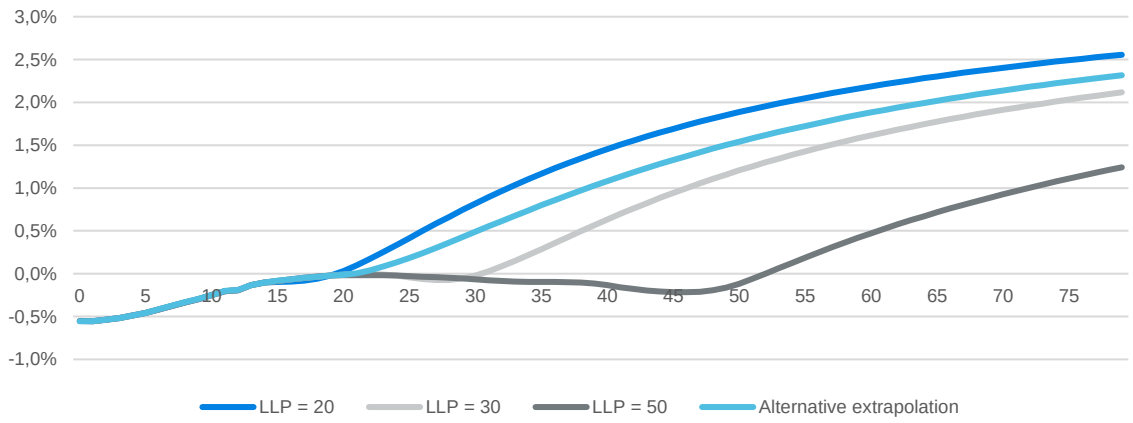
1. A shift from the LLP to 30 years
2. A shift from the LLP to 50 years
3. An alternative extrapolation methodology

Each of the options considered partly resulted from the fact that in the DLT assessment evidence was found that for maturities 25-year, 30-year, 40-year, and 50-year the Euro swap market was still DLT. The impact of each option considered is visualized in Figure 1.

[2] https://www.eiopa.europa.eu/sites/default/files/risk_free_interest_rate/21.08.2020_-_technical_documentation.pdf

[3] Source: https://www.eiopa.europa.eu/sites/default/files/publications/consultations/eiopa-bos-19-465_cp_opinion_2020_review.pdf

FIGURE 1: SOLVENCY II CURVES CONSIDERED (CURVES PER DECEMBER 2021)



The alternative extrapolation method uses weights based on the DLT assessment to determine the last-liquid forward rate (LLFR). The LLFR is an important parameter to determine the extrapolation in conjunction with the UFR. The technicalities of this parameter are described in our previous paper, in particular the impact of changing the assumptions are shown in the last section of this paper.[4] In EIOPA's opinion issued in December a smoothed introduction of the alternative extrapolation, where the speed of convergence parameter is dependent on the level of the 20Y interest rate. In our briefing note we have showed the impact of this smoothing on the volatility of the discount curve.[5]

EIOPA's DLT assessment method

The decision on the relevant instrument to derive the risk-free interest rates is made on the basis of the results of the DLT assessment for the swap and the government bond markets in accordance with Article 44 of the Solvency II Delegated Regulation. According to that article, swaps are the default reference instruments.

In deciding on the relevant maturities on the Solvency II risk-free curve EIOPA apply multiple DLT assessments[6]:

- DLT assessment of the swap market
  - The assessment should be based on the following thresholds for **depth** and **liquidity**:
    - the average daily notional amount traded is at least EUR 50,000,000
    - the average daily number of trades is at least 10
  - The financial markets should be considered **transparent** for the swaps of a currency and maturity where up-to-date information on the market swap rates for that currency and maturity is available from a reliable data provider for each working day.
- DLT assessment of the government bond and the bond market as a whole
  - In this assessment the trade volume and trade frequency of government bonds and the bond market as a whole for different maturities are studied.
  - As the bond market includes the government bond market, both the trade volume and trade frequency of the bond market are at least as high as those of the government bond market. Therefore, where the government bond market for a currency is DLT also the bond market for that currency should be considered DLT. Where the risk-free interest rates are derived from government bonds because the swap market is not DLT, this implies in particular that the DLT assessment of the bond market should not introduce further restrictions for the use of DLT maturities identified in the DLT assessment of the government bond market.

[4] https://www.milliman.com/en/insight/introduction-to-the-changes-in-the-solvency-ii-yield-curve-and-the-implications-for-hedging

[5] https://www.milliman.com/en/insight/solvency-ii-2020-review-eiopas-final-opinion

[6] Components of the DLT framework are explained in full detail from page 727 in the consultation paper on the opinion on the 2020 review of the Solvency II https://www.eiopa.europa.eu/sites/default/files/publications/consultations/eiopa-bos-19-465_cp_opinion_2020_review.pdf

- For the Euro, the DLT assessment of the (government) bond market has not been carried out because trade volume and trade frequency data for government bonds of those currencies were not available. In this paper the DLT assessment considered will thus be focused on the assessment of the swap market.

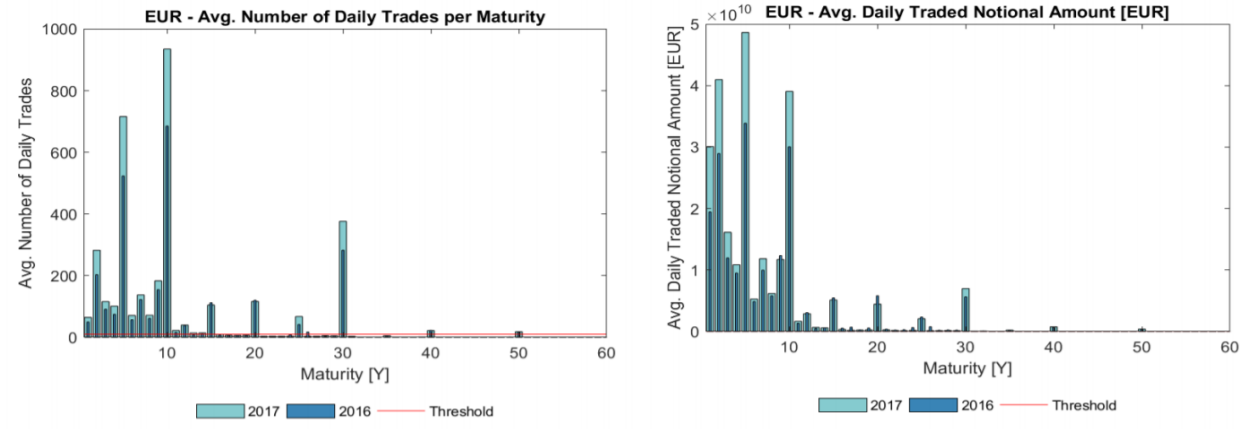
Furthermore, the following criteria have been put in place for determining the LLP:

1. **Matching criterion**: This criterion is reflected in recital 30 of the Omnibus II Directive and is motivated by the idea that sufficient bonds should be available to match the insurance cash flows up to the LLP. For the purpose of implementing this criterion bond, cash flows and liability cash flows are compared per maturity to assess the maturity when no longer sufficient bond volume is available on the market to match the liabilities. The matching criterion sets a limit to the LLP. In assessments of the criterion for the Euro in 2016, 2018, and 2019 the limit to the LLP was set to 10-year, 15-year, and 15-year, respectively.
2. **Residual volume criterion**: As set out in recital 21 of the Omnibus II Directive, the market for bonds denominated in euro should not be regarded as deep and liquid where the cumulative volume of bonds with maturities larger than or equal to the last maturity is less than 6 percent of the volume of all bonds in that market. In line with the matching criterion, this criterion sets a limit to the LLP. Several studies performed during 2008 and 2018 indicate that the limit to the LLP ranges between 18 and 22 years.
3. **LLP of 20 years**: Recital 30 of the Omnibus II Directive specifies that the LLP for the euro under market conditions similar to those at the date of entry into force of that Directive to be at a maturity of 20 years. Where the market conditions are similar to those in Q2 2014 and the matching criterion and residual volume criterion contradict each other, the recital on the 20 years LLP takes precedence.

Since the matching criterion and residual volume have contradicted in each assessment, the LLP has remained at 20 years up until now.

EIOPA has published the results of the DLT assessments of the swap market over 2016 and 2017. The results are visualized in Figure 2.

FIGURE 2: DLT ASSESSMENTS OF THE SWAP MARKET OVER 2016 AND 2017



Source: EIOPA https://www.eiopa.europa.eu/sites/default/files/publications/consultations/eiopa-bos-19-465_cp_opinion_2020_review.pdf (page 744)

The graphs indicate that for years 25, 30, 40, and 50 the minimum depth and liquidity thresholds are met. In the next section this part of the DLT assessment is repeated based on publicly available data.

Redoing the DLT assessment

A complete DLT assessment of the EUR swap market requires access to multiple data sources. The swaps market is fragmented as some transactions are executed on different venues[7] (e.g., SEF, MTF) or negotiated bilaterally off-venues. Trades are reported to different trade repositories (TR). Finally, the trade data obtained from various sources and TRs is not presented in a standardized format.

Due to these points a complete DLT assessment overlooking the entire swaps market becomes challenging. In our analysis we attempt to use the (public) data coming from several sources that cover a significant part of the market.

Similar to EIOPA, we look at the number and notional amount of trades reported on a daily basis. Only EUR fixed-for-float swaps are considered in the assessment.[8]

The data comes from 2 sources:

- **Swapsinfo.**[9] Interest rate derivatives transactions with 30Y tenor reported to the Depository Trust & Clearing Corporation (DTCC) and Bloomberg swap data repositories (SDRs) sources.
- **Bloomberg SDR**. Interest rate derivatives transactions reported to the DTCC. Here we look at 30Y, 40Y, and 50Y tenors.

The data frequency is daily, and the time period is 01/2016 through 12/2020. In both sources we look only at spot starting interest rate swaps, i.e., no forward starting swaps unless comprised as a combination of two spot starting products.

The data available for the DLT assessment is limited. Our analysis does not contain daily volume / trade count data from Swapsinfo sources for 2016–2020 except for 30Y point. To approximate the entire market volume / trade count, data scaling factors are applied to 40Y and 50Y points. A scaling factor is derived as Bloomberg SDR average daily volume / Bloomberg SDR + Swapsinfoaverage daily volume in 30Y point for each year. A similar set of factors is derived for average daily trades.

FIGURE 3: SCALING FACTOR LEVELS PER YEAR

AVERAGE DAILY VOLUME	BLOOMBERG SDR / BLOOMBERG SDR + SWAPSINFO
2016	39%
2017	35%
2018	31%
2019	34%
2020	29%
2016 - 2020	33%
AVERAGE DAILY TRADES	**BLOOMBERG SDR / BLOOMBERG SDR + SWAPSINFO**
2016	38%
2017	36%
2018	37%
2019	34%
2020	27%
2016 - 2020	33%

[7] A-Practical-Guide-to-Navigating-Derivatives-Trading-on-US-EU-Recognized-Trading-Venues.pdf (isda.org)

[8] Note that by this definition forward starting swaps, constructed of a payer and receiver swaps, are not taken into account. These instruments are popular as they allow for hedge accounting and avoid IFRS P&L volatility. Consequently, an amount of liquidity on the long-end is not recognized in EIOPA's analysis.

[9] Source: http://swapsinfo.org/

In the following section these weights are applied to Bloomberg SDR data to derive implied Bloomberg SDR + Swapsinfo trading volumes and trade count for 40Y and 50Y points.

FIGURE 4: AVERAGE DAILY VOLUME – 30Y SWAP

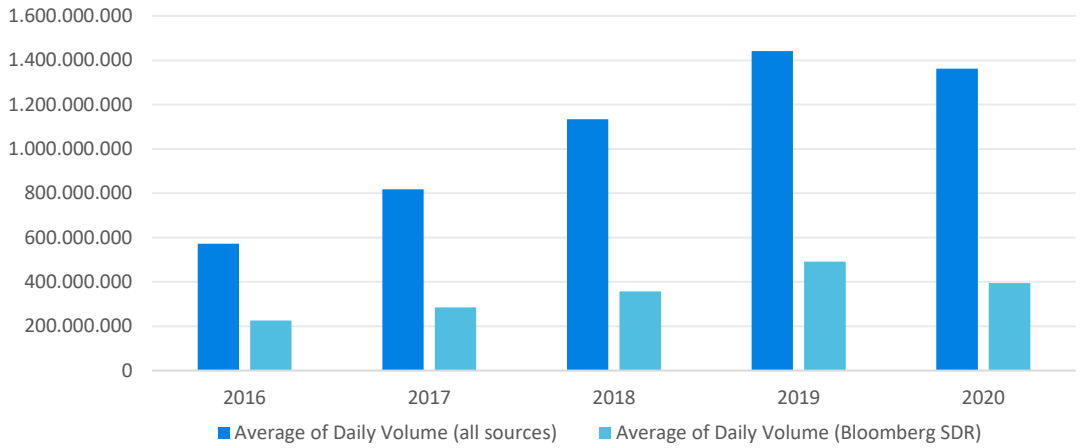
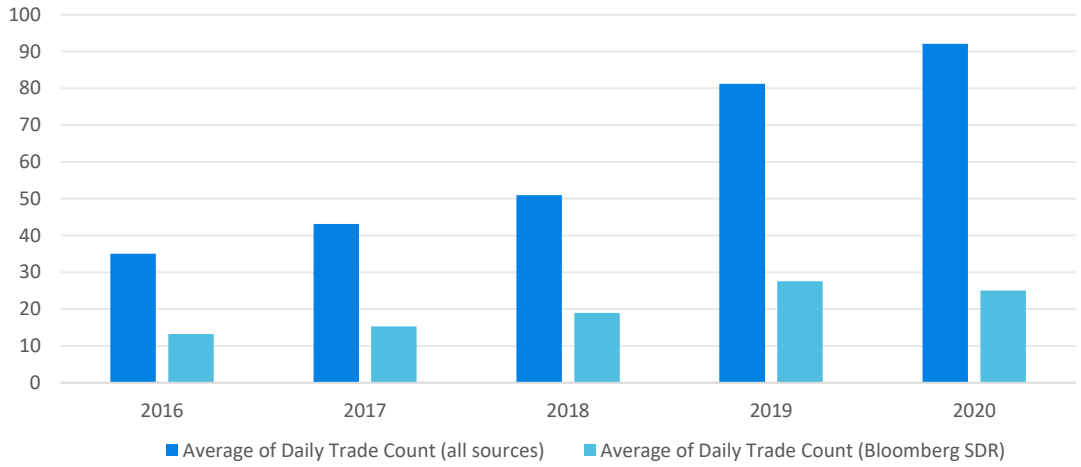


FIGURE 5: AVERAGE DAILY TRADE COUNT – 30Y SWAP



Over 2016–2020 both the average daily volume and trade count for 30Y swap point experienced an upward trend. According to Bloomberg SDR and Swapsinfo sources the average daily volume increased from ~ 600mio EUR to 1.4bln EUR over that period; the average daily trade count from 35 to 90. These levels are significantly above the thresholds set in the EIOPA assessment (50mio EUR notional and 10 trades, respectively).

As a side note, the data coming only from the Bloomberg SDR for 30Y point is already enough to comply with the depth and liquidity criteria. Between 2016 and 2020 the average daily volume according to that source has increased from 200mio EUR to 400mio EUR and the average daily trade count has gone from low 10s to 25.

We note the difference in 30Y point results with EIOPA assessment for 2016 and 2017. The figures in our analysis are somewhat lower, but that comes due to the following reasons:

- EIOPA had a wider coverage of the swap trade data via EMIR.
- The data obtained by EIOPA in 2016 and 2017 was scaled up to allow for trades not covered by data sources. The scaling factors were obtained from the triannual OTC derivative statistics of the Bank for International Settlement.

FIGURE 6: AVERAGE DAILY VOLUME AND TRADE COUNT – 40Y SWAP

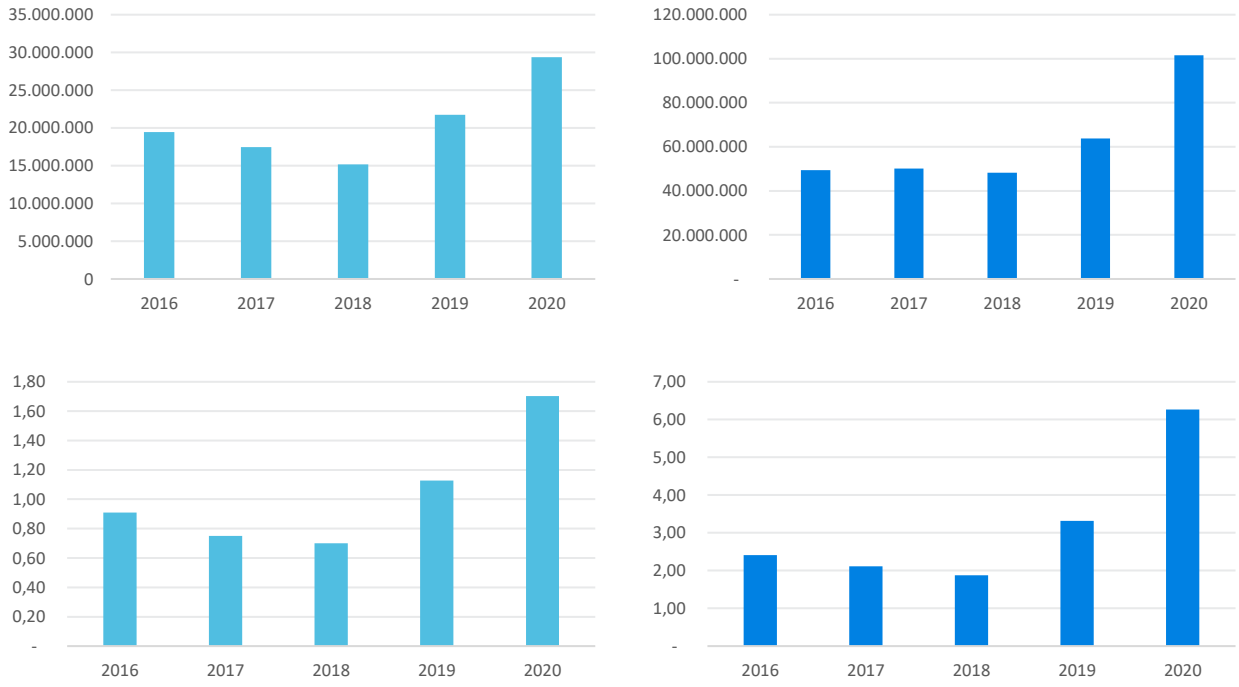
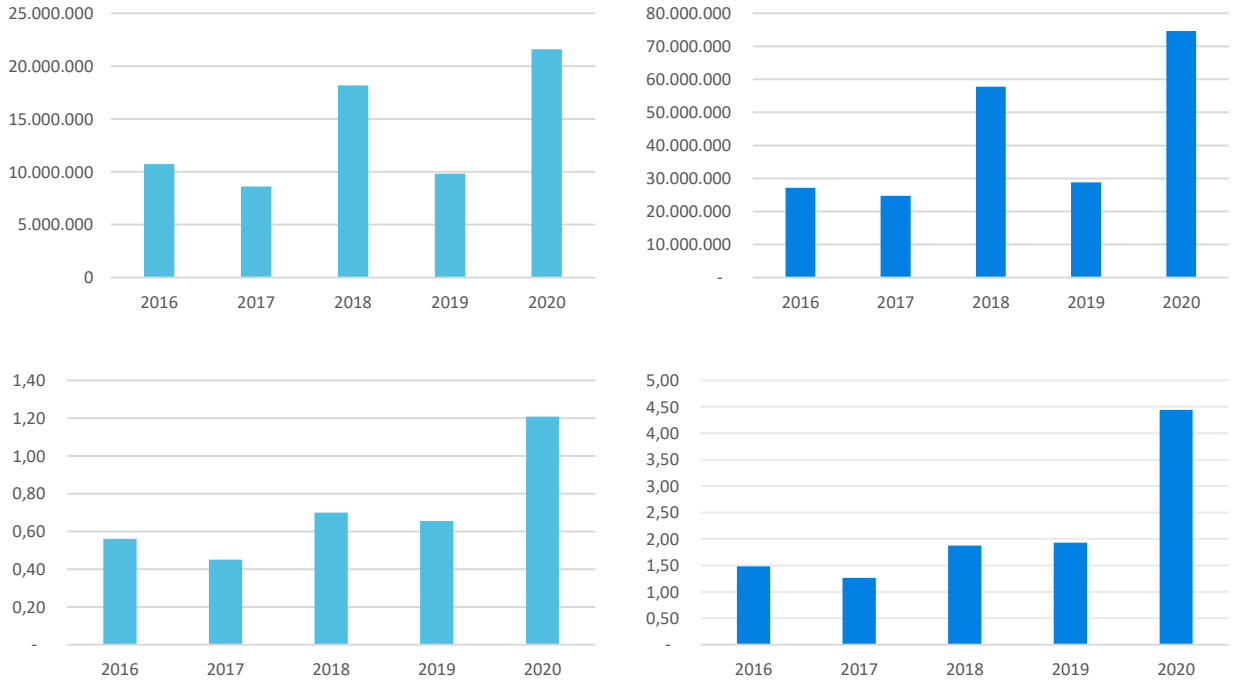


FIGURE 7: AVERAGE DAILY VOLUME AND TRADE COUNT – 50Y SWAP



In a similar manner to the 30Y point analysis we have assessed 40Y and 50Y EUR swap points for depth and liquidity criteria. Though the levels observed are just a fraction of the 30Y point there is still an upward moving trend in terms of both daily trade notional and trade count.

For 40Y point according to the DTCC and MIFID sources (with scaling factors) the average daily volume increased from ~50mio. EUR to 100mio. EUR over the 2016–2020 period; the average daily trade count – from 2 to 6. For 50Y point the average daily volume increased from ~25mio. EUR to 75mio. EUR over 2016–2020 period; the average daily trade count – from 1.5 to 4.5. We see a clear trend in rising levels, especially in 40Y point. In 2020 there was a significant spike in average daily notional and trade count across ultra-long end swaps.

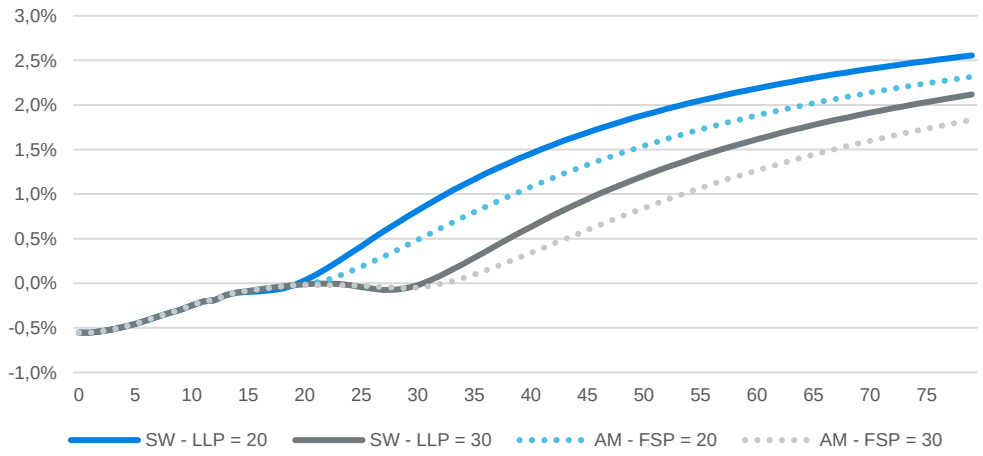
Impact on the Solvency II discount curves

DLT assessments can impact future Solvency II discount curve in several ways:

- With the Smith-Wilson method extrapolation method:
  - The inclusion/removal of liquid terms
  - A shift of the LLP
- With the alternative extrapolation method:
  - The inclusion/removal of liquid terms
  - A change to the FSP (First Smoothing Point, similar to the LLP in the SW method)
  - A change to the weights used in constructing the LLFR

From a practical perspective these curve dynamics will have implications for hedging. Notably, changes to the LLP and FSP would require significant portfolio rebalancing as key rate sensitivities change, especially around the LLP/FSP. The implications of the interest dynamics are visualized below in Figure 8.

FIGURE 8: A CHANGE OF THE LLP/FSP FROM 20 YEARS TO 30 YEARS



To understand the consequences of a shift to the LLP/FSP for hedging, we assess the sensitivities of key rates of the interest rate curve. Below are charts that plot base curves against key rate shocks for years 1, 2, 5, 10, 15, 20, 30, 40, and 50. Each curve represents the impact on an up shock to each of those key rates, leaving all others fixed, and then interpolating and extrapolating the full curve consistent with that single shocked value. Figure 9 shows the behaviour of the Smith-Wilson method, and Figure 10 shows the alternative method. In each of these cases, we look at the change relative to base to better draw out the differences between the two approaches, which is less apparent if we are looking at the curves directly.

FIGURE 9: SMITH-WILSON EXTRAPOLATION

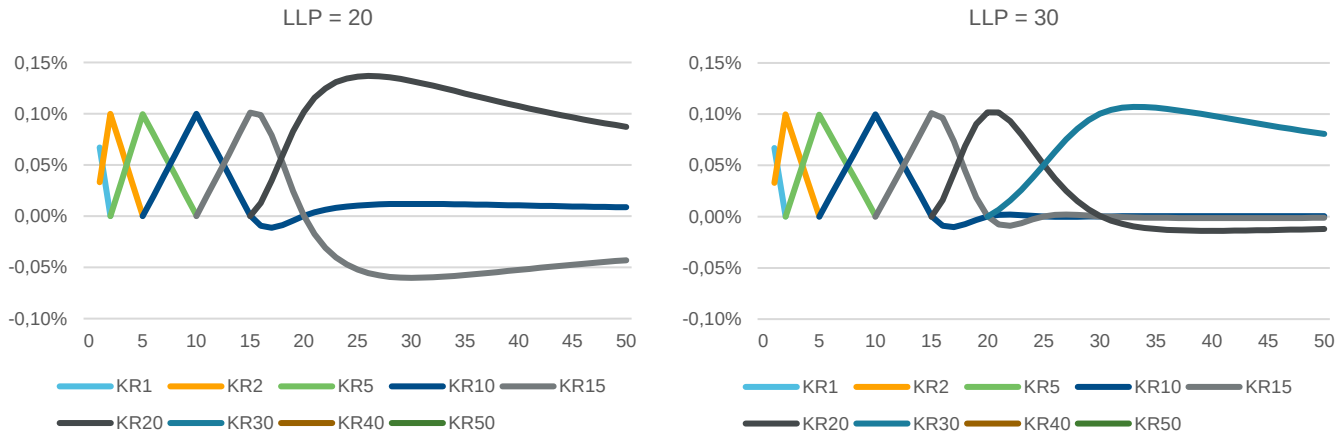
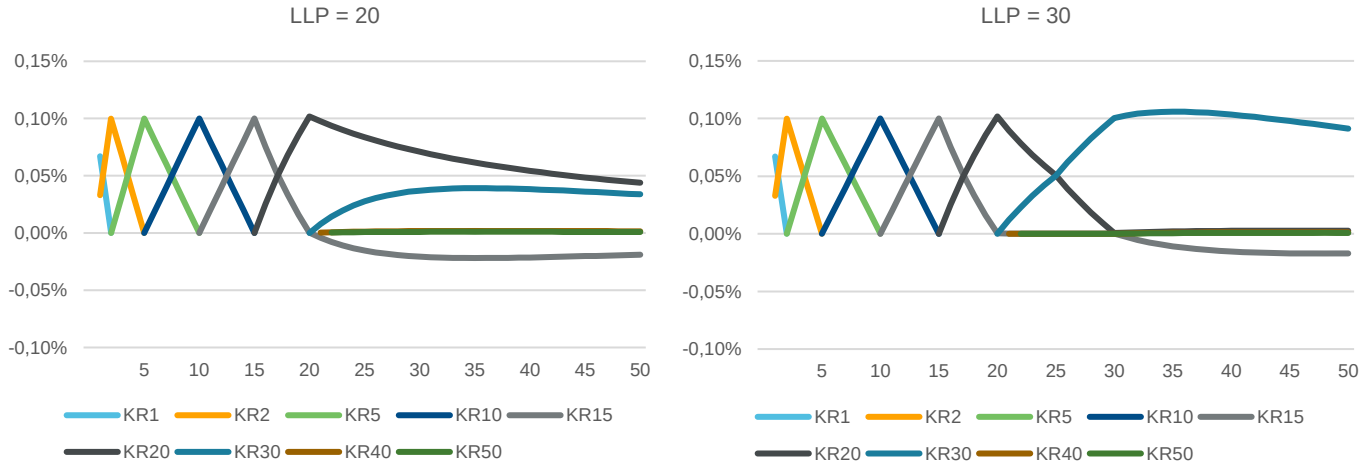


FIGURE 10: ALTERNATIVE EXTRAPOLATION



The graphs indicate that the sensitivities of the KR20 and KR30 change significantly as a result of a change to the LLP and FSP. The sensitivity to the 20Y reduces, but the sensitivity of the 30Y increases significantly. Overall, the sensitivity of the liability increases and would require an increase of the sensitivity of the asset portfolio.

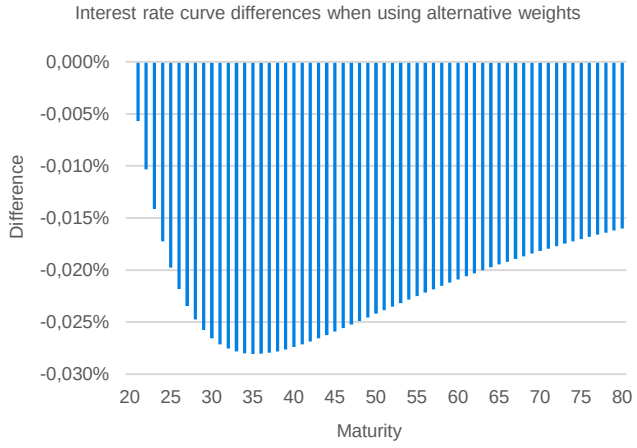
A CHANGE TO THE WEIGHTS USED IN CONSTRUCTING THE LAST-LIQUID FORWARD RATE

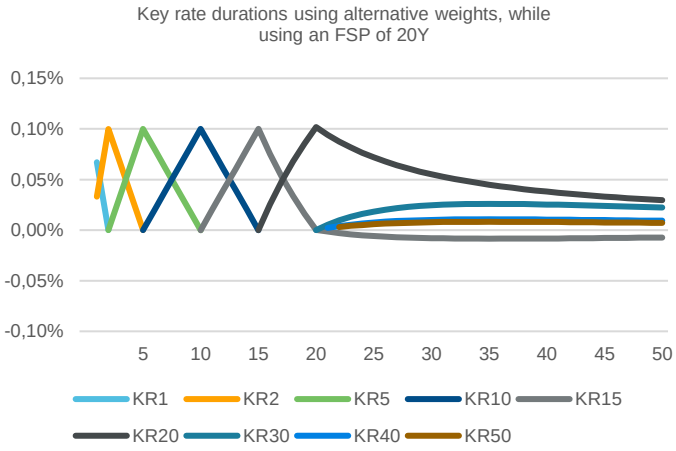
To reflect the impact of changes to the weights used in constructing the LLFR an alternative weight portfolio is created. The weight portfolio reflects the relative liquidity of the liquid terms beyond the FSP, which follow from the DLT assessment. In the alternative portfolio the weights of the longest maturities are increased at the expense of the shorter maturities. Note that the alternative portfolio does not necessarily reflect a realistic scenario, but aims to show the impact of a significant change to the weights on the interest rate curve.

FIGURE 11:

Bucket	Weights	Change	Alternative
15-20	0,330	-/-0,2	0,130
20-25	0,120	-	0,120
20-30	0,480	-/-0,2	0,280
20-40	0,040	+0,2	0,240
20-50	0,030	+0,2	0,230

FIGURE 12:





In this example the impact of changes to the weights on the level of the interest rate curve is relatively limited, below 3 bps. The impact on the curve is negative since the forward rates for 40Y and 50Y are below the 20Y and 30Y. However, the key rate sensitivities for 40Y and 50Y do increase, while the 20Y and 30Y decrease and would trigger a shift of the hedge portfolio. Note that with a further decrease of the UFR and potential slower speed of convergence this effect would be significantly larger.

Concluding remarks

In this paper, we refreshed EIOPA's DLT assessment to include market information from the last couple years. The goal was to determine how changing market liquidity may influence the construction of the Solvency II discount curve, both under the standard Smith-Wilson approach, and under the new Alternative Methodology. We observed that these changes will have practical implications for hedging. Specifically, changes to the LLP and FSP are likely to require substantial hedge portfolio rebalancing, especially around the LLP/FSP. While the impact to key rate duration appears small, that is more of a function of the current yield curve levels and is naturally also going to depend on the product being valued.

In our next paper, we will explore the dynamics of ratio hedging in more detail. Our focus will be on hedging over time, and how the changing weights implied by our DLT reassessment will affect hedge portfolio construction. We will conclude the series with a set of recommendations for how insurers can leverage the analysis we have performed into concrete ALM policies.

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