

# Transition in Sterling Non-Linear Derivatives referencing GBP LIBOR ICE Swap Rate (ISR)

The Working Group on Sterling Risk-Free Reference Rates

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## Introduction

1. The overall objective of the Working Group on Sterling Risk-Free Reference Rates (the "**Working Group**")<sup>1</sup> is to enable a broad-based transition to SONIA by the end of 2021 across the sterling bond, loan and derivative markets<sup>2</sup>. This will reduce the financial stability risks arising from widespread reliance on GBP LIBOR.
2. In November 2020, the Working Group, with the support of its Non-Linear Derivatives Task Force (NLTF), published a paper<sup>3</sup> describing how a non-linear derivative market, based on a risk-free rate, could be structured using compounded-in-arrears SONIA for a wide range of product sets. The paper considered how existing uncleared GBP LIBOR-referencing non-linear derivatives could transition to reference compounded-in-arrears SONIA in a manner consistent with the ISDA IBOR Fallbacks Protocol and IBOR Fallbacks Supplement. It also flagged an open market infrastructure issue from the discontinuation of ICE Swap Rates which could have implications for cash settled swaptions, as well as other products (e.g. constant maturity swaps), that rely on these as a component of their settlement processes.
3. Central counterparties clearing GBP LIBOR contracts are expected to cease clearing those contracts on the permanent cessation of GBP LIBOR, resulting in the inability of contract holders to exercise a GBP LIBOR-based swaption with cleared physical settlement. Under the current ISDA fallback terms, the settlement of such a contract will revert to cash settlement at a price ("Collateralised Cash Price"), which is calculated using the GBP LIBOR ICE Swap Rate (ISR). Discontinuation of the GBP LIBOR ISR, following the cessation of GBP LIBOR, will therefore have implications for all GBP LIBOR cash-settled or cleared-settled swaptions using those fallback terms, because all such swaptions become cash-settled and hence dependent on a published ISR being available.
4. Timothy J Bowler, President of ICE Benchmark Administration (IBA), discussed with the NLTF the potential for the new GBP SONIA ISR to be used as a building block to help settle legacy contracts written by reference to the GBP LIBOR ISR, as well as IBA's engagement with ISDA on this to facilitate a smooth transition.<sup>4</sup> On 15 December 2020, IBA subsequently launched the GBP SONIA ISR, which had been published daily in beta form since 2 October 2020.<sup>5</sup> The market is in the process of moving to incorporate this rate in new SONIA-based non-linear derivatives, facilitated by the publication of the GBP-SONIA Floating Rate Options by ISDA.<sup>6</sup>
5. The Working Group has always acknowledged the need to support the transition of legacy contracts<sup>7</sup> and the possible use of GBP swap rates such as the GBP SONIA ISR as a building block is consistent with this approach. The purpose of this paper is to document how the NLTF has been considering the use of SONIA swap rates to develop a potential methodology for a replacement for GBP LIBOR ISR.<sup>8</sup> This paper is intended to support market participants' use of non-linear derivatives, structured products and cash market instruments that reference the GBP LIBOR ISR, in their efforts to meet the target milestones in the Working Group's roadmap and priorities for 2021.<sup>9</sup>

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<sup>1</sup> The Bank of England and the Financial Conduct Authority (the "FCA") are each ex-officio members of the Working Group. The views and outputs set out in this document do not constitute guidance or legal advice from the Bank of England (including the Prudential Regulation Authority (the "PRA") or the FCA and are not necessarily endorsed by the Bank of England (including the PRA) or the FCA. This document is not intended to impose any legal or regulatory obligations on market participants. It does not constitute a comprehensive outline of all relevant considerations and is not a substitute for market participants' own research and professional advice.

<sup>2</sup> <https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/rfr-terms-of-reference.pdf>

<sup>3</sup> <https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/rfr/transition-in-sterling-non-linear-derivatives.pdf>

<sup>4</sup> [https://www.theice.com/publicdocs/IBA\\_Letter\\_GBP\\_RFR\\_WG-27\\_OCT\\_20.pdf](https://www.theice.com/publicdocs/IBA_Letter_GBP_RFR_WG-27_OCT_20.pdf)

<sup>5</sup> <https://ir.theice.com/press/news-details/2020/ICE-Benchmark-Administration-launches-GBP-SONIA-ICE-Swap-Rate-as-a-benchmark-for-use-by-licensees/default.aspx>

<sup>6</sup> [https://www.isda.org/a/L5fTE/Supplement-66-to-the-2006-ISDA-Definitions\\_GB-SONIA-Swap-Rate-FRO\\_Publication-Version.pdf](https://www.isda.org/a/L5fTE/Supplement-66-to-the-2006-ISDA-Definitions_GB-SONIA-Swap-Rate-FRO_Publication-Version.pdf)

<sup>7</sup> <https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/rfr/letter-to-ice-benchmark-administration-from-the-frwg-18-september-2020.pdf>

<sup>8</sup> Previously referred to as a 'synthetic' or 'legacy' GBP LIBOR ISR by the Working Group. This paper is based on analysis of the GBP ISRs developed by ICE. If market participants choose to use a GBP swap rate other than GBP SONIA ISR in their replacement for GBP LIBOR ISR, they would need to take account of any differences in their analysis.

<sup>9</sup> <https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/rfr/rfr-working-group-roadmap.pdf>

6. The replacement formula described in this paper could be adapted to other markets where the discontinuation of the relevant ISRs is likely to trigger similar challenges. The ARRC in the US has expressed an interest in this approach and, as a result, the NLTF on behalf of the Working Group and the ARRC have agreed to engage in an international collaboration aimed at addressing this topic amongst others.

### Replacement for GBP LIBOR ISR

7. A replacement for GBP LIBOR ISR can be constructed as follows:

- GBP SONIA ISR for relevant tenor, plus
- fixed spread adjustment, published by Bloomberg and applicable to GBP LIBOR fallbacks in Supplement 70 to the 2006 ISDA Definitions, based on the median of the differences between GBP LIBOR in the relevant tenor and SONIA compounded over each corresponding period over a static five-year period (ISDA Spread), plus
- the convexity adjustment calculation to compensate for the varying payment frequencies between the fixed and floating legs of the GBP SONIA ISRs and the GBP LIBOR ISRs.

8. The combination of these three components results in the following formula:

$$y^L = \begin{cases} 2 \left( (1 + y^{OIS})^{\frac{1}{2}} - 1 \right) + s^{6M} & \text{tenor} > 1Y \\ y^{OIS} + s^{3M} \frac{\left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)}{4} & \text{tenor} = 1Y \end{cases}$$

Where:

- $y^L$  is the replacement for the GBP LIBOR ISR;
- $y^{OIS}$  is the GBP SONIA ISR;
- $s^{6M}$  is the fixed ISDA Spread for the 6M GBP LIBOR rate; and
- $s^{3M}$  is the fixed ISDA Spread for the 3M GBP LIBOR rate.

9. The approximation needs to account for differences in convention between the GBP LIBOR ISR and the GBP SONIA ISR. Specifically, the formulation assumes:

- The GBP LIBOR ISR is
  - 6m ACT/365 Fixed vs 6m ACT/365 Floating for tenors > 1Y, and
  - 12m ACT/365 Fixed vs 3m ACT/365 Floating for the 1Y tenor.
- The GBP SONIA ISR is 12m ACT/365 Fixed vs 12m ACT/365 Floating for all tenors.

10. For a detailed explanation of this methodology, see appendix 1. Some back-testing and stress-testing analysis is presented in appendix 2.

11. Market participants should note that this formula is intended for use after the cessation or non-representativeness of GBP LIBOR. The formula assumes that the ISDA Spreads for the various GBP LIBOR tenors have been fixed as the result of an announcement regarding the cessation or non-representativeness of GBP LIBOR (as required by the fallbacks for GBP LIBOR in Supplement 70 to the 2006 ISDA Definitions). To apply this formula before the cessation or non-representativeness of GBP LIBOR would incur potential inconsistencies between the crystallised ISDA Spreads and the prevailing spreads between GBP LIBOR fixings and compounded SONIA for the respective tenors.

## Appendix 1: Derivation of the replacement for GBP LIBOR ISR and Worked Example

### Benchmark

12. As a benchmark, the LIBOR rates in the GBP LIBOR ISR formula are replaced by the daily compounded SONIA rates plus the fallback spread:

$$y^L = \frac{\sum_i \alpha_i^{L,FLOAT} \left( \frac{1}{\alpha_i^{L,FLOAT}} (\prod_j (1 + \beta_j r_j) - 1) + s \right) D_{i+1}}{\sum_i \alpha_i^{L,FIXED} D_{i+1}} \quad (1)$$

where  $\alpha^{L,FIXED} / \alpha^{L,FLOAT}$  are the daycount fractions for the fixed / floating legs using the LIBOR conventions,  $\beta_j$  are the daily daycount fractions associated to the SONIA rates,  $r_j$  are the daily SONIA rates,  $D_{i+1}$  are the payment date discount factors, and  $s$  is the fixed ISDA spread.

### Extending the Benchmark

13. Formula (1) can be re-written as:

$$y^L = \frac{\sum_i (\prod_j (1 + \beta_j r_j) - 1) D_{i+1} + s \sum_i \alpha_i^{L,FLOAT} D_{i+1}}{\sum_i \alpha_i^{L,FIXED} D_{i+1}} = y^{OIS} \frac{A^{OIS,FIXED}}{A^{L,FIXED}} + s \frac{A^{L,FLOAT}}{A^{L,FIXED}} \quad (2)$$

where  $y^{OIS}$  is the GBP SONIA ISR,  $A$  is the annuity and the superscripts denote whether it uses OIS or LIBOR conventions based on the fixed / floating legs.

14. The annuity ratios in formula (2) ensure that the differences in the fixed / floating payment frequencies between the OIS and LIBOR conventions are corrected for. The accrual basis is the same in both legs in GBP, so there is no need to correct for this.

15. Formula (2) can be re-written as:

$$y^L = \begin{cases} y^{OIS,6MFIXED} + s^{6M} & \text{tenor} > 1Y \\ y^{OIS} + s^{3M} \frac{A^{L,FLOAT}}{A^{L,FIXED}} & \text{tenor} = 1Y \end{cases} \quad (3)$$

where  $y^{OIS,6MFIXED}$  is the OIS swap rate with a 6M payment frequency on the fixed leg,  $s^{6M}$  is the fixed ISDA Spread for the 6M LIBOR rate, and  $s^{3M}$  is the fixed ISDA Spread for the 3M LIBOR rate.

## Approximations

16. In order to adjust for different payment frequencies, the following approximations are made:

$$(1 + y^{OIS}) \approx \left(1 + \frac{y^{OIS,6MFIXED}}{2}\right)^2 \quad (4)$$

$$(1 + y^{OIS}) \approx \left(1 + \frac{y^{OIS,3MFIXED}}{4}\right)^4 \quad (5)$$

17. The term  $\frac{A^{L,FLOAT}}{A^{L,FIXED}} \approx 1$  for the 1Y swap tenor if  $y^{OIS} = 0$ . Otherwise,

$$\frac{A^{L,FLOAT}}{A^{L,FIXED}} = \frac{y^{OIS}}{y^{OIS,3MFIXED}} \approx \frac{y^{OIS}}{4 \left( (1 + y^{OIS})^{\frac{1}{4}} - 1 \right)} \quad (6)$$

## Replacement for GBP LIBOR ISR formula

18. The replacement formula is given by:

$$y^L = \begin{cases} 2 \left( (1 + y^{OIS})^{\frac{1}{2}} - 1 \right) + s^{6M} & \text{tenor} > 1Y \\ s^{3M} & \text{tenor} = 1Y, y^{OIS} = 0 \\ y^{OIS} + s^{3M} \frac{y^{OIS}}{4 \left( (1 + y^{OIS})^{\frac{1}{4}} - 1 \right)} & \text{tenor} = 1Y, y^{OIS} \neq 0 \end{cases} \quad (7)$$

19. The formula for the 1Y tenor can be simplified as follows:

$$\begin{aligned} \frac{y^{OIS}}{4 \left( (1 + y^{OIS})^{\frac{1}{4}} - 1 \right)} &= \frac{y^{OIS} \left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right)}{4 \left( (1 + y^{OIS})^{\frac{1}{4}} - 1 \right) \left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right)} \\ &= \frac{y^{OIS} \left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)}{4 \left( (1 + y^{OIS})^{\frac{1}{2}} - 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)} \\ &= \frac{y^{OIS} \left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)}{4 \left( (1 + y^{OIS}) - 1 \right)} \\ &= \frac{\left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)}{4} \end{aligned} \quad (8)$$

20. The replacement formula for the GBP LIBOR ISR  $y^L$ , is then given by:

$$y^L = \begin{cases} 2 \left( (1 + y^{OIS})^{\frac{1}{2}} - 1 \right) + s^{6M} & \text{tenor} > 1Y \\ y^{OIS} + s^{3M} \frac{\left( (1 + y^{OIS})^{\frac{1}{4}} + 1 \right) \left( (1 + y^{OIS})^{\frac{1}{2}} + 1 \right)}{4} & \text{tenor} = 1Y \end{cases} \quad (9)$$

where  $y^{OIS}$  is the GBP SONIA ISR,  $s^{6M}$  is the fixed ISDA Spread for the 6M LIBOR rate, and  $s^{3M}$  is the fixed ISDA Spread for the 3M LIBOR rate.

#### Worked Example: 10Y Replacement Rate

21. Suppose the cessation event for the 6M GBP LIBOR rate has been announced and the ISDA Spread has been set to 0.00240. Also, suppose the ICE 10Y GBP SONIA ISR fixing is given by 0.01252.
22. The replacement for the 10Y GBP LIBOR ISR fixing can be obtained using formula (9):

$$2 \left( (1 + 0.01252)^{\frac{1}{2}} - 1 \right) + 0.0024 = 0.01488$$

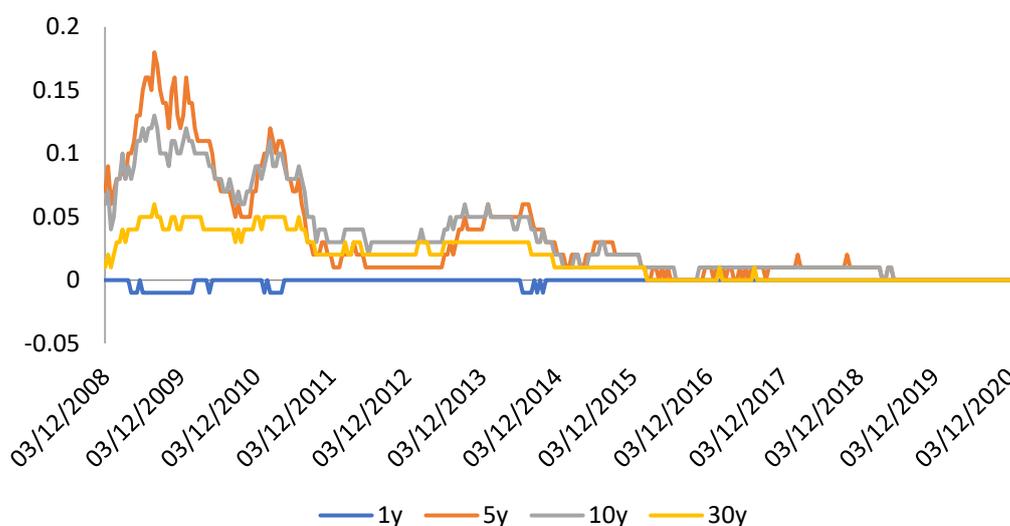
## Appendix 2: Back Testing and Stress Testing

23. The following sections summarise some analysis on the practical application of the replacement for GBP LIBOR ISR performed by members of the NLTF. However, market participants are strongly encouraged to perform their own analysis in order to build market confidence in this, or any alternative, approach.

### Back Testing

24. In order to test the accuracy of the replacement for GBP LIBOR ISR, the difference between the replacement formula (9) and the benchmark (1) are computed using data from Dec 2008 to today and estimates of the fall-back spreads:

Figure 1: Difference of Swap Rates ( [ Formula ] – [ RFR + Spread ] ) in basis points



25. The differences are less than 0.175 basis points.

### Stress Testing

26. In order to test the replacement for GBP LIBOR ISR under stressed market conditions, stressed scenarios are computed as follows:

- A sparse curve made up of 2Y, 2Y3Y, 5Y5Y, and 10Y20Y instruments is created.
- PCA analysis is run on historical market moves generated by these instruments.
- Stresses to the first three PCA vectors are computed. These PCA vectors correspond roughly to level, tilt, and curvature.
- The corresponding moves on 1Y, 5Y, 10Y, 30Y instruments are then computed.

27. The difference between the replacement formula and the benchmark using data from 29-10-20 can be found below. The data shows that the largest difference is around 0.6 basis points.

Figure 2: PCA Vector 1. Difference of Swap Rates ( [ Formula ] – [ RFR + Spread ] ) in basis points

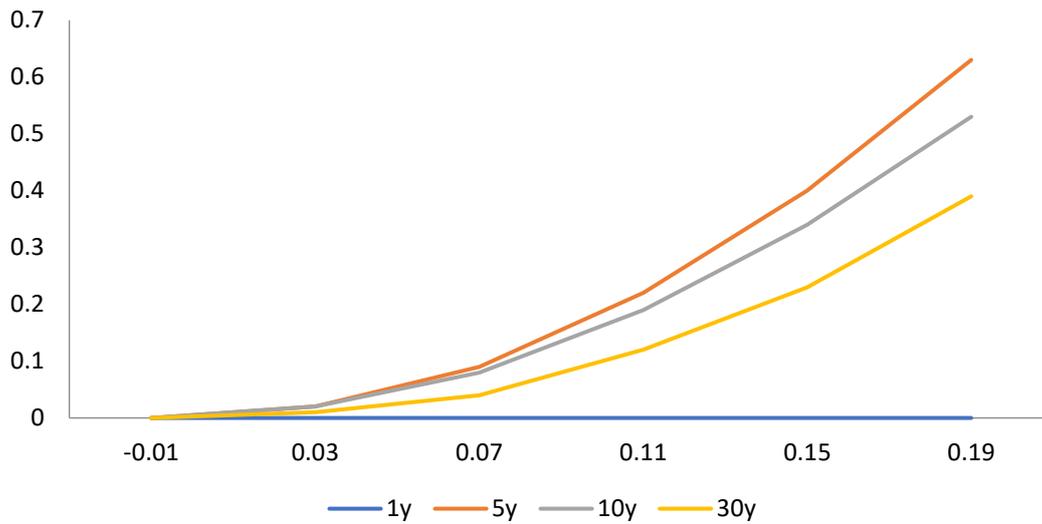


Figure 3: PCA Vector 2. Difference of Swap Rates ( [ Formula ] – [ RFR + Spread ] ) in basis points

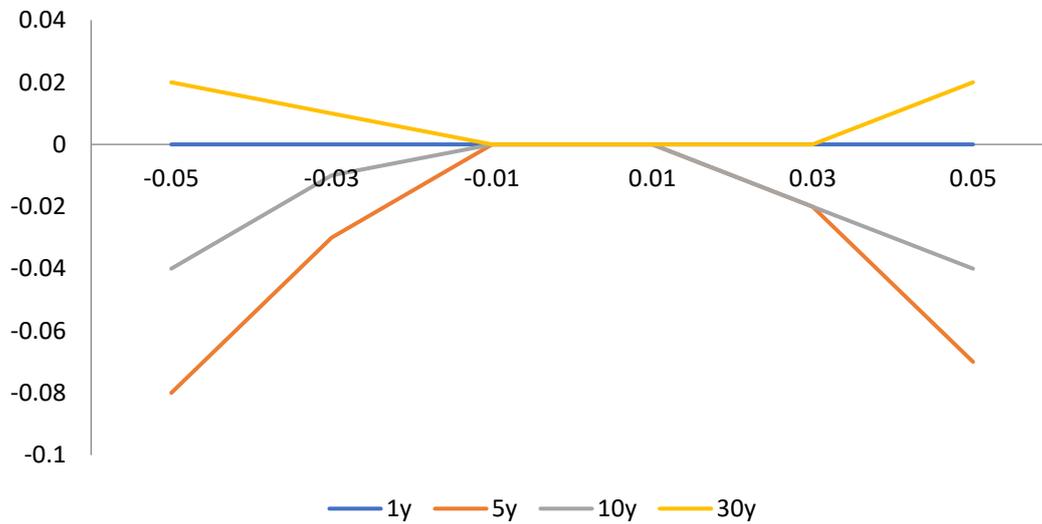
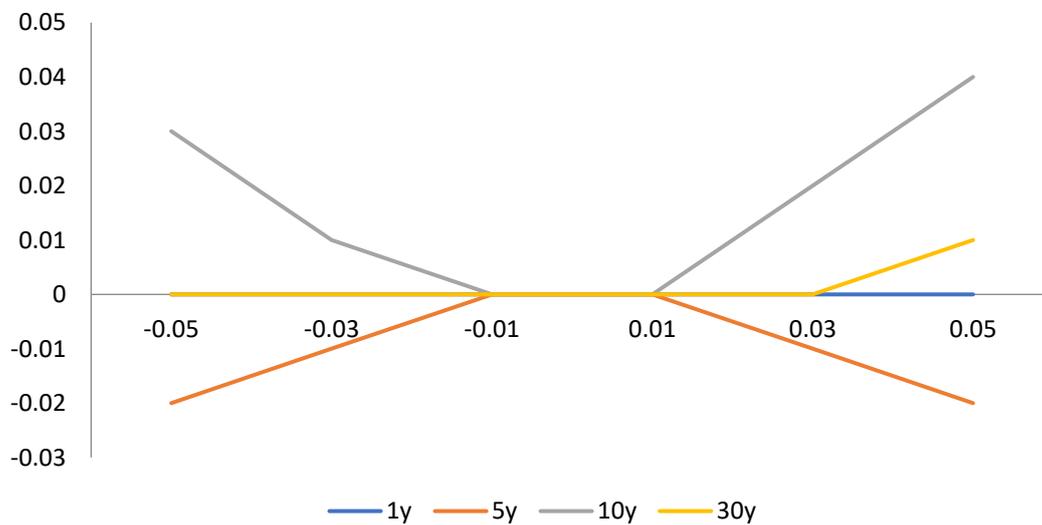
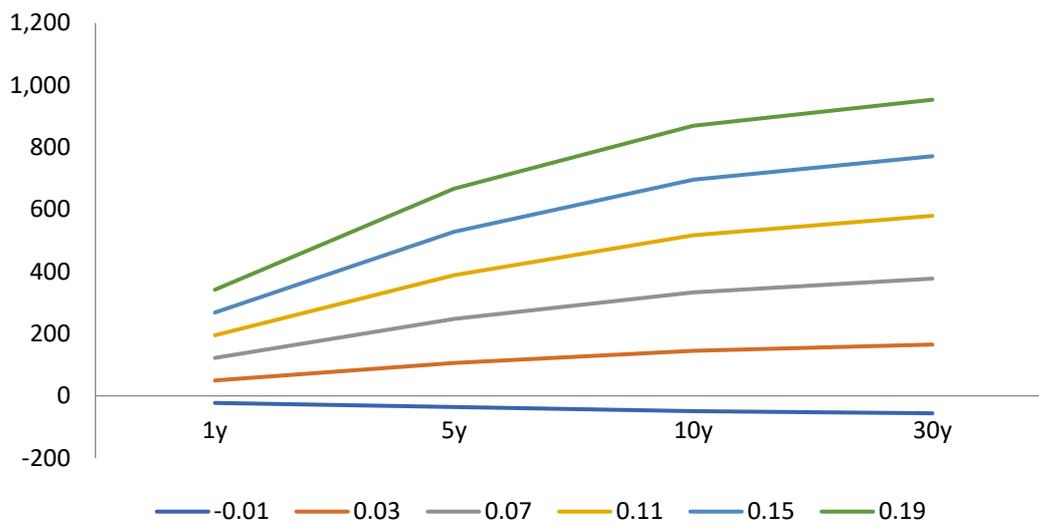


Figure 4: PCA Vector 3. Difference of Swap Rates ( [ Formula ] – [ RFR + Spread ] ) in basis points



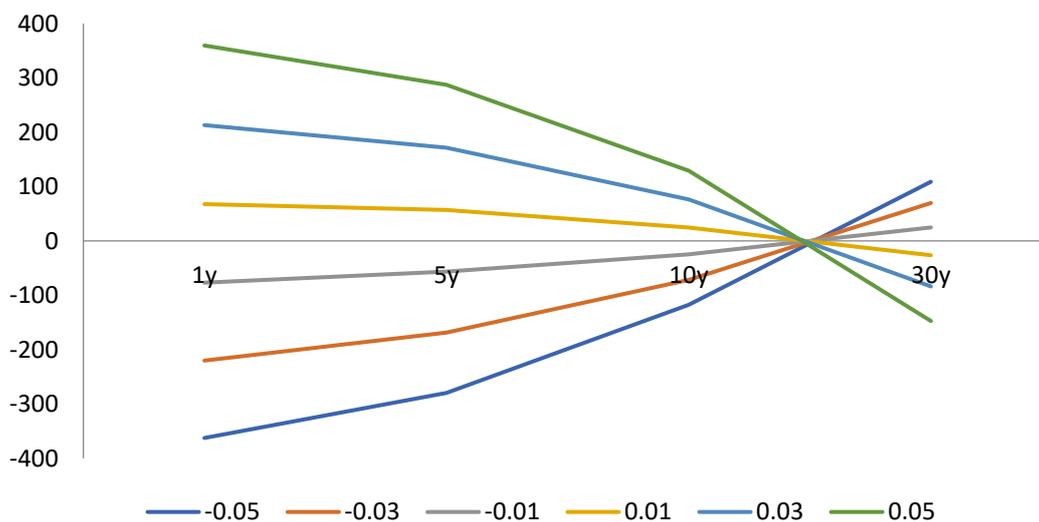
PCA Scenarios

Figure 5: PCA Vector 1. Change in Swap Rates in basis points.



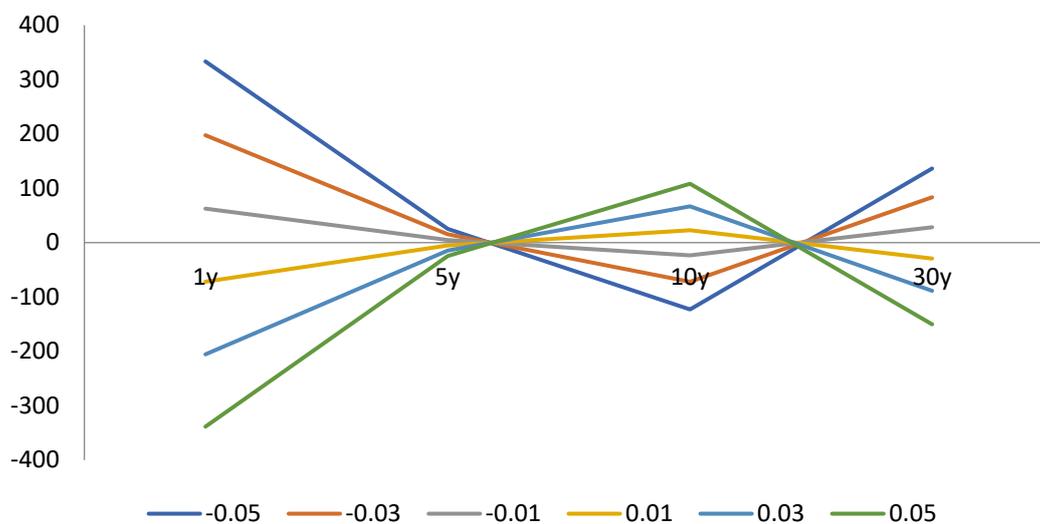
PCA Vector 1 shift	-0.01	0.03	0.07	0.11	0.15	0.19
1y	-22.74	49.58	122.20	195.11	268.31	341.80
5y	-35.54	106.39	247.70	388.34	528.30	667.56
10y	-48.78	144.60	333.20	516.91	695.72	869.64
30y	-56.05	165.19	377.47	579.63	771.44	953.37

Figure 6: PCA Vector 2. Change in Swap Rates in basis points.



PCA Vector 2 shift	-0.05	-0.03	-0.01	0.01	0.03	0.05
1y	-362.51	-220.13	-76.75	67.63	213.02	359.42
5y	-279.43	-168.57	-56.50	56.81	171.36	287.15
10y	-117.59	-71.94	-24.44	24.92	76.19	129.38
30y	108.79	69.77	24.79	-26.34	-83.70	-147.28

Figure 7: PCA Vector 3. Change in Swap Rates in basis points.



PCA Vector 3 shift	-0.05	-0.03	-0.01	0.01	0.03	0.05
1y	333.31	197.61	62.58	-71.78	-205.48	-338.49
5y	25.41	15.12	5.00	-4.95	-14.71	-24.29
10y	-122.90	-71.97	-23.40	22.83	66.75	108.38
30y	136.30	83.77	28.51	-29.05	-88.63	-150.05