Development of IFRS 17 Compliant Discount Rates for The Bahamas

December 2023

INSURANCE COMMISSION
OF THE BAHAMAS

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Executive Summary

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- Bahamas Government Registered Stock (BGRS) Secondary Market Prices information published by the Central Bank of The Bahamas was the main data source.

- BRS are bonds issued by the Govt. of The Bahamas. They can have a maturity date of up to 30 years.

- Our recommendations for the development of IFRS 17 Compliant Discount Rates:
  - use of the commonly used Nelson-Siegel-Svensson parametric model
  - last observable point of 28 years
  - deduction for Government of Bahamas sovereign risk based on the credit rating
  - average historical long term bond yields for setting the ultimate rate
  - linear interpolation method to interpolate from the last observable point to the ultimate rate over a 5-year period
  - use of the spot curve based on bid yields as the risk-free curve for liquid insurance contracts
  - spot curve for illiquid contracts based on a flat adjustment to the curve for liquid contracts

Project Objectives

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Develop IFRS 17 compliant reference curves to aid the ICB in its supervision of the insurance industry

- Valuation of liquid and illiquid insurance contracts
- Bahamian currency curves
- Assess reasonableness of the discount curves used by insurance companies

Overview of Model Development

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1. Use case review
- Accounting standards, actuarial guidance, market practice

2. Data sources
- Review of existing and alternative data sources

3a. Bond Universe
- Review existing and agree upon aggregate bond universe and all justifiable subsets

3b. Fitting approach
- Review model fitting approaches

3c. Parameter Selection
- Last Observable Point
- Ultimate Risk Free Rate
- Sovereign Credit Risk Adjustment

3d. Interpolation approach
- Review approaches to interpolating from the last observable point to the risk free ultimate rate

4. Model testing
- Back testing, comparisons and stress testing

1. Use Case Review

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IFRS 17 Standards

- Discount rates shall be consistent with observable current market prices
- Exclude the effect of factors that influence such observable market prices but do not affect future insurance cash flows
- Where rates are not observable, an entity shall estimate the rates. This process will entail judgement
- The discount rate should reflect the yield curve in the appropriate currency for instruments that expose the holder to no or negligible credit risk, adjusted to reflect the liquidity characteristics of the insurance contracts

Actuarial guidance

- IAN100 Chapter 3 provides guidance on how to set IFRS17 compliant discount rates including approaches to determining the ultimate rate and illiquidity premium
- CIA Educational Note *IFRS 17 Discount Rates for Life and Health Insurance Contracts* as modified by the supplement *Changes to the Reference Curves' Ultimate Risk-free Rate Development Approach Outlined in the Committee on Life Insurance Financial Reporting's Educational Note on IFRS 17 Discount Rates* provides guidance on all aspects of setting the discount rate

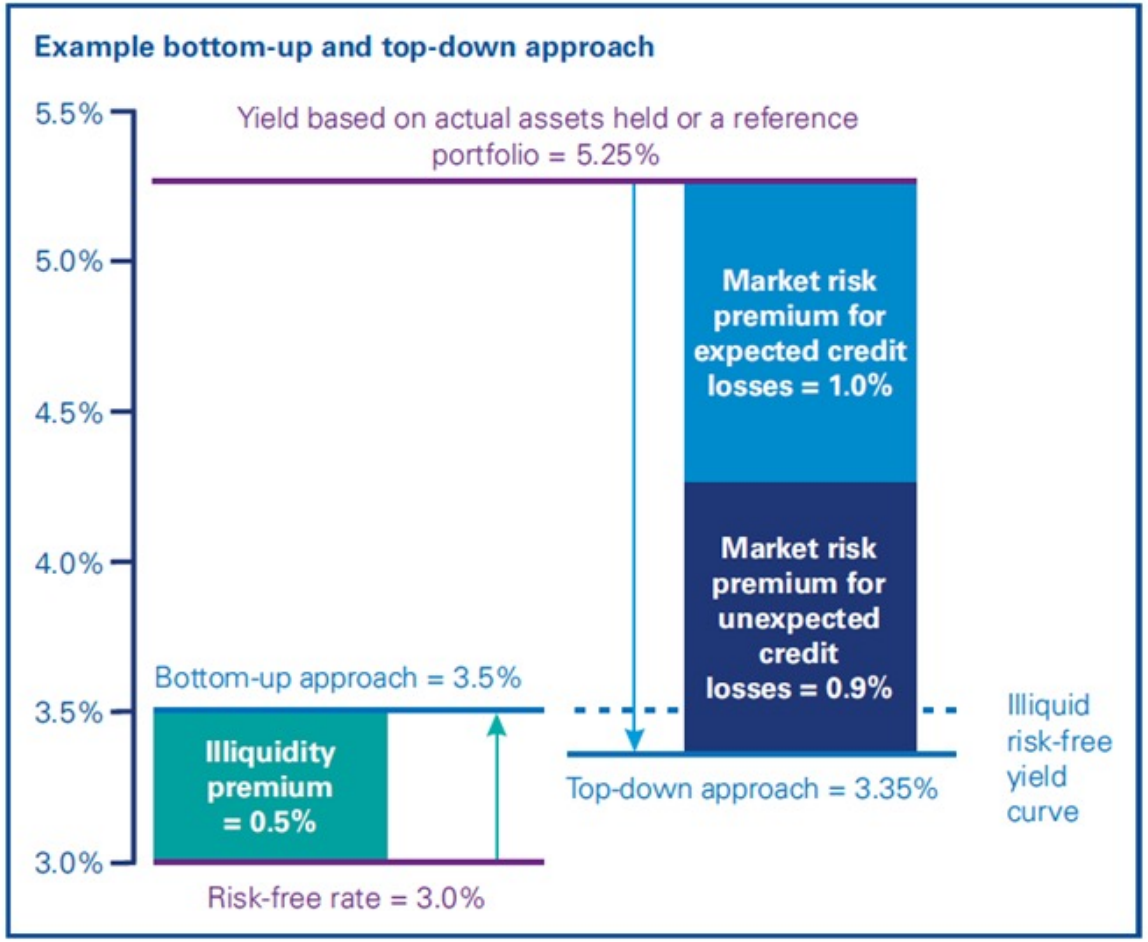
Bottom-up versus Top-down

Bottom-up

- **Risk free rates** based on highly liquid bonds with **little or no credit risk**

  +

- **Illiquidity premium** adjustment for the liquidity difference between insurance contracts and highly liquid bonds



Top-down

- Yield curve based on asset portfolio
- Adjusted to eliminate factors not relevant to the insurance contracts e.g. credit risk premium
- No adjustments needed for liquidity differences

The bottom-up approach will be used to develop IFRS 17 compliant discount rates.

2. Data Sources

- BGRS data* from Secondary Market Prices information published by the Central Bank of The Bahamas https://www.centralbankbahamas.com/news/brs-secondary-market-prices

Other data:

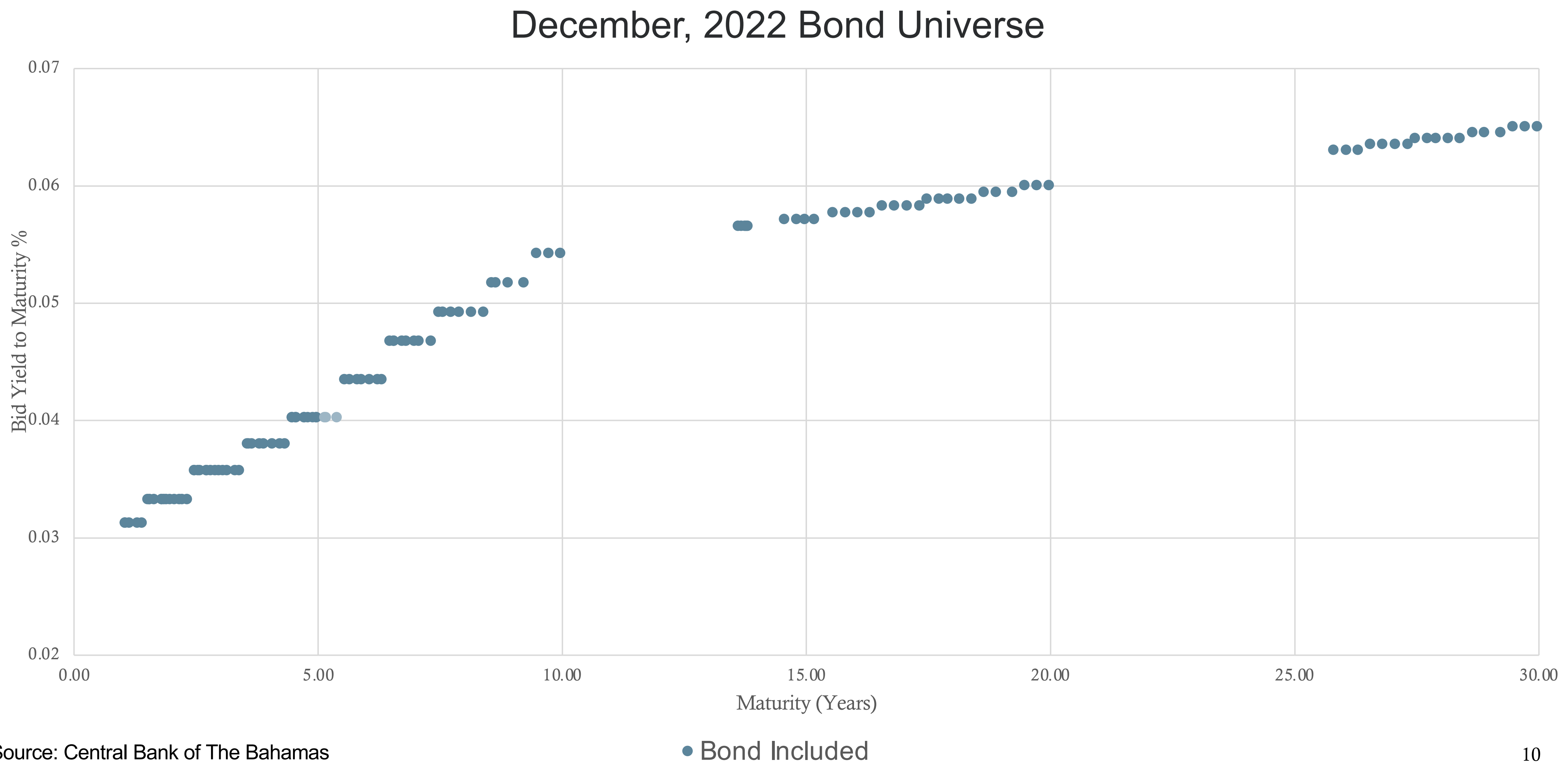
- Sovereign default and recovery studies produced by Moody's and Standard and Poor's
- Historical GDP growth, historical inflation and GDP growth forecast from the World Bank and IMF
- Government of Bahamas Treasury Bill Yields https://www.centralbankbahamas.com/news/t-bill-auction-results
- Historical Residential Mortgages interest rates https://www.centralbankbahamas.com/money-credit-aggregates
- Bahamas Registered Stock IPOs https://www.centralbankbahamas.com/news/bahamas-registered-stock-ipo-s

*We note that the BGRS Secondary market data as provided by the Central Bank is priced at mid-month dates. Therefore, the curves resulting from our model are effective at mid-month dates.

3a. Bond Universe

- Bahamian $ denominated Bahamas Government Registered Stock (BGRS).
- Qualifying securities must have a fixed coupon schedule (for example, any bonds with optionality features are removed).
- All bonds included regardless of the amounts outstanding or when they were issued as we want to include as many data points as possible to support a robust construction of the curve.
- Outliers (e.g. bonds with very high or low relative yields) are removed. The key question is how to agree what constitutes an outlier and also noting we do not wish to materially reduce the size of the bond universe. These were identified through a filtering process which carried out checks on implied market yields.

3a. Bond Universe



Source: Central Bank of The Bahamas

3b. Fitting Approach: Parametric model

- There are a number of parametric models and spline-based models that are commonly used for the purpose of fitting the term structure of interest rates. We recommend adoption of a parametric model given it is relatively simple to implement and various papers have shown that these perform as well as, if not better than spline based models. In addition, parametric models involve less user judgement (no need to select smoothing parameters, penalty functions or knot points) and are more transparent and easier to interpret[1]
- The two most commonly used parametric models are those presented by Nelson and Siegel (1987)[2] and Svensson (1994)[3], commonly referred to as the Nelson-Siegel model and the Nelson-Siegel-Svensson model respectively. These models are used by Central Banks around the world, and many other market participants
- The Nelson-Siegel-Svensson model is an extension of the Nelson-Siegel model and is more sophisticated than its predecessor. As computing power has increased the use of the Nelson-Siegel-Svensson model now dominates and so we recommend the use of this model

1. European Central Bank Statistics Paper Series: Yield curve modelling and a conceptual framework for estimating yield curves: evidence from the European Central Bank's yield curves. No 27/February 2018
2. "Parsimonious Modeling of Yield Curves." Journal of Business 60: 473–489.
3. "Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994." Centre for Economic Policy Research, Discussion Paper 1051.

3b. Fitting Approach: Estimation technique

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- It is generally not appropriate to estimate the spot curve using only yield to maturity data, as this measure is strongly influenced by each bond's coupon rate (a coupon bias)
- Instead, we aim to replicate the market prices or market yields of the bonds in our universe, using an estimated spot curve
- We will use statistical regression techniques to estimate the spot curve. A standard approach is to aim to minimize the sum of squared errors (between the market prices / yields and the estimated prices / yields) which we recommend using
- Minimizing price errors sometimes results in large yield errors for bonds with short maturities, because prices are very insensitive to yields for short maturities. Similarly, minimizing yield errors sometimes results in overfitting at longer maturities because longer bonds are very sensitive to differences in yields
- We recommend a balanced approach which minimizes prices errors, but we also apply a weighting to the price errors. The appropriate weighting is a value related to the inverse of the bond's duration[1]
- Constraints are applied to the fitting parameters to ensure stable and consistent curves are estimated

1. Bank of Canada. Technical Report No. 84. Yield Curve Modelling at the Bank of Canada.

December 2022 Example Curve

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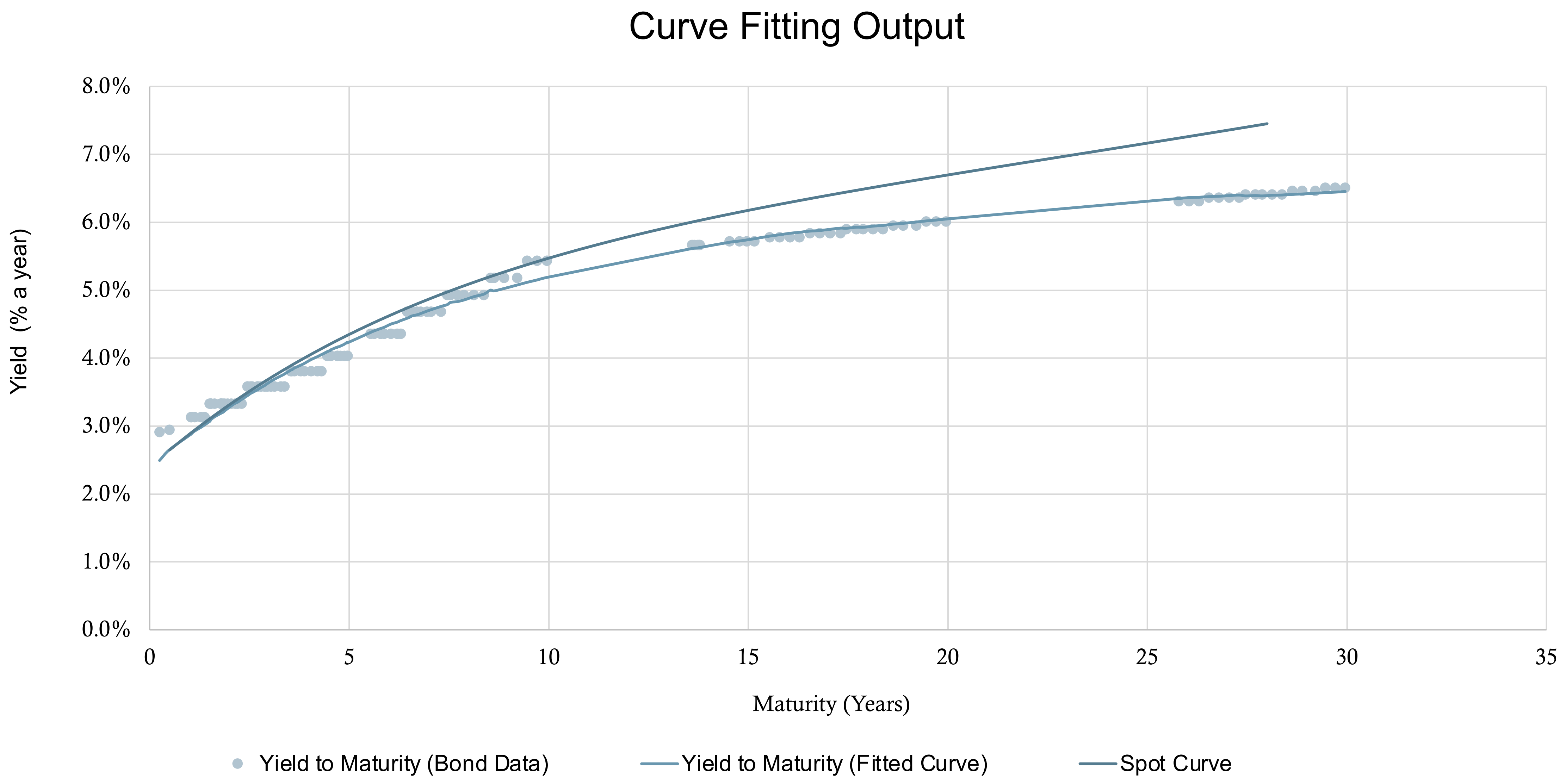

3c. Parameter Selection: Last Observable Point

The last observable point would correspond to the term of the asset with the longest maturity for which there is a quoted price from an active market. IFRS 13 defines an active market as a market in which transactions for an asset take place with sufficient frequency and volume to provide pricing information on an ongoing basis

Possible approaches:

- Select the term where the amount of assets in excess of that term compared to the total outstanding amount of assets is below a certain percentage (6% established by the CIA Educational Note)
- Assessment of liquidity via bid ask spreads.
- Assessment of trading volumes at the various terms.

3c. Parameter Selection: Last Observable Point

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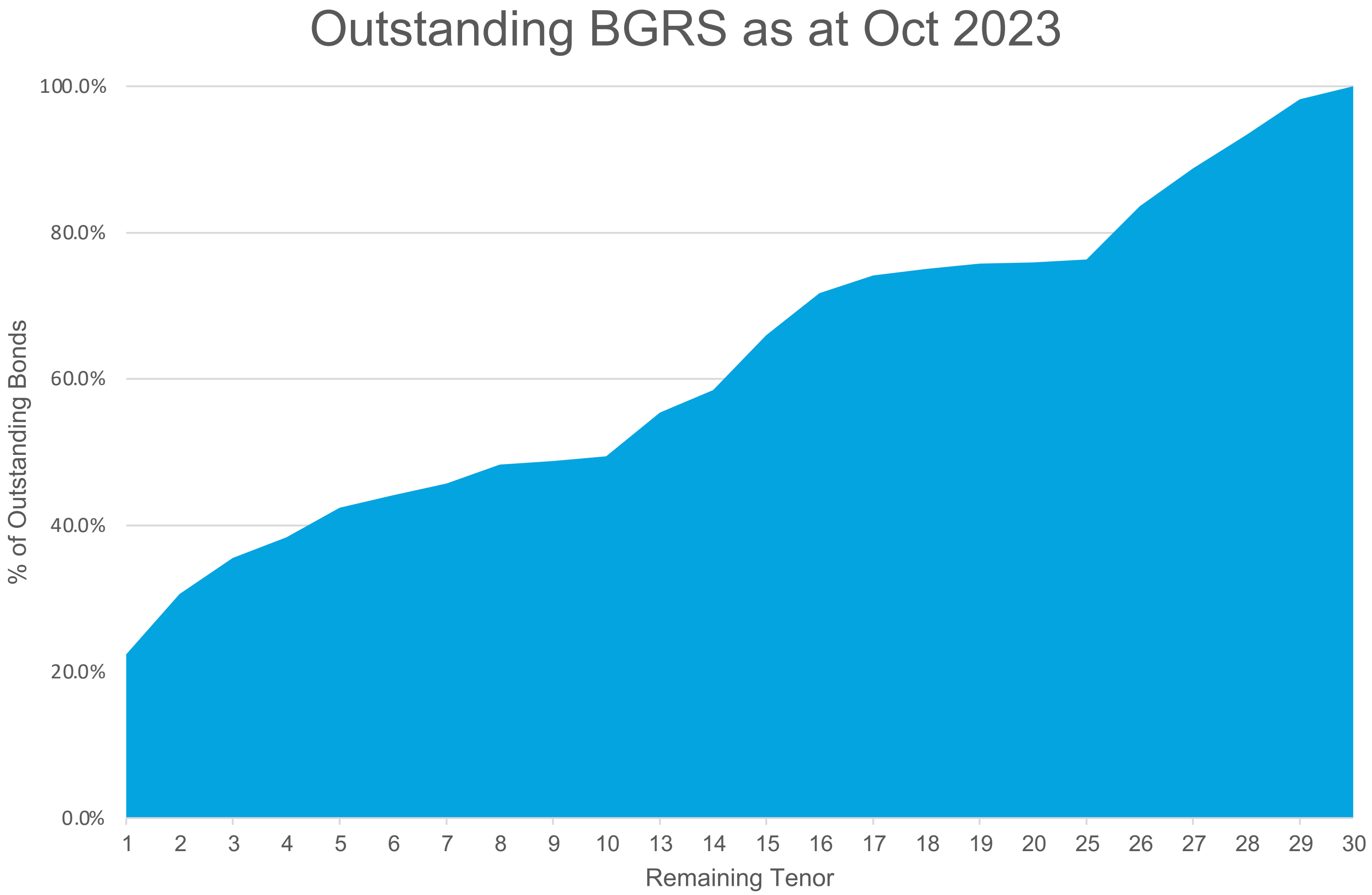

Term	% of outstanding bonds
< 30	100%
< 28	93%
< 20	76%

Recommendation: **28 years**

Note that all data is used to derive the curve however we consider that the curve is reliable up to 28 years.

3c. Parameters: Sovereign Credit Risk Adjustment

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IFRS 17 B79:
The discount rate should reflect the yield curve in the appropriate currency for instruments that expose the holder to no or negligible credit risk adjusted to reflect the liquidity characteristics of the insurance contracts.

Credit risk adjustment calculated as:
Expected Credit Loss (ECL) + Unexpected Credit Loss (UCL)

There are a variety of different approaches for measuring the impact of credit risk, but IFRS 17 methodologies largely focus on corporate credit risk rather than sovereign credit risk. We recommend an approach based on sovereign credit ratings and published sovereign default studies which is less subjective and will provide a more stable output.

3c. Parameters: Sovereign Credit Risk Adjustment

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Expected credit loss(t) = (1- (1-cumulative PD(t))^(1/t)) * LGD

PD = probability of default
Based on S&P's 2022 Annual Global Sovereign Default and Rating Transition Study of local currency defaults for B rated sovereigns
Moody's study did not differentiate between local and foreign currency defaults

LGD = loss given default
36%
Based on the average LGD for countries in the Caribbean region from Moody's study Sovereign default and recovery rates 1983 – 2022.

Credit Ratings

Moody's	S&P
Aaa	AAA
Aa1	AA+
Aa2	AA
Aa3	AA−
A1	A+
A2	A
A3	A−
Baa1	BBB+
Baa2	BBB
Baa3	BBB−
Ba1	BB+
Ba2	BB
Ba3	BB−
B1	B+
B2	B
B3	B−
Caa	CCC
Ca	CC
C	C
	D

Credit ratings as at December 31, 2022:

- Moody's: B1
- S&P: B+

Credit ratings can sometimes vary between the agencies
The proposed methodology allows for the use of the ratings from both agencies

3c. Parameters: Sovereign Credit Risk Adjustment

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Expected credit loss adjustment by credit rating

- Steep jumps observed from BB -> B -> CCC

Year/ Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AAA	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
AA	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.03%	0.04%	0.05%	0.06%
A	0.00%	0.00%	0.03%	0.06%	0.08%	0.10%	0.11%	0.12%	0.13%	0.15%	0.16%	0.17%	0.18%	0.19%	0.20%
BBB	0.00%	0.08%	0.11%	0.11%	0.10%	0.10%	0.12%	0.12%	0.12%	0.11%	0.10%	0.09%	0.08%	0.08%	0.07%
BB	0.16%	0.21%	0.17%	0.15%	0.16%	0.19%	0.19%	0.22%	0.24%	0.24%	0.25%	0.26%	0.27%	0.28%	0.28%
B	0.52%	0.54%	0.56%	0.53%	0.52%	0.51%	0.50%	0.51%	0.49%	0.50%	0.50%	0.49%	0.48%	0.48%	0.49%
CCC/ CC	4.30%	2.56%	2.02%	2.05%	2.12%	2.25%	2.17%	1.91%	1.70%	1.53%	1.61%	1.48%	1.37%	1.27%	1.19%

To add stability to the method, the table was expanded to include additional rows using linear interpolation to reflect the rating modifiers. For example, BB- and B+ was inserted between rows BB and B allowing the change from BB to B to be split over 3 steps.

3c. Parameters: Sovereign Credit Risk Adjustment

Expected credit loss adjustment for credit rating B to BB including modifiers

Year/ Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BB	0.16%	0.21%	0.17%	0.15%	0.16%	0.19%	0.19%	0.22%	0.24%	0.24%	0.25%	0.26%	0.27%	0.28%	0.28%
BB-	0.28%	0.32%	0.30%	0.28%	0.28%	0.29%	0.30%	0.31%	0.32%	0.33%	0.33%	0.33%	0.34%	0.35%	0.35%
B+	0.40%	0.43%	0.43%	0.40%	0.40%	0.40%	0.40%	0.41%	0.41%	0.41%	0.41%	0.41%	0.41%	0.42%	0.42%
B	0.52%	0.54%	0.56%	0.53%	0.52%	0.51%	0.50%	0.51%	0.49%	0.50%	0.50%	0.49%	0.48%	0.48%	0.49%

Rating	Average ECL over all years
BB	0.22%
BB-	0.31%
B+	0.41%
B	0.51%

3c. Parameters: Sovereign Credit Risk Adjustment

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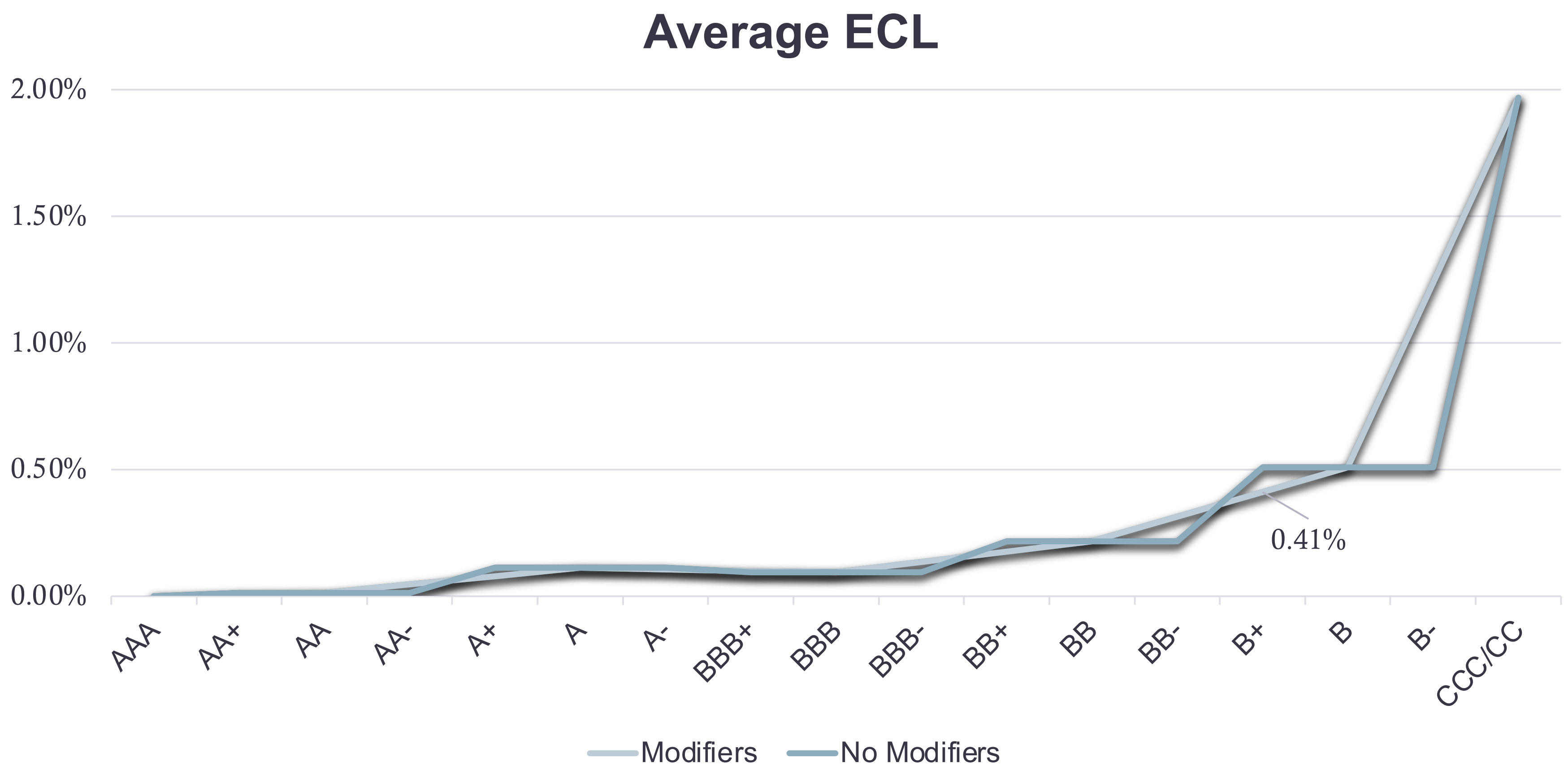

Adjustment for ECL is calculated as 0.41% as both credit agencies have rated Bahamas B+ or B1.

3c. Parameters: Sovereign Credit Risk Adjustment

Adjustment for unexpected credit loss is based on judgement

Unexpected credit loss(t) = 100% of the expected credit loss(t)

This approach was one of the approaches tested in the CIA Educational Note *IFRS 17 Discount Rates for Life and Health Insurance Contracts Appendix 3* and is listed as an approach observed in use by insurers in IAN100 Chapter 3 3.19.

Total adjustment for credit risk:

- A flat 0.82% adjustment at all durations is proposed as at December 2022
- Calculated as 0.41% ECL + 0.41% UCL

3c. Parameter Selection: Ultimate Risk-Free Rate

Approaches to setting the ultimate risk-free rate include:

1. Prospective approach utilizing the Central Bank's target inflation and GDP growth forecasts
2. Retrospective approach – arithmetic / geometric mean of the historical nominal interest rate or real rate; historical GDP growth plus historical inflation
3. Blended approach with prospective and retrospective elements:
   - Historical real interest rate + inflation target
   - Historical short term real rate + historical term premium + inflation target

   Key desirable characteristic of chosen approach is stability. We note that the Canadian Institute of Actuaries recently changed their approach to the URFR from historical short term real rate + historical term premium + inflation target to historical long term nominal rates as the former was found to be volatile to changes in short term inflation.

3c. Parameter Selection: Ultimate Risk-Free Rate

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Retrospective approach: Use of historical real GDP growth and historical inflation

	Last 10 years	Last 20 years	Last 30 years	Last 40 years	Last 50 years	All
Historical real GDP Growth	1.10%	0.83%	1.76%	1.99%	2.28%	2.39%
Historical Inflation	1.86%	2.11%	1.96%	2.74%	3.81%	4.05%
URFR	2.95%	2.94%	3.71%	4.73%	6.09%	6.44%

Source:
World Bank national accounts data, and OECD National Accounts data files.
International Monetary Fund, International Financial Statistics and data files.

- Historical data has the advantage of having a predictable and stable ultimate risk-free rate assumption.
- No explicit adjustment made in respect of sovereign risk which we assume is already reflected in GDP.

3c. Parameter Selection: Ultimate Risk-Free Rate

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Prospective approach: Use of GDP growth forecast and target inflation

		Source
Real GDP Growth Forecast	1.6%	World Bank 2025 estimate
Inflation Target*	4.1%	Historical Average Inflation: 1967-2022
Ultimate Risk-Free Rate	5.7%	

Use of prospective assumptions could put too much weight on short term fluctuations in GDP Growth Forecasts and would be less predictable.

*In the absence of a specified inflation target by the Central Bank of The Bahamas, we have estimated it using average historical inflation.

3c. Parameter Selection: Ultimate Risk-Free Rate

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Recommended approach: Average historical long term Government bond yields

Tenor	Avg Yield (data up to Dec 2022)	Source
20	5.62%	Registered Stock IPO results published by the Central Bank of The Bahamas (Jan 2013 – Dec 2022)
30	6.16%	
>20	5.87%	

- The URFR was set equal to the average yield on BGRS with tenors greater than 20 years issued over a 10-year historic period i.e., 5.87%.
  - This approach compares favourably with the approach using GDP Growth forecast plus target inflation (5.7%) in particular given that "target" inflation can only be estimated using historic . data.
  - The chosen approach is expected to be stable and is consistent with the approach used by the CIA.
- Ultimate rate expressed as a forward rate (rather than a spot – further discussion on this in section 3d)
- The following limits will be applied:
  - The rate will be rounded to 2 decimal points and updated at each calculation date so that it moves smoothly over time
  - Limit of +/- 0.25% on how much the rate can change from year to year

3c. Parameter Selection: Illiquidity Premium

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IFRS 18 B79
For cash flows of insurance contracts that do not vary based on the returns on underlying items, the discount rate reflects the yield curve in the appropriate currency for instruments that expose the holder to no or negligible credit risk, adjusted to reflect the liquidity characteristics of the group of insurance contracts. That adjustment shall reflect the difference between the liquidity characteristics of the group of insurance contracts and the liquidity characteristics of the assets used to determine the yield curve.

IFRS 17 does not require a particular technique for determining the illiquidity premium however in keeping with IFRS 17 principles, any chosen method should maximize the use of observable inputs and reflect current market conditions.

3c. Parameter Selection: Illiquidity Premium

The approaches considered in the setting of the adjustments for illiquidity included the following:

1. Use of the bid-ask spreads on Government of Bahamas bonds
2. Use of average historical mortgage rates above ultimate rate adjusted to remove credit risk
3. Use of judgement including consideration of illiquidity premiums in other jurisdictions

In other markets, approaches based on the decomposition of corporate bond spreads into credit and liquidity components appears to be the preferred approach to setting the illiquidity premium. The lack of Bahamian corporate bond data limited the ability to employ this approach.

3c. Parameter Selection: Illiquidity Premium for Liquid Insurance Contracts

Recommended Approach: Use the difference between bid and mid prices on BGRS to set the adjustment for liquid insurance contracts

Recommend using the spot curve based on bid yields as the risk-free curve for liquid insurance contracts, which includes a modest amount of illiquidity relative to the mid spot curves.

We were unable to quantify this allowance for illiquidity due to the unavailability of ask yields in the secondary market price data.

3c. Parameter Selection: Illiquidity Premium for Illiquid Insurance Contracts

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Considered Approach: Use of average historical mortgage rates

		Source
Average historic mortgage rate	7.30%	Historical Average Mortgage rates issued by commercial banks[1] 2000-2022
Ultimate Rate	5.87%	
Spread	1.43%	
Illiquidity Premium	0.43% to 0.71%	A Moody's Analytics 2018 study of investment grade corporate bonds in various jurisdictions (A Cost of Capital Approach to Estimating Credit Risk Premia) indicated that illiquidity accounts for around 30% - 50% of total spread[2]

[1] Source: Central Bank of The Bahamas
[2] Assuming this range can also be applied to mortgage spreads

Analysis of historic mortgage rates produces a range of illiquidity premia from 0.43% to 0.71%

3c. Parameter Selection: Illiquidity Premium

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Considered Approach: Consideration of illiquidity premiums in other jurisdictions to set the adjustment for illiquid insurance contracts

The results of a 2019 Moody's Analytics study "Illiquidity and Credit Premia for IFRS 17 at End December 2018" showed illiquidity premiums on investment grade corporate bonds ranging from 40bps - 70bps at the short end to 80bps - 160bps for bonds over 10 years.

Illiquidity Premia in Basis Points per Annum

Maturity / Jurisdiction	**1-3**	**3-5**	**5-10**	**10+**
EUR	41	46	67	81
GBP	65	75	96	100
USD	54	75	91	115
CAD	69	91	120	164

Recommendation: A flat adjustment of 75bps over the curve used for liquid contracts, which is consistent with the 80bps ultimate adjustment adopted by the CIA Educational Note, the results of the Moody's study above and the high end of the range indicated from the analysis of historic mortgage rates.

3d. Interpolation Approach

Background

- The approach to interpolate from the last observable point to the ultimate risk-free rate
- Ultimate risk-free rate can be expressed as a forward rate or as a spot rate
- Length of the convergence period depends on whether a forward or spot rate is used (it should be longer for a spot rate) and the differential between the rate at the last observable point and the ultimate risk-free rate

Recommendation

- Use a forward rate (discussion on the next slide)
- Use a linear interpolation method (any other method is unnecessarily complicated and is unlikely to have a material impact on outcomes)
- Use a convergence period of 5 years. Use of forward rates imply a shorter convergence period; however, we took into consideration the differential between the rate at the last observable point (9.1%) and the ultimate risk-free rate (5.87%)

3d. Interpolation Approach

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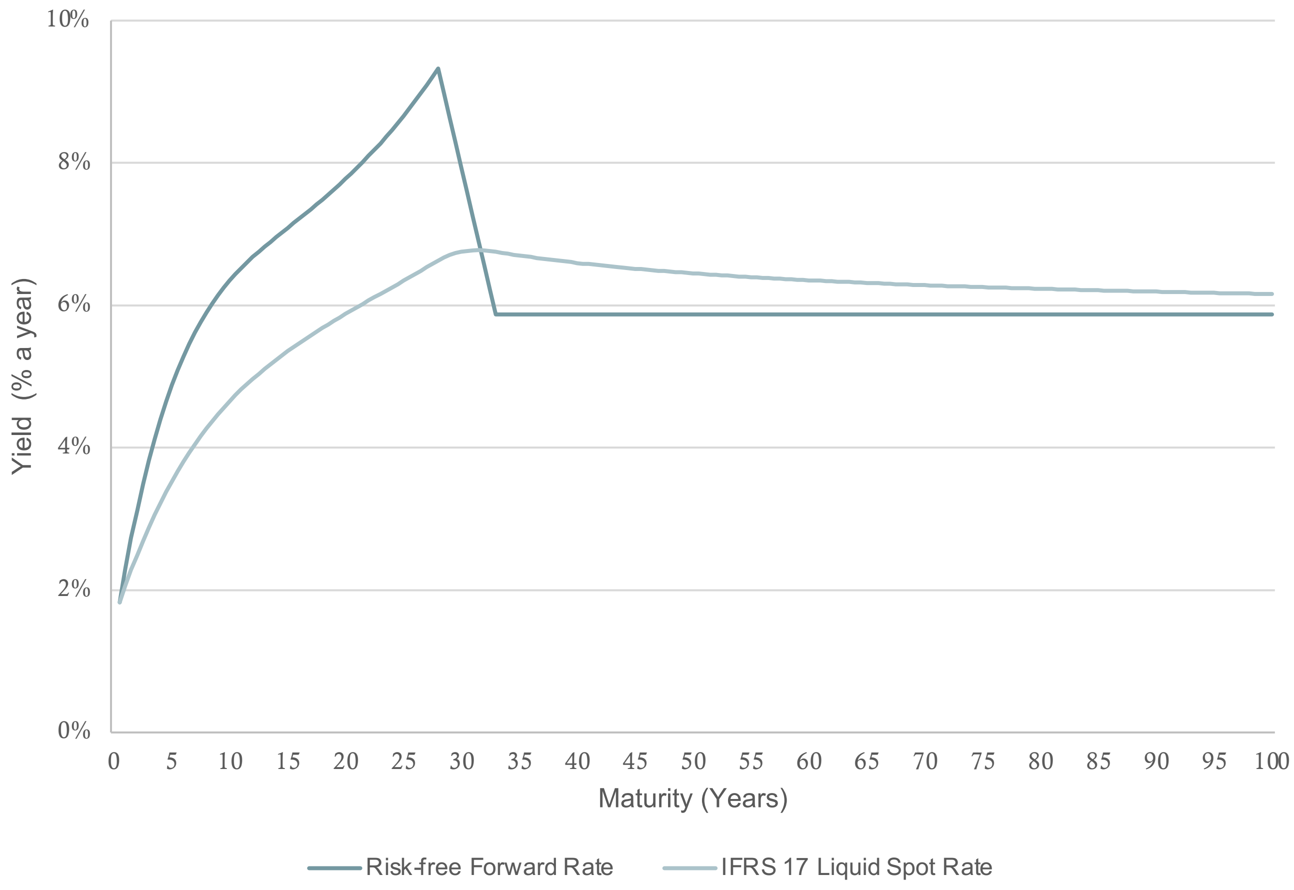
Recommend use of a forward rate for the ultimate risk-free rate as the interpretation of the ultimate risk-free rate is easier using forward rates, and it avoids extreme discontinuities in the forward curve as compared to expressing the ultimate rate as a spot rate.



3. Modelling Steps: December 2022

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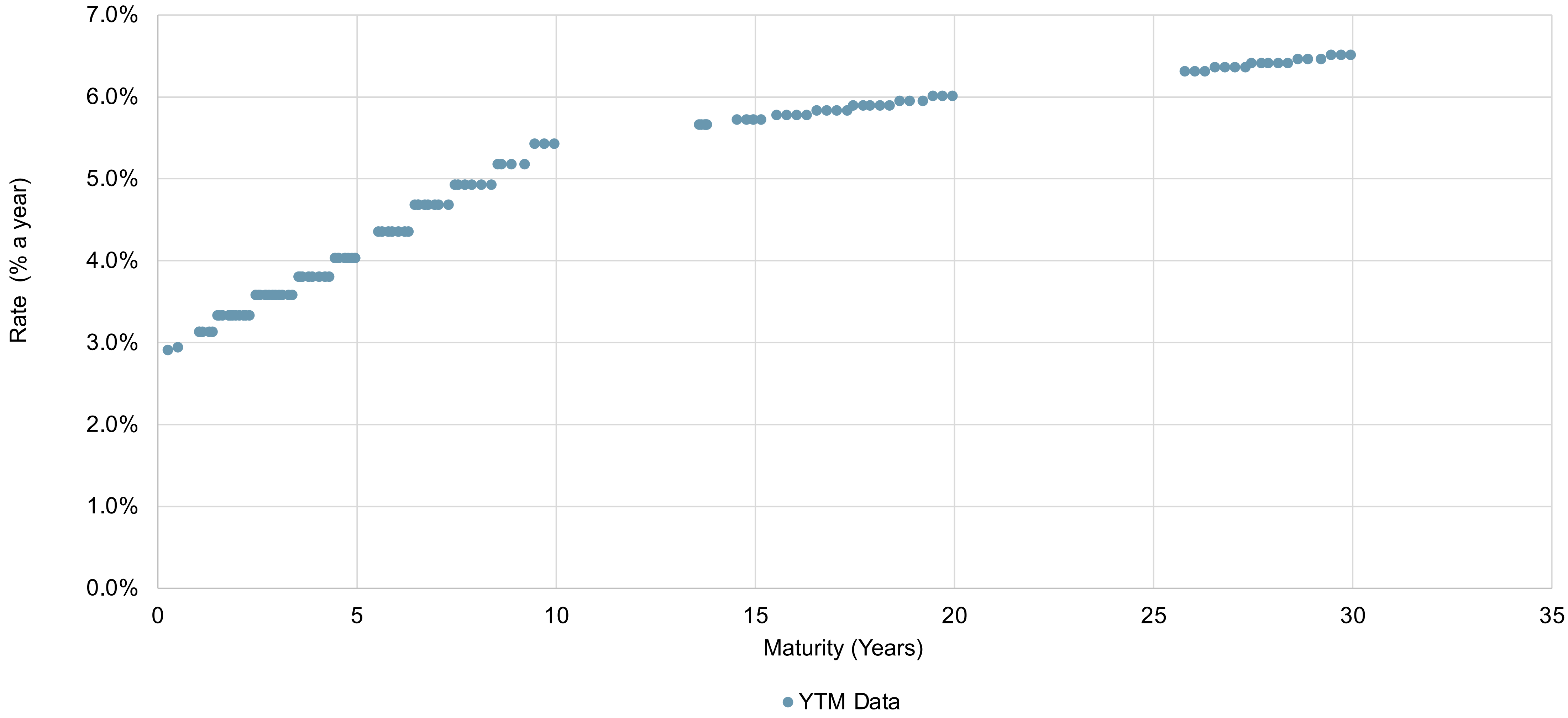
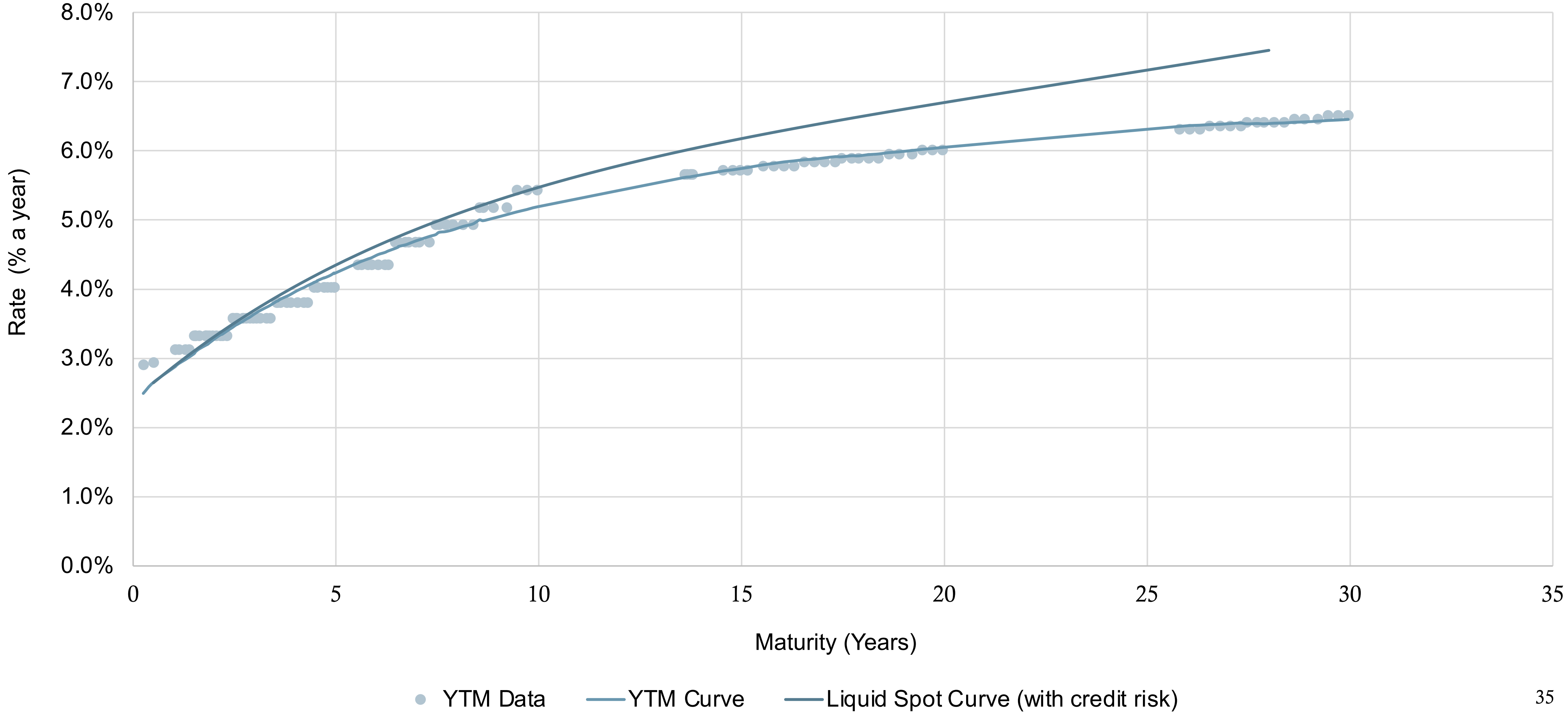
Select bond universe and remove outliers



3. Modelling Steps: December 2022

Fit a curve to last observable point



3. Modelling Steps: December 2022

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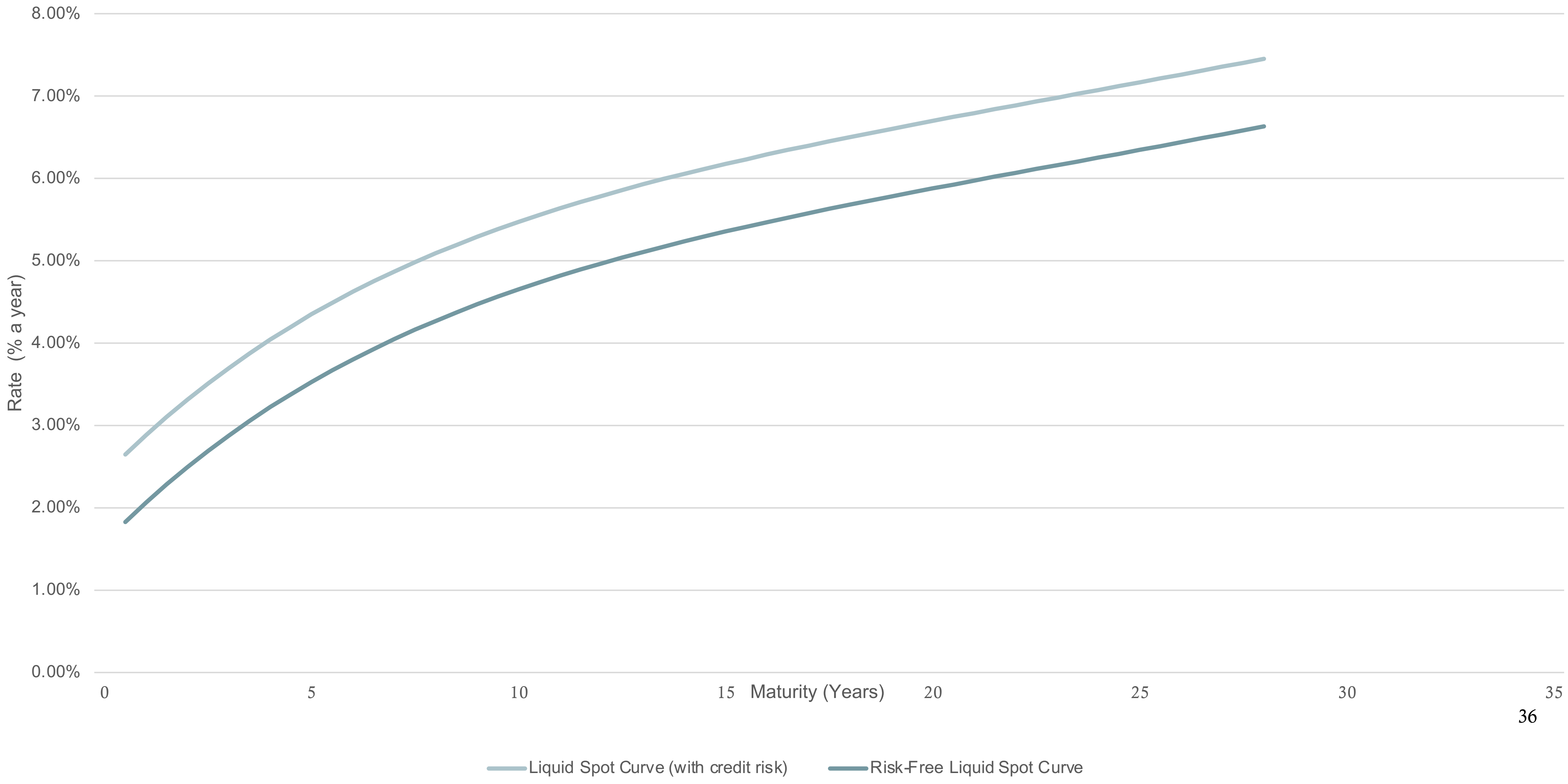
Remove sovereign credit risk



3. Modelling Steps: December 2022

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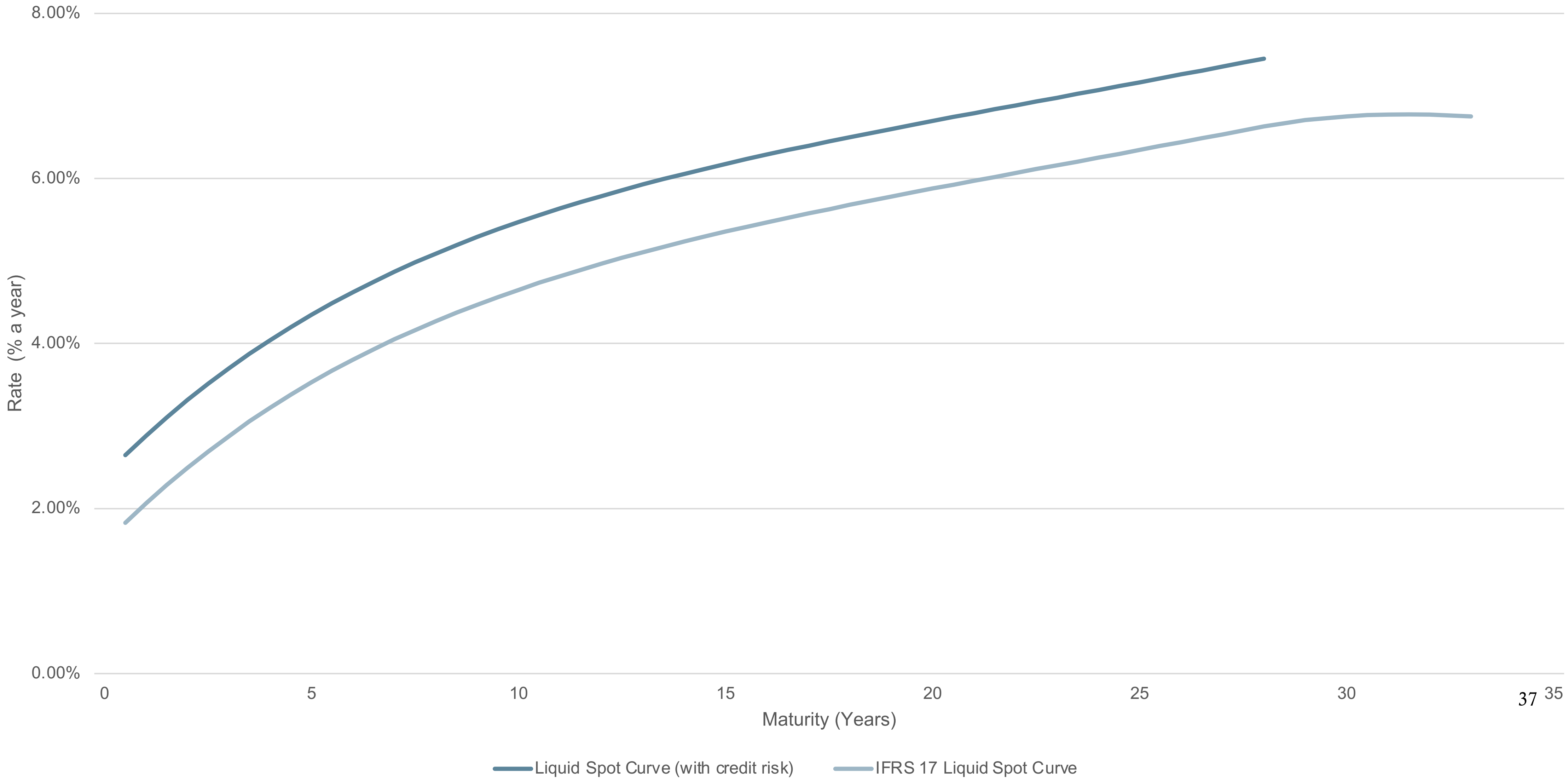
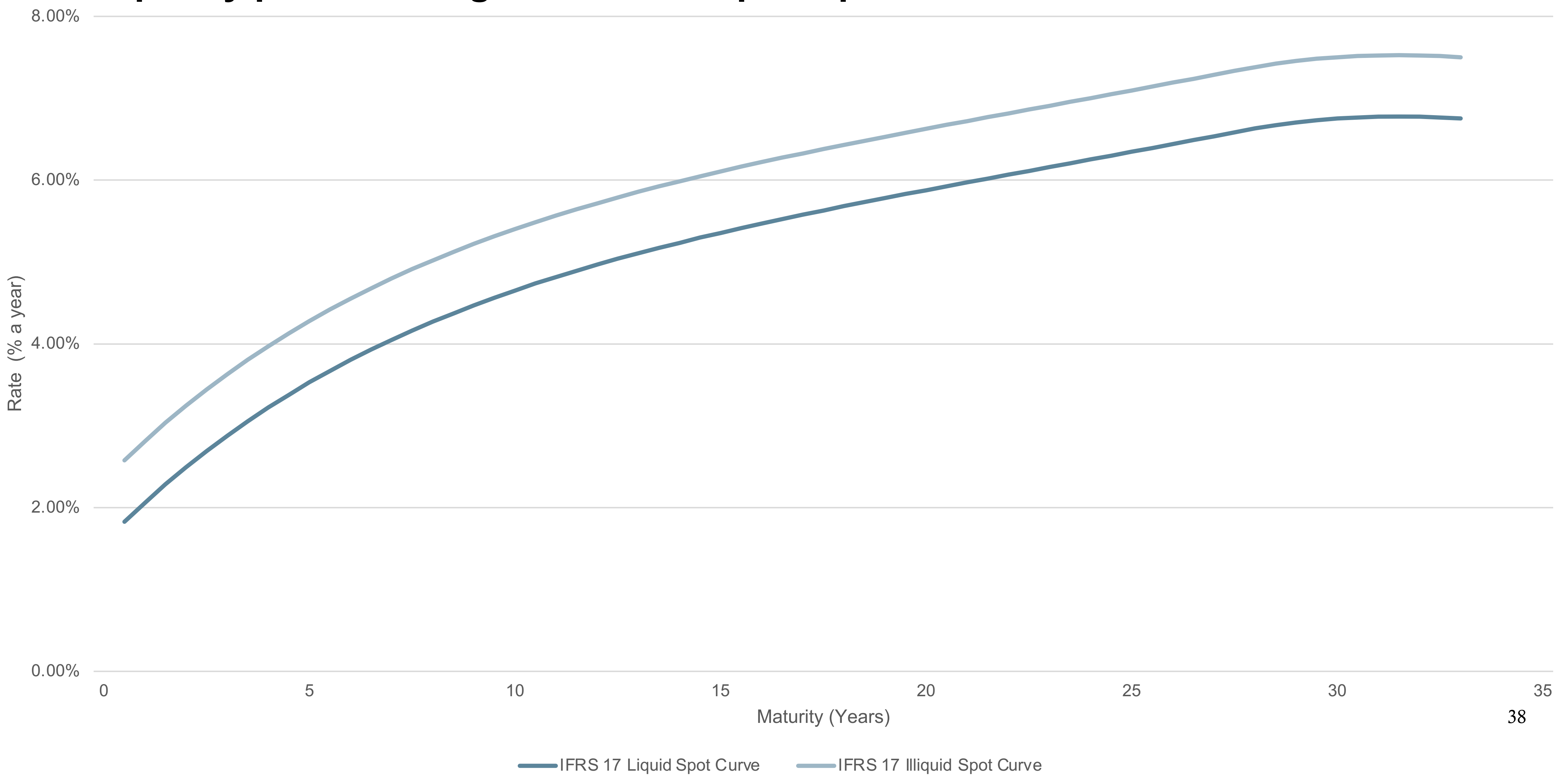
Extrapolate using Ultimate Risk-Free Forward Rate to get IFRS 17 Liquid Spot Curve



3. Modelling Steps: December 2022

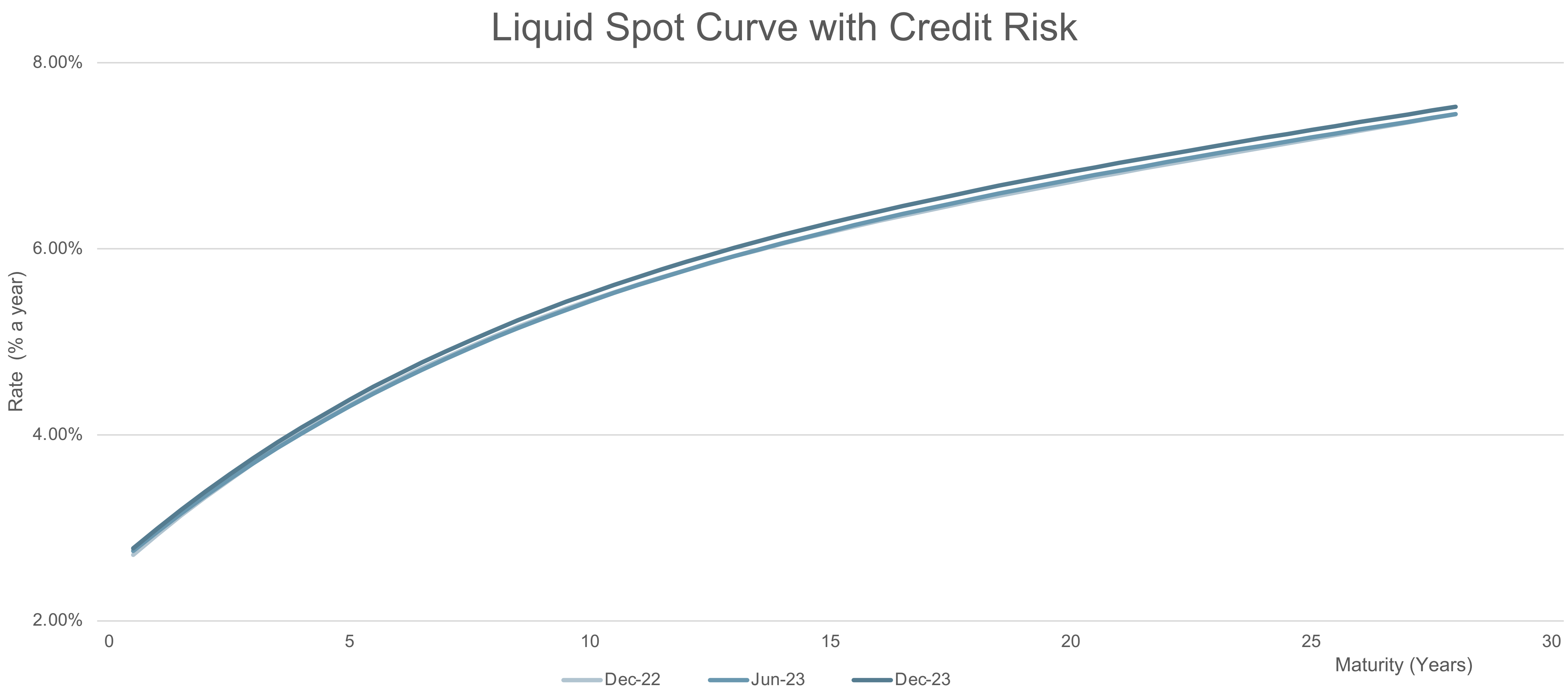
Add illiquidity premium to get IFRS 17 Illiquid Spot Curve



4. Model Testing

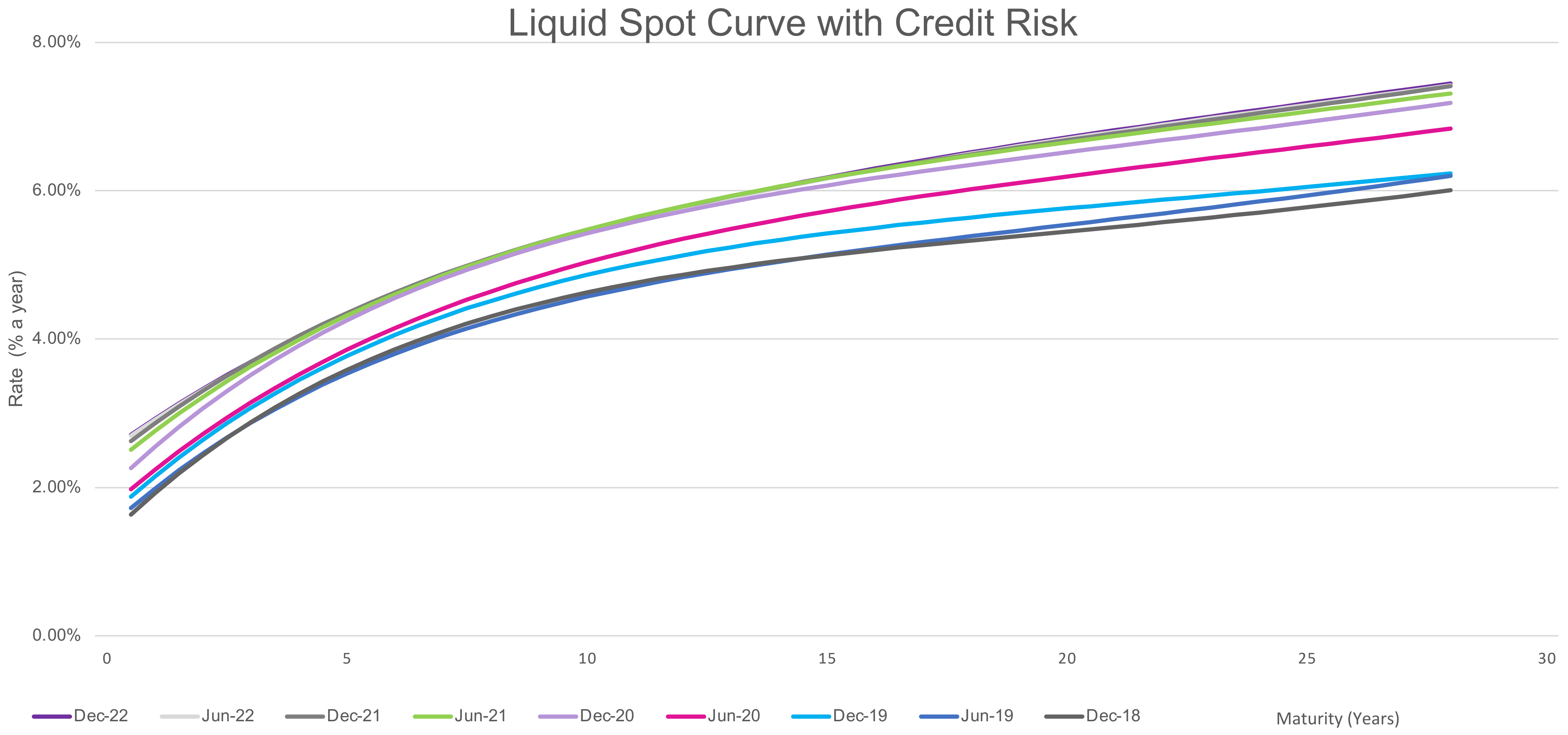
- Extensive back testing is required to ensure robustness of the proposed approach.
- Testing was undertaken based on data between December 2018 and December 2023.
- Testing has not indicated any issues with the proposed approach, noting that the period covered included volatility through the COVID-19 pandemic, and the significant interest rate movements seen through 2022.

4. Model Testing



For more recent periods, we note consistent results throughout the curve.

4. Back testing output



Consistent curve shapes observed in back testing. Near parallel shifts are observed between consecutive dates. The gap between the spot rates widens with maturity.

References

- International Financial Reporting Standard 17 Insurance Contracts
- Canadian Institute of Actuaries Committee on Life Insurance Financial Reporting Education Note “IFRS 17 Discount Rates for Life and Health Insurance Contracts” June 2022.
- Canadian Institute of Actuaries Educational Note Supplement “Changes to the Reference Curves’ Ultimate Risk-free Rate Development Approach Outlined in the Committee on Life Insurance Financial Reporting’s Educational Note on IFRS 17 Discount Rates” July 2023.
- Bank of Canada. Technical Report No. 84. Yield Curve Modelling at the Bank of Canada.
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- Standard & Poor’s Default, Transition, and Recovery: 2022 Annual Global Sovereign Default and Rating Transition Study
- Moody’s Investors Service Sovereign default and recovery rates, 1983-2022
- Moody’s Analytics Illiquidity and Credit Premia for IFRS 17 at End December 2018

Appendix A.1 – IFRS 17 Spot Rates as at December 2022

Maturity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IFRS 17 Liquid Spot Rate	2.1%	2.5%	2.9%	3.2%	3.5%	3.8%	4.0%	4.2%	4.4%	4.6%	4.8%	5.0%	5.1%	5.2%	5.4%	5.5%	5.6%	5.7%	5.8%	5.9%
IFRS 17 Illiquid Spot Rate	2.9%	3.3%	3.6%	4.0%	4.3%	4.5%	4.8%	5.0%	5.2%	5.4%	5.5%	5.7%	5.8%	6.0%	6.1%	6.2%	6.3%	6.4%	6.6%	6.6%
Maturity	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
IFRS 17 Liquid Spot Rate	6.0%	6.1%	6.2%	6.3%	6.4%	6.4%	6.5%	6.6%	6.7%	6.7%	6.8%	6.8%	6.7%	6.7%	6.7%	6.7%	6.6%	6.6%	6.6%	6.6%
IFRS 17 Illiquid Spot Rate	6.7%	6.8%	6.9%	7.0%	7.1%	7.2%	7.3%	7.4%	7.4%	7.5%	7.5%	7.5%	7.5%	7.5%	7.4%	7.4%	7.4%	7.4%	7.3%	7.3%
Maturity	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
IFRS 17 Liquid Spot Rate	6.6%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.3%
IFRS 17 Illiquid Spot Rate	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%
Maturity	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
IFRS 17 Liquid Spot Rate	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%
IFRS 17 Illiquid Spot Rate	7.1%	7.1%	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%

Appendix A.2 – IFRS 17 Spot Rates as at December 2023

INSURANCE COMMISSION OF THE BAHAMAS

Maturity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IFRS 17 Liquid Spot Rate	2.2%	2.6%	2.9%	3.3%	3.6%	3.8%	4.1%	4.3%	4.5%	4.7%	4.9%	5.0%	5.2%	5.3%	5.5%	5.6%	5.7%	5.8%	5.9%	6.0%
IFRS 17 Illiquid Spot Rate	2.9%	3.3%	3.7%	4.0%	4.3%	4.6%	4.8%	5.1%	5.3%	5.5%	5.6%	5.8%	5.9%	6.1%	6.2%	6.3%	6.4%	6.6%	6.7%	6.8%
Maturity	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
IFRS 17 Liquid Spot Rate	6.1%	6.2%	6.3%	6.4%	6.5%	6.5%	6.6%	6.7%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.7%	6.7%	6.7%	6.7%	6.6%	6.6%
IFRS 17 Illiquid Spot Rate	6.9%	6.9%	7.0%	7.1%	7.2%	7.3%	7.4%	7.5%	7.5%	7.6%	7.6%	7.6%	7.5%	7.5%	7.5%	7.5%	7.4%	7.4%	7.4%	7.4%
Maturity	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
IFRS 17 Liquid Spot Rate	6.6%	6.6%	6.6%	6.6%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%
IFRS 17 Illiquid Spot Rate	7.4%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.1%	7.1%	7.1%
Maturity	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
IFRS 17 Liquid Spot Rate	6.4%	6.4%	6.4%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.2%
IFRS 17 Illiquid Spot Rate	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%

Appendix B - Nelson-Siegel-Svensson parametric model

- Nelson-Siegel-Svensson parametric model form for producing spot rates:

$$\mathrm{y}(\boldsymbol{m}) = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \times \left[\frac{1-e^{-\frac{m}{\tau_1}}}{\frac{m}{\tau_1}}\right] + \boldsymbol{\beta}_2 \times \left[\frac{1-e^{-\frac{m}{\tau_1}}}{\frac{m}{\tau_1}} - e^{-\frac{m}{\tau_1}}\right] + \boldsymbol{\beta}_3 \times \left[\frac{1-e^{-\frac{m}{\tau_2}}}{\frac{m}{\tau_2}} - e^{-\frac{m}{\tau_2}}\right]$$

- $\mathbf{y}(\boldsymbol{m})$ is the instantaneous zero coupon spot rate at time **m**
- $\boldsymbol{\beta}_0, \boldsymbol{\beta}_1, \boldsymbol{\beta}_2, \boldsymbol{\beta}_3, \boldsymbol{\tau}_1, \boldsymbol{\tau}_2$ are parameters to be estimated
- $\boldsymbol{\beta}_0$ is the asymptotic value of $\mathbf{y}(\boldsymbol{m})$ as m -> ∞ and so the curve will tend towards this as time increases
- $\boldsymbol{\beta}_0$ + $\boldsymbol{\beta}_1$ is the short term value of $\mathbf{y}(\boldsymbol{m})$ when m -> 0
- The various parameters allow for the general curve shape, and two humps or U-shapes, which are combined to produce the fitted curve