Life Insurance Practice Committee and General Insurance Practice Committee

Technical Paper Discount Rates for APRA Capital Standards

January 2023

Contents

1. Status of Technical Paper

This Technical Paper was prepared by the Life Insurance Practice Committee ("LIPC") and General Insurance Practice Committee ("GIPC") of the Institute of Actuaries of Australia ("Actuaries Institute").

It does not represent a Professional Standard or Practice Guideline of the Actuaries Institute and has been prepared for the purpose of informing members of issues in determining discount rates (pre allowance for any applicable illiquidity premium) under regulatory prudential capital standards effective 1 January 2013.

This Technical Paper does not constitute legal advice. Any interpretation or commentary within the Technical Paper regarding specific legislative or regulatory requirements reflects the expectations of the Institute but does not guarantee compliance under applicable legislation or regulations.

Accordingly, Members should seek clarification from the relevant regulator and/or seek legal advice in the event they are unsure or require specific guidance regarding their legal or regulatory obligations.

This IN does not override the requirements in this Professional Practice Document or in any other Professional Standards or Practice Guidelines that are relevant to this area of work.

This is the second version of this Technical Paper with references to AASB 1038 (Life Insurance Contracts) replaced with AASB 17 (Insurance Contracts). A full review of developing practice in the area of determining discount rates has not been completed since the original Technical Paper was drafted in 2012. Consequently, practices may have developed since that time.

Feedback or comments on the Technical Paper can be submitted to LIPC and GIPC at the following address: ppd@actuaries.asn.au or directly to the current Chairperson and Secretary of each Group using the contact details on the Institute's Committee webpage.

2. Background

2.1 APRA capital standards

2.1.1 Introduction

Liability calculations required under regulatory prudential capital standards effective 1 January 2013 are to be based on discount rates derived from yields on Commonwealth Government Securities ("CGS").

This Technical Paper sets out issues that may be considered when deriving discount rates both up to the date of the longest maturing CGS (that is, interpolation or curve fitting) and when extrapolating.

Overall, the life insurance and general insurance requirements in the prudential capital standards relating to interpolation and extrapolation are similar.

Therefore, unless explicitly stated otherwise, this Technical Paper is relevant to Members working for both types of companies.

Further comments on the specific discount rate requirements for life insurers and general insurers are set out below.

2.1.2 Life insurance

The calculations under the regulatory prudential capital standards require the calculation of a "risk-free best estimate liability (RFBEL)".

The gross investment yield and discount rate adopted in the RFBEL calculation is set equal to the risk-free discount rate plus illiquidity premium.

The requirement to add an illiquidity premium applies for certain types of life insurance policies. Considerations associated with the application of the illiquidity premium are not addressed in this Technical Paper.

The risk-free rate definition is set out in Prudential Standard LPS 001 (Definitions) ("LPS 001") and is reproduced in Appendix A to this Technical Paper.

It is noted that the risk-free discount rate definition under AASB 17 issued by the Australian Accounting Standards Board is somewhat different to that under LPS 001. Considerations for setting discount rates under AASB 17 are set out in "Technical Paper: AASB 17 Insurance Contracts" issued by the Actuaries Institute. However, certain principles in this Technical Paper may be worthwhile considerations when interpolating or extrapolating yield curves to determine risk-free discount rates under AASB 17.

2.1.3 General insurance

Paragraphs 30 to 32 of Prudential Standard GPS 340 (Insurance Liability Valuation) contains requirements for discount rate(s) for calculating insurance liabilities.

These requirements are reproduced in Appendix A to this Technical Paper.

3. Issues to consider when extrapolating the yield curve

3.1 Background

The approach to extrapolation involves judgment and therefore it is likely that the extrapolated discount rates calculated by different actuaries may be different.

Nonetheless, the approach and results would be expected to be reasonable based on relevant available information.

Reviewing the reasonableness of the results produced by the method adopted may involve undertaking various analyses and/or determining rates under alternative approaches. The smoothness of the resulting rates would also be considered as part of such a review.

It is possible that a particular approach may produce reasonable results in certain market conditions which are not reasonable in other market conditions or when new data becomes available.

Given this, it is important that the extrapolation approach and resulting rates are reasonable and are updated or changed as necessary to take into account both market conditions and new and emerging data sources.

3.2 High-level overview of market data

3.2.1 Australian Commonwealth Government security yields

In the recent past, the longest duration bonds have been approximately 10 years. More recently, bonds have been issued with terms to maturity of up to 15 years.

Historically, the majority of CGS issued have been fixed coupon bonds ("Treasury Bonds"). A smaller proportion of shorter term notes ("Treasury Notes") and inflation-linked bonds ("Treasury Indexed Bonds") have also been issued. For the purpose of this Technical Paper, it is likely that Treasury Bonds and Treasury Notes will be most relevant when constructing a yield curve.

3.2.2 Other Australian bond yield data

There is currently limited corporate bond data with durations beyond the duration of the longest dated Australian Commonwealth Government Bonds.

However, should such bond data become available, this may provide further information (after taking into account appropriate adjustments for credit and illiquidity) for extrapolating discount rates.

3.2.3 Swap rates

Swap rates are commonly used as a benchmark in the construction, hedging and valuation of derivative contracts. They represent the fixed rate paid or received by a party in exchange for receiving or paying a floating (that is, variable) short-term interest rate.

Quoted swap rates typically incorporate an allowance for underlying credit risk, representing the credit risk associated with investing in the rate underlying the floating leg of a swap contract for the term of the swap. Additional counterparty risk also exists, but is typically small given the requirements to post collateral for mark-to-market movements in most swap contracts.

A variety of floating rate instruments are used as underlying securities on which swap rates are based. In Australia, the most common of these is the range of Bank Bill Swap Rates (“BBSW”) which reflect a trimmed average of surveyed mid-rates on reference bank bills of exchange for various short-term maturities. In overseas currencies, LIBOR plays a similar role. Other variations with alternative credit characteristics also exist, for instance Overnight Indexed Swaps (“OIS”), which are based on an underlying short-term interest rate (for example. the Reserve Bank of Australia cash rate).

Swap rates are typically not publicly quoted, although surveyed rates are generally available from a variety of financial data providers.

Swap data may be a useful benchmark for use in extrapolating risk-free rates of return, as data typically exists for rates beyond the longest available maturity of CGS. However, where such data is used, the following points are relevant for consideration:

- quoted swap rates may be based on instruments which exhibit some illiquidity. Indeed, quoted rates may be based on broker quotes rather than actual trade prices. Additionally, where swap instruments are actually traded, spreads may be non-trivial, indicating a lack of liquidity in that instrument. This may reflect long-dated swap rates which are heavily influenced by an excess of supply or demand for fixed or floating interest rate exposures at that time.

  These illiquidity effects may be particularly relevant for the least liquid, longer dated instruments beyond available CGS maturities. Care should be taken to understand the implications of such liquidity effects if the approach of using swap rates to extrapolate the risk free curve is being considered;

- where swap rates are to be used, it is relevant to consider the amount of underlying credit risk priced in to the swap rates. For example, if being used to extrapolate a curve, whether any such credit component exhibits a term structure, so that a suitable adjustment to remove this is made; and

- when using swap rates, care should be taken with the compounding convention of the quoted rate. Swap rates are commonly quoted as fixed leg rates with payments semi-annually, equivalent to a par yield on bond paying semi-annual coupons. Quarterly rates are also quoted, particularly for shorter-term swap contracts.

3.3 Extrapolation methods

3.3.1 Spread methodologies

APRA has indicated that it expects other securities to be used as a reference point for extrapolating beyond the term of available CGS securities, subject to suitable adjustments for liquidity and credit risk elements.

A natural methodology to achieve this is to estimate the credit and liquidity components of the reference security curve by considering the spread between CGS yields and the yield on reference securities for terms in which CGS are available. This estimate could then be extrapolated to adjust reference yields beyond these terms.

If considering this approach, care needs to be taken to ensure that the extrapolation of these adjustments is appropriate for longer dated instruments. In particular, care will be needed to ensure that the credit and liquidity characteristics of the instruments used to estimate this spread are either consistent with the instruments used beyond the term of available CGS securities, or that additional adjustments are made.

This includes taking care to consider any material term structure to the credit and liquidity risk components (that is, how the credit and liquidity spreads to CGS change with duration) and the implications for estimating an appropriate spread for the period to which rates are being extrapolated.

Care may also be required to consider any impacts on the yields on the securities (used as reference points) of the lack of availability of CGS (for example, the availability of CGS for hedging purposes may impact yields).

3.3.2 Direct adjustment for credit and liquidity risks

An alternative approach is to directly estimate the credit and liquidity components of the yield on a particular reference security with a maturity date longer than the long-dated CGS.

An estimate of the risk-free rate is obtained by deducting these credit and liquidity components from the security yield.

For most securities, there may be no direct method of observing these risk components directly from capital markets data, and some indirect method which produces an estimate is likely to be required.

3.3.3 Parametric model fitting

Where suitable reference securities are not available, alternative extrapolation methods may need to be used. This could, for example, take the form of extrapolation by fitting a specified functional form to the available CGS data, and using this fitted model to extrapolate yields beyond the longest maturity CGS data. A number of yield curve models exist within the academic literature and are widely used for this purpose (for example, the Nelson-Siegel and Smith-Wilson methods).

Where using such an approach, additional constraints might be applied beyond a direct fit to available CGS yield data (for example, to ensure that the very long end of the fitted curve is reasonable).

Such methods may be useful particularly for very long durations if there is limited reliable yield data for any relevant securities/indices. Where this is the case, care would be needed to ensure consistency with both the underlying CGS yields and the adjusted reference security yields.

In particular, extrapolated rates produced using such a method may need to be blended into shorter dated yields which have been produced using available CGS or other securities.

Applying additional constraints during the curve fitting process, for example to achieve smoothness of a resulting curve, may be beneficial.

3.3.4 Non-parametric extrapolation

Alternatively, a variety of simpler methods may be adopted which project the available yields beyond the term of the available CGS securities. For example, a simple extrapolation assuming constant forward rates beyond the longest available term might be used.

3.4 Considerations and issues

3.4.1 Curvature of yield curve at long end

It is not uncommon for yields, including swaps and CGS, to exhibit curvature at the long end.

This may be due to various reasons, for example the yields on the longest dated securities may be impacted by supply and demand factors and the purchase/sale of these securities for hedging purposes (including hedging rates on cashflows beyond the longest instrument term).

Equally, swap yields at longer terms may be impacted by supply and demand factors and the ability to source appropriately long-term physical securities to hedge exposures.

It is important to be aware of these features where they exist in market data and the potential impact they might have on the results based on the interpolation and extrapolation approach adopted.

In this context, it is noted that care needs to be exercised before ignoring or smoothing out such features, either explicitly or implicitly within the extrapolation method used. For example, where such features exist because of a particular supply/demand environment, they may nonetheless reflect applicable market “prices/yields” that would be relevant to an insurer in purchasing securities/derivatives to hedge or obtain a fixed interest rate exposure/outcome.

Such market features should be considered when extrapolating rates.

3.4.2 Economic long-term rate

As noted in section 3.3.3, applying additional assumptions about long-term rates by reference to economic arguments could be considered. Such techniques may be relevant particularly where there are no suitable instruments at longer terms to be used as a reference security, or where there is no market data at all.

The following are noted, among other issues, in the use of long-term economic rates.

If using such a long-term rate assumption, care is needed in selecting the period and method for blending rates between observable yields into the long-term economic rate. This includes care that the smoothness and shape of the resulting yield curve is reasonable. Use of parametric models to fit the yield curve, potentially with additional smoothness constraints applied during the fitting process, may provide parameters which assist with managing such features.

By construction, such long-term economic assumptions are likely to be relatively stable over time. However, care should be taken to regularly review such assumptions and ensure that they remain suitable under current expectations of future economic conditions. If using such an assumption, it is also important to be aware of unintended consequences. For example, a stable long-term yield assumption could produce increasing amounts of volatility in long-dated forward rates, depending on the behaviour of the available market data.

Care should be taken to ensure consistency of the long-term economic rates with any available market data. This might include reference to overseas risk free data where yields may be available for very long durations.

3.4.3 Simple approaches such as ‘use last forward / last spot’ or extrapolating the curve fitted to interpolate rates

While typically straightforward, objective and requiring fewer assumptions than other methods, care needs to be taken that the resulting yields of such simple approaches are reasonable. In particular, such methods may produce results which are more sensitive to small changes in underlying yield data than other methods, particularly when extrapolating using long-dated forward rates, or when extrapolating terms well beyond the longest available CGS maturities.

These approaches may produce reasonable rates in some market environments, but in others shortcomings may arise including:

- inconsistency with longer term yield information – such as swap data or overseas interest rate data;
- inconsistency with views on long term economic rates; and
- excessive impacts from supply and demand factors (as noted above).

3.4.4 Use of overseas data

Overseas yield data may be available at longer terms than those available in Australia. Such data may provide a useful reference point on which to extrapolate Australian yield curves.

However, care needs to be taken to understand, quantify and adjust for likely differences between the relevant overseas instruments and Australian CGS instruments. Such differences may include, but are not limited to:

- differences in credit quality between overseas securities and Australian CGS;
- differences in contractual terms and conditions of the underlying securities compared to Australian CGS;
- differences in expected economic conditions between countries, including expectations of real and nominal interest rates and inflation; and
- other issues affecting the consistency of overseas and Australian instruments (for example, the costs of hedging exchange rate risks). When considering potential hedging strategies, it should be noted that these may be imperfect and be impacted by residual uncertainties or risks. In some cases, there may be limited ability to hedge exchange rate risks.

3.4.5 Appropriateness of methods over time and reasonableness of results

A method that may provide suitable yield curves in certain market conditions, may not do so in other market conditions. It is important to assess the suitability of the method and resulting curve on an ongoing basis.

For example, the suitability of a particular method may be impacted by changes in the quality or availability of underlying market data, weaknesses in the method used which are not apparent under some market conditions, or an unexpected change in economic conditions.

It is important that rates are considered for smoothness and for consistency with rates derived by other approaches. As well, the use of approximations needs to have regard to the materiality of outcomes.

3.5 Adjusting references to remove allowances for credit risk and illiquidity

The main Australian data for which adjustments are likely to be made are for swap rates.

As noted in section 3.2.3, the main credit risk in the swap curve is the risk of the underlying securities on which the swap is based. For semi-annual swaps, this is typically 180 day bank bills.

Where directly estimating the credit risk contained in the swap curve, potential methods include analysis of current and historic spreads of BBSW over Treasury bills and overnight cash. Care is needed to allow for the fact that this risk is continually "reset" over the term of the swap, and is not simply the risk for the term of the underlying floating BBSW leg.

Nonetheless, it should be noted that the credit spread is primarily based on the expectation of creditworthiness of 'A' rated banks, likely to constitute the components of the underlying BBSW benchmark at each future floating rate reset date, and not those that make up the benchmark at the current date.

The potential impacts from market supply and demand factors have been noted in section 3.2.3 above.

4. Fitting or interpolating yield curves

4.1 Background

A limited number of CGS securities are typically on issue at any time. This provides for a limited amount of data with which to estimate yields across required maturities. As such, interpolation would be required to estimate yields between the available data points.

4.2 Interpolation methods

Common methods for interpolating the yield curve include those set out below. Note that this list is not exhaustive, and alternative methods may be equally applicable.

4.2.1 Parametric model fitting

Similar to the methodology set out in section 3.3.3, a parametric form may be fitted to available bonds to produce a set of interpolated rates.

As noted previously, a range of generic yield curve models or other parametric forms may be appropriate for this purpose.

4.2.2 Other interpolation methods

Alternatively, a range of generic interpolation methods may be applied to some function of the available yields. For example, a spline function or some other interpolation method might be fitted to the available data. Alternatively, simple linear interpolation methods could be considered.

In applying any such methodology, care needs to be taken to understand the limitations and implications of the chosen interpolation methodology relative to the materiality of the resulting yield curves. For example, where data is sparse, spline methods may produce unacceptably "wiggly" fitted results between data points. Similarly, linear interpolation methods may produce "kinks" in the resulting data which might impact the resulting valuation.

4.2.3 Bootstrapping

Bootstrapping refers to an approach of constructing a yield curve by calculating zero coupon (spot) yields from the redemption yields on a series of coupon-paying bonds. Such an approach relies on using recursive formulae to identify zero coupon yields at successive coupon and redemption payment dates under available bonds. Given the relatively small number of CGS bond issues and potential differences in coupon payment dates from bond to bond, this approach will in practice provide an approximation only, as insufficient information is likely to be available to directly evaluate spot rates at all bond coupon dates.

It should be noted that such an approach will only produce a set of rates at the date of coupons or maturity dates of the available bonds. Additional interpolation may also be required for yields outside of these dates.

4.3 Considerations and issues

4.3.1 Reasonableness of results

It is important that rates are considered for smoothness and for consistency with rates derived by other approaches.

The reasonableness of the rates produced by such methods can be impacted by, among other things, the fitting method (for example, the curve applied and location/number of fitting points (“knots”)) and the yields of the individual securities (for example, unusual patterns of the security yields by duration).

It is important that curve-fitting techniques are not applied blindly and that the rates produced by the curve-fitting approach are reasonable.

The use of approximations needs to have regard to the materiality of outcomes.

4.3.2 Data used in interpolation

Interpolation methods can be applied to a large number of alternative definitions of yield or other functions of fixed interest securities. For example, interpolation could be applied to redemption yields, zero coupon spot rates, discount bond prices, etc. Different choices of the quantity to which interpolation is to be applied may produce different results. Some choices may produce less stable resulting rates than others, for example due to the sensitivity of some rate measures (for example, forward rates) to small changes in data. It is important to have a clear understanding of the impact of applying an interpolation method to a particular quantity, and the potential impact this choice might have on the resulting yield curve under alternative market conditions.

4.3.3 Validation of results

It is important to validate the resulting curves produced from any interpolation. One simple check used to validate results is to ensure that, when applying the interpolated curve to price securities, the resulting bond prices or redemption yields are consistent with the original CGS bond input data.

5. Overseas liabilities

Non-government instruments may be used as a reference point for liabilities written in a currency where there is no security yield data for highly liquid sovereign risk securities and with counterparty grade 1.

However, adjustments would need to be made to remove any allowances for credit risk and illiquidity that are implicit in the yields on these instruments.

“Technical Paper: AASB 17 Insurance Contracts” issued by the Actuaries Institute contains a brief discussion of example methods for decomposing yield curves and identifying the credit risk and illiquidity risk components.

Appendix A

Definition of risk-free discount rate in Prudential Standard LPS 001 (Definitions)

Risk-free discount rate for liabilities denominated in Australian currency means the rate (or rates) based on the yields of Commonwealth Government Securities that relate to the term of the future liability cash flows. If the term of the liability cash flows exceeds the maximum available term of Commonwealth Government Securities, APRA expects other instruments with longer terms to be used as a reference point for the purpose of extrapolation unless the insurer can demonstrate there are no other suitable instruments. Adjustments must be made to remove any allowances for credit risk and illiquidity that are implicit in the yields on these instruments. For foreign liabilities, the rate (or rates) must be based on the yields of highly liquid sovereign risk securities in the currency of the policy liabilities and with counterparty grade 1. If there are no securities satisfying these requirements, other instruments may be used as a reference point. Adjustments must be made to remove any allowances for credit risk and illiquidity that are implicit in the yields on these instruments.

Requirements for discount rate(s) for calculating insurance liabilities under Prudential Standard GPS 340 (Insurance Liability Valuation)

Discount rates

30. The rates to be used in discounting the expected future claims payments of insurance liabilities denominated in Australian currency for a class of business are derived from yields of Commonwealth Government Securities (CGS), as at the calculation date, that relate to the term of the future insurance liability cash flows for that class.

31. Where the term of the insurance liabilities denominated in Australian currency exceeds the maximum available term of CGS, other instruments with longer terms and current observable, objective rates are to be used as a reference point for the purpose of extrapolation. If there are no other suitable instruments, or the Appointed Actuary elects to use an instrument that does not meet this requirement, the Appointed Actuary must justify the reason for using that particular instrument in the insurer's AVR. Adjustments must be made to remove any allowances for credit risk and illiquidity that are implicit in the yields of those instruments.

32. For foreign insurance liabilities not denominated in Australian currency, the risk-free discount rate must be based on the yields of highly liquid sovereign risk securities with current observable, objective rates, in the currency of the insurance liabilities and with counterparty grade 1. If there are no securities satisfying this requirement, or the Appointed Actuary elects to use an instrument that does not meet this requirement, the Appointed Actuary must justify the reason for using that particular instrument in the insurer's AVR. Adjustments must be made to remove any allowances for credit risk and illiquidity that are implicit in the yields of those instruments.

End of Technical Paper