TE TAI ŌHANGA
THE TREASURY

Risk-Free Discount Rates and CPI inflation

Assumptions for Accounting Valuations

21 May 2019

New Zealand Government

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Purpose, background and approach

Purpose

The purpose of this paper is to document the review of the methodology adopted to determine the risk-free discount rates and Consumer Price Index (CPI) inflation assumptions for use in certain accounting valuations that are reported to the Crown for consolidation purposes. The previous in-depth review of the methodology was performed three years ago, in May 2016.

The methodology is not intended to apply to the valuation of traded securities.

Background

A number of Crown reporting entities use discounted cash flow models to value various assets and liabilities to be reported in general purpose financial statements. These valuations are typically attempting to measure obligations or rights incurred on or before balance date, where the settlement of those obligations or receipt of payments will occur sometime after balance date.

This paper focuses mainly on the reporting of insurance liabilities and employee benefit obligations in general purpose financial statements which must comply with relevant accounting standards.

Accounting standards acknowledge that valuing such liabilities is complex because actuarial assumptions are required to measure the obligation. The scope of this paper is limited to determining two financial assumptions used in actuarial valuations for financial statements; risk-free discount rates and CPI inflation assumptions.

The discounting of future cash flows is a technique that can be used for many other purposes and therefore may lead to the use of different financial assumptions than those used in general purpose financial statements. For example, discounting techniques can be used to:

- negotiate a price of an asset or liability in a sales transaction
- determine a specific funding policy and contribution rate
- provide a cost benefit analysis and economic impact appraisal.

These other valuation exercises are not governed by an accounting standard, so the choice of financial assumptions can differ and may be set in a more flexible way or determined by other regulators or industry guidance. In particular, accounting standards do not mandate that a liability is funded in a certain way or that the same financial assumptions used for financial reporting are also used to determine a certain contribution rate.

To ensure consistency and efficiency across accounting valuations reported in the financial statements of the Government, The Treasury produce a central table of risk-free discount rates and CPI inflation assumptions that must be used for reporting to the Crown for consolidation purposes. Specifically, these assumptions must be used for:

- valuing insurance claims liabilities under PBE IFRS 4 Insurance Contracts
- valuing employee benefits such as pension obligations, long service leave and retiring leave under PBE IPSAS 25/ PBE IPSAS 39 Employee Benefits[1]
- building a fair value discount rate for valuing student loans.

Actuarial valuations for financial reporting require many other demographic and financial assumptions. Those other assumptions are generally specific to the obligation and best determined by the separate Government agency which is responsible for reporting them, rather than determined centrally by The Treasury.

While the scope of this paper is focused on compliance with PBE IFRS 4 and PBE IPSAS 39, the discount rates and CPI inflation assumptions may be applied to other accounting valuations where a risk-free discount rate or CPI inflation assumption is used. In these cases, the rates may be used unadjusted, or as a building block to calculate another assumption at the reporting entity's discretion, depending on the relevant accounting standard being complied with. In particular, we have determined that The Treasury's central risk-free rates are an appropriate building block for determining a fair value discount rate for valuing student loans in compliance with the accounting standard for financial instruments.

Determining the nominal amounts to be settled or received in the future is likely to be impacted by inflation which is specific to the liability or asset being measured. We have only considered inflation as measured by the CPI in this exercise. Each valuation will need to consider the appropriate inflation index to use in relation to this CPI inflation assumption.

The methodology, assumptions and table of rates and CPI inflation assumptions are audited annually to assess that they are compliant with the relevant accounting standards.

The External Reporting Board (XRB) has issued an exposure draft, ED 2018-7 (PBE IFRS 17), proposing to replace PBE IFRS 4 Insurance with a new insurance standard which reflects the requirements of NZ IFRS 17[2]. However, any new PBE insurance standard is not expected to be finalised until later this year, after the XRB considers public sector specific issues. We expect the effective date of any new PBE standard will either align with the for-profit sector (1 January 2022) or be a later date.

We have not considered any new guidance on discount rate calculation from NZ IFRS 17 or the PBE IFRS 17 exposure draft in this review. NZ IFRS 17, based on IFRS 17, reflects a new comprehensive accounting model for insurance contracts and resulted from years of international discussion, exposure drafts and debate. The guidance in NZ IFRS 17 differs significantly from many aspects of PBE IFRS 4, including certain aspects relating to the

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1 PBE IPSAS 39 Employee Benefits, effective from 1 July 2019 for the Financial Statements of the Government, will replace PBE IPSAS 25. The requirements and guidance for determining the discount rate and inflation assumptions are the same under both standards. Throughout the remainder of this report we will refer to PBE IPSAS 39 but it equally applies to PBE IPSAS 25.

2 NZ IFRS 17 Insurance Contracts has been incorporated into the for-profit sector standards in New Zealand and will be effective for annual reporting periods beginning on or after 1 January 2021, although the date is expected to be changed to 1 January 2022 in line with the international standard setter proposed amendment.

calculation of discount rates, and is not appropriate to consider as authoritative support for interpretation of the current requirements in PBE IFRS 4.

The methodology adopted to determine risk-free discount rates and CPI inflation assumptions will be reviewed prior to the adoption of PBE IFRS 17.

Approach

A number of valuations recorded in the financial statements of the Government involve valuing cash flows fifty or more years into the future. The principles in PBE IFRS 4 and PBE IPSAS 39 require that discounting should be at a rate that reflects the time value of money ie, the risk-free discount rate for liabilities.

For valuing some assets, such as student loans, the standards require risk-adjusted discount rates and in practice, particularly in absence of an observable market, these are typically built up from risk-free discount rates with adjustments for risk. Therefore, the main objective of this paper is to determine a suitable risk-free yield curve for discounting cash flows of long durations in accordance with the relevant accounting standards.

One of the challenges is that, in practice, the risk-free discount rates cannot be directly observed; they are usually proxied by the return on a very safe asset. When selecting the risk-free discount rate, the first step is to identify a suitable observable proxy and then to determine if any adjustments to that proxy are required. Therefore, this methodology determines the most appropriate yield that can be observed to provide the best proxy to a New Zealand risk-free discount rate.

An additional challenge is that New Zealand market data only extends out 18 years for Government bonds. At extreme durations there are no observable market values for interest rates.

Although there has been an increase in inflation-indexed bonds issued since we developed the original methodology, we do not believe this means that the starting point for the methodology should now be the real return determined from inflation-indexed bonds rather than calculating nominal discount rates and inflation separately. In our view, this would not be an appropriate interpretation of the relevant accounting standards and the market in inflation-indexed bonds is not deep compared to the market in nominal Government bonds, which we consider deeper and more liquid. Refer to Appendix B for discussion of the accounting standard interpretation and the chapter on short to medium-term inflation regarding the quality of the inflation-indexed bond market.

Summary of methodology

Overall framework

The framework for determining the risk-free discount rates and CPI inflation assumptions can be summarised in eight steps as follows. The framework of applying eight steps has been kept unchanged since 2010, although the assumptions under each step are subject to review and have changed over time in some cases.

Table 1: Eight step framework for determining the Treasury risk-free discount rates and CPI assumptions

Assumption	Step	
Short to medium-term assumptions	1	Determine risk-free discount rates for the first year with reference to the overnight cash rate and Treasury bills
	2	Determine any adjustments required to the nominal Government bond yields to give short to medium-term risk-free discount rates
	3	Determine the smoothed market forward rate curve with reference to the overnight cash rate, Treasury bills and nominal Government bond yields
	4	Determine short to medium-term CPI inflation assumptions
Long-term assumptions	5	Determine the long-term real risk-free discount rate
	6	Determine the long-term nominal risk-free discount rate
	7	Determine the long-term CPI inflation from the above, cross-checked against available market and historical data
Assumptions for bridging the short to medium and long-term	8	Determine the method of blending short to medium-term and long-term rates

Methodology steps 1 to 8

The assumptions under each of these eight steps is discussed further in the body of the report. However below is a summary of the methodology and principles that will apply to each of the eight steps under the framework, including any updates from the current review. These will be applied consistently at each valuation date.

Short to medium-term risk-free discount rates (steps 1 to 3)

The overnight cash rate, Treasury bills and nominal Government bonds will be the starting point for determining short to medium-term risk-free discount rates. The relevant accounting and actuarial standards acknowledge that reference to Government bonds in determining a proxy for risk-free discount rates is a good starting point. The use of Government bonds as a suitable risk-free proxy is also widely accepted by current practice in New Zealand.

In the past, adjustments have been required to the nominal Government bond yields both internationally and in New Zealand to better proxy risk-free discount rates. There have been a number of reasons for this, principally a lack of liquidity in the market for nominal Government bonds due mostly to inadequate supply or low levels of trading activity.

At present, nominal Government bonds and Treasury bills are liquid and so can be used directly to determine risk-free discount rates without any adjustment. At present there is no expectation that this will change in the medium term.

The process for assessing any required adjustments to the nominal Government bond yields to proxy short to medium-term risk-free discount rates in the future is described in Appendix C – Process for adjusting market data.

Short to medium-term CPI inflation (Step 4)

There are two main sources of short to medium-term inflation information; inflation forecasts and breakeven inflation determined from the relationship of the market price of inflation-indexed Government bonds to the market price of nominal Government bonds.

Breakeven inflation is defined as the future inflation that is required to make the yield on an inflation indexed bond equivalent to the yield on a nominal bond of the same duration. Breakeven inflation may differ from future inflation expectations for a number of reasons, such as differences in the liquidity of the inflation-indexed and nominal Government bonds and inflation risk premium[3].

Our analysis of international data indicates the average differential between breakeven inflation and inflation swaps is 0.30% pa since 2010 (after the impact of the global financial crisis where the breakeven inflation is lower), and this differential has been taken as a proxy for the inflation-indexed price adjustment. While the equivalent data is not available in New Zealand to do the same analysis, in our view, it is reasonable to assume the inflation-indexed price adjustment is likely to be at least as large here. The purpose of the inflation-indexed price adjustment is to allow for the relative illiquidity of inflation-indexed government bonds compared to nominal government bonds because there are a limited number of domestic buyers and significant concentrations of holdings in the inflation-indexed government bond market. We believe that the evidence strongly suggests inflation-indexed government bonds are not as liquid as nominal government bonds, and so the break-even inflation rates calculated from the inflation-indexed government bonds need to be adjusted to reduce this bias before being used to estimate inflation.

We are not aware of any reliable and relevant information which can be used to assess the inflation risk premium.

The process to determine short to medium-term inflation rates is:

- every six months
  - consider both forecasts and breakeven inflation
  - assess the baseline forecast inflation using forecasts for the short term (4 years) and the RBNZ mid-range target of 2.0% pa for the medium term

3 An inflation risk premium could be either positive or negative depending on whether the investor is prepared to pay a premium for protection, or partial protection from inflation being greater than expected or whether the investor considers the risk of inflation being lower than expected is a greater risk.

  - determine the rate of breakeven inflation through to the date of the earlier of the last nominal or last inflation-indexed Government bond (2037 at present) and add an inflation-indexed price adjustment of 0.30%
  - give a 50% weighting to each of the forecast inflation and adjusted breakeven inflation

- in intermediate months, adjust the inflation assumption by 50% of the movement in the breakeven inflation
- in the future, if there is credible information that inflation should follow a curve or linear trend, then this will be allowed for.

Adding an inflation-indexed price adjustment of 0.30% to the rate of breakeven inflation is a new assumption as part of the 2019 review.

Long-term risk-free discount rates (Steps 5 and 6)

The methodology assumes that a single long-term real risk-free discount rate (ie, the real rate of interest that an investor would expect to earn from a very safe asset, after taking into account inflation expectations) can be set and this rate should be stable for a reasonable time.

The real risk-free discount rate is the most critical long-term assumption for accounting valuations with inflation-indexed cash-flows, and the nominal rate is the most critical for valuations with no inflation impact.

While models use nominal risk-free discount rates and CPI inflation assumptions, these assumptions are products of this real risk-free discount rate. Therefore, the difference in quantum between them (ie, the real-return assumption) is critical to the final valuation.

Having said that, these components are important individually in that they inform our views of an appropriate real risk-free discount rate assumption. Minimal guidance is given on real rates of return and inflation assumptions in the standards.

As there is no observable data for the real (or nominal) long-term risk-free discount rate, judgment is required in selecting the rate that proxies the long-term real risk-free discount rate. Recent historical nominal and real risk-free returns, returns on long-term nominal and inflation-indexed bonds, returns on relevant offshore nominal and inflation-indexed bonds and economic theory are all relevant to selecting the long-term risk-free discount rate. While recent historical experience and trends are taken into consideration, as the rates selected are intended to apply for the next three years and given the extent to which the rates vary over a three year period, the rates selected should not be overly influenced by the actual rates at the date of this report but seek to reflect the expected level over the next three years.

The review concludes that a reasonable long-term real return assumption for accounting valuations is 2.30% pa (2.25% pa compound) and this is proposed as the long-term risk-free discount rate in the methodology. This assumption has been updated as part of the 2019 review and will be reassessed as part of the next review, expected to be in 2022. The previous long-term real return assumption was 2.75% pa.

Long-term CPI inflation (Step 7)

Consistent with the long-term nominal risk-free discount rate, the methodology sets a single CPI rate for the long term. This rate is calculated as the long-term nominal rate less the long-term real rate.

In the current, comparatively stable economic environment, this rate has been validated by reference to historic levels of CPI inflation and the historic relationship between CPI inflation and the RBNZ inflation targets.

The mid-point of the RBNZ inflation target is currently 2.0% pa and the current Governor of the Reserve Bank has commented that “Annual CPI inflation is forecast to reach 2 percent in late 2020, as domestic inflationary pressure rises. Survey measures of inflation expectations remain anchored at close to 2 percent across all horizons”. The methodology concludes that a reasonable long-term CPI inflation rate is 2.0% pa.

Bridging the short and long-term (Step 8)

The nominal Government bond yield curve currently finishes at 15 April 2037 (currently 18 years). In future the longest duration for Government bonds is likely to range from 15 and 20 years. This raises the question on how the Government bond yield curve should be blended with the long-term assumptions.

The methodology assumes the difference between short to medium-term and long-term risk-free discount rates should be smoothed.

Smoothing should commence at the maturity date of the last nominal Government bond.

A simple linear blending, through to 10 years after the maturity date of the last nominal Government bond, subject to a maximum slope of 0.05% per year is used, as investigations indicate that more complex blending processes have little impact on the final rates.

Methodology parameters

The following is a table of the long-term parameters using the framework and methodology summarised above:

Table 2: Modelling parameters

Item	Value	Comment
Adjustment to nominal NZ Government bonds	0	No adjustment required
Amount of NZ Government bond on issue to be included	$4 billion	Proxy for meeting liquidity requirement
Inflation-indexed price adjustment used to adjust break-even inflation	0.30%	Based on international data. This is a new assumption since the 2016 review
Weighting given to inflation forecasts	50%	
Weighting given to breakeven inflation	50%	
Long-term real return	2.30%	Compound 2.25% and a reduction from 2.75% in the 2016 review
Long-term nominal discount rate	4.30%	Reduction from 4.75% in the 2016 review
Long-term CPI inflation	2.0%	
End of market observations (nominal discount rates and CPI inflation)	End of nominal yield curve	Currently 15 April 2037
Start of long-term assumptions	End of nominal yield curve plus 10 years (15 April 2047)	At 30 April this is 2065 or 46 years because of the slope maximum
Bridging assumption		Linear between the end of market and the start of long term with a maximum slope of 0.05% per year of duration

A sample table of annual rates from year one to year 46 determined using this methodology, as at 30 April 2019, is shown in Appendix E – Sample table of rates as at 30 April 2019.

These rates are expressed as forward rates, ie, a different rate for each year of the projection. It is recommended that where possible forward rates are used. However, adopting forward rates require that the valuation program can cope with different interest rates each year.

There may be cases where the valuation program can only handle a single rate. Spot rates have also been provided which are the single-equivalent interest rates and inflation for each duration in the table. In the case where a single rate is required then the appropriate spot rate can be selected to match the duration of the liabilities.

The appropriate inflation index or rate for the liabilities must be used for each individual case. Guidance on this has been explicitly excluded from the scope of this report. It is however expected that inflation assumptions will be consistent with the specified CPI inflation. All adjustments to the CPI inflation should be supported by evidence, data or a reasonable argument.

Reviews and investigations required

The inputs and parameters will be reviewed according to the following table.

Table 3: Timetable for review of inputs

Input	Update based on market data	Review of methodology
Short to medium-term risk-free discount rate	At each monthly calculation date	Three yearly
Inclusion of new Government bonds	30 June and 31 December	Three yearly
Short-term inflation forecasts	30 June and 31 December	Three yearly
Breakeven inflation	At each monthly calculation date	Three yearly
Short to medium-term inflation	At each monthly calculation date, based on short-term inflation forecasts determined at previous 30 June or 31 December and adjusted breakeven inflation	Three yearly
Inflation-indexed price adjustment	N/A	Three yearly
Long-term real return	N/A	Three yearly
Long-term nominal return	N/A	Three yearly
Long-term CPI inflation	N/A	Three yearly
Bridging methodology	N/A	Three yearly

We have considered what circumstances might lead to the review of the methodology before three years. As the short to medium-term assumptions are based on market information, we consider that these will adjust automatically to a change in the market. Due to the long-term over which the bridging assumptions apply and the relatively low significance of the long-term assumptions, we do not consider that these would need adjusting sooner than three years.

Events that might lead to earlier review are:

- The 0.3% inflation-indexed price adjustment for breakeven inflation has been determined based on international experience since 2010. The historic information indicates that that breakeven inflation becomes less reliable in times of extreme market stress, eg, through the Global Financial Crisis, and in these circumstances the quantum of the inflation-indexed price adjustment would need to be reconsidered.

- A change in the RBNZ inflation target could also lead to a circumstance in which the methodology and assumptions need to be reviewed.

The discount rates will be reviewed prior to the implementation of PBE IFRS 17.

Accounting and actuarial standards and other literature

A full review of the accounting and actuarial standards relating to setting discount rates and CPI inflation assumptions can be found in Appendix A - Literature review.

Generally, the accounting standards provide principles but have limited specific guidance in a number of areas, particularly where there are market shortcomings such as mismatches between liability durations and the length of the market yield curves. PBE IPSAS 39 provides more guidance for risk-free discount rates than PBE IFRS 4 but still requires significant judgement around how it is applied in practice.

While the words of PBE IFRS 4 and PBE IPSAS 39 in relation to risk-free discount rates are not exactly the same, we have concluded that both standards require the same risk-free discount rate in substance. Therefore, it is appropriate to determine a single table of risk-free discount rates and CPI inflation assumptions centrally for both insurance liabilities and pension obligations reported in the financial statements of the Government.

Because the standards provide principles and limited application guidance in selecting financial assumptions, significant judgement must be used extensively in this paper to achieve the objectives of general purpose financial statements, which is to provide information about an entity that is useful to readers of those financial statements for accountability purposes and for decision-making purposes.

Some of the key principles and pieces of guidance from PBE IFRS 4 and PBE IPSAS 39 that we have applied in developing this methodology and assumptions are:

- Actuarial assumptions shall be unbiased and mutually compatible [PBE IPSAS 39.77].
- Actuarial assumptions are unbiased if they are neither imprudent nor excessively conservative [PBE IPSAS 39.79].
- Actuarial assumptions are mutually compatible if they reflect the economic relationships between factors such as inflation, rates of salary increase and discount rates. For example, all assumptions that depend on a particular inflation level (such as assumptions about interest rates and salary and benefit increases) in any given future period assume the same inflation level in that period [PBE IPSAS 39.80].
- An entity determines the discount rate and other financial assumptions in nominal (stated) terms, unless estimates in real (inflation-adjusted) terms are more reliable, for example, in a hyperinflationary economy (see PBE IPSAS 10 Financial Reporting in Hyperinflationary Economies), or where the benefit is inflation-indexed, and there is a deep market in inflation-indexed bonds of the same currency and term [PBE IPSAS 39.81].
- Financial assumptions shall be based on market expectations, at the end of the reporting period, for the period over which the obligations are to be settled [PBE IPSAS 39.82].
- The rate used to discount post-employment benefit obligations (both funded and unfunded) shall reflect the time value of money. The currency and term of the financial instrument selected to reflect the time value of money shall be consistent with the currency and estimated term of the post-employment benefit obligations [PBE IPSAS 39.85].

- The discount rate reflects the time value of money but not the actuarial or investment risk. Furthermore, the discount rate does not reflect the entity-specific credit risk borne by the entity's creditors, nor does it reflect the risk that future experience may differ from actuarial assumptions [PBE IPSAS 39.86].

- The discount rate reflects the estimated timing of benefit payments. In practice, an entity often achieves this by applying a single weighted average discount rate that reflects the estimated timing and amount of benefit payments, and the currency in which the benefits are to be paid [PBE IPSAS 39.87].

- In some jurisdictions, market yields at the end of the reporting period on Government bonds will provide the best approximation of the time value of money. However, there may be jurisdictions in which this is not the case, for example, jurisdictions where there is no deep market in Government bonds, or in which market yields at the end of the reporting period on Government bonds do not reflect the time value of money [PBE IPSAS 39.88].

- There may also be circumstances where there is no deep market in government bonds or high quality corporate bonds with a sufficiently long maturity to match the estimated maturity of all the benefit payments. In such circumstances, an entity uses current market rates of the appropriate term to discount shorter term payments, and estimates the discount rate for longer maturities by extrapolating current market rates along the yield curve [PBE IPSAS 39.88].

- The outstanding claims liability shall be discounted for the time value of money using risk-free discount rates that are based on current observable, objective rates that relate to the nature, structure and term of the future obligations [PBE IFRS 4.D6.1].

- The discount rates proposed are not intended to reflect risks inherent in the liability cash flows, which might be allowed for by a reduction in the discount rate in a fair value measurement, nor are they intended to reflect the insurance and other non-financial risks and uncertainties reflected in the outstanding claims liability [PBE IFRS 4.D6.1.1].

- Typically, government bond rates may be appropriate discount rates for the purposes of this Appendix, or they may be an appropriate starting point in determining such discount rates [PBE IFRS 4.D6.1.2].

Short to medium-term risk-free discount rates

Introduction

The purpose of this section is to describe the methodology and the judgments made in determining the short to medium-term risk-free discount rates for accounting valuations. In this context short to medium-term means the period in which market yields are available in New Zealand to proxy risk-free nominal discount rates.

In practice, the risk-free discount rate cannot be directly observed; it is usually proxied by the return on a very safe, liquid asset. When selecting the risk-free discount rate, the first step is to identify a suitable observable proxy and then to determine if any adjustments are required.

There are a number of sources of risk-free discount rates that an entity could use and these are discussed in international technical papers. These papers also highlight that there has been considerable debate internationally on what the “best” basic risk-free discount rate source is and this can vary across jurisdictions. Each international paper is written for a specific purpose and so the choice of reference rate is influenced by that purpose and in this context we note that, subject to markets being deep, liquid and transparent, the starting points specified are bank SWAPs, high quality corporate bonds and Government bonds.

When selecting a proxy, we have been guided by the New Zealand accounting standards, specifically PBE IFRS 4, PBE IPSAS 39 and PBE IPSAS 29, that suggest Government bonds are a suitable risk-free proxy, subject to markets being deep and reflecting the time-value of money, but have considered whether a more reliable and relevant proxy to risk-free discount rates exists in New Zealand.

After reviewing the international papers and examining the current market in New Zealand, we have formed a view that the alternatives proposed, bank SWAPs and corporate bond rates, do not provide a more reliable and relevant source of risk-free discount rates in New Zealand than Government bonds.

We recognise that in Europe the bank SWAP rate is regarded as a more appropriate starting point. However Europe has the complication of multiple Sovereigns issuing debt in a common currency and Sovereigns with lower credit ratings which are not relevant in New Zealand. Therefore, this current European view is not automatically applicable to the New Zealand context.

The following analysis is divided into three topics:

- the risk-free discount rates for terms of up to one year
- the risk-free discount rates for terms of more than one year
- liability liquidity adjustment to the risk-free discount rate.

Terms of up to one year

Treasury bills are liquid and so Treasury bill data can be used to determine risk-free discount rates for the first six months without any adjustment. At present there is no expectation that this will change and therefore we have not considered in this paper any impacts of possible (but unlikely) future liquidity issues for Treasury bills.

The overnight cash rate and Treasury bill rates for 1, 2, 3 and 6 months are readily available. These are used for curve fitting, with the Treasury bill rates weighted by market value.

Terms of more than one year

In an ideal world, market data on risk-free discount rates would be available directly from market observations. In practice we have limited observations from markets that have shortcomings. We therefore need to consider how to best determine risk-free discount rates from available market data.

The review of the international literature and discussions indicate a number of different sources for risk-free discount rates, including:

- Government bond rates
- Government bond rates plus an adjustment for scarcity
- bank SWAP rates
- bank SWAP rates minus an adjustment for risk
- corporate bond rates minus an adjustment for risk.

The relevant accounting standards infer the appropriate starting point is Government bonds, unless there is not a deep market in Government bonds, or the market in Government bonds does not reflect the time value of money.

The next part of this section considers Government bonds, as this determines whether Government bonds are used. We then consider whether bank SWAP rates are a better basis for determining risk-free discount rates than Government bonds. Government bond rates and bank SWAPs have been prone to yield anomalies in the past when stresses are put on the market, and this section also considers whether or when any adjustments to the rate is needed. Finally we consider corporate bonds.

Government bonds

Market data is generally considered reliable, where the market is deep, liquid and transparent. Aspects which are indicative of a market which is deep, liquid and transparent (DLT) are:

- high trading volumes and turnovers – note the converse does not necessarily imply the market is not DLT as an asset may be easily traded even if it is not frequently traded
- low bid-ask spread

- existence of appropriate supervision which ensures that large transactions will only affect prices according to the natural trends of the market, and not because of any spurious influence

- the way in which market prices are collected which gives reassurance that the influence of large transactions or unusual trades is likely to be immaterial.

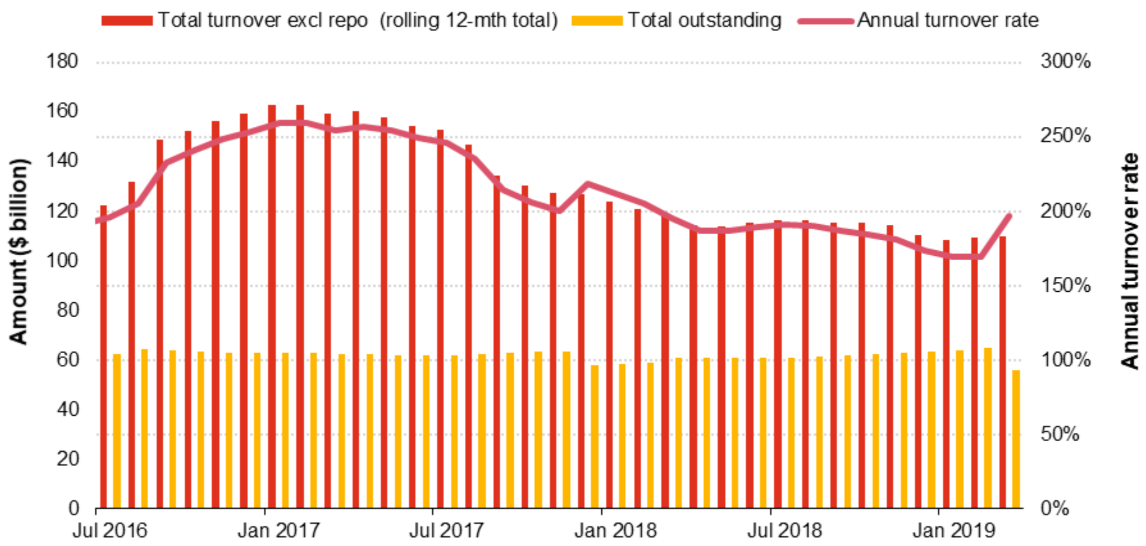
Amount on issue and turnover

The amount of nominal Government bonds on issue and turnover are as follows.

Table 4: Nominal Government bonds on issue (30 April 2019) by maturity

Maturity	Coupon (% pa)	Total Issue ($m)	Available (net of RBNZ) ($m)
15-Apr-2020	3.00	6,710	6,310
15-May-2021	6.00	11,309	11,059
15-Apr-2023	5.50	9,195	8,945
15-Apr-2025	2.75	7,100	6,850
15-Apr-2027	4.50	5,950	5,700
20-Apr-2029	3.00	5,250	5,000
14-Apr-2033	3.50	4,700	4,450
15-Apr-2037	2.75	5,400	5,150
Total		**55,614**	**53,464**

Figure 1: Total nominal Government bonds on issue and turnover



There is $53b of nominal Government bonds available. The amount of nominal Government bonds on issue has been relatively stable over recent years. The Australian Group of 100 adopted a minimum amount outstanding for an individual security of AUD100 million as indicative of meeting the DLT criteria. Each issue meets this criteria.

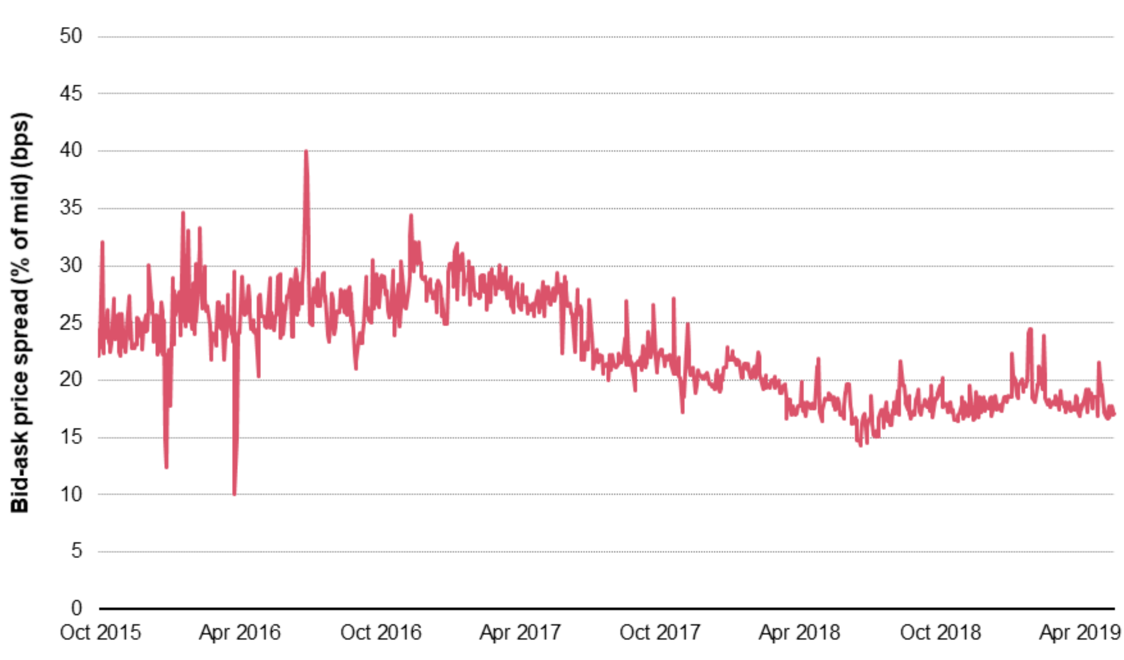
Milliman adopted a 50 basis point criteria for liquidity when assessing whether AA Corporate bonds are liquid. The Australian Group of 100 commented Sweden and Norway use corporate bonds for IAS 19 purposes, which requires a deep and liquid market in corporate bonds, and that their liquidity ratio was about 50%. The above indicates the liquidity of nominal Government bonds (annual turnover rate) is significantly greater than this. We note that Milliman also indicated the turnover on Australian Commonwealth bonds was 370%, so significantly higher than for New Zealand Government bonds. All parties we have consulted with consider nominal Government bonds liquid.

The difference between yields on bank SWAPs and Government bonds is considered later in this section.

Bid-ask spreads

The chart below shows the amount by which the ask price exceeds the bid price for nominal Government bonds, as a percentage of the mid-point of the ask and bid prices. The ask and bid prices have been obtained from Bloomberg. Shown below is the weighted average bid-ask price spread (% of mid) of all nominal Government bonds on issue maturing in at least 2020, weighted by amount outstanding.

Figure 2: Nominal Government bonds – weighted average bid-ask price spread (% of mid)



The Australian G100 paper written by Milliman adopts a difference of less than 50 basis points (bps) in the bid-ask price spread (% of mid) as indicative of a liquid market. The chart above shows that the difference has been below this threshold, indicating a liquid market for New Zealand nominal Government bonds.

Outlook for the New Zealand Government bond market

The Treasury's funding strategy aims to balance three key goals:

- considering the overall structure of the Crown's balance sheet
- capturing and simulating investor demand
- promoting well-functioning and liquid New Zealand Government Securities markets.

The Treasury's Capital Markets team has updated its borrowing programme and plans to gradually increase total government stock on issue from $74.2 billion in 2018 to $77.1 billion in 2022. Nominal Government bond issuance in 2018/2019 was expected to be $7 billion of the total $8 billion. The Treasury comments that forecast Government bonds on issue are consistent with the Government's commitment to maintain levels of Government bonds on issue at not less than 20 percent of gross domestic product over time and that adjustments to the programme volumes were not required to specifically meet this commitment. The implications of these plans are that the Government bond market is likely to remain at a similar level of liquidity in the near future.

Bank SWAPs compared to Government bonds

The purpose of this section is to determine if bank SWAPs are a better alternative source for risk-free discount rates than Government bonds and whether the basic rates are required to be adjusted for risk or adjusted for scarcity in either case and the size of the adjustment if required.

The reason for making market adjustments is based on the theory that the true risk-free discount rate lies somewhere between the market for Government bonds and bank SWAPs. The adjustments can be summarised as:

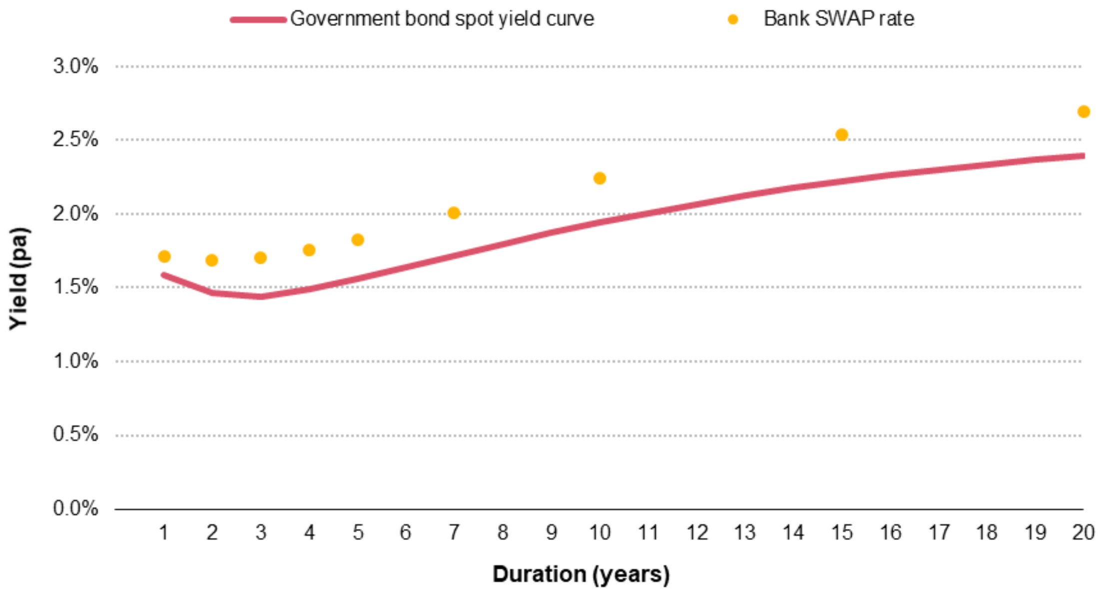
- a scarcity discount adjustment to apply to Government bond rates (will increase the yield)
- a credit risk adjustment to apply to bank SWAP rates (will reduce the yield).

The most useful market information on scarcity discount and credit risk adjustments is the bank SWAP spread, which is the difference between bank SWAP rates and Government bond rates. "Bank SWAP rates" is the commonly used description of the quoted market rates used to price a variety of interest rate SWAP instruments between two parties. In this paper we only consider the quoted market in New Zealand dollars, and refer to the rates as bank SWAP rates.

The bank SWAP spread gives guidance on the total of the scarcity discount and the credit risk adjustments but not the split between the two. It is extremely difficult to accurately decompose the spread into its components.

The graph below compares the bank SWAP rates as at 30 April 2019 to the Government bond forward and spot yield curves. There is no market data on the liquidity or otherwise of bank SWAPs.

Figure 3: Government bond spot and forward yield curves and bank SWAP rates (30 April 2019)

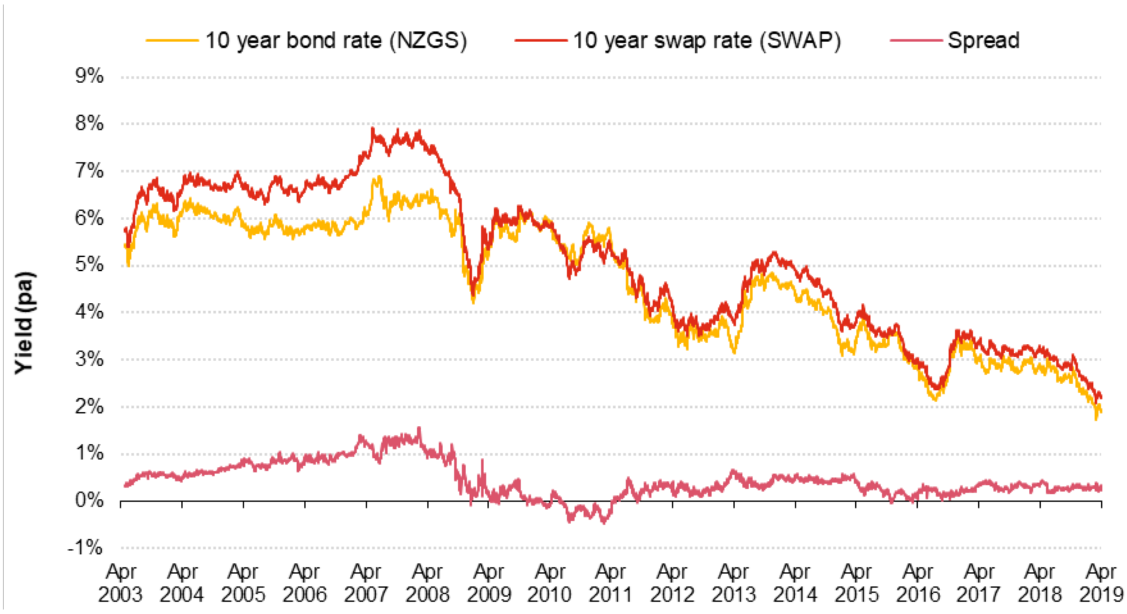


This shows that the SWAP spreads are reasonably consistent at the different terms, other than being lower at the shortest durations.

The chart below shows how the bank SWAP spread has varied over time. The following observations can be made about the historic size of the spread shown in the chart:

- From 2003 until the 2008 Global Financial Crisis, the spread increased. This was largely due to the fact that there was a large demand for Government bonds and limited availability, as a lot of bonds were tightly held and the New Zealand Government were paying off debt, driving the yields on Government bonds down.
- Later, bank SWAPs were effectively Government guaranteed through until 31 December 2011 and the Government bond market also become significantly more liquid. The spread reduced to close to zero and was below zero for a lot of 2011.
- After this, the bank SWAPs were no longer Government guaranteed, which caused the spread to increase slightly. Over the last three years, the SWAP spread has generally been in the region of 0.0% pa to 0.5% pa and is currently 0.33% (30 April 2019).

Figure 4: Comparison of 10 year bank SWAPs and NZ Government bond yields



The bank SWAP spread is a good measure of the sum of the upwards adjustment to Government bonds (the scarcity adjustment) and the downwards adjustment to bank SWAP rates (the risk adjustment). Because the sum is small, we can conclude that both the scarcity and the risk adjustments are small.

In Appendix C – process for adjusting market data, we set out a process to adjust market data, if necessary.

Corporate bonds

The purpose of this section is to determine if corporate bond rates adjusted for risk are a better alternative source for risk-free discount rates than Government bonds adjusted for scarcity.

The corporate bond market in New Zealand is nowhere near as extensive as in other countries and the available bonds cover a wide range of credit ratings. It is generally accepted that New Zealand does not have a high quality corporate bond market. Furthermore, even if we did believe the corporate bond market was a viable starting point, the adjustments required for removing risk are not straight forward to determine and requires reference to other “risk-free” assets. For these reasons we have eliminated corporate bonds as a viable option as a reference to risk-free discount rates in New Zealand.

Liability liquidity adjustment to the risk-free discount rate

An additional adjustment that can be made to the risk-free discount rates is a liability liquidity adjustment, to reflect the nature of the liquidity of liabilities. The accounting standards, specifically IFRS 4, state risk-free discount rates should be based on current observable, objective rates that relate to the nature, structure and term of the future obligations. Some argue that the liquidity of the liabilities is part of the nature. The argument is that if liabilities are illiquid, then the provider can invest in illiquid risk-free assets that will return a slightly higher yield.

The criteria that the liabilities must meet to be considered illiquid are that the liabilities must be certain and not able to be redeemed immediately at no cost. APRA's interpretation of this is that this adjustment is only applicable to insurance annuity contracts. The size of a typical adjustment is generally less than the spread between government bond and bank SWAPS.

This adjustment is specific to the nature of the liabilities and in aggregate the Crown liabilities would not meet the APRA definition of illiquid liabilities. A liability liquidly adjustment for specific liabilities would require very solid evidence as the strong preference is to have one set of rates applying to all liabilities.

Summary and conclusion

In our opinion, there is a deep market, which reflects the time value of money, for nominal Government bonds and as such it is appropriate to determine risk-free discount rates through to the end of the nominal Government bond yield curve using the overnight cash rate, Treasury bill and nominal Government bond data. Over recent years the bank SWAP spread has been small, indicating any scarcity adjustment would be small, and we have concluded that it is reasonable to make no scarcity adjustment at present.

This approach will be reconsidered as a part of the in-depth review of assumptions, expected in three years' time.

The smoothing process will allow for the relative liquidity of different Government bond issues by weighting the various bonds by the amount on issue. Consequently a new, small volume bond will receive a lower weighting in the fitting of the yield curve. Based on past experience, we have adopted a minimum issuance of $4 billion before a Government bond is included for calculation purposes.

We believe that short to medium-term risk-free discount rates should be expressed as forward rates and the yield curve smoothed because this automatically hypothecates a portfolio of risk-free assets that matches the duration and timing of the liability cash-flows. The details of the curve fitting and smoothing are described in Appendix D – forward rate yield curve fitting methodology.

No change was made to step 1 to 3 of the methodology from the 2019 in-depth review.

Short to medium-term inflation

Introduction

To value insurance and defined benefit pension obligations it is necessary to make assumptions as to future inflation. The scope of this section is focused on CPI inflation. CPI measures the relative price of consumer goods and services purchased by households at different dates. Statistics New Zealand determines and report actual CPI.

Short to medium-term CPI inflation means up until the end of the nominal yield curve. This is currently 18 years, through to 2037. After this, the bridging and long term assumptions apply.

While the insurance and employee benefit accounting standards provide guidance about the discount rate to be applied, there is no guidance on how the inflation assumption should be determined other than that the accounting standard for employee benefits states; “Actuarial assumptions shall be unbiased and mutually compatible” and “Actuarial assumptions are mutually compatible if they reflect the economic relationships between factors such as inflation, rates of salary increase, and discount rates” [PBE IPSAS 39 para 77 and 80]. This means that actuarial assumptions used should be unbiased and internally consistency with other actuarial assumptions used within the defined benefit pension liability valuation.

International Standard of Actuarial Practice 3 (ISAP 3) provides guidance to actuaries when performing actuarial services in connection with International Accounting Standard 19 - Employee Benefits, which has a lot of similarities to PBE IPSAS 39 – Employee Benefits. ISAP 3 has a number of comments on how to determine inflation assumptions. It indicates that both market-implied expectations and other information should be considered, including:

- changes in price indices
- yields on nominal and inflation-indexed debt (taking into account the effect of any significant supply-demand imbalances)
- forecasts of inflation
- central bank monetary policy
- analyses prepared by experts.

The analysis is shown under four headings.

- forecasters’ views of CPI inflation, with those forecasters including experts
- break-even inflation implied by the inflation-indexed bond yields
- historical CPI inflation, which is shown relative to the Reserve Bank of New Zealand (RBNZ) targets
- term structure.

Forecasters' views of CPI inflation

The readily available CPI inflation forecasts are summarised in the following table. All of these forecasts are published at different times of the year and for different projection periods. The first forecast is a consensus forecasts produced by New Zealand Institute of Economic Research (NZIER). The figures quoted are an average of the views of complied from a survey of financial and economic agencies, who could reasonably be considered experts. The last forecast is an average from a survey conducted by the Reserve Bank of New Zealand (RBNZ) of business managers and professionals, in the belief that market expectation of business manager is a key determinant of future inflation.

Table 5: Forecasts of CPI inflation

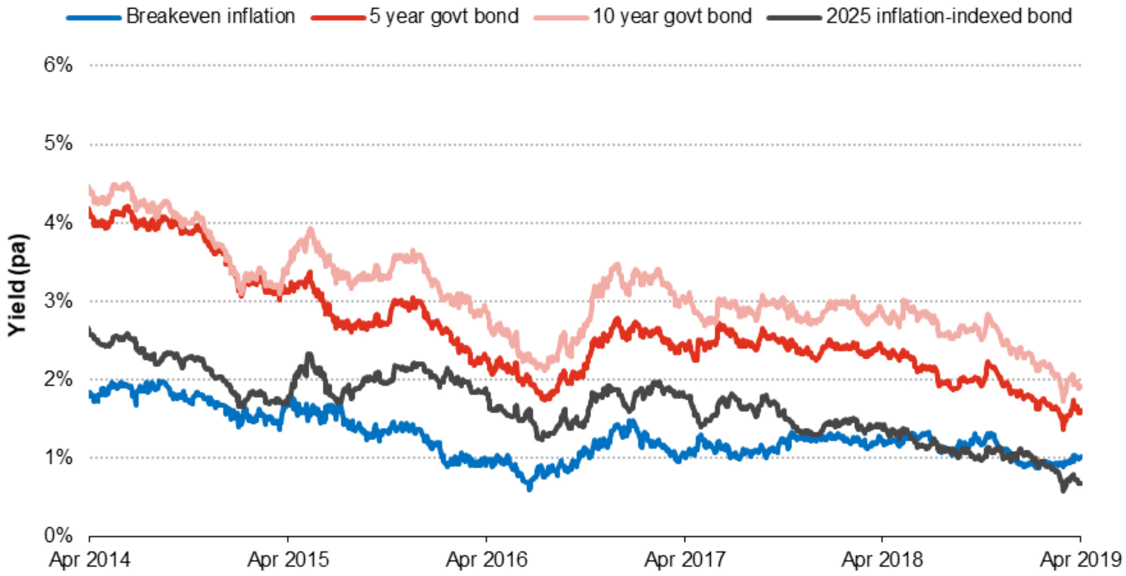
Source (date of release)	Year ending	2020 (% pa)	2021 (% pa)	2022 (% pa)	2023 (% pa)	2024 (% pa)	2025 (% pa)	2026 (% pa)	2027 (% pa)	2028 (% pa)	2029 (% pa)
NZIER Consensus Forecasts (Mar 2019)	March	1.9	2.0	2.0	-	-	-	-	-	-	-
NZIER Quarterly Predictions (Mar 2019)	March	2.0	2.0	2.0	2.0	-	-	-	-	-	-
Treasury (Dec 2018, HYEFU)	June	2.0	2.0	2.0	2.0	-	-	-	-	-	-
RBNZ (May 2019)	March	1.9	1.9	2.1	-	-	-	-	-	-	-
RBNZ Survey of Expectations (May 2019)	June	2.0	2.0	-	-	2.0	-	-	-	-	2.0

Where multiple forecasts are available, they are mostly similar, indicating a range of 1.9% to 2.0% for both the year ended March 2020 and the year ended March 2021, and 2.0% pa for 2022 and 2023. The only longer term forecast is also 2.0%, equal to midpoint of the Reserve Bank target.

Break-even inflation implied by inflation-indexed bond yields

The following graph shows an estimate of the breakeven inflation implied by the 2025 bond since March 2014 using a weighted average of the 5 and 10 year Government bond yields, with the weighting determined by the time remaining to 2025 at each date. The exact breakeven is complicated to determine but should move up and down in a similar fashion to the estimate shown.

Figure 5: Estimated breakeven inflation from 2025 inflation-indexed bond



This graph indicates the breakeven inflation has shown a fairly consistent downward trend to 2016 and has remained close to 1.0% pa since then. This differs to forecast inflation which has been close to 2.0% for this period (albeit the forecast inflation is for a shorter period).

There are a number of reasons why forecast inflation and breakeven inflation may differ:

- If inflation-indexed bonds are less liquid than nominal bonds, ie, a higher expected yield is demanded by the same investor on inflation-indexed Government bonds than on nominal Government bonds to compensate for the lower liquidity of inflation-indexed Government bonds, then this difference in liquidity will result in break-even inflation being lower than expected inflation. We refer to this difference between breakeven inflation and expected inflation as the inflation-indexed price adjustment.

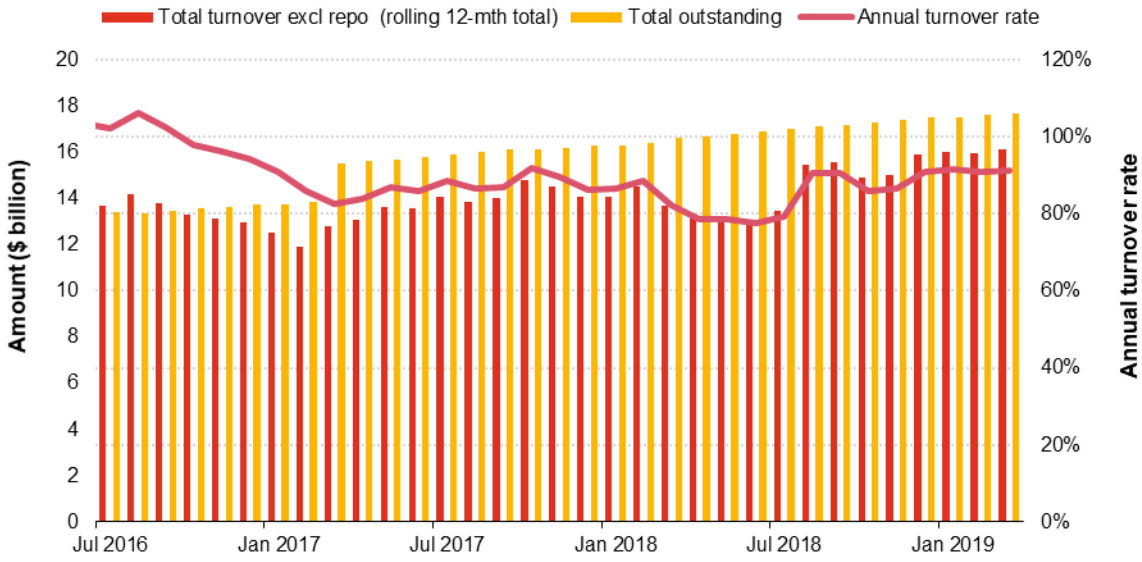
- Breakeven inflation may differ due to an inflation risk premium. This risk premium could be positive (increasing breakeven inflation compared to forecast inflation) or negative (reducing breakeven inflation). It has been commented (internationally) that the premium used to be positive, as the main concern was inflation shocks (upwards), but now the premium is generally negative, as the main concern is demand shocks and protecting the nominal return.

Different parties consulted had differing views on whether inflation-indexed bonds are “liquid”. On page 14 we looked at the amounts on issue and turnover of nominal bonds. The equivalent information for inflation-indexed bonds is shown below.

Table 6: Inflation-indexed Government bond maturities on issue (30 April 2019)

Maturity	Coupon (% pa)	Total Issue ($m)	Available (net of RBNZ) ($m)
20-Sep-2025 CPI Indexed	2.00	5,450	5,200
20-Sep-2030 CPI Indexed	3.00	4,450	4,200
20-Sep-2035 CPI Indexed	2.50	4,250	4,000
20-Sep-2040 CPI Indexed	2.50	3,650	3,400
Total		17,800	16,800

Figure 6: Inflation-indexed Government bonds on issue and turnover

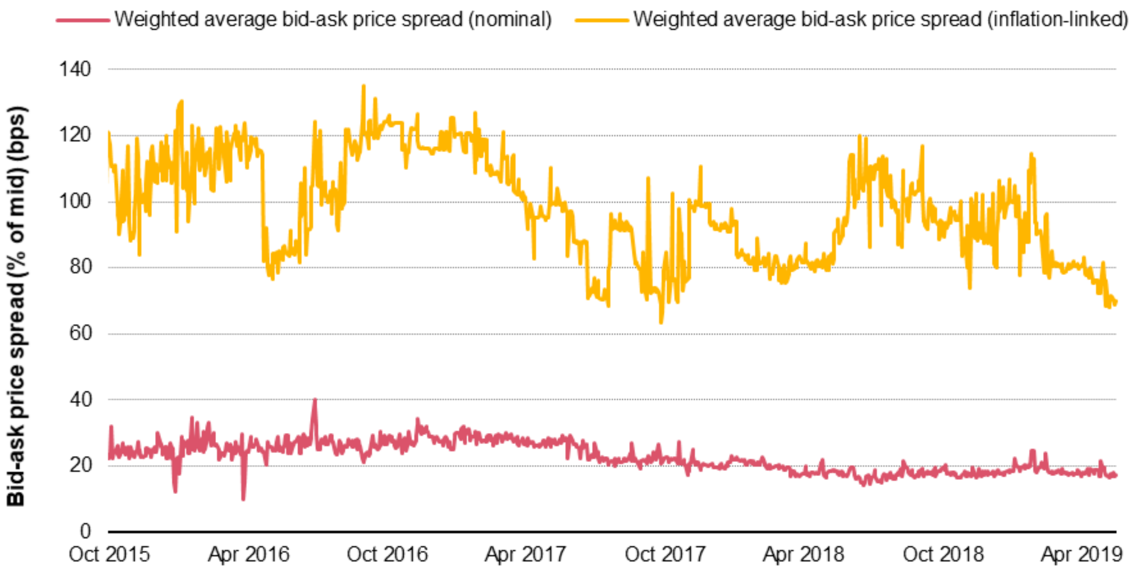


There is $17b of indexed stocks available. The amount of inflation-indexed Government bond on issue has been increasing. The Australian Group of 100 adopted a minimum amount outstanding for an individual security of AUD100 million as indicative of meeting the DLT criteria. Each issue meets this criteria.

Turnover, while still above the 50 basis point criteria adopted by Milliman, is significantly lower than for nominal Government bonds. There are a limited number of domestic buyers, and significant concentration of holdings. For example, as at 30 June 2018, ACC owned 53% of the inflation-indexed bonds, with a much lower proportion of the nominal (source ACC 2018 Annual Report). Inflation-indexed bonds do not feature prominently in fixed interest indices and benchmarks and are unlikely to have made it into fund manager's asset allocation policies.

The bid-ask price spread (% of mid) is also generally higher than for nominal Government bonds, noting the period below has been fairly benign with limited pressure on liquidity. The weighted average bid-ask price spread (% of mid) uses all Government bonds on issue maturing in at least 2020, weighted by amount outstanding.

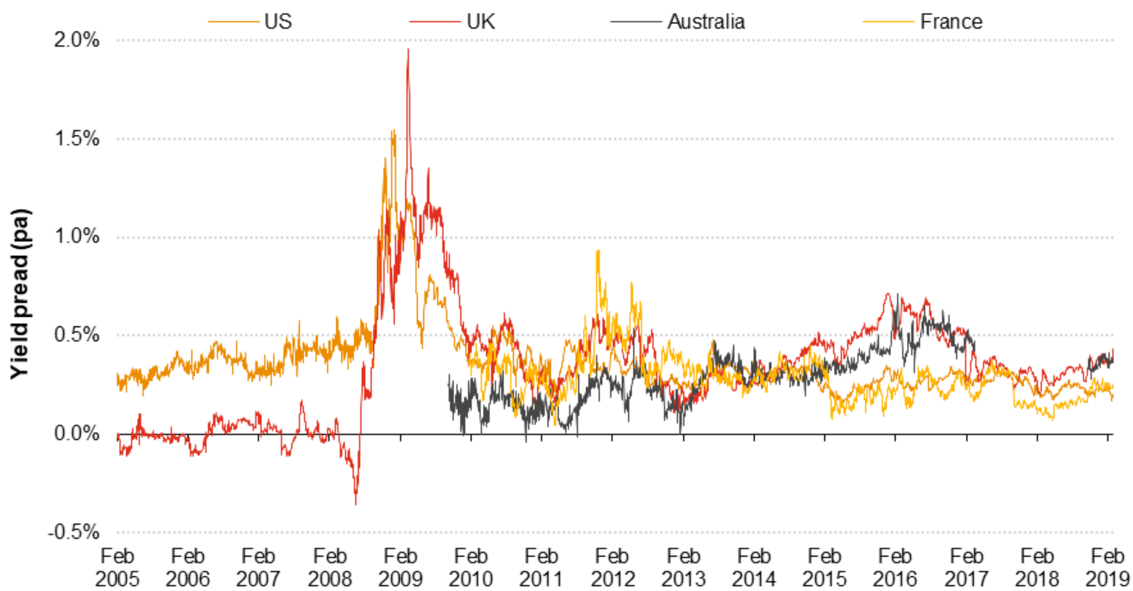
Figure 7: Bid-ask price spread (% of mid), inflation-indexed bonds compared to nominal bonds



All of the above indicate that inflation-indexed bonds are less liquid than nominal Government bonds and so it is reasonable to assume that breakeven inflation determined from comparing the yields on inflation-indexed Government bonds and nominal Government bonds will be less than investors' true expectations for inflation. The next question is how large is this difference.

The chart below shows a comparison of the spread between 10 year inflation swaps and 10 year breakeven inflation for the United States, United Kingdom, France and Australia. Inflation swaps are generally considered liquid, although it must be noted that there may not be a large number of investors in inflation swaps in each case. This shows that since 2008, breakeven inflation estimates have been consistently below inflation swaps for all four economies, illustrating the idea that given inflation-indexed bonds are less liquid than nominal bonds, there is a downward bias in derived breakeven inflation expectations.

Figure 8: 10 year inflation swaps less 10 year breakeven inflation



This chart shows an almost surprising consistency between the different countries. The average difference over the last 10 years has been 0.30% pa. The impact of the global financial crisis post 2008 is also apparent and indicates break-even inflation is potentially not a good estimate of inflation when financial markets are under extreme stress.

Equivalent information is not available for New Zealand. The equivalent New Zealand margin would depend on the relative liquidity of inflation-indexed bonds to nominal bonds compared to the relative liquidity in the other countries. Given the liquidity information above, it is reasonable to assume the difference is likely to be at least as large.

The chart above compares inflation swaps with breakeven inflation and so the comparison would not incorporate the inflation risk premium. As mentioned above, commentary is that at present this premium is negative as there is limited concern that inflation will get out of control. In New Zealand there are few institutions with inflation-indexed liabilities actively seeking investment in inflation-indexed bonds (ACC being the notable exception), whereas these are prevalent in the UK. The impact of the inflation risk premium is difficult to quantify but may explain the difference between forecast inflation and break-even inflation plus inflation-indexed price adjustment.

The EU, as specified by EIOPA, only uses forecast inflation. To the best of our knowledge, no other country fully uses breakeven inflation to set inflation assumptions. A guidance note issued by the Actuaries Institute in November 2017, comments that when determining inflation assumptions there should be consideration of breakeven inflation rates implied by inflation-indexed bonds, adjusted where appropriate for any difference between the inflation underlying the indexed-linked bonds and the inflation underlying the liability. However, as far as we are aware inflation assumptions adopted for very long term insurance and pension liabilities are not based on breakeven inflation, although they may take them into consideration. As far as we are aware, in other countries, it would be unusual to use an unadjusted breakeven inflation.

Use of breakeven inflation internationally

We have made enquiries as to the common practices for setting inflation assumptions internationally. Note the number of countries that have similar accounting standards and comparable liabilities is limited.

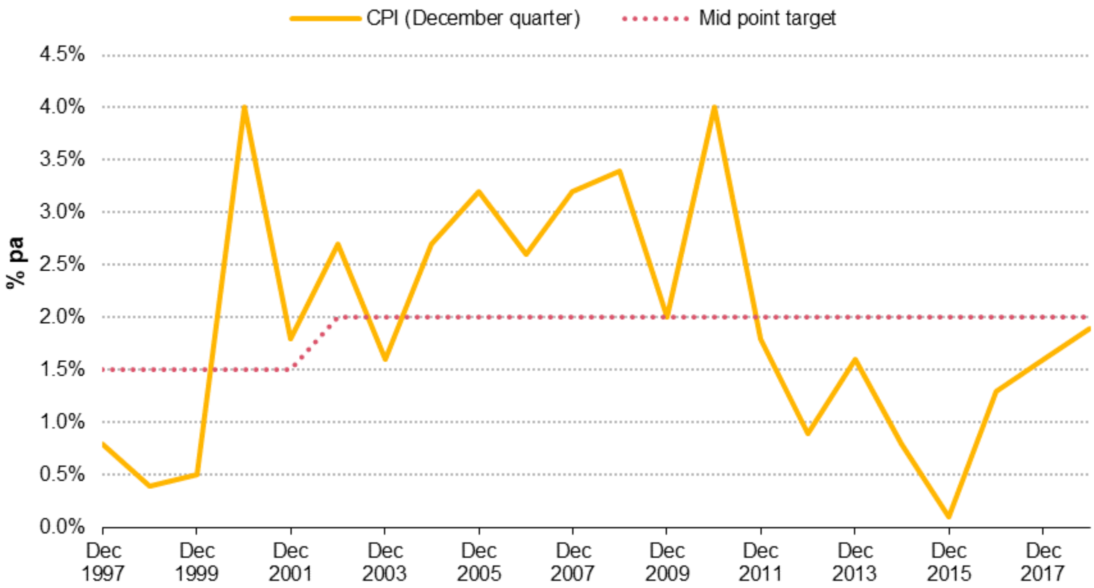
- The European Union follows the guidance set by EIOPA where the inflation is a flat rate set by reference to long term inflation expectations. This is 2% for the majority of countries, with some “low inflation” and “high inflation” exceptions.

- Australia has similar availability of index linked instruments to NZ. The Actuaries Institute has issued an information note on discount rates and inflation assumptions for General Insurance in 2017. This has resulted in two alternative approaches; firstly to use breakeven inflation with appropriate liquidity adjustments, secondly to use solely forecast inflation. All the Australian Government workers’ compensation schemes we are aware of adopt the second approach which is to use forecast inflation, and in many cases a “long term gap”, ie, a fixed real return in the longer term.

Historical CPI inflation

The following chart shows the historical CPI inflation and the RBNZ target.

Figure 9: Historical CPI inflation rates



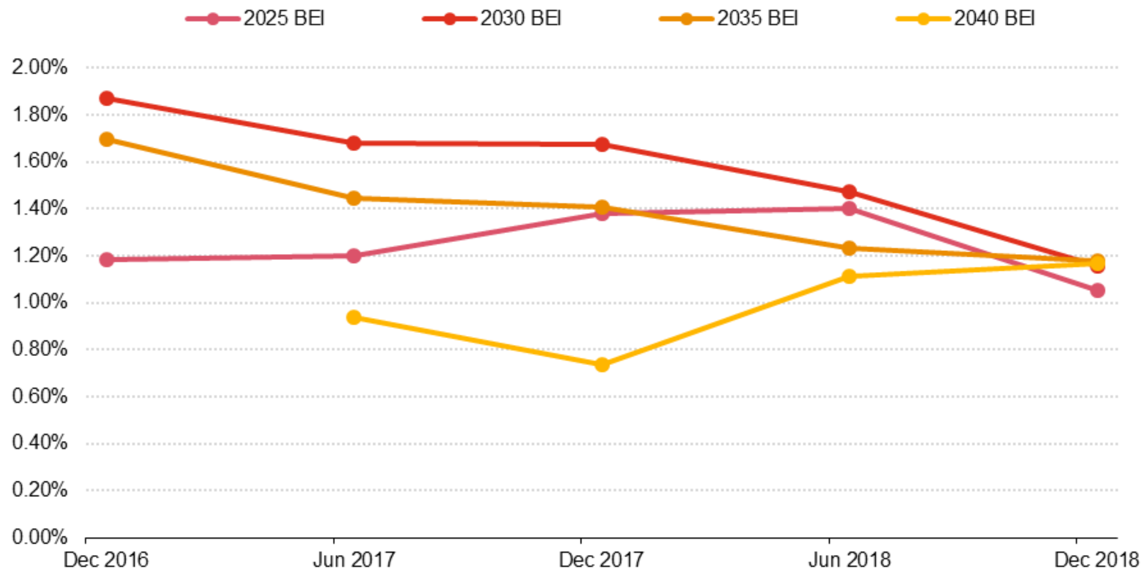
Historically CPI inflation experience has generally been above the midpoint of the target range. However, in the last seven years, the CPI increase has mostly been below the midpoint of the target range.

Over the longer term, CPI inflation has been reasonably close to the target and forecast inflation is consistent with future inflation being close to the target. The Reserve Bank target is also the assumption adopted by EIOPA.

Term structure

Breakeven inflation is defined as the future inflation that is required to make the yield on an inflation indexed bond equivalent to the yield on a nominal bond of the same duration. As there are several inflation-indexed bonds, it is possible to determine the break-even inflation for different periods in the future. The following chart shows the breakeven inflation over the previous two years.

Figure 10: Breakeven inflation



This shows that there has not normally been a consistent pattern from short to long-term inflation and there has not been a consistent pattern to expected future inflation from one date to the next. As a result, we do not consider the term structure indicated by breakeven inflation to be reliable. However, should this situation change in the future and there is evidence of consistent, significant and sustained differences by duration, the methodology should not constrain us from fitting some term structure to the inflation. Consequently, if in the future there is credible information that inflation should follow a curve or linear trend, then this will be allowed for. Note that there would have to be evidence of significant differences by duration to warrant moving away from the simplicity of a flat inflation rate. This will be considered in conjunction with the six monthly update of forecast inflations. The approach used will be one which ensures the real discount rates follow a smooth curve.

Summary and conclusion

In our view, both inflation forecasts and breakeven inflation need to be considered because both provide important but slightly different information, but that a margin needs to be added to breakeven inflation to allow for the lower liquidity of inflation-indexed Government bonds compared to nominal Government bonds. We believe that there is likely a further inflation risk premium reducing breakeven inflation but that the amount of this premium cannot be determined. Consequently, we believe there is sufficient evidence that giving full credibility to either forecasts or the market break-even inflation is not appropriate. It is, however, extremely difficult to quantify exactly how much weight to give to the forecast market information or alternatively quantify the adjustment that should be made to the breakeven inflation. In spite of the difficulties in quantifying an adjustment, we believe determining some type of weighting between all available pieces of inflation information must be made.

The information to determine the CPI inflation assumptions for the short to medium-term is:

- CPI inflation forecasts, which mostly currently indicate 2.0% pa
- breakeven inflation determined from each of the inflation-indexed bonds
- an inflation-indexed price adjustment of 0.3% pa
- RBNZ target mid-range, which is 2.0% pa.

The methodology proposed is as follows:

- Determined forecast inflation: Each six months, consider the forecasts in the short-term (4 years) and in the medium-term use the RBNZ mid-range target of 2.0% pa. At the moment this is consistent with forecasters' views of over the next four years. Using this approach we determine a short to medium term forecast inflation rate, of currently 2.0% pa. If short term forecast inflation differed significantly from the RBNZ mid-range target, this assumption could vary by term.

- Identify inflation-indexed bonds to use to determine breakeven inflation, being bonds which:

  – Are considered sufficiently liquid. This assessment will be reviewed every six months. At present the criteria is that there is at least $4 billion on issue.

  – Have a maturity date which is less than or reasonably close to the maturity date of the longest nominal bonds. For example, once the 2040 inflation-indexed bonds meets the $4 billion threshold it will be included, but if a bond with a maturity later than 2040 were issued and the longest nominal bond still matures earlier than the 2040 bonds then the longer inflation-indexed bond would not be included.

- Determine the rate of breakeven inflation thtough to the last inflation-indexed bond being used (currently 2035) by:

  – fitting the nominal risk-free yield curve to the last nominal bond if required.

  – assuming the inflation rate is a flat rate through to the maturity date of the longest inflation-indexed bond being used. A certain amount of judgement and flexibility in approach is required to achieve a reasonable result. At 30 April 2019, the weightings used were discounted cash flows.

  – Add an adjustment of 0.30% pa. We will refer to this as the inflation-indexed price adjustment.

- The breakeven inflation rate to 2035, at 30 April 2019, using this approach is 1.09% pa.

- If in the future, there is credible information that inflation should follow a curve or linear trend, then this will be allowed for.

- Give a 50% weighting to each of the forecast inflation and adjusted breakeven inflation. The basis for the weighting is that there is no evidence as to how much adjustment or weight is reasonable, and given this we propose the simple equal or 50/50 weighting. However, in our view ignoring one of these important pieces of information entirely in favour of the other is not tenable for determining actuarial assumptions when valuing general insurance and defined benefit pension schemes.

Under this methodology, the short term CPI inflation assumption will need to be determined every time the nominal yield curve is derived, to ensure consistency between the nominal discount rate curve and the CPI inflation assumptions.

The forecast inflation, which inflation-indexed bonds to use for determining breakeven inflation and whether to vary from the flat breakeven inflation will be determined every six months.

The inflation-indexed price adjustment of 0.30% has been added to the breakeven inflation calculated under step 4 of the methodology from the 2019 in-depth review. No other changes to step 4 have been made.

Real long-term risk-free discount rates

Introduction

This section sets out the review of the real long-term risk-free discount rate.

The real long-term risk-free discount rate is considered before the other long-term rates because this is the primary driver of the value of cash flows that are inflated. In addition, it is reasonable to expect the real discount rate to be more robust to changes in long-term inflation outlook than nominal discount rates.

The real risk-free discount rate is the theoretical rate of return of an investment with zero risk, after taking into account the effects of inflation. The real risk-free discount rate represents the real return an investor would expect from an absolutely risk-free investment over a given period of time, ie the real rate of interest is the amount by which the nominal interest rate is higher than the inflation rate. The long-term real risk-free discount rate is a critical assumption in the valuation of the ACC claims liability and the GSF pension obligation as both of these obligations are indexed to inflation. An increase or decrease of the same amount in both inflation and discount rates together will not change the value of the liabilities.

We believe that determining a single long-term real return is a rational and pragmatic approach to the long end of the yield curve. This approach, in our view, is supported by international commentators in the actuarial profession as described in of this paper.

We have concluded in the earlier discussion of short-term assumptions that the most appropriate proxy for risk-free rates in New Zealand is the yield on Government bonds. Therefore, in this context, it is consistent that the resulting risk-free rate assumed in this methodology is cross-checked against available market data and historical rates of long-term real returns on Government bonds in New Zealand.

Market data

Government bond rates compared to inflation

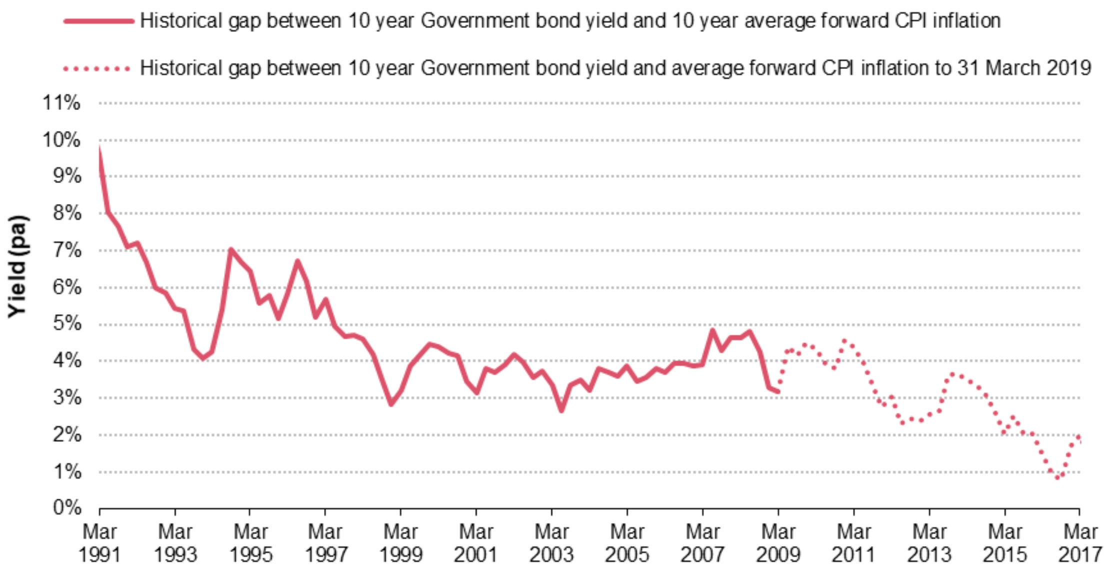
In reviewing the historical real risk-free discount rates, we have looked at the difference between interest rates and inflation rates in the past. There are a number of ways of considering this. The following chart shows the historical difference between the 10 year Government bond yield at the start of a year and the average inflation experienced over the following ten years.

Up to March 2009, the gap has been calculated as the difference between the 10 year Government bond yield and the average annual CPI inflation over the following 10 years.

After that, CPI inflation is averaged over the period to March 2019. For example, for the data point March 2011, this is the 10 yield Government bond yield at the end of the month, less the average CPI inflation over the following eight years.

Historical real risk-free returns are important inputs into making our judgement because they are a significant factor in setting investor's expectations. In the absence of market data in the long term, current investor expectations become an important starting point. The period of history over which this assessment is made is critical.

Figure 11: 10 year Government bond yield less average inflation in following 10 years



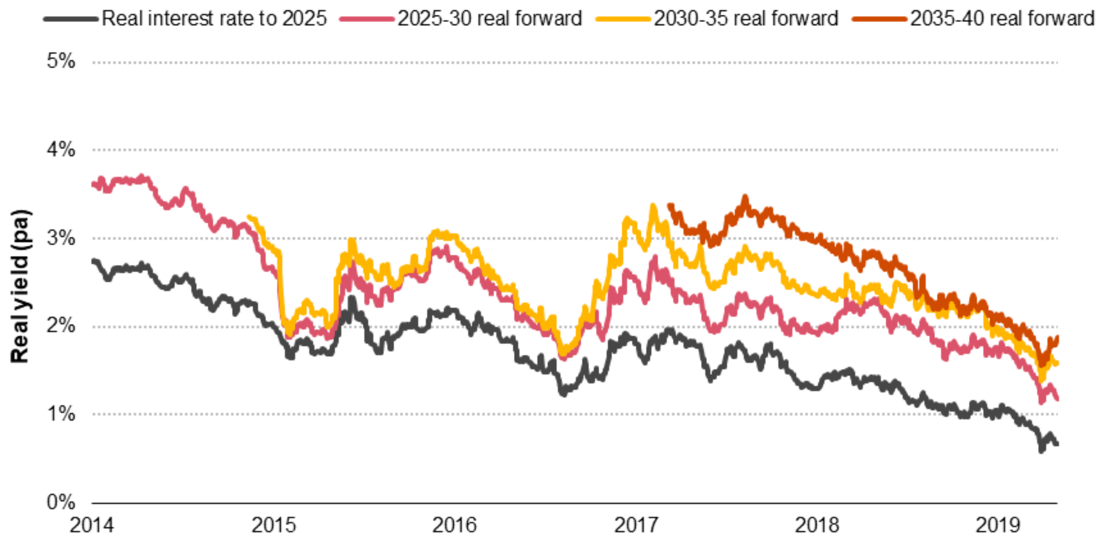
Over the 15 years to 2013, the difference between 10 year Government bond yields and CPI inflation was generally between 3.0% pa and 4.5% pa. Since then, this difference has reduced. However, it should be noted that for this later period we do not have a full 10 years of CPI inflation to determine real 10 year returns. Figure 11 only shows results up to March 2017 as we do not have enough CPI data beyond this point for any reliable comparison (although the average forward is calculated up to March 2019 for March 2009 onwards).

Inflation-indexed bonds

Inflation-indexed bonds can be useful evidence of the market's view of real rates of return. The first inflation indexed bond was issued in January 2014. At 30 April 2019, the inflation-indexed bonds on issue were: $5.5 billion maturing on 20 September 2025, $4.5 billion maturing on 20 September 2030, $4.3 billion maturing on 20 September 2035 and $3.7 billion maturing on 20 September 2040.

The following chart shows the real return on the 2025 inflation-indexed bond and the forward rates implied by the 2025, 2030, 2035 and 2040 inflation-indexed bonds.

Figure 12: New Zealand real forward interest rates, determined from inflation-indexed bonds to 30 April 2019



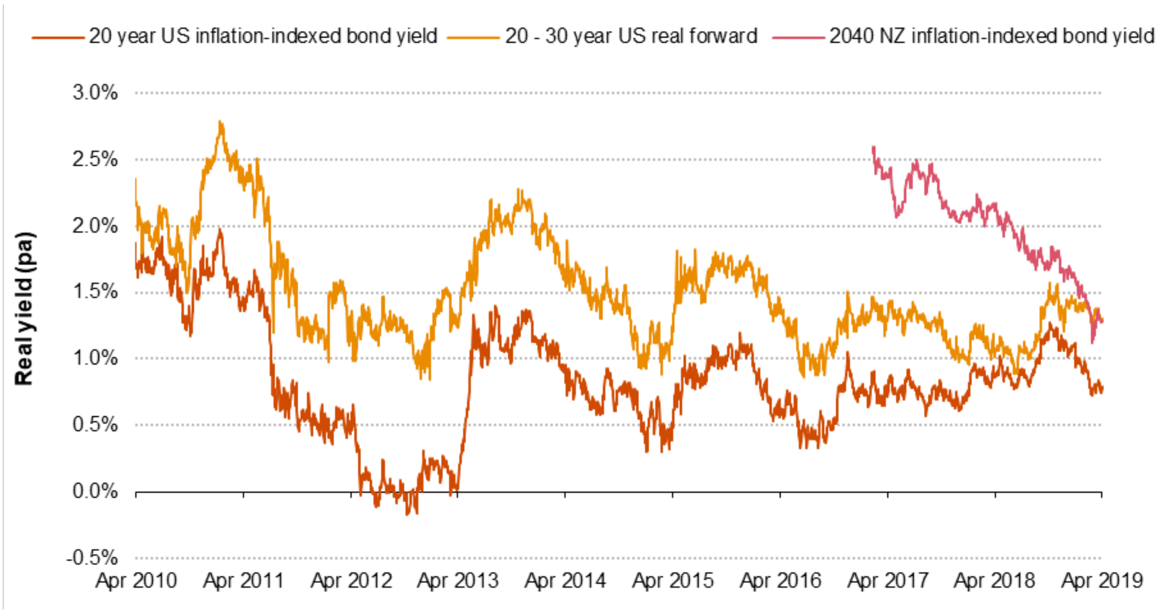
This shows the longest term real forward rates have been mostly range of 1.8% pa and 3.5% pa with a downwards trend over the past few years. The real 2035-40 forward has fallen from 3.37% pa when it commenced in March 2017 to 1.87% pa currently (an average of 2.68% pa). The real forward rates are currently below 2.0% pa. The chart above indicates that this has occurred twice previously since 2014, with the rates subsequently increasing.

US

There is no New Zealand data on real forward rates beyond 2040 (21 years at present).

A 30 year inflation-indexed bond was first issued in February 2010 by the US Treasury. This allows the US forward real rate for between 20 and 30 years to be determined and this is shown below.

Figure 13: US 20 year inflation-indexed bond yields, US 20 - 30 year forward yields, and the NZ 2040 inflation-indexed bond yield



This shows that:

- typically the 20-30 year forward rate is higher than the 20 year bond yield and for the US the average difference since 2010 is 0.8% pa, although it has varied quite significantly over this period

- typically the 20 year bond yield in New Zealand is higher than in the US, although this has not been the case for the last year.

The difference in returns between NZ and the US has been narrowing significantly over the last couple of years but it is reasonable to expect that New Zealand real returns will attract a greater premium over US rates in the foreseeable future than is indicated by the most recent data and it is reasonable to expect longer term forward rates to be higher than this.

The Treasury long term return study

The Treasury conducted an exercise in 2015 on estimating an appropriate long-term, stable setting for the real annual interest rate on 10-year government bonds. This exercise involved econometric modelling, seeking the views of experts in the area, and reviewing what other international financial agencies were doing, especially the United States Congressional Budget Office (CBO). The outcome of that exercise was a lowering of this long-run assumption form its precious value of 4.0% (6.0% nominal) to 3.3% (5.3% nominal).

It is now four years since that exercise was conducted and interest rates, both in New Zealand and Australia and for major economies like the United States and the United Kingdom, have remained low, relative to their levels before the global financial crisis occurred in 2007/08. Since reducing their assumption, for the value of the long-run annual real rate for the US government 10-year bond, from 3.0% real to 2.5% in 2014 and then 2.3% in 2015, the CBO have not further reduced, or increased, this. However, with each annual update of their Long-Term Budget Outlook, they have increased the length of the transition to reach this value, with their latest 2018 projection not reaching 2.3% until the mid-2040s. The New Zealand Treasury may re-examine their long-run assumption for the real annual interest rate on 10-year government bonds at some time over the next year. For the meantime, they are planning to follow the practice of the CBO and project quite a gradual transition from the mid-2020s, where current forecasts end, to reach the 3.3% real rate assumption, meaning this probably will not be attained until sometime in the 2040s.

EIOPA methodology

EIOPA has also adopted a single long term real return assumption referred to as the ultimate forward rate (UFR). This is calculated by finding the simple arithmetic mean of the annual real rates, from 1961 to the year before the recalculation of the UFRs, for 12 economies (Italy, Germany, France, Japan, Switzerland, Denmark, Netherlands, UK, Canada, US, Sweden and Australia). The expected real rate calculated in 2018 for use in 2019 is the average of real rates from 1961 to 2017; this is 1.60% pa.

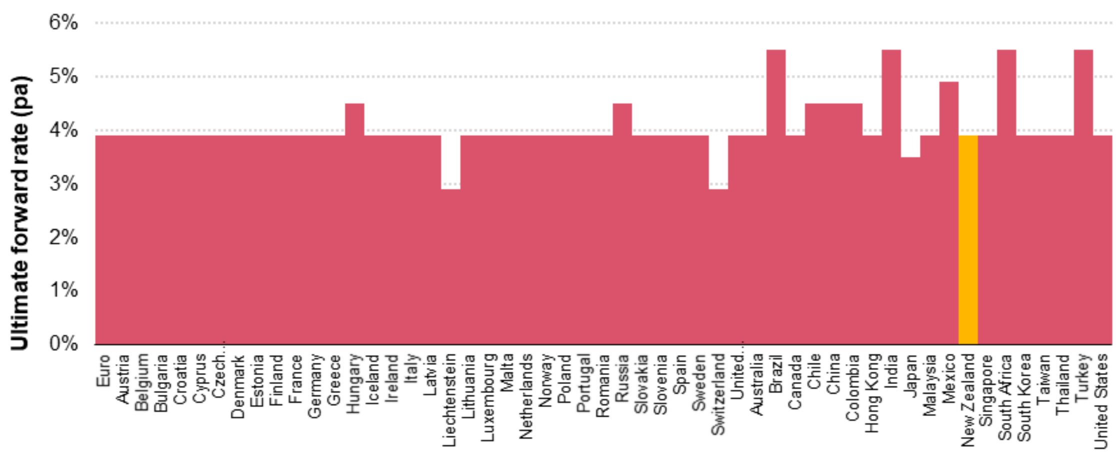
For each currency the annual change to the UFR is limited to increase or decrease by no more than 15 basis points, so that stability is maintained. This means that the UFR applicable in 2019 is not necessarily the same as the calculated UFR. For example, for New Zealand the UFR is calculated as 3.60% pa (2.0% pa inflation plus 1.6% pa expected future short-term real rates), however the UFR applicable in 2019 is 3.90% pa due to the constraint on the rate of change.

Note that this is the real short term return expected in the long term, ie, it does not include a term premium.

The same assumption is used for all economies world-wide. In our view it is reasonable to expect New Zealand to continue to attract a premium over the UK and the EU. For this reason and also because EIOPA includes no term premium, we are comfortable with a rate that is higher.

The New Zealand EIOPA assumption is compared to the assumption for other economies below.

Figure 14: EIOPA 2019 Ultimate Forward Rates



Summary and conclusion

Market data indicates:

- Over the 15 years to 2013, the difference between 10 year Government bond yields and CPI inflation over the next 10 years has generally been between 3.0% pa and 4.5% pa. Since then this difference appears to have reduced (there is not 10 years of CPI inflation data for this later period).

- The longest term real forward rates have mostly been in the range of 1.8% pa and 3.5% pa over the last few years, with a downwards trend. The average has been 2.68% pa. The current real forward rate is below 2.0%. This has occurred twice previously since 2014 with the rates subsequently increasing.

- 20 to 30 year forward yields on US inflation-indexed bonds have been in the range of 0.8% pa to 2.8% pa since the 30 year inflation-indexed bond was issued in 2010 and in the last year has been between 0.8% pa and 1.6% pa. It is reasonable to expect the New Zealand real returns will attract a premium over US rates in the future, even though this is not currently the case.

- While the current US real 10 year bond rate is 0.56% pa (at 30 April 2019), the United States Congressional Budget Office has retained the 2.3% pa assumption for this in the long term, indicating an expectation that the rate will increase.

- The real return calculated by EIOPA is 1.6% pa but this does not include the term premium for long-term bonds.

The data indicates that there has been some further reduction in the market that justifies a reduction in the long term rate from the 2.75% pa real rate of return assumption set in 2016. From the range indicated above we have selected 2.3% pa arithmetic (or 2.25% pa compound) as the long term assumption. Selection of 2.3% pa is a judgement balancing The Treasury's research of an appropriate long term real yield for forecasting purposes, and expectation of an, albeit declining, country premium over US and Europe rates and our analysis of the New Zealand inflation-indexed bonds. Taking into account all these factors, we believe that 2.3% pa is a more appropriate long term assumption in the range of 1.8% pa and 3.5% pa, rather than selecting the top or bottom end of that range.

The long-term real yield has been reduced from 2.75% pa to 2.3% pa under step 5 of the methodology from the 2019 in-depth review. No other changes to step 5 have been made.

Nominal long-term risk-free discount rates

Introduction

This section sets out the review of the long-term nominal risk-free discount rate. In this context, long-term rates are rates for durations longer than the New Zealand market yields available.

It is important that the nominal risk-free discount rate is a robust stand-alone assumption as well as being mutually compatible with other actuarial assumptions such as the real long-term risk-free discount rate and long-term CPI inflation assumption. PBE IPSAS 39.88 provides guidance by stating preparers should estimate the discount rate for longer maturities by extrapolating current market rates along the yield curve. The same standard suggests that the total present value of the defined benefit obligation is unlikely to be particularly sensitive to the discount rate applied to the portion of benefits that is payable beyond the final maturity of the available financial instrument, such as Government bonds or corporate bonds.

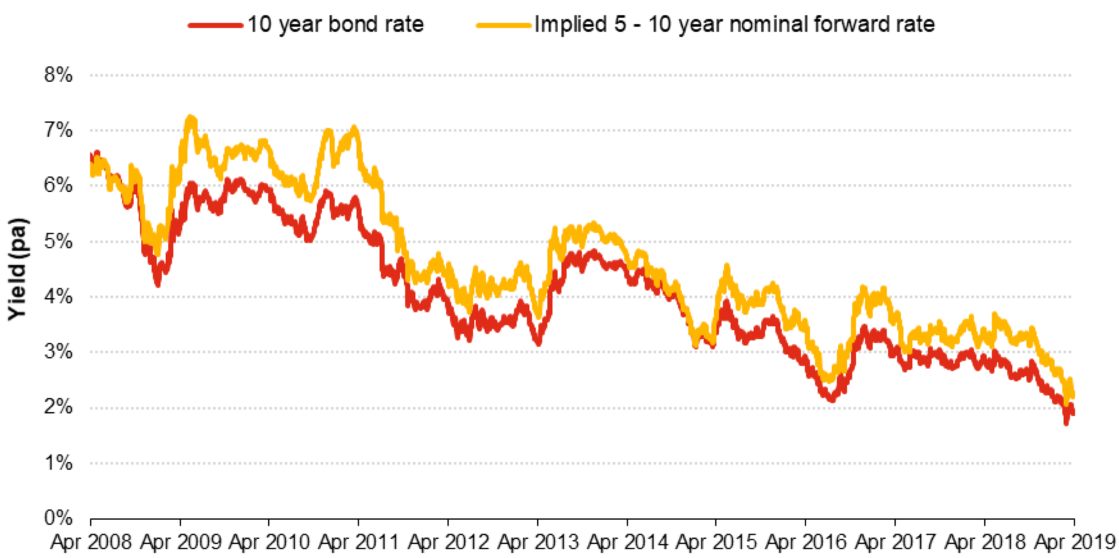
It is worth noting that the available market data in New Zealand has lengthened in duration, making the results less sensitive to the long term assumptions.

Our methodology is to determine a single long-term risk-free discount rate from historical Government bond yields and other available data, which is consistent with the long term real return assumption. In our view the long-term rate methodology has worked well, with some refinements, through some pretty challenging economic circumstances. The EIOPA also uses a similar approach by selecting an ultimate forward rate that will apply in the very long term.

Government bonds

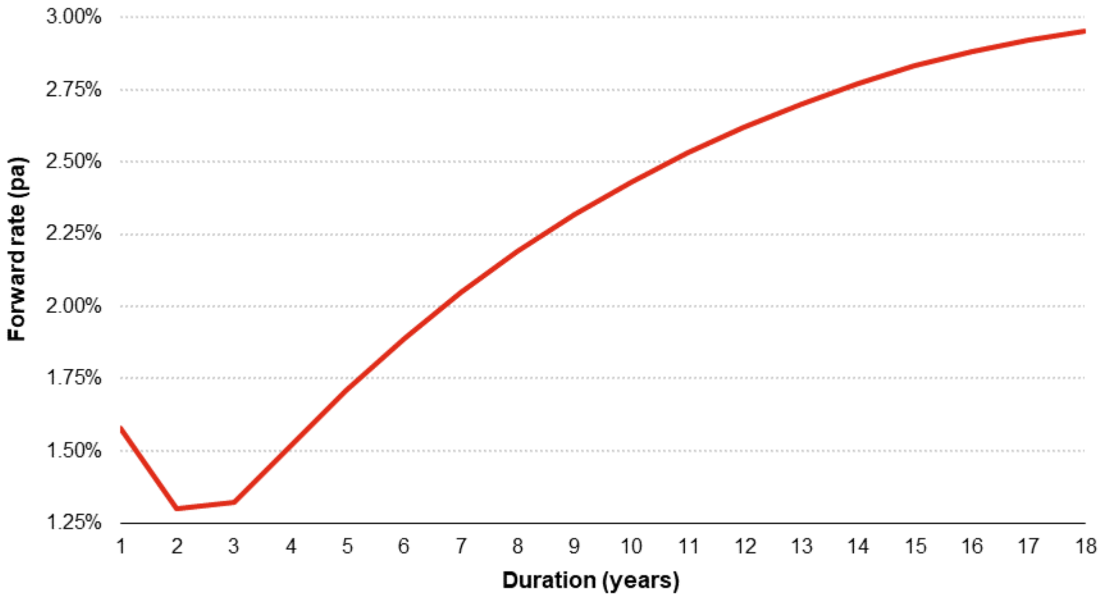
The following chart shows the historical market yields on 10 year Government bonds and the implied forward rate between the 5 and 10 year bonds.

Figure 15: 10 year Government bond yields



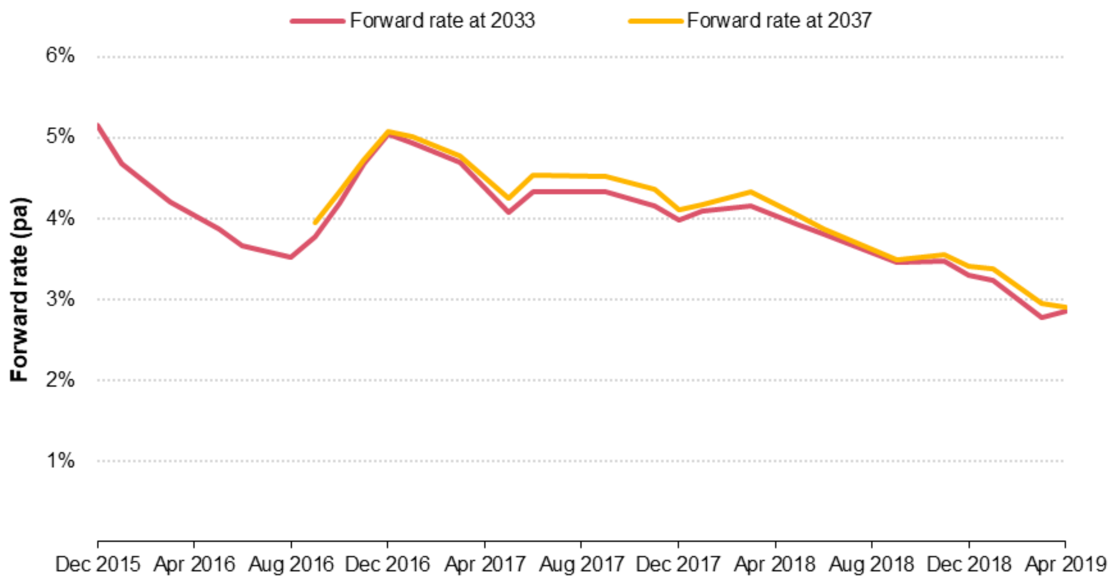
While this chart shows a crude measure of both 10 year nominal bond yield and 5 - 10 year forward rates, it indicates that there has been a term premium for most of this time. The longest dated nominal bond matures in 2037 and forward rates as at 30 April 2019 indicated by existing Government bonds are as follows:

Figure 16: Forward rates as at 30 April 2019



This shows that at 30 April 2019 the forward rate at the end of the yield curve, was 2.90% pa. The difference between the 20 year spot rate and the 10 year spot rate was 0.46%.

Figure 17: Calculated forward rate at 2033 and 2037



International observations

Germany, Japan, UK and USA all have 30 year bonds. This data could be useful to indicate the yield which would apply to a hypothetical New Zealand 30 year bond. Clearly a direct relationship would not be expected, as there are differences in the contractual terms, credit quality, expected economic conditions including expected inflation and exchange rate risk, and supply and demand. This data indicates the following differences between current yields on 30 and 10 year Government bonds.

Table 7: International long-term spot rates

	Germany	Japan	USA	UK
10 year spot rate	-0.05	-0.05	2.44	1.14
30 year spot rate	0.61	0.54	2.86	1.68
Difference	0.66	0.59	0.42	0.54

* Data taken on 13th May 2019

This indicates significant consistency in the differences, with the differences being between 0.42% pa and 0.66% pa.

As New Zealand is a smaller economy than any of the above, a higher differential would be expected. Smaller economies are expected to have a greater term premium than the larger economies due to factors such as having a more limited liquidity, more limited supply and greater exchange rate risk.

Also, New Zealand does not have the massive pension schemes and annuity schemes present in the other economies to drive demand for long dated Government bonds. For these reason, we believe it would be reasonable to take the upper end of the range, ie, 0.66% pa, or higher. The proposed methodology, as at 30 April 2019, would give difference between the 30 and 10 year spot rates of 0.74%, which is consistent with 0.66% pa, or higher indicated above.

The Treasury work on long term rates

As discussed in the previous section, The Treasury conducted an exercise, involving research, modelling and international comparisons, on this subject at the end of 2015 and as a result, in both the Fiscal Strategy Model (FSM) and the Long-Term Fiscal Model (LTFM) The Treasury adopted a long term Government bond rate of 5.3% pa, keeping inflation at 2.0% pa and therefore having a 3.3% pa real return. At this time this is still The Treasury's long-run assumption, although the length of the transition period to reach this has extended in recent Economic and Fiscal Updates.

Summary and conclusion

In our view, there is enough evidence that an acceptable range for the long-term nominal return is 3.5% pa to 5.0% pa and that 4.3% pa is a reasonable best estimate.

Our findings are:

- five to ten year forward rates have been in the range of 2.0% pa to 4.6% pa over the last four years
- EIOPA adopts a long term assumption for the short term nominal return of 3.6% pa, in our view it is reasonable to allow for a term premium on this
- the forward rate at the end of the yield curve (18 years) was 2.9% pa at 30 April 2019

- international data indicate a 0.66% pa, or higher differential between 10 and 30 year spot rates, compared to 0.74% pa on the proposed methodology (30 April 2019).

The long term rate has been reduced from 4.75% pa to 4.3% pa to reflect the lower forward rates experienced in recent years and as rates appear to have stabilised at these lower levels. The analysis of the long-term nominal rate in the 2019 review is consistent with the change in the long-tern real rate change when combined with the inflation rate assumption remaining the same at 2.0% pa (see the next chapter).

We have also noted that recent 10 year bank swap spreads have been in the range expected, indicating no adjustment is currently required to the Government bond yield due to inconsistencies with bank swap rates.

The long-term nominal yield has been reduced from 4.75% pa to 4.3% pa under step 6 of the methodology from the 2019 in-depth review. No other changes to step 6 have been made.

Note that since the February consultation the forward rates have dropped by approximately 0.5%, and reduced the acceptable range from 4% to 6% down to 3.5% to 5.0%. We still consider that on balance 4.3% is a reasonable assumption, noting that at present due to the bridging assumption it only makes an immaterial difference, affecting only durations longer than 40 years.

Long-term inflation

Introduction

Long-term inflation is the third step of the three connected components. The long-term inflation is determined as the long-term real risk-free discount rate less the long-term nominal risk-free discount rate (or by allowing for compounding). Consequently, a single long-term inflation assumption is derived for accounting valuations.

As noted in previous sections, many of the Crown's obligations or assets valued using estimated future cash payments and receipts are sensitive to various inflation assumptions, including CPI. This is particularly true for estimated future cash flows over long durations, such as the Crown's ACC claims liabilities and GSF pension obligations, which are just as sensitive to inflation rates as they are to discount rates, because of the compounding nature of both. Below is a summary and analysis of our view of an appropriate long-term CPI inflation assumption for accounting valuations reported to The Treasury.

There is limited discussion in the technical papers of ways in which to set long-term inflation assumptions. EIOPA has adopted currency-specific expected inflation rates based on announced inflation targets. These expected inflation rates can take the values 1.0% pa, 2.0% pa, 3.0% pa or 4.0% pa. The expected inflation rate adopted by EIOPA for New Zealand in 2019 is 2.0% pa and the majority of economies are 2.0% pa.

Inflation over the last 20 years

CPI inflation in New Zealand has been relatively stable since the introduction of the Reserve Bank Act with inflation targets (1989/90). CPI inflation has been impacted by the introduction of GST in 1986, its subsequent increase from 10% to 12.5% (1989) and then further increase from 12.5% to 15% (2010).

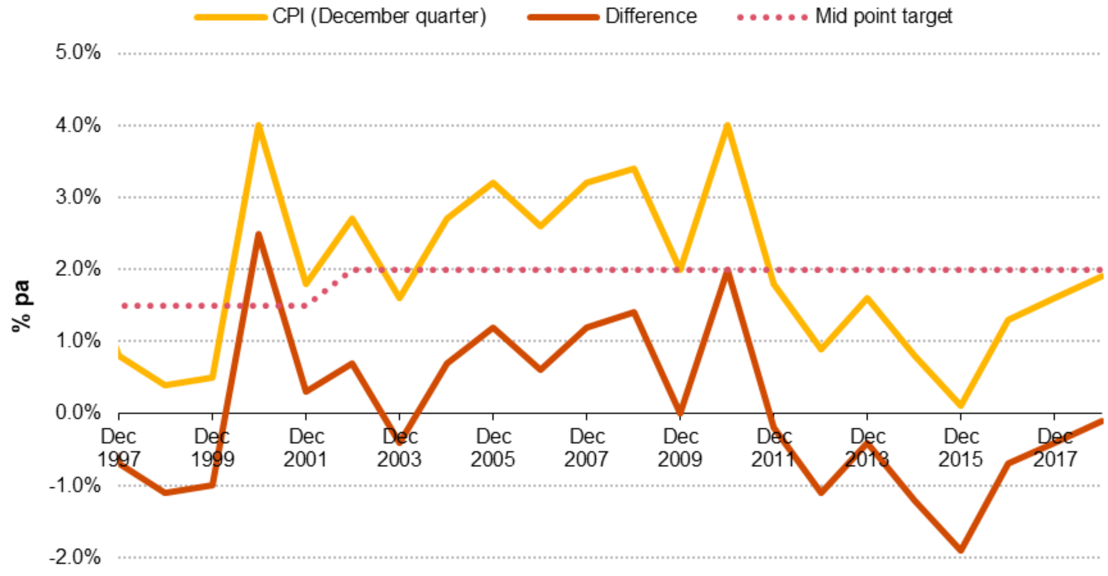
Table 8: RBNZ inflation targets

	Range	Mid-point (% pa)
March 1990 to August 1996	0% pa to 2% pa	1.0
September 1996 to November 2002	0% pa to 3% pa	1.5
December 2002 to current	1% pa to 3% pa	2.0

In this analysis on inflation, the effect of a GST change should be backed out. It is generally accepted that GST is a step change and is unlikely to impact on longer term inflation expectations. In the following analysis, we have removed the impact of GST on CPI inflation due to the increase in GST from 12.5% to 15% in October 2010. The introduction of GST in 1986 and the earlier GST rate increase in 1989 do not impact the analysis as they were made before RBNZ established inflation targets.

The chart below shows the year-by-year progression of annual CPI inflation plotted next to the target mid-point.

Figure 18: CPI inflation compared to target midpoint



The actual inflation has more often been above the mid-point than below. However, since 2012 actual inflation has generally been less than the mid-point.

Inflation-indexed bonds

Inflation-indexed Government bonds can be useful evidence of the market's view of real rates of return. At 30 April 2019, $5.5 billion of inflation-indexed bond maturing on 20 September 2025, $4.5 billion of inflation-indexed bond maturing on 20 September 2030, $4.3 billion of inflation-indexed bond maturing on 20 September 2035, and $3.7 billion of inflation-indexed bond maturing on 20 September 2040 had been issued. The break even inflation from 2030 to 2035 implied by the yield on inflation-indexed bonds at 30 April 2019 is 1.1% pa (the 2040 bond does not yet meet the criteria for inclusion but also indicates 1.1% pa from 2035 to 2040).

For the reasons out-lined earlier (see Short to medium-term inflation section), the inflation-indexed bonds should not be used as the only determinant of inflation.

Reserve Bank influence

The current Policy Targets Agreement, released by the Reserve Bank in February 2019, states "the policy target shall be to keep future annual CPI inflation between 1 and 3 percent over the medium-term, with a focus on keeping future inflation near the 2 percent mid-point. "

In an earlier statement from Reserve Bank Governor Adrian Orr in May 2018, the Reserve Bank committed to "maintaining low and stable inflation".

The Reserve Bank, in its May 2019 Monetary Policy Statement, commented that there were upside and downside risk to the investment outlook. The OCR was reduced to support the outlook for inflation and employment consistent with its policy remit.

Market forecasts

As indicated by Table 5: on page 21, market forecasts of CPI inflation by economists extend out four years, and the four year forecasts are all 2.0%. We also consider surveyed inflation expectations from RBNZ which surveys a wider audience of business managers and professionals. This survey indicates expectations of a future inflation rate (at both five years and ten years) of 2.0%, in line with the RBNZ inflation target.

Summary and conclusion

In summary:

- Over the last 17 years since the current RBNZ inflation targets have applied, the average annual CPI inflation has been very close to the 2.0% mid-point of the range.
- The breakeven inflation over 2030 to 2035, implied by the break-even yield determined from the inflation-indexed bonds at 30 April 2019, is 1.1% pa. There is consistent market evidence that break-even inflation is consistently below market inflation expectations, although the amount of this difference is not as easy to quantify in New Zealand.
- Statements made by the Governor of the Reserve Bank indicate a focus on keeping future inflation near the 2% target mid-point and the OCR was recently reduced to support this policy.
- Market forecasts by economists indicate an expected future inflation rate of 2.0% pa.
- Surveyed market expectations by business managers and professionals indicate an expected future inflation rate of 2.0% pa.
- The Treasury uses 2.0% pa for the long term fiscal projections.

In our view, these indicate that a reasonable best estimate of long-term CPI inflation is 2.0% pa.

No change was made to step 7 of the methodology from the 2019 in-depth review.

Bridging assumption

Introduction

The bridge is one of the most subjective areas of the methodology. The accounting standards do not contemplate this requirement and therefore, we have used research and discussion papers to outline the broad principles of extrapolation in the Methodology.

We have also looked at the shape of US yield curves to help inform our analysis of the bridging methodology.

The information available to consider bridging all relates to discount rates. In order to ensure a smooth progression of real returns, the same bridging period is used for CPI inflation as for nominal discount rates.

Literature review

Papers by Mulquiney and Miller (November 2012 and May 2013) and EIOPA referred to in the next section argue that smoothing period for discount rates should be over a long period.

The three main conclusions from Mulquiney and Miller were:

- there is reasonable international market evidence for reversion to a flat long term forward rate
- the rate of reversion is slow
- linear path reversion is plausible, with other approaches possible.

The EIOPA papers consider a global approach to setting long term discount rates, and made recommendations on long term rate and bridging methodology. The extrapolation method used by EIOPA is the Smith-Wilson technique. The impact from using this technique is also investigated.

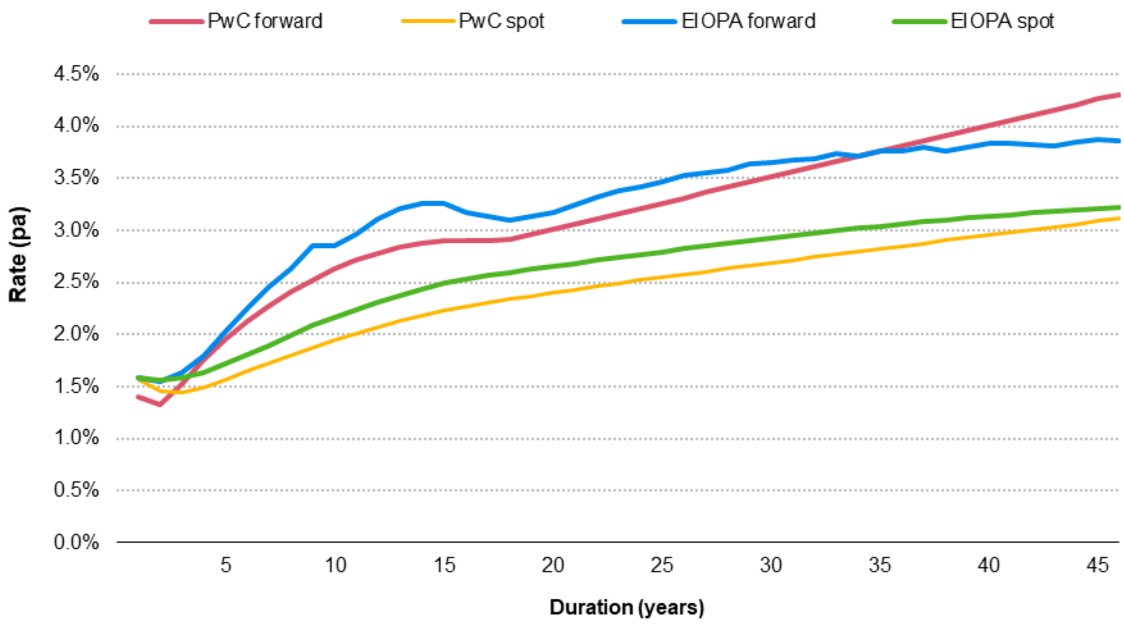
Refer to the Literature section for more details on both these papers.

Both papers recommend periods of more like 40 years to reach the long term rate.

Smoothing methodologies

The chart below shows the similarity between the results produced by EIOPA under their methodology (Smith-Wilson), and the methodology proposed in this report.

Figure 19: Yield curves as at 30 April 2019 (as calculated by PwC and EIOPA)



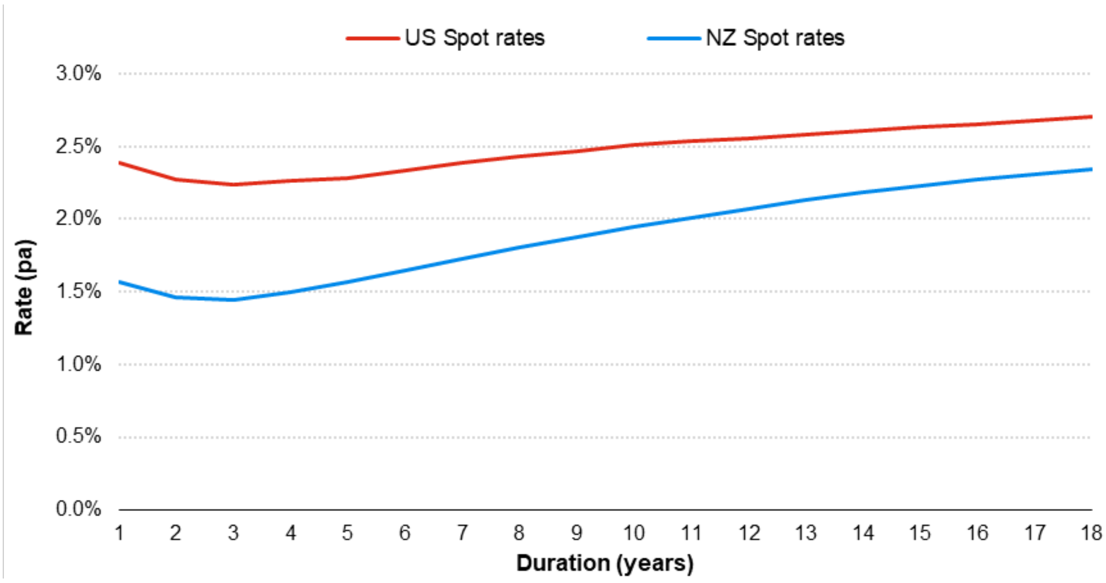
US Treasury forward rates

The graph below shows the US spot and implied forward rates as at 30 April 2019. Note that the spot rates for maturities not published by the US Treasury have been interpolated between using a straight line and as a result, the curves are not smooth. The forward rates increase by 0.34% pa from 10 years to 20 years and by 0.25% pa from 20 years to 30 years implying a slope of about 0.029% pa.

Figure 20: US Treasury yield curve 30 April 2019

The New Zealand observable yield curve is currently slightly steeper than the US yield curve, as shown in the graph below.

Figure 21: Comparison of New Zealand and US observable yield curve



The current maximum slope assumption of 0.05% pa for the New Zealand yield curve still seems a reasonable upper bound to adopt.

Summary and conclusion

Current international thinking and the slope of the US forward yield curve suggest that the length of the transition period could be longer than our currently methodology. However we think it's appropriate to keep the current methodology because:

- whilst the shortest transition period is 10 years the maximum slope lengthens automatically when the gap is more than 0.5%
- we can derive a slope from 10 to 30 years from US market data, and the current slope assumption of 0.05% pa is reasonable in relation to this
- the Smith-Wilson bridging from EIOPA results in a very similar outcome to our much simpler methodology.

This assumption still retains a great deal of subjectivity, and we accept that a number of different recommendations are viable.

We continued to support a straight line extrapolation of forward rates, as in our view there is no reason to depart from the simplicity of a linear extrapolation. Although other more technically justifiable curves can be fitted, there is no consensus on the best method and a different shape to the extrapolated curve does not have a material impact on the result. It should also be noted that further reductions in slope or extensions in the transition period will have a decreasing marginal impact.

No change was made to step 8 of the methodology from the 2019 in-depth review.

Appendix A Literature review

Review of accounting and actuarial standards, and other literature

This section summarises the accounting standards, actuarial standards and other literature referenced in in this paper. The methodology outlined in the main body of this paper is supported by and is consistent with the views documented in this section.

The Financial Statements of the Government of New Zealand are prepared in accordance with the Public Finance Act 1989 and with New Zealand generally accepted accounting practice (NZ GAAP), as defined in the Financial Report Act 2013. For the purposes of external reporting, the Government reporting entity has been designated as a public benefit entity (PBE). Public Benefit entities (PBEs) are reporting entities whose primary objective is to provide goods or service for community or social benefit and where any equity has been provided with a view to supporting that primary objective. The Financial Statements of the Government since 2014/15 have been prepared in accordance with Public Sector PBE Accounting Standards (PBE Standards) – Tier 1.

Overview of the relevant literature

The development of the methodology has focused on the financial reporting requirements of the Government's largest valuations that use present value cash flow models; the ACC Insurance obligation, the Government Superannuation Fund (GSF) pension liability and the Student Loan Scheme's loan assets. The applicable accounting standards for these are PBE IFRS 4 Insurance Contracts, PBE IPSAS 39 Employee Benefits and PBE IPSAS 29 Financial Instruments: Recognition and Measurement (and from 1 July 2018 PBE IFRS 9 Financial Instruments) respectively. However, a review of PBE IPSAS 19 Provisions, Contingent Liabilities and Contingent Assets is also included because the measurement of some of the Government's provisions also uses present value cash flow techniques.

We have specifically focused on implementing and complying with PBE IFRS 4 and PBE IPSAS 39 in developing the central methodology. However, we have also concluded that the methodology described in this paper would comply with all relevant PBE standards requiring the use of risk-free discount rates.

In the case of Student Loans under PBE IPSAS 29 and PBE IFRS 9, we acknowledge that a risk-adjusted rate is required. However, given the absence of any market for New Zealand student loan assets and no suitable observable proxy, we believe it is appropriate to use the risk-free discount rate as a starting point on to which a risk premium is added. This analysis therefore may have relevance not only for Student Loans, but other accounting valuations where a net present value is determined by using a risk-free discount rate plus a risk adjustment.

Actuarial Standards are guidance for actuaries to ensure that their work meets certain levels of professional standards. Actuarial standards complement accounting standards in that they provide guidance on how to apply the accounting requirements to valuations using actuarial techniques. The major valuations noted above are all valued by professional actuaries on behalf of the Government and therefore it is appropriate to review actuarial standards as part of this paper.

Relevant actuarial standards have been developed to apply under NZ IFRS, but given the high degree of convergence between NZ IFRS and NZ IAS and PBE standards, no conflicts or inconsistencies are expected to arise between the accounting standards (ie, “what to measure”) and the actuarial standards (ie, “how to measure”). However, there are a number of international debates between actuaries on how to value insurance and pension obligations, including debates on how to determine a basic risk-free discount rate. If any conflict or inconsistency between the accounting and actuarial standards were to arise, the accounting standard would need to receive more weighting because the valuations must comply with PBE standards.

There have been many international articles and papers on discount rates written by actuaries and finance professionals over the years. This reflects the importance of discount rates in valuations; small movements in discount rates can have significant impacts on the financial results of entities. The use of discount rates is a very sensitive issue, particularly in Europe and the US where there are large defined benefit pension schemes and insurance obligations on balance sheets. The global financial crisis following 2008 further heightened this sensitivity because all bond markets were extremely volatile and accepted historical norms about the risk-free nature of debt issuances by sovereigns were questioned, particularly in Europe.

Literature hierarchy

There is a definite hierarchy in the literature in terms of how much weight should be given to any conclusions or guidance contained in the literature. The hierarchy is:

- New Zealand accounting standards
- New Zealand actuarial standards
- International actuarial standards
- Papers from international bodies.

Note that the actuarial standards do not refer directly to the accounting standards, and both the accounting and actuarial standards have shortcomings. The papers from international bodies are a range of discussion notes and research and also have evolving conclusions. Consequently not all of the findings in the papers have been given equal weight.

Accounting standards

PBE IFRS 4, PBE IPSAS 39 and other relevant accounting standards require a significant amount of judgment to be applied when determining discount rates for calculating valuations using discounted cash flow models.

The External Reporting Board (XRB) has issued an exposure draft, ED 2018-7 (PBE IFRS 17), proposing to replace PBE IFRS 4 Insurance with a new insurance standard which reflects the requirements of NZ IFRS 17.

We have not considered any new guidance on discount rate calculation from NZ IFRS 17 or the PBE exposure draft in this review. NZ IFRS 17, based on IFRS 17, reflects a new comprehensive accounting model for insurance contracts and resulted from years of international discussion, exposure drafts and debate. The guidance in NZ IFRS 17 differs significantly from many aspects of PBE IFRS 4, including certain aspects relating to the calculation of discount rates, and is not appropriate to consider as authoritative support for interpretation of the current requirements in PBE IFRS 4.

We will consider PBE IFRS 17 when it is published and the government decides to implement any new standard in the Financial Statements of the Government. Establishing the discounting principles across the relevant standards is vital. If the principles in the accounting standards are clear, selection decisions can be made with confidence. Such selection decisions may include

- choosing a suitable yield curve from New Zealand markets to proxy a risk-free discount rate
- deciding whether any adjustments need to be made to the yield curve selected as a risk-free discount rate proxy
- determining a risk-free discount rate when there are no observable yield curves in the New Zealand markets (usually for longer duration assets and liabilities).

When IFRS was first introduced, risk-free discount rates were very strictly interpreted as being market rates with no adjustment. As best practice has evolved, there has been significant work on how to cope with market shortcomings such as illiquid tranches.

To be compliant with the principle of determining a risk-free discount rate, it may be appropriate to adjust an observable yield curve. An example may be adjustments to Government bond rates by giving less weight to the market rates of very illiquid tranches.

Below is an analysis and interpretation of the applicable accounting standards which the Government's reported valuations must comply with.

PBE IFRS 4 Insurance Contracts

The discounting requirements in PBE IFRS 4 are specified below.

PBE IFRS 4 Appendix D Financial Reporting of Insurance Activities – Discount Rates
D6.1 The outstanding claims liability shall be discounted for the time value of money using risk-free discount rates that are based on current observable, objective rates that relate to the nature, structure and term of the future obligations. D6.1.1 The discount rates adopted are not intended to reflect risks inherent in the liability cash flows, which might be allowed for by a reduction in the discount rate in a fair value measurement, nor are they intended to reflect the insurance and other non-financial risks and uncertainties reflected in the outstanding claims liability. The discount rates are not intended to include allowance for the cost of any options or guarantees that are separately measured within the outstanding claims liability.

D6.1.2 Typically, government bond rates may be appropriate discount rates for the purposes of this Appendix, or they may be an appropriate starting point in determining such discount rates.
PBE IFRS 4 Paragraph 12.1 – Definitions
Financial risk is the risk of a possible future change in one or more of a specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating or credit index or other variable, provided in the case of a non-financial variable that the variable is not specific to a party to the contract.
PBE IFRS 4 Appendix B Definition of an Insurance Contract – Distinction Between Insurance Risk and Other Risks
B9. The definition of financial risk in paragraph 12.1 includes a list of financial and non-financial variables. That list includes non-financial variables that are not specific to a party to the contract, such as an index of earthquake losses in a particular region or an index of temperatures in a particular city. It excludes non-financial variables that are specific to a party to the contract, such as the occurrence or non-occurrence of a fire that damages or destroys an asset of that party. Furthermore, the risk of changes in the fair value of a non-financial asset is not a financial risk if the fair value reflects not only changes in market prices for such assets (a financial variable) but also the condition of a specific non-financial asset held by a party to a contract (a non-financial variable). For example, if a guarantee of the residual value of a specific car exposes the guarantor to the risk of changes in the car's physical condition, that risk is insurance risk, not financial risk. B11. Under some contracts, an insured event triggers the payment of an amount linked to a price index. Such contracts are insurance contracts, provided the payment that is contingent on the insured event can be significant. For example, a life-contingent annuity linked to a cost-of-living index transfers insurance risk because payment is triggered by an uncertain event—the survival of the annuitant. The link to the price index is an embedded derivative, but it also transfers insurance risk. If the resulting transfer of insurance risk is significant, the embedded derivative meets the definition of an insurance contract, in which case it need not be separated and measured at fair value (see paragraph 7 of this Standard).

Principles:

- risk-free based on current observable, objective rates not intended to reflect risks inherent in the liability cash flow
- typically Government bonds may be appropriate or an appropriate starting point for determining risk-free discount rates.

Unfortunately the standard does not provide any detailed guidance on how to determine the risk-free discount rate where the term of an insurance obligation is longer than the current observable market data or of the meaning of nature and structure. Nor does it give any guidance on how to determine inflation.

PBE IPSAS 39 Employee Benefits

The discounting requirements in PBE IPSAS 39 for long-term employee benefits are shown below. PBE IPSAS 39 provides principles and highlights the need for judgment in applying those principles.

PBE IPSAS 39 Employee Benefits: Actuarial Assumptions — Discount Rate
85 The rate used to discount post-employment benefit obligations (both funded and unfunded) shall reflect the time value of money. The currency and term of the financial instrument selected to reflect the time value of money shall be consistent with the currency and estimated term of the post-employment benefit obligations. 86 One actuarial assumption that has a material effect is the discount rate. The discount rate reflects the time value of money but not the actuarial or investment risk. Furthermore, the discount rate does not reflect the entity-specific credit risk borne by the entity's creditors, nor does it reflect the risk that future experience may differ from actuarial assumptions. 87 The discount rate reflects the estimated timing of benefit payments. In practice, an entity often achieves this by applying a single weighted average discount rate that reflects the estimated timing and amount of benefit payments, and the currency in which the benefits are to be paid. 88 An entity makes a judgement whether the discount rate that reflects the time value of money is best approximated by reference to market yields at the end of the reporting period on government bonds, high quality corporate bonds, or by another financial instrument. In some jurisdictions, market yields at the end of the reporting period on government bonds will provide the best approximation of the time value of money. However, there may be jurisdictions in which this is not the case, for example, jurisdictions where there is no deep market in government bonds, or in which market yields at the end of the reporting period on government bonds do not reflect the time value of money. In such cases, the reporting entity determines the rate by another method, such as by reference to market yields on high quality corporate bonds. There may also be circumstances where there is no deep market in government bonds or high quality corporate bonds with a sufficiently long maturity to match the estimated maturity of all the benefit payments. In such circumstances, an entity uses current market rates of the appropriate term to discount shorter term payments, and estimates the discount rate for longer maturities by extrapolating current market rates along the yield curve. The total present value of a defined benefit obligation is unlikely to be particularly sensitive to the discount rate applied to the portion of benefits that is payable beyond the final maturity of the available financial instrument, such as government bonds or corporate bonds.

Principles:

- the discount rate reflects the time value of money but not the actuarial or investment risk
- the currency and term of the financial instrument selected to reflect the time value of money shall be consistent with the currency and estimated term of the post-employment benefit obligations.
- the discount rate does not reflect entity-specific credit risk or future experience differing from actuarial assumptions

- the yield on Government bonds would be the best measure of the risk-free discount rate unless there is no deep market or where market yields do not reflect the time value of money
- if there is no deep market in bonds with a significantly long maturity, an entity uses current market rates of the appropriate term for short-term payments and estimates the discount rate for longer-term payments by extrapolating current market rates along the yield curve.

PBE IPSAS 39 provides very little guidance about how to determine inflation assumptions. CPI and salary inflation are important assumptions in both the ACC and GSF valuations. However PBE IPSAS 39 does provide some principles below.

PBE IPSAS 39 Employee Benefits: Actuarial Assumptions
77 Actuarial assumptions shall be unbiased and mutually compatible. 78. Actuarial assumptions are an entity's best estimates of the variables that will determine the ultimate cost of providing post-employment benefits. Actuarial assumptions comprise: (b) Financial assumptions, dealing with items such as: (i) The discount rate (see paragraphs 85–88); (ii) Benefit levels… 79 Actuarial assumptions are unbiased if they are neither imprudent nor excessively conservative. 80 Actuarial assumptions are mutually compatible if they reflect the economic relationships between factors such as inflation, rates of salary increase, and discount rates. For example, all assumptions that depend on a particular inflation level (such as assumptions about interest rates and salary and benefit increases) in any given future period assume the same inflation level in that period. 81 An entity determines the discount rate and other financial assumptions in nominal (stated) terms, unless estimates in real (inflation-adjusted) terms are more reliable, for example, in a hyperinflationary economy (see PBE IPSAS 10 Financial Reporting in Hyperinflationary Economies), or where the benefit is index-linked, and there is a deep market in index-linked bonds of the same currency and term. 82 Financial assumptions shall be based on market expectations, at the end of the reporting period, for the period over which the obligations are to be settled.

In our view, this standard reinforces the importance of the internal consistency between the discount rate and inflation rate assumption and therefore, the importance of the real rate of return assumption. Determining the real rate of return assumption, particularly in the long term, is a significant issue addressed by the methodology.

PBE IPSAS 29 Financial Instruments: Recognition and Measurement and PBE IFRS 9 Financial Instruments

Student loans, which are largely interest-free, were reported in the Government's accounts in accordance with PBE IPSAS 29 until 30 June 2018. The Government's accounting policy for these loans was to recognise them initially in the accounts at fair value plus transaction costs and subsequently measure them at amortised cost using the effective interest rate method.

From 1 July 2018, the Crown has early adopted PBE IFRS 9 for non-hedge financial instruments and has exercised the option under PBE IFRS 9 to continue to apply the hedge accounting requirements of PBE IPSAS 29. One of the main changes under PBE IFRS 9 is that the classification of financial assets has been simplified and streamlined. This means there is a change to the way Student Loans are subsequently classified and measured from July 2018. There is no change to the way Students Loans are initially recognised, which is still at fair value.

Student loan repayments are contingent on the income of the borrower and therefore do not meet the new PBE IFRS 9 cash flow characteristics criteria for measurement at amortised cost and therefore, are now to be subsequently measured at fair value through operating balance (FVTOB). This means the entire loan book will be revalued using current market discount rates at every balance date. Previously market discount rates were applied for each year of lending and locked in for the duration of the loan.

As there is no active market for student loans assets, their initial and subsequent fair value is measured using a valuation technique incorporating the present value of estimated future cash flows[4]. This involves, among other things, determining a risk-adjusted discount rate to calculate the present value. As there are no observable market rates for student loans, nor any suitable yields to proxy in New Zealand, the discount rate is hypothetically derived by establishing a risk-free discount rate and adding an adjustment for credit risk. Therefore, the methodology outlined in this paper is applicable for determining the risk-free component of the Student Loan Scheme discount rate.

The discounting requirements in PBE IPSAS 29 / PBE IFRS 9 are the same and are specified below.

PBE IPSAS 29 / PBE IFRS 9 Application Guidance
No active market: valuation technique AG 112 / B5.1A.12 In applying discounted cash flow analysis, an entity uses one or more discount rates equal to the prevailing rates of return for financial instruments having substantially the same terms and characteristics, including the credit quality of the instrument, the remaining term over which the contractual interest rate is fixed, the remaining term to repayment of the principal and the currency in which payments are to be made. Short-term receivables and payables with no stated interest rate may be measured at the original invoice amount if the effect of discounting is immaterial.

4 The fair value is based on discounting cash flows and a calculation of the present value of expected repayments. Determining expected repayments is complex and is modelled by actuaries using numerous assumptions and statistical methods to determine lenders future income, and hence repayment levels. Repayments will cover the principal lent, establishment and account fees added to the principal, and any interest charged when a lender is overseas.

Inputs to valuation techniques

AG 115 / B5.1A.13 An appropriate technique for estimating the fair value of a particular financial instrument would incorporate observable market data about the market conditions and other factors that are likely to affect the instrument's fair value. The fair value of a financial instrument will be based on one or more of the following factors (and perhaps others).

a. The time value of money (ie, interest at the basic or risk-free rate). Basic interest rates can usually be derived from observable government bond prices and are often quoted in financial publications. These rates typically vary with the expected dates of the projected cash flows along a yield curve of interest rates for different time horizons. For practical reasons, an entity may use a well-accepted and readily observable general market rate, such as a swap rate, as the benchmark rate. (If the rate used is not the risk-free interest rate, the credit risk adjustment appropriate to the particular financial instrument is determined on the basis of its credit risk in relation to the credit risk in this benchmark rate). In some countries, the central government's bonds may carry a significant credit risk and may not provide a stable benchmark basic interest rate for instruments denominated in that currency. Some entities in these countries may have a better credit standing and a lower borrowing rate than the central government. In such a case, basic interest rates may be more appropriately determined by reference to interest rates for the highest rated corporate bonds issued in the currency of that jurisdiction.

b. Credit risk. The effect on fair value of credit risk (ie, the premium over the basic interest rate for credit risk) may be derived from observable market prices for traded instruments of different credit quality or from observable interest rates charged by lenders for loans of various credit ratings.

Principles:

- basic interest rates can usually be derived from Government bond prices
- for practical reasons, other well-accepted and readily observable general market rates such as a swap rate can also be used as the benchmark rate
- if Government bonds carry significant credit risk and some entities in that country have a better credit standing and a lower borrowing rate, basic interest rates may be more appropriately determined by referencing interest rates for the highest rated corporate bonds issued in the same currency of that jurisdiction.

PBE IPSAS 19 Provisions, Contingent Liabilities and Contingent Assets

There may be some provisions on the Government's balance sheet that use valuation techniques such as present valuing future cash outflows and therefore the requirements in PBE IPSAS 19 are considered for completeness.

It is likely that entities valuing provisions using cash flow techniques will reflect the risk in adjusting the cash flow and discount at the risk-free discount rate. This is normally easier than adjusting the discount rate for risk, which is complex and often requires significant amounts of judgment.

Therefore, the methodology outlined in this paper should be appropriate for determining a risk-free discount rate where it is required for valuing provisions under PBE IPSAS 19.

The discounting requirements in PBE IPSAS 19 are specified below.

PBE IPSAS 19 - Present value
53 Where the effect of the time value of money is material, the amount of a provision shall be the present value of the expenditures expected to be required to settle the obligation. 54 Because of the time value of money, provisions relating to cash outflows that arise soon after the reporting period are more onerous than those where cash outflows of the same amount arise later. Provisions are therefore discounted, where the effect is material. 56 The discount rate (or rates) shall be a pre-tax rate (or rates) that reflect(s) current market assessments of the time value of money and the risks specific to the liability. The discount rate(s) shall not reflect risks for which future cash flow estimates have been adjusted.

This does not add any additional principles to those discussed earlier.

IPSASB's Conceptual Framework for General Purpose Financial Reporting by Public Sector Entities

The following Conceptual Framework published by the International Public Sector Accounting Standards Board comments on the characteristics of open, active and orderly markets.

Chapter 7 - Measurement of Assets and Liabilities in Financial Statements
Market Values in Open, Active and Orderly Markets 7.28 Open, active and orderly markets have the following characteristics: • There are no barriers that prevent the entity from transacting in that market; • They are active so there is sufficient frequency and volume of transactions to provide price information; and • They are orderly, with many well-informed buyers and sellers acting without compulsion, so there is assurance of “fairness” in determining current prices – including that prices do not represent distressed sales. An orderly market is one that is run in a reliable, secure, accurate and efficient manner. Such markets deal in assets that are identical and therefore mutually interchangeable, such as commodities, currencies and securities where prices are publically available. In practice few, if any, markets fully exhibit all of these characteristics, but some may approach an orderly market as described.

Actuarial standards

Actuaries apply financial and statistical techniques to value certain assets or liabilities for various purposes, including financial reporting under New Zealand equivalents to IFRS and IPSAS. Therefore, some professional bodies or societies of actuaries issue professional standards, both technical and ethical in nature, which attempt to provide detailed guidance on valuing obligations under accounting standards. These professional standards are therefore generally consistent with accounting standards.

The New Zealand Society of Actuaries (NZSA) issues professional standards for actuaries in New Zealand. There are different standards for general insurance business and superannuation.

General insurance business

NZSA Professional Standard No. 30 applies to valuations of general insurance claims. The standard applies to a Member undertaking any valuation of the Outstanding Claim Liability or Future Claim Liability of Insurance Contracts required under any New Zealand legislation or regulation, excluding life policies. The relevant section is:

NZSA PS30 – Valuations of General Insurance Claims
10.5.2 Discount rates used must be based on risk-free rates of appropriate duration, having regard to the liabilities, as at the Valuation Date.

However, NZSA PS30 does not provide any guidance on how to deal with market shortcomings (eg, when the liability duration exceeds the market observable rates of a portfolio of assets).

Superannuation schemes

NZSA Professional Standard No.40 applies to actuarial reporting of superannuation schemes but has no specific guidance on discount rates.

ISAP 3 - Actuarial Practice in Relation to IAS 19 Employee Benefits

International Standard of Actuarial Practice (ISAP) 3 provides guidance to actuaries when performing actuarial services in connection with International Accounting Standard 19 (IAS 19) Employee Benefits and has a number of comments on how to determine discount and inflation assumptions. Under this standard the starting point is high quality corporate bonds and the standard is written in this context.

The relevant principles in ISAP 3 are specified below.

ISAP 3 – Section 2. Appropriate Practices – Proportionality
2.3 (a) The actuary may use simplified approaches to recommending assumptions when those assumptions will not materially affect the results or are proportionate for the actuarial services. For example, when a pension plan pays primarily lump sum benefits at termination or retirement, the choice of mortality assumption may have little impact on the liabilities. As a second example, for certain work-related accident or injury benefits, the projected benefit cash flows may be so uncertain as to make a highly refined approach to selecting the discount rate disproportionate.
ISAP 3 – Section 2. Appropriate Practices – Actuarial Assumptions
2.6.3 Discount Rate Assumption – When advising the principal on the selection or reasonableness of the discount rate assumption, the actuary should take into account IAS 19's requirement that the discount rate reflect market yields at the measurement date on high-quality corporate bonds if the market for such bonds is deep or government bonds otherwise, where such bonds are consistent with the currency and estimated term of the employee benefit obligation. The actuary may use a variety of approaches to identify a discount rate assumption that satisfies this requirement, including the following: a Full Yield Curve – The actuary may recommend a full spot-rate yield curve for discounting projected benefit cash flows. The actuary may develop an appropriate yield curve from bond yield data at the measurement date. Alternatively, the actuary may apply a third party's yield curve, which the actuary has determined is appropriate for the purpose of selecting an IAS 19 discount rate (or has adjusted so as to make it appropriate). When applying a third party's yield curve, the actuary should be guided by ISAP 1, 2.3. Reliance on Others. i Bond Universe – When developing a yield curve or assessing the appropriateness of a third party's yield curve, the actuary should consider the characteristics of the bond universe used to create the yield curve, including currency and, for corporate bonds, quality. The actuary should also consider whether adjustments are needed to deal with "outliers"— bonds with substantially different yields than the yields on most bonds of similar quality and duration included in the universe—or with bonds that have special characteristics, such as call features. ii Curve Fitting, Interpolation, and Extrapolation – When the actuary is constructing the yield curve from the available bond data in the same currency, the actuary should exercise professional judgment in applying appropriate curve-fitting, interpolation, or extrapolation techniques to estimate yields at durations where the actuary considers the bond market data unreliable or such data do not exist. Such techniques may take into account (with an appropriate spread or other adjustment) other market data sources such as yields on government or lower-rated corporate bonds, the swaps market, or yields on government or corporate bonds in other currencies with market-observable yields at durations beyond the longest duration bond in the same currency as the employee benefits and which the actuary, having applied professional judgment, considers appropriate for this purpose.

2.6.4. General Price Inflation Assumption – When the actuary is advising the principal on the selection or reasonableness of a general price inflation assumption, the actuary should review market-implied expectations and other information at the measurement date. Examples of such information include:

a Changes in price indices;

b Implicit price deflators;

c Yields on nominal and inflation-indexed debt (taking into account the effect of any significant supply-demand imbalances);

d Forecasts of inflation;

e Relevant regional factors;

f Central bank monetary policy;

g Other relevant economic data; and

h Analyses prepared by experts.

2.6.7. Change in Process for Developing Assumptions – The actuary generally should apply a consistent process from year to year to develop recommended assumptions for a particular reporting entity. When the actuary considers it appropriate to change the process used to develop a recommended assumption, the actuary should discuss the change with the principal, and should seek guidance from the principal regarding whether to make the change, and if so, what, if any, information about the change should be disclosed in the actuary's report. For example, if the principal determines that the change in the assumption-setting process may be subject to IAS 8, Accounting Policies, Changes in Accounting Estimates and Errors, the principal may ask the actuary to disclose the nature of the change and its general effect in the report.

Principles:

- whether adjustments are needed to deal with "outliers"— bonds with substantially different yields than the yields on most bonds of similar quality and duration needs to be considered
- When interpolating, or extrapolating to estimate yields at durations where the bond market data unreliable is considered unreliable or data do not exist, other market data sources such as yields on corporate bonds, the swaps market, or yields on government or corporate bonds in other currencies with market-observable yields at durations beyond the longest duration bond may be taken into account
- A wide variety of market-implied expectations to take into consideration when determining inflation assumptions.

Actuaries Institute information note

The Actuaries Institute of Australia issued an information note in November 2017 to assist actuaries undertaking a valuation of general insurance claims. It discusses some considerations regarding discount rates, inflation assumptions and the interaction with accounting standards. While the information note is not specifically applicable to New Zealand accounting requirements, the Australian and New Zealand accounting standards are similar in many respects. The information note makes the following comments.

Members should consider the following when determining discount rate and inflation assumptions:

- the principles described in the information note: Discount Rates for APRA Capital Standards issued in December 2012
- methods for extrapolating yield curves, for example, those described by New Zealand Treasury, Mulquiney and Miller and EIOPA.

In circumstances where "economy-wide" inflation assumptions are used, they should be consistent with the nominal discount rates, taking into account break-even inflation rates implied by index-linked bonds, adjusted where appropriate for any difference in the inflation underlying the index-linked bonds and the inflation underlying the liability.

New Zealand papers

The Treasury 2016 Statement of the Long Term Fiscal position

In November 2016, The New Zealand Treasury released its latest review of the long-term fiscal position. This included a review of the nominal rate of return for the 10-year government bond and inflation. These are relevant to modelling fiscal projections because these assumptions impact on:

- projected interest costs on public debt;
- projected interest revenue from publicly-owned financial assets; and
- the calculation of capital contributions to (and in later years withdrawals from) the NZSF.

The projected nominal rate of return for the 10-year government bond was reduced from 5.5% in 2020s, rising to 6% from 2030s to 5.3% from 2025. CPI inflation was retained at 2.0%pa. Reviewing the assumption involved the production of a predictive econometric model, reviewing the assumptions and opinions of a range of domestic and international financial agencies or commentators; and modelling the consequence of any change to the long-term bond. As the long-run assumption for annual inflation, as measured by the CPI, has not changed from 2%, this nominal rate assumption is equivalent to a long-term assumption for the annual real rate of return on the 10-year government bond of 3.3%.

Papers from international bodies

Australia Group of 100 - Milliman discount rate report March 2016

Milliman generates a set of discount rates to be used to discount employee benefit liabilities under Australian Accounting Standard 119 (AASB119). AASB119 requires discount rates to be determined by reference to market yields on high quality corporate bonds, unless there is no deep market in such bonds. While the paper covers neither risk-free discount rates nor inflation assumptions, there are aspects which are relevant to determining risk-free discount rates.

Interpolation

Milliman considered a range of parametric and non-parametric methods for interpolation. Factors noted were:

- there is a trade-off between fit and smoothness
- non-parametric methods such as bootstrapping require the asset calibration set to be very homogenous, so that there is little or no residual pricing variance that can cause forward rates to become discontinuous. Bootstrapping also requires the coupon and maturity payments dates across bonds to be in alignment
- parametric approaches are preferred where the data is heterogeneous
- spline methods are typically more attractive where a heterogeneous calibration set exits and each calibration asset can be considered to exhibit sufficiently similar characteristics
- Weighting options are:
  - weight by market capitalisation – in general, the deeper and more liquid bonds convey more accurate pricing information, and thus it may be desirable that more liquid bonds are given greater weight. If market capitalisation is a reasonable proxy for security depth and liquidity, it may provide a reasonable weighting scheme
  - equal weighting – this has the benefit of simplicity, but makes no allowance for varying degrees of price uncertainty across securities
  - weighting by inverse duration – so longer bonds are assumed to have lower weighting. The rational for this approach is that longer duration bonds are expected to have more volatile prices and greater uncertainty. Hence pricing errors may be expected be, on average, larger for longer duration bonds
  - Combination of approaches – if price uncertainty depends on both maturity and the size of the issue, it may be appropriate to weight using both market capitalisation and duration.

Milliman recommend the Merrill Lynch Exponential Spline (MLES) model, with weightings based on inverse duration and an optimisation process focused on replicating market price, due to the heterogeneity of the calibration set, finding from academic authors and it being similar to the approach used by RBA to derive yield curves on Commonwealth bonds, hence providing consistency with published risk free rates.

Deep market

Much of the paper is focused on determining whether Australia has a “deep” market in high quality corporate bonds. Factors identified to consider in evaluating whether a particular bond market is deep or not are:

- the size of the outstanding amount on issue and the number of issuers of those bonds – as compared with the total bond market. Small bond issues are unlikely to be liquid securities
- access to observable market yields
- turnover volumes and bid-ask pricing spreads
- macro-economic factors such as the status of initiatives by the government to create or support a deep and liquid bond market
- trends in volumes of bonds traded over time.

Milliman define the liquidity ratio for a bond or market as the annual turnover divided by the amount outstanding. The liquidity ratio for Commonwealth bonds was calculated as 370%, for corporate securities as 55% and for all securities being considered as “liquid” as 86%.

Milliman also assess bonds with a bid-ask price spread (% of mid) less than approximately 0.5% as being liquid and on this basis assessed the AAA corporate bond market as liquid out to 10 years. This bid-ask price spread (% of mid) is defined as the amount by which the ask price exceeds the bid price, divided by the average of the ask and bid price. This calculation is performed for each security individually, and a weighted average is then calculated using the amount outstanding as weights.

A minimum amount outstanding on an individual security of $100 million was selected.

Extrapolation

The constant forward rate and parametric ultimate forward rate methods are the primary extrapolation methods which could be justified. The choice between these is dependent largely upon whether consistency with observed rates at a point in time or liability stability across time is more important. Both methods are entirely consistent with observable market prices – each of the extrapolation methods only applies to maturities beyond the last available data observation.

The advantage of the first method identified is simplicity and the key disadvantage that it can be extremely sensitive to the original data fitted, and where liability exposures are of extremely long duration, this can result in significant balance sheet volatile that is arguably artificial in nature and difficult to mitigate or hedge.

The European Insurance and Occupational Pensions Authority

EIOPA is a level-3 committee of the European Union which is participating in the wider process to develop financial service industry regulations used by the European Union. Consequently the EIOPA views carry considerable weight internationally. The EIOPA replaced the CEIOPS (Committee of European Insurance and Occupational Pensions Supervisors) in January 2011.

EIOPA published in August 2018 the paper: Technical documentation of the methodology to derive EIOPA's risk-free interest rate term structures. This paper includes the method used by EIOPA to determine the risk-free interest rate term structure internationally, including for New Zealand. Many of the parameters of the risk-free discount rates are determined by legislation; other are selected to secure the following objectives:

- replicability – the rates should be capable of replication by other interested parties
- market consistency – a common approach between countries and wherever possible, data from deep, liquid and transparent (DLT) financial markets are used
- stability for insurance undertakings – avoid exacerbating volatility in the value of liabilities through unwarranted changes to the risk-free discount rate.

The EIOPA approach to determining risk-free discount rates, relevant to New Zealand is as follows.

Term

Only risk-free discount rates from 1 year maturity are published

Bank swaps

The construction of the basic risk risk-free discount rate term structure is based on swaps and/or Government bonds, as set out in Article 44 of the Delegated Regulation. Solvency II prescribes swaps as the first choice of instrument for deriving the relevant risk-free discount rates term structure. Government bonds are only used in currencies where there is not a DLT market in swaps. In New Zealand, swaps are deemed DLT through to 20 years. The swap rates are reduced by the credit risk adjustment.

Deep, liquid and transparent (DLT)

An analysis of the depth, liquidity, and transparency of the swap market is carried out based on evidence from the markets. The purpose of the DLT assessment is focused on ensuring the reliability of market interest rates rather than the need to convert assets into cash. It is accepted that no single metric can be conclusive in assessing the DLT nature of a financial instrument. For example, high trading volumes and turnovers indicate that assets are liquid, while the converse does not necessarily hold true (some assets may be in high demand without being traded often, and hence could easily be liquidated if necessary). For the swap market, the lack of information on real trading volumes means that it is not possible to use some of the main indicators generally used when making DLT assessments of other types of instruments. The main pieces of analysis are:

- volatility analysis – behaviours of the available interest rates for each maturity over the past 105 business days (five months approx.)
- bid-ask spreads.

EIOPA is of the view that the assessment of the depth of a financial market should take into account the existence of appropriate supervision; such supervision can be an effective mechanism to ensure that large transactions will only affect prices according to the natural trends of the market, and not because if any spurious influence. Another relevant qualitative consideration for the assessment of market depth is the way in which market prices are collected; market data providers have developed effective methods and controls that can help to give reassurance that the influence of large transactions or unusual trade on process is likely to be immaterial.

EIOPA will update the DLT assessment for the relevant currencies on an annual basis, with changes resulting from the DLT assessment being implement after a warning period of three months.

Credit risk adjustment

The calculation of the credit risk adjustment was developed in accordance with recital 20 and Article 45 of the Delegated Regulation.

Extract from the Delegated Regulation

“Article 45 Adjustment to swap rates for credit risk

The adjustment for credit risk referred to in Article 44(1) shall be determined in a transparent, prudent, reliable and objective manner that is consistent over time. The adjustment shall be determined on the basis of the difference between rates capturing the credit risk reflected in the floating rate of interest rate swaps and overnight indexed swap rates of the same maturity, where both rates are available from deep, liquid and transparent financial markets. The calculation of the adjustment shall be based on 50 percent of the average of that difference over a time period of one year. The adjustment shall not be lower than 10 basis points and not higher than 35 basis points.”

This adjustment is applied as a parallel downward shift of the market rates up to the last liquid point (LLP).

Where the risk-free discount rate term structure is based on swap rates and the relevant overnight indexed swap (OIS) rate meets the DLT requirements, the maturity of the OIS rate used to derive the credit risk adjustment is consistent with the tenor of the floating legs of the swap instruments used to determine the term structure (New Zealand; three month). The calculation of the one year average is based on daily data over the last 12 months. The average is a simple average calculated giving equal weight to all of the observation.

EIOPA does not consider it appropriate to apply hard thresholds purely based on quantitative metrics, because it is necessary to make an appropriate allowance for the characteristics of each individual market and for prevailing financial conditions.

Last liquid point (LLP) and convergence point

The Omnibus II Directive explicitly specifies a convergence period of 40 years for the euro and an LLP of 20 years. The LLP for New Zealand is also take as 20 years.

For currencies other than euro, the convergence point is taken as the maximum of the LLP + 40 years, and 60 years. The convergence period is therefore the maximum of 60 years – LLP, and so is 40 years.

Ultimate forward rate (UFR)

At the end of March 2017, after extensive consultation, EIOPA presented the changes to the UFR methodology, which were implemented from 2018.

The UFR is based only on estimates of expected inflation and expected future short-term real rates, ie it does not include a term premium. This follows the principles in the Solvency II legislative framework which state that the UFR should be stable over time and only be changed as a result of changes in long-term expectations.

EIOPA has adopted currency-specific expected inflation rates based on announced inflation targets. These expected inflation rates can take the values 1.0% pa, 2.0% pa, 3.0% pa or 4.0% pa. The expected inflation rate adopted by EIOPA for New Zealand in 2019 is 2.0% pa.

EIOPA has adopted a single expected real rate for all currencies. This is calculated by finding the simple arithmetic mean of the annual real rates, from 1961 to the year before the recalculation of the UFRs, for 12 economies (Italy, Germany, France, Japan, Switzerland, Denmark, Netherlands, UK, Canada, US, Sweden and Australia). The expected real rate calculated in 2018 for use in 2019 is the average of real rates from 1961 to 2017; this is 1.60% pa, a decrease of 60 basis points since 2016 (2.20% pa).

For each currency the annual change to the UFR is limited to increase or decrease by no more than 15 basis points, so that stability is maintained. This means that the UFR applicable in 2019 is not necessarily the same as the calculated UFR. For example, for New Zealand the UFR is calculated as 3.60% pa (2.0% pa inflation plus 1.6% pa expected future short-term real rates), however the UFR applicable in 2019 is 3.90% pa due to the constraint on the rate on change.

Interpolation and extrapolation

The points on the curve are interpolated between and extrapolated past the LLP based on the Smith-Wilson methodology. The parameters for this are the LLP, the ultimate forward rate, convergence point, and the convergence tolerance.

International Actuarial Association

The IAA is the worldwide association for national professional actuarial associations and their individual actuaries. The IAA exists to encourage the development of a global profession and as such publishes articles and discussion papers for the international actuarial profession to consider.

In 2013, a book titled *Discount Rates in Financial Reporting, A Practical Guide* was published by the IAA. It illustrates different approaches to determine risk-free yield curves along with the factors that should be considered when determining expected inflation rates. We have used this book as guidance in developing our methodology because it is one of the internationally recognised discussion documents on the topic of determining discount rates for valuing insurance contracts.

The IAA's book states that there are a number of different sources for risk-free discount rates. These are detailed below.

Government bond rates

In a politically stable, economically developed country, it is believed that governments have a low probability of defaulting on debt due to:

- taxing power
- ability to expand the money supply
- debt forgiveness and foreign aid.

However, there are considerations that need to be made when choosing to use Government debt yields as risk-free discount rates:

- the debt securities that should be used, eg, Government bond strips, on-the-run vs off-the-run securities
- whether relevant maturities are available in the market
- liquidity of the Government debt market; although the credit risk adjustment may be close or equal to zero, there may still be an liquidity premium due to Government securities being thinly traded. If this is the case, then this premium needs to be backed out. Low bid-ask spreads and high trading volumes would indicate a liquid market
- tax considerations; in some countries, Government debt securities receive special tax treatment. Investors may therefore accept a lower rate of return than the true risk-free discount rate.

Using swap rates to determine risk-free discount rates

A swap rate curve includes some counterparty risk, credit risk, and agency risk in the underlying reference rate. However, they are still often used to calculate the risk free rates because:

- the counterparty is often a highly rated bank or exchange with a credit risk that is seen as very low. However, post the Global Financial Crisis this perception may need to be scrutinised
- swap contracts are often collateralised, reducing the exposure to a default event
- a credit spread can be taken off the swap rate observed to obtain the risk-free discount rate. This spread could be the published corporate bond spread on a bond with the same credit rating as the swap counterparty
- swap markets are not subject to regulation so they may be a better reflection of market conditions than Government bonds
- there are often more maturities available.

Considerations do still need to be made though, as there are potential disadvantages to using swap rates such as:

- how liquid the swap markets are. A liquidity premium may be present in the swap rates if the market is not sufficiently liquid
- potential for agency risk as evidenced by the 2012 LIBOR scandal
- the credit risk adjustment needs to be carefully evaluated.

Using corporate bond rates to determine risk-free discount rates

In some markets, corporate bonds are widely traded so they may be an appropriate base for developing a risk-free yield curve.

Using option-pricing methods to determine risk-free discount rates

An appropriate base for the risk-free discount rate may not be available in the market, or it may be unclear what the reference rate should be. An alternative approach is to solve for the risk-free discount rate implied by a more readily observed market price.

The approach outlined involves using a historically validated option pricing model (like the Black-Scholes-Merton option-pricing formula for call options) and calculating the risk-free discount rate that results in the option value calculated by the formula being equal to the market-observed price.

Using this method does not require a reference rate to be determined. However, the calculations involved can be complex, there are still some assumptions which need to be made, and the market price of options must be readily observable which could be a problem if the market is not be very deep or liquid as is the case in New Zealand.

The IAA book also discusses models to determine future inflation assumptions.

If the market for nominal and inflation-indexed securities is sufficiently liquid, then it is possible to measure the market expectation of future inflation using the Fisher equation. This involves solving for the implied inflation that would set the returns on an inflation-indexed bond equal to the return on a nominal bond of the same maturity.

In the case where markets for either type of bond are illiquid, care needs to be taken as liquidity premiums may be present. Other sources of information to determine future levels of expected inflation are:

- historical levels of realised inflation
- historical levels of nominal yields
- central bank target inflation rates and ranges
- central bank projections of short-term inflation rates
- economists’ surveys of future inflation rates.

Australian Prudential Regulation Authority (APRA)

APRA has been following the European debates on discounting insurance obligations and the discussions of EIOPA in developing insurance regulation in Australia. APRA issued a Discussion Paper - Review of capital standards for general insurers and life insurers on 13 May 2010. Since then they have released a Review Paper on the liquidity premium and two Response Paper's on feedback received about the content in their papers. These papers have useful sections on risk-free discount rates.

APRA – Review of capital standards for general insurance and life insurers (13 May 2010) **Risk-free rates**
"For Australian-denominated liabilities, APRA regard the zero coupon spot yield curve of Commonwealth Government Securities (CGS) as the best proxy for risk-free rates. In forming this view, APRA has considered the views of the Reserve Bank of Australia (RBA) on the appropriateness of CGS yields as a proxy for the risk-free rate. The RBA has indicated that no persuasive evidence exists to suggest that the nominal CGS yield curve exhibits any downwards bias or that a shallow market exists."

APRA's initial conclusion in 2010 was that, for the purposes of capital reporting, the risk-free discount rate should be a term structure derived from Government securities.

Other international papers

Annex E of the first CEIOPS paper is a discussion of macroeconomic extrapolation methods that we believe is applicable in developing our methodology.

The Swedish and Norwegian markets are similar to New Zealand markets in that there are no Government bonds or SWAP rates long enough to cover the full term of the liabilities. The method discussed in Annex E uses unconditional fixed forward rates after a selected duration. It quotes research done on the macro-economic arguments by Barrie and Hibbert A Framework for estimating and extrapolating the term structure of interest rates, Sept 2008.

The following issues, which are of interest to The Treasury in developing our methodology, are discussed under the headings:

- at what maturity should the fixed forward rate be set
- which method should be used to interpolate between the last observable liquid rate and the fixed forward rate.

The Norwegian macroeconomic model that is used for extrapolation uses the forward rates from the yield curve up to year 10 and then smoothes linearly to an unconditional macroeconomic target for all maturities over a given threshold. In the example the target is 4% after 20 years.

The Treasury believes this is a useful reference and clearly articulates principles, adjustments required and the projection of yield curves. Their conclusion about the model described above is that it is:

- adequate from a theoretical point of view; almost all academic literature is based on extrapolating forward rates and not spot rates
- adequate from a practical point of view, as using forward rates is standard in financial pricing and analysis
- very simple to implement and very transparent
- producing a term structure that will be based on assumptions which are cautious, fairly undisputed and robust over time
- forward looking; some of the excessive volatility of the term structure (due to distortions) is taken out at the long end, but a large part of the volatility in the rates is left. The spot rates for a given maturity are an average over all one-period forward rates up to this maturity. Longer periods with very high or very low short-term interest rates (up to 10 years) are thus anticipated, and do not need any frequent adjustments of parameters.

The Dutch Actuarial Association and Actuarial Institute has issued Report in Principles for the Term Structure of Interest Rates (undated but approx June 2009). This paper addresses similar issues to the other European papers, but does not address the issue of extrapolating the curve. The paper is more of an overview and discusses the same issues as the other papers but there are less useful principles.

The Institute of Actuaries of Australia Life Insurance & Wealth Management Practice Committee Information Note: Risk-free Discount Rates under AASB 1038', March 2010 states:

- Government bonds may provide the rates or be the starting point
- it may be appropriate to allow for shallow market adjustments including scarcity discounts and liquidity premiums
- it may be appropriate to allow for credit risk adjustments (eg, to bank SWAP rates)
- the scarcity discount for indexed bonds may be higher than nominal bonds due to limited supply
- it may be appropriate to adjust for the liquidity of liabilities
- forward rates should be used, if spot rates are used this should be justified.

In summary this supports the methodology framework for short-term rates, but has no guidance on what to do at durations longer than observed rates.

Mulquiney & Miller

Mulquiney & Miller (November 2012 and May 2013) presented a paper at the Actuaries Institute's General Insurance Seminar. They had a number of conclusions including:

- there is reasonable international market evidence for reversion to a flat long term forward rate. This rate is reached via extrapolation from the end of the observable yield curve.
- the rate of reversion is slow. Mulquiney & Miller believe term 40 is about the minimum point to reversion based on the bond markets examined, with a central estimate closer to term 60. This conclusion rests on the assumption that the unconditional forward rate has been stable over the period 1998 to 2012.
- linear path reversion is plausible, with other approaches possible. Non-linear paths may have implications for term at which the long term rate can be reached.

Appendix B Use of inflation-indexed bonds

Introduction

In this section we consider whether the starting point for risk-free discount rate should be nominal discount rates (ie based on nominal Government bond rates) or real discount rates (ie based on inflation-indexed Government bonds).

This has been considered in previous reviews of the methodology and we are not aware of any new literature in this area. While there are more inflation-indexed bonds on issue than at the time of the previous review, issuances remain significantly smaller than for nominal government bonds and liquidity measures continue to indicate that they are significantly less liquid than nominal government bonds.

We note that:

- the risk-free discount rates apply to all accounting valuations reported in the financial statements of the Government
- the amount of inflation-indexed government bond on offer is significantly less than the value of the liabilities being discounted
- to adopt inflation-indexed Government bonds as the basis for determining inflation would require ignoring all other market information.

PBE IFRS 4

PBE IFRS 4 refers to risk-free discount rates that are based on current observable, objective rates that relate to the nature, structure and term of the future obligations

The accounting standard NZ IFRS 4 Insurance Contracts was issued in 2004 as an interim step in the accounting regulation of the insurance industry worldwide. It permitted the continuation of a wide variety of existing accounting treatments in different jurisdictions, but gave some guidance while the International Accounting Standards Board (IASB) and the Financial Accounting Standards Board (FASB) undertook a longer term project in this area.

New Zealand already had insurance standards in effect prior to 2004: FRS-34 Life Insurance Business (1998) and FRS-35 Financial Reporting of Insurance Activities (1999). These standards were developed jointly with the Australian standard setter. On transition to NZ IFRS, it was confirmed that FRS 34 and 35 would continue with no change after NZ IFRS 4 was introduced. On transition, FRS 34 and 35 were attached to IFRS 4 as Appendix C Life Insurance Entities and Appendix D Financial Reporting of Insurance Activities.

There is no Basis of Conclusion for either FRS-34 (Appendix C) or FRS-35 (Appendix D), so there is no Board insights to what the New Zealand and Australian standard setter meant by the term "nature" in the above paragraph. Ken Warren, Principal Accounting Advisor at The Treasury was on the New Zealand standard setting Board, the FRSB, during the latter part of the development of the insurance standard in the late 1990s and provided the following comment: "The word nature was generally used by the Board to reflect the view that the amount and timing of future cash flows that the insurer expects its existing insurance contracts to generate as it fulfils them, are uncertain and subject to a number of assumptions including inflation. This is reflected in the disclosure requirements under Appendix D headed up “Nature and Extent of Risks Arising from Insurance Contracts”.

The standard setter also appears to have had two separate ideas in mind when measuring an insurance liability under FRS-34 and FRS-35; the estimation of future cash flows associated with the insurance contract, which may include assumptions around inflation, and discounting those estimated cash flows at the risk-free rate to reflect the effects of the time value of money. This is evident from the discussion around determining the nominal cash flows and inflation assumptions in IFRS 4 Appendix D.

Term should clearly be taken into account and this is done through the use of a forward rate curve.

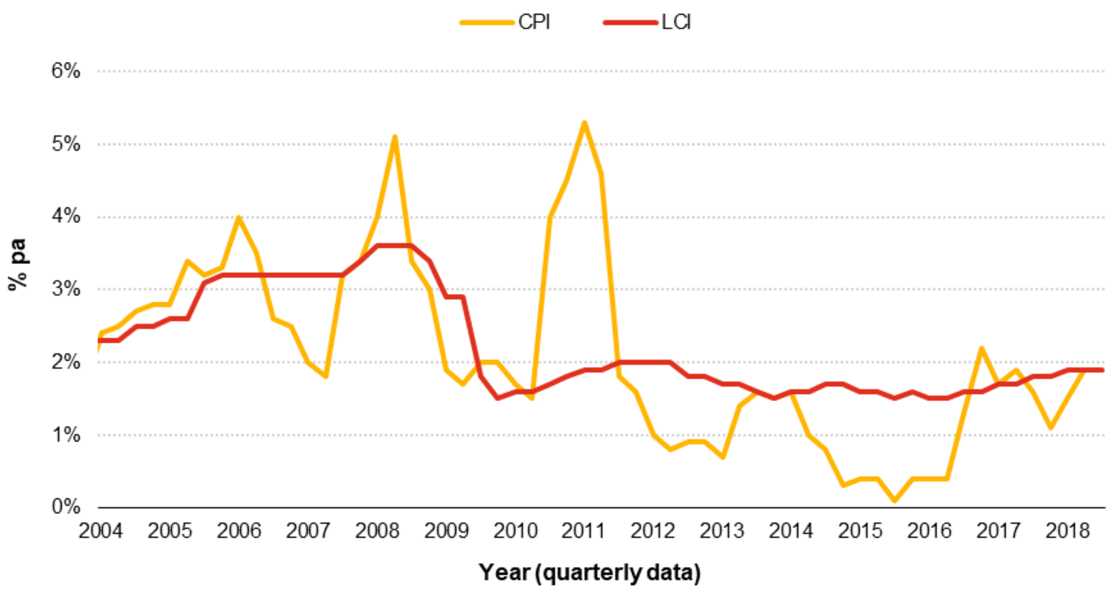
Currency is also taken into account and the discount rates in this report are designed to apply to New Zealand denominated cash-flows.

It has been raised that the fact that the future liabilities increase with inflation means that nature of the liabilities is such that the starting point should be the real return determined from inflation-indexed bonds rather than calculating nominal discount rates and inflation separately (albeit the breakeven inflation is a consideration in determining appropriate assumption for future inflation).

Inflation-indexed bonds did not exist in New Zealand at the time the wording of this standard was drafted and probably did not exist in Australia either and there is no indication in the standard that this was considered, consequently our view is the standard is written with the presumption that risk-free discount rates are nominal risk free discount rates.

We also note that only a very small proportion of the insurance liabilities are directly indexed to CPI increases. A larger proportion of the liabilities are linked to the increase in the LCI index and there is an assumption that these will tend to move together but the chart below shows there are significant variances between the two. Other long term liabilities are expected to increase with inflation but these increases are not specifically tied to any particular index.

Figure 22: Comparison of CPI and LCI inflation



For almost all long term insurance liabilities, the future liabilities with inflation and the there is no clear difference between the Crowns insurance liabilities and those of Australian accident compensation schemes. As far as we can ascertain each of these adopts a risk-free discount rate based on nominal bond returns and inflation assumptions based primarily on forecasts and none that we have identified start with inflation-indexed bonds or used break-even inflation as a starting point for the inflation estimate.

Consequently we have concluded that under PBE IFRS 4 the appropriate approach is to consider nominal risk free discount rates as the starting point rather than the real yield determined from inflation-indexed bonds.

PBE IPSAS 39 – Employee Benefits

PBE IPSAS 39 states that an entity determines the discount rate and other financial assumptions in nominal (stated) terms, unless estimates in real (inflation-adjusted) terms are more reliable, for example, in a hyperinflationary economy (see PBE IPSAS 10 Financial Reporting in Hyperinflationary Economies), or where the benefit is inflation-indexed, and there is a deep market in inflation-indexed bonds of the same currency and term.

The pension benefits of both the Government Superannuation Fund and the DBP Annuitants Scheme are directly indexed to increases in the CPI index. Therefore, it would be appropriate to use inflation-indexed bonds if there is a deep market for the relevant terms. As discussed in the body of the report, the market in inflation-indexed Government bonds is not deep. In addition, there are a limited number of bonds and insufficient bonds to determine a sufficiently comprehensive term structure for the real discount rates.

Consequently we have concluded that under PBE IPSAS 39 the more appropriate approach is to consider nominal risk free discount rates as the starting point rather than the real yield determined from inflation-indexed bonds.

Appendix C Process for adjusting market data

The following is an appropriate process proposed for assessing if any adjustments are required for Government bond and bank SWAP data:

- assess whether any adjustment is required by considering the bank SWAP spread
  - if there is a large bank SWAP spread, quantify the discount
  - quantify the risk premium or any other adjustment to bank SWAP rates
- reconcile the two adjustments and make a judgment on the best approach considering the adequacy of the information available.

Assess whether any adjustment is required

The first step is to investigate that there is any reason for market data to be adjusted. The clearest signal will be obtained from the bank SWAP spread, which should be at levels consistent with long term recent experience both in New Zealand and other markets.

If both sets of rates are essentially the same, then no adjustment is possible or required. The market is telling us that there is no scarcity of Government bonds and minimal extra risk in bank SWAP rates. Consequently, when these rates are similar, we can be confident that the overall level of the Government bond curve is reasonable and needs no adjustment hence this is the preferred method.

Scarcity discount

A large bank SWAP spread may indicate a scarcity discount on Government bonds.

Firstly, to support the need for a scarcity adjustment, volumes of trading, volumes available, buy sell spreads or price volatility can be looked at to assess if there have been any changes in the market liquidity. This situation occurred in 2007 and 2008 in New Zealand, where there was evidence of a shortage of Government bonds, including the presence of a large bank SWAP spread. Another indicator was the yield on debt used by sovereign backed organisations in New Zealand dollars, for example the World Bank. The difference in yield between Government bonds and these could not be explained adequately by risk and liquidity.

The Australian G100 paper written by Milliman adopts a difference of less than 0.5% in the bid-ask spread (% of mid) as indicative of a liquid market.

It not straightforward to evaluate the size of the market adjustment required and the approach would need to depend on the circumstances at the time. There are a number of sources available, including international fixed interest. It is possible to generate a synthetic US Treasury security in New Zealand dollars by using cross currency SWAPS. The cross currency SWAPS are reasonably robust as they are an important component or by-product of the global market for bank SWAPS. The difference between the synthetic US Treasury yield curve in NZ dollars and the Government bond yield curve gives an indication of the extent of any adjustment required. This method was used for the ACC outstanding claims liability valuation in June 2008, when the bank SWAP spread was greater than 1.0%.

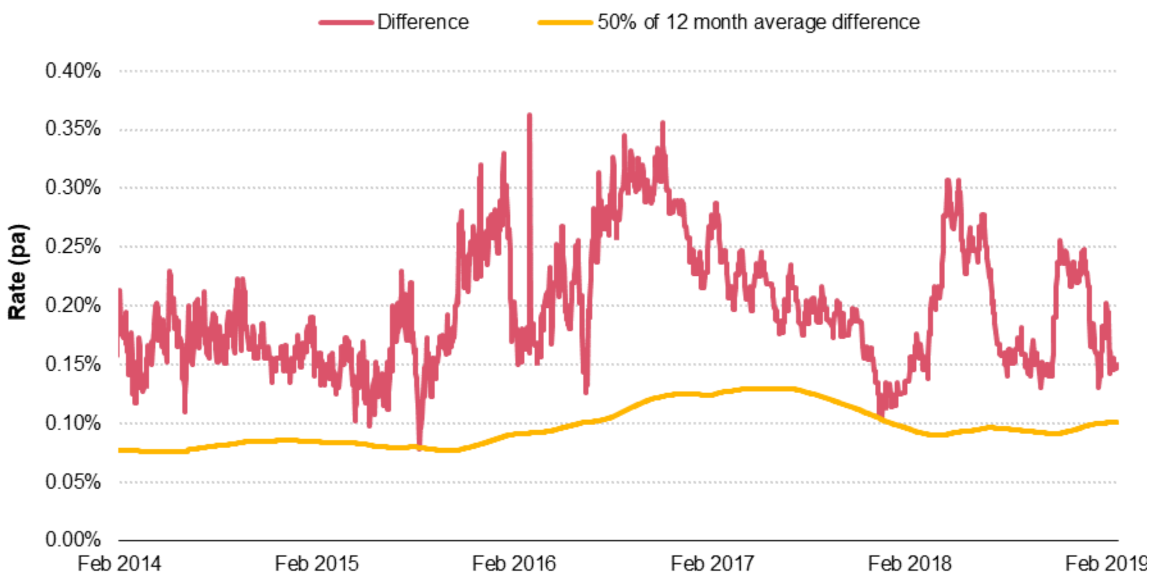
If adjustments are required in future, then a range of options will need to be considered.

Risk premium

The adjustment to bank SWAPs to reflect the risk is also complex and relies on judgement. There is a fairly well developed methodology for decomposing the yields on corporate bonds into components such as default risk, uncertainty of default risk and liquidity. This analysis can be extended to bank SWAP rates where the default risk has two components. The first component is the default risk of the instrument itself which is limited to the coupon payments; the second component is the default risk on the 90 day bank bill that is included in the yields used to price the SWAPS.

The method adopted by EIOPA to credit risk adjust the bank swap rates by reducing them by half of the average difference between the floating reference rate of bank swaps and the overnight indexed swap rate of the same maturity. The minimum adjustment is 10 basis points and the maximum is 35 basis points. This method is outlined in more detail in Section 8 as it is used by EIOPA.

Figure 23: Difference between floating reference rate of bank SWAPs and the overnight indexed SWAP rate



The chart shows that the credit risk adjustment implied by half the average difference between the 90 day bank bill yield and three month overnight indexed swap rate has been below 15 basis points and averaged about 10 basis points over the last few years.

An alternate method outlined in the IAA paper detailed in Section 8 involves using the corporate bond yield curve and adjusting for credit risk by using a published bond spread. However, the spreads that are published are spreads to the swap rate so the full extent of the credit risk will not be accounted for. The corporate bond market also has sporadic liquidity so would not provide a basis as robust as swap rates or Government bond rates. This approach is unlikely to be reliable in New Zealand.

Reconcile adjustments and decide on the best approach

Ideally the two methods and starting points; Government bonds plus scarcity of bank SWAP less risk will give the same answer. In order to determine which will provide the most robust answer, a judgement will need to be made on the stability of the adjustments and the likely outlook for each market in terms of supply, liquidity and trading.

If both methods are judged to be equally robust, then Government bonds are the preferred starting point.

Appendix D Forward rate yield curve fitting methodology

The purpose of this appendix is to describe the process of converting quoted Government bond yields to a smoothed forward rate yield curve to be used as a basis for the short-term risk-free discount rates.

Short-term interest rates

The available sources of information are the overnight cash rate and Treasury bills.

Construction of zero coupon portfolio

Government bonds are decomposed into maturity and individual coupon payments to produce a set of equivalent zero coupon bonds maturing on the 15th of the month.

Bootstrapping

Starting at the short end of the yield curve a forward rate is determined for the shortest bond, equal to the spot rate for the whole period up until the first bond matures. For the period between the first bond and the second bond a forward rate is determined so that the second bond market value is equalled using the previous forward rate as well. The forward rates are applied to the deconstructed cash flows already determined. This process is repeated solving for each successive forward rate until all bonds have been valued.

Curve fitting and interpolation

The fitting process will ideally be able to allow for anomalous prices for a particular bond. This is most likely to occur for a bond with less available on the market.

The process is to fit a curve of forward rates to the zero coupon portfolio of available bonds. The parameters of the fitted curve are determined by solving to minimize the least squares differences of the resulting fitted market values with the actual market values.

This process is equivalent to weighting the yields by the amount available in the market, which excludes the amounts held by the Reserve Bank of New Zealand (RBNZ) and the Earthquake Commission (which is not usually traded). This means that implied forward rates automatically give less weight to those bonds which represent a smaller proportion of the tradeable market.

The curve fitted is a cubic spline on the forward rates with 4 knots. This is fairly standard methodology with enough flexibility to fit most yield curves. There is some judgment involved in selecting the position of the knots, but this also gives a little flexibility to cope with any anomalies that may be present in the yield curve without changing the fundamental principles.

The smoothing process in itself is not particularly important as unsmoothed forward rates could be used with a minimal effect on the overall liability; however the critical factor in the smoothing is how it copes with any market anomalies, particularly at the longer end of the curve, or anywhere there are gaps between maturities.

Appendix E Sample table of rates as at 30 April 2019

The assumptions below are as at 30 April 2019 based on the methodology described in this paper.

Table 9: Table based on market rates at 30 April 2019

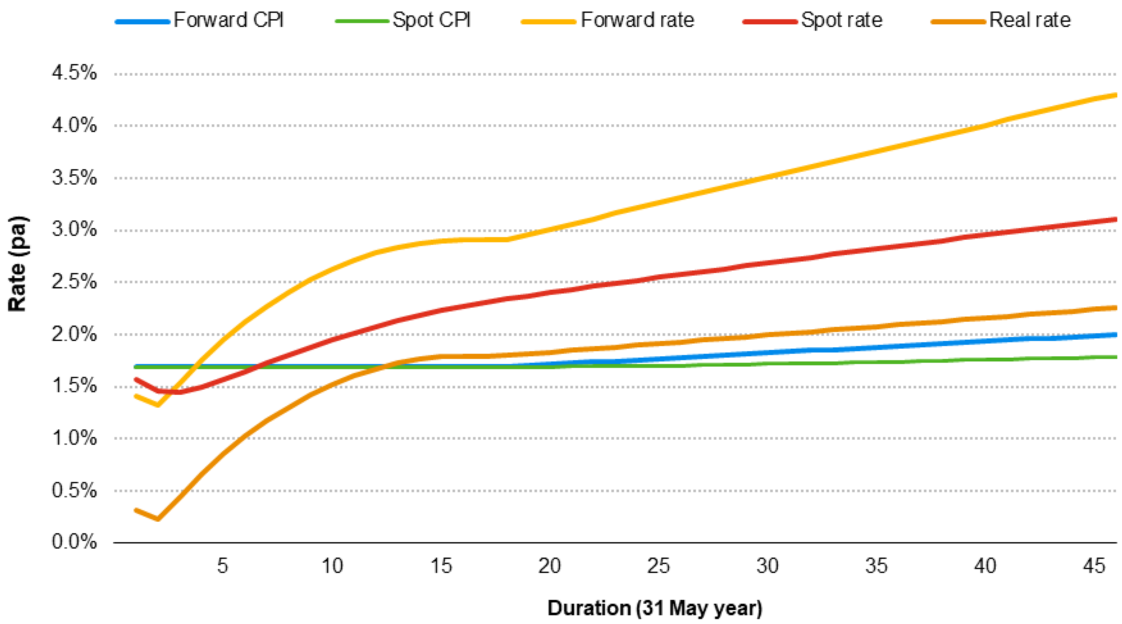
This table is duration based and is to be used for valuations as at 30 April 2019. The resulting fitted rates are plotted below:

Year (31 May)	Forward CPI (% pa)	Spot CPI (% pa)	Forward rate (% pa)	Spot rate (% pa)	Real rate (% pa)
1	1.69	1.69	1.40	1.57	0.31
2	1.69	1.69	1.32	1.46	0.23
3	1.69	1.69	1.53	1.45	0.43
4	1.69	1.69	1.76	1.50	0.66
5	1.69	1.69	1.96	1.57	0.86
6	1.69	1.69	2.13	1.65	1.03
7	1.69	1.69	2.27	1.73	1.17
8	1.69	1.69	2.41	1.80	1.30
9	1.69	1.69	2.52	1.88	1.42
10	1.69	1.69	2.62	1.95	1.52
11	1.69	1.69	2.71	2.01	1.60
12	1.69	1.69	2.78	2.07	1.67
13	1.69	1.69	2.83	2.13	1.73
14	1.69	1.69	2.87	2.18	1.77
15	1.69	1.69	2.90	2.23	1.79
16	1.69	1.69	2.90	2.27	1.80
17	1.69	1.69	2.90	2.31	1.80
18	1.69	1.69	2.91	2.34	1.80
19	1.70	1.69	2.96	2.37	1.81
20	1.71	1.69	3.01	2.40	1.83
21	1.73	1.69	3.06	2.43	1.85
22	1.74	1.69	3.11	2.46	1.86
23	1.75	1.70	3.16	2.49	1.88
24	1.76	1.70	3.21	2.52	1.90
25	1.77	1.70	3.26	2.55	1.91
26	1.78	1.70	3.31	2.58	1.93
27	1.79	1.71	3.36	2.60	1.95
28	1.80	1.71	3.41	2.63	1.96

Year (31 May)	Forward CPI (% pa)	Spot CPI (% pa)	Forward rate (% pa)	Spot rate (% pa)	Real rate (% pa)
29	1.81	1.71	3.46	2.66	1.98
30	1.82	1.72	3.51	2.69	2.00
31	1.84	1.72	3.56	2.71	2.01
32	1.85	1.72	3.61	2.74	2.03
33	1.86	1.73	3.66	2.77	2.05
34	1.87	1.73	3.71	2.79	2.06
35	1.88	1.74	3.76	2.82	2.08
36	1.89	1.74	3.81	2.85	2.09
37	1.90	1.75	3.86	2.87	2.11
38	1.91	1.75	3.91	2.90	2.13
39	1.92	1.75	3.96	2.93	2.14
40	1.94	1.76	4.01	2.95	2.16
41	1.95	1.76	4.06	2.98	2.18
42	1.96	1.77	4.11	3.01	2.19
43	1.97	1.77	4.16	3.03	2.21
44	1.98	1.78	4.21	3.06	2.23
45	1.99	1.78	4.26	3.08	2.24
46	2.00	1.79	4.30	3.11	2.25

The resulting fitted rates are plotted below:

Figure 24: Yield curve, real rate and forward and spot CPI inflation rates at 30 April 2019



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