Methodology for Risk-free Discount Rates and CPI Assumptions for Accounting Valuation Purposes

Updating the Nominal Risk-free Yield Curve and the Short Term CPI Assumptions

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THE TREASURY
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1 Introduction

1.1 Overview of the Methodology

1.1.1 The approach taken to set the risk-free rates and CPI inflation assumptions was first documented in Treasury's report "Methodology for Risk-free Discount Rates and CPI Assumptions for Accounting Valuation Purposes", dated July 2010 (Methodology report).

1.1.2 The Treasury's central methodology for risk-free rates is based on using New Zealand government bonds as the best proxy for risk-free rates. Given the short-term nature of market data on government bond yields in New Zealand in 2010, and the long-term nature of some of the Government's obligations, the methodology was developed under three headings:

- short-term assumptions (based on market yields)
- long-term assumptions
- assumptions for bridging the short and long-term assumptions.

1.1.3 The long-term and bridging assumptions cannot be directly observed and macroeconomic extrapolation techniques are used to derive the risk-free rates beyond the last available data point. These techniques assume a long-term equilibrium risk-free interest rate and that the ultimate long-term forward rate should be a non-volatile measure over time and only change due to fundamental changes in the long-term expectations. The most important economic factors explaining long-term forward rates are expected long-term inflation and expected long-term real interest rates.

1.1.4 A long-term CPI inflation assumption was set, which was adjusted in the short-term to allow for short-term market expectations.

1.2 Review of the Methodology 2013

1.2.1 Since the application of the original central methodology, there have been a number of reviews of the assumptions. The most recent review is documented in Treasury's report, "Methodology for Risk-free Discount Rates and CPI Assumptions for Accounting Valuation Purposes – Review of long-term economic assumptions", June 2013 (2013 Report). Below is a summary of changes made in the 2013 review.

- The long-term nominal risk-free discount rate was reduced from 6.0% pa to 5.5% pa.
- The long-term CPI inflation rate of 2.5% pa was retained and the long-term real risk-free discount rate was reduced from 3.5% pa to 3.0% pa.
- The bridging period between market and long-term rates was extended from 5 years to 10 years and the maximum slope of the risk-free yield curve was reduced from 0.15% pa to 0.05% pa.
- The bridging approach for CPI inflation was made the same as for the discount rates, ie the medium term inflation, up until the end of the yield curve, and smoothed into the long term rate over the same period as the nominal discount rate.

1.2.2 A 5.5% nominal and 3.0% real rates were considered appropriate as long-term risk-free equilibrium rates because of a combination of the following:

- a view of the reduced range of the long-term real rate, of 2.0% pa to 3.5% pa
- the New Zealand market data reflecting the lower stabilised nominal rate for the 5 to 10 year forward rate for government stock (stabilised in the 4.5% pa to 5.0% pa range), and
- the international data of differentials between 10 year stock and 30 year stock in the US, UK and Japan, as an indication of the yield which would apply to a hypothetical New Zealand 30 year stock.

1.2.3 With the bridging period's maximum slope of 0.05% pa, the methodology automatically lengthens the smoothing period between the market rates and the long-term assumed rate in extreme circumstances. This means that the bridging will always take care of situations where the market yields are significantly different from the long term assumption.

1.3 Ongoing reviews and proposed changes

1.3.1 In 2014, the Treasury updated the *Ongoing Review* section of their published methodology to be more specific and transparent about the scope of ongoing assumption updates and when they occur. This set out that the long-term assumptions be reviewed every three years, with the next review being in time for the valuations at 30 June 2016.

1.4 Scope of this document

1.4.1 This document covers items for updating the short–term nominal risk-free yield curve and the updating the short-term CPI inflation assumptions. In this context, CPI inflation means through to the maturity date of the longest nominal New Zealand Government bond, ie 2033 (18 years).

2 Updating the nominal risk-free yield curve

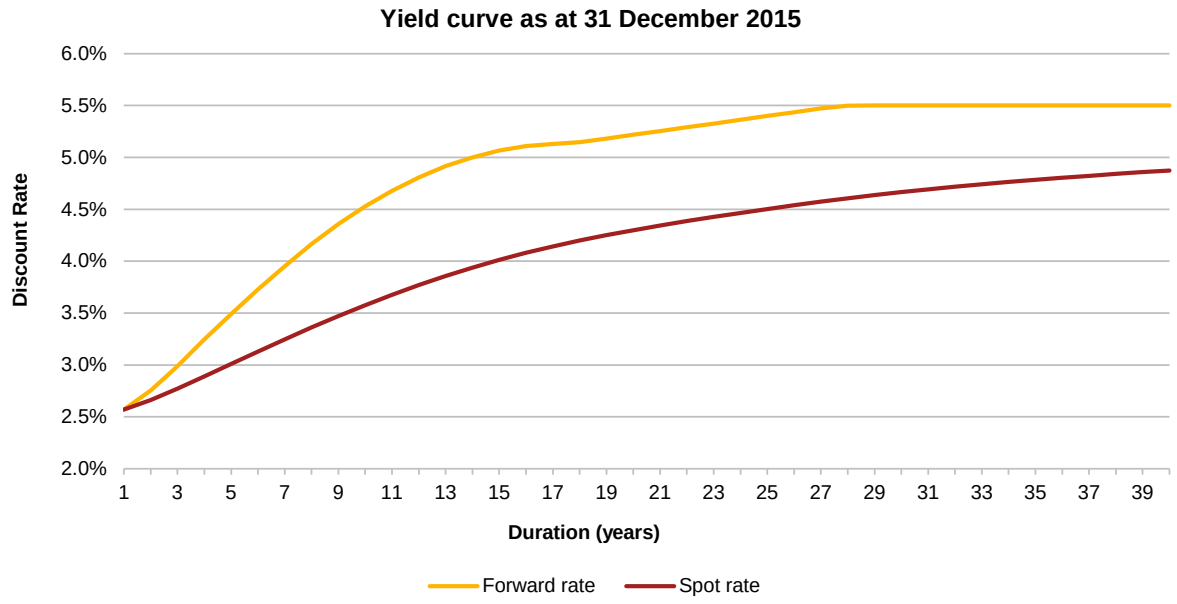
2.1 Approach

2.1.1 The steps for determining the nominal risk-free yield curve are summarised below:

1. Determine risk-free discount rates for the first year, by reference to Treasury Bills and the Overnight Cash Rate (OCR).
2. Determine the smoothed market forward rate curve for the remainder of the short term rates by reference to New Zealand Government bond yields, through to the maturity date of the longest nominal New Zealand Government bond, ie 2033 (18 years).
3. Smooth these short-term rates into the long-term rate.

2.2 Results

2.2.1 The following chart shows the risk-free rates as at 31 December 2015, which have been set following the approach above.



2.2.2 The long-term forward rate, of 5.5% pa, is greater than the forward rate of 5.1% pa implied by the longest duration bonds. The transition between the two sections of the curve occurs over a period of 10 years, with the slope of 0.04% pa starting in 2033 and ending in 2043.

3 Updating the short term CPI inflation assumptions

3.1 Approach

3.1.1 Short-term CPI means up until the end of the nominal yield curve. This is 18 years, through to 2033 and in forecasting terms covers both the short term 5 year and medium term 15 year forecasts. After this, the bridging and long term assumptions apply.

3.1.2 Determining the inflation assumption over the short to medium period is challenging because of the judgments that need to be made. There are a number of sources of information that need to be considered. The only "market pricing" information available is the break-even inflation implied by inflation-indexed bonds, and this needs to be assessed against a number of other market expectations of CPI which are generally expressed in published forecasts.

3.1.3 CPI inflation assumptions for valuing insurance and defined benefit pension obligations are predictions of the average price of consumer goods and services purchased by households in the future. Statistics New Zealand determine and report actual CPI.

3.1.4 Therefore the update of the short-term CPI inflation assumptions included the following considerations:

- forecasters' views of CPI inflation
- the New Zealand Government inflation-index bond yields and the break-even inflation implied by these
- historical CPI inflation relative to the Reserve Bank of New Zealand (RBNZ) target
- historical rolling annual CPI inflation.

3.1.5 The discussion below covers all the pieces of information we have considered in determining the appropriate CPI assumptions for valuing certain liabilities such as ACC's insurance obligation and GSF's defined pension scheme at 31 December 2015.

3.2 Forecasters' views of CPI inflation

3.2.1 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 Treasury's Half Yearly Economic and Fiscal Update (HYEFU) is the latest forecast. All the other forecasts were released before The Treasury released HYEFU. The 25th percentile, median and 75th percentile of the forecasts (excluding consensus forecasts) is also shown.

Table 1 - Forecasts of CPI Inflation

Source (date of release)	Period covered	2016 %pa	2017 %pa	2018 %pa	2019 %pa	2020 %pa	2021 %pa	2022 %pa	2023 %pa
NZIER Consensus Forecasts (Dec 2015)	March year	1.3	1.9	2.0	1.9	-	-	-	
Aon Economists Survey (Oct 2015)	Sep/Oct year	-	2.0	-	-	2.1	-	-	2.2
NZIER Quarterly Predictions (December 2015)	March year	1.6	1.7	2.0	2.0	2.0	-	-	
Treasury (December 2015, HYEFU)	March year	1.4	2.1	1.9	2.1	*2.2*	-	-	
RBNZ (Sep 2015)	March year	1.5	2.1	2.0	-	-	-	-	
RBNZ (Sep 2015) : Low interest rate scenario	March year	1.6	2.2	2.2	-	-	-	-	
RBNZ (Sep 2015) : High interest rate scenario	March year	1.4	1.9	1.9	-	-	-	-	

3.2.2 The first two forecasts in the above table are consensus forecasts produced by Aon and NZIER. The figures quoted are an average of the views of different selections of participants and so some differences in the averages are to be expected.

3.2.3 Forecasts available are mostly similar, indicating a range of 1.3% to 1.6% pa for the year to March 2016 and 1.9% to 2.2% pa for the years ended March 2017, 2018 and 2019. Short term forecasts for 2016 are quite dependent on the year definition and therefore how much past known inflation is included. For example, Treasury's forecast for 2016 includes two quarter of actual inflation. Treasury's projection for the first quarter of 2016 is 2.2% pa and for the calendar year 2016 is 2.1% pa.

3.2.4 Previously we have started with consensus forecasts and then adjusted to be consistent with the Treasury forecasts, this gives a combination of the Treasury view and an external view.

3.2.5 We recommend adopting a forecast baseline of 2.0% from 1 January 2016, this is effectively rounding the Treasury 2017 to 2020 forecasts slightly and using the Treasury medium term forecasts for after 2020.

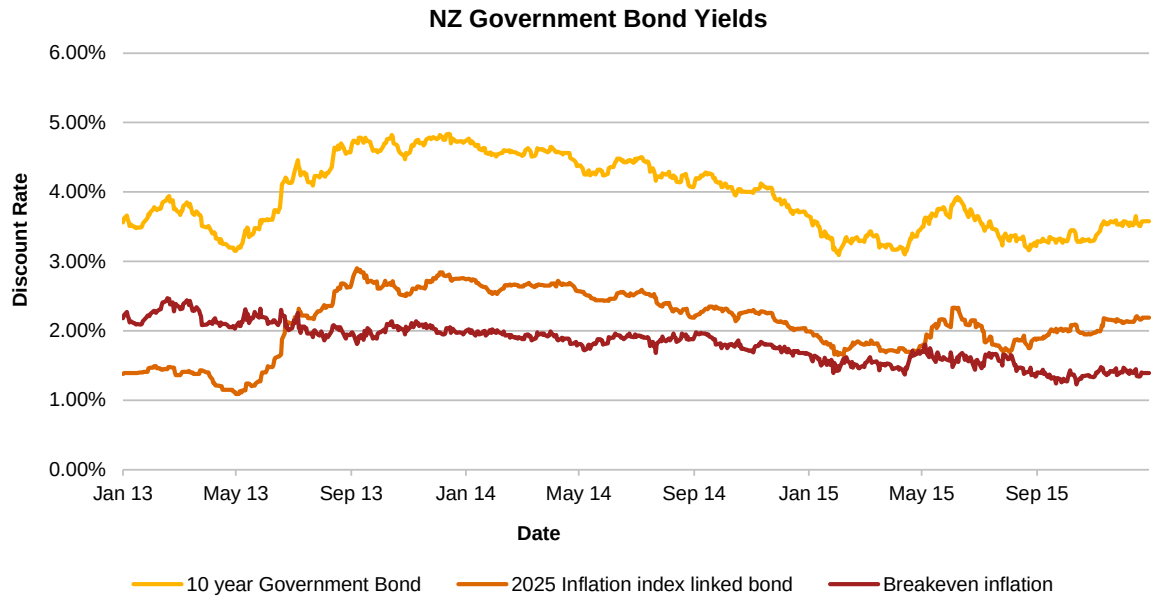
3.3 Inflation indexed bond yields

3.3.1 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.

3.3.2 In the past one to two years, there has been a significant amount of the inflation-indexed bonds issued and there is more trading and a more robust market than previously. At 31 December 2015, $5.5 billion of inflation-indexed bond maturing on 20 September 2025, $4.5 billion of inflation-indexed bond maturing on 20 September 2030, and $2.7 billion of inflation-indexed bond maturing on 20 September 2035 (30 June 2015: $1.95 billion) had been issued.

3.3.3 The breakeven inflation implied at 31 December 2015, by the 2025 inflation-indexed bond was 1.31% pa, by the 2030 inflation-indexed bond was 1.48% pa and by the 2035 inflation-indexed bond 2035 was 1.57% pa. These are calculated based on our smoothed yield curve, and the average breakeven across all 3 index stocks weighted by amount on issue is 1.45%. These rates are consistent with the forecasts for 2016 but lower than the forecasts for later years.

3.3.4 The following graph shows an estimate of the breakeven inflation implied by the 2025 bond since January 2013. The exact breakeven is complicated to determine but should move up and down in a similar fashion to the estimate shown.



3.3.5 This graph indicates the breakeven inflation has shown a fairly consistent downward trend for the last few years.

3.3.6 There are a number of reasons why breakeven inflation may be different to expected or forecast inflation. These include the liquidity or scarcity of the inflation-indexed bond and of the nominal bond, the risk premium payable for inflation certainty, or conversely the discount for being exposed to inflation risk, and the different impact of tax to the different investors. These will determine the different supply and demand pressures for nominal and inflation-indexed bonds. Greater demand for inflation–indexed bonds would increase the breakeven inflation; greater demand for nominal government bonds would decrease the breakeven inflation.

3.3.7 Currently the breakeven inflation is less than forecast inflation, which implies that either: there is a lower demand for inflation-indexed bonds, or that the inflation forecasts are too high. Nominal government bonds are more heavily subscribed than inflation–indexed bonds, which implies lower demand for inflation-indexed bonds (ie actual expected inflation is greater than the breakeven inflation).

3.3.8 The advantage of using breakeven inflation to determine CPI inflation assumptions is that it means the real discount rates implied from the nominal discount rates and CPI inflation assumptions are consistent with the yields on the inflation-indexed bonds.

3.3.9 While the insurance and pension accounting standards provide guidance about the discount rate to be applied[1], there is no guidance on how actuaries should determine the inflation assumption to be applied in a valuation of an insurance or defined benefit pension liability.

3.3.10 The accounting standard for defined benefit pension does state: Other actuarial assumptions shall be unbiased and mutually compatible. Actuarial assumptions are mutually compatible if they reflect the economic relationships between factors such as inflation, rates of salary increase, the return on plan assets, and discount rates [PBE IPSAS 25.85 and 25.89].

3.3.11 This means that actuarial assumptions used should be unbiased and internally consistent with other actuarial assumptions used within the defined benefit pension liability valuation.

3.3.12 The expected return on assets is specifically mentioned in the pension standard because defined pension liabilities are recognised net of plan assets on an employer's balance sheet and the actuary needs to disclose the expected return on pension assets each year. General insurance liabilities such as ACC's outstanding claims obligation are recognised on a gross basis using actuarial assumptions.

3.3.13 In valuing an insurance liability or defined pension net liability we are looking to determine the best actuarial assumption for inflation given **all** the information available.

3.4 Inflation indexed bond market

3.4.1 There are a number of features of the NZ inflation-indexed bond market that need to be considered:

- there has been a significant increase in the amount of inflation-indexed bonds issued ($13bn plus $1.1bn in 2016) and significantly longer term stock is available than for the nominal bonds
- there is a limited number of domestic buyers, and significant concentration of holdings. For example, as at 30 June 2015, ACC owned 40% of the inflation indexed bonds, with a much lower proportion of the nominal (source ACC 2015 Annual Report)
- trading volumes for inflation-indexed bonds are a lot lower than nominal bonds

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[1] *An entity makes a judgment whether the discount rate that reflects the time value of money is best approximated by reference to market yields at the reporting date on government bonds, high quality corporate bonds, or by another financial instrument... 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 25.94 *Employee Benefits*]

Typically, government bond rates may be appropriate discount rates for the purposes of this requirement, or they may be an appropriate starting point in determining such discount rates [PBE IFRS 4, Appendix D 6.1.2 *Insurance Contracts – General insurance]*

- inflation-indexed bond yields appear to overreact to short term expectations, oil prices and recent inflation results
- inflation-indexed bonds don't feature prominently in fixed interest indices and benchmarks and are unlikely to have made it into fund manager's asset allocation policies
- DMO have scaled back their inflation-indexed bond issues in the 2015/16 fiscal year, in favour of nominal bonds, this has been favourably received by the market
- globally breakeven inflation rates have been falling, and there is weak global demand
- inflation-indexed bonds are currently unattractive to traders because taking a trading position on a widening break-even inflation is expensive.

3.4.2 The implied break-even inflation provides some evidence of market expectations of inflation, but it is also significantly different from economic forecasters' views of expected inflation. These conflicting views of inflation expectations in the broader market needed to be investigated further before finalising the 31 December inflation assumption.

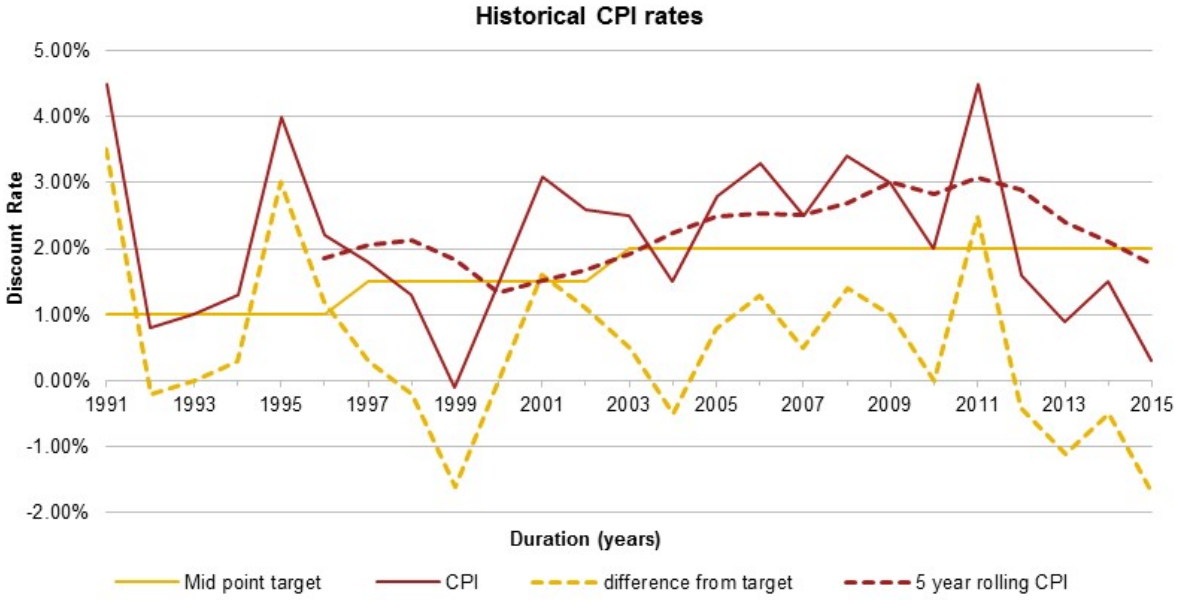
3.4.3 At 30 June 2015, the short to medium CPI assumption of around 1.63% was based on 100% weighting of the implied break even inflation based on inflation-indexed bonds after taking into account all other sources of information. Although the 100% weighting on the market data for inflation index bonds at 30 June 2015 was lower than forecasters' views of assumption, at the same time, the result was within a reasonable range. Since that time we have gathered evidence that suggests that the market weighting of 100% is now too high and the December rates should be adjusted accordingly to a more balanced view of 50% market and 50% economic view. This is entirely appropriate given that each time we perform a valuation we need to reconsider the market weighting in light of evidence.

3.4.4 Index linked bonds are directly linked to the CPI, as are some pension benefits that are indexed to CPI, whereas most insurance liabilities are more loosely "influenced" or dependent on broader CPI trends. So it is not unreasonable and not inconsistent with accounting standards, to expect insurance liabilities to be driven by an inflation that is not exactly the breakeven inflation from the index linked bonds.

3.4.5 In summary we believe there is sufficient evidence that giving full credibility to the market break-even inflation is now not appropriate. It is however extremely difficult to quantify exactly how much weight to give to the market information or alternatively quantify the adjustment that could 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. This approach is not inconsistent with other jurisdictions, in particular Australia, where it would be unusual to use an unadjusted breakeven inflation.

3.5 Historical CPI inflation

3.5.1 The following chart shows the historical CPI inflation relative to the RBNZ target and historical rolling annual CPI inflation.



3.5.2 Historical CPI inflation experience has generally been above the midpoint of the target range. However, in the last four years the CPI increase has been below the midpoint of the target range. The latest Policy Targets Agreement of 2012 adds that the Reserve Bank should "focus on keeping future inflation near the 2% target midpoint.

3.5.3 There have now been four years of very low inflation, with the year to March 2015 being the lowest point since 1999. Inflation has been less than 2.0% for four years with a four year average of 1.0% pa.

3.6 Summary

3.6.1 In summary, the information to determine the CPI inflation assumptions through to 2033 are:

- available CPI inflation forecasts indicate a range of 1.3% to 1.6% pa for the year to March 2016 and 1.9% to 2.2% pa for the years ended March 2017, 2018 and 2019
- a forecast baseline summary of 2.0% pa
- the breakeven inflation implied by the inflation-indexed bonds, is 1.40% pa
- the Debt Management Office has a view that the index linked stock market is still a developing market
- CPI inflation has been less than 2.0% pa for four years, with a four year average of 1.0% pa
- RBNZ target mid-range is 2.0% pa.

3.7 Determination of CPI inflation assumptions at 31 December 2015

3.7.1 In 2014, the various indicators of future inflation were relatively consistent. There was a significant weighting placed on the breakeven inflation implied by the inflation-indexed bond yields.

3.7.2 At 30 June 2015, CPI inflation assumptions were solely on the breakeven inflation implied by the inflation-indexed bonds, as:

- there has been an increase in the amount of inflation-indexed bonds in the market and in the extent to which they are traded
- there was no evidence that there is any risk premium in the 2025 bond
- accounting standards require that full use is made of all available information, including market information where it is available
- the two and three year forecasts have not been good predictors in recent years; the one year forecast has been more accurate
- inflation forecasters seem to be reluctant to go below the 2% midpoint of the RBNZ range
- there had been a significant decline in global inflation and breakeven inflation is driven by both lower inflation expectations and lower demand for inflation linked assets
- the breakeven inflation was consistent with various inflation forecasts for 2016, which support the use of a flat rate and the starting level.

3.7.3 At 31 December 2015 we have used the following methodology:

1) Forecast inflation: Assessed the baseline forecast inflation as 2.0% pa thereafter.

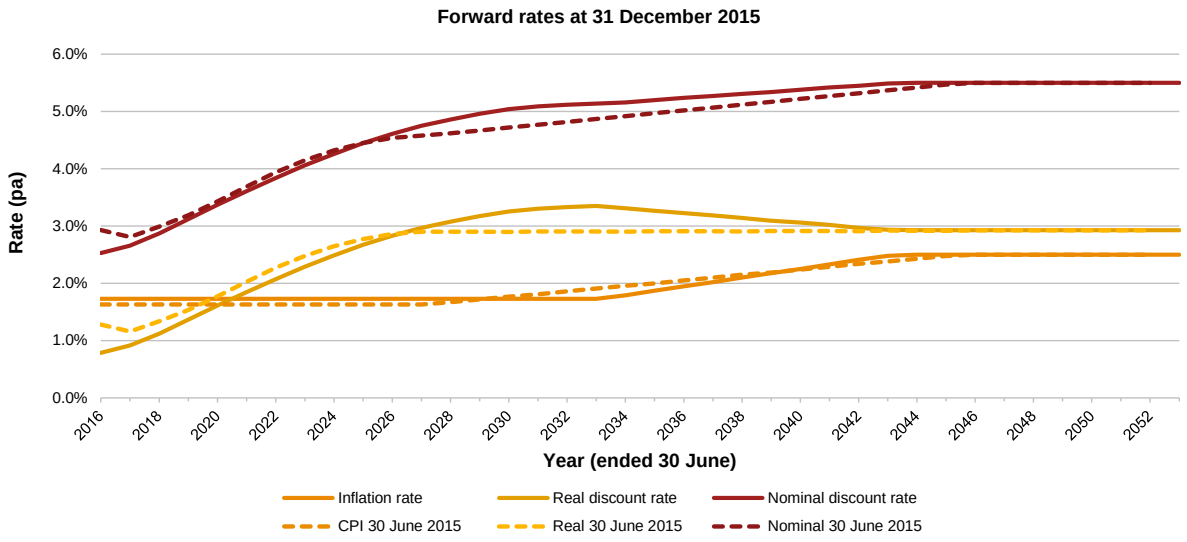
2) Flat rate of breakeven inflation: Determined the flat rate of breakeven inflation though to 2033 by:

   - Fitting the nominal risk-free yield curve to 2033 (the last nominal bond) followed by smoothing to the long-term rate.
   - Assuming the inflation rate is a flat rate through to the end of the nominal yield curve (2033) and then trends linearly to the long-term CPI inflation assumption (2.5% pa) over the same period as the nominal yield curve (to 2045). Using the same period as the nominal curve ensures the real discount rate curve follows a smooth progression.
   - Solved for the flat rate by minimising the error to all three index linked bonds. Different weightings are applied to each of the bonds. The weightings applied to each of the bonds reflect the liquidity of each issue. Consequently, the 2025 bond receives a higher weighting than the other two. A certain amount of judgement and flexibility in approach is required to achieve a reasonable result. At 31 December 2015, the weightings used were the amount on issue for each bond.
   - The breakeven inflation rate to 2033 using this approach is 1.45% pa.

3) Given a 50% weighting to the baseline forecast inflation and 50% weighting to the breakeven inflation.

3.7.4 The basis for the 50/50 weighting is that there are concerns with the index linked market, and that this needs some adjustment. There is no evidence as to how much adjustment or weight is reasonable, and given this we have adopted 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 no longer tenable for determining actuarial assumptions when valuing general insurance and defined benefit pension schemes.

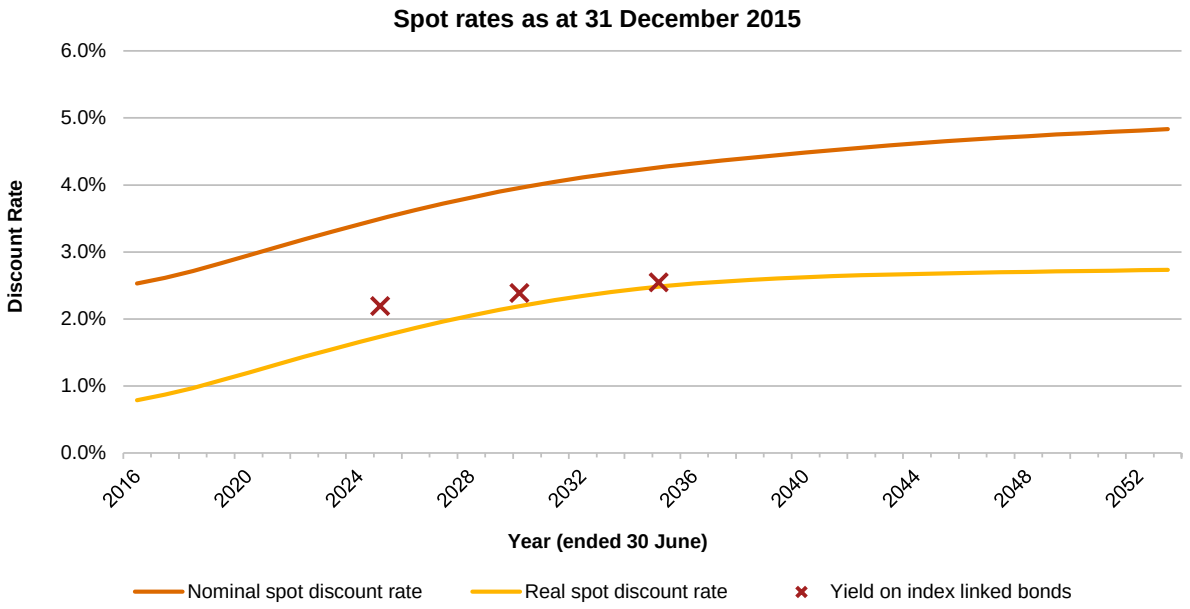
3.7.5 Using this methodology, we have produced the following results at 31 December 2015.



3.7.6 The chart shows how the smoothing adopted for the inflation rate gives a smooth progression of the real yield curve out to the long-term assumption of 3% pa. The short to medium term inflation is 1.7%.

3.7.7 The dotted lines show the assumptions at 30 June 2015, which are all remarkably similar.

3.7.8 The following chart shows the nominal and real spot discount rates for the flat rate of breakeven inflation.



3.7.9 The chart shows the real spot rates are lower than the yields on the 2025, 2030 and 2035 inflation-indexed bonds. The difference is consistent with the 0.3% adjustment made to the breakeven inflation.

3.8 Updating the short term CPI inflation assumption

3.8.1 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.

3.8.2 The methodology to do this will be to keep the forecast baseline and then adjust this by 50% of the difference between this and the recalculated market breakeven inflation at the time. This should be fairly straight forward to do automatically each month. If there are any significant anomalies created in using this approach we will need to review and modify as necessary.

3.8.3 The forecast inflation will be reviewed for the June 2016 rates.

Table 2 - CPI inflation assumptions and real risk-free rates at 31 December 2015

Year ending 31 December	CPI inflation assumption	Previous assumption (March year)	Nominal risk-free forward rate	Real risk-free forward rate (simple)	Real risk-free forward rate (compound)	Real risk-free spot rate
2016	1.73%	1.63%	2.57%	0.84%	0.83%	0.83%
2017	1.73%	1.63%	2.75%	1.03%	1.01%	0.92%
2018	1.73%	1.63%	2.99%	1.26%	1.24%	1.03%
2019	1.73%	1.63%	3.25%	1.52%	1.49%	1.14%
2020	1.73%	1.63%	3.49%	1.77%	1.74%	1.26%
2021	1.73%	1.63%	3.73%	2.00%	1.97%	1.38%
2022	1.73%	1.63%	3.95%	2.23%	2.19%	1.49%
2023	1.73%	1.63%	4.16%	2.44%	2.40%	1.61%
2024	1.73%	1.63%	4.36%	2.63%	2.59%	1.71%
2025	1.73%	1.63%	4.53%	2.80%	2.75%	1.82%
2026	1.73%	1.63%	4.68%	2.95%	2.90%	1.92%
2027	1.73%	1.63%	4.81%	3.08%	3.03%	2.01%
2028	1.73%	1.67%	4.92%	3.19%	3.13%	2.09%
2029	1.73%	1.72%	5.00%	3.27%	3.22%	2.17%
2030	1.73%	1.77%	5.07%	3.34%	3.28%	2.25%
2031	1.73%	1.81%	5.11%	3.38%	3.32%	2.31%
2032	1.73%	1.86%	5.13%	3.40%	3.35%	2.37%
2033	1.76%	1.91%	5.15%	3.39%	3.33%	2.43%
2034	1.83%	1.96%	5.18%	3.35%	3.29%	2.47%
2035	1.91%	2.00%	5.22%	3.31%	3.25%	2.51%
2036	1.99%	2.05%	5.25%	3.27%	3.20%	2.54%
2037	2.06%	2.10%	5.29%	3.23%	3.16%	2.57%
2038	2.14%	2.15%	5.33%	3.19%	3.12%	2.60%
2039	2.22%	2.19%	5.36%	3.15%	3.08%	2.62%
2040	2.29%	2.24%	5.40%	3.11%	3.04%	2.63%
2041	2.37%	2.29%	5.43%	3.07%	2.99%	2.65%
2042	2.45%	2.34%	5.47%	3.03%	2.95%	2.66%
2043	2.50%	2.38%	5.50%	3.00%	2.93%	2.67%
2044	2.50%	2.43%	5.50%	3.00%	2.93%	2.68%
2045	2.50%	2.48%	5.50%	3.00%	2.93%	2.68%
2046	2.50%	2.50%	5.50%	3.00%	2.93%	2.69%
2047	2.50%	2.50%	5.50%	3.00%	2.93%	2.70%
2048	2.50%	2.50%	5.50%	3.00%	2.93%	2.71%
2049	2.50%	2.50%	5.50%	3.00%	2.93%	2.71%
2050	2.50%	2.50%	5.50%	3.00%	2.93%	2.72%
2051	2.50%	2.50%	5.50%	3.00%	2.93%	2.73%