The real risk-free interest rate in thin debt markets

It is standard practice to use the yield on inflation-indexed CGS as a direct observation of the real risk-free rate of return. However, it has been argued that excess demand for such securities artificially depressed their yields, causing this estimate to be understated, and forecasts of inflation given by the difference between nominal CGS and inflation-indexed CGS to be overstated. This paper suggests an additional hypothesis, namely that there has also been an excess demand for nominal corporate bonds.[1]

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FOR A NUMBER OF YEARS Australian regulators have relied on market yields for CPI-indexed Commonwealth Government Securities (CGS) to estimate the real risk-free rate of return, and used this in conjunction with nominal CGS yields to estimate inflation. These estimates have been used as inputs into the weighted average cost of capital (WACC) calculation applied by regulators to determine the price or revenue path for regulated businesses. Hence the establishment of the real risk-free rate is an important component of the regulatory outcome for businesses.

However, the common practice of using indexed CGS yields to estimate the real risk-free rate of return and the difference between nominal and indexed CGS yields as a measure of forecast inflation has been challenged. For example, the consulting firm National Economic Research Associates (NERA) proposed that due to excess demand for inflation-indexed bonds, there is a 20 basis points (bps) downward bias in the yield on inflation-indexed Commonwealth Government bonds compared to the real risk-free rate.[2] (This implied an equivalent overstatement of the forecast inflation rate from comparing nominal and indexed CGS yields.)

In this paper, this 'indexed bond shortage' hypothesis is reviewed and an additional hypothesis considered. While it is not possible to discriminate between the two hypotheses, further evidence is presented to support the view that there has been a downward bias in estimated real yields.

Potential bias in indexed CGS bond yields

NERA (2007) observed that since the year 2000, the supplies of real CGS fell considerably when compared against the increasing size of the economy (GDP). In an era of budget surpluses and relatively low inflation, the Government had discontinued issuing indexed CGS. Table 1 shows that inflation-linked (or 'real') bonds have come to represent a small fraction (0.7%) of the total bonds issued in Australia, and that this is less than in many other advanced economies. In the United States and United Kingdom by contrast, inflation-indexed government bonds make up between 25% and 39% of all bonds on issue.

TABLE 1: **Inflation-linked government bond markets**

Country	Outstanding USD bn	% of Total bonds	Number of issues
Australia	7	0.7	3
US	407	38.5	212
UK	263	24.9	12
France	160	15.1	10
Italy	85	8.0	5
Germany	12	1.1	1
Other Europe	12	1.1	1
Japan	45	4.3	10
Sweden	36	3.4	6
Canada	31	2.9	4

Sources: Barclays, various statistical agencies, RBA calculations (in I. Wilson 2007, 'Developments in inflation indexed securities', presentation to ENA seminar)

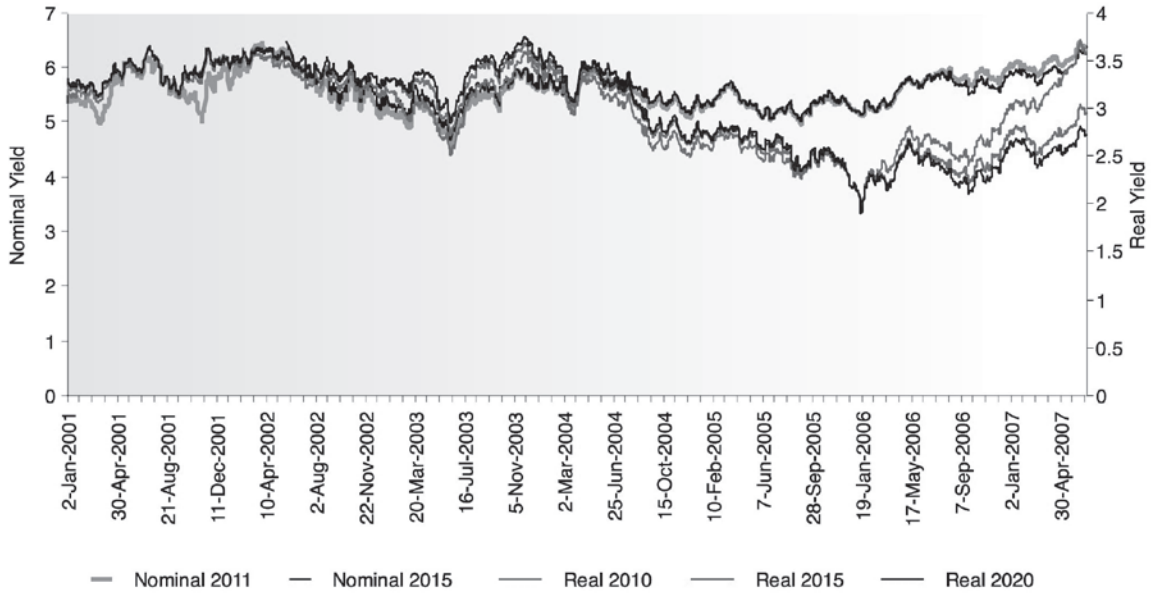
Assuming that demand for real CGS is positively correlated to GDP, and noting that there are no close substitutes for them, NERA reasoned that there would be a growing shortfall of demand for indexed CGS, which would inflate their prices and drive down their yields artificially. A further implication was that since the yield on real CGS would underestimate the real risk-free rate, the difference between nominal and real CGS must upwardly bias the level of forecast inflation.

Figure 1 shows nominal and real CGS yields between January 2001 and April 2007. From late 2004 there was a fall in real CGS yields relative to nominal CGS yields, opening up a gap between them, although the gap between shorter maturity nominal (2011) and real (2010) CGS yields narrowed by January 2007. NERA proposed that either there was an actual reduction in the real CGS yields from late 2004, with a coincident increase in inflationary expectations that kept nominal yields relatively constant, or there had been an artificial reduction in the real CGS yield due to increasing scarcity of supply, and continuing greater demand for real CGS.

In April 2007, the inflation rates implied by the differences between nominal and real CGS yields were, in the main, considerably outside of the Reserve Bank of Australia's (RBA) inflation target range of 2% to 3%. The implied inflation forecast, assuming no bias in real CGS, was 2.77% for the period from June 2007 to April 2010, and substantially higher for later years.

NERA was not alone in considering the yield on real CGS to be downward biased, with the spread between nominal and real CGS overestimating inflationary expectations. In its February 2007 *Statement on Monetary Policy*, the RBA noted that, 'While this spread is usually seen as a measure of expected inflation, its recent increase is at odds with other measures of inflation and is at odds with other measures of inflation expectations and reflected special factors, unrelated to inflationary pressures'.[3]

FIGURE 1: **Yield on nominal and real CGS**



Source: RBA data.

Measuring the bias in indexed CGS

To measure the magnitude of the bias in real CGS yields, NERA found matching maturity pairs of real and nominal corporate bonds issued by the same company, which should have the same margin for risk (over the true real or nominal risk-free rate of return respectively). The margins of the real and nominal corporate bonds over equivalent maturity real and nominal CGS were calculated. If the real CGS yield was downward biased, NERA predicted that the gap between real corporate and government bond yields would exceed the gap between the nominal corporate and CGS bond yields. By rearranging the terms in NERA's equation, the downward bias, measured as the 'difference in spreads' (DS) can also be written as:

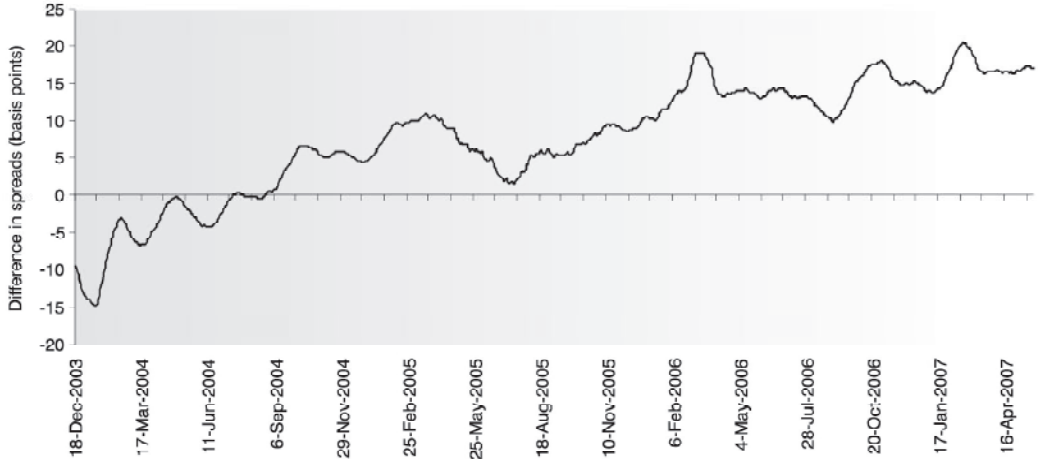
DS = (Real Corp Yield – Real CGS yield) – (Nominal Corp Yield – Nominal CGS yield) (1)

NERA obtained daily yield data for nominal and real ElectraNet and Envestra bonds to March 2007. The results can be summarised as follows:

TABLE 2:

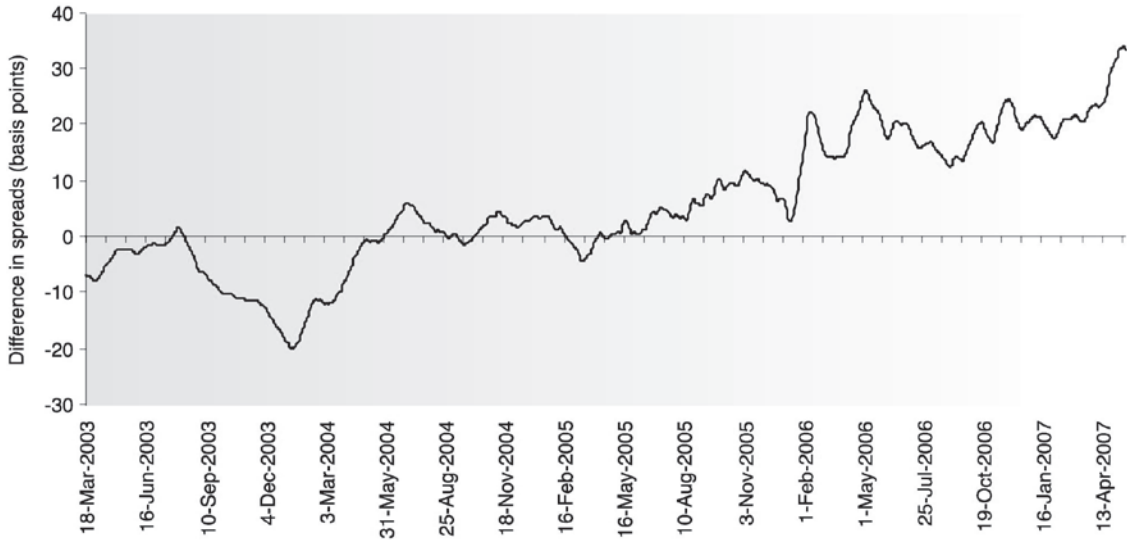
Company	Real Bond Maturity	Nominal Bond Maturity	DS spread (bp)
ElectraNet	20 August 2010	17 November 2009	17-19
ElectraNet	20 August 2015	17 November 2009	19-24
Envestra	20 May 2011	21 February 2008 interpolated with 14 October 2015	21
Envestra	14 October 2025	14 October 2015 (extrapolated)[4]	21

FIGURE 2: **ElectraNet real 2010 vs. nominal 2009** bond DS (nominal-real spreads)



Source: ABN AMRO data.

FIGURE 3: **Envestra real 2011 vs. interpolated Envestra nominal 2011 bond DS (nominal-real spreads)**



Source: Macquarie Bank data.

Graphical representations of the development of the 20 bps DS for ElectraNet and Envestra bonds are displayed in Figures 2 and 3. For Envestra, DS had increased to 30 bps by the end of April 2007.

Based on these results, NERA concluded that during March 2007, the quantum of the downward bias in the yield of indexed CGS (i.e. the difference in spreads shown in Figure 3) was around 20 bps. To attribute a positive DS to an understatement in the real CGS yield implies that real corporate bond yields are unbiased, nominal corporate bond yields are unbiased, and that there are no other reasons for the margins on the bonds to differ.

Reassessment of the empirical evidence

Discussions with market participants generated agreement in August 2007 that indexed CGS yields were biased downwards, but there was no agreement that this bias had been present during the whole period since 2004. Market participants felt that the increasing differential between nominal and real CGS was likely to incorporate:

- an increase in inflationary expectations;
- an increase in the inflation premium impounded in nominal bonds; and
- a downward bias in the yield on real CGS.

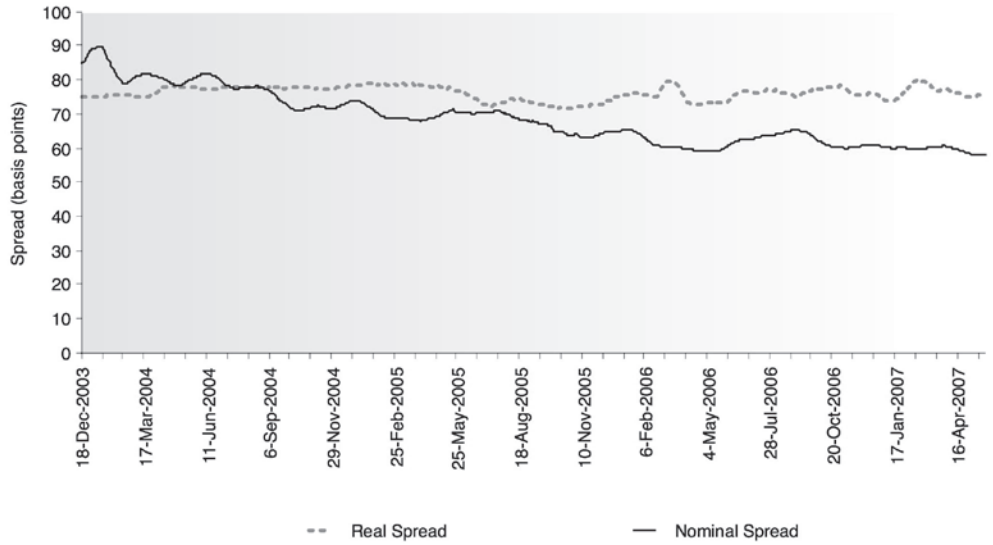
Market practitioners also stressed that real corporate bonds were very infrequently traded. Hence the 'yields' used did not necessarily reflect trades, but rather the valuations that were placed on the bonds by market analysts. For some time, investment banks have valued thinly traded fixed income securities on a weekly or daily basis in the absence of trades on the basis of a margin to the government bond reference yield.[5] To decompose the drivers of the observed increases in DS, plots of the individual corporate real and nominal bond spreads over the same period are shown in Figures 4 and 5.

An alternative hypothesis was that there had been an excess market demand for corporate nominal bonds over the preceding few years (despite record issuance levels), and this was causing their yields to be depressed.

Referring back to equation (1), if the main driver of DS is the artificially depressed real CGS yield, the nominal corporate bond yield and the nominal CGS yield would be expected to move together. Figure 4 suggests the opposite. As the real CGS yield decreased over the period, the real ElectraNet yield decreased with it, maintaining an almost constant 76 bps margin. By contrast, the nominal CGS yield rose by twice the amount of the rise in the nominal ElectraNet bond. The lack of a widening real corporate-CGS margin does not constitute either a confirmation or refutation of the 'indexed bond shortage' hypothesis. It appears that the trader valuations of the ElectraNet yield had approximately held the same margin to the underlying benchmark, which was the real CGS yield.

An alternative hypothesis for the positive DS value in equation (1), suggested by bond market analysts and traders, was that there had been an excess market demand for corporate nominal bonds over the preceding few years (despite record issuance levels), and this was causing their yields to be depressed. The reduction in the nominal bond yield spread was caused by the ElectraNet nominal bond yield increasing by less than the nominal CGS yield, which is consistent with the 'excess market demand' hypothesis; but existence of a causal relationship is confounded by the possibility of other factors, such as the market's changing assessment of the default/credit risk rating of ElectraNet.

FIGURE 4: **ElectraNet real 2010 bond and nominal 2009 bond spreads to CGS**



Source: ABN AMRO data.

Analysis of Envestra's real and nominal bond spreads (shown in Figure 5) provides a different picture. Up to 18–19 January 2006 – the turning point in the real bond market – the margins for Envestra's nominal and real bonds had been roughly stable relative to their respective CGS yields. From January 2006 a divergence occurred, with the real margin increasing, and the nominal margin declining to create a 20 bps gap (DS). As proposed in the 'indexed bond shortage' hypothesis, the real margin increased as a result of a relative decline in the real CGS yield compared with the real Envestra yield. However, the other half of the rise in DS was caused by a relative increase in the nominal CGS yield compared with the nominal Envestra bond yield. Accordingly, the behaviour of the Envestra bond yields provided support for both the 'indexed bond shortage' (excess demand for real CGS) hypothesis, as well as the 'excess demand for corporate nominal bonds' hypothesis; however, it is not possible to conclude on the basis of this evidence that these were the causal factors.

Comparison with US and UK inflation-indexed bond markets

The notion that demand and supply imbalances for inflation-indexed government bonds can distort yields and break-even inflation forecasts has also been raised in the United States and the United Kingdom. The US Treasury began issuing Treasury inflation-protected securities (TIPS) in 1997 and, by 2003, US$176 billion had been issued, constituting 7% of all US Government bonds on issue.

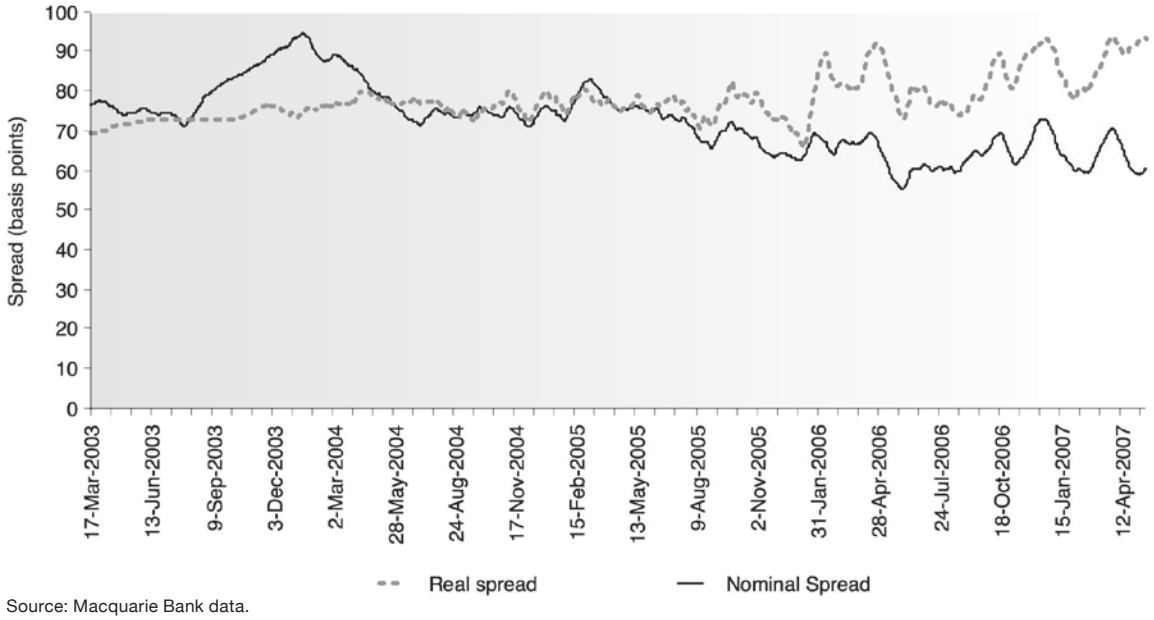
However, the US experience with inflation-linked government bonds was the opposite of Australia's recent experience. Sack and Elsasser observed that the yields on US TIPS were unusually high, providing break-even forecasts of inflation that were well below market surveys of long-run inflation.[6] They attributed the exceptionally high yields on TIPS to a number of factors, including: investors' inexperience; supply exceeding demand; their relatively low liquidity (requiring an illiquidity premium); and a generally benign outlook on inflation (i.e. a low or absent inflation premium for holding nominal bonds).

Bank of England researchers have recently produced two studies examining the market for inflation-linked government bonds. Hurd and Rellen compared the market's information on future inflation impounded into inflation swaps with that provided through nominal and inflation-indexed government bonds.[7] Discussions about UK bond rates have often referred to the distorting influence of the Minimum Funding Requirement (MFR) that requires financial institutions to hold government bonds in their portfolios, and potentially artificially depresses government bond yields. Examining inflation swap data provides a market viewpoint on future inflation that is independent of MFR constraints.

Hurd and Rellen found that as at 21 February 2004, the break-even inflation forecast implied by 10 and 15-year maturity bonds was just over 3%, while the swaps data implied a slightly higher rate of approximately 3.25% at 15 years.[8] In a more recent UK study, McGrath and Windle found that by the end of 2006, the 10-year horizon inflation forecast curves had converged, with the break-even inflation forecast at 3%, and the inflation swap-derived forecast just slightly higher. Hurd and Rellen noted that the 'relatively unpredictable nature of both demand and non-government supply can have an impact on the price of inflation-linked assets (and hence real interest rates and break-even inflation rates)'.[9]

McGrath and Windle noted the drop in real ultra long (30 to 50 year) inflation-linked yields to all-time lows on 18 and 19 January 2006 (which was also the yield nadir in the Australian market) and put this down to continued institutional demand and uncertainty about future issuance. The subsequent rally in yields was explained by quiet institutional demand and greater inflation-linked supply.

FIGURE 5: **Envestra real 2010 bond and nominal 2009 bond spreads to CGS**



Source: Macquarie Bank data.

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In summary, there was evidence from other markets with much larger issues of inflation-linked bonds that demand/supply and institutional factors had influenced estimates of the real risk-free rate. This strengthened the case that in Australia an excess demand for inflation-linked bonds was likely to have distorted the yield.

Conclusions

While it is difficult, using the DS approach, to demonstrate that the extent of the bias was approximately 20 bps, as had been suggested, the fact that a bias existed was given credence by the RBA and independently by market bond trading participants. The break-even inflation forecasts derived from nominal and real CGS appeared to be overstating the level of inflation being forecast by participants in the market.[10]

Now that we cannot use real bonds, we need to use nominal bond yields and deduct inflation, so the question becomes: 'How do you forecast inflation directly?' One potential solution would be to examine the inflation forecasts that are implied in inflation swap contracts. While this market is growing rapidly, it has not yet achieved the levels of liquidity seen in the United Kingdom in recent years. It is, however, a market that bears watching in the future. The problem with market estimates is that most extend out only two or three years, and longer-term estimates are, in any case, influenced by the RBA's stated inflation target band of 2% to 3%.[11]

Notes

1 This paper relies in part on material provided in an Expert Witness Statement by Jeffrey John Balchin and Michael Lubomyr Lawriwsky titled 'Relative bias in the yields of indexed Commonwealth Government Securities when used as a proxy for the CAPM risk free rate', which was provided to the Essential Services Commission in August 2007. I am grateful to Jeff Balchin for helpful comments on an earlier draft.

2 NERA 2007, 'Bias in indexed CGS yields as a proxy for the CAPM risk free rate', a report for the Energy Networks Association, March. This was prepared in relation to the *Victorian Essential Services Commission (ESC) Gas Access Arrangements Review 2008–2112*.

3 Reserve Bank of Australia 2006, *Statement on Monetary Policy*, February, pp. 48–49.

4 Note that extrapolations were also required to generate yields for hypothetical real and nominal CGS.

5 Donald Wiss 1993, 'Valuation of thinly traded fixed income securities', Chapter 31 in Raymond H. Rupert (ed.), *The new era in investment banking*, Probus, Chicago and Cambridge, pp. 347–349. Wiss noted that the margin of error in the estimated yield margin for an individual security could be in the order of 25 bps, but would be low or negligible for a portfolio of securities.

6 Brian Sack and Robert Elsasser 2004, 'Treasury inflation-indexed debt: a review of the US experience', *FRBNY Economic Policy Review*, May, pp. 47–63.

7 Matthew Hurd and Jon Rellen 2004, 'New information from inflation swaps and index-linked bonds', *Bank of England Quarterly Bulletin*, Spring, vol. 46, no. 1, pp. 24–34.

8 Grellan McGrath and Robin Windle 2006, *Bank of England Quarterly Bulletin*, Spring, vol. 46, no. 1, pp. 386–396.

9 Ibid. p. 393.

10 Ultimately, the ESC determined to use nominal bonds and deduct a forecast of inflation derived from RBA and analyst forecasts and an assumption that the RBA hits its target range in the medium term to calculate a real interest rate.

11 As noted by the Chief Economist of one of the major banks, setting a long-term inflation rate above the RBA range would imply that the RBA cannot achieve its target range in the long run.