AusNet Gas Services Pty Ltd

Gas Access Arrangement Review 2018–2022

Appendix 9C: Historic Reports on Inflation

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ceg COMPETITION ECONOMISTS GROUP

Measuring expected inflation for the PTRM

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Executive summary

1. Over SAPN's averaging period my best estimate of expected inflation used as an input into the PTRM is 2.06%. By way of comparison, application of the AER's methodology will result in an estimate expected inflation of 2.58%. There are sources of the difference in estimate. The first is that I adopt a market based estimate of inflation which accounts for 0.27% of the difference. The second is that I adopt a weighted average of 5 and 10 year horizons for my estimate where the weights are determined by the weight of debt and equity in the RAB. This accounts for the remaining 0.25% difference.

2. The total difference of 0.52% will, depending on which estimate is adopted, result in a commensurate difference in the total compensation received by SAPN. Specifically, adoption of the AER's estimate rather than mine will result in compensation received by SAPN over the next five years being 0.52% of the RAB lower. The selection of inflation forecast is, therefore, a highly material issue.

Compensation for inflation in the regulatory framework

3. The PTRM uses forecast inflation as an input in order to model an assumed path of the nominal RAB over the regulatory period. The higher the inflation forecast used in the PTRM the higher will be the assumed growth in the nominal value RAB and, consequently, the lower the level of compensation provided for in modelled revenues during the regulatory period.

4. However, only if actual and forecast inflation are the same will the modelled growth of the RAB in the PTRM due to inflation be the same as the actual growth in the RAB that will subsequently be compensated (in the RAB roll-forward model used to determine the opening RAB for the next regulatory period). The RAB roll-forward model will roll-forward the RAB using actual rather than forecast inflation.

5. Consequently, if forecast inflation in the PTRM is less than actual inflation then the business will actually receive higher compensation for inflation than modelled in the PTRM (and vice versa). In fact, the business will receive:

   - real compensation equal to nominal costs less forecast inflation (modelled in the PTRM); plus
   - actual inflation (modelled in the RAB roll forward model five years later when actual inflation is known).

Horizon of inflation forecast in the PTRM

6. To the extent that the objective is to deliver compensation equal to the nominal return on debt and equity inputs into the PTRM then the inflation forecast in the

PTRM must be a forecast of the actual inflation that will be used in the RAB roll-forward model at the beginning of the next regulatory regime. Given that the RAB roll-forward model will utilise five years of actual inflation it is these five years of inflation that the PTRM inflation input must forecast.

7. For the cost of debt it is clear that the objective should be to deliver compensation as close as possible to the nominal cost of debt used as an input into the PTRM. The cost of debt is a fixed nominal contract with lenders. That is, instead of the real cost of debt being fixed and the nominal cost of debt varying with inflation, the opposite is true. The nominal cost of debt is fixed under contracts entered into historically and the real cost of that debt falls/rises depending on whether future inflation is higher/lower. In order to accurately deliver compensation equal to the nominal (and real) cost of debt the inflation input into the PTRM needs to be a 5 year inflation forecast – and it needs to be specific to the start and end dates over which inflation will be measured when the RAB roll-forward model is implemented at the beginning of the next regulatory period.

8. The same conclusion does not apply when it comes to the cost of equity. Equity contracts are not written to promise fixed nominal or a fixed real return. That said, it is the real return that investors care about and which a regulated business must offer in order to induce equity investors. To the extent that inflation is higher/lower than expected, so long as the nominal return adjusts upwards/downwards in line with inflation, then this real return will be delivered.

9. When it comes to the cost of equity, the objective is to determine a real cost of equity and deliver nominal compensation consistent with this based on actual inflation. In this context, the horizon of the inflation forecast used in the PTRM needs to be specific to the horizon of the nominal cost of equity estimate. If this is the case then the PTRM will, in effect, turn the nominal cost of equity into a real cost of equity (which will be compensated in regulated revenues during the regulatory period) and compensation for actual inflation will be delivered in the RAB roll-forward model when it is applied at the beginning of the next regulatory period.

10. The AER's current practice is to use the prevailing 10 year Commonwealth Government Security (CGS) yield as the proxy for the free rate upon which the nominal cost of equity is built. A 10 year horizon inflation expectation is, naturally, embedded in the prevailing 10 year nominal CGS yield. It follows that the prevailing real risk free rate must be estimated by removing expected inflation over the same 10 year horizon.

Weighted average inflation forecast

11. For the reasons set out above, there is a tension between the correct horizon to use for the inflation forecast in the PTRM. The cost of debt must be deflated by a five year horizon forecast of inflation while the cost of equity requires a 10 year horizon

forecast of inflation. Consequently, the appropriate inflation forecast used as an input into the PTRM is a weighted average of 5 and 10 year expected inflation with the weights reflecting the assumed proportion of debt versus equity financing (60%/40%).

Methodology for arriving at an inflation forecast

12. Separately from the issue of the selection of a horizon of the inflation forecast used in the PTRM, for any given horizon there remains the question of how to arrive at a forecast of inflation. The AER's inflation estimation methodology assumes that expected inflation is equal to:

    - the RBA's most recent forecast of short term inflation published in the quarterly Statement of Monetary Policy. This provides a forecast of up to two years inflation; plus
    - an assumption that investors expect inflation to be 2.5% in every year thereafter, which corresponds to the mid-point of the RBA's inflation target band.

13. I consider this approach to be broadly reasonable in most market circumstances where investors expect that monetary policy can be relied on to return inflation to, and maintain inflation at, the midpoint of the RBA's target range.

14. However, I do not consider this to be reflective of the current market circumstances, considering the fact that:

    - global inflation rates have been persistently below target, with instances of deflation in the US, Japan, the UK and the Eurozone;
    - the ability of monetary policy to provide economic stimulus is limited, given the proximity of official interest rates to the 'zero lower bound', coupled with the fact that, at current low interest rates, further rate reductions are of uncertain value in terms of providing economic stimulus; and
    - the IMF's April 2015 World Economic Outlook publication specifically mentions Australia as being at risk of falling into a low inflation trap.

15. These are all points that the RBA and its Governors have made or echoed in various publications and speeches. For example, Deputy Governor Philip Lowe stated on 5 March 2015:

> *Overall, looking at this experience, I find it difficult to escape the conclusion that changes in interest rates are not affecting decisions about spending and saving in the way they might once have done.*[1]

16. In this context, it is reasonable to expect that investors perceive an asymmetry in the probability that inflation will be above/below the RBA's target, at least in the medium term.

17. Based on the above observations, I consider that the best estimate of expected inflation is derived from the difference in yields on nominal and inflation indexed CGS of the same maturity. This is known as 'breakeven' inflation because, if inflation is expected to be higher/lower than this level, then the expected return on nominal CGS will be lower/higher than the expected return on indexed CGS. In the table below I report breakeven inflation estimates at a 5 and 10 year horizon and, for the purpose of comparison, the inflation estimate derived from the AER method.

Table 1: Weighted average of 5 and 10 year inflation; 9 February to 6 March

	5 year	10 year	Weighted average
Breakeven	1.91%	2.28%	2.06%
AER method	2.60%	2.55%	2.58%

Source: Bloomberg, RBA, CEG analysis

[1] RBA Deputy Governor Lowe, Speech to the Goldman Sachs Annual Global Macro Economic Conference, Sydney - 5 March 2015

1 Introduction

18. I have been asked by SAPN to provide a report advising on the best estimate of the inflation expectation to be used as an input into the PTRM. The terms of reference are provided at Appendix C.

19. The remainder of this report is structured as follows:

    - **Section 2** provides an assessment of investors' expectations of future inflation; and
    - **Section 3** examines whether the PTRM requires an estimate of expected inflation at the 5 or 10 year horizon.

20. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*. I have made all inquiries that I believe are desirable and appropriate to answer the questions put to me. No matters of significance that I regard as relevant have to my knowledge been withheld. I have been provided with a copy of the Federal Court of Australia's *Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia*, and confirm that this report has been prepared in accordance with those Guidelines.

Thomas Nicholas Hird

2 Breakeven vs AER estimated inflation

21. The AER's proposed methodology for estimating 10 year inflation results in an estimate that is in excess of breakeven inflation; where breakeven inflation is the difference between the yields on nominal and indexed CGS. In my view, breakeven inflation is a better estimate of expected inflation than the method associated with the AER's estimate. There are two reasons for this:

    - First, the AER's methodology assumes that investors expect that inflation will be in the middle of the AER target range beyond 2 years. While this is a reasonable assumption in most market circumstances it is not a reasonable assumption in current market circumstances - whereby the risks of below-target inflation are heightened. By contrast, breakeven inflation takes its estimate of medium to long term inflation from traded prices in bond markets.
    - Second, adopting breakeven inflation in the PTRM has the advantage of setting the real risk free rate equal to the yield on indexed CGS. This is an advantage because, as explained in a separate report for United Energy,[2] indexed CGS have a beta that is, while still negative, materially closer to zero than nominal CGS. Consequently, adopting the yield on indexed CGS as the real risk free rate will substantially reduce the potential for bias from this source.

2.1 Why the AER method is unsound in current circumstances

22. The AER's methodology for estimating expected inflation is to take the longest available forecast of future inflation from the RBA's most recent Statement on Monetary Policy (published quarterly) and to assume that inflation beyond that forecast period is equal to the midpoint of the RBA's inflation targeting range (2.5%).

23. Given that the RBA's forecasts only tend to extend out one or two years into the future and the AER is estimating expected inflation with a 10 year horizon, then this result inevitably centres very strongly on 2.5%. I consider that this approach is reasonable in most market circumstances where investors expect that monetary policy can be relied on to return inflation to, and maintain inflation at, the midpoint of the RBA's target range.

24. Moreover, I consider that there have been some periods in the past when the AER's method has resulted in a better estimate of expected inflation than market based estimates (such as breakeven inflation measured as the difference in yields between

[2] CEG, Measuring risk free rates and expected inflation, A report for United Energy, April 2015. See section 2.

nominal and CPI indexed CGS). Specifically, in the period from 2006 to late 2008 the indexed CGS market was much smaller than today. RBA analysis suggested that the limited supply, in combination with heightened demand by foreigners due to regulatory changes, were combining to push up indexed CGS prices and push down real yields; with the effect that breakeven inflation estimates were overstated.

25. For example, as noted in a report that I co-authored,[3] in its February 2006 Statement on Monetary policy (pages 48 to 49) the RBA states:

> *"…Other investors, such as hedge funds, are said to have recognised that this process is likely to continue for some time and have added to demand. These developments, against a background of a small, tightly-held domestic supply of indexed bonds, have seen their prices rise (yields fall) significantly. As a consequence, and despite having fallen a little in February, the current spread between yields on nominal and indexed government bonds overstates the market's expectations of inflation."*

26. At that time the Australian Office of Financial Management was not issuing new indexed linked securities and there were doubts about its commitment to maintain a supply of these bonds into the future. However, since then the AOFM has recommenced issuance of these bonds and the stock of bonds have increased by more than 400% and the number of different maturity dates have more than doubled from 3 to 7.[4] The AOFM has also announced the imminent issuance of a new 2040 or 2045 CPI indexed bond.[5]

27. On this basis I consider that the shortage of supply of these bonds which led to breakeven inflation *overstating* expected inflation prior to 2009 is no longer a material concern. In any event, to the extent that it this was a material concern it would imply that breakeven inflation would be overestimating expected inflation which, if true, would suggest the AER's methodology (which forecasts higher inflation than breakeven inflation currently) was overestimating by even more.

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3 NERA, Relative Bias in Indexed CGS Bonds as a Proxy for the CAPM Risk Free Rate March 2007.

4 In a 26 May 2015 speech "*Australian Government Sovereign Debt: Are we there yet? What more can be expected in terms of developing the market? – Presentation to the Australian Business Economists luncheon*" the CEO of the AOFM stated:

> *From a modest starting point in 2009 when we recommenced indexed issuance (with $6 billion on issue spread across 3 lines), we now have around $27 billion in stock outstanding ($33 billion when adjusted for inflation indexation). This is spread across 7 lines with a curve extending 20 years.*

5 The following quote from "*Australian Government Securities: Issuance and Market – CEO presentation at the Australian Government Fixed Income Forum, Tokyo*" states:

> *"We have recently announced to the market that we will establish another new long-end maturity for the coming year – this will be either a 2040 or 2045 maturity."*

28. While the AER method may be reasonable in what might be termed 'normal' market conditions, this is not currently the case. With the RBA cash rate at record low levels of 2.00%, and with further near term rate cuts priced into financial markets,[6] the RBA cash rate is dangerously close to the 'zero lower bound'. Monetary policy's most direct effect on the economy and, therefore, inflation is through lower interest rates. However, the RBA cannot set a cash rate below zero (or at least not materially below zero) because at such levels, businesses and households will prefer to hold cash – which delivers a zero rate of interest. Thus, the potential for monetary policy to stimulate economic activity diminishes as policy interest rates approach zero, thereby creating the potential for a low inflation trap, which monetary policy may be ineffective at extracting the economy from.

29. This is not a theoretical prospect but is the actual experience of many countries in recent history (consistent with the global low returns on government debt). At the time of writing, the United States, the Eurozone and Japan have all had policy interest rates at the zero lower bound for extended periods and have all suffered from below target inflation (and deflation in much of the Eurozone and in Japan). While the US, after five years at the zero lower bound, is expected to be able to raise policy interest rates towards the end of this year, this is not the case in the Eurozon or Japan. As noted by the IMF recently:

> *"… with the United States expecting to exit the zero lower bound this year, but with no such prospects for the euro area or Japan."*[7]

30. In the same document, the IMF pointedly refers to the risk that Australia will fall into the same low inflation trap.

> *However, in economies in which output gaps are currently negative (Australia, Japan, Korea, Thailand), policymakers may need to act to prevent a persistent decline in inflation expectations.*[8]

31. The Australian Financial Review has, in an article entitled "*IMF warns Australia faces low*-inflation *trap*" interpreted this statement as an unusually direct reference to the serious risks facing a member nation.

> *The International Monetary Fund has put Australia in the same category as deflation-wracked Japan, saying the Reserve Bank of Australia may need to cut interest rates again to prevent inflation slowing too quickly.*

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6 At the time of writing, market expectation, as revealed in short term debt prices, are for the RBA cash rate to reach around 1.86% by the end of 2015. See Appendix A.

7 International Monetary Fund, "World Economic Outlook", April 2015, p. xiii.

8 Ibid, p. 56.

> *The warning raises the prospect of Australia succumbing to the weak growth and inflation malaise that has gripped Europe and North America since the 2008 crisis.*
>
> *…*
>
> *In a first, the IMF pointedly listed Australia alongside Japan, Korea and Thailand as an Asia-Pacific economy growing slower than its "potential" pace, raising the prospect that inflation may become too weak.*
>
> *…*
>
> *While the Reserve Bank has kept open the option of further reductions in rates, the official cash rate is rapidly nearing the level at which it is unlikely to spur any significant additional growth – something the bank has acknowledged in recent months.*[9]

32. This last statement refers to a series of statements by the RBA to the effect that, at current levels, lower interest rates are not stimulating economic activity to the same extent as historically. For example, Deputy Governor Philip Lowe stated on 5 March 2015:

> *Overall, looking at this experience, I find it difficult to escape the conclusion that changes in interest rates are not affecting decisions about spending and saving in the way they might once have done.*[10]

33. On the 13 February 2015 RBA Governor Stephens stated:

> *The Board is also very conscious of the possibility that monetary policy's power to summon up additional growth in demand could, at these levels of interest rates, be less than it was in the past. A decade ago, when there was, it seems, an underlying latent desire among households to borrow and spend, it was perhaps easier for a reduction in interest rates to spark additional demand in the economy. Today, such a channel may be less effective. Nonetheless we do not think that monetary policy has reached the point where it has no ability at all to give additional support to demand. Our judgement is that it still has some ability to assist the transition the economy is making, and we regarded it as appropriate to provide that support.*[11]

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9 Australian Financial Review, IMF warns Australia faces low-inflation trap, Apr 14 2015 (Updated Apr 15 2015 at 6:33 AM)

10 RBA Deputy Governor Lowe, Speech to the Goldman Sachs Annual Global Macro Economic Conference, Sydney - 5 March 2015

11 RBA Governor Stevens, Opening Statement to House of Representatives Standing Committee on Economics, Sydney - 13 February 2015.

34. In this context, it is reasonable to expect that investors perceive an asymmetry in the probability that inflation will be above/below the RBA's target, at least in the medium term. This means that, even if the 'most likely' estimate is for expected inflation to average 2.5% in the medium to long term, this is not the mean (probability weighted) estimate. That is, there is more downside than upside risk to inflation. Indeed, this is precisely what market-based estimates of expected inflation are predicting – as I discuss in the subsequent sections.

2.2 Breakeven inflation is a better estimate

35. The CAPM is, like all asset pricing models, a model of the determinants of the real return on assets. As such, the risk free rate that is relevant in the CAPM is the real risk free rate. Nominal CGS are only meaningfully an input into the CAPM once they are transposed into a real return by the subtraction of an estimate of investors' expected inflation rates. Indeed, and as discussed in section 3.1 below, this is precisely what is done in the PTRM when the nominal risk free rate is combined with an assumption regarding expected inflation. That is, the implicit real risk free rate used in the PTRM is the nominal risk free rate estimated by the AER (traditionally the nominal 10 year CGS yield) less the AER's estimate of expected inflation.

36. Breakeven inflation is simply the difference between nominal and inflation indexed CGS. It is referred to by this name because, at this inflation rate, the two different types of bonds will provide investors with the same nominal return (that is, returns on one bond will equal returns on the other bond over the life of the bonds).

10 yr breakeven infl. = $CGS_{10}^{nominal}$ - $CGS_{10}^{Indexed}$ [12]

37. Adopting breakeven inflation, unlike adopting the midpoint of the RBA's inflation target, can be viewed as the probability weighted forecast of inflation in all possible circumstances that market participants perceive. For example, market participants may believe that the most likely (mode or median) outcome is for inflation to be equal to the midpoint of the RBA's target range. However, if investors believe that

    - there is a greater probability of Australia falling into a low inflation trap (with inflation continually at the low end or below the RBA range as warned of by the IMF and as has been the experience of most other developed countries over the last half decade or so); than

[12] This equation is actually a simplification of the Fisher equation where 10 yr breakeven infl. = $CGS_{10}^{nominal}$ - $CGS_{10}^{Indexed}$)/(1+ $CGS_{10}^{Indexed}$). This equation accounts for the impact of inflation on not just the capital value of the bond but also the return. However, at low levels of real risk free rates and inflation this more complicated formula delivers very similar results to its simpler counterpart. I use the simpler version in this report for ease of exposition.

- Australia falling into an inflationary spiral (where inflation rises above the RBA target and the RBA is unwilling/powerless to bring it down to the middle of the target); then
- this asymmetry of probabilities will be reflected in a breakeven inflation estimate that is lower than the midpoint of the RBA range (even if investors believe the midpoint is the most likely estimate).

38. It follows mathematically that, if breakeven inflation is used in the PTRM, and the AER continues to use 10 year nominal CGS as the proxy for the nominal risk free rate, then the real risk free rate in the PTRM will equal the yield on indexed CGS.

$$Real\ RFR^{PTRM} = Nominal\ RFR^{PTRM} - Expected\ Inflation^{PTRM}$$

39. If 10 year nominal CGS yields are used as the proxy for $Nominal\ RFR^{PTRM}$ and 10 year breakeven inflation is used as the proxy for $Expected\ Inflation^{PTRM}$ then the real risk free rate in the PTRM is:

$$Real\ RFR^{PTRM} = CGS_{10}^{nominal} - (CGS_{10}^{nominal} - CGS_{10}^{Indexed})$$

$$Real\ RFR^{PTRM} = CGS_{10}^{Indexed}$$

40. This means that the use of nominal CGS as the risk free rate in combination with the use of breakeven inflation results in the real risk free rate being set equal to the yield on indexed CGS. As explained in a separate report for United Energy,[13] this is a material advantage to the use of breakeven inflation. This is because both nominal and indexed CGS yields are depressed by the existence of negative beta risk for government bonds. However, indexed CGS are less affected by the bias associated with negative betas so this source of bias is automatically reduced by the use of breakeven inflation. That is, any relatively higher bias in nominal CGS is automatically removed by the use of breakeven inflation as the forecast inflation in the PTRM.

41. In the SAPN averaging period of 9 February to 6 March, applying the AER's method for arriving at an expected inflation estimate results in expected 5/10 year inflation of 2.60%/2.55%. The nominal 5 and 10 year CGS yields were 2.03% and 2.55% respectively. Consequently, if the AER's method for estimating expected inflation is accepted as accurate then the implied real return on 5/10 year nominal CGS is -0.57%/0.00%. This is below the guaranteed real yield on indexed CGS available in the bond market over the same period at 5/10 year maturity of 0.12%/0.27%. If the AER's inflation forecast was correct it would imply that investors in nominal bonds expect to receive a negative real yield – notwithstanding that they could invest in an indexed CGS that will deliver a guaranteed positive real yield.

[13] CEG, Measuring risk free rates and expected inflation, A report for United Energy, April 2015. See section 2.

42. Put another way, if the AER were to use its current methodology then its cost of capital allowance would be based on the implicit assumption that investors require not only a negative real return on the "risk free"[14] asset, but a substantially lower real return than is available from the purchase of inflation indexed CGS.

43. If the AER's methodology for estimating inflation expectations is accurate (I will explain in the next section why I do not consider this to be true), then investors must be willing to accept a lower expected real return on nominal CGS than inflation indexed bonds. However, if we accept that investors are willing to accept a lower real yield on nominal CGS than inflation indexed CGS, the next relevant question becomes why this would occur.

44. The only plausible reason is that they are perceived as lower risk. However, as already discussed and explained in my separate report for United Energy,[15] and consistent with the IMF analysis surveyed in that report, an assessment of this relative risk reveals that nominal CGS have materially more negative beta. This is consistent with nominal CGS having lower risk. However, if the AER rejects the use of breakeven inflation on this basis then the logical corollary is that nominal CGS should also be rejected as the proxy for the risk free rate in the CAPM. This then leads to the need to adjust the nominal risk free rate upwards by around 1% as discussed in section 2.5 of my report for United Energy.

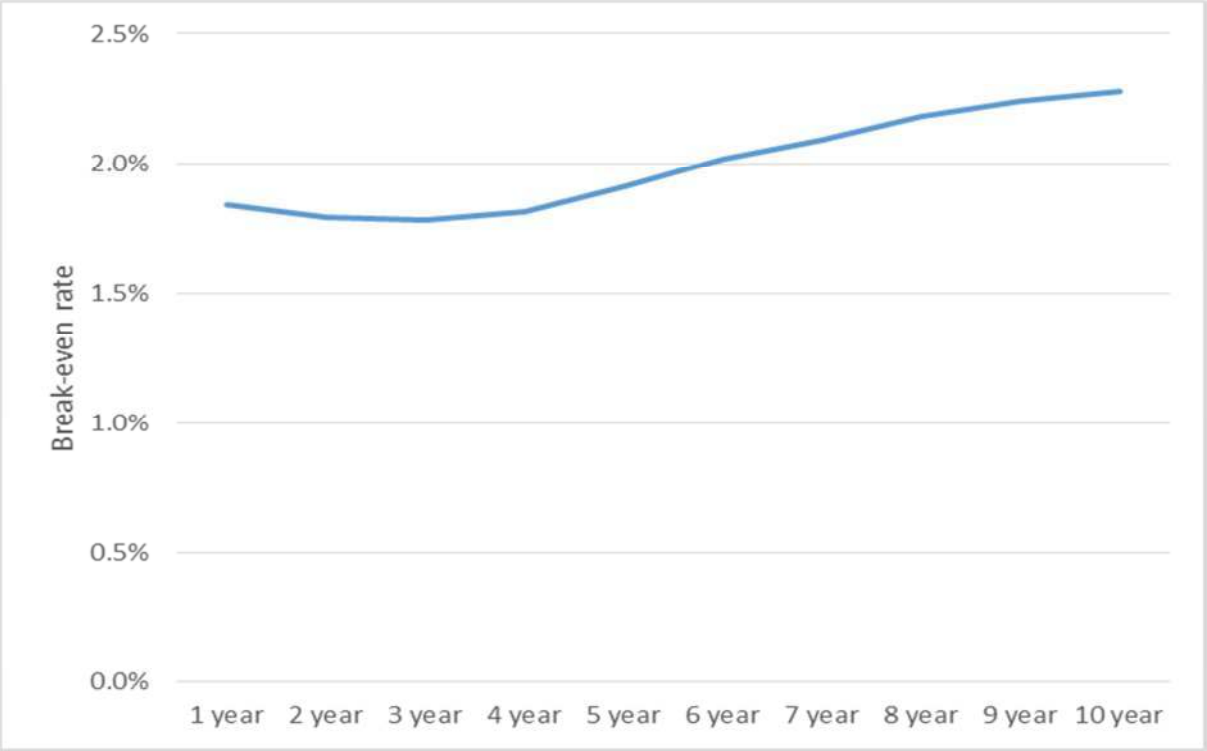
2.3 Break-even inflation over SAPN averaging period

45. Break even forecasts of inflation are currently much lower than 2.5% at both the 5 and 10 year term. Over 9 February to 6 March 2015, the implied term structure of average annual inflation from CGS yields is shown in Figure 1. This figure shows that average annual breakeven inflation over 10 years was 2.28%.

[14] The asset is free of default risk but, because it is nominal, it is still exposed to inflation risk. Moreover, its long maturity means that its market value can vary overtime. This is how it is possible to have negative beta risk. Indeed, the fact that the nominal bond will have a high real yield if inflation turns out to be low is one reason why its beta is negative (and more negative than indexed CGS). That is, in the event of the economy falling into recession and a low inflation trap (circumstances when the equity market will have low real returns) the real return on holding nominal CGS will be high (because coupons will not fall with inflation).

[15] CEG, Measuring risk free rates and expected inflation, A report for United Energy, April 2015. See section 2.

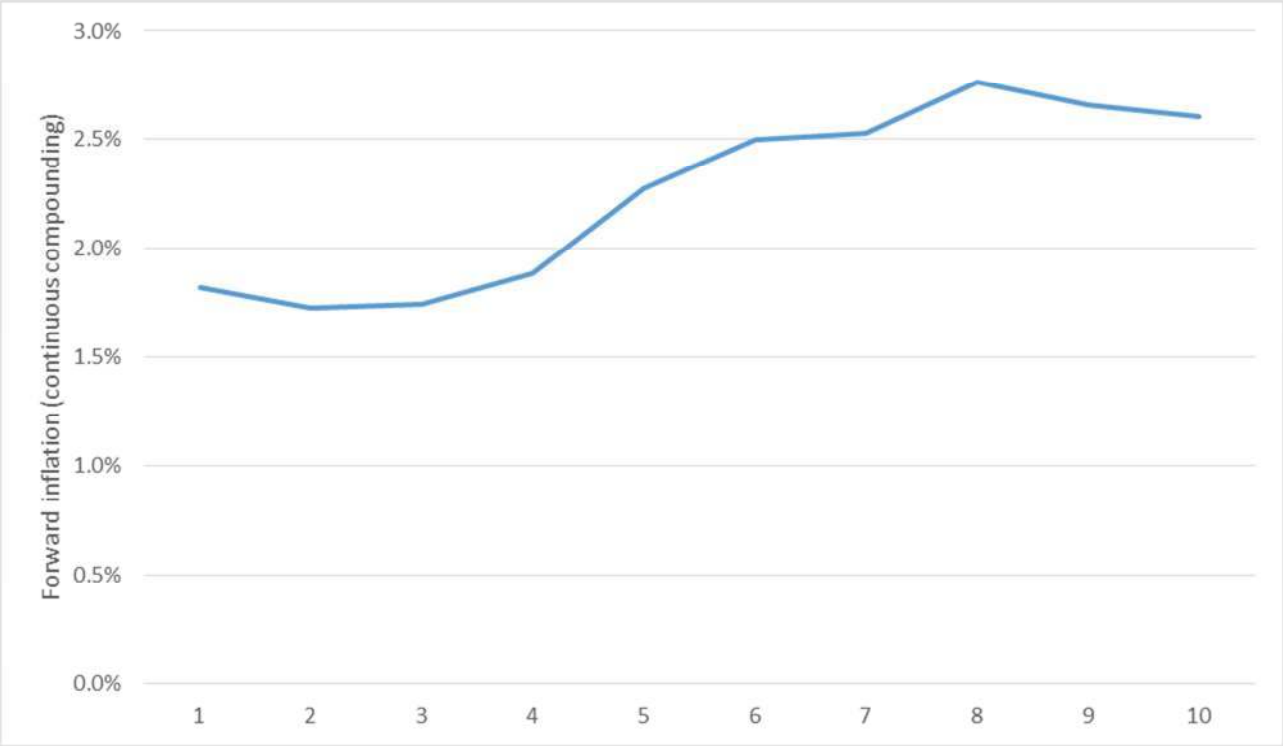
Figure 1: Implied (breakeven) inflation term structure from nominal and indexed CGS yields



Source: RBA, CEG analysis

46. The figures reported in Figure 1 above are average annual rates of increase in CPI over the horizon provided on the horizontal axis. However, implied in this term structure is expected breakeven inflation in each of the future years ("forward inflation"). This is provided in Figure 2 below.

Figure 2: Forward (breakeven) inflation implied by nominal and indexed CGS yields



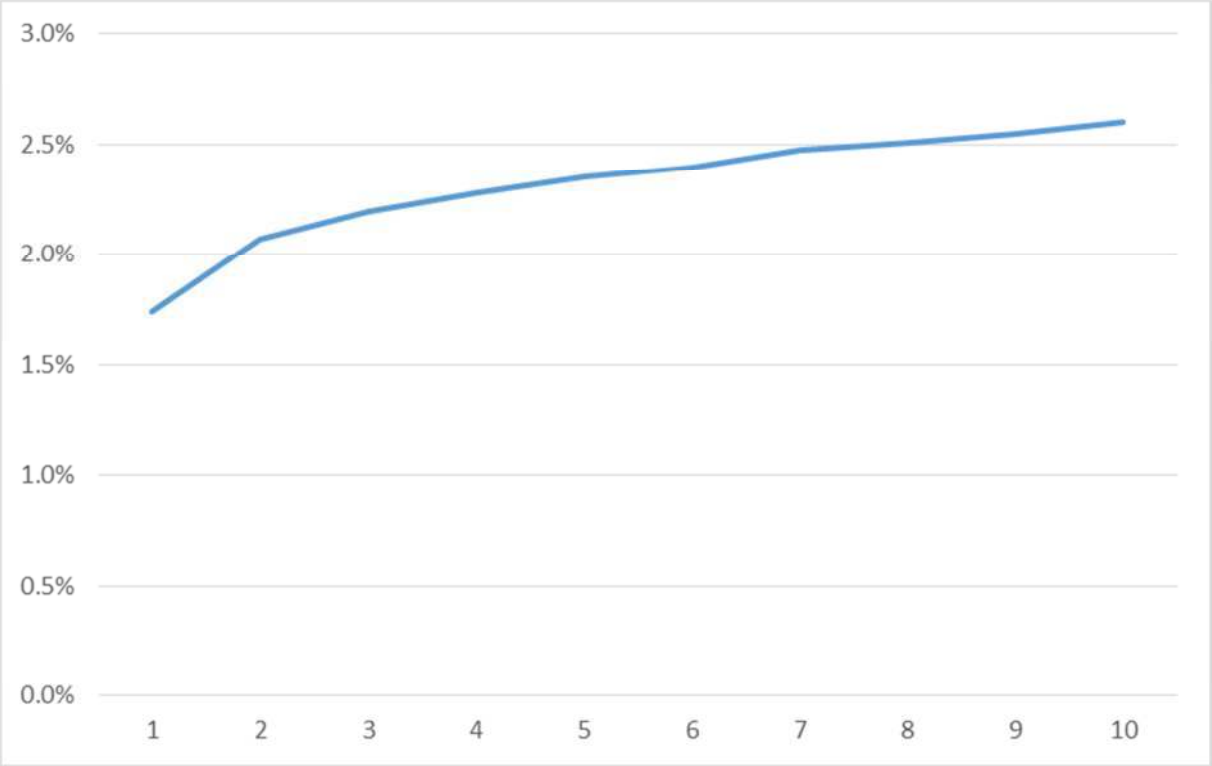
Source: RBA, CEG analysis

47. It can be seen that breakeven inflation is expected to remain below 2.0% over the next 4 years, rising to be approximately equal to 2.5% only after 6 years. This is entirely consistent with the evidence surveyed above, which suggests that the downside risks to inflation exceed the upside risks in the medium term.

2.4 Inflation swaps over the SAPN averaging period

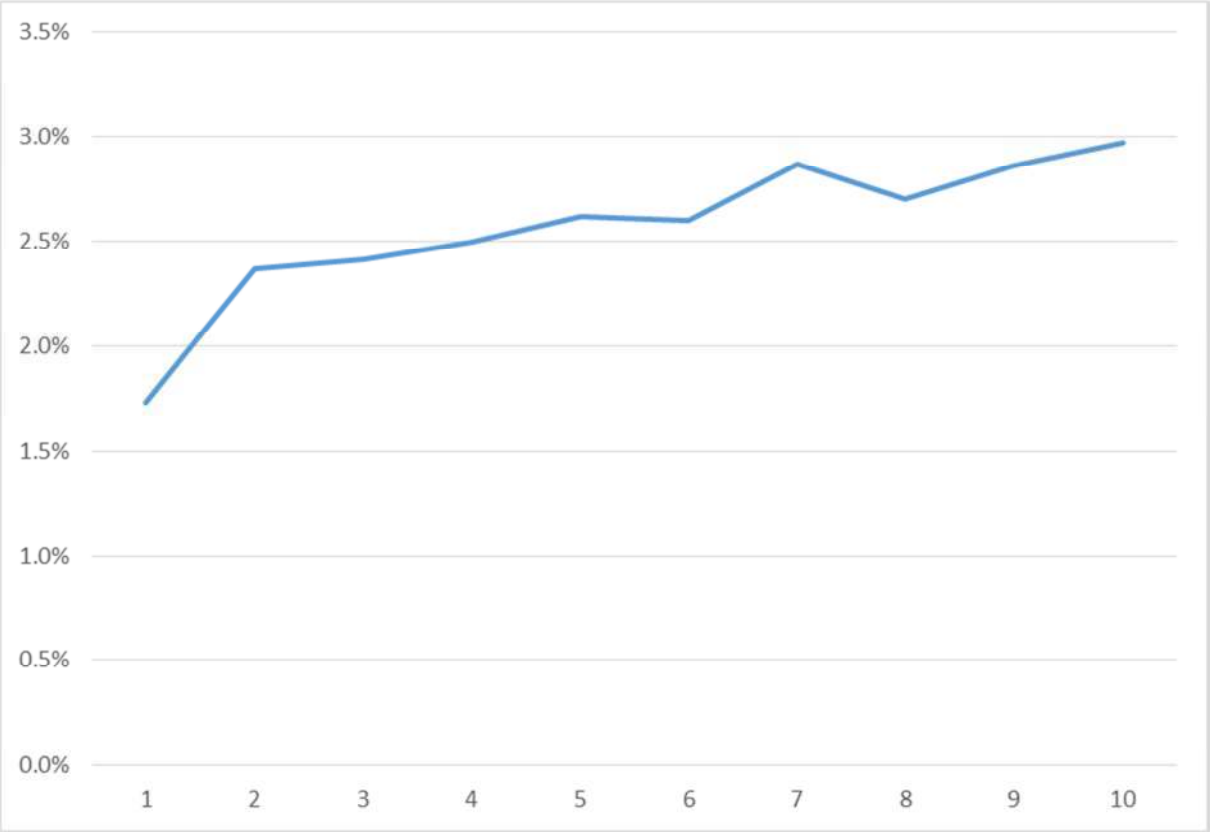
48. Another source of information about investor expectations of future inflation is inflation swaps. The term structure of inflation, over 9 February to 6 March 2015, implied by inflation swaps and the associated forward rates of inflation are provided below.

Figure 3: Implied inflation term structure from inflation swap markets



Source: Bloomberg, CEG analysis

Figure 4: Forward inflation from inflation swap markets



Source: Bloomberg, CEG analysis

49. Beyond 1 year the implied inflation from swap markets rise much faster than from CGS markets, such that implied forward inflation from year 4 to 10 is above the midpoint of the RBA target range (2.5%) and by year 10 is at the top of the RBA range.

50. In my view, implied inflation from swap markets at long maturities should be treated with caution. This is because the inflation swap market is one-sided in the sense that there is more demand for the fixed leg of an inflation swap than the floating leg. That is, there are more investors wanting to hedge long-term inflation than who want to be exposed to long term inflation (by taking on floating rate exposure). The Australian Treasury has, in its Treasury Roundup series, published analysis that notes this:

> *Further, one of the counterparties to an inflation swap will usually be a swaps dealer, who may seek to hedge their inflation exposure with parallel trades in the indexed bond market. Because a cash position in the indexed bond market necessarily entails a capital cost, and because indexed bonds are relatively illiquid, the swaps dealer may demand additional compensation for the cost and potential difficulties involved in*

> *hedging this risk. This, in turn, may drive a wedge between inflation swap rates and bond break-evens.*[16]

51. In this example the dealer is promising to pay the floating leg of the swap and then buy (taking a 'cash position' on) indexed bonds in order to receive a floating CPI payment which is a hedge to its floating exposure. If the swap market was evenly balanced the dealer would just take the floating side of another swap rather than buy indexed bonds.

52. Therefore, it is to be expected that inflation swap data will be above breakeven inflation because breakeven inflation defines the base rate of inflation that the dealer can use to hedge its exposure. Thus, the fixed rates offered by dealers must be above breakeven inflation if the dealer is to cover their costs and risks.

53. This issue is also discussed by Campbell, Shiller, and Viceira (2009):

> *The figure shows that the two breakeven rates track each other very closely up to mid-September 2008, with the synthetic inflation breakeven rate being about 35-40 basis points larger than the cash breakeven inflation rate on average.*
>
> *This difference in breakeven rates is typical under normal market conditions. According to analysts, it reflects among other things the cost of manufacturing pure inflation protection in the US. Most market participants supplying inflation protection in the US inflation swap market are levered investors such as hedge funds and banks proprietary trading desks. These investors typically hedge their inflation swap positions by simultaneously taking long positions in TIPS and short positions in nominal Treasuries in the asset swap market. A buying position in an asset swap is functionally similar to a levered position in a bond. In an asset swap, one party pays the cash flows on a specific bond, and receives in exchange LIBOR plus a spread known as the asset swap spread. Typically this spread is negative and its absolute magnitude is larger for nominal Treasuries than for TIPS. Thus a levered investor paying inflation - i.e. selling inflation protection - in an inflation swap faces a positive financing cost derived from his long-short TIPS-nominal Treasury position.*[17]

54. The Treasury Roundup paper quoted from above illustrates the persistently higher inflation in CPI swap markets than in breakeven markets as illustrated in the following figure from that paper.

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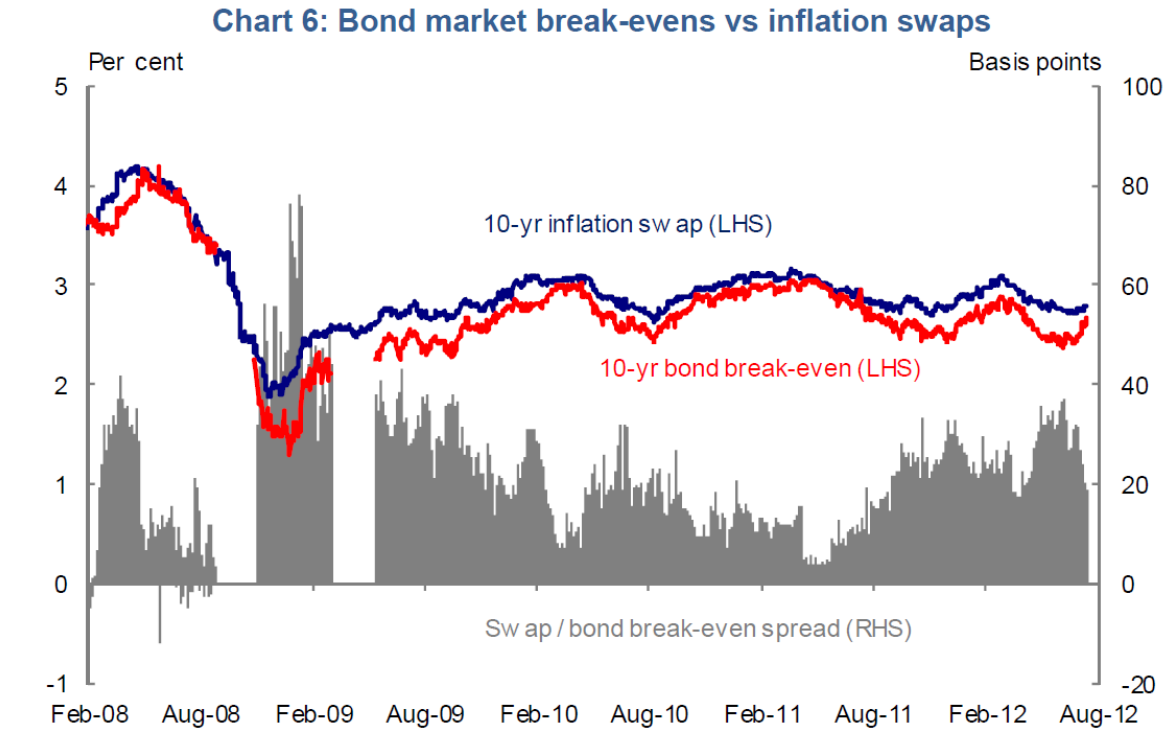
16 W. Devlin and D. Patwardha, Measuring market inflation expectation, Economic Roundup, Issue 2, 2012.

17 Campbell, Shiller, and Viceira, Understanding Inflation-Indexed Bond Markets, NBER Working Paper No. 15014, (2009), p. 21.

Figure 5: Chart 6 from Treasury round up



Source: Bloomberg and Treasury.

55. Consistent with this, inflation swap rates remain well above breakeven inflation. It is notable that the period in early 2009 and late 2008 has the greatest difference between breakeven and inflation swap rates. This is an exceptional period where the opportunity cost of capital was very high for financial firms suggesting the costs of providing inflation swaps would be high. However, it is also the case that this was a period of extremely high liquidity premiums which likely depressed breakeven inflation rates (noting that nominal CGS tend to be more liquid than indexed CGS). In such exceptional circumstances it is difficult to be sure what the best estimate of expected inflation was. In periods outside of financial crisis the better estimate will tend to be break-even inflation given that the no-arbitrage condition means that the CPI swap market tends to reflect breakeven inflation rate plus a premium for the hedging costs of swap dealers.

56. This conclusion is borne out by noting the implied CPI swap forward rate for inflation of around 3% at the 10 year horizon. Consistent with the analysis in section 2.1, I do not think that this is a plausible best estimate of expected inflation. That is, while there are reasons to believe that the best estimate of expected inflation in 10 years' time will be below the midpoint of the RBA range, there is no reason that I am aware of to believe that the best estimate is for inflation to be at the top of the RBA range.

57. In any event, it is relevant to note that, in the SAPN averaging period, breakeven inflation and CPI swaps are both predicting that inflation will be at or below 2.5% for the next 5 years – such that average inflation over the next 5 years is well below 2.5%.

2.5 Conclusion

58. The previous sections have surveyed:

- the recent experience of the United States, Eurozone and Japan;
- warnings from the IMF that Australia is at risk of falling into a low inflation trap;
- statements of concern by the RBA about the potency of monetary policy in a low interest rate environment; and
- evidence of market expectations of expected inflation consistent with expected inflation at less than 2.5% over the next 5 years.

59. In this context, the assumption implicit in the AER methodology that investors believe that inflation will be 2.5% beyond 2 years is not reasonable. The best assumption is that investors perceive a greater risk of underperforming relative to the RBA's midpoint than over-performing. In this context I regard breakeven inflation from the CGS market as the best estimate of expected inflation. In the below table I report both breakeven inflation and inflation associated with application of the RBA method.

60. I distinguish between 5 and 10 year inflation for the reasons set out in the next section. Specifically, because I recommend that the inflation forecast used in the PTRM should be a weighted average of the inflation expectations at the 5 and 10 year horizons where the weights are 60% to the five year horizon and 40% to the 10 year horizon – consistent with the weights of debt and equity in the RAB.

Table 2: Weighted average of 5 and 10 year inflation; 9 February to 6 March

	5 year	10 year	Weighted average
Breakeven	1.91%	2.28%	2.06%
AER method	2.60%	2.55%	2.58%

Source: Bloomberg, RBA, CEG analysis

3 Should 5 or 10 year inflation be used in the PTRM

61. This section sets out why the estimate of expected inflation used as an input into the PTRM should be equal to the weighted average of 5 and 10 year inflation expectations – where the weights given to 5/10 years should match the weights given to debt/equity finance respectively.

3.1 The role of forecast inflation in the PTRM

62. It is first necessary to understand the role of expected inflation in in the PTRM. While the PTRM is superficially a 'nominal model' in that it has nominal inputs for the WACC, the actual operation of the PTRM is best understood as a real return model. That is, the PTRM effectively:

    i. Takes a nominal input for the cost of debt and equity;

    ii. Deducts forecast inflation (another input into the PTRM) to arrive at a real return which is then embedded in the real regulated revenue path;

    iii. Provides nominal compensation that is equal to:

        a. The real return derived in step ii); plus

        b. The inflation that will occur over the regulatory control period (this is compensated primarily in the RAB roll forward model used to set the opening RAB at the beginning of the next regulatory period but also in the form of price escalation for inflation during the regulatory period).

63. The real revenue path in step ii) is the final output of the PTRM and is expressed in terms of a real "X"% increase or decrease plus actual inflation that will accrue (but is not yet known) over the regulatory period. This gives rise to the familiar CPI±X% expression of the revenue/price path.

64. As will become critical below, the nominal compensation from step iii) will be expected to be the same as the nominal compensation inputted into the PTRM in step i) if:

The inflation input into the PTRM in step ii ($\pi^{PTRM}_{Forecast}$)	=	Expected inflation over the regulatory control period ($Exp(\pi^{Actual}_{Over\ 5\ year\ reg\ period}$)

65. More specifically, if $\pi^{PTRM}_{Forecast}$ > Exp($\pi^{Actual}_{Over\ 5\ year\ reg\ period}$), then expected nominal compensation from regulated revenues will be less than the nominal cost inputted into the PTRM (and vice versa).

66. Given that the AER uses a 10 year forecast of inflation in the PTRM, then whenever 5 and 10 year forecasts are different, the expected nominal compensation will not match the estimated nominal costs inputted into the PTRM. For the reasons described below this is:

- entirely appropriate where the relevant cost is a fixed real cost, such that the corresponding nominal value varies with inflation (as is the case for the cost of equity); and
- inappropriate where the relevant cost is a fixed nominal cost, such that the corresponding real value varies with inflation (as is the case for the cost of debt).

3.2 Inflation input to the PTRM used to deflate the cost of equity

67. I agree with the AER that expected inflation over a 10 year horizon should be used to deflate the nominal cost of equity (although I consider that breakeven inflation should be used to derive this measure). This is consistent with the fact that the cost of equity that is of interest is the *real* cost of equity demanded by investors. The AER arrives at a real cost of equity by building up a cost of equity based on a 10 year CGS yield as the proxy for the CAPM risk free rate.

68. This means that 10 year inflation expectations are embedded in the AER's nominal cost of equity. It follows that the real cost of equity demanded by investors must be estimated by removing expected inflation with *the same* 10 year horizon.

69. In this context the PTRM and the final revenue path will:

- take the 10 year nominal cost of equity;
- deflate this, using a 10 year inflation estimate to arrive at an internally consistent real cost of equity;
- use this to set a real 5 year revenue path that compensates for this real cost;
- apply actual CPI inflation over the five year regulatory control period to ensure (other things equal) that, whatever actual inflation is over this period, the estimated real cost of equity will be compensated.

70. As already noted, if the 5 year inflation expectation is less than the 10 year inflation expectation, then the benchmark entity will expect to receive a lower *nominal* compensation for the cost of equity than the *nominal* compensation that is used as the input into the PTRM.

71. However, this is entirely appropriate because this is necessary to deliver the best estimate of the real cost of equity. This recognises that it is the real cost of equity[18] that is, in fact, the important input into the PTRM and which is important for investors to have an expectation of receiving.

72. A numerical example will illustrate this. Imagine that the real cost of equity was invariant at 5% and that:

- inflation over the next 5 years of the regulatory control period is expected to be 0% pa; and
- inflation over the subsequent 5 years is expected to be 10% pa; such that
- average inflation over 10 years is expected to be 5%; and
- the nominal cost of equity over a 10 year horizon would be 10%(=5%+5%).

73. Using this nominal cost of equity over a 10 year horizon (10%) as an input into the PTRM along with the expected inflation over a 10 year horizon (5%) will deliver the correct real cost of equity (5%). This would then define the real revenue path and, if inflation grew, as expected, at 0% over the 5 year regulatory control period, then the nominal and real returns would both also be 5%. If inflation grew at "z%" then nominal returns would be 5+z% but real returns would always be 5%.

74. In contrast, combining the nominal cost of equity over a 10 year horizon (10%) in the PTRM with the expected inflation over a 5 year horizon (0%) would deliver an (incorrect) real cost of equity of 10%. This figure of 10% reflects the real return that will be earned no matter what the actual inflation is over the regulatory period – including if it was 0% pa as expected. In this example, double the real cost of equity is compensated for by using the 5 year horizon inflation forecast in the PTRM.

3.3 Inflation input to the PTRM used to deflate the cost of debt

75. The same is not true when it comes to the cost of debt because, unlike the cost of equity, the cost of debt is a nominal contract with lenders.[19] Moreover, the cost of debt input into the PTRM is an estimate of the nominal payments *made in each year of the* regulatory *period* (while the nominal cost of equity is an estimate at a horizon beyond the regulatory period).

---

18 The real cost of equity is a combination of a nominal cost of equity, which itself incorporates a 10-year expectation of inflation, (the nominal cost of equity input into the PTRM) less 10 year inflation expectations (which are captured in the actual inflation forecast that is entered into the PTRM).

19 The nominal cost of debt is fixed in nominal (not real) terms and is estimated specific to each year of the regulatory control period (not beyond).

76. Consequently, the nominal cost of debt must be converted into a real cost of debt within the PTRM using an inflation forecast that is expected to be the same as the actual inflation that will 'reinflate' real compensation over the regulatory period (under the CPI±X revenue path) and, most crucially,[20] in the RAB roll-forward model applied at the beginning of the next regulatory period.

77. This observation can be illustrated using an example that is analogous to the one above (an algebraic discussion is provided in Appendix B). Consider a scenario in which the nominal payments to debt holders over the regulatory period was expected to be 5% and that:

- inflation over the next 5 years of the regulatory control period is expected to be 0% pa; and
- this implies that inflation over the subsequent 5 years is expected to be 10% pa; such that
- average inflation over 10 years is expected to be 5%.

78. If the inflation forecast used as an input into the PTRM is the 5 year forecast (0%) then the real cost of debt allowance in the PTRM will be 5% (calculated as 5%-0%). This would then define the real revenue path. If inflation grew, as expected, at 0% over the 5 year regulatory control period, then the nominal return (inclusive of 0% actual RAB roll-forward) would also be 5%, which is the correct result that matches the fixed nominal obligations of the business.[21] .

79. In contrast, if the 10 year horizon inflation forecast of 5% was used in the PTRM, this would deliver an incorrect real cost of debt estimate of 0% (calculated as 5%-5%). This would then define the real revenue path and, if inflation grew, as expected, at 0% over the 5 year regulatory control period, then the nominal return (inclusive of 0% actual RAB roll-forward) would also be 0%. In this example, zero nominal compensation is allowed despite the modelled fixed nominal interest payments being 5%. This is clearly an incorrect outcome.

80. It is worth noting that the above stylised example is highly relevant to the market circumstances during the SAPN averaging period. Inflation expectations, as depicted in Figure 2 and Figure 4 (derived from CGS and inflation swap markets over 9 February to 6 March 2015), show that expected inflation at a 5 year horizon is well below the corresponding estimate at a 10 year horizon. Over the SAPN averaging period the difference between 10 and 5 year inflation was:

- Breakeven inflation from CGS markets: 0.37% (2.28%-1.91%); and

[20] This is where the majority of inflation compensation is provided.

[21] If inflation grew at more/less than this then the nominal compensation would be higher/lower than the modelled nominal payments but the possibility of gain/loss from this would be symmetric so there is not expected bias

- Inflation swap markets: 0.24% (2.60% less 2.35%).

3.3.1 Implications for the assumed benchmark efficient term of debt issued

81. For the absence of doubt, the analysis and conclusions in this section have no implications for the benchmark efficient debt management strategy and, in particular, the assumed term at which debt is issued. The assumed term of debt issued should, in my view, remain at 10 years consistent with business practice. All this section does is to describe the inflation input into the PTRM that must be used to give rise to an expectation that nominal revenues will be in line with nominal interest costs on 10 year debt.

82. In this context, the cost of debt is no different to any other long term contract efficiently entered into. If the benchmark entity efficiently entered into one (or a series of overlapping) 20 year nominal contracts with a supplier of transformers then the regulatory regime should be designed to compensate the benchmark entity for these nominal costs *over the course of each regulatory period over which the contract(s) span*. This would require that the nominal payments in that (those) contracts *over the course of each regulatory period* be converted into real costs using expected inflation *over the course of each regulatory period* – not expected inflation over the 20 year horizon of the contract or any other period. Precisely the same logic applies to the cost of debt as it would to long term contracts with suppliers.

Source: Bloomberg, RBA, CEG analysis

3.4 Should inflation forecasts be purely prospective or can inflation that has already occurred be relevant?

83. Consistent with the analysis set out in sections 3.2 and 3.3 above:

- The inflation forecast that is paired with the cost of equity should be purely forward looking with the same maturity as the risk free rate and cost of equity and should be measured in the same averaging period as the risk free rate/cost of equity; and
- The inflation forecast that is paired with the nominal cost of debt should be the best estimate, available at the time of the final decision, of the inflation rate that will be used by the AER to escalate the RAB in the RAB roll-forward model and to index revenues over the regulatory period.

84. SAPN's revenues/RAB roll forward will be indexed to year ended December inflation. The five year period covered by this indexation begins with inflation from December 2014 to December 2015 and ends with inflation from December 2018 to December 2019. Therefore, the relevant period over which inflation must be estimated is December 2014 to December 2019.

85. In ordinary circumstances, at the time of the AER's Final Decision, the ABS will not yet have published any historical inflation estimates (or, at best, one quarter of inflation estimates) that will be used by the AER in its RAB roll forward model/revenue indexation over the forthcoming regulatory period. Therefore, in the ordinary course of events, the forecast of inflation that is paired with the nominal cost of debt will be precisely that – a forecast of future Australian Bureau of Statistics (ABS) published rates.

86. However, in the special case of SAPN, the AER will be making its final decision in 2015/16 to apply retrospectively to the regulatory period starting in July 2015. Therefore, at least some of the ABS published rates will actually be available to inform the AER's best estimate of inflation that will be used in the RAB roll forward model. For example:

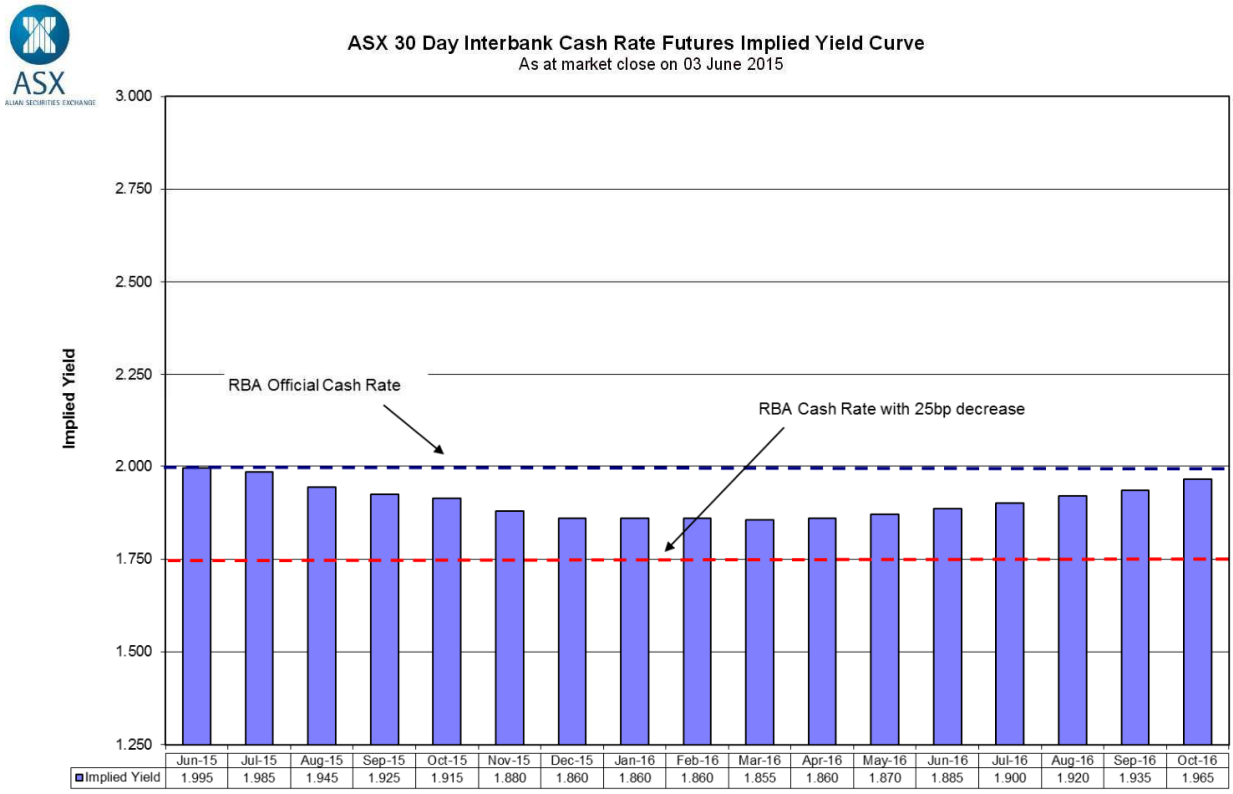
- Already the ABS has published its March 2015 quarter CPI – a quarterly increase of 0.19% or 0.75% annualised. Given that the SAPN inflation indexation is on a year ended December basis, this means that one quarter of actual inflation (inflation that will be used to index the RAB/revenues over the 2015-20 SAPN regulatory period) is already known;
- By July 2015 the June 2015 quarter CPI index will be known. This means that two quarters of actual inflation (inflation that will be used to index the RAB/revenues over the 2015-20 SAPN regulatory period) will be known;
- By October 2015 the September 2015 quarter CPI index will be known. This means that 3 quarters of actual inflation (inflation that will be used to index the RAB/revenues over the 2015-20 SAPN regulatory period) will be known;
- By January 2016 the December 2016 quarter CPI index will be known. This means that the full first year of actual inflation (inflation that will be used to index the RAB/revenues over the 2015-20 SAPN regulatory period) will be known.

87. To the extent that the AER final decision is made after these dates then regard should be had to the actual inflation that has already occurred and been measured by the ABS. This means that the five year inflation forecast that is paired with the cost of debt will need to be an average of actual inflation already measured and prospective inflation not yet measured.

Appendix A Market forecasts of cash rates

88. Figure 6 displays a chart published by the ASX, which shows the future expected cash rates implied by government bond yield curves.

Figure 6: ASX 30-day interbank cash rate futures implied yield curve



Source: ASX

Appendix B Algebraic example of the need for 5 year inflation forecast when deflating the nominal cost of debt

89. Let the average modelled nominal cost of debt over the regulatory period be $R_d^{Nominal\ 5\ year\ actual}$ and let this be measured without error and the estimate used as an input into the PTRM. Given that the PTRM will be annually updated for estimates of the nominal cost of debt, there is no need to forecast $R_d^{Nominal\ 5\ year\ actual}$.

90. Let the forecast of expected inflation in the PTRM be $\pi_{Forecast}^{PTRM}$. The PTRM will deliver a real cost of debt approximately[22] equal to:

$$R_d^{Real\ PTRM} = R_d^{Nominal\ 5\ year\ actual} - \pi_{Forecast}^{PTRM}$$

91. The compensation for the nominal cost of debt over the regulatory period is given by the following equation – recalling that the PTRM provides a real return which is then inflated by actual inflation over the regulatory period ($\pi_{Over\ 5\ year\ reg\ period}^{Actual}$) to provide nominal compensation.

$$R_d^{Compensated\ Nominal\ 5\ year\ actual} = R_d^{Real\ PTRM} + \pi_{Over\ 5\ year\ reg\ period}^{Actual}$$

92. Combining these two equations, the actual compensated nominal cost of debt is given by:

$$R_d^{Compensated\ 5\ Nominal\ year\ actual} = R_d^{Nominal\ 5\ year\ actual} - \pi_{Forecast}^{PTRM} + \pi_{Over\ 5\ year\ reg\ period}^{Actual}$$

93. In order for a business to expect to recover the nominal cost of debt that is an input to the PTRM ($R_d^{Nominal\ 5\ year\ actual}$) it must be the case that $\pi_{Forecast}^{PTRM} = \pi_{Over\ 5\ year\ reg\ period}^{Actual}$. To the extent that $\pi_{Forecast}^{PTRM}$ is, at the time it is

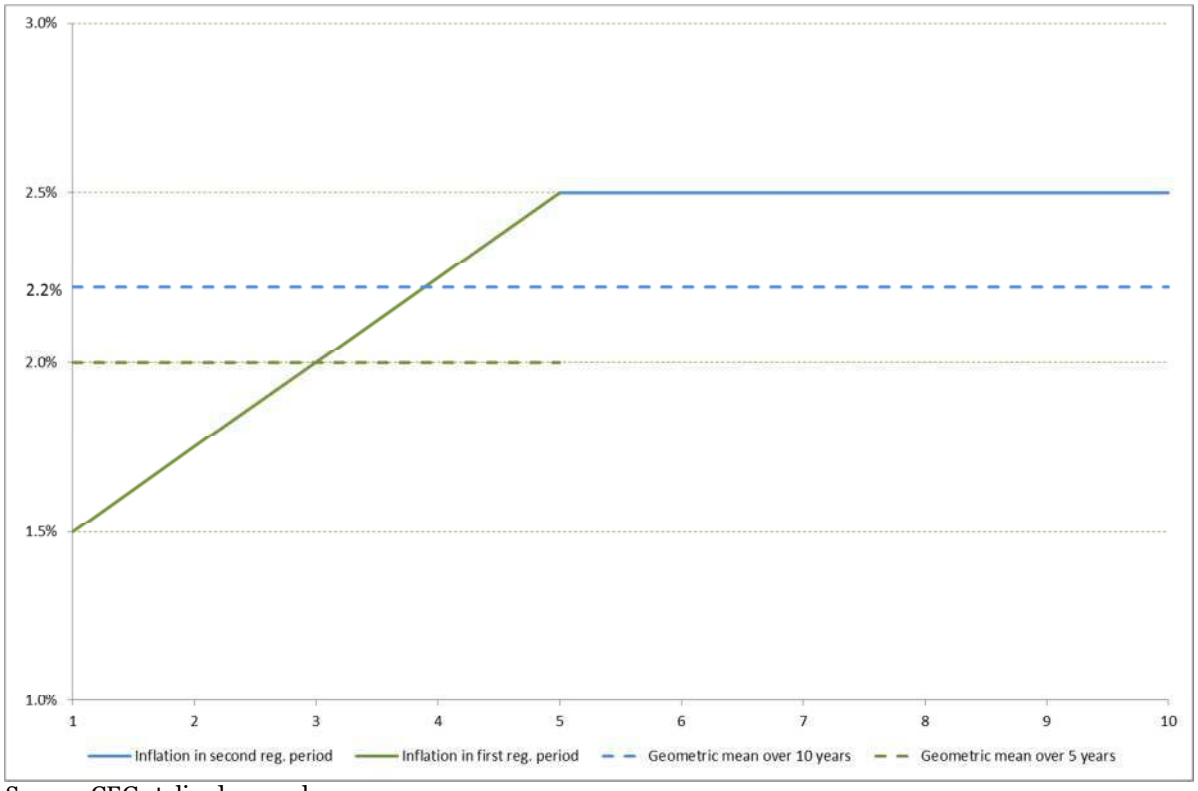
[22] In the following equations I simplify the relationship between real and nominal returns by assuming away the "Fisher effect" – which is small at low levels of nominal and real returns. However, the same result applies when using the Fisher equation; which states: $R_d^{Real} = \frac{R_d^{Nominal\ Actual} - \pi_{Forecast}^{PTRM}}{1+\pi_{Forecast}^{PTRM}}$.

made, above/below the best forecast of $\pi^{Actual}_{Over\ 5\ year\ reg\ period}$ then the resulting allowance for the nominal cost of debt will be biased relative to $R_d^{Nominal\ 5\ year\ actual}$.

94. The following example illustrates this. Let inflation expectations in the long run, say, beyond 5 years, be anchored around 2.5%. Also assume that, at the beginning of the next regulatory period (i.e., immediately prior to regulatory year t=1), the economy is depressed and inflation expectations are low, such that expected inflation over the next five years is expected to average 2.0%. Assume that this reflects an expectation that inflation will rise from 1.5% to 2.5% over the five years of the regulatory period but that investors expect inflation to remain at 2.5% in all subsequent years.

95. In this scenario, expected inflation at the 10 year horizon is 2.2% (which is the geometric mean of inflation over 10 years) but expected inflation over the next five years is only 2.0% (geometric mean over 5 years). This is illustrated in the following graphic.

Figure 7: Graphical illustration of stylised inflation assumption



Source: CEG stylised example

96. Figure 7 above illustrates that the average 10 year inflation forecast (2.2%) is a biased estimate of the 5 year inflation forecast (2.0%) because it is 'dragged up' by higher expected inflation beyond the regulatory period. Consequently, using expected inflation at a 10 year horizon will result in expected actual nominal

compensation for the cost of debt ($R_d^{Compensated}$) that is 20bp lower than the nominal cost of debt ($R_d^{Nominal\ 5\ year\ actual}$) used as an input into the PTRM.

97. It is worth noting that the above stylised assumptions about inflation expectations actually match fairly closely the market measures of inflation expectations depicted in Figure 2 and Figure 4 (derived from CGS and inflation swap markets over 9 February to 6 March 2015). Over 9 February to 6 March 2015 the difference between 10 and 5 year inflation was:

- Breakeven inflation from CGS markets: 0.37% (2.28%-1.91%); and
- Inflation swap markets: 0.24% (2.60% less 2.35%).

Appendix C Terms of reference

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16 June 2015

Partner
Nicolas Taylor
Telephone: +61 2 8272 0715
Email:
NJTaylor@JonesDay.com

Dr Tom Hird
CEG

TERMS OF REFERENCE

You are engaged by Jones Day on behalf of SA Power Networks (SAPN).

You have previously written reports concerning the estimation of inflation for energy network regulatory purposes. In particular, those reports concerned the issue of whether projected inflation should be drawn from an analysis of traded capital market data or central bank projections and targets in the prevailing economic conditions at the time of the report.

In order to answer the questions below, please review and consider the following in the current economic circumstances:

- the suitability of sourcing inflation estimates for regulatory purposes from observed trading in capital and swap markets; and
- the prevailing commentary concerning the degree to which central banks generally, and the Reserve Bank of Australia in particular, provide suitable near term forecasts for economic regulatory purposes or have targets that are suitable for the AER to use as longer term measures of expected inflation.

In particular, please explain the following matters in your report:

1. How are measures of forecast and actual inflation used in the regulatory structure? In what way do these measures affect revenues and returns of network businesses?
2. Given the answers you provide to Question 1, what is the relevant term over which the AER should be projecting inflation?
3. Compare and contrast the different measures available from market trading data and from Reserve Bank of Australia forecasts and targets and recommend which is currently the most appropriate source of inflation for use by the AER.
4. More specifically, if the AER were to continue its current approach in SAPN's Final Determination, would the projection be accurate and would SAPN be afforded a reasonable opportunity to recover its efficient costs including earning a fair market return on its investments?

Compliance with the Code of Conduct for Expert Witnesses

Attached as **Annexure 1** is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines).

Please read and familiarise yourself with the Expert Witness Guidelines, and comply with them at all times over the course of your engagement.

In particular, your report prepared should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1. contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;

2. identify the questions that the expert has been asked to address;

3. set out separately each of the factual findings or assumptions on which the expert's opinion is based;

4. set out each of the expert's opinions separately from the factual findings or assumptions;

5. set out the reasons for each of the expert's opinions; and

6. otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

The declaration contained within the report should be that "[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the report".

Please also attach a copy of these terms of reference to the report.

Kind regards

Nicolas Taylor

Nicolas Taylor

Partner

Annexure 1

FEDERAL COURT OF AUSTRALIA
Practice Note CM 7
EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the Evidence Act 1995 (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[1], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court[2]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report[3]

---

1 As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

2 The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[4]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the Court."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[5].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[6].

3. Experts' Conference

(continued…)

3 Rule 23.13.

4 See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

5 The "Ikarian Reefer" [1993] 20 FSR 563 at 565

6 The "Ikarian Reefer" [1993] 20 FSR 563 at 565-566. See also Ormrod "Scientific Evidence in Court" [1968] Crim LR 240

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013

ceg COMPETITION ECONOMISTS GROUP

Measuring expected inflation for the PTRM

Dr. Tom Hird

January 2016

COMPETITION ECONOMISTS GROUP

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1 Executive summary

1.1 Current AER practice is to estimate

1. Current AER practice is to forecast inflation for use in the PTRM over a 10 year horizon using RBA forecasts for the first year or so and an assumed 2.5% inflation (the mid-point of the RBA's 2-3% inflation target) over all of the remainder of the 10 year horizon. Ultimately, this means that the AER's estimate is always 2.5% or very close to it.

2. We consider that the AER should amend its approach to:

   - forecast inflation based on the break-even inflation rate implied by the difference between nominal and CPI indexed government bond yields; and
   - give more weight (at least 60%) to inflation forecasts over a 5 year period rather than a 10 year period.

1.2 Break even inflation

3. We consider that breakeven inflation[1] provides the best estimate of inflation expected over any given future period. This can depart significantly from the mid-point of the RBA range.

1.3 5 year horizon

1.3.1 Compensation for inflation in the regulatory framework

4. The PTRM uses forecast inflation as an input in order to model an assumed path of the nominal RAB over the regulatory period. The higher the inflation forecast used in the PTRM the higher will be the assumed growth in the nominal value RAB and, consequently, the lower the level of compensation provided for in modelled revenues during the regulatory period.

5. The fact that higher inflation leads to lower prices may seem counterintuitive. However, this can be understood by taking into account the interaction for the RBA roll forward model (RFM). When the RAB roll forward model comes to be applied

[1] Derived using the 'Fisher equation' which states that the nominal yield (n) on an asset is equal to the real yield (r) multiplied by inflation (p). That is: (1+n) = (1+r)*(1+p). Solving for p givers p=(n-r)/(1+r). Using the yield on nominal government bonds as 'n' and the yield on inflation indexed bonds as 'r' the 'break even' inflation rate is given by the above formula – which is the level of inflation at which the two assets will provide the same nominal return.

at the next regulatory review, higher inflation over the regulatory period will lead to a higher RAB due to inflation indexation of the RAB.

6. The joint operation of the PTRM and the RAB RFM is such that a nominal return is delivered in two parts:

   - A real return (the nominal return less expected inflation) is delivered during the regulatory period; and
   - Compensation for inflation is delivered in the form of a higher RAB in the RFM which is based on actual inflation.

7. Consequently, for any given nominal return (on debt and/or equity) used as an input into the PTRM, higher expected inflation leads to a lower real return and lower nominal revenues over the regulatory period (regulatory period 't'). However, higher expected inflation leads to a higher expected nominal RAB at the beginning of the subsequent regulatory period (regulatory period 't+1'). In this way, the PTRM and the RAB RFM interact in a manner intended to deliver nominal compensation inclusive of the impact of inflation.

1.3.2 Horizon of inflation forecast in the PTRM

8. It is, however, important to note that the two processes will only work together to deliver an expected nominal return equal to the nominal return used as an input to the PTRM if forecast inflation in the PTRM is the best forecast of inflation that will be used in the RFM. That is, the objective for the inflation forecast must be to forecast inflation over the five year period that the RFM will cover.[2]

1.3.2.1 Compensating for nominal debt costs

9. The cost of debt input into the PTRM is an estimate of the nominal payments that a benchmark efficient entity (BEE) has entered into with lenders.[3] In this context, it is clear that the objective must be to deliver nominal compensation that is sufficient to allow these payments to be met. Therefore, for the purpose of forecasting inflation used in the PTRM it is clear that this must be the best estimate of inflation over the 5 year period covered by the next application of the RFM.

1.3.2.2 Compensating for nominal equity costs

10. By contrast, equity contracts are not written to promise a fixed nominal return (or even a fixed real return). Arguably, the objective of the regulatory regime is to

[2] Given the necessity of using lagged inflation in the regulatory process – some of this inflation will be known (published by the ABS) at the time of the regulatory decision.

[3] The BEE is not assumed to have entered into debt contracts with a CPI indexation clause.

deliver to investors the best estimate of the real (inflation adjusted) return that they require and to add to this compensation for actual inflation. If this is accepted the inflation forecast used in the PTRM must be one that, when combined with the nominal cost of equity input, delivers the appropriate real return – which will then be supplemented by compensation for actual inflation in the RFM.

11. In this scenario, the correct horizon over which to estimate expected inflation is the horizon used to arrive at the estimate of the nominal cost of equity. The AER's current practice is to use the prevailing 10 year Commonwealth Government Security (CGS) yield as the proxy for the free rate upon which the nominal cost of equity is built. A 10 year horizon inflation expectation is, naturally, embedded in the prevailing 10 year nominal CGS yield. It follows that the prevailing real risk free rate must be estimated by removing expected inflation over the same 10 year horizon.

1.3.2.3 Weighted average inflation forecast

12. If it is accepted that the objective of the regulatory regime (PTRM plus RFM) is to deliver compensation for a:

    - nominal cost of debt input into the PTRM; and
    - real cost of equity (which is not an input into the PTRM itself but which is derived from the nominal cost of equity and the forecast inflation).

    then there is a tension between the correct horizon to use for the inflation forecast in the PTRM. The cost of debt must be deflated by a five year horizon forecast of inflation while the cost of equity requires a 10 year horizon forecast of inflation. Consequently, the appropriate inflation forecast used as an input into the PTRM is a weighted average of 5 and 10 year expected inflation with the weights reflecting the assumed proportion of debt versus equity financing (60%/40%).

1.4 AER response

13. The above arguments have been put to the AER by United Energy, SAPN and AGN. The AER has not disputed the veracity of the analysis but has rejected making any change to its approach. The rationale for doing so is that the appropriate place in which to subject our analysis to review is within the next rate of return guideline review.[4]

    Going forward, the AER would consider a change to inflation forecasting in accordance with the consultation processes mandated by the NER. The

4 AER, Preliminary decision for United Energy, October 2015, p. 3-258.

next rate of return guideline review may be a suitable process for also reviewing the inflation forecasting method.

14. This is similar but not the same as the conclusion reached for United Energy which appears to rely on a legal as opposed to general policy constraint. [5]

> *Going forward, the AER would consider a change to inflation forecasting in accordance with the consultation* ***processes mandated by the NER****. The next rate of return guideline review may be a suitable process for also reviewing the inflation forecasting method.* [Emphasis added]

15. In doing so the AER appears to have relied on an argument to the effect that:

    a. the problems identified by CEG are caused by an inappropriate specification of the inflation forecast method in the PTRM - one which creates an alleged downward biased level of expected compensation in current market circumstances;

    b. the PTRM specification of the inflation forecast method can only be amended following a formal review of the PTRM and this is not possible within the current regulatory process; and

    c. any other solution to the problem that has the effect of correcting the PTRM inflation forecast bias (e.g., by amending the nominal cost of debt/equity inputs to the PTRM to offset the bias) is similarly not legally possible.

16. We express no opinion in relation to part b. of the above argument which appears to be based on legal reasoning (at least for electricity businesses). However, we do note that there is an underlying economic presumption embedded in part a. that is not, in our view, correct. The problems that we have identified cannot be said to reside in the PTRM inflation forecast. Rather, they result from the interaction and interdependencies between:

    - The PTRM and the inflation forecast method;
    - The nominal cost of equity and debt that is used as an input into the PTRM; and
    - The RAB roll forward model.

17. Consequently, the problems that we have identified can be corrected by changes to any one (or more than one) of these three components of the regulatory regime. Consequently, even if the AER's 'hands are tied' not to correct the problem via a change to the PTRM inflation forecast, this is not a sufficient reason to do nothing.

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5 AER, Preliminary decision for United Energy, October 2015, p. 3-258.

The AER's hands must be tied not to use any of the three means of correcting the problem. That is, it must be the case that the position expressed in c. also holds.[6]

18. Moreover, the position expressed in part c. is inconsistent with the AER's approach to compensating for debt raising costs. In that context the AER has explicitly relied on what it regards as overcompensation built into the timing assumptions of the PTRM in order to not compensate for the efficient costs associated with meeting Standard and Poor's requirements around liquidity and prefunding debt.

19. Moreover, in that context TransGrid's legal advisers explicitly put to the AER the view that it was not legally permissible to make an offsetting change to the inputs to the PTRM in order to undo overcompensation built into the structure of the PTRM.

> *"[t]he other reason given by the AER for not including the relevant Debt Raising Costs is that the timing assumptions in the post-tax revenue model already overcompensate TransGrid. Again, it is not clear why this is relevant to the assessment under the NER given that the claimed overcompensation from the post-tax revenue model is not considered in clause 6A.6.6 of the NER. As such, the AER cannot rely on this claimed overcompensation when determining TransGrid's allowed operating expenditure when applying clause 6A.6.6 of the NER as it is required to do"*

20. In rejecting this position the AER stated:[7]

> *We do not accept this interpretation of the NER. Under s.16 of the NEL, we must perform our functions in a manner that will or is likely to contribute to the achievement of the NEO. In giving effect to this, we must specify the manner in which the constituent components of our decision relate to each other, and the manner in which that interrelationship has been taken into account in the making of our decision.*
>
> *Accordingly, if costs are adequately compensated in one component of our decision, we must take that into account when considering the interrelated components of our decision.* ***Otherwise, the overall decision may over- or under- compensate the service provider.***
>
> *We are satisfied that TransGrid's proposed 'other' debt raising costs are appropriately compensated through the timing assumptions employed in the PTRM as a constituent component of our decision. Neither TransGrid, Ashurst or Incenta appear to dispute this analysis; instead they argue it is*

6 We note that, unlike the NER for electricity businesses, the NGR do not prescribe the use of a PTRM for gas businesses (nor has the AER published a PTRM for gas businesses or guidelines for its use). Rather, the key objectives are satisfying the ARORO and the NGO.

7 AER, Final decision for Transgrid, April 2015, 3-545 to 3-546.

> *not relevant. We disagree. When we consider whether the total opex forecast reasonably reflects the opex criteria and the rate of return reflects the efficient financing costs of a benchmark efficient business,* ***we must have regard to the interrelationships between the different aspects of our decision****.*
>
> *This approach is supported in the reasoning of SCER for proposing the amendments to s.16 of the NEL. These amendments require us to specify the manner in which the interrelated components of our decision have been taken into account. SCER explained that considering constituent revenue components in isolation ignores the importance of interrelationships between components. SCER observed that this would not contribute to the achievement of the NEO and, in the past, has resulted in regulatory failures.* [Emphasis added.]

21. Of course, this logic was employed in the context of an aspect of the PTRM resulting in overcompensation. However, it is not obvious why it would not equally apply in the context of an aspect of the PTRM resulting in undercompensation. Therefore, the same logic would suggest that the AER "*must have regard to the interrelationships between the different aspects of*" its decision and that in doing so it is open to the AER to set the inputs to the PTRM in a manner that is likely to contribute to the achievement of the NEO and NGO.

22. We do not offer any legal view on whether Ashurst or the AER is correct in their legal interpretation. However, we do note that as a matter of economics the issues raised above are the same as the issues that are raised in relation inflation forecasting. That is, the AER's logic above is that it is appropriate to set the inputs to the PTRM for liquidity/prefunding costs in a manner that takes into account how the PTRM is structured and, in so doing, will lead to an appropriate level of compensation. The AER says that this is appropriate because "o*therwise, the overall decision may over- or under- compensate the service provider*".

23. The same logic would suggest that the AER should set the nominal cost of debt and equity inputs into the PTRM in a manner that takes into account how the PTRM is structured and, in so doing, will lead to an appropriate level of compensation.

2 Introduction

24. We have been asked by United Energy to provide a report advising on the best estimate of the inflation expectation to be used as an input into the PTRM. The exact scope of work is set out in Appendix A. This report should be read in conjunction with our earlier reports for SAPN[8] and United Energy[9] covering the same issues.

25. The remainder of this report is structured as follows:

    - **Section 2** provides an assessment of investors' expectations of future inflation; and
    - **Section 3** summarises how, in the light of the estimates from section 2, the inputs into the PTRM can be amended to ensure that investors can expect the appropriate level of nominal compensation for the cost of debt and equity;
    - **Section 4** assesses the AER's arguments for not making any amendments.

26. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*. I have made all inquiries that I believe are desirable and appropriate to answer the questions put to me. No matters of significance that I regard as relevant have to my knowledge been withheld.

Thomas Nicholas Hird

8 CEG, Measuring expected inflation for the PTRM, June 2015

9 CEG, Measuring risk free rates and expected inflation, April 2015.

3 Investors' inflation expectations

3.1 Breakeven vs AER estimated inflation

27. In our two previous reports[10] [11] on this issue we have argued that breakeven inflation is a better estimate of expected inflation than the method associated with the AER's estimate. There are two reasons for this:

    - First, the AER's methodology assumes that investors expect that inflation will be in the middle of the AER target range beyond 1-2 years. While this is a reasonable assumption in most market circumstances it is not a reasonable assumption in current market circumstances[12] - where the risks of below-target inflation are heightened. By contrast, breakeven inflation takes its estimate of medium to long term inflation from traded prices in bond markets.
    - Second, the reason for previously abandoning break-even inflation as the best estimate of expected inflation no longer applies. The indexed bond market has had much greater and deeper issuance creating much improved liquidity in this market.

28. In support of the second point we noted in our previous report that in a 26 May 2015 speech[13] the CEO of the AOFM stated:

    > *From a modest starting point in 2009 when we recommenced indexed issuance (with $6 billion on issue spread across 3 lines), we now have around $27 billion in stock outstanding ($33 billion when adjusted for inflation indexation). This is spread across 7 lines with a curve extending 20 years.*

29. Since then there has been a further $2bn in net issuance with the following maturity profile –with the largest value of indexed bonds having maturities between 10 and 15 years.

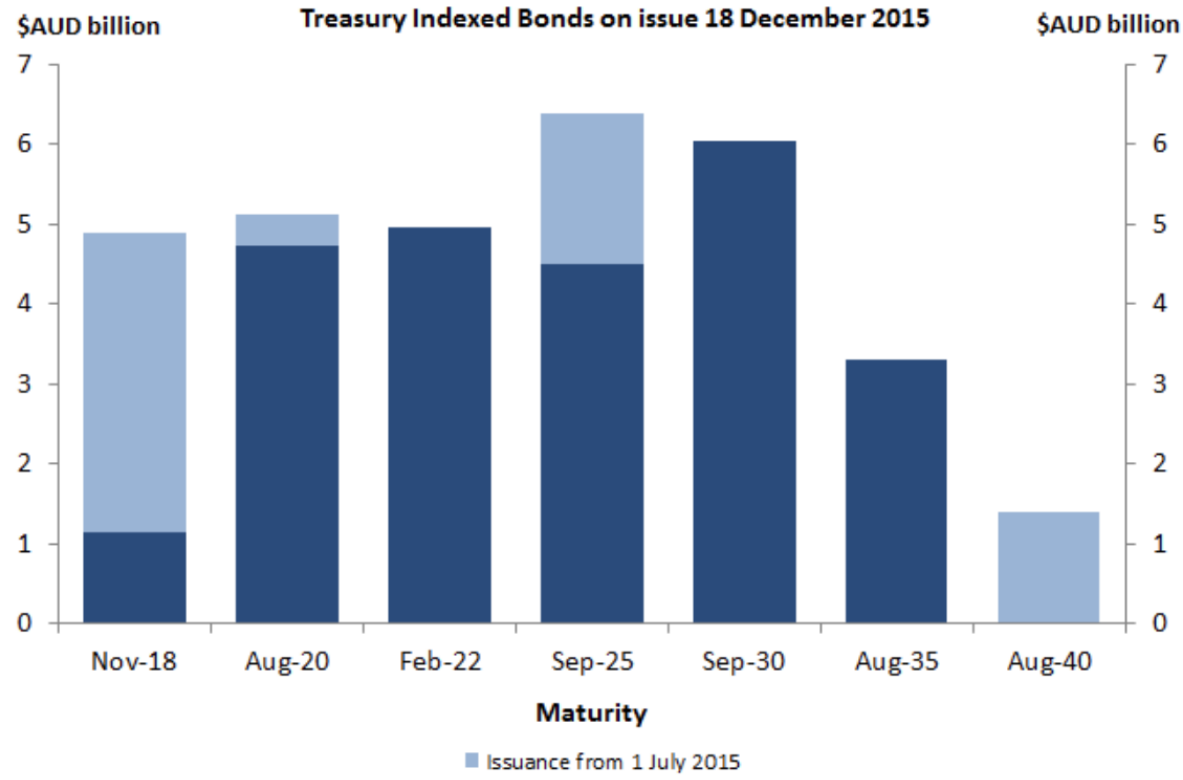
[10] CEG, Measuring expected inflation for the PTRM, June 2015

[11] CEG, Measuring risk free rates and expected inflation, April 2015.

[12] CEG, Measuring expected inflation for the PTRM, June 2015, section 2 and 2.1 in particular.

[13] Australian Government Sovereign Debt: Are we there yet? What more can be expected in terms of developing the market? – Presentation to the Australian Business Economists Luncheon.

Figure 1: Treasury indexed bonds on issue as at 18 December 2015



Source: AOFM website accessed on 23 December 2015

3.2 Best estimate of inflation expectations

30. In United Energy's averaging period (13 November 2015 to 10 December 2015 inclusive) the AER's methodology for setting expected inflation results in a 2.50% value.

31. The nominal 5 and 10 year CGS yields were 2.34% and 2.92% respectively. Consequently, if the AER's method for estimating expected inflation is accepted as accurate then the implied real return on 5/10 year nominal CGS is -0.16%/0.42%. This is below the guaranteed real yield on indexed CGS available in the bond market over the same period at 5/10 year maturity of 0.34%/0.67%. If the AER's inflation forecast was correct it would imply that investors in nominal bonds expect to receive a negative real yield over the next 5 years – notwithstanding that they could invest in an indexed CGS that will deliver a guaranteed positive real yield.

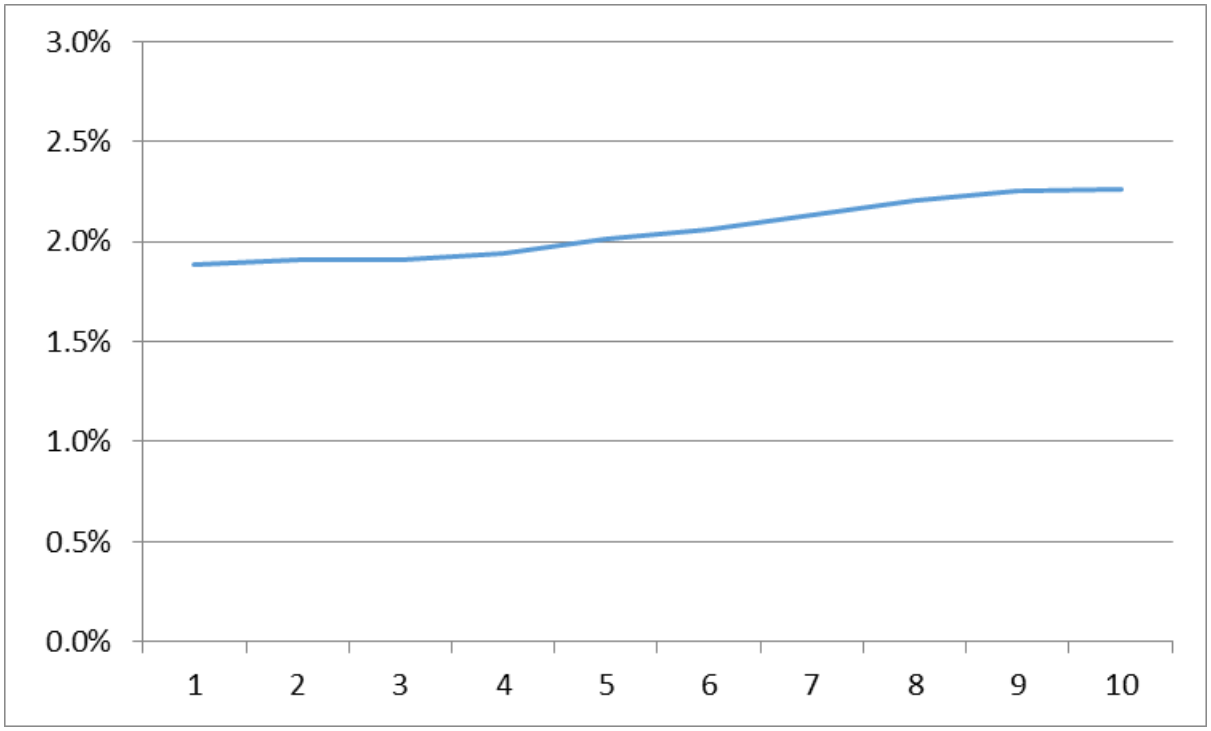
32. Put another way, if the AER were to use its current methodology then its cost of capital allowance would be based on the implicit assumption that investors require not only a negative real return on the "risk free" asset, but a substantially lower real return than is available from the purchase of inflation indexed CGS.

33. By contrast, expected 5/10 year inflation over the United Energy averaging period, as measured by break even inflation was 2.01%/2.26%. This implies a positive real yield on 5/10 year nominal CGS of around 33bp/66bp.

3.3 Break-even inflation over UE averaging period

34. Break even forecasts of inflation are currently much lower than 2.5% at both the 5 and 10 year term. Over the UE averaging period, the implied term structure of average annual inflation from CGS yields is shown in Figure 2. This figure shows that average annual breakeven inflation over 10 years was 2.26%.

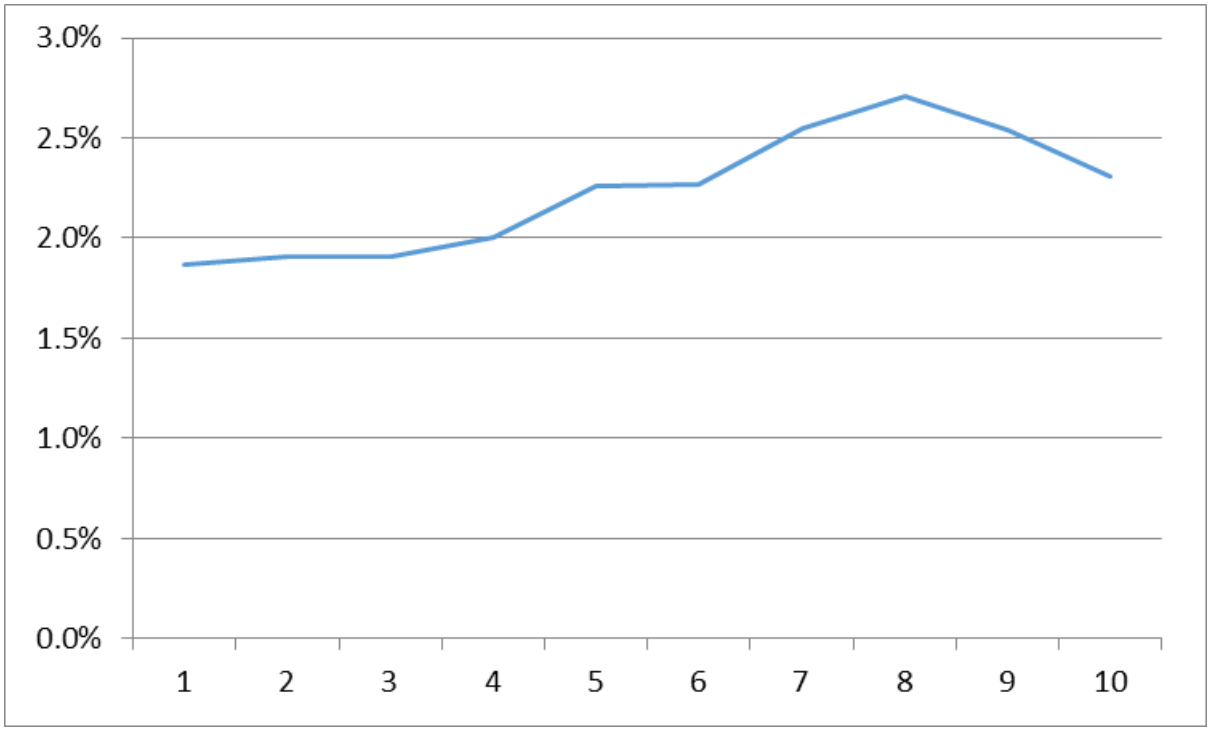
Figure 2: Implied (breakeven) inflation term structure from nominal and indexed CGS yields



Source: RBA, CEG analysis

35. The figures reported in Figure 2 above are average annual rates of increase in CPI over the horizon provided on the horizontal axis. However, implied in this term structure is expected breakeven inflation in each of the future years ("forward inflation"). This is provided in Figure 3 below.

Figure 3: Forward (breakeven) inflation implied by nominal and indexed CGS yields



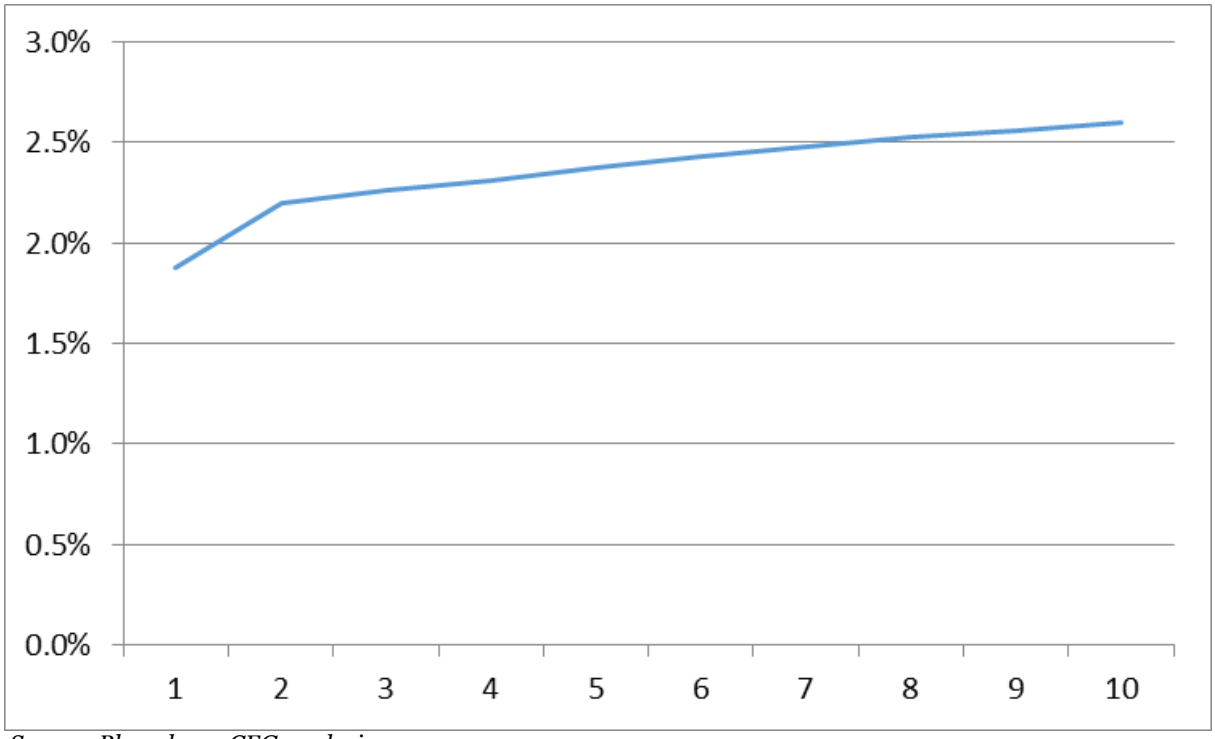
Source: RBA, CEG analysis

36. It can be seen that breakeven inflation is expected to remain below 2.0% over the next 4 years, rising to be approximately equal to 2.5% only after 7 years. This is entirely consistent with the evidence surveyed in our previous reports for SAPN and United Energy, which suggests that the downside risks to inflation exceed the upside risks in the medium term.

3.4 Inflation swaps over the UE averaging period

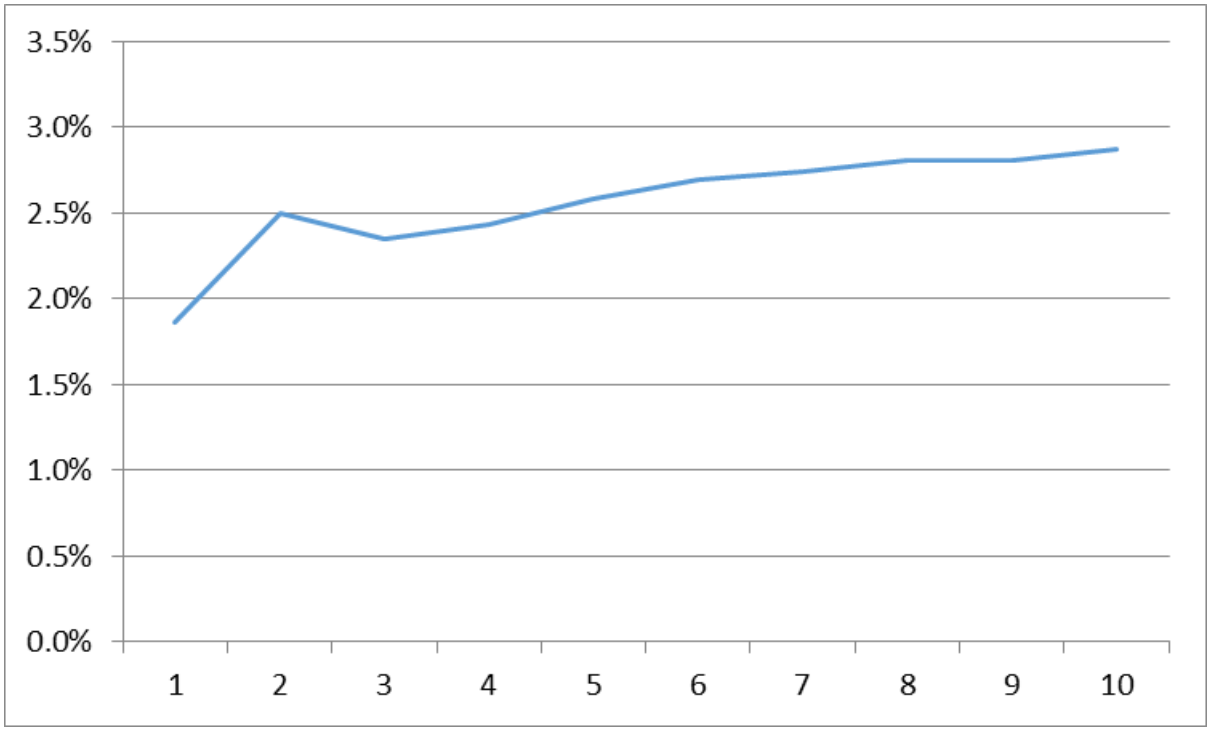
37. Another source of information about investor expectations of future inflation is inflation swaps. The term structure of inflation on the last day of United Energy's averaging period (10 December 2015) and the associated forward rates of inflation are provided below.

Figure 4: Implied inflation term structure from inflation swap markets (10 December 2015)



Source: Bloomberg, CEG analysis

Figure 5: Forward inflation from inflation swap markets (10 December 2015)



Source: Bloomberg, CEG analysis

38. Beyond 1 year the implied inflation from swap markets rise much faster than from CGS markets, such that implied forward inflation from year 5 to 10 is above the midpoint of the RBA target range (2.5%) and by year 10 is at the top of the RBA range.

39. As explained in our previous reports, implied inflation from swap markets will tend to result in an overestimate of expected inflation. This conclusion is borne out by noting the implied CPI swap forward rate for inflation is well above the midpoint of the RBA target range in years 6 to 10. Consistent with the analysis in our previous reports,[14] we do not believe that this is a plausible best estimate of expected inflation. That is, while there are reasons to believe that the best estimate of expected inflation in 10 years' time will be below the midpoint of the RBA range, there is no reason that we aware of to believe that the best estimate is for inflation to be at the top of the RBA target range.

40. In any event, it is relevant to note that, in the UE averaging period, breakeven inflation and CPI swaps are both predicting that inflation will be below 2.5% over the next 5 years – such that average inflation over the next 5 years is well below 2.5%.

[14] For example section 2.1 of our June 2015 report for SAPN, *Measuring expected inflation for the PTRM*

3.5 Conclusion

41. For the reasons set out in our past report we recommend that the inflation forecast used in the PTRM should be a weighted average of the inflation expectations at the 5 and 10 year horizons where the weights are 60% to the five year horizon and 40% to the 10 year horizon – consistent with the weights of debt and equity in the RAB.

Table 1: Weighted average of 5 and 10 year inflation; 13 November to 10 December

	5 year	10 year	Weighted average
Breakeven	2.01%	2.26%	2.11%

Source: Bloomberg, RBA, CEG analysis

42. However, we also noted in our previous report that the five year estimate of expected inflation should be measured over the period that the RAB RFM is intended to be applied.

43. Consistent with the analysis set out in our previous report for SAPN the inflation forecast that is paired with the nominal cost of debt should be the best estimate, available at the time of the final decision, of the inflation rate that will be used by the AER to escalate the RAB in the RAB roll-forward model and to index revenues over the regulatory period.

44. We understand that United Energy's RAB roll forward will be indexed over the five year period from June 2014 to June 2019. Therefore, the relevant period over which inflation must be estimated is June 2014 to June 2019.

45. In ordinary circumstances, at the time of the AER's Final Decision, the ABS will not yet have published any historical inflation estimates (or, at best, one quarter of inflation estimates) that will be used by the AER in its RAB roll forward model/revenue indexation over the forthcoming regulatory period. Therefore, in the ordinary course of events, the forecast of inflation that is paired with the nominal cost of debt will be precisely that – a forecast of future Australian Bureau of Statistics (ABS) published rates.

46. However, in the special case of the Victorian electricity distribution businesses the AER will be making its final decision in early 2016 to apply retrospectively to the regulatory period starting in January 2016. Therefore, at least 6 quarters of actual published inflation data (June 2014 to December 2015) and possibly seven (including March 2016) will actually be available to inform the AER's best estimate of inflation that will be used in the RAB roll forward model.[15]

[15] We note that this is an issue that is specific to these businesses and could not be assumed to be dealt with in any general PTRM review.

47. At the time of writing we have actual inflation from June 2014 to September 2015 which has grown at an annual rate of just 1.58%. This is clearly much lower than 2.50%. Were the AER to use 2.50% as its best estimate of inflation (and make no other adjustments to its PTRM inputs) then this would mean that the actual nominal return delivered to investors for the first 1.25 years of the regulatory period would be 0.92% (2.50% less 1.58%) lower than the nominal returns used as inputs into the PTRM. This is calculated as:

    - 2.50% being the nominal reduction in PTRM derived revenues on the assumption that this would be 'added back' in RAB indexation; less
    - 1.58% being the actual amount of RAB RFM indexation that will relate to these years.

48. The following table provides the best estimate of 5 year inflation from June 2014 to June 2019 given what we know about actual inflation that has already occurred. This is combined into the best estimate of expected inflation that could be used as an input to the PTRM assuming that it is open[16] to the AER to amend the methodology for estimating expected inflation in the PTRM.

Table 2: Best estimate of inflation

Row	Inflation estimate	
1	10 year breakeven estimate in UE averaging period	2.26%
2	3.75 year break even	1.93%
3	Actual Jun 14 to Sept 15 (1.25 years)	1.58%
4	5 year RFM forecast (=3.75/5*(row 2)+1.25/5*(row 3))	1.85%
5	60%/40% weight to rows 4/1 above	2.01%

49. Of course, at the time of the AER's decision it should revise rows 2 to 5 to take account of the latest information – including the latest ABS estimate of actual inflation for the December 2015 quarter.

[16] The following section considers how the AER should estimate the nominal inputs to the PTRM or RFM if this is not the case.

4 Critique of AER response to date

4.1 AER response to date

50. The AER has not disputed the veracity of the analysis but has rejected making any change to its approach. The rationale for doing so is that the appropriate place in which to subject our analysis to review is within the next rate of return guideline review.[17]

> *Going forward, the AER would consider a change to inflation forecasting in accordance with the consultation processes mandated by the NER. The next rate of return guideline review may be a suitable process for also reviewing the inflation forecasting method.*

51. This is similar but not the same as the conclusion reached for United Energy. [18]

> *Going forward, the AER would consider a change to inflation forecasting in accordance with the consultation* ***processes mandated by the NER****. The next rate of return guideline review may be a suitable process for also reviewing the inflation forecasting method.* [Emphasis added]

52. In doing so the AER appears to have relied on an argument to the effect that:

    a. the problems identified by CEG are caused by an inappropriate specification of the inflation forecast method in the PTRM - one which creates an alleged downward biased level of expected compensation in current market circumstances;

    b. the PTRM specification of the inflation forecast method can only be amended following a formal review of the PTRM and this is not possible within the current regulatory process; and

    c. any other solution to the problem that has the effect of correcting the PTRM inflation forecast bias (e.g., by amending the nominal cost of debt/equity inputs to the PTRM to offset the bias) is similarly not legally possible.

53. Part c. is implicit in that the AER has not sought to explore whether such a course of action will promote the ARORO and the NGO/NEO.

54. The AER's views on parts a. and b. are encapsulated in the below quote.[19]

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17 AER, Preliminary decision for United Energy, October 2015, p. 3-258.

18 AER, Preliminary decision for United Energy, October 2015, p. 3-258.

19 AER, Preliminary decision for United Energy, October 2015, p. 3-257 to 3-258.

Under the nominal vanilla approach an inflation forecast is not a direct input in determining the allowed rate of return. As per clause 6.5.2(d)(2) of the NER, subject to achieving the rate of return objective, we are required to determine a rate of return on a nominal vanilla weighted average cost of capital basis. This approach was confirmed in the AEMC's 2012 Economic Regulation of Network Service Providers rule determination.807 Given that under the NER inflation is expressly required to be dealt with in the PTRM, it is both consistent with, and unsurprising that, the NER mandates a nominal basis for determining rate of return. The various provisions of the NER have to be read together in a logical manner that recognises the interrelationships between the different components of the AER's determination. For similar reasons, it is not surprising that the rate of return is required to be determined on a vanilla basis, consistent with the fact that taxation is assessed separately under the NER.808

Under both the NER and NGR, an inflation forecast is required for modelling revenue over the next regulatory control period. The NER mandates the use of the AER's Post tax revenue model (PTRM). The NGR does not mandate the use of the PTRM, but requires service providers to provide financial information on a nominal basis or real basis or some other recognised basis for dealing with the effects of inflation.810 Under the NER, the AER's published PTRM must include a method the AER determines is likely to result in the best estimate of inflation.811 Under the NGR, a service provider must propose an estimate on a reasonable basis which is the best forecast or estimate possible in the circumstances.812

Any changes/amendments to the PTRM must be done in accordance with the distribution consultation procedures.

CEG's analysis and reasoning raises a number of matters for robust testing including the appropriate inflation estimation horizon and consistency of approach between debt, equity and expenditure forecasts. We consider the research, analysis and reasoning submitted to us should be subject to review through a comprehensive process allowing effective engagement with all stakeholders.

In our recent rate of return guideline development consultation process we raised the inflation method as an issue for potential review. We noted that the indexed bond market had changed since we departed from the Fisher equation, and asked for submissions on whether we should change the approach. We also noted different methods and what other regulators were adopting. In response, stakeholders endorsed the continuation of the current approach. We therefore are satisfied that the current approach is the appropriate approach for this determination.

> ***Going forward, the AER would consider a change to inflation forecasting in accordance with the consultation processes mandated by the NER.*** *The next rate of return guideline review may be a suitable process for also reviewing the inflation forecasting method.* [Emphasis added.]

55. We understand that the AER is saying that irrespective of the merits of the analysis we have presented the only context in which the AER can subject our analysis to "*review through a comprehensive process allowing effective engagement with all stakeholders*" is at a later stage and not in the current determination process. We infer that this is a perceived legal constraint to do with amending the PTRM inflation forecast methodology because we assume that but for such a perceived legal constraint the AER would subject our analysis to *review through a comprehensive process allowing effective engagement with all stakeholders* within the current determination process.

56. We express no opinion in relation to whether such a legal constraint actually exists. However, we note that in AGN's draft decision the above language is missing (despite the decision being made the following month and the subject matter being the same). We note that the AER does state in United Energy's preliminary decision that:[20]

> *The NGR does not mandate the use of the PTRM, but requires service providers to provide financial information on a nominal basis or real basis or some other recognised basis for dealing with the effects of inflation.*

57. It may be that this distinction explains why the above discussion is missing from AGN's draft decision. However, it does not explain why the AER reaches the identical conclusion.[21]

58. In any event, we note that there is an underlying economic presumption embedded in part a. that is not, in our view, correct. The problems that we have identified cannot be said to reside in the PTRM inflation forecast. Rather, they result from the interaction and interdependencies between:

- The PTRM and the inflation forecast method;
- The nominal cost of equity and debt that is used as an input into the PTRM; and
- The RAB roll forward model.

[20] AER, Preliminary decision for United Energy, October 2015, p. 3-257.

[21] As in Section 1.4, we note that unlike the NER for electricity businesses, the NGR do not prescribe the use of a PTRM for gas businesses (nor has the AER published a PTRM for gas businesses or guidelines for its use). Rather, the key objectives are satisfying the ARORO and the NGO.

59. Consequently, the problems that we have identified can be corrected by changes to any one (or more than one) of these three components of the regulatory regime. Consequently, even if the AER's 'hands are tied' not to correct the problem via a change to the PTRM inflation forecast, this is not a sufficient reason to do nothing. The AER's hands must be tied not to use any of the three means of correcting the problem. That is, it must be the case that the position expressed in c. also holds.

60. Moreover, the position expressed in part c. is inconsistent with the AER's approach to compensating for debt raising costs. In that context the AER has explicitly relied on what it regards as overcompensation built into the timing assumptions of the PTRM in order to not compensate for the efficient costs associated with meeting Standard and Poor's requirements around liquidity and prefunding debt.

61. Moreover, in that context TransGrid's legal advisers explicitly put to the AER the view that it was not legally permissible to make an offsetting change to the inputs to the PTRM in order to undo overcompensation built into the structure of the PTRM.

> *"[t]he other reason given by the AER for not including the relevant Debt Raising Costs is that the timing assumptions in the post-tax revenue model already overcompensate TransGrid. Again, it is not clear why this is relevant to the assessment under the NER given that the claimed overcompensation from the post-tax revenue model is not considered in clause 6A.6.6 of the NER. As such, the AER cannot rely on this claimed overcompensation when determining TransGrid's allowed operating expenditure when applying clause 6A.6.6 of the NER as it is required to do"*

62. In rejecting this position the AER stated:[22]

> *We do not accept this interpretation of the NER. Under s.16 of the NEL, we must perform our functions in a manner that will or is likely to contribute to the achievement of the NEO. In giving effect to this, we must specify the manner in which the constituent components of our decision relate to each other, and the manner in which that interrelationship has been taken into account in the making of our decision.*
>
> *Accordingly, if costs are adequately compensated in one component of our decision, we must take that into account when considering the interrelated components of our decision.* ***Otherwise, the overall decision may over- or under- compensate the service provider.***
>
> *We are satisfied that TransGrid's proposed 'other' debt raising costs are appropriately compensated through the timing assumptions employed in the PTRM as a constituent component of our decision. Neither TransGrid,*

[22] AER, Final decision for Transgrid, April 2015, 3-545 to 3-546.

> *Ashurst or Incenta appear to dispute this analysis; instead they argue it is not relevant. We disagree. When we consider whether the total opex forecast reasonably reflects the opex criteria and the rate of return reflects the efficient financing costs of a benchmark efficient business,* ***we must have regard to the interrelationships between the different aspects of our decision****.*
>
> *This approach is supported in the reasoning of SCER for proposing the amendments to s.16 of the NEL. These amendments require us to specify the manner in which the interrelated components of our decision have been taken into account. SCER explained that considering constituent revenue components in isolation ignores the importance of interrelationships between components. SCER observed that this would not contribute to the achievement of the NEO and, in the past, has resulted in regulatory failures.* [Emphasis added.]

63. Of course, this logic was employed in the context of an aspect of the PTRM resulting in overcompensation. However, it is not obvious why it would not equally apply in the context of an aspect of the PTRM resulting in undercompensation. Therefore, the same logic would suggest that the AER "*must have regard to the interrelationships between the different aspects of*" its decision and that in doing so it is open to the AER to set the inputs to the PTRM in a manner that is likely to contribute to the achievement of the NEO and NGO.

64. We do not offer any legal view on whether Ashurst or the AER is correct in their legal interpretation. However, we do note that as a matter of economics the issues raised above are the same as the issues that are raised in relation inflation forecasting. That is, the AER's logic above is that it is appropriate to set the inputs to the PTRM for liquidity/prefunding costs in a manner that takes into account how the PTRM is structured and, in so doing, will lead to an appropriate level of compensation. The AER says that this is appropriate because "o*therwise, the overall decision may over- or under- compensate the service provider*".

65. The same logic would suggest that the AER should set the nominal cost of debt and equity inputs into the PTRM in a manner that takes into account how the PTRM is structured and, in so doing, will lead to an appropriate level of compensation.

4.2 Alternative solutions (other than amending the AER's inflation forecast methodology)

66. This section describes how other inputs into the PTRM can be amended to ensure that the correct level of compensation for the cost of equity/debt is compensated. Before outlining these solutions we provide a recap of how the components of the regulatory regime interact to deliver an inflation adjusted return.

4.2.1 Compensation for inflation in the regulatory framework

67. The PTRM uses forecast inflation as an input in order to model an assumed path of the nominal RAB over the regulatory period. The higher the inflation forecast used in the PTRM the higher will be the assumed growth in the nominal value RAB and, consequently, the lower the level of compensation provided for in modelled revenues during the regulatory period.

68. The fact that higher inflation leads to lower prices may seem counterintuitive. However, this can be understood by taking into account the interaction with the RBA roll forward model (RFM). When the RAB roll forward model comes to be applied at the next regulatory review, higher inflation over the regulatory period will lead to a higher RAB due to inflation indexation of the RAB.

69. The joint operation of the PTRM and the RAB RFM is such that a nominal return is delivered in two parts:

- A real return (the nominal return less expected inflation) is delivered during the regulatory period; and
- Compensation for inflation is delivered in the form of a higher RAB in the RFM which is based on actual inflation.

70. Consequently, for any given nominal return (on debt and/or equity) used as an input into the PTRM, higher expected inflation leads to a lower real return and lower nominal revenues over the regulatory period (regulatory period 't'). However, higher expected inflation leads to a higher expected nominal RAB at the beginning of the subsequent regulatory period (regulatory period 't+1'). In this way, the PTRM and the RAB RFM interact in a manner intended to deliver nominal compensation inclusive of the impact of inflation.

71. It is, however, important to note that the two processes will only work together to deliver an expected nominal return equal to the nominal return used as an input to the PTRM if forecast inflation in the PTRM is the best forecast of inflation that will be used in the RFM. That is, the objective for the inflation forecast must be to forecast inflation over the five year period that the RFM will cover.[23]

4.2.1.1 Compensating for nominal debt costs

72. The cost of debt input into the PTRM is an estimate of the nominal payments that a benchmark efficient entity (BEE) has entered into with lenders.[24] In this context, it is clear that the objective must be to deliver nominal compensation that is sufficient

[23] Given the necessity of using lagged inflation in the regulatory process – some of this inflation will be known (published by the ABS) at the time of the regulatory decision.

[24] The BEE is not assumed to have entered into debt contracts with a CPI indexation clause.

to allow these payments to be met. Therefore, for the purpose of forecasting inflation used in the PTRM it is clear that this must be the best estimate of inflation over the 5 year period covered by the next application of the RFM.

4.2.1.2 Compensating for nominal equity costs

73. By contrast, equity contracts are not written to promise a fixed nominal return (or even a fixed real return). Arguably, the objective of the regulatory regime is to deliver to investors the best estimate of the real (inflation adjusted) return that they require and to add to this compensation for actual inflation. If this is accepted the inflation forecast used in the PTRM must be one that, when combined with the nominal cost of equity input, delivers the appropriate real return – which will then be supplemented by compensation for actual inflation in the RFM.

74. In this scenario, the correct horizon over which to estimate expected inflation is the horizon used to arrive at the estimate of the nominal cost of equity. The AER's current practice is to use the prevailing 10 year Commonwealth Government Security (CGS) yield as the proxy for the free rate upon which the nominal cost of equity is built. A 10 year horizon inflation expectation is, naturally, embedded in the prevailing 10 year nominal CGS yield. It follows that the prevailing real risk free rate must be estimated by removing expected inflation over the same 10 year horizon.

4.2.1.3 Weighted average inflation forecast

75. If it is accepted that the objective of the regulatory regime (PTRM plus RFM) is to deliver compensation for a:

    - nominal cost of debt input into the PTRM; and
    - real cost of equity (which is not an input into the PTRM itself but which is derived from the nominal cost of equity and the forecast inflation),

    then there is a tension between the correct horizon to use for the inflation forecast in the PTRM. The cost of debt must be deflated by a five year horizon forecast of inflation while the cost of equity requires a 10 year horizon forecast of inflation. Consequently, the appropriate inflation forecast used as an input into the PTRM is a weighted average of 5 and 10 year expected inflation with the weights reflecting the assumed proportion of debt versus equity financing (60%/40%).

4.2.2 Alternative means for arriving at appropriate compensation

76. If it is the case that the AER is legally obliged to retain its current methodology for estimating expected inflation in the PTRM it is still possible to correct the problem that we have identified in one of two ways:

- Amend the nominal cost of debt/equity inputs into the PTRM so that, when combined with the PTRM (including the PTRM inflation forecast) and the RAB RFM, they are expected to deliver the correct level of nominal compensation; or
- Amend (or signal an intention to amend) the RAB roll-forward model to use forecast inflation rather than actual inflation when escalating the RAB (at least for the debt component of the RAB).

77. We assume that if legal constraints prevent the PTRM inflation forecast from being amended the same constraints would prevent the RAB RFM being amended. For this reason we focus on the first of the above two alternative solutions.

78. To see how this would work note that, based on Table 2 the best estimate of expected inflation required to deflate the nominal cost of debt/equity is 1.85%/2.26%. However, under the AER method the nominal cost of debt/equity will be deflated by 2.5% which is 0.65%/0.24% too high.

79. As a consequence, the expected nominal PTRM plus RAB RFM compensation for the cost of debt will be set 0.65% below the nominal cost of debt input into the PTRM. This can be corrected by setting the nominal cost of debt input into the PTRM 0.65% above the target efficient nominal compensation for the cost of debt.

80. Similarly, the expected real PTRM plus RAB RFM compensation for the cost of equity will be set 0.24% below the real cost of equity input into the PTRM. This can be corrected by setting the nominal cost of equity input into the PTRM 0.24% above the target efficient nominal compensation for the cost of debt.

Appendix A Scope of work

81. The scope of the work we have been asked to provide is set out below.

COMPETITION ECONOMISTS GROUP

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4 January 2016

Dr Tom Hird
Competition Economists Group
234 George Street
SYDNEY NSW 2000

Dear Dr Hird

2016-2020 Price Determination

We act for United Energy (**UE**) in relation to the Australian Energy Regulator's (**AER**) review of United Energy's regulatory proposal under the National Electricity Law for the period 2016 to 2020.

UE wishes to engage you to prepare an expert report in connection with UE's revised regulatory proposal, in particular in relation to expected inflation.

This letter sets out the matters which UE wishes you to address in your report and the requirements with which the report must comply.

Terms of Reference

It is the AER's practice to apply the *nominal* rate of return to an *indexed* capital base. As a result, it is necessary to deduct from the building blocks an amount on account of expected inflation to prevent double counting. An estimate or forecast of expected inflation is required to index the capital base and to effect this deduction.

In its initial regulatory proposal (as submitted on 30 April 2015) UE indicated its intention to adopt a market based estimate of expected inflation (by applying the same methodology set out in your report for SA Power Networks dated June 2015 and entitled *Measuring expected inflation for the PTRM*) if the June 2015 quarter inflation outcome did not materially increase from the March 2015 quarter inflation outcome (which it did not).

The AER published its Preliminary Decision in relation to UE's proposal on 29 October 2015. In its Preliminary Decision, the AER continued its previous approach of estimating expected inflation by

reference to the mid-point of the Reserve Bank of Australia's short term inflation forecasts and inflation targeting band rather than adopting a market based estimate.

Opinion

In this context, UE wishes to engage you to prepare an expert report which provides:

1 Your opinion as to the appropriate methodology for constructing the best estimate of expected inflation for use in the building block approach to calculating UE's total revenue under the National Electricity Rules (having regard to the requirements of the Rules and the National Electricity Objective set out in section 7 of the National Electricity Law).

2 A calculation of the estimate of expected inflation using that methodology (using a placeholder averaging period of December 2015).

3 Your comments on the Preliminary Decision insofar as it relates to expected inflation.

Use of Report

It is intended that your report will be submitted by UE to the AER with its response to the Preliminary Decision. The report may be provided by the AER to its own advisers. The report must be expressed so that it may be relied upon both by UE and by the AER.

The AER may ask queries in respect of the report and you will be required to assist in answering these queries. The AER may choose to interview you and, if so, you will be required to participate in any such interviews.

The report will be reviewed by UE's legal advisers and will be used by them to provide legal advice as to its respective rights and obligations under the National Electricity Law and National Electricity Rules.

If UE was to challenge any decision ultimately made by the AER, that appeal will be made to the Australian Competition Tribunal and your report will be considered by the Tribunal. UE may also seek review by a court and the report would be subject to consideration by such court. You should therefore be conscious that the report may be used in the resolution of a dispute between the AER and UE. Due to this, the report will need to comply with the Federal Court requirements for expert reports, which are outlined below.

Compliance with the Code of Conduct for Expert Witnesses

Attached is a copy of the Federal Court's Practice Note CM 7, entitled "*Expert Witnesses in Proceedings in the Federal Court of Australia*", which comprises the guidelines for expert witnesses in the Federal Court of Australia (**Expert Witness Guidelines**).

Please read and familiarise yourself with the Expert Witness Guidelines and comply with them at all times in the course of your engagement by UE.

In particular, your report should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1 contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;

2 identify the questions that the expert has been asked to address;

3 set out separately each of the factual findings or assumptions on which the expert's opinion is based;

4 set out each of the expert's opinions separately from the factual findings or assumptions;

5 set out the reasons for each of the expert's opinions; and

6 otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

It is also a requirement that the report be signed by the expert and include a declaration that "*[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the report*".

Please also attach a copy of these terms of reference to the report.

Terms of Engagement

Your contract for the provision of the report will be directly with UE. You should forward your account for the work performed directly to UE.

Please sign a counterpart of this letter and return it to us to confirm your acceptance of the engagement.

Yours faithfully

Enc: Federal Court of Australia Practice Note CM 7, "Expert Witnesses in Proceedings in the Federal Court of Australia"

……

Signed and acknowledged by Dr Tom Hird

Date ……

ceg COMPETITION ECONOMISTS GROUP

Best estimate of expected inflation

Dr. Tom Hird

September 2016

COMPETITION ECONOMISTS GROUP

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1 Executive summary

1. Expected inflation is used by the AER as an input to the Post Tax revenue Model (PTRM) wherein it is used to convert the nominal allowed rate of return into a real allowed rate of return which is embedded in allowed revenues. The removal of expected inflation from regulated revenues set in by the PTRM in the immediate regulatory period is consistent with the fact that the compensation for inflation occurs subsequently primarily via indexation of the regulatory asset base (RAB) in the AER's RAB roll forward model (RFM).

2. Broadly speaking the rationale for the current approach is to avoid double counting of inflation. Absent any decrement for expected inflation in the PTRM (step ii), the regime would provide double compensation for inflation:

   a. once through the nominal rate of return allowed (step i at paragraph 15); and

   b. once through the inflation indexation of the RAB across regulatory periods (as per the AER's RAB Roll forward model (RFM)) (step iiib at paragraph 15).

3. The AER's methodology for estimating 10-year inflation results in an estimate that is currently much higher (around 70bp) than expectations implied in bond market prices. It also results in a significantly negative real risk free rate (around -50bp) applied in its regulatory decisions. This is contrary to investors being able to earn a positive guaranteed real return on inflation indexed Commonwealth Government Securities (CGS).

4. In our view, break-even inflation is a better estimate of expected inflation than the method associated with the AER's estimate. The AER's methodology assumes that investors expect that inflation will be in the middle of the RBA target range (2.5%) at horizons beyond 2 years. While this may have been a reasonable assumption historically (and may be in future years) it:

   - cannot always be presumed to be reasonable; and
   - is not a reasonable assumption in current market circumstances.

5. In current circumstances the AER's estimate of inflation, in particular the assumption that investors expect inflation to average 2.5% beyond 2 years, is at odds with all of the available evidence. Namely:

   - Break-even inflation estimates (1.7%) are well below AER forecasts (2.4%) even at a horizon of 10 years. The RBA itself is forecasting inflation out to December 2018 to be below the bottom of its target range out to the end of the RBA forecast horizon.
   - In the current monetary policy environment, where policy rates are close to the zero lower bound, the greatest risks to inflation are to the downside. This risk is

not theoretical, all western developed countries currently have monetary policy settings with policy rates close to zero and all are currently undershooting inflation targets.

- Expected inflation is the actuarially expected inflation (average of all possible inflation outcomes weighted by their probability). So, even if investors perceived that the most likely expected inflation was 2.5%, expected inflation would be below this once the greater downside risks were appropriately weighted.
- The AER's estimate of expected inflation implies that investors expect a negative real return on the risk free rate. The fact that they can achieve a positive guaranteed real risk free return simply by buying inflation indexed CGS demonstrates this is clearly not the case; and
- Break-even inflation forecasts have been more reliable than the AER's forecasting methodology in recent years. Break-even inflation forecasts accurately predicted the recent fall in inflation below the bottom of the RBA's target range while the AER's methodology did not;
- An expectation that Australian inflation will jump to 2.5% at the end of the RBA forecast period is inconsistent with the fact that Australian (and global) inflation rates have been persistently below target for many years, with instances of deflation in Australia (March quarter CPI), US, Japan, the UK and the Eurozone.
- Falling 10-year break-even inflation is a statistically significant explanatory variable when regressed against nominal CGS yields – suggesting that most of the recent fall in nominal CGS yields is due to falling inflation expectations (not falling required real returns as implicitly assumed by the AER).

6. The AER has raised potential sources of bias in the use of break-even inflation. We have reviewed the relevant literature relied on by the AER (and more widely). The overwhelming conclusion of this literature survey is that the potential sources of bias alluded to by the AER are small and, in any event, are just as likely to result in an over-estimate of expected inflation as an underestimate. Certainly, it is not plausible that these account for the current around 70bp difference between break-even inflation and the AER's estimate of expected inflation.

7. In any event, the sources of potential bias in break-even inflation identified by the AER actually imply that the nominal CGS yield is a biased proxy for the risk free rate. If these sources of bias did exist to the extent claimed by the AER then the appropriate course of action would be to adopt the indexed CGS yield as the real risk free rate proxy.

8. We explain how this can be done by estimating a real cost of capital directly. The nominal cost of capital inputs to the PTRM can then be estimated by adding expected inflation to the real cost of equity and debt. Under this approach, the nominal cost of debt and equity used as inputs into the PTRM are set equal to the estimated real of debt and equity plus expected inflation. This approach has, in our view, the material

advantage that it renders the estimate of expected inflation used in the PTRM relatively unimportant to the compensation that will be provided to the regulated entity.

9. This is because, it is the real cost of capital that is, ultimately, what the PTRM uses to determine the amount of compensation for the cost of capital embedded in allowable revenues (as was set out in Section 3). Therefore, it is appropriate that this real rate of return be the central focus of a cost of capital decision by the regulator.

10. In addition, notwithstanding our view that breakeven inflation provides superior estimates to the AER's estimates, we note that this approach can also be used even if the AER's method for estimating expected inflation in the PTRM must be applied.

2 Introduction

11. I have been asked by Johnson Winter & Slattery to provide a report advising on the best estimate of expected inflation and the real cost of capital which are, or feed into, inputs to the PTRM and to respond to the AER's recent Draft Decision for AusNet Services' transmission determination.

12. The remainder of this report has the following structure:

    - Section 3 discusses how expected inflation, as used in the rules and the PTRM, should be defined. We show that it is expected inflation by investors in bond markets that is relevant. Section 3 emphasises the fact that expected inflation takes into account the (probability weighted) average of all possible perceived outcomes by investors in bond markets;
    - Section 4 explains why break-even inflation best captures the inflation expectations of investors in bond markets;
    - Section 5 explains why we consider that break-even inflation is the best estimate of expected inflation and why it is superior to the AER's method for estimating expected inflation;
    - Section 6 surveys the literature relied on by the AER as part of its decision to not give any weight to break-even inflation when estimating expected inflation;
    - Section 7 discusses how to estimate the real cost of capital using the indexed Commonwealth Government Security (CGS) yield as the real risk free rate. It is explained that this approach renders the estimate of expected inflation relatively unimportant to the real compensation paid/earned by consumers/investors.

13. I acknowledge that I have read, understood and complied with the Federal Court of Australia's Practice Note CM 7, "Expert Witnesses in Proceedings in the Federal Court of Australia". I have made all inquiries that I believe are desirable and appropriate to answer the questions put to me. No matters of significance that I regard as relevant have to my knowledge been withheld.

14. I have been assisted in the preparation of this report by Johnathan Wongsosaputro and Ker Zhang in CEG's Sydney office. However, the opinions set out in this report are my own.

Thomas Nicholas Hird

3 Expected Inflation in the regulatory context

15. The current structure of the inflation compensation arrangements can be summarised as follows:

    i. Take a nominal input for the cost of debt and equity as inputs to the PTRM;

    ii. Deduct an estimate of expected inflation (also an input to the PTRM) to arrive at a real return which is then embedded in the real regulated revenue path which is the output of the PTRM;

    iii. Provide nominal compensation that is equal to:

        a. The real return derived in step ii); plus

        b. Compensate for the inflation that actually occurs over the regulatory control period as provided in the RAB roll forward model (RFM).[1]

16. In the context of step i), the rules state that the allowed rate of return is to be determined on a nominal vanilla basis.[2] In relation to step ii), the rules state that the PTRM must specify:[3]

    a methodology that the AER determines is likely to result in the best estimates of expected inflation

17. In relation to step ii), within the structure of the PTRM expected inflation gives rise to the "indexation of the regulatory asset base" building block as set out in 6A.5.4(b)(1) of the National Electricity Rules. The regulatory asset base is calculated in accordance with clause 6A.6.1 and schedule 6A.2. The building block comprises a negative adjustment equal to the amount referred to in clause S6A.2.4(c0(4) for that year (being the amount necessary to maintain the real value of the regulatory asset base as at the beginning of the subsequent year by adjusting that value "for inflation", or, more specifically, for expected inflation).

18. In relation to step iiib) the RAB is indexed for actual inflation between regulatory periods. Specifically, the RAB is rolled forward to the start of the next regulatory

[1] This is compensated primarily in the RAB roll forward used to set the opening RAB at the beginning of the next regulatory period but also (to a small extent) in the form of price escalation for inflation during the regulatory period.

[2] NER, R6A.6.2(d)(2).

[3] NER, R6A.5.3(b)(1).

period using actual (outturn) inflation in each year of the previous regulatory period (NER 6A.6.1(e)(3)).[4]

19. The National Gas Rules do not contain an equivalent to the above, but the AER's approach and application of its PTRM and RAB RFM is the same.

3.1 Simplified example

20. A simple example illustrates the calculations. Let there be a one-year regulatory period and a perpetual (non-depreciating) asset in the RAB with a value of $100. Let the nominal WACC be 8% and let expected inflation be 2% over the regulatory period and beyond (also let the tax rate be zero). In this stylised example, allowed revenues generated by this asset over the regulatory period will be $6 – comprised of 8% return on $100 less 2% ($2) expected revaluation.

21. If inflation turns out to be 2% then the asset owner will receive an actual $2 revaluation of their asset at the end of the one year regulatory period. Consequently, their total return comprising both revenues within the regulatory period and revaluation at the end of it will be equal to the 8% estimated cost of capital at the beginning of the regulatory period (6% in the form of revenues and 2% in the form of revaluation).

22. However, if actual inflation turns out to be 0% then the asset owner will receive 0% actual revaluation at the beginning of the next regulatory year. Consequently, the asset owner's nominal return will be 6% and not the estimated 8% at the beginning of the previous regulatory year. Similarly, if actual inflation turns out to be 4% then the asset owner will receive nominal compensation of 10% (6% in revenues and 4% in revaluations).

23. It can be seen that the current arrangements deliver a return on capital that is equal to the real cost of capital estimated at the beginning of a regulatory period. This real return is the key cost of capital assumption in the AER's methodology (even if it is derived from two separate assumptions). This is the real return that the regulated entity can expect to earn - with actual inflation added to this return via the operation of the RAB RFM in order to give a nominal return. Of course, the nominal return earned fluctuates with actual inflation – always consistent with the real return that was determined within the PTRM.

4 CEG, Measuring expected inflation for the PTRM, January 2016, paragraph 6.

3.2 Rationale for current approach

24. Broadly speaking the rationale for the current approach is to avoid double counting of inflation. Absent any decrement for expected inflation in the PTRM (step ii), the regime would provide double compensation for inflation:

    a. once through the nominal rate of return allowed (step i at paragraph 15); and

    b. once through the inflation indexation of the RAB across regulatory periods (as per the AER's RAB Roll forward model (RFM)) (step iiib at paragraph 15).

25. The role of the decrement for expected inflation in the PTRM is to cancel out the expected value of one of the above sources of compensation for inflation. This still leaves open the question of which of these two sources of inflation compensation should be cancelled out?

26. This becomes an issue when it is recognised that the two sources of inflation compensation are not necessarily the same. That is, the inflation expectations that are built into the nominal rate of return (which it is the AER's practice to benchmark based on 10 year bond yields) is not necessarily the same as the expectation of inflation over the 5 year period that the RAB RFM will be applied. Therefore, it becomes an open question as to whether expected inflation used in the PTRM should have a 10 year horizon or a 5 year horizon.

27. We have previously proposed the adoption of two different terms for inflation forecasts - a 5 year term to be applied in the PTRM to the debt portion of the RAB and a 10 year term to be applied to the equity portion.[5] Our basis for this proposal was that it targeted a nominal return on debt which, we considered appropriate given that debt is issued in nominal terms and attempting to remove the same inflation compensation expected to be provided in the RAB RFM would target a nominal return.

28. In its final decision for AusNet electricity distribution the AER clearly stated its view that a 10 year term should be used:[6]

> *It is both internally consistent and necessary to use a 10 year inflation expectation to convert a nominal return on debt with a 10 year term to a real return on debt with a 10 year term. Debt contracts are based on prices investors are willing to pay. These prices reflect investor expectations of the risk free rate, debt risk premium and inflation over their investment horizon at the time they raise this debt. Service providers, including AusNet Services agree that this horizon (or term) for the return on debt is 10 years.*

5 See CEG, Measuring expected inflation for the PTRM, June 2015, CEG, Measuring risk free rates and expected inflation, April 2015. CEG, Measuring expected inflation for the PTRM, January 2016.

7 Sheldon M. Ross, Introduction to Probability Models, Academic Press, 2007, p.39

> *Therefore, while debt contracts may fix the nominal cost of debt, this cost incorporates investor expectations of inflation over the next 10 years*. (Emphasis added.)

29. Here, the AER expresses its view that the objective in setting expected inflation is to cancel out inflation compensation built into the nominal allowed rate of return (step i at paragraph 15) not compensation that will be provided in the RAB RFM (step iiib at paragraph 15).

30. We accept the logic of this view as it applies to the cost of equity but, in our view we consider that the logic is weak when applied to the cost of debt. Nonetheless, for the purpose of this report we proceed on the basis that the objective is to use expected inflation to remove prevailing 10 year, and only 10 year, expectations of inflation from the nominal allowed rate of return in the PTRM. That is, we accept the AER's premise as set out in the above quote. We note that this is conservative and that, instead, giving 60% weight to a 5 year term would lower the expected inflation estimate and raise both expected real and nominal compensation.

4 Expected inflation is a probability weighted average

31. This section establishes that expected inflation, as used in the PTRM, is a probability weighted average of all possible inflation outcomes as perceived by bond investors. This is important for a number of reasons, most notably:

    - It explains the distinction between "most likely" inflation outcomes and expected inflation. This becomes critical when attempting to estimate expected inflation in the presence of an asymmetric distribution of perceived outcomes which is currently the case (as discussed in section 5 below).
    - It highlights the fact that inflation measures taken from bond markets are measures of expected inflation (while many forecasts cannot be assumed to be) and are the most relevant measures of expected inflation.

4.1 Expected vs most likely inflation

32. The term 'expected inflation' has a precise meaning as a matter of financial economics. This precise meaning is also consistent with the way in which expected inflation is used within the PTRM.

33. As a matter of financial economics (and mathematics more generally), the use of the term 'expected' connotes the mean of the distribution of all possible outcomes.[7]

> *In other words, the expected value of X is a weighted average of the possible values that X can take on, each value being weighted by the probability that X assumes that value.*

34. That this is the same use of the term 'expected' in financial economics is clear from reading any finance text book, including Brealey and Myers.[8] An example of an expected return on a risky asset is the probability weighted average of all outcomes. Consider a $100 bet on the toss of a fair coin. There are two possible outcomes – being the gambler loses $100 (100% loss) or wins $100 (100% gain) each with 50% probability. However, the *expected* outcome is that the gambler earns a zero return on their bet.

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7 Sheldon M. Ross, Introduction to Probability Models, Academic Press, 2007, p.39

8 For example, see Brealey and Myers, Principles of Corporate Finance, tenth edition, Mcgraw-Hill/Irwin, p. 578.

35. This example illustrates that the expected return is not, necessarily, the most likely outcome.[9] Rather, it is the weighted average across each possible outcomes, where the weight is given by the probability attached to each outcome. In the context of expected inflation, an investor may believe that inflation could be:

- 1.0% with 30% probability;
- 2.0% with 50% probability; and
- 2.5% with 20% probability.

36. Here the expected inflation outcome is 1.8% - which is the probability weighted average of all inflation outcomes. This is not the most likely (modal) outcome which is 2.0% and nor is it the median outcome (which is also 2.0%). This is because the investors' perception of all possible outcomes is skewed – in that a there is a greater perceived probability of lower than modal/median inflation than higher than modal/median inflation.

37. In this regard it is important to note that 'expected inflation' is not necessarily the same as 'forecast inflation'. A forecast of inflation could, and typically is, a statement of what is the most likely outcome. This need not correspond with the probability weighted expected outcome. In the case of the above example, forecast inflation may be reported as 2.0% - being the most likely outcome. However, the expected inflation estimate is 1.80% - being the probability weighted average of all possible outcomes.

4.2 Bond investors' inflation expectations are the most relevant

38. The reason that an investor's inflation expectations are important is that they determine the nominal return the investor will expect for any given target real return. For example, imagine the same investor in our above example had a required real return on investments in government debt of 1.0%. In which case, that investor would, given inflation expectations of 1.8%, require a promised nominal return of 2.8% (=1.0% + 1.8%).[10] [11]

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9 In fact, in this case the expected return cannot actually come to fruition (at least not on a single coin toss).

10 For simplicity of illustration the calculations are performed without using the Fisher equation. The correct calculation of real returns are equal to (n-p)/(1+p), where n=the nominal return and p=inflation.

11 This assumes that the investor does not demand an additional premium in order to compensate for the fact that the investor is still exposed to inflation risk – being the variability in actual (as opposed to expected) real returns given that the actual inflation outcome is not known. This is because the 1.0% expected real return is the probability weighted return across three possible inflation outcomes, namely:

- 1.8% (2.8%-1.0%) with 30% probability;
- 0.8% (2.8% - 2.0%) with 50% probability; and
- 0.3% (2.8% - 2.5%) with 20% probability.

39. The previous section explains that the expected inflation input to the PTRM determines, in combination with the nominal cost of capital inputs to the PTRM, a real rate of return that is delivered to the regulated entity. The AER's current methodology is to estimate the nominal cost of capital inputs based on:

    - nominal corporate bond yields for the cost of debt; and
    - nominal government bond yields as the risk free rate used to determine the cost of equity.

40. The nominal bond yields determined by supply and demand in financial markets already include bond investors' expectations of inflation. As the AER argues,[12] it follows that it is this expectation of inflation that should be removed from these bond yields.

41. That is, it is the expectation of inflation that is built into nominal bond yields that must be removed from these bond yields to derive an internally consistent estimate of the real return on capital – the return that is going to be delivered to the regulated entity by the operation of the regime. In this context, a measure of expected inflation taken directly from bond market prices, as discussed in section 5 below, is the obvious first place to look for a measure of expected inflation built into nominal bond yields.

[12] AER, Final decision, AusNet distribution, May 2016, p. 3-154.

5 Break-even rates best capture bond investors' expectations

42. Break-even inflation is calculated based on the difference in yields between inflation indexed Commonwealth Government Securities (CGS) and nominal CGS. This is termed 'break-even' inflation because that is the inflation expectation at which investors expect the same nominal return from either asset. That is, it is the rate of inflation that, if it actually occurred, would leave investors' indifferent between having purchased a nominal bond versus an inflation indexed bond.

43. By contrast, the AER's method is to assume expected inflation over the next 10 years is equal to the average of:

    - The midpoint of the RBA's inflation forecast range which typically only extends out 2 years;
    - An assumption that inflation expectations are 2.5% in every year thereafter.

44. Break-even inflation has three critical advantages over the AER's proposed method for estimating expected inflation:

    - First, and foremost, break-even inflation is a direct measure of inflation expectations in the same bond market that the AER uses to set the nominal rate of return on equity (i.e., the CGS market).
    - Second, break-even inflation already reflects a probability weighted average of all possible inflation outcomes as perceived by bond investors. This cannot be assumed to be the same, and generally is not the same, as published forecasts of the most likely inflation outcome.[13]
    - Third, break-even inflation is available at a 10 year horizon when alternative non-market based[14] forecasts of inflation are not typically available for more than one or two years.

45. All of these points suggest advantages in the use of break-even measures of expected inflation estimates. A further important advantage of adopting break-even inflation in the PTRM is that doing so has the effect of setting the real risk free rate equal to

[13] It is also possible that expected inflation by bond investors is different to expected inflation of other members of society (e.g., consumers, 'talking head' economic pundits, government agencies etc.).

[14] We note that we can also observe fixed rates on CPI indexed swaps. However, as we have stated in our previous reports, and repeat in Appendix B, CPI swaps are in effect equal to break-even inflation plus a margin for bank costs (including regulatory costs in the form of capital requirements). They are therefore an upwardly biased measure of inflation expectations in bond markets. It is also the case that transaction costs associated with entering into CPI swaps are likely to be high.

the observable yield on indexed CGS. This is an advantage because, as explained section 7.1, indexed CGS are a more direct proxy for the real risk free rate than nominal CGS less an estimate of expected inflation (even if that estimate of expected inflation is accurate). Consequently, adopting the yield on indexed CGS as the real risk free rate will substantially improve the accuracy of the PTRM in setting real returns (which, as set out in section 3, is the ultimate output of the PTRM).

46. We consider the AER's estimate of inflation, in particular the assumption that investors expect inflation to average 2.5% beyond 2 years, to be at odds with all of the available evidence. Namely, The 80% weight to an assumption of 2.5% inflation, without any circumstance specific justification, means that AER's estimate of expected inflation cannot, by construction, respond to either falling actual inflation (which has been below target on average over the last three years) or other evidence which strongly suggests falling inflation expectations (including dramatically lower nominal CGS yields in absolute terms and relative to yields on inflation indexed CGS).

47. Evidence in support of break-even inflation providing a better measure of expected inflation includes:

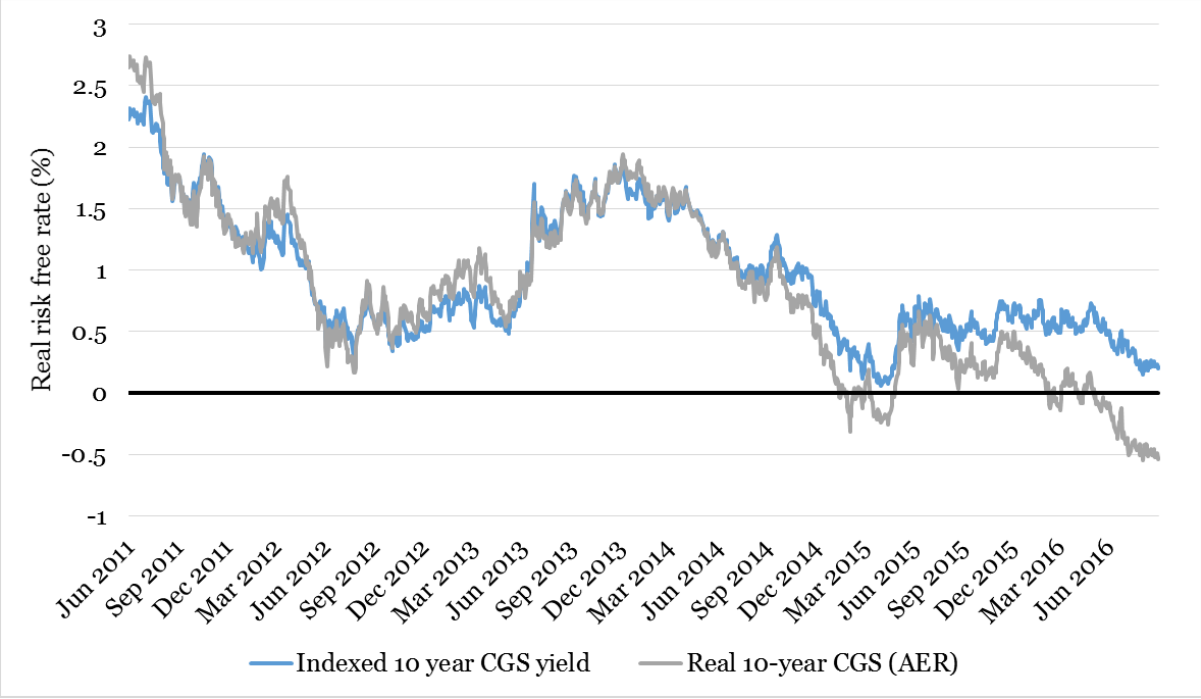
- The AER's estimate of inflation expectations implausibly suggests that investors expect a negative real return on nominal CGS at the same time that they can achieve a positive guaranteed real risk free return simply by buying inflation indexed CGS (see **section 5.1**); and
- Break-even inflation estimates have, unlike AER estimates, responded materially to the sustained low inflation outcomes over the last three years (in a manner consistent with expectations (see **section 5.2** below).
- Break-even inflation accurately predicted the recent fall in inflation below the bottom of the RBA's target range – more accurately than RBA forecasts (see **section 5.3**);
- Break-even rates are the only plausible way in which the uncertainty about the multiple different paths inflation could take can be weighted in a manner consistent with the probabilities that bond investors attach to these outcomes. This is critical in the current environment where such uncertainties are heightened by unusually low recent inflation outcomes and the RBA's target cash-rate approaching the "zero lower bound". See **section 5.1** below;
- Moreover, RBA short term forecasts are "central forecasts" and, therefore, likely to underestimate "expected inflation" where the downside risks exceed the upside risk (see **section 5.5** below);
- An expectation that Australian inflation will jump to 2.5% at the end of the RBA forecast period is inconsistent with the fact that Australian (and global) inflation rates have been persistently below target for many years, with instances of deflation in Australia (March quarter CPI), US, Japan, the UK and the Eurozone (see **section 5.6**).

- Falling 10 year break-even inflation is a statistically significant explanatory variable when regressed against nominal CGS yields – suggesting that most of the recent fall in nominal CGS yields is due to falling inflation expectations (not falling required real returns as implicitly assumed by the AER – see **section 5.7** below).

5.1 The AER's estimate for expected inflation implies negative real returns

48. The yield on 10-year indexed CGS over the last 5 years is provided in Figure 1 below. It is relevant to compare this yield with the estimated real risk free rate applying the AER's current methodology, which is to deduct its estimate of expected inflation from the yield on 10-year nominal CGS.

Figure 1: Competing 10-year real risk free rate estimates (last 5 years)



Source: AER, RBA, CEG analysis

49. It can be seen that until late 2014, the AER's methodology implied a real risk free rate that was similar to the yield on indexed CGS. However, since then the AER's estimate of the real risk free rate has fallen precipitously and is currently negative 0.5. That is, the AER's estimate implies that investors are expecting to lend to the Australian government in return for receiving less in purchasing power after 10 years than they invested originally.

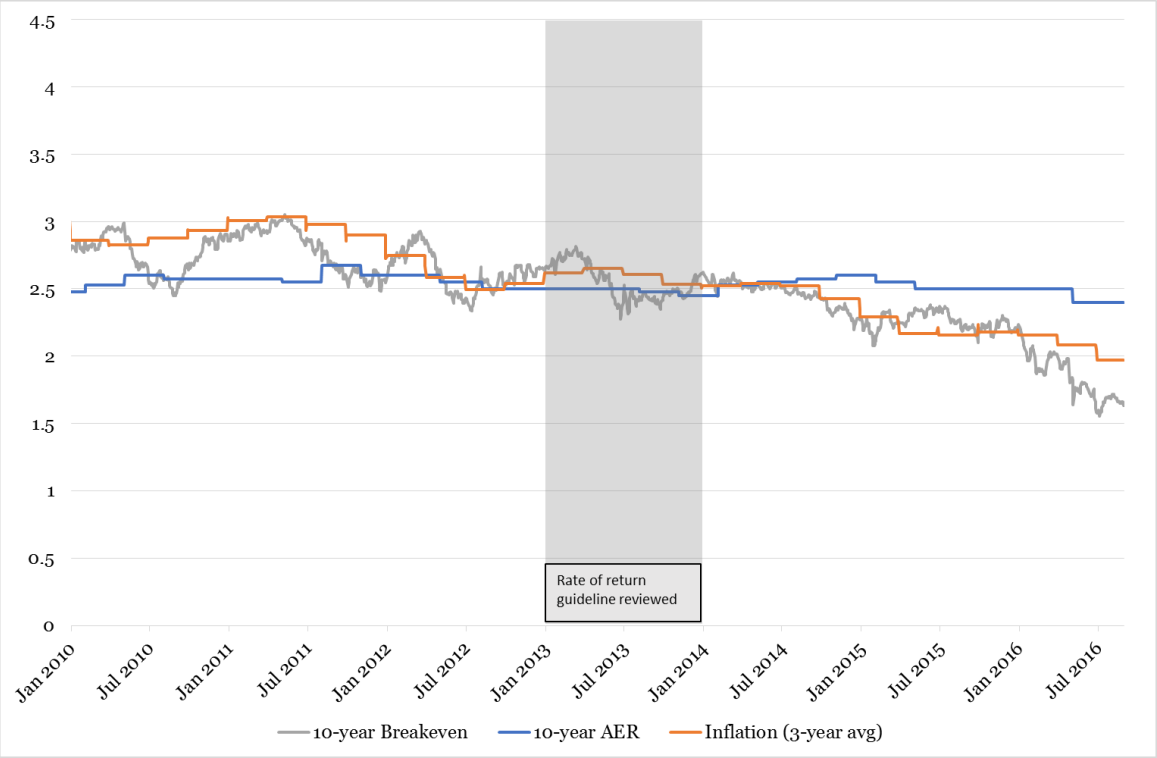
50. The unreasonableness of such an outcome is demonstrated by observing that investors' could buy inflation indexed CGS at a guaranteed positive real return. We believe that the anomaly (negative estimated real returns to risk free saving in nominal assets) is a result of the AER's estimate of the expected inflation rate being inappropriate for the current economic environment rather than a true anomaly in investor required returns.

51. We further note that the late 2014 divergence between the AER's real risk free rate estimate and the yield on indexed CGS has coincided with actual inflation falling well below the RBA's target range. That is, annual inflation fell below the bottom of the RBA range for the year ended December 2014 and has remained below that range since (being just over 1% in the most recent year to June 2016). By contrast, the AER's estimate of expected 10 year inflation has fallen by only 10bp to 2.40%.

5.2 Break-even inflation estimates vs AER estimates

52. Over the month of August, 10-year break-even inflation rates averaged 1.7%. A time series for 10 year break-even inflation and AER 10 year inflation estimates is provided in Figure 2 below. Also shown is the actual inflation averaged over three years (ending on the date shown on the x-axis). Average inflation over three years is provided as a measure of the recent trend in CPI outcomes that would have been apparent to investors in bond markets on the relevant dates.

Figure 2: break-even inflation vs AER inflation (10 years) vs actual inflation (1 year) less 2.5%



Source: AER, RBA, CEG analysis

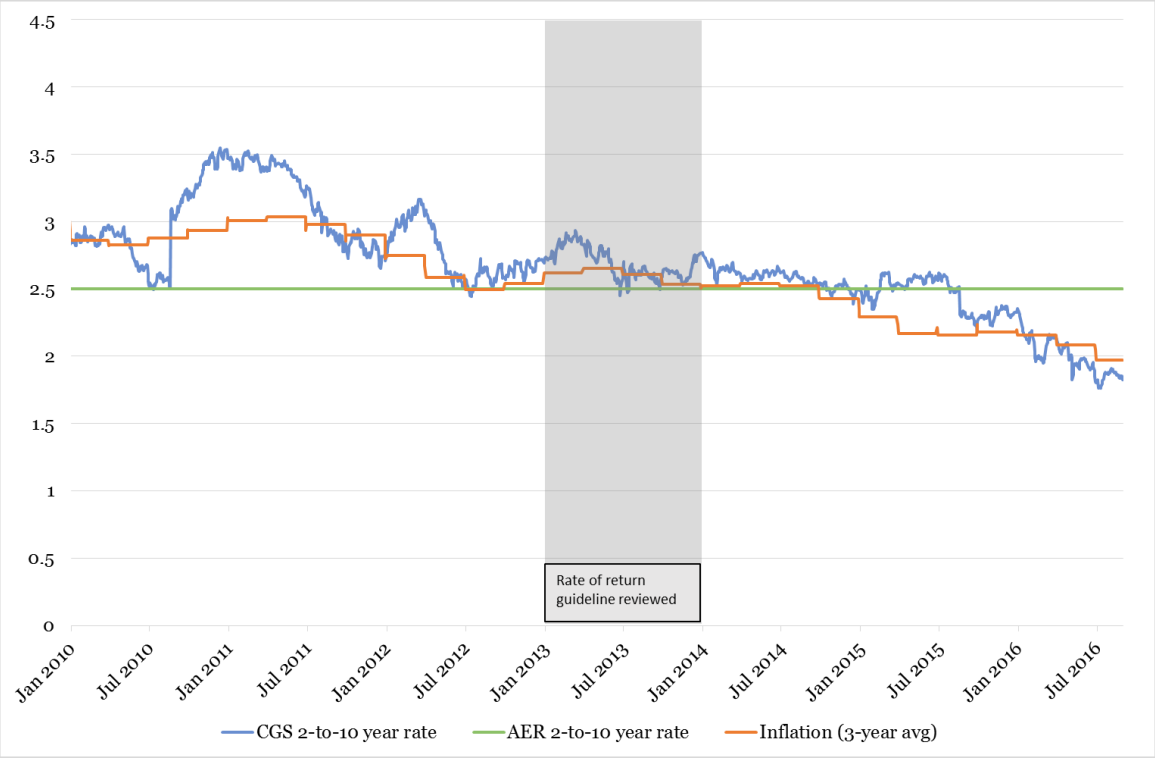
53. It can be seen that break-even inflation responded quickly to actual inflation falling well below RBA target from late 2015. We have highlighted the period in which the rate of return guideline was reviewed. It is relevant to note that this was:

    - before the sustained decline in actual inflation outcomes; and
    - a period where there was not a material difference between break-even and AER estimates of expected inflation.

    This explains why there was not a high degree of stakeholder concern about the AER's forecasting methodology expressed during the Guideline review.

54. Figure 2 follows the same structure as does Figure 1 except instead of showing the 10 year inflation estimate (break-even and AER) it shows the implied 8 year forward inflation rate. The AER's estimate is, by assumption, 2.5% in all future years. The implied 8 year forward break-even inflation rate is back-solved from the 2 year and 10 year break-even inflation rates.

Figure 3: break-even inflation vs AER inflation (10 years) vs actual inflation (1 year) less 2.5%



Source: AER, RBA, CEG analysis

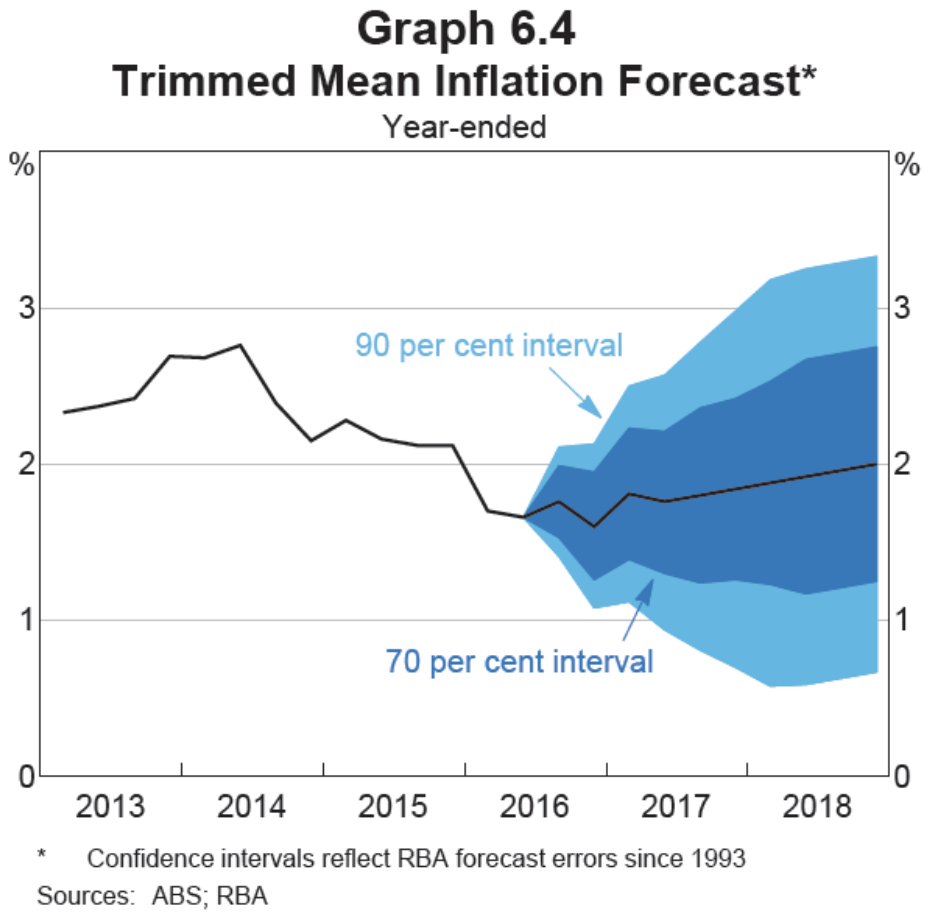
55. This illustrates that the AER's estimate of inflation beyond year 2 is impervious to market developments while the corresponding break-even inflation rate has declined dramatically.

5.2.1 RBA forecasts of underlying inflation are below 2.0% over the maximum forecast period

56. In this context it is relevant to note that the RBA's central forecast of underlying inflation (trimmed mean inflation)[15] increases only gradually over the next two and a half years as evidenced from Graph 6.4 of the August SoMP (reproduced below).

[15] The RBA's standard measure of underlying inflation is trimmed mean inflation. See RBA Bulletin, Measures of Underlying Inflation, March Quarter 2010 which states "Given that CPI inflation is quite volatile, most of the models and equations used in the Bank to explain inflation use some measure of underlying inflation (often 15 per cent trimmed-mean inflation) as the dependent variable."

Figure 4: RBA forecast path for underlying inflation



* Confidence intervals reflect RBA forecast errors since 1993

Sources: ABS; RBA

57. It is important to note, as the chart itself does, that the confidence intervals portrayed here are based on the historical average accuracy of RBA forecasts. They do not represent a bespoke estimate of the RBA's estimate of the distribution of possible future outcomes given the specific uncertainties that exist today.

5.3 Break-even inflation has accurately predicted actual inflation

58. This section examines the forecasting accuracy of break-even inflation estimates since 2011. Figure 5 compares actual inflation (orange bar) over the (single) year ending in each of the quarters specified on the horizontal axis to:

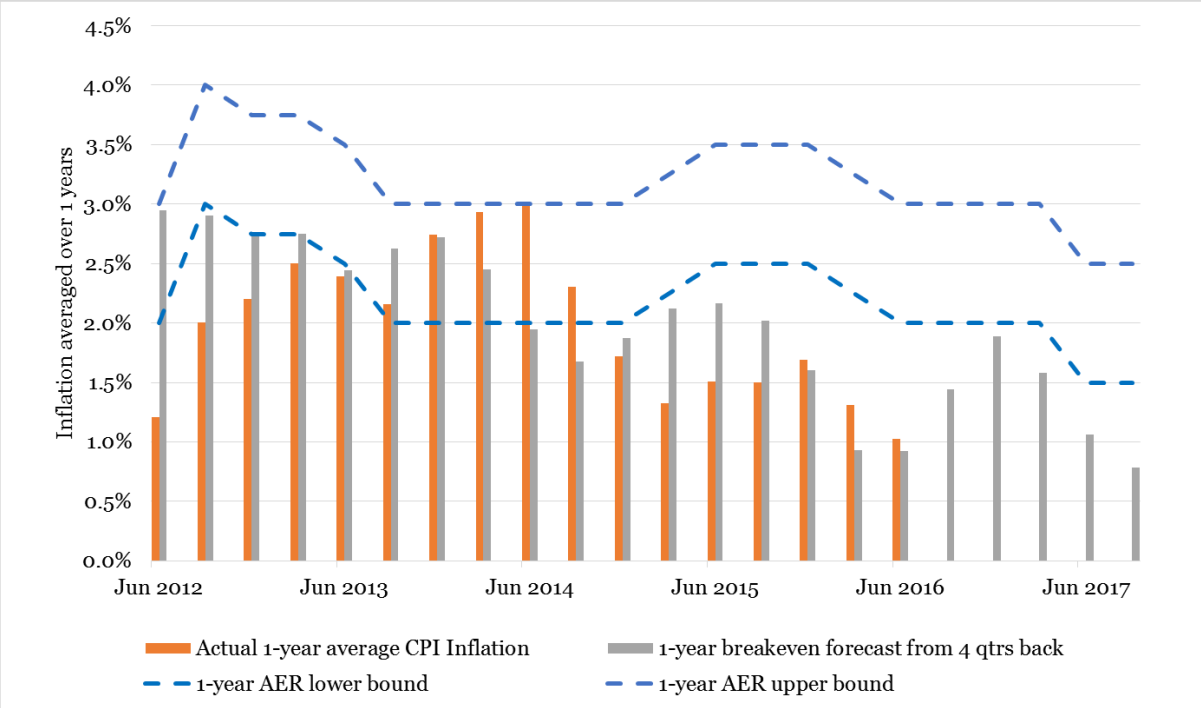
- The RBA forecast range (the midpoint of which is the AER forecast) (blue dotted lines) in that year made one year prior; and
- The 1-year break even inflation rate (grey bar) one year earlier.

59. It can be seen that break even inflation has typically performed best (grey bar is closer to orange bar than is the middle of the RBA forecast range). In fact, break-even

inflation is more accurate in predicting inflation from the December quarter 2014 onwards (which is associated with predictions made in December 2013 onwards).

60. Note also that the chart is extended out to June 2017 where there are no actual CPI figures available. This is done to remind the viewer that the forecasts shown are all made one year prior to the actual inflation figures (i.e., we have some forecasts that are yet to be tested). It also illustrates that the RBA only very recently reduced its midpoint forecast below 2.5% to follow break-even rates down.

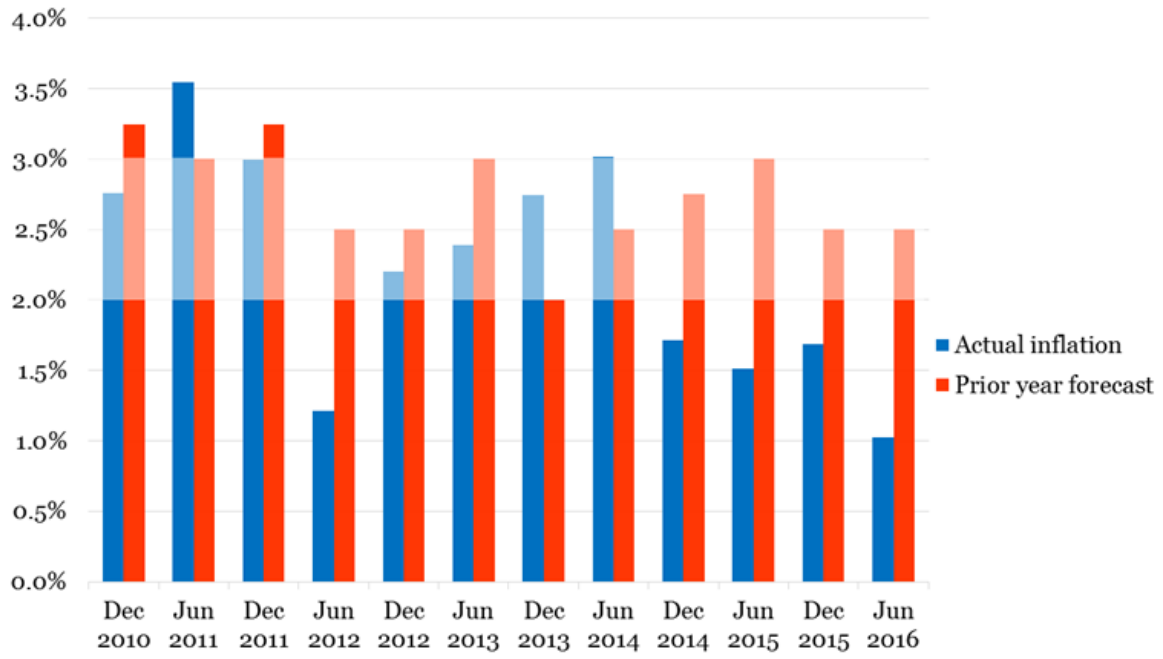
Figure 5: 1 year break-even inflation vs RBA range



Source: AER, RBA, CEG analysis

61. Similar content is presented slightly differently in Figure 6 below which compares, with semi-annual updates, actual inflation to RBA forecast inflation one year prior. Also shown via light shading is the RBA's target range of 2.0% to 3.0% inflation.

Figure 6: 1 year break-even inflation vs RBA range

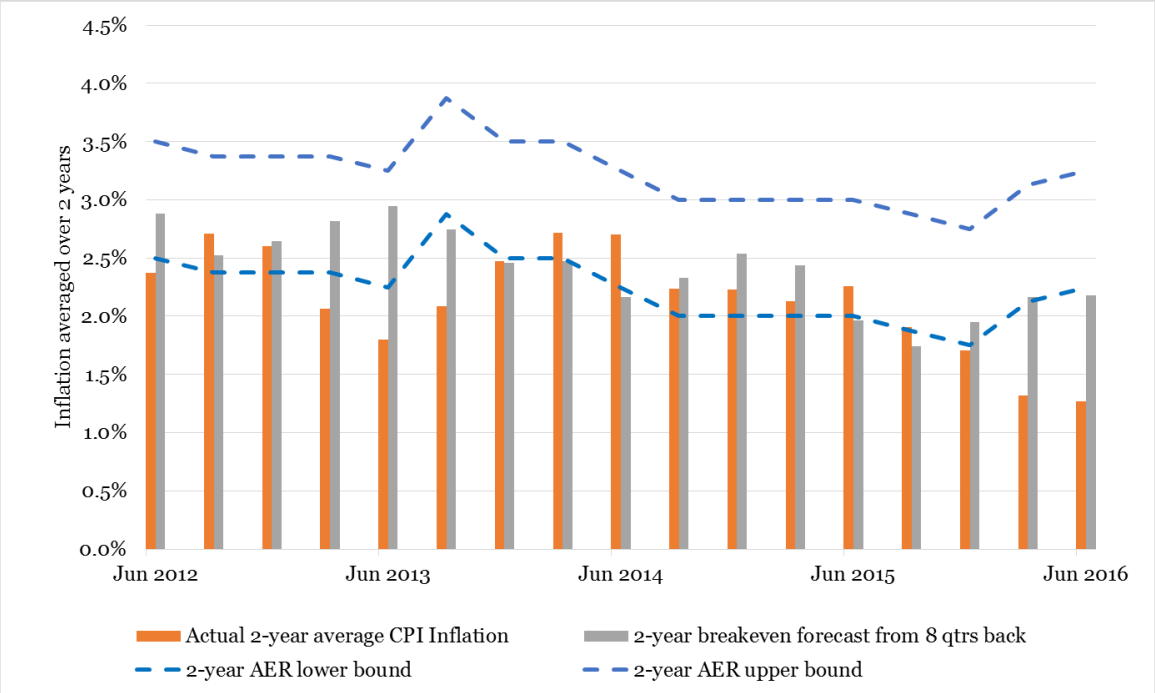


Source: AER, RBA, CEG analysis

62. The next chart is the same as the Figure 5 but uses 2 year inflation forecast horizons. Once more, break even inflation has performed materially better than the midpoint of the RBA range in the most recent years. In interpreting this chart, it must be kept in mind that the forecasts provided are now from one additional year earlier (two year prior to the date marked on the horizontal axis). That is why the RBA forecast range is still centred on 2.5 for June 2017 (because it was made in June 2015).

63. Once more, break-even inflation is almost always a better predictor of actual 2 year inflation than the midpoint of the RBA forecast range.

Figure 7: 2 year break-even inflation vs RBA range



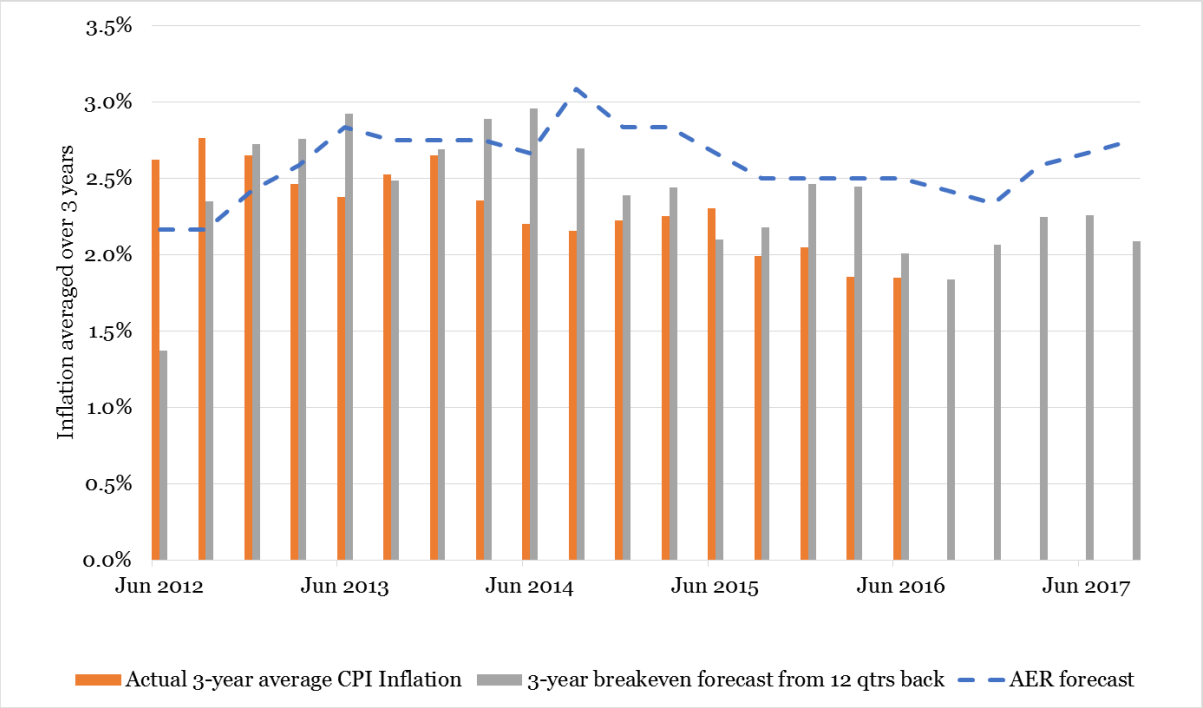
Source: AER, RBA, CEG analysis

64. A similar story exists for 3 year forecast horizons as shown in Figure 8 below. 3 year AER forecasts simply add one year of 2.5% estimated inflation to the midpoint of RBA forecasts. For this reason we dispense with showing a range because this is no longer based purely on an RBA forecast range.

65. Break-even inflation has been more accurate in predicting actual 3 year inflation ending in every quarter since September 2014. However, this is now associated with all predictions made since September 2011.

66. In this chart, the earliest inflation forecasts (left hand side of the chart) are from June 2009, which is affected by the GFC and the abnormally high liquidity premium at that time. This is a reasonable explanation of why break-even inflation underestimated actual inflation over the next three years. However, for forecasts from September 2009 (associated with September 2012 on the x-axis of Figure 8) break even inflation has been almost always the more accurate forecast and especially in more recent periods.

Figure 8: 3 year break-even inflation vs AER forecast



Source: AER, RBA, CEG analysis

5.4 Break-even rates capture and weight highly uncertain and asymmetrically distributed outcomes

67. A critical advantage to the use of break-even inflation as a measure of inflation expectations is that it will incorporate the probability weighted average of all possible inflation outcomes perceived by bond market investors. This is a critical advantage in the current market circumstances in which there is a great deal of uncertainty around these possible outcomes and where there is every reason to believe that the balance of inflation risks are to the downside of the 'most likely' outcome.[16]

68. With the RBA cash rate at record low levels of 1.5%, the policy interest rates are dangerously close to the 'zero lower bound'. Monetary policy's most direct effect on the economy and, therefore, inflation is through lower interest rates. However, the RBA cannot set a cash rate below zero (or at least not materially below zero) because at such levels, businesses and households will prefer to hold cash – which delivers a zero rate of interest. The potential for monetary policy to stimulate economic activity diminishes as policy interest rates approach zero, thereby creating the potential for a

[16] In this circumstance, reliance on forecasts of inflation that typically reflect the forecaster's assessment of the most likely outcome (see section 5.5 below) will be biased upwards relative to the true expected inflation (just as was the case in the example in section 4.1).

low inflation trap, for which monetary policy may be ineffective at extracting the economy from.

69. Governor Brainard of the US Federal Reserve released the text of a speech made on 12 September 2016 (i.e., immediately prior to finalisation of this report) which made precisely this point:[17]

> *The four features just discussed that define the new normal make it likely that we will continue to grapple with a fifth new reality for some time: the ability of monetary policy to respond to shocks is* ***asymmetric****. With policy rates near* ***the zero lower bound*** *and likely to return there more frequently even if the economy only experiences shocks similar in magnitude to those experienced pre-crisis, due to the low level of the neutral rate, there is an asymmetry in the policy tools available to respond to adverse developments. Conventional changes in the federal funds rate, our most tested and best understood tool,* ***cannot be used as readily to respond to downside shocks to aggregate demand as it can to upside shocks****.*
>
> …
>
> *Indeed, it is striking that despite active and creative monetary policies in both the euro area and Japan, inflation remains below target levels.* ***The experiences of these economies highlight the risk of becoming trapped in a low-growth, low-inflation, low-inflation-expectations environment*** *and suggest that policy should be oriented toward minimizing the risk of the U.S. economy slipping into such a situation.* [Emphasis added.]

70. This is, obviously, not a concern limited to the circumstances of the United States. Following the RBA's May 2016 rate cut, the financial press reported that: [18]

> *Australians must urgently confront the danger that the Reserve Bank of Australia is nearing the very limits of its powers* ***and risks stumbling***

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[17] Governor Lael Brainard, At the Chicago Council on Global Affairs, Chicago, Illinois, September 12, 2016, *The "New Normal" and What It Means for Monetary Policy,* available at http://www.federalreserve.gov/newsevents/speech/brainard20160912a.htm

[18] AFR Weekend, RBA joins race to the interest rate bottom, 6 May 2016 at 11.45pm. Available at this link: http://www.afr.com/news/economy/monetary-policy/rba-joins-race-to-the-interest-rate-bottom-20160506-gooblo#ixzz47xFNhJoE . See also Bloomberg, RBA's New Head Seen Facing Risk of Rate Cuts to 1% by JPMorgan May 9, 2016 (Available at http://www.bloomberg.com/news/articles/2016-05-08/rba-s-new-head-seen-facing-risk-of-rate-cuts-to-1-by-jpmorgan.) which reports:

> *The central bank's focus Friday on inflation expectations was notable given the phrase appeared 16 times in a document that rarely mentions it, said Joseph Capurso, a senior currency strategist in Sydney at Commonwealth Bank of Australia. "It is very hard to lift inflation expectations when they are low and Japan is a good example of this," he said*

> ***into the same zero-interest rate trap that has neutered European and Japanese central banks****, say two high-profile economists. …*
>
> *"The evidence is that even aggressive monetary policy action doesn't seem to be driving up inflation, so far," Mr Yetsenga told* AFR Weekend.

71. It is the potential to fall into such a trap is, naturally, an important factor for bond investors when valuing nominal bond yields. Low nominal bond yields may still offer reasonable real returns in the event that an economy falls into such a low inflation 'trap'. This is, of course, not a new insight and Appendix A discusses other evidence that this is a real concern both in Australian and internationally.

72. It is difficult to over-emphasise the importance of these considerations in the context of arriving at an estimate of expected inflation built into nominal bond yields. Even if investors attribute a low probability of Australia falling into a low inflation trap this will have a material impact on their expected inflation and, therefore, the compensation for inflation they require to be priced into nominal bond yields.

73. In order to illustrate this imagine a highly simplistic scenario where investors believe that:

- there is a one third probability of Australia falling into a low inflation trap, in which case inflation would average around 0.9% pa over the next 10 years;
- there is a two third probability that it would avoid falling into such a trap, in which case inflation would average 2.4%.

74. In this case the bond investors' expected inflation will be 1.9% notwithstanding that by far the most likely inflation outcome will be 2.4%. Nonetheless, the bond investor will only price in expected inflation of 1.9% into their valuation of nominal bonds.

75. In reality, the real world uncertainties are much greater than in this simplistic scenario. With some non-trivial probabilities almost certainly being attached to extended deflationary outcomes (as experienced in Japan and the Euro zone (and in Australia, albeit so far only in the March quarter 2016)).

76. It is an extremely fraught task for an individual/organisation to accurately model all such possible outcomes and to weight them by the perceived probability of those events occurring. As we discuss in the next section this is not what the RBA does when it arrives at its 2 year ahead forecasts – let alone what the AER does when it arrives at its assumption that beyond 2 years investors expect 2.5% inflation in every year. However, this probabilistic weighting is what occurs in financial markets where interactions between investors result in a market average expectation of future inflation being reflected in traded nominal bond yields.

5.5 RBA central forecasts of inflation are not the RBA's inflation expectation

77. The most recent IMF April 2016 World Economic Outlook provides a cogent summary of the difference between central forecasts and probability weighted forecasts where the distribution of possible outcomes is tilted to the downside. This discussion, while focussed on global forecasts and risks is, as we shall show, effectively mirrored by the RBA in relation to its domestic forecasts.[19]

> *WEO [(World Economic Outlook)] growth forecasts form a* ***central, or modal, scenario****—growth rates that the IMF staff estimates to be the* ***most likely*** *in each year of the forecast horizon. The weakening in global growth in late 2015 and the escalation of threats to global economic activity since the start of this year have led the staff to reduce the projected growth rates under the central scenario.*
>
> *Alongside these reduced central projections, the staff views* ***the likelihood of outcomes worse than those in the central scenario as having increased****. Put differently, not only is the central WEO scenario now less favorable and less likely;* ***in addition, the even weaker downside outcomes have become more likely****.*
>
> *… Over the near term, the main risks to the outlook revolve around (1) the threat of a disorderly pullback of capital flows and growing risks to financial stability in emerging market economies, (2)* ***the international ramifications of the economic transition in China****, …* ***Perceptions of limited policy space to respond to negative shocks, in both advanced and emerging market economies, are exacerbating concerns about these adverse scenarios.*** *In the euro area,* ***the persistence of low inflation*** *and its interaction with the debt overhang is also a growing concern. Beyond the immediate juncture, the danger of secular stagnation* ***and an entrenchment of excessively low inflation in advanced economies,*** *as well as of lower-than-anticipated potential growth worldwide, has become more tangible.*
>
> [Emphasis added.]

78. RBA Assistant Governor Christopher Kent, in a speech made on 6 April 2016, has used precisely the same example to illustrate the difference between central forecasts of what is most likely to occur and probability weighted consideration of all possible outcomes.[20]

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19 IMF, World Economic Outlook (WEO), April 2016, p. 24.

20 Christopher Kent, Assistant Governor (Economic), Address to the Economic Society of Australia (Hobart), University of Tasmania, Hobart – 6 April 2016. See also section 5.3 of RBA Research Discussion Paper,

> *One can also imagine scenarios that are unlikely to occur but may have far more substantial implications for the economic outlook if realised. These scenarios can be difficult to quantify but may be worth discussing nonetheless.* ***An example that we discussed in our most recent*** **Statement** ***which was the potential for financial instability in China to lead to a sharp slowdown in economic activity there and in the Asian region more broadly.***

79. The "Statement" referred to above is the February 2016 SoMP where there is a long discussion of downside risks to the forecasts associated with negative development in China which mirrors the IMF's own discussion.[21] This is repeated in the August SoMP in which the RBA states under the heading of "uncertainties":[22]

> *The forecasts are based on a range of assumptions about the evolution of some variables, such as the exchange rate and population growth, and judgements about how developments in one part of the economy will affect others. One way of demonstrating the uncertainty surrounding* ***the central forecasts*** *is to present confidence intervals based on historical forecast errors (Graph 6.3; Graph 6.4; Graph 6.5).*
>
> *It is also worth considering the consequences that different assumptions and judgements might have on the forecasts and the possibility of events occurring that are not part of the* ***central forecast***. (Emphasis added.*)*

80. Put simply, the midpoint of the RBA's forecast range cannot be assumed to be the probability weighted mean inflation expectation that is perceived by investors (and which will be reflected in nominal CGS yields). The best way to ensure that this is the case is to use inflation forecasts derived from financial market prices which automatically reflect investors' mean actuarial expectations across all possible outcomes.

5.5.1 RBA forecasts are a policy tool as well as an independent estimate

81. It is also relevant to note that the biggest challenge the RBA faces is avoiding a low inflation is the self-fulfilling prophecy of low inflation expectations. In the words of Nobel Prize winning economist Paul Krugman:[23]

Estimates of Uncertainty around the RBA's Forecasts, Peter Tulip and Stephanie Wallace, 2012-07. This article is referenced by Assistant Governor Kent in his 6 April 2016 speech.

[21] See RBA, Statement On Monetary Policy, February 2016 pp. 63-64.

[22] RBA, Statement On Monetary Policy, May 2016 p. 63.

[23] Paul Krugman, Rethinking Japan, 20/10/2015, New York Times, The Opinion Pages (online, available at: http://krugman.blogs.nytimes.com/2015/10/20/rethinking-japan/?_r=0)

"...if nobody believes that inflation will rise, it won't"

82. If the RBA does forecast inflation to continue to be below its target range then this very act may make its task of returning inflation expectations, and ultimately actual inflation, back to within its target range more difficult. That is, RBA forecasts are a policy tool for anchoring inflation expectations as well as an expression of the RBA's view.

83. Consistent with this, break-even inflation forecasts fell materially following the release of the RBA's downgraded inflation forecast in its 5 May 2016 SoMP. In that publication the midpoint of the RBA forecast range for inflation was 2.0%; at the bottom of, but still within, the target range of 2.0% to 3.0%. This would appear to have shifted market expectations of inflation - with the 10 year break-even rate falling from 1.84% on 4 May to 1.64% on 6 May (noting that in the 5 days after the ABS release of the March quarter CPI deflation (i.e., 28 April to 4 May) the 10 year break-even rate had traded at between 1.80% and 1.84%).

84. The influence of RBA forecasts on inflation expectations creates a potential tension for the RBA. If it publishes a forecast well below its target range it risks triggering a reduction in inflation expectations that is self-fulfilling. On the other hand, the RBA must preserve its credibility and it cannot be seen to be publishing forecasts that are inaccurate or overly optimistic.

85. One way the RBA could deal with this issue is to adopt a set of central assumptions that are credible but that limit, to the extent possible, the risks that the forecast will lower expected inflation in the community. At the same time, the RBA could adopt a wide range around that forecast (which it has recently done by widening its forecast interval) and deal with potentially asymmetric risks to the central forecasts in a discursive manner. It is certainly arguable that this is consistent with the RBA's current practice.

5.6 Actual inflation has been persistently low (in Australia and internationally)

86. Figure 8 from the previous section shows that average inflation in Australia has been below 2.0% for more than the last 3 years. As discussed previously, low Australian inflation is entirely consistent with international experience across western developed countries, with inflation persistently at or below the bottom end of central bank targets.[24] RBA Governor Glenn Stevens has made the same point in a 3 May 2016 speech when announcing a further cut in the official cash rate by 25bp to 1.75%.

[24] See IMF, World Economic Outlook (WEO), April 2016. "*Headline inflation in advanced economies in 2015, at 0.3 percent on average, was the lowest since the global financial crisis, mostly reflecting the*

> *Inflation is quite low. Recent information has confirmed that growth in labour costs remains quite subdued. Given this, and with inflation also restrained elsewhere in the world, inflation in Australia* ***is likely to remain low over the next year or two.*** [25]
>
> *Inflation has been quite low for some time and recent data were unexpectedly low. While the quarterly data contain some temporary factors,* ***these results, together with ongoing very subdued growth in labour costs and very low cost pressures elsewhere in the world, point to a lower outlook for inflation than previously forecast***.[26] [Emphasis added]

87. The most recent statement following the August 2016 RBA rate reduction echoed the same logic.

> *Recent data confirm that inflation remains quite low. Given very subdued growth in labour costs and very low cost pressures elsewhere in the world,* ***this is expected to remain the case for some time***.

5.7 Falling break-even inflation is a statistically significant explanatory variable for falling nominal CGS yields

88. There has been a material fall in nominal CGS returns in recent years. As seen in Figure 9, the downward trend in 10-year nominal CGS yields has been associated with a similar downward trend in break-even inflation estimates.[27]

89. If one believes, as we do, that break-even inflation estimates are an accurate measure of expected inflation, then this implies that much, indeed most, of the fall in nominal CGS yields has been due to a fall in inflation expectations – rather than falls in real yields.[28]

---

sharp decline in commodity prices, with a pickup in the late part of 2015 (Figure 1.2). Core inflation remained broadly stable at 1.6–1.7 percent but was still well below central bank targets."

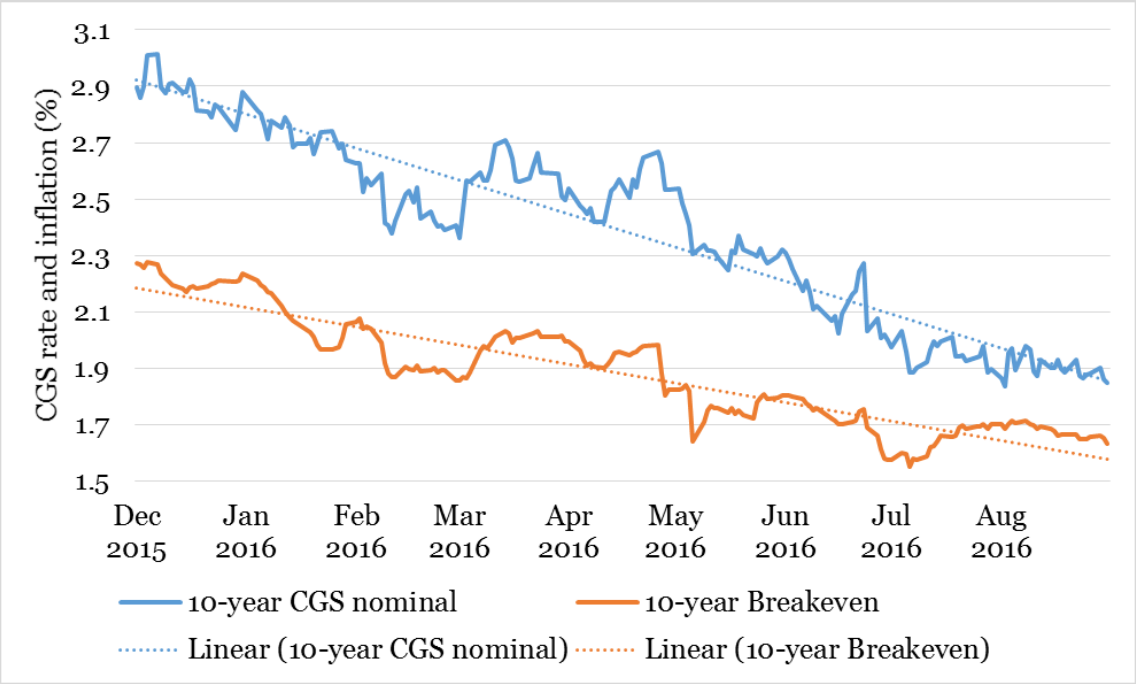
25 RBA, Statement by Glenn Stevens Governor: Monetary Policy Decision, 2016-08, April 2016.

26 RBA, Statement by Glenn Stevens Governor: Monetary Policy Decision, 2016-10, 3 May 2016.

27 Inflation is the link between nominal and real returns on assets. Other things equal, a rise/fall in expected inflation implies a rise/fall in nominal yields as investors demand more/less compensation for the erosion of the purchasing power of money.

28 This does not imply that changes in inflation expectations are the only cause of changes in nominal interest rates or that they are always the dominant cause. It may also be that real interest rates change (as they have dramatically since the GFC). However, over the period from December 2015 it is apparent that changes in inflation expectations have been the dominant driver of changes in nominal yields.

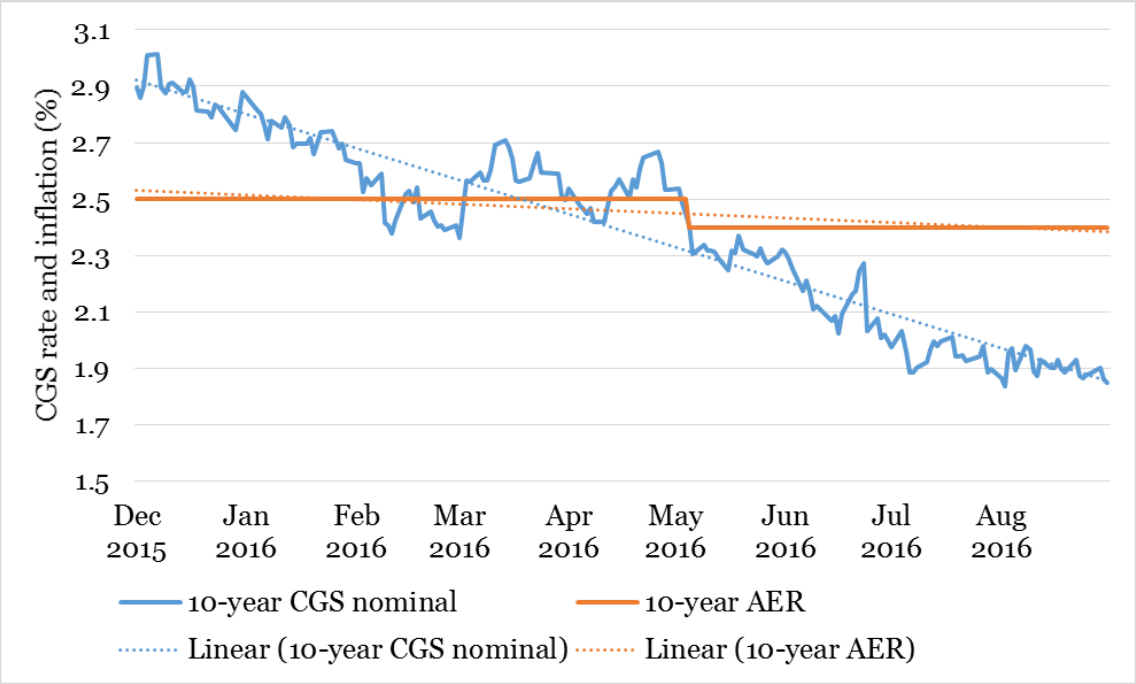
Figure 9: 10-year nominal CGS rates and 10-year breakeven inflation



Source: RBA, CEG analysis

90. By contrast, the AER's estimate of expected inflation has barely changed over this period – see Figure 10. If this was correct then almost all of the fall in nominal CGS yields would be due to falling real required returns.

Figure 10: 10-year nominal CGS rates and 10-year AER inflation



Source: AER, RBA, CEG analysis

91. The failure of the AER's inflation estimate to decline materially over this period is why, given significant declines in nominal yields, the AER's 10 year real risk free rate estimate has fallen to negative levels.

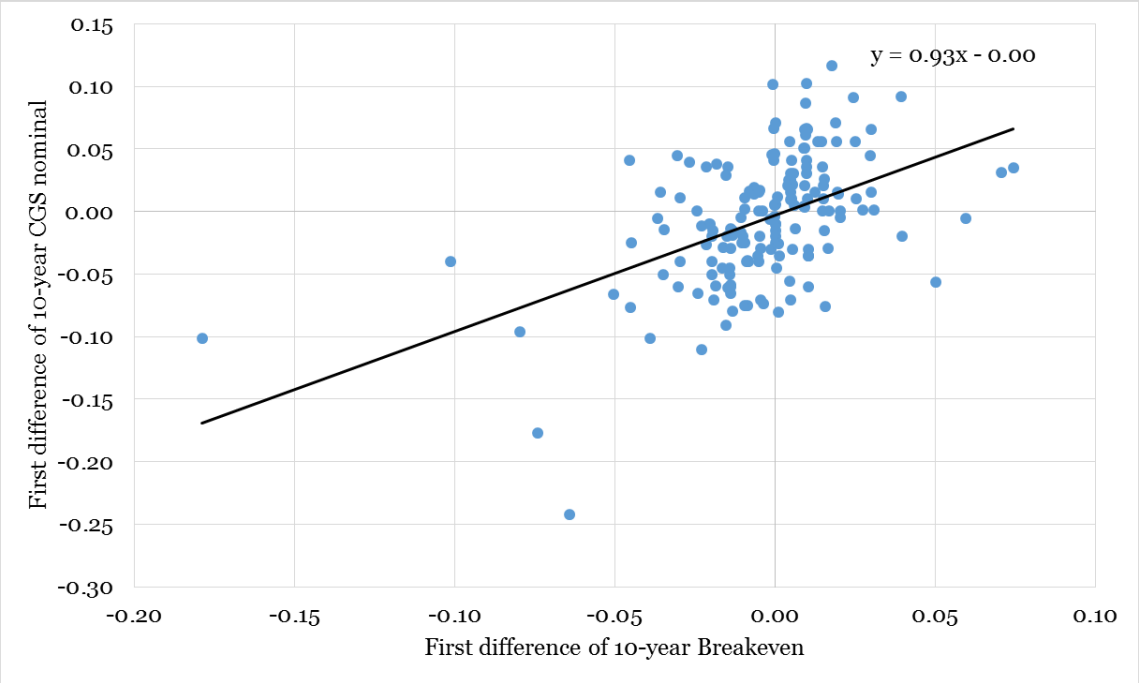
92. Our view that this is inappropriate is supported by noting that, over the course of 2016, daily changes in 10-year break-even inflation have strong explanatory power in explaining daily changes in nominal 10-year CGS yields (as one would expect of an accurate measure of expected inflation). From 31 December 2015 to 31 August 2016, regression of daily changes in CGS yields on daily changes in break-even inflation results in an estimated coefficient of 0.93, suggesting that, on average, one-unit changes in inflation expectations are reflected in changes in nominal yields by 0.93 units, as shown in Table 1 below, with the corresponding scatterplot shown in Figure 11. This coefficient is highly statistically significantly different to zero (significant at the 99% confidence level, with the standard errors of each parameter shown in parentheses).

Table 1: Regression of nominal CGS yields against inflation

	Date range	Frequency	Constant	Slope
Change in 10 year nominal CGS vs change in 10 year breakeven inflation	31/12/15 – 31/8/16	Daily	-0.00 (0.00)	0.93 (0.13)
Change in 10 year nominal CGS vs change in 10 year breakeven inflation	31/12/05 – 30/6/16	Quarterly	-0.05 (0.04)	1.08 (0.15)
Change in 10 year nominal CGS vs change in 10 year AER inflation	31/12/05 – 30/6/16	Quarterly	-0.07 (0.06)	0.06 (1.17)

Source: Bloomberg, RBA, CEG analysis

Figure 11: 10-year nominal CGS and 10-year breakeven inflation (31 Dec 2015 to 31 August 2016, daily)



Source: RBA, CEG analysis

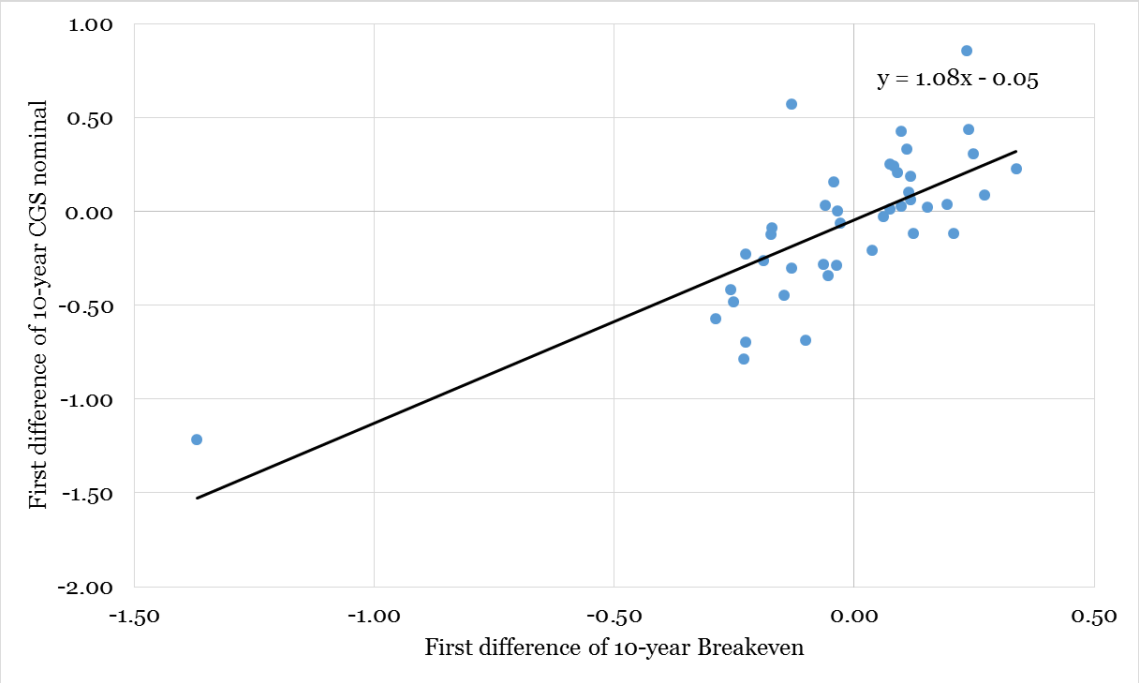
93. Since AER inflation is only updated on a quarterly basis we cannot perform daily analysis to test the AER's inflation estimates' explanatory power. We therefore repeat the regression using quarterly data over a longer timeframe from December 2005 to June 2016.

94. Once again, the slope coefficient of 1.08 for breakeven inflation is close to 1, and is statistically significant, as shown in Table 1 above and Figure 12. On the other hand, the slope coefficient of 0.06 for AER inflation is close to zero and is not statistically significant, as shown in Table 1 above and Figure 13.

95. The AER inflation estimates therefore have little explanatory power over 10-year nominal CGS rates, leading to the counterintuitive implication that the fall in nominal

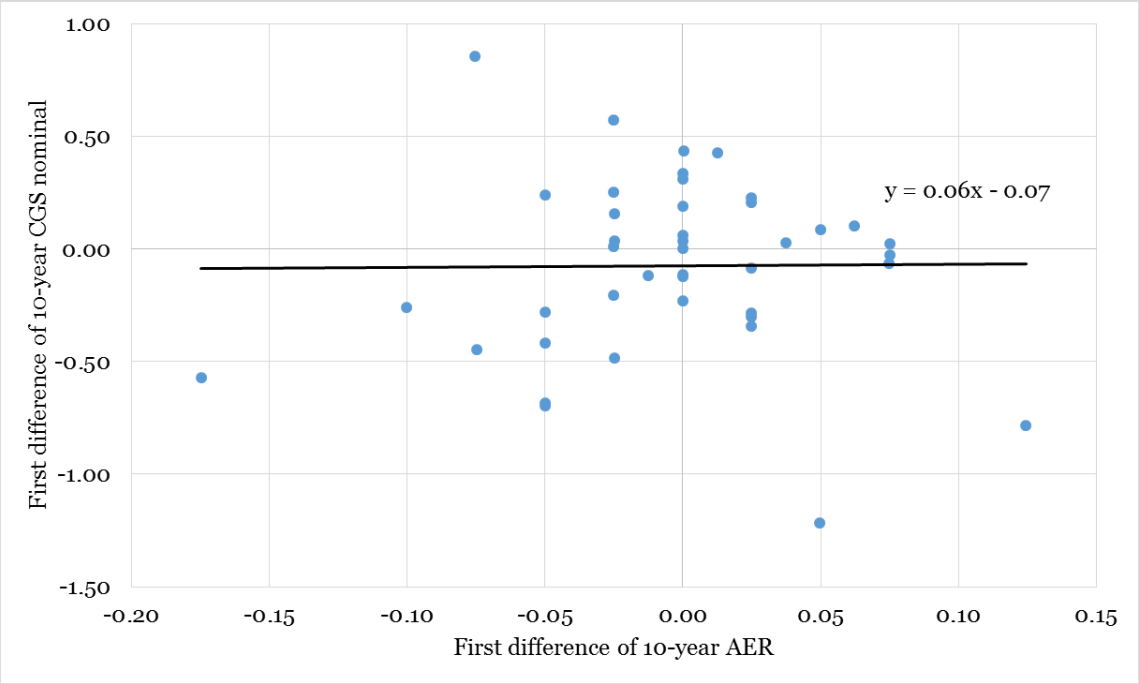
CGS yields over the last 10 years is almost completely attributed to a fall in real yields as opposed to a fall in inflation expectations. Such an implication has been demonstrated to be false, as seen in the discussion above.

Figure 12: 10-year nominal CGS and 10-year breakeven inflation (31 Dec 2005 to 30 June 2016, quarterly)



Source: RBA, CEG analysis

Figure 13: 10-year nominal CGS and 10-year AER inflation (31 Dec 2005 to 30 June 2016, quarterly)



Source: AER, RBA, CEG analysis

5.8 Conclusion

96. Based on the analysis in this section, the AER's estimate of forecast inflation is unrealistically stable (by virtue of AER assumption rather than any external evidence) and has not responded materially to the dramatically changing inflation environment. Moreover, the AER's estimate does not have the desired power to explain movements in nominal CGS yields. The failure of the AER's expected inflation estimate to fall the face of falling actual inflation and falling nominal yields has led to it overestimating any reasonable estimate of the expected inflation that is built into 10 year CGS yields (and, even more so, the inflation over 5 years that is expected to be used to roll forward the RAB). A consequence of this is the AER's implied estimate of required real returns on risk free assets is negative – despite investors having the option to invest in inflation indexed CGS that guarantee positive real returns.

97. By contrast, there are strong theoretical reasons for believing break-even inflation will provide the best measure of expected inflation in the current context (both regulatory and market). The breakeven approach has responded to the dramatically changing inflation environment. Changes in break-even inflation do have the desired power to explain movements in nominal CGS yields. Break-even inflation also has a much better track record in predicting actual inflation outcomes over recent years. In light of these considerations break-even inflation provides a materially better

estimate of the inflation expectations built into prevailing 10 year CGS yields (and, even more so, the inflation over 5 years that is expected to be used to roll forward the RAB).

6 Quantification of potential sources of bias in break-even inflation

98. This section provides a review of literature on issues related to RBA forecasts and break-even inflation as raised in the AER's draft decision[29]. It is broken into two parts consisting of a review and discussion of the results in papers:

    - cited by the AER; and
    - other papers not cited by the AER.

99. The overwhelming conclusion of this literature survey is that the potential sources of bias alluded to by the AER are small and just as likely to result in an over-estimate of expected inflation as an underestimate. Certainly, it is not plausible that these account for the current 70bp difference between break-even inflation and the AER's estimate of expected inflation.

[29] AER, AusNet Services transmission determination 2017-28 to 2021-22, Draft Decision, Attachment 3 – Rate of return, July 2016.

Table 2: Summary of literature on bias in break-even inflation

Paper	AER criticism	Actual findings	CEG Comments
		Research cited by AER	
Tulip and Wallace (2012)	RBA forecasts are historically more accurate than private sector forecasts	No significant difference between RBA and private sector forecasts	RBA only provides forecast intervals up to 2 years ahead. Our main criticism pertains to the AER's use of the midpoint of the fixed interval*, as well as its 2.5% assumption for the remaining 8 years.
D'Amico, Kim and Wei (2010)	Breakeven estimates are biased and require adjustment	Excluding the GFC, break-even inflation has mostly been similar to, or above, inflation expectations	The paper's conclusion suggests that if any adjustment is needed, it would be a downward adjustment. Given that break-even inflation is already lower than the AER's forecasts, this suggests that the former is a more accurate estimate.
Scholtes (2002)	Bond convexity could bias long-term inflation rates below expectations	The possibility of convexity bias was stated but not estimated.	Ang, Bekaert and Wei (2008) find that convexity bias amounts to less than 1 bp, even at longer maturities
Grishchenko and Huang (2012)	Inflation risk premium bias ranges from -0.16 to 0.10	Over 2000-2008, inflation risk premium ranges from -16 to 10. Over 2004-2008, the range is 14 to 19.	The risk premium in the longer sample has a range with a midpoint close to zero, while the shorter more recent sample has a range that suggests break-even inflation substantially overestimates expected inflation. The earlier period in the longer sample reflects a period when TIPS was still new, and may not reflect current conditions. The authors also explicitly state that they consider the second set of estimates (14-19) as more reasonable.
Shen and Corning (2001)	Liquidity premium is: (1) likely to be greater during periods of uncertainty; and (2) is difficult to identify and remove	No support for (1) in the paper. (2): Breakeven inflation calculated from TIPS is lower than estimates from surveys, but study was conducted while TIPS was new. The liquidity premium is likely to decline, allowing closer approximations of market inflation expectations.	With regard to (1), note that a high liquidity premium during the GFC cannot be generalised as applying broadly to "periods of uncertainty". Shen and Corning (2001) were careful to note that TIPS was still new when their study was done, and also stated that experience from UK suggests that the liquidity premium would decline.

Paper	AER criticism	Actual findings	CEG Comments
Literature not cited by AER			
Ang, Bekaert and Wei (2008)	-	Convexity bias amount to less than one basis point, even for longer maturities. Inflation risk premium is 114 bp on average over the period studied.	Our own simulation modelling also finds the convexity bias to be trivial, and is insufficient to explain the gap between break-even inflation and the AER's estimate. Inflation risk premium has historically been positive.
Pflueger and Viceira (2015)	-	TIPS liquidity premiums fell below 50 bp from 2012 onwards. Liquidity premium is lower in the UK than the US.	The study was carried out by regressing breakeven inflation on variables related to liquidity. However, the sample includes periods when TIPS was first introduced, which is likely to bias the results. Their results also suggest that there may be instability in their estimates.
Lehman Brothers (2006)	-	For the 3-year forward rate, convexity bias is 4 bp, inflation risk premium is 35 bp, liquidity premium is 15 bp.	The net bias is an underestimation of expected inflation by 16 bp, even after including liquidity premium in indexed bonds.
Banco Central do Brasil (2014)	-	Liquidity premium for Brazilian indexed bonds is not statistically different from zero. Inflation risk premium is positive for all bonds majority of the time.	The net effect of liquidity premium and inflation risk premium is that break-even inflation is more likely to over-estimate expected inflation.
Coroneo (2016)	-	Using a dynamic factor model, the liquidity premium has been close to zero since 2005, aside from the GFC. During the quantitative easing period, liquidity premium was negative.	-

*Source: Articles and CEG analysis; *The RBA's does not derive its forecast interval in a manner that sets its point estimate as the midpoint of the interval. Instead, the interval is obtained by taking the closest 25 bp unit and then placing the interval at ±50 bp around it.*

6.1 Liquidity premium

100. Before proceeding with a discussion of teach individual paper it is useful to make a few observations about the existence or otherwise of a 'liquidity premium'. The first point to note is that in much of the literature the reported 'liquidity premium' is, in

reality, an error term in the analysis. It is the term given to the amount of the difference between nominal and indexed government bonds that is not explained by the other factors in the researchers' models. For example, D'Amico, Kim and Wei (2016) estimate a TIPS[30] liquidity premium that has historically been negative (i.e., associated with breakeven inflation underestimating expected inflation) but has recently been positive (i.e., associated with breakeven inflation overestimating expected inflation). This is despite the fact that TIPS are generally acknowledged to have been less liquid than nominal US Treasuries over the entire period.

101. However, there is a specific theoretical reason for the existence of a liquidity premium. Investors will have a preference for assets that are more liquid because those assets allow them to optimise their portfolios at lowest cost. Specifically, a 'liquid' market is one where an individual investor can expect to be able to buy or sell into the market without their personal transaction having a significant impact on the price paid/received in the transaction.

102. In reality, both indexed and nominal CGS are highly liquid. This means that the value investors place on any differential in liquidity is likely to be trivial. Both the nominal and indexed CGS markets are highly liquid with turnover of around $1,000bn and $50bn respectively. While the turnover in nominal bonds is around 20 times larger both are very large in absolute magnitude.

103. Moreover, liquidity is a function of the ability of an investor to divest their holding without moving the market and, given that investors' holdings on nominal CGS tend to be larger, the absolute turnover must be adjusted for the average holding of these bonds in an investor's portfolio. The standard way to do so is to divide turnover rates by total outstanding stock in order to provide the 'turnover ratio'. The Australian Financial Markets Association produces this metric for nominal CGS and it has fallen from 5.2 in 2007/08 to 3.2 in 2014/15. [31] A similar metric for indexed CGS was around 1.2 in 2007/08 and 2.0 in 2014/15.[32] On this metric, liquidity in nominal CGS is only modestly higher than for indexed CGS.

104. Moreover, it is important to note that investors valuation of additional liquidity falls to zero as soon as they are confident that their own trading will not move the market against themselves. That is, if I am already confident that I will not move the CGS market against myself when trading, then I receive no advantage, and will not value CGS any higher, if the turnover in the market doubles/quadruples. Both nominal and indexed CGS are a homogenous product that are very easy to value (i.e., there are not

30 US Treasury Inflation Protected Securities.

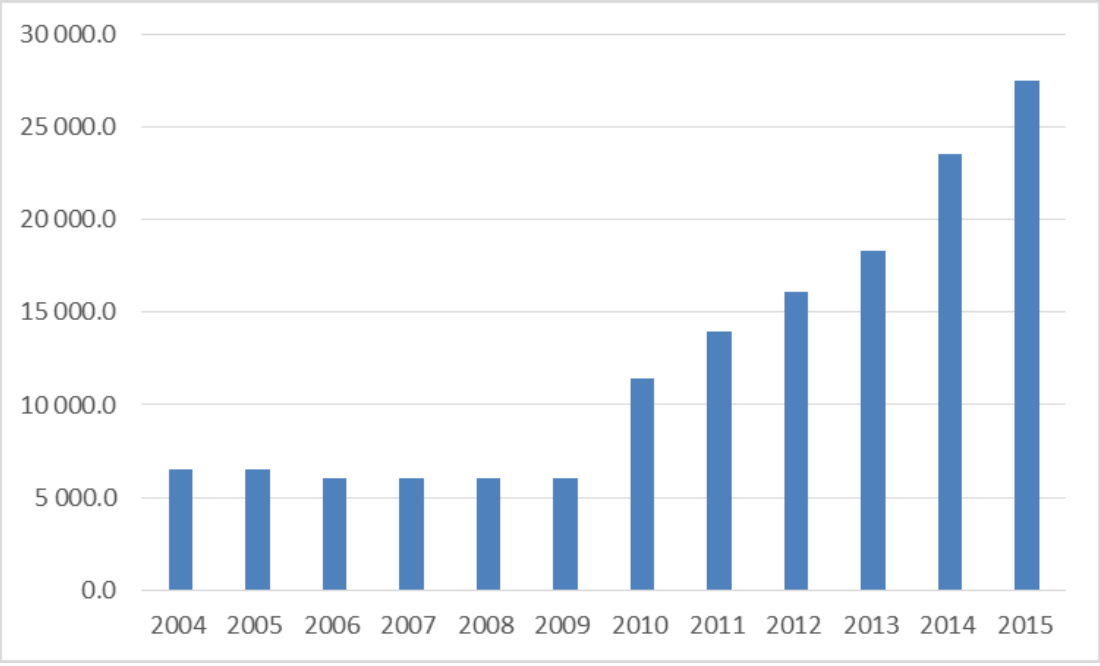
31 AFMA, 2008 and 2015 Australian Financial Markets Report.

32 AFMA does not explicitly present this ratio but it can be calculated as total turnover in index linked CGS (e.g., $51bn in 2014-15) divided by total bonds outstanding available from AOFM ($25.5bn average of beginning and end of year outstanding in 2014-15).

the same 'inside information issues' that arise with trading corporate equity and debt) and are very large in size (and turnover relative to size). It is therefore reasonable to assume that the potential value of incremental increases in turnover/liquidity ratio when moving from indexed CGS to nominal CGS are very small. That is not to say that there might be a more material liquidity premium when moving from CGS to less liquid assets (such as corporate debt/equity or real-estate). However, there is no reason to believe that a material liquidity premium exists when moving from indexed to nominal CGS – at least not in normal market circumstances (see discussion of GFC in section 7.2.3 below).

105. In this regard we note that in 2007/08 when the Government had ceased issuing indexed CGS and the liquidity ratios for nominal CGS were much higher (around 5 times) those of indexed CGS it is accepted by the AER that, if anything, breakeven inflation was overestimating expected inflation. (This was around the time that the AER ceased relying on break-even inflation on the basis that it was over-estimating expected inflation.) It is generally accepted that this reflected a lack of supply of indexed CGS at that time – a lack of supply that has been reversed with fivefold increase in indexed CGS on issue.

Figure 14: Indexed CGS on issue



Source: AOFM

106. The relevant point here is that when indexed CGS were relatively much less liquid than they are today there was no evidence that a differential liquidity premium was causing break-even inflation to under-estimate expected inflation – in fact the opposite was accepted as being the case.

6.2 Research Cited by AER

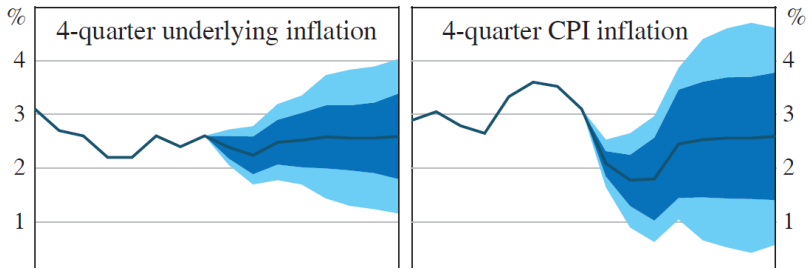
6.2.1 Tulip and Wallace (2012)[33]

107. Regarding the quality of RBA forecasts, the AER cites from Tulip and Wallace (2012), to state that the RBA's *"1 year forecasts of inflation have substantial explanatory power and in the past RBA forecasts have been marginally more accurate than private sector forecasts."*

108. First, we note that our main concern with the AER's forecast methodology is not with the use of RBA forecasts for the first two years but with the assumption of 2.5% inflation in all subsequent years. Relatedly, we note that the point of interest to us is the relative accuracy of break-even inflation expectations versus AER year estimates of inflation – an issue not addressed by Tulip and Wallace (at the 10 year horizon or any other horizon). We have addressed this issue in section 5 of this report and find break-even inflation is superior.

109. In any event, Tulip and Wallace (2012) report wide confidence intervals for the RBA forecasts as illustrated in Figure 15. For underlying inflation, actual inflation lies outside a 100bp range 30% of the time. For CPI inflation the actual inflation will lie outside a 200bp range 30% of the time.

Figure 15: 70% and 90% Confidence Interval for RBA forecasts



Source: Tulip and Wallace (2012)

110. Furthermore, comparing the accuracy of RBA forecasts relative to forecasts by the private sector, Tulip and Wallace (2012) states *"the differences are small and not statistically significant"*. That is, the RBA is forecasts are not found to be statistically significantly different to other forecasts.

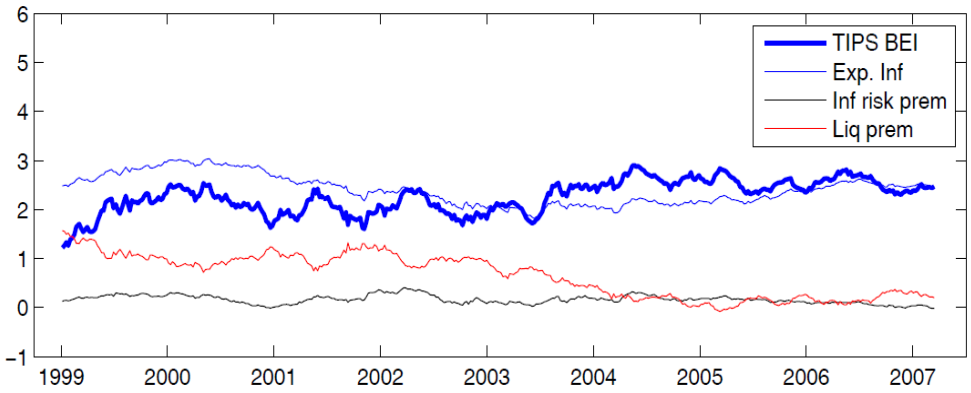
33 Tulip, P., Wallace, S., (2012) "Estimates of uncertainty around the RBA's forecasts", RBA Research Discussion Paper – November 2012, RDP2012-07.

6.2.2 D'Amico, Kim and Wei (2010)[34]

111. The AER references D'Amico, Kim and Wei (2010) and says, "*breakeven estimates require adjustment to account for several different types of bias*." The AER mentioned this paper in passing, claiming that it supports the view that some adjustments are required for expected inflation. However, the AER fails to mention the methodology to breakdown the components proposed by D'Amico, Kim and Wei (2010) and the findings on the net effect of the bias.

112. The result of D'Amico, Kim and Wei (2010) is summarised in Figure 16. This clearly shows break-even inflation at, *or above*, expected inflation from around 2002.

Figure 16: Decomposing 10-year TIPS Breakeven Inflation D'Amico, Kim and Wei (2010)

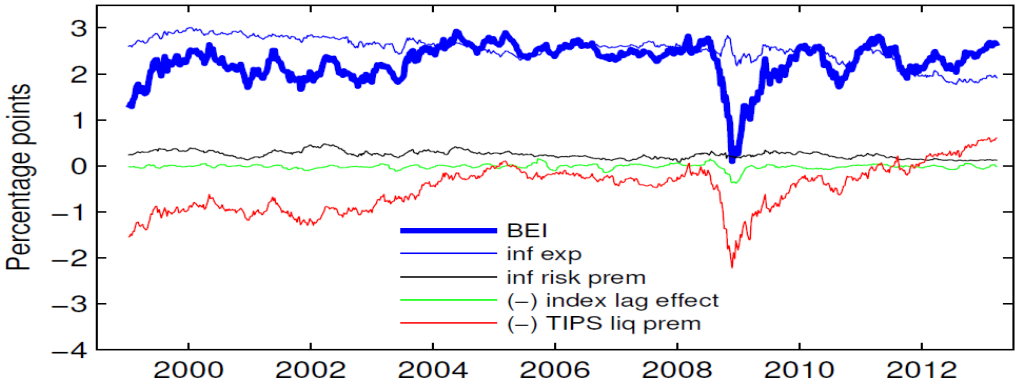


Source: D'Amico, Kim and Wei (2010)

113. Figure 17 and Figure 24 show an update of the same estimates in a subsequent 2014 paper by the same authors (this time including the index lag effect). The thick blue line is breakeven inflation, the thin blue line is the expected inflation, the black line is the inflation risk premium, the green line is the index lag effect and the red line is the liquidity premium. Once more, since the early 2000s, but with the exception of the GFC, break-even inflation has been very similar to inflation expectations and, most recently, above. The authors estimate that in 2013, there is a negative liquidity premium, indicating a preference for indexed bonds compared to nominal bonds.

34 D'Amico, S., Kim, D.H., Wei, M., (2010) 'Tips from TIPS: the informational content of Treasury inflation-protected security prices', Federal Reserve Board, 2010-19 (Draft Version December 29, 2009)

Figure 17: Decomposing 10-year TIPS Breakeven Inflation D'Amico, Kim and Wei (2016)



Source: D'Amico, Kim and Wei (2014)[35]

6.2.3 Scholtes (2002)[36]

114. The AER cites Scholtes (2002) when it describes "the differences in bond convexity bias could bias long-term breakeven inflation rates below inflation expectations." While Scholtes (2002) does not attempt to estimate the impact of the convexity bias, Ang, Bekaert and Wei (2008)[37] has found that the "*convexity bias amount to less than one basis point, even for longer maturities*".[38]

6.2.4 Grishchenko and Huang (2012)[39]

115. We also note that the AER cites Grishchenko and Huang (2012), which finds that the "the inflation risk premium to range from -0.16 to 0.10." However, the -0.16 to 0.10 range is not the inflation risk premium in its strictest definition, rather it is the bias after taking into account the liquidity premium, and it can therefore be considered as the net bias. Grishchenko and Huang (2012) states: "*…if we add a monthly average*

35 D'Amico, S., Kim, D. H., and Wei, M., (2014) "Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices," FEDS Working Paper 2014-24 (Draft Version February 19, 2016)

36 Scholtes, C., (2002) "On market-based measures of inflation expectations", Bank of England Quarterly Bulletin, Spring 2002

37 Ang, A., Bekaert, G., Wei, M., (2008) "The Term Structure of Real Rates and Expected Inflation," Journal of Finance, Volume 63, No 2, pg 797-849

38 Further discussion of Ang Bekaert and Wei (2008) is in Section 6.3.1 Ang, Bekaert and Wei (2008)

39 Grishchenko, O., Huang, J.Z. (2012), "Inflation Risk Premium: Evidence from the TIPS market", Finance and Economics Discussion Series Divisions of Research and Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C. 2012-06

liquidity adjustment to it,..., we obtain the estimates that vary from -16 to 10 basis points."[40] That is, an average very close to zero.

116. Furthermore, the analysis is done for the whole sample from 2000 to 2008. If the result is restricted to the sample period from 2004 to 2008, Grishchenko and Huang (2012) finds "*that 10-year inflation risk premium is between 14 and 19 basis points*," after taking into account the liquidity adjustment. That is, when the sample is limited to after 2004, after the TIPS market has matured, Grishchenko and Huang (2012) finds that breakeven inflation lies within the range of 19 basis points above to 14 basis points above expected inflation on average. That is, break even inflation *overestimates* expected inflation by around 14-19 bp.

117. When comparing the two sets of estimates (-16 to 10 bp versus 14 to 19 bp), the authors explicitly noted that they favoured the second set of estimates [emphasis added]:[41]

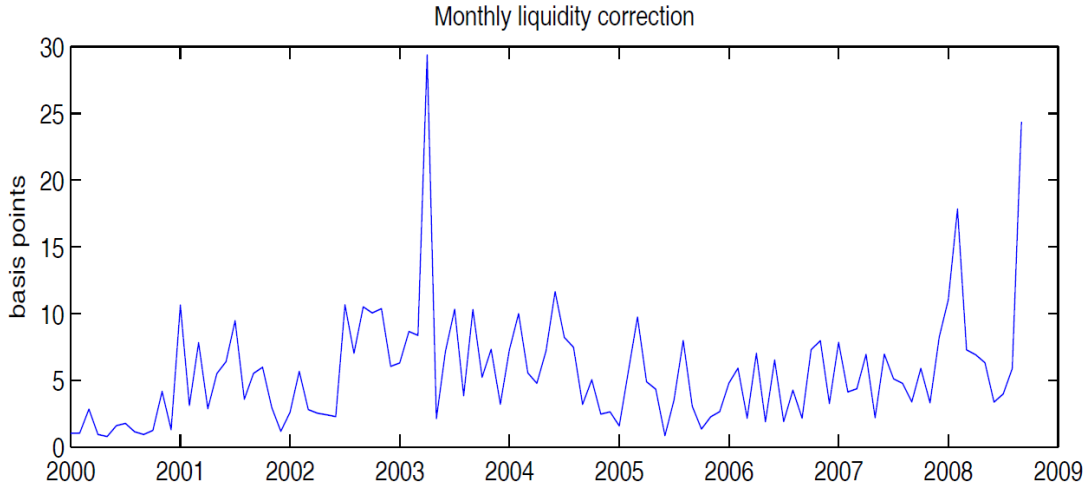
> *As a result of the above discussion of causes of negative inflation risk premia,* ***we consider the estimates of inflation risk premium obtained over the second half of the sample period to be more reasonable****. Furthermore, we focus on estimates relative to CPI but not core CPI as TIPS are indexed to the former.* ***As such, we conclude that the 10-year inflation risk premium ranges between 14 and 19 b.p.****, depending on the proxy used for expected inflation, based on our empirical analysis and when we correct for liquidity using a liquidity adjustment (28).*

118. Figure 18 reports the monthly average liquidity premium reported by Grishchenko and Huang (2012). It shows that, with the exception of a month in 2003 and the period of the 2008/09 GFC, the liquidity premium is generally around 10 basis points or less.

[40] In Section 5.4 Liquidity correction of Grishchenko and Huang (2012).

[41] Grishchenko, O., Huang, J.Z. (2012), "Inflation Risk Premium: Evidence from the TIPS market", Finance and Economics Discussion Series Divisions of Research and Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C. 2012-06, p. 30.

Figure 18: Liquidity Premium in Grishchenko and Huang (2012)



Source: Grishchenko and Huang (2012)

6.2.5 Shen and Corning (2001)[42]

119. Shen and Corning (2001), published only a few years after the introduction of TIPS, is also cited by the AER. The AER cites this paper in support of its two statements that:[43]

> *This premium is likely to be greater during periods of uncertainty when there is a 'flight' to more liquid nominal bond markets*
>
> *Liquidity bias can be material and difficult to identify and remove from the breakeven rate—particularly as evidence indicates that it can vary considerably over time.*

6.2.5.1 Liquidity premium and the GFC

120. We do not find support for the first statement in Shen and Corning. However, we do agree with the AER's statement and, as is explained in section 7.2.3, consider that in times of very high liquidity premium (as observed during the GFC) it is nominal government bond yields that are depressed by a "liquidity premium" making them an inappropriate foundation from which to build up a real rate of return for illiquid corporate financing instruments.

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42 Shen, P., Corning, J., "Can TIPS Help Identify Long-Term Inflation Expectations?', Federal Reserve Bank of Kansas City, Economic Review, Fourth Quarter 2001, pp. 61–87.

43 AER, AusNet Transmission Draft Decision, p. 3-134 and p. 3-136.

121. In relation to the experience during the GFC, D'Amico, Kim and Wei (2014)[44] does show that the liquidity premium for TIPS rose up dramatically as seen in Figure 17 above. However, this experience is specific to the most significant financial crisis since the great depression. It is unreasonable to proceed 'as if' such volatility is a random and difficult-to-discern event that could be materially depressing break-even inflation now.

122. Relevantly, D'Amico, Kim and Wei (2014) argue that part of the reason for the high liquidity premium in the GFC is because of the liquidation of TIPS holdings following the Lehman collapse. The reason, as explained by Haubrich, Pennacchi, Ritchken (2012)[45], is due to:

> *Lehman's use of substantial amounts of TIPS to collateralize its repo borrowings and derivative positions. Lehman's bankruptcy led to creditors releasing a flood of TIPS into the market at a time when there were few willing buyers. Many hedge funds that had bought TIPS also were forced to sell to meet withdrawals by clients.*

6.2.5.2 Liquidity premium can be "material and difficult to identify"

123. Shen and Corning's (2001) support for the AER's second statement must be tempered somewhat by the fact that Shen and Corning (2001), published in 2001, claim difficulty in assessing the use of TIPS as a forecast for inflation due to the "*short history of TIPS*". Moreover, the method used by Shen and Corning (2001) to arrive at an estimate of the liquidity premium is, in retrospect, highly problematic. Shen and Corning compare the breakeven spread against:

- historical 10-year average consumer price index inflation from 1960 to 2000; and
- survey forecasts of economists.

124. Shen and Corning (2001) find the breakeven inflation to be 87 basis points lower than the (latter) survey on average. Assuming the survey of forecasts by economists is the same as the inflation expectation of investors, Shen and Corning (2001) attributes the difference to liquidity premium. This is a very strong assumption (i.e., unlikely to be true).

125. In any event, Shen and Corning (2001) note that, given the relative newness of TIPS and its uniqueness, its low trade volumes were likely causing liquidity premiums in the yields of TIPS. The high liquidity premium in the first few years after the introduction of TIPS is corroborated in more recent research which is illustrated in

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44 D'Amico, S., Kim, D. H., and Wei, M., (2016) "Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices," FEDS Working Paper 2014-24 (Draft Version 2016)

45 Haubrich, J., Pennacchi, G., and Ritchken, P., (2012) "Inflation Expectations, Real Rates, and Risk Premia: Evidence from Inflation Swaps," Review of Financial Studies, Volume 25, No 5, pg 1588-1629

Figure 24. Research by D'Amico, Kim and Wei (2016) shows that breakeven inflation is persistently lower than the expected inflation prior to 2004.

126. Shen and Corning (2001) remark that in the UK, where inflation indexed bonds had a longer history and were traded at a higher rate compared to the U.S., "*the liquidity difference there is much smaller*", and "*the liquidity premium on indexed debt is smaller than the inflation risk premium on conventional debt.*" Shen and Corning (2001) also state that "*if the current trends continue, indexed Treasuries should become liquid and the liquidity premium should gradually decline, allowing the yield spread to more closely approximate market inflation expectations*." In fact this can be seen in Figure 17, where the breakeven inflation has either hovered around or lie above the expected inflation.

6.3 Other Literature not cited by AER

6.3.1 Ang, Bekaert and Wei (2008)[46]

127. Ang, Bekaert and Wei (2008) analyse the breakeven spread between nominal bonds and indexed bonds by breaking it down into two components: expected inflation; and inflation risk premium. Regarding convexity, the paper concludes that the "*convexity bias amount to less than one basis point, even for longer maturities.*"

128. This is a consistent finding across other papers and our own simulation modelling[47] of this potential source of bias (including surveyed below). That is, it is trivial in magnitude and cannot be expected to make any contribution to explaining the gap between break-even inflation and the AER estimates.

129. However, the paper does find a material source of bias in the form of the inflation risk premium. Figure 19 shows its estimated inflation risk premium for a 5 year bond. The grey lines are two standard deviation intervals and the grey bars are periods of recession. The average inflation risk premium calculated is approximately 1.14 percentage points.

130. That is, based on this element of 'bias' identified by the AER break-even inflation would tend to *overestimate* expected inflation by around 1.14% over the period studied. This is the average of the dark line in the below chart. This shows the value is never negative but has been lower since the 1980s (consistent with more stable inflation outcomes in that period). However, even in that period it has averaged around 50bp.

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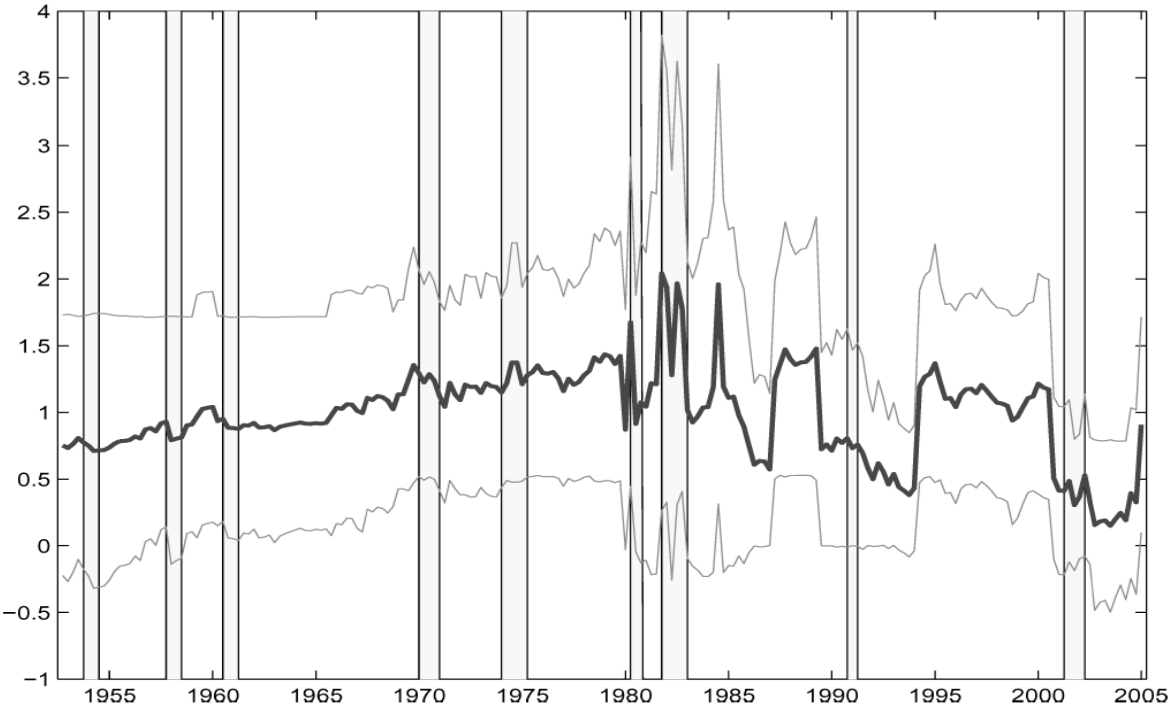
46 Ang, A., Bekaert, G., Wei, M., (2008) "The Term Structure of Real Rates and Expected Inflation," Journal of Finance, Volume 63, No 2, pg 797-849

47 See 7.2.3Appendix C Convexity Bias.

131. This means that any other bias (namely liquidity/index lag effect) would have to make up approximately 50bp in order to make the total bias negative (i.e., lead to an understatement of expected inflation).

Figure 19: Inflation Risk Premium



Source: Ang, Bekaert and Wei (2008)

6.3.2 Pflueger and Viceira (2015)[48]

132. Pflueger and Viceira (2015) calculates the highest liquidity premium for the U.S. TIPS. It adopts a different approach for determining the liquidity premium. Pflueger and Viceira (2015) regresses the breakeven inflation on variables that may indicate liquidity issues[49] and published expected inflation. The component of the regression with variables related to liquidity issues is considered as the liquidity premium. The result is illustrated in Figure 20, it finds the liquidity premium for the U.S. TIPS to be approximately 50 basis points or more up to 2010. After 2012, TIPS liquidity

48 Pflueger, C. E. and Viceira, L. M., (2015) "Return Predictability in the Treasury Market: Real Rates, Inflation, and Liquidity", Working Paper, (Draft Version February 2015)

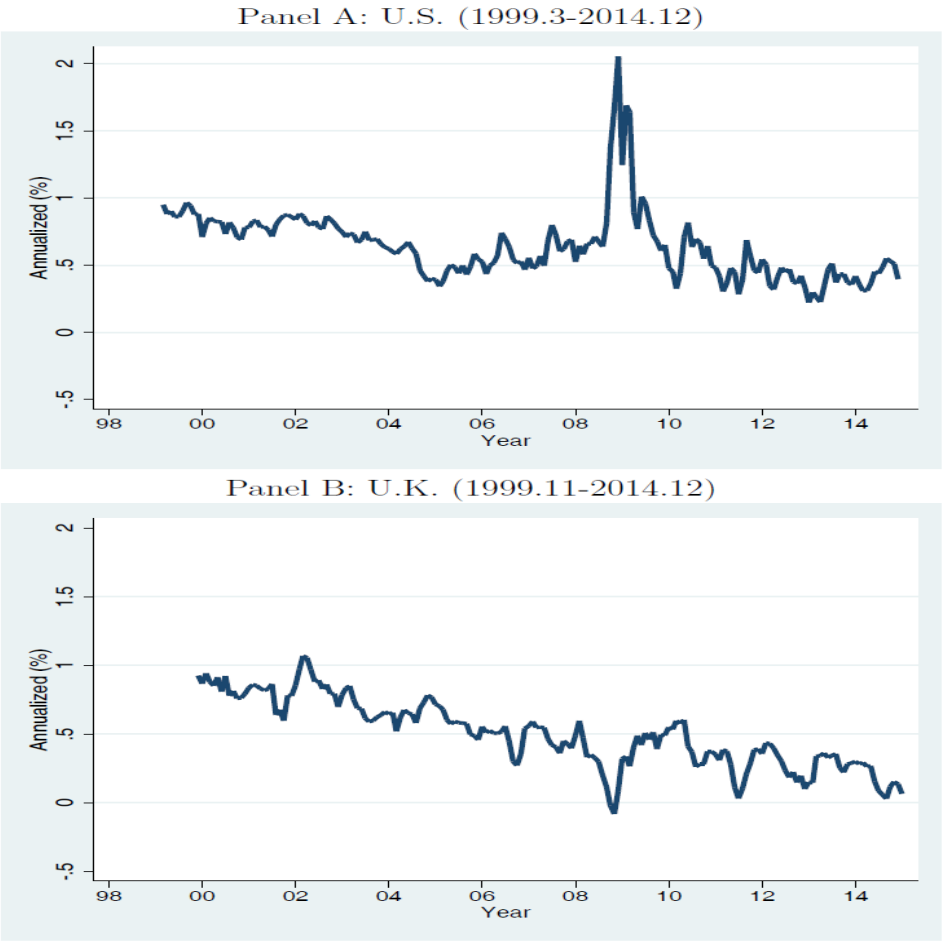
49 The variables are the spread between on-the-run nominal bonds and off-the-run nominal bonds; synthetic and cash breakeven inflation differential; and transaction volume ratio between nominal bonds and TIPS.

premiums have fallen to below 50 basis points. However, it finds much lower liquidity premium in the U.K. TIPS where it has fallen below 50 basis points since 2006.

133. Since the coefficients on the variables related to liquidity do not change over time, the model utilised by Pflueger and Viceira (2015) assumes a constant relationship between liquidity premium and the explanatory variables. If these variables do not explain all the movements of liquidity premium across time, the liquidity premium will be over-estimated for some time periods and under-estimated for other time periods. This is because the coefficient is trying to capture the average relationship between the liquidity premium and the explanatory variables. Since Pflueger and Viceira's (2015) sample includes the periods when TIPS are first introduced and the global financial crisis, which exhibits high liquidity premium, the estimation will overestimate the relationship between the liquidity premium and the explanatory variables in other periods.

134. Pflueger and Viceira (2015) do not test the stability of the estimated coefficient or allow for the removal of the impact of the global financial crisis and introductory period of TIPS. Pflueger and Viceira (2015) do run a separate regression for the period prior to the global financial crisis and finds that the estimated coefficient for two of the liquidity indicators is no longer statistically significant, which may indicate instability in the coefficient.

Figure 20: Liquidity premium in Pflueger and Viceira (2015)



Source: Pflueger and Viceira (2015)

6.3.3 Lehman Brothers (2006)[50]

135. Lehman Brothers (2006) discusses how it managed convexity, inflation risk premium and liquidity in its valuation framework. Lehman Brothers (2006) does not report the size of the premiums for a 5 year bond, however it reports the premiums for a 3 year forward rate, two years forward which approximate a 5 year bond. The use of forward rates (rather than spot rates) will exaggerate the impact of convexity. For the 3 year forward rate, two years forward, the convexity bias is 4 basis points, the inflation risk premium is 35 basis points, and the liquidity premium is 15 basis points. Therefore the net bias is an *underestimation* of the expected inflation by 16 basis points – even including any liquidity premium in indexed bonds.

[50] Lehman Brothers, (2006) "A TIPS Valuation Framework," U.S. Interest Rate Strategy, Fixed Income Research,

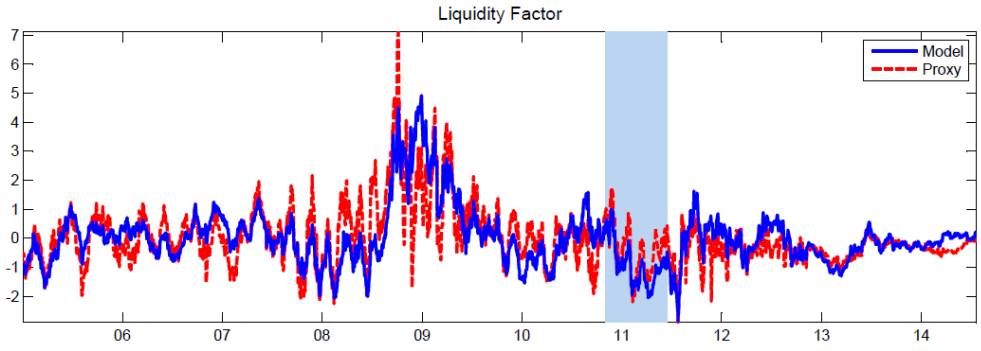
6.3.4 Banco Central do Brasil (2014)[51]

136. Banco Central do Brasil (2014) analyses breakeven inflation for Brazilian indexed bonds with horizon between 1 to 4 years. It concludes that its convexity bias is close to 1 basis points for these bonds (once more, trivial). It finds that the "*liquidity premium is not statistically different from zero.*"

6.3.5 Coroneo (2016)[52]

137. Coroneo (2016) attempts to measure the size of the TIPS liquidity premium using a dynamic factor model. The model separates the TIPS yield into two components, the real interest rate component that causes movements in both the nominal yield and TIPS yield, and the liquidity component that causes movements only in the TIPS. Corneo (2016) also checks the robustness of its result by extrapolating the liquidity premium via inflation swaps. The model obtains the real interest rate via the difference in the nominal yield and inflation swaps, which is then used to generate a proxy for liquidity. The result is presented in Figure 21. It shows that other than the period during the global financial crisis, the liquidity factor calculated based on the dynamic factors model and robustness proxy hovers around zero since 2005. Furthermore during the quantitative easing period, marked by the blue vertical region, the period just prior to the global financial crisis in early 2008 and early 2010, the liquidity factor is below zero. This implies a negative liquidity premium for TIPS bonds.

Figure 21: Liquidity Factor in Coroneo (2016)



Source: Coroneo (2016)

[51] Banco Central do Brazil, (2014), "Breaking the Break-even Inflation Rate," Inflation Report, 2016 December

[52] Coroneo, L, (2016) "TIPS Liquidity Premium and Quantitative Easing", Working paper (draft version April 2nd 2016)

7 Estimating the real cost of capital directly

138. The sources of potential bias in break-even inflation identified by the AER (and addressed in section 6) actually imply that the nominal CGS yield is a biased proxy for the risk free rate. If these sources of bias did exist then the appropriate course of action would be to adopt the indexed CGS yield as the real risk free rate proxy.

139. In this section we explain how this can be done by estimating a real cost of capital directly (although we note that, notwithstanding our view that breakeven inflation provides superior estimates to the AER's estimates, our approach for estimating the real cost of capital can also be used to deliver the appropriate real cost of capital in the PTRM even if the AER's method for estimating expected inflation in the PTRM must be applied).

140. The nominal cost of capital inputs to the PTRM can be estimated by adding expected inflation to the real cost of equity and debt. Under this approach, the nominal cost of debt and equity used as inputs into the PTRM are set equal to the estimated real of debt and equity plus expected inflation. This approach has, in our view, the material advantage that it renders the estimate of expected inflation used in the PTRM relatively unimportant to the compensation that will be provided to the regulated entity.

7.1 Practical method for building a nominal cost of debt/equity from the real risk free rate

141. Once a real risk free rate has been determined, it is necessary to transform this into a real cost of debt and equity by adding a risk premium to each. However, the PTRM requires nominal (not real) inputs for the cost of debt, the cost of equity and expected inflation. In order to arrive at estimates of the nominal cost of debt and equity that are internally consistent, the expected inflation input into the PTRM the latter must be added to the estimates of the real cost of debt and equity.

142. We set out mechanically how this would be done for equity and debt in the following sections – assuming that, in all other respects, the AER's methodology is followed.

7.1.1 Equity

143. The AER's methodology is for estimating the cost of equity is to add a risk premium of 4.5500%[53] to the risk free rate. The AER's practice has been to add this to nominal

[53] This is estimated as the product of an equity beta of 0.7 and an MRP of 6.5%.

risk free rate (of, say, 2.0000%) to arrive at a nominal cost of equity of 6.5500% from which, within the PTRM, expected inflation is removed in order to deliver a real rate of return.

144. In the same circumstances our proposal is that the AER deflate this 4.5500% risk premium by expected inflation in order to turn it into a real risk premium.[54] Let expected inflation be 0.9901% in which case the real risk premium is given by:

Real risk premium = 4.5500%/(1+0.9901%)= 4.5054%

145. This real risk premium is then added to the best estimate of the real risk free rate which, for the purpose of this example, we let be 1.0000%. This gives a real cost of equity of:

Real cost of equity = 5.5054%.

146. This estimate of the real cost of equity is then transformed into a nominal return using the Fisher equation and expected inflation (assumed above to be 0.9901%).

Nominal cost of equity (PTRM input) = 5.5054%+0.9901% +5.5054×0.9901%

= 6.5500%

147. It is useful to note that, in this illustration the nominal risk free rate is 2.0%, the real risk free rate is 1.0% and the estimate of expected inflation is the difference between these values (using the Fisher equation).[55] In this situation we get the same answer whether we start with a nominal or a real risk free rate. This is because our estimate of expected inflation is consistently determined as the difference between these real and nominal rates.

148. By contrast, if the estimate of expected inflation was higher than implied by the Fisher equation (say, 2.00%) then our nominal cost of equity would be higher (7.62)%. Of course, the real return delivered by the PTRM would be unaffected at 5.5054 because the higher expected inflation used to derive the nominal cost of equity would also be removed from revenues within the PTRM – leaving the real return unchanged.

54 This risk premium is largely, but not wholly, net of inflation in the form the AER uses it. Because the risk premium is expressed as a return in excess of the risk free rate it is already in excess of inflation (in the Fisher equation (n=r+p +r*p) it is in excess of "p". However, it still has r*p embedded in it (i.e., it is the real risk premium plus the real risk premium multiplied by inflation). Therefore, it must be divided by (1+p) in order to remove this element of inflation compensation to transform it into a pure real risk premium.

55 That is, 0.9901% expected inflation is the inflation implied by a 2.0000%/1.0000% nominal/real risk free rate (0.9901%=(2%-1%)/(1+1%))

7.1.2 Debt

149. The AER's methodology for estimating the cost of debt is to simply take the average nominal cost of debt from various published data sources. Imagine for the purpose of this example that this average was 5.5000%.

150. In the same circumstances, our proposal is that the AER would calculated a debt risk premium by deducting its estimate of the nominal risk free rate. Consistent with the previous example, imagine that this is 2.0000% implying a DRP of 3.5000%. Once more, this 3.5000% risk premium would be deflated by expected inflation in order to turn it into a real risk premium. Let expected inflation, once more, be 0.9901% in which case the real risk premium is given by:

$$\textit{Real risk premium} = 2.5000\% / (1+0.9901\%) = 2.4755\%$$

151. This real risk premium is then added to the best estimate of the real risk free rate which, for the purpose of this example, we let be 1.0000%. This gives a real cost of debt of:

$$\textit{Real cost of debt} = 2.4755\% + 1.0000\% = 3.4755\%.$$

152. This estimate of the real cost of debt is then transformed into a nominal return using the Fisher equation and expected inflation (assumed above to be 0.9901%):

$$\textit{Nominal cost of debt (PTRM input)} = 3.4755\%+0.9901\% +3.4755\%\times0.9901\%$$

$$= 4.5000\%$$

153. Once more, in this illustration the nominal risk free rate is 2.0%, the real risk free rate is 1.0% and the estimate of expected inflation is the difference between these values (using the Fisher equation). Consequently, we get the same answer whether we start with a nominal or a real risk free rate. This is because our estimate of expected inflation is consistently determined as the difference between these real and nominal rates.

154. By contrast, if the estimate of expected inflation was higher than implied by the Fisher equation (say, 2.00%) then our nominal cost of debt would be higher (5.51)%. Of course, the real return delivered by the PTRM would be unaffected at 3.4755% because the higher expected inflation used to derive the nominal cost of equity would also be removed from revenues within the PTRM – leaving the real return unchanged.

7.2 Why indexed CGS are the best proxy for the real risk free rate

155. The AER has rejected using break-even inflation as the best estimate of expected inflation on the basis that it may be biased. However, even if the AER were correct and break-even inflation were a biased measure of expected inflation (a proposition

we do not accept and one that the AER has not demonstrated – see section 6) then the same logic should lead the AER to adopt indexed CGS as the best estimate of the real risk free rate.

156. The AER has expressed the view that break-even inflation may be biased as a measure of expected inflation based on a number of factors unrelated to inflation expectations. These are:

- Inflation risk premium, whereby investors demand a higher expected real yield from nominal CGS due to the fact that they are exposed to inflation risk when investing in nominal CGS;
- Liquidity premium, whereby investors demand a lower expected real yield from nominal CGS because they place value on the higher liquidity of these instruments;
- Convexity premium, whereby investors demand a lower expected real yield from nominal CGS in order to compensate for the greater sensitivity of nominal yields to changes in inflation expectations;
- Indexed lag bias whereby the reported yield on indexed CGS may be influenced by one quarter of known inflation that is yet to be included in the indexed capital value of the bond.

157. To the extent that such sources of bias in break-even inflation existed they would imply that the nominal CGS yield requires adjustment to be an idealised risk free rate (not the indexed CGS yield). This is because a conclusion that the difference between indexed and nominal CGS is not the best estimate of expected inflation must be because:

a. Nominal CGS yields are an imperfect proxy for the real risk free rate plus expected inflation;

b. Indexed CGS are an imperfect proxy for the real risk free rate; or

c. Both of the above are true.

158. That is, even if the potential sources of bias in break-even inflation raised by the AER were considered to be material (and negative), that would not justify rejecting indexed CGS as the best proxy for the real risk free rate. In order to arrive at that conclusion, the AER would also need to believe that the 'bias' manifested in indexed CGS yields being 'too high' rather than nominal CGS yields being 'too low'.

159. The remainder of this section sets out what relevance, if any, the sources of potential bias in break-even inflation (as raised by the AER) have for any attempt to make adjustments to the indexed CGS yield as the best proxy for the real risk free rate.

7.2.1 Convexity and indexed lag bias

160. Nominal CGS prices are sensitive to both changes in real risk free rates and expected inflation. Indexed CGS prices are only sensitive to changes in real yields. Therefore, convexity risk is greater for nominal CGS (their value is more sensitive to potential changes in discount rates). This implies that nominal CGS are more risky than indexed CGS and are a worse starting point for a calculation of the real risk free rate (even if expected inflation was known with certainty).

161. Indexed lag bias is something that, if it exists at all, can be calculated directly and removed. This leaves us with inflation risk and liquidity risk bias as potential reasons why a) and/or b) may be true.

7.2.2 Inflation risk premium

162. The inclusion of an inflation risk premium in nominal CGS yields is clearly a reason to prefer indexed CGS yields as the best proxy of the real risk fee rate. The logic of an inflation risk premium bias in break-even inflation is that investors will demand an additional risk premium from nominal CGS due to the fact that these bonds do not deliver a guaranteed real risk free return but, instead, will deliver volatile real returns depending on the actual inflation outcome over the investment horizon (in this case 10 years). Clearly, as this is a risk premium built into nominal yields, it is inappropriate for inclusion in real yields.

163. It is worth noting that, in the current environment, inflation risk very likely has a strong systematic element such that if inflation is:

- lower than expected this will tend to be associated with 'bad' economic events (slow growth or recession); or
- higher than expected this will tend to be associated with 'good' economic events (stronger growth and the breaking out from a 'low inflation trap').

164. This means that the inflation risk premium built into nominal CGS at the moment is likely to be negative (have negative beta risk). That is, rather than being 'risk free', nominal CGS are providing an insurance premium to investors against bad economic news such that they will benefit (in the form of higher real returns) if the economy performs poorly and inflation is lower than expected.

165. The IMF considers that the reduction in the asset beta of nominal government bonds to negative levels has been an important contributor to the fall in nominal government bond yields. That is, government bonds now exhibit not just low or zero risk, but have become negative risk in the CAPM sense.

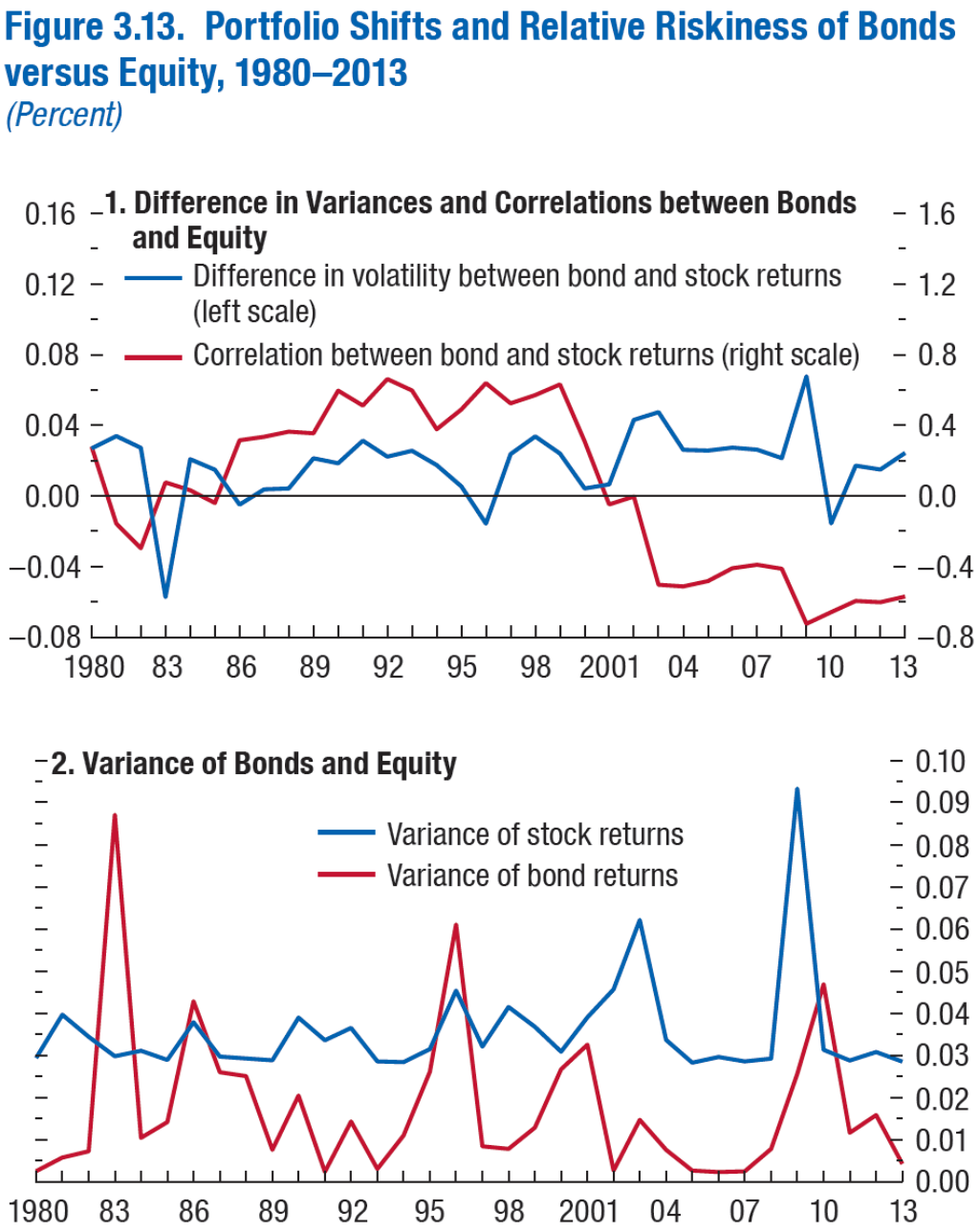
> *"… a change in the relative riskiness of bonds and equities has made bonds relatively more attractive. In particular, the evidence summarized in Figure 3.13 (panel 1) shows that the correlation between bond and equity returns*

has steadily declined (similar results have been found in Campbell, Sunderam, and Viceira, 2013)…"[56]

166. The evidence summarised in panel 1 of Figure 3.13 from the IMF (2014) report is reproduced below.

[56] International Monetary Fund World Economic Outlook: April 2014, Chapter 3, Perspectives On Global Real Interest Rates p.13.

Figure 22: IMF estimates of correlation between bond and stock returns



Source: IMF

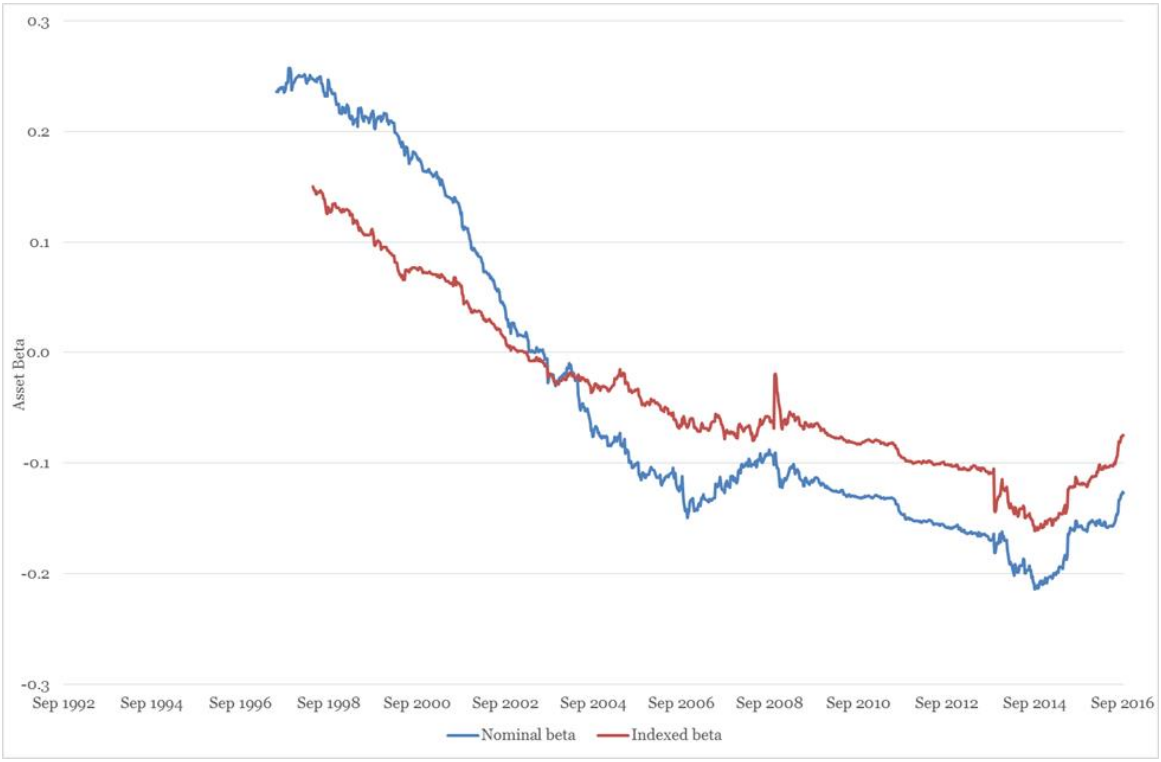
167. The beta on nominal government bonds implied by the above analysis is around negative 0.25.[57] If one believes that the MRP is 6.5% this would imply that whatever

[57] While the IMF does not specifically report the beta for government bonds, the data in the above two panels covers the constituent elements of beta. Specifically, the asset beta is equal to the correlation between stock and government bond returns (shown in the top panel) multiplied by the square root of the ratio of the variance of bond returns to the variance of stock returns (with the variances shown in the bottom

risk exposure is causing negative beta for nominal government bonds is around negative -1.25%.

168. The IMF's estimates are global but are similar to our own for Australian CGS. An examination of the beta for Australian CGS clearly shows the same trend as reported by the IMF. Nominal and indexed 5 and 10 year CGS have had materially negative betas since around 2000. This is apparent in Figure 23 below, which shows weekly asset betas measured over 5 years to the date on the horizontal axis (such that the point at which the time series crosses zero in early 2003 is using data from early 1998 to early 2003). Similarly, the first observations in 1997 use data from 1992 to 1997.

Figure 23: Weekly rolling 5-year betas for 10-year maturity – nominal and indexed CGS



Source: RBA, Bloomberg, CEG analysis

panel). The ratio of variances will always be positive (as will its square root) and consequently the sign of the beta is determined by the sign of the correlation.

The IMF panel shows, based on a global analysis, that there existed positive betas for government bonds prior to 2000 and strongly negative betas for government bonds since then. Reading off the first panel of the IMF figure the correlation has been at, or below, -0.4 since around 2003. Let us conservatively say that this has been -0.5 on average. Reading off the second panel, the average variance for bonds/stocks appears to be around 0.01/0.04=0.25; such that the square root of this ratio is around 0.5 (√0.25=0.5). This implies an asset beta of around -0.25 (=correlation×√ratio of variances= -0.5×0.5=-0.25).

169. Notably, nominal CGS have, since the early 2000s) had materially more negative (further from zero) betas than indexed CGS. This is consistent with nominal CGS being exposed to greater (negative beta) inflation risk than indexed CGS.[58]

170. The above result suggests that both indexed and nominal CGS yields may be depressed by virtue of having negative betas. However, indexed CGS yields are likely less depressed and, therefore, are a better proxy of the real risk free rate (as one would expect given zero inflation risk exists for indexed CGS).

7.2.3 Liquidity premium

171. The fact that indexed CGS also have a negative measured beta suggests that there may be other risk factors influencing the riskiness of both real and nominal CGS yields. An obvious explanation is liquidity risk.

172. In the Sharpe-Lintner CAPM, used by the AER as its foundation model, relative liquidity plays no role in determining the required return on an asset. The CAPM is a one-period model in which investors invest once, hold the asset for a single period and then divest and consume the entirety of their wealth. In this model there is no role for 'liquidity' to play a role in determining required returns. Consequently, at least in terms of the mathematics of the derivation of the Sharpe Lintner CAPM, it is not obvious how one should deal with the existence of liquidity risk in the real, multi-period, world.

173. A role for liquidity does exist in a multi-period asset pricing model (such as the inter-temporal CAPM). In multi-period models investors are optimising and altering their investment portfolios in response to unexpected news/shocks. In such models investors will have a preference for assets that are more liquid because those assets allow such optimisation to occur at lowest cost. Specifically, a 'liquid' market is one where an individual investor can expect to be able to buy or sell into the market without their personal transaction having a significant impact on the price paid/received in the transaction.

174. It may, or may not, be the case that nominal CGS are materially more liquid than indexed CGS. However, based on the theory of the Sharpe-Lintner CAPM there is simply no way of inferring whether the existence of a difference in liquidity makes indexed CGS a better or worse proxy for the real risk free rate.

175. In order to reach any conclusion along these lines one must step out of the Sharpe Lintner CAPM and ask, in a world where relative liquidity plays a role in investors' required returns, what is the optimal liquidity of the proxy for the real risk free rate?

[58] However, the fact that both have negative betas suggests that there is some risk factor other than inflation risk affecting both forms of CGS (noting that inflation indexed CGS have no inflation risk). This may have a relationship with interest rate risk (valu with the 'liquidity premium' as discussed in section 7.2.3.

The answer to this is that the real risk free rate should have the same liquidity as the assets being valued (the assets whose required return is being estimated).

176. In which case, both the nominal and indexed CGS are imperfect proxies for the nominal/real risk free rate because both are much more liquid than any other asset in the Australian economy. This means that both nominal and indexed CGS will have negative liquidity premiums relative to other less liquid assets; assets such as equity in an energy infrastructure company.

177. This need not be problematic for the application of the Sharpe-Lintner model if the liquidity premium is constant (i.e., if the higher required return on corporate equity/debt is due to lower liquidity is constant over time). In this case, the liquidity premium will simply be built into the estimate of the historical average market risk premium (MRP) and, at least for assets with betas of around 1.0, will not affect the estimated required return (i.e., depressed risk free rates will be offset by higher MRP estimates of the same magnitude).

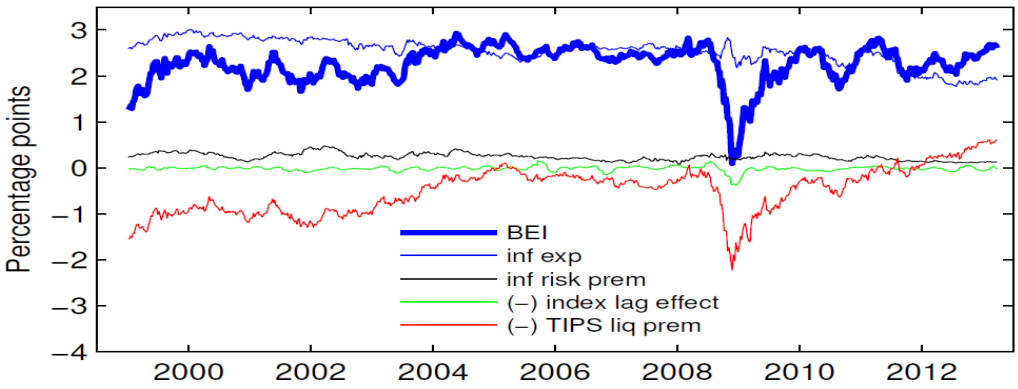
178. However, if there are some periods where investors place an unusually high value on liquidity, such as was the case in the GFC of 2008/09, using either nominal or indexed CGS as risk free rate proxies within the Sharpe-Lintner CAPM will result in:

- estimated risk free rates that are unusually low (unusually depressed by high value placed on liquid assets); and
- market risk premium estimates that are too low (unless they are increased to reflect an unusually high premium (relative to liquid CGS) required for investment in illiquid assets, do not offset the depressed CGS yields). (For low beta stocks (beta less than 1.0), this is true even if the AER increases the MRP to incorporate the heightened liquidity risk premium).

179. The behaviour of CGS yields in the GFC provides a perfect illustration of this point. During the GFC it is generally accepted that the liquidity premium was exceptionally high. This led to significant falls in both indexed and nominal government bonds – but greater falls for the latter than the former.[59] This event is picked up in the academic literature which suggests that during this period break-even inflation was biased downward as an estimate of expected inflation due to nominal government bond yields being depressed by more than indexed government bond yields. This is illustrated in 2008/09 in the below figure – with the thick blue line falling well below the thick blue line.

[59] Note that the events of September 2008 can be seen to have measurable differential impact on betas of nominal and indexed CGS – with the latter spiking up towards zero and the former spiking down further away from zero – see Figure 23 above.

Figure 24: Decomposing 10-year TIPS Breakeven Inflation D'Amico, Kim and Wei (2016)



Source: D'Amico, Kim and Wei (2014) [60]

180. However, the critical point to understand is that in the same period the required return on less liquid assets was increasing dramatically – consistent with the massive sell-off on global stock markets and the unprecedented spike in risk premiums on corporate debt.

181. This, at least in part, reflects the fact that the forces driving down yields on liquid government bonds were the *exact same* forces driving up required returns on less liquid corporate assets. If one applied an assumption, as the AER indeed does and did during the GFC, that the market risk premium is very stable and centred on historical average excess returns, then using a very liquid proxy for the risk free rate in a period of unusually high liquidity premium will tend to result in an underestimate of the true cost of capital. Such a conclusion was ultimately arrived at by the Australian Competition Tribunal in assessing the reasonableness of the AER's use of a risk free rate measured in the midst of the GFC.[61]

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60 D'Amico, S., Kim, D. H., and Wei, M., (2014) "Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices," FEDS Working Paper 2014-24 (Draft Version February 19, 2016)

61 *Application by EnergyAustralia and Others (includes corrigendum dated 1 December 2009)* [2009] ACompT 8 (12 November 2009), paras. 112-114.

> *The Applicants submitted that these facts demonstrated that basing a risk free rate on the AER's specified averaging periods would not achieve the objective of an unbiased rate of return consistent with market conditions at the date of the final decision. They appealed to expert opinion that the market risk premium was far higher than its deemed value while the risk free rate was abnormally low, so that the return required by investors was much higher than the AER's specified averaging period would generate.*
>
> ...
>
> *The Tribunal considers that an averaging period during which interest rates were at historically low levels is unlikely to produce a rate of return appropriate for the regulatory period.*

182. On this basis, if there was a materially higher liquidity premium built into nominal CGS yields compared to indexed CGS yields, this would make indexed CGS yields a superior proxy for the risk free rate used to determine the required (real) rate of return on relatively illiquid corporate assets.

Of course, the indexed CGS yield would not be a perfect proxy for the risk free rate when valuing illiquid corporate equity. This is because both indexed and nominal CGS are highly liquid.[62] In circumstances where the liquidity premium is so high that it is differentially effecting nominal and indexed CGS yields, the liquidity premium difference between either form of CGS and illiquid corporate equity would dwarf the liquidity premium differential between nominal and indexed CGS.[63] That is, while both nominal and CGS yields will be depressed relative to required returns on risky assets, the indexed CGS yield will be less depressed.

62 Both the nominal and indexed CGS markets are highly liquid with turnover of around $1,000bn and $50bn respectively. While the turnover in nominal bonds is around 20 times larger both are very large in absolute magnitude. Moreover, liquidity is a function of the ability of an investor to divest their holding without moving the market and, given that investors' holdings on nominal CGS tend to be larger, the absolute turnover must be adjusted for the average holding of these bonds in an investor's portfolio. The standard way to do so is to divide turnover rates by total outstanding stock in order to provide the 'turnover ratio'. The Australian Financial Markets Association produces this metric for nominal CGS and it has fallen from 5.2 in 2007/08 to 4.7 in 3.2 in 2014/15. A similar metric for indexed CGS was around 1.2 in 2007/08 and 1.9 in 2014/15. On this metric, liquidity in nominal CGS is only modestly higher than for indexed CGS.

63 Noting that nominal and indexed CGS are likely the most liquid asset classes in Australia with many billions of dollars of turnover each year for a relatively homogenous assets.

Appendix A Low inflation concerns domestically and internationally

183. At the time of writing, the United States, Great Britain, the Eurozone and Japan have all had policy interest rates at or near the zero (below 0.5%) for extended periods and have all suffered from below target inflation (and deflation in much of the Eurozone and in Japan). The US, after five years at the with rates below 0.5% has recently raised policy interest rates to 0.5% but this, as noted by Governor Brainard, does not imply that the zero lower bound no longer affects the potential future path of monetary policy.

184. Moreover, as noted by the IMF in 2015:

> *"… with the United States expecting to exit the zero lower bound this year, but with no such prospects for the euro area or Japan."*[64]

185. In the same document, the IMF pointedly refers to the risk that a number of other countries, including Australia, will fall into the same low inflation trap.[65]

> *However, in economies in which output gaps are currently negative (Australia, Japan, Korea, Thailand), policymakers may need to act to prevent a persistent decline in inflation expectations.*

186. Since then, inflation outcomes have continued to come in below the RBA target range and the RBA policy interest rate has declined even closer to the zero lower bound.

187. In a low interest rate environment, as explained by Governor Brainard, the risks associated with inflation outcomes in the current environment are asymmetric – with greater risk of below target inflation than above target inflation. The essential point is that monetary policy is constrained in how low interest rates can go in order to raise inflation (the 'zero lower bound') with no similar constraint on raising interest rates in order to reduce inflation. This creates the potential for a 'low inflation/interest rate trap' that has no symmetrical opposite. Following the RBA's May 2016 rate cut, the financial press reported that:

> *Australians must urgently confront the danger that the Reserve Bank of Australia is nearing the very limits of its powers and risks stumbling into the same zero-interest rate trap that has neutered European and Japanese central banks, say two high-profile economists. …*

64 International Monetary Fund, "World Economic Outlook", April 2015, p. xiii.

65 Ibid, p. 56.

"The evidence is that even aggressive monetary policy action doesn't seem to be driving up inflation, so far," Mr Yetsenga told AFR Weekend. [66]

188. Bloomberg also reported that the May SoMP inflation forecasts are built on an assumption that the RBA will reduce interest rates in line with market expectations.[67] This implies that the RBA's then inflation forecasts were based on the RBA reducing interest rates to 1.5% (which, indeed, did occur).[68]

> *"If after cutting once and factoring in another rate cut, as per market pricing, you are still only getting to the bottom half of your target band by the end of the forecast horizon, that's giving a clear signal you feel quite concerned about underlying inflation pressures and the outlook," said James McIntyre, head of economic research at Macquarie Group Ltd.*

189. Similar sentiments were expressed following the August 2016 RBA rate cut:

> *"With 50 basis points of easing since May 2016, we now believe the RBA has delivered the first increment of its likely policy response to lower than expected inflation outcomes," JPMorgan chief economist Sally Auld said.*
>
> *"**Our bias is to think that Australia risks a more protracted - period of low inflation**, and as such, we continue to forecast a further 50 basis points of easing from the RBA in the first half of 2017."*
>
> ...
>
> *ANZ senior economist Kieran Davies agreed that the path of the currency and the extent of the pass-through of the cash rate to lending rates would affect the RBA's thinking on interest rates from here, although he expected rates to bottom at 1.5 per cent.*

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66 AFR Weekend, RBA joins race to the interest rate bottom, 6 May 2016 at 11.45pm. Available at this link: http://www.afr.com/news/economy/monetary-policy/rba-joins-race-to-the-interest-rate-bottom-20160506-goobl0#ixzz47xFNhJoE . See also Bloomberg, RBA's New Head Seen Facing Risk of Rate Cuts to 1% by JPMorgan May 9, 2016 (Available at http://www.bloomberg.com/news/articles/2016-05-08/rba-s-new-head-seen-facing-risk-of-rate-cuts-to-1-by-jpmorgan.) which reports:

> *The central bank's focus Friday on inflation expectations was notable given the phrase appeared 16 times in a document that rarely mentions it, said Joseph Capurso, a senior currency strategist in Sydney at Commonwealth Bank of Australia. "It is very hard to lift inflation expectations when they are low and Japan is a good example of this," he said*

67 RBA, May 2016 SoMP, p. 60. "*In preparing the domestic forecasts, a number of technical assumptions have been employed. The forecasts are conditioned on the assumption that the cash rate moves broadly in line with market pricing as at the time of writing*."

68 Bloomberg, *Reserve Bank of Australia Cuts Core Inflation Forecast to 1-2%,* May 6, 2016. (Available at http://www.bloomberg.com/news/articles/2016-05-06/rba-cuts-core-inflation-forecast-unlikely-to-hit-target-in-16.)

> *"Our central case is unchanged and we see rates on hold at this point, albeit with a clear risk of further easing given we think that* ***the RBA's forecast outlook of persistently low inflation*** *is consistent with an easing bias," he said.*

190. In its October 2015 World Economic Outlook publications, the IMF projected inflation to continue to be generally below central bank targets.[69]

> *In advanced economies, inflation is projected to rise in 2016 and thereafter, but to remain generally below central bank targets.*

191. This projection was revised down by the IMF in the April 2016 World Economic Outlook with the IMF now stating: [70]

> *With the December 2015 declines in oil prices mostly expected to persist this year, consumer price inflation has been revised downward across almost all advanced economies and is projected to remain below central bank targets in 2016.*

69 IMF, World Economic Outlook, October 2015, p. 16

70 IMF, World Economic Outlook, April 2016, p. 21

Appendix B CPI Swaps are a biased estimate of expected inflation

192. Implied inflation measured from inflation swap markets is also a market measure of inflation expectations. However, this measure will tend to be biased upwards to account for risk premiums and capital costs for the banks providing these products. This is because the inflation swap market is one-sided in the sense that there is more demand for the fixed leg of an inflation swap than the floating leg. That is, there are more investors wanting to hedge long-term inflation than who want to be exposed to long term inflation (by taking on floating rate exposure).

193. This means that the sellers of inflation protection in the swap market (who promise to pay the floating leg of the swap) and buy indexed bonds in order to receive a floating CPI payment which is a hedge to its floating exposure. (If the swap market was evenly balanced the dealer would just take the floating side of another swap rather than buy indexed bonds.) Therefore, it is to be expected that inflation swap data will be above breakeven inflation because breakeven inflation defines the base rate of inflation that the seller can use to hedge its exposure. Thus, the fixed rates offered by dealers must be above breakeven inflation if the dealer is to cover their costs and risks. This issue is also discussed by Campbell, Shiller, and Viceira (2009):

> *The figure shows that the two breakeven rates track each other very closely up to mid-September 2008, with the synthetic inflation breakeven rate being about 35-40 basis points larger than the cash breakeven inflation rate on average.*
>
> *This difference in breakeven rates is typical under normal market conditions. According to analysts, it reflects among other things the cost of manufacturing pure inflation protection in the US. Most market participants supplying inflation protection in the US inflation swap market are levered investors such as hedge funds and banks proprietary trading desks. These investors typically hedge their inflation swap positions by simultaneously taking long positions in TIPS and short positions in nominal Treasuries in the asset swap market. A buying position in an asset swap is functionally similar to a levered position in a bond. In an asset swap, one party pays the cash flows on a specific bond, and receives in exchange LIBOR plus a spread known as the asset swap spread. Typically this spread is negative and its absolute magnitude is larger for nominal Treasuries than for TIPS. Thus a levered investor paying inflation - i.e. selling inflation*

protection - in an inflation swap faces a positive financing cost derived from his long-short TIPS-nominal Treasury position.[71]

194. Consistent with this, inflation swap rates remain well above breakeven inflation – in June 2016 the average 4-year inflation swap was 1.81% vs break-even inflation of 1.22%. It is notable that the period in early 2009 and late 2008 has the greatest difference between breakeven and inflation swap rates. This is an exceptional period where the opportunity cost of capital was very high for financial firms, suggesting that the costs of providing inflation swaps would be high.[72]

195. This conclusion is borne out by noting that the implied CPI swap 10 year forward rate for inflation has typically been well above 2.5% at a 10 year horizon – on average 3.0% since 1 January 2012. That is, the implied expected inflation rate in 10 years' time is typically 0.5% above the middle of the RBA target forecast – and this in a context of low Australian and global inflation. This provides an indication of the magnitude of the bias in inflation swaps.

[71] Campbell, Shiller, and Viceira, Understanding Inflation-Indexed Bond Markets, NBER Working Paper No. 15014, (2009), p. 21.

[72] However, it is also the case that this was a period of extremely high liquidity premiums which likely depressed breakeven inflation rates (noting that nominal CGS tend to be more liquid than indexed CGS). In such exceptional circumstances it is difficult to be sure what the best estimate of expected inflation was. However, in more normal periods outside of financial crisis circumstances the best estimate will be break-even inflation given that the no-arbitrage condition means that the CPI swap market tends to reflect breakeven inflation rate plus a premium for the hedging costs of swap dealers.

Appendix C Convexity Bias

196. The convexity bias is caused by the curvature of the yield to price function and the dispersion of inflation expectation. It can be approximated using the yield to price function of a zero coupon bond based on the present value formula.

197. The model assumes the nominal yield contains two components, the expected real interest rate and the expected inflation.[73] The expected inflation is assumed to follow a log-normal distribution and the period of the bonds is assumed to be 5 years. We find the convexity bias is increasing on the dispersion of the belief on forecast inflation.

198. Table 3 shows the underestimation of expected inflation caused by the convexity bias. It shows than when the range of the 90% confidence interval is 200 basis, (this implies when the annual expected inflation is 2%, the range of the 90% confidence interval for annual inflation is from 1.1% to 3.1%) the impact of the convexity bias is only 2.2 basis points.

Table 3: Simulated Underestimation of Expected Inflation (basis points)

Expected inflation	Range of 90% Confidence Interval Around Mean (bppa)		
	100	150	200
1.5%	-0.5	-1.2	-2.2
2.0%	-0.5	-1.1	-2.0

73 The convexity bias does not depend on the expected real interest rate and its dispersion. Its impact on the price of nominal bond is offset by its impact on the price of the indexed bond. Therefore its effect disappears when the convexity bias is calculated.