Best estimate of inflation for regulatory purposes

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1 Executive summary

1. I have been asked to update the analysis from my November 2016 inflation report.[1] Since November 2016, there have been a number of additional developments that precipitated this updated report:

   - In February 2017, the QCA finalised DBCT's 2015 Draft Access Undertaking, affirming that the QCA would move away from a forecast inflation that was fixed at 2.5%, and instead adopt the 'Midpoint of RBA Ranges' approach; and
   - Since inflation forecasts are time-varying, the best estimate of inflation will need to be evaluated with reference to the latest data and regulatory developments.

2. In this report, I use data from the 20 business days ending 30 June 2017 to illustrate my conclusions. In addition, although, consistent with the QCA focus,this report mostly addresses the 4-year inflation forecast, I note that the conclusions remain consistent for 10-year forecasts.

1.1 Conceptual conclusions

3. My key conclusions are as follows:

   a. The best method for estimating inflation depends on how it is used in Aurizon Network's revenue modelling and how this fits with the overall regulatory regime;

   b. The relevant context is that the regulatory regime as presently applied by the QCA to Aurizon Network delivers a real (inflation adjusted) return to investors. This real return is estimated by:

      i. starting with the observed return on nominal bonds; and

      ii. removing the estimate of inflation from these observed returns to arrive at a real return.

   c. In this context, the correct measure of inflation is whatever compensation for inflation is built into the nominal bond returns used in b.i) above.

   d. The best estimate of this is inflation compensation derived directly from bond markets (being the difference in observed yields between inflation-protected and nominal bonds).

4. These conclusions hold whether or not the inflation compensation built into nominal bond yields includes an inflation risk premium (positive or negative). A positive/negative inflation risk premium on nominal bonds might exist if investors of

[1] CEG, Best estimate of inflation: revaluations and revenue indexation, November 2016.

nominal bonds dislike/like the exposure to real returns that vary inversely with the level of actual future inflation.

5. In fact, the existence of an inflation risk premium (positive or negative) built into nominal bond yields makes it imperative that it be removed when arriving at a real return used to compensate Aurizon investors.[2] This is because Aurizon investors do not bear inflation risk associated with receiving a fixed nominal return irrespective of inflation. Therefore, it would be an error to compensate those investors 'as if' they were exposed to (positive or negative) inflation risk.

1.2 Empirical conclusion

6. Table 1-1 below, which reproduces Table 4-1, contrasts bond market inflation with the midpoint of the RBA range over the 20 trading days ending 30 June 2017.

Table 1-1: Midpoint of RBA ranges vs bond market inflation (June 2017)

Horizon	Midpoint of ranges	Bond market inflation	Nominal bond yields	Indexed yields	Real return on nominal bonds implied by midpoint of ranges
	#1	#2=(#3-#4)*	#3	#4	#5=(#3-#1)
Four years	2.37%	1.62%	1.90%	0.28%	-0.47%
Ten years	2.45%	1.83%	2.44%	0.59%	-0.01%

*Source: QCA, Bloomberg, RBA, CEG analysis. *The full formula used to derive bond market inflation is #2=(#3-#4)/(1+#4).*

7. During the 20 trading days ending 30 June 2017, inflation compensation in nominal bond yields (estimated by applying the Fisher equation to the difference between yields on nominal and inflation-protected bonds issued by the Australian Government) was 1.62% at a four year horizon and 1.83% at a 10 year horizon.

8. This is materially below the estimate of expected inflation[3] arrived at by applying the methodology recently applied by the QCA in a decision for DBCT. That method involves using the midpoint of RBA forecasts of short term inflation and then averaging these with an assumption of 2.5% thereafter – where 2.5% is the midpoint

[2] The QCA rejected DBCT's proposal to use the expected inflation rate to index the RAB in each year instead of outturn inflation. Instead, the QCA affirmed the use of outturn for RAB indexing. See: QCA, DBCT Management's 2015 draft access undertaking, Final decision, November 2016, pp. 173-175.

[3] Expected inflation has a specific meaning. It is the probability weighted average of all possible inflation outcomes perceived by investors. For example, if inflation could only ever be 1% (with 40% probability) or 2.5% (with 60% probability) then expected inflation would be 1.90% (=1.0%*.5+2.5%*.6). Expected inflation would not be 2.5% even though this is the 'most likely' outcome. Investors do not care only about the most likely outcome. They care about all the possible outcomes weighted by the likelihood of each outcome occurring.

of the RBA inflation target range. That method, applied in June 2017, would result in an estimate of 2.37% at a four year horizon and 2.45% at a 10 year horizon.

9. There are two possible explanations for these differences.

   a. The first is that bond investors expect that inflation will be at the midpoint of the RBA forecast/target range. However, bond investors are happy to earn less than this in compensation for expected inflation because they value being exposed to 'inflation risk' (or some other risk that nominal bonds deliver that inflation-protected bonds do not);

   b. The second is that bond investors do not expect inflation to be in the midpoint of the RBA forecast/target range.

10. Both of these are possible and they are not mutually exclusive – it may be that both are true. Indeed, it is my view that it is simply not plausible for the first explanation to be the only reason the estimates differ. To the extent that the first explanation holds it can, at best, be a partial explanation for the magnitudes involved.

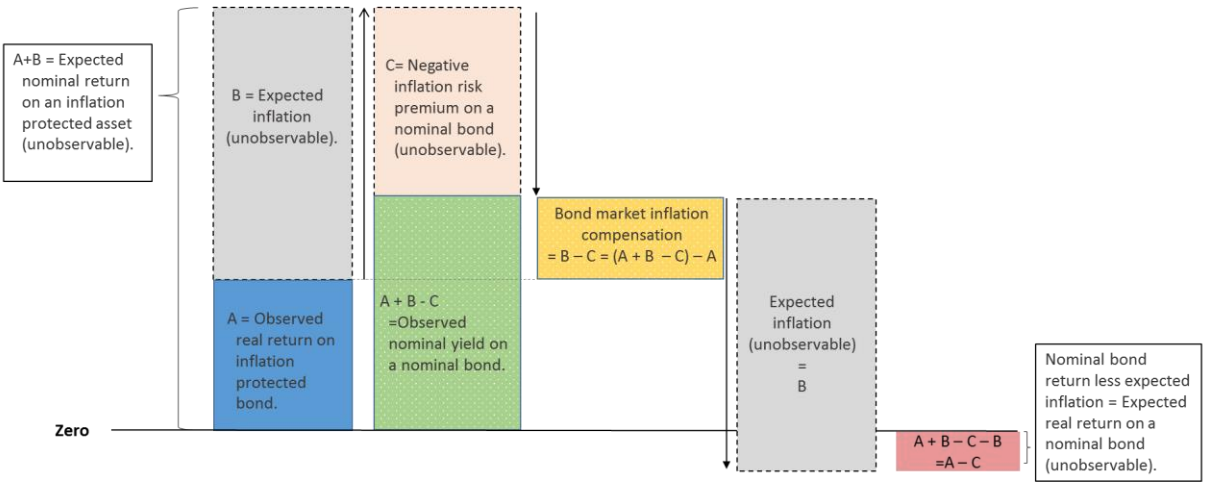
11. Fortunately, it is not necessary to attempt to disentangle these potential sources of difference. If investors truly do have a negative inflation risk premium, leading to a lower return on nominal bonds, then this 'negative inflation risk premium' must be added back into the QCA cost of capital for Aurizon Network because the QCA regulatory regime does not offer nominal returns (it offers inflation-protected returns).[4]

1.3 Graphical illustration

12. The following graphic provides an illustration of the error associated with trying to disentangle the sources of difference provided at paragraph 9 above, with a view to excluding any inflation risk premium from the estimate of regulatory inflation used by the QCA.

4 That is, unless the QCA adopts Aurizon Network's proposed changes that would have the effect of converting returns from real to nominal terms. However, the QCA has rejected this for DBCT and this report is drafted on the assumption that it will apply the same decision to Aurizon.

Figure 1-1: Illustration of logical error



13. The QCA's regulatory regime provides inflation protection to investors. Therefore, the relevant real risk free rate for investors in Aurizon is the return required by investors in an inflation-protected risk free asset. This is the value "A" signified by the blue box on the left hand side of Figure 1-1 – the observed real yield on inflation-protected bonds. In the 20 days to 30 June 2017 this value is 0.28%.

14. Expected inflation ("B") is signified by the grey box. If the midpoint of RBA ranges approach is assumed to be accurate then B=2.37% in the 20 days to 30 June 2017. The expected nominal return on an inflation-protected bond is given by A+B – i.e., the guaranteed real return plus the expected level of inflation.

15. However, if investors prefer to be exposed to inflation risk (i.e., they prefer a guaranteed nominal return to a guaranteed real return) then investors will demand a lower return on nominal bonds than they expect to receive on inflation-protected bonds. Call this value "-C" signified by the removal of the pink "negative inflation risk premium" box to arrive at the green "observed nominal yield on a nominal bond" box. That is, the observed nominal yield (green box) is equal to A + B – C (the observed real yield (A) plus unobservable expected inflation (B) less the (negative) inflation risk premia (-C) on nominal bonds). (In the 20 days to 30 June 2017 the observed nominal yield on 4 year government bonds was 1.90%.)

16. If the regulator starts with this observed *nominal* bond yield (green box) this starting point will automatically include both expected inflation (B) and any inflation risk premium (-C). Therefore, in order to get back to the objective, which, in a regulatory regime that delivers *inflation-protected* returns, is the required real return on an asset *with inflation protection*, the regulator must remove the effect of *both* expected inflation (B) and the inflation risk premium (-C). That is, the regulator must remove B - C in inflation compensation from nominal returns. It can be seen that this is given

by observed bond market inflation. That is, observed nominal government bond yields less observed inflation-protected government bond yields (i.e., B – C = observed nominal less inflation-protected yields = (A + B – C) – A).

17. However, if the regulator starts with the observed *nominal* bond yield (green box) and removes only expected inflation (B) and not the negative nominal risk premium (-C) then the regulator will end up providing a real return of A – C (in the illustration this is negative because C exceeds A).

1.4 Conclusion

18. In my view, the gap between the 'midpoint of ranges' and bond market inflation estimates cannot plausibly be explained by the existence of risk premia differentials between nominal and inflation protected bonds. The gap is simply too large and, in my view, the only plausible conclusion is that the 'midpoint of ranges' estimate is overestimating inflation expected by bond market investors.

19. However, even if the 'midpoint of ranges' estimate was an accurate measure of investors' expected inflation, it should not be used as the measure of regulatory inflation. This is because nominal bond investors would have to be demanding much less (76bp less) than expected inflation in compensation for exposure to inflation. This can only be because the inflation exposure for a nominal asset are highly valued (at 76bp) by investors.

20. However, the QCA regulatory regime is not offering a nominal investment – it is offering an inflation protected investment. Given that the QCA's nominal cost of capital is based on the yields on nominal bonds, it will have compensation for inflation that is depressed by 76bp – reflecting investors' desire to be exposed to inflation risk on nominal returns. Removing expected inflation from the nominal cost of capital will, therefore, deliver a real cost of capital that is 76bp below that demanded by investors in an asset that is inflation protected (i.e., does not offer inflation risk on nominal returns).

2 Introduction

21. I have been asked by Aurizon Network (henceforth referred to as "Aurizon") to provide my expert opinion on the best estimate of inflation to use in the QCA's revenue model and in the wider context of the regulatory regime as presently applied by the QCA under the QCA Act. This is an update to my November 2016 report, having regard to both more recent market data and also the QCA's reasoning in relation to forecast inflation in its November 2016 Final Decision on DBCT Management's 2015 draft access undertaking.

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

    - Section 3 describes how forecast and actual inflation interact within the regulatory regime to deliver compensation to investors. I explain why this context means that bond market inflation must be used by the QCA to derive a real return within its revenue model – even if it is not an accurate estimate of expected inflation.
    - Section 4 describes why, irrespective of the above conclusion, alternatives to bond market inflation based on the midpoint of RBA forecast/target ranges for inflation are less reliable than bond market inflation.

23. I have read the Guidelines for Expert Witnesses in Proceedings of the Federal Court of Australia and confirm that I have made all inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to the best of my knowledge, been withheld.

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3 Inflation and the regulatory regime

3.1 Terminology

24. Before proceeding with the analysis in this section it is useful to first define the relevant terms.

- **Regulatory inflation** estimate is the inflation value that is used as an input to the QCA revenue model and which has the effect of turning the nominal return on capital into a real return. (The QCA does not publish its model but I am instructed that the mechanism by which this is done is similar to the AER's PTRM, where the allowable revenue is reduced by the amount of regulatory inflation applied to the RAB, which is then indexed by actual inflation).
- **Bond market inflation** is the difference in the yields of nominal and inflation-protected bonds.[5] This is the compensation that investors in nominal government bonds demand for exposure to uncertain inflation outcomes above the guaranteed real return on inflation-protected government bonds (whose yields are quoted before inflation because the nature of such bonds is that actual inflation is compensated via indexation of the capital value of the bond). I also refer to this as 'bond market inflation compensation' or similar.
- **Expected inflation** is the probability-weighted average of all possible inflation outcomes perceived by investors. For example, if inflation could only ever be 1% (with 40% probability) or 2.5% (with 60% probability) then expected inflation would be 1.90% (=1.0%*.4+2.5%*.6). Expected inflation would not be 2.5% even though this is the 'most likely' outcome. Investors do not care only about the most likely outcome. They care about all the possible outcomes weighted by each outcome's likelihood of occurring.
- **Inflation risk premia** refers to any positive or negative risk premium demanded by investors in nominal bonds (relative to otherwise similar[6] (e,g. maturity and credit risk) inflation-protected bonds). This is separate from the compensation they demand for expected inflation.

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5 In the November 2016 report for Aurizon, I used the term "breakeven inflation" instead of "bond market inflation". The terms are interchangeable, although the new terminology is used in order to clarify that the estimate is obtained directly from the bond market, which is also the source of estimates for cost of debt calculations.

6 Differences in liquidity premia between nominal and inflation-protected bonds can be included in a more broadly defined 'inflation risk premium' as is discussed in Appendix A. However, for simplicity, I generally restrict myself in the body of this report to a narrower concept of inflation risk premia relating purely to differences in inflation risk exposure (not differences in liquidity between bonds with different inflation risk exposure).

25. Provided 'expected inflation' refers to inflation expected by bond investors, the mathematical relationship between the last three terms is as follows:

Bond market inflation = Expected inflation ± Inflation risk premia

26. As will be shown in the remainder of this section, the existence of inflation risk premia – if it does exist – actually supports the use of Bond market inflation, given that it reflects an actual cost incurred by the regulated firm, which must in turn be compensated for.

27. Furthermore, section 4 demonstrates that the magnitude of inflation risk premia is likely to be immaterial, such that Bond market inflation generates superior estimates of both the Expected inflation and Inflation risk premia parameters.

3.2 The regulatory regime

28. Section 2 of my November 2016 report described the role of inflation forecasts in the regulatory framework as applied by the QCA under the QCA Act. I summarise the pertinent aspects here. The regulatory regime, as implemented by the QCA, can be summarised as delivering real returns to investors in Aurizon via the following steps:

Step 1 – Start with a nominal return on capital based on observations of prevailing nominal yields in bond markets with a term matched to the regulatory period (plus an Aurizon-specific risk premium estimate);[7]

Step 2 – Derive a real (inflation-protected) return on capital by subtracting the QCA's value for regulatory inflation from the value determined in Step 1. This real return is delivered in the form of revenues during the regulatory period;

Step 3 – Compensate for actual inflation (not the inflation removed in Step 2) by indexing revenues and the value of the RAB to actual inflation.

29. This regime results in the following interactions between regulatory inflation, expected inflation, inflation risk premia and actual inflation:

Step 1 – The QCA's starting point is a nominal return that includes the compensation that nominal bond investors demand for exposure to inflation (i.e., bond investors' inflation expectation plus/minus any inflation risk premia). This is the inflation compensation that is built into the nominal bond yields that the QCA uses to set the nominal cost of capital;

7 I note once again that even though the analysis here focuses on four-year inflation forecasts, the findings are also consistent for ten-year inflation forecasts.

Steps 2 – The regulatory inflation (which may, or may not be, equal to inflation compensation demanded by bond investors) is then removed from Step 1 nominal returns to derive a real return. This real return forms the basis of the determined revenue path;

Step 3 - Aurizon investors are compensated for actual inflation (i.e., are provided a nominal return) via the indexation of revenues and the indexation of the RAB to actual inflation.

30. In summary, under the regulatory regime as currently applied by the QCA, Aurizon investors are compensated for actual inflation plus the difference between nominal bond investors' required compensation for inflation and the value of regulatory inflation.

Total inflation compensation	=	Nominal bond investors' required compensation for exposure to inflation. (**Step 1**)	-	Regulatory inflation (**Step 2**)	+	Actual inflation. (**Step 3**)

3.3 Step 2 requires bond market inflation compensation to be used

31. An understanding of the regulatory framework makes it clear that the role of regulatory inflation should be to remove from the nominal cost of capital the compensation for inflation exposure that is already embedded in the nominal cost of capital. This is required in order to achieve the ultimate goal, which is delivering the real return investors require for investment in an inflation-protected regulatory regime.

32. The objective is not to remove the best estimate of expected inflation *per se*. Rather, the regulatory inflation that must be removed, in Step 2, is the value that is embedded in the nominal yields used in Step 1. Specifically, the compensation that nominal bond investors demand for the exposure of their investment to both expected and unexpected inflation.

33. Investors in nominal bonds have real 'skin in the game'. Nominal yields do not adjust for unexpected inflation and, consequently, higher inflation erodes real returns (while lower inflation delivers a real windfall). Therefore, nominal bond investors have strong incentives to buy/sell at yields that provide accurate compensation for expected inflation.

34. It is possible, for one reason or another, that bond investors demand compensation for expected inflation that is higher/lower than the best estimate of expected inflation that is available to a regulator. This might simply be because bond investors collectively misestimate expected inflation and the regulator has access to a better model of expected inflation. Alternatively, bond investors might correctly estimate

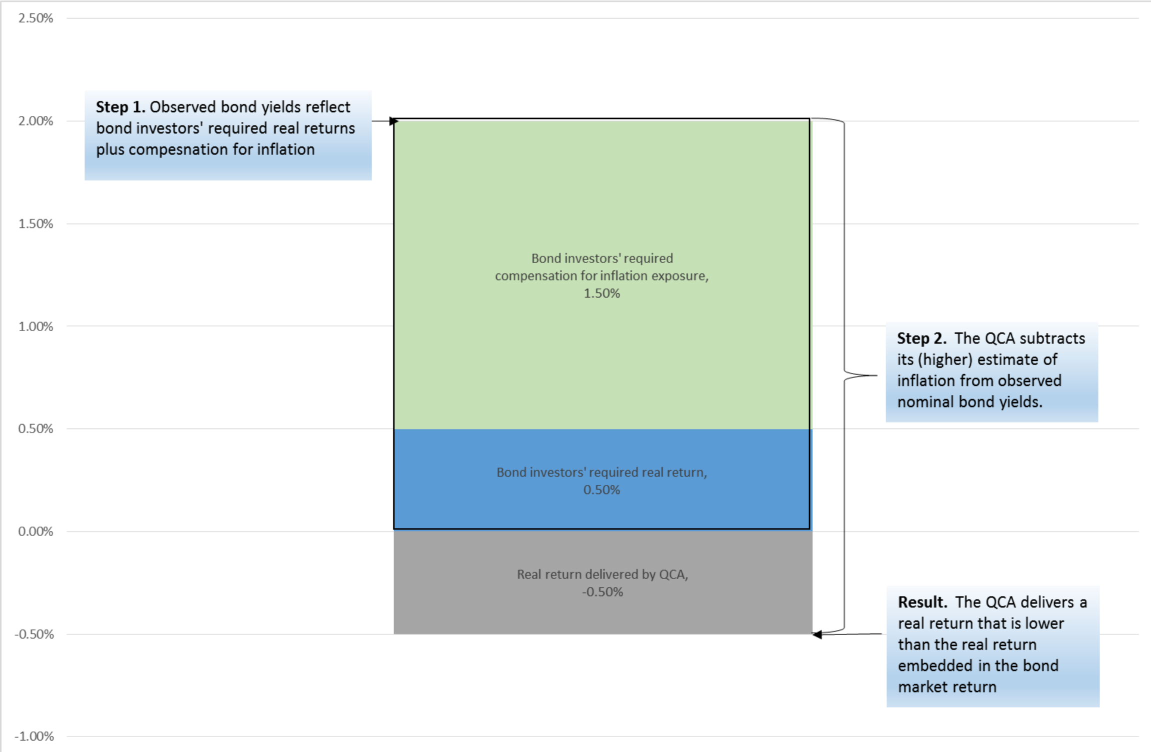
expected inflation but might demand more/less than this in yields due to the existence of a positive/negative inflation risk premium.

35. However, the logic of the regulatory regime as presently applied by the QCA requires that bond market inflation is used in Step 2 irrespective of whether either of these possibilities holds true. This is because the objective of Step 2 must be to remove the inflation compensation included in Step 1. The inflation compensation included in Step 1 is the compensation for inflation demanded by investors in nominal bonds. Therefore, it is this value of regulatory inflation that must be the objective in Step 2.

36. Put concretely, if bond investors require 1.5% compensation for inflation then this means that nominal bonds only include 1.5% compensation for inflation. Therefore, in order to arrive at a real return that reflects investors' compensation absent inflation exposure, 1.5% must be removed. This is true even if there are grounds for believing that actual inflation is more likely to be 2.5%. 1.5% is the inflation compensation included in the QCA nominal cost of capital and, therefore, 1.5% is the regulatory inflation that should be removed to arrive at a real cost of capital.

37. Consider an example, illustrated below, where nominal bond investors would require a 0.5% real return on an otherwise identical (i.e., identical maturity, liquidity, credit risk etc.) inflation-protected government bond. However, the nominal bond is not inflation-protected so these investors also require compensation for expected inflation plus any risk that comes from exposure to variation in actual inflation from expected levels. Let expected inflation be 2.5% but bond investors require only 1.5% inflation compensation because they perceive a 1.0% negative risk premium (they like to be exposed to inflation risk and are prepared to accept a 1.0% lower return in order to gain this exposure).

Figure 3-1: Illustration of mismatch due to failure to use inflation compensation embedded in nominal bond yields



38. In this case, the observed nominal bond yields will be 2.0% - equal to bond investors' required real return on an otherwise identical inflation-protected asset (0.5%) plus bond investors' required compensation for inflation (1.5%).

39. Now imagine that, notwithstanding that bond investors only require 1.5% compensation for inflation (and nominal yields reflect this), the QCA proceeds to remove regulatory inflation based on what it believes is the best estimate of expected inflation (2.5%). The end result is that the base real risk free return that Aurizon investors are provided is -0.5% - which is 1.0% lower than the real return that investors would require in an inflation-protected government bond that otherwise had all the attributes of a nominal government bond.

40. The key conclusion of this report is that the positive 0.5% return is the answer to the correct question, namely, what real return do investors require in a risk free asset that shares the same inflation risk as the regulated asset (i.e., offers an inflation-protected return)? The negative 0.5% return is the correct answer to the wrong question, namely, what real return do investors require in an otherwise risk free asset that is not inflation-protected and does not have the same inflation risk protection as the regulated asset (i.e., promises a guaranteed nominal return not a guaranteed real return)?

3.4 Illustration of correct treatment of inflation risk premia

41. A similar, although less extreme, result is applied in the averaging period used by the QCA to set the cost of capital for DBCT. In that decision the QCA adopted the midpoint-of-ranges method and this resulted in an implied real return on nominal government bonds of negative 0.17% (0.55% lower than the positive 0.37% return available on inflation-protected government bonds).

42. The QCA's justification for why this could be a plausible outcome was that:

    a. Nominal government bonds are not, in fact, risk free. Rather, they expose investors to inflation risk (higher real returns when inflation is unexpectedly low and lower real returns when inflation is unexpectedly high). Moreover, and critically, that investors actually like being exposed to this form inflation risk and, therefore, are prepared to pay (i.e., accept lower, and even negative, real return) in order to gain exposure to this risk via holding assets with specified nominal returns; and

    b. Investors prefer not to earn a higher expected return (and a guaranteed real return) on inflation-protected government bonds because:

        i. Inflation-protected government bonds do not have the inflation risk that investors desire to be exposed to (point a. above) and, consequently, investors demand a higher return on these bonds; and/or

        ii. Inflation-protected government bonds are less liquid assets than nominal government bonds and, consequently, investors demand a higher return on these bonds.

43. In the DBCT decision the QCA hypothesises that investors prefer to be exposed to inflation risk than to be protected against inflation risk.[8]

> *Specifically, investors (presumably) care about their real, not nominal, returns on a bond. Given this reasonable assumption, indexed bonds are risk-free, while nominal bonds are risky because their real return depends on the actual inflation rate that occurs during the relevant period. It is therefore commonly assumed* [that] *nominal bonds have an inflation risk premium. This is typically assumed to be positive, but the issue is controversial. The relevant academic literature indicates 'the inflation risk premium' bias could be in either direction.*

[8] QCA, DBCT decision, p. 169.

44. The QCA goes onto give an example in which the difference between the negative real risk free rate it determines for DBCT (-0.17%) and the observed real risk free rate on inflation-protected government bonds (0.37%) is explained by a hypothesised: [9]

- -0.45% inflation risk premium in nominal bond returns; and
- -0.10% liquidity premium built into nominal bond yields.

45. This may, or may not, have been plausible in the DBCT averaging period. However, the same could not be said in the 20 days to 30 June 2017. The negative 0.47% real return and 0.76% differential to inflation-protected bonds cannot, in my view, be explained by the above factors. I explain this in more detail in section 4.

46. However, even if it were the case that the midpoint of ranges approach resulted in an accurate estimate of expected inflation, this does not alter the conclusion in section 3.3 that bond market inflation should still be used in the QCA revenue model.

47. If an inflation risk premia exists for nominal bonds then, when faced with a choice between investing in nominal (inflation risky) and indexed (inflation-protected) government bonds, investors will prefer the former. Therefore, investors will require a lower expected real yield on nominal bonds. If so, this means that the required (expected) real yield on inflation risky assets (such as nominal bonds) is depressed below the required real yield on inflation-protected assets (such as inflation-protected bonds).

48. At this point the potential for error in deriving a real return for Aurizon investors based on observed returns on nominal assets becomes clear. Investors in Aurizon are investing in an inflation-protected asset. This asset does not offer the (alleged) desirable inflation risk profile of nominal assets. If such a negative inflation risk premium does exist for nominal bonds then this will depress the required yield on these bonds - but will not depress the required return for investors in Aurizon.

49. It would, therefore, be a mistake to estimate the real return, including real risk free rate, for Aurizon investors by:

Step 1: starting with nominal bond yields depressed by a negative inflation risk premia for nominal assets;

Step 2: remove expected inflation without any adjustment for the negative inflation risk premia to arrive at an estimate of the real return on a nominal asset (one that is below the return on an inflation-protected asset);

Step 3: use this to set the real return that investors in Aurizon, an inflation-protected asset, will receive.

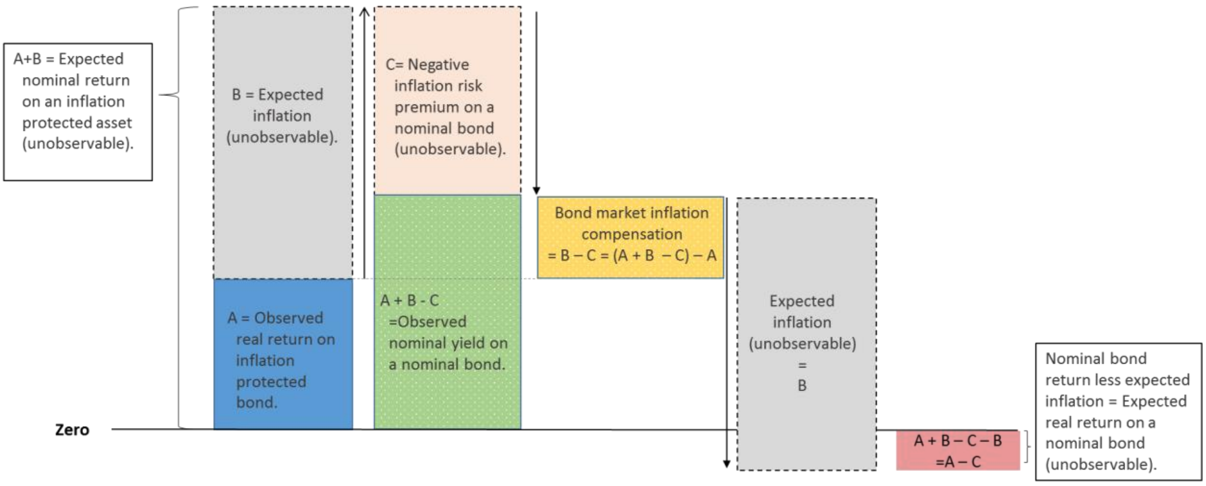
[9] QCA, DBCT decision, first paragraph on page 170.

50. This is a very straightforward proposition. If nominal bonds have low real yields because investors like exposure to inflation risk, then any inflation risk premia must be removed from the estimated cost of capital applied to Aurizon. This is because investors in Aurizon, by virtue of the QCA's regulatory regime, are investing in an inflation-protected investment. To do otherwise would be logically and economically inconsistent.

3.4.1 Bond market inflation automatically removes any inflation risk premium embedded in nominal bond yields

51. The following graphic provides an illustration of why bond market inflation automatically deals with the potential problem associated with the existence of inflation risk premia.

Figure 3-2: Logical error in not using bond market inflation



52. The regulatory regime as presently applied by the QCA provides inflation protection to investors. Therefore, the relevant real risk free rate for investors in Aurizon is the return required by investors in an inflation-protected risk free asset. This is the value "A" signified by the blue box on the left hand side of Figure 3-2 – the observed real yield on inflation-protected bonds. (In the 20 days to 30 June 2017 this value is 0.28%.)

53. Expected inflation ("B") is signified by the grey box. (If the midpoint of ranges approach is assumed to be accurate then B=2.37% in the 20 days to 30 June 2017.) The expected nominal return on an inflation-protected bond is given by A+B – i.e., the guaranteed real return on an inflation-protected asset plus the expected level of inflation.

54. However, if investors prefer to be exposed to inflation risk (i.e., they prefer a guaranteed nominal return to a guaranteed real return) then investors will demand a lower return on nominal bonds than they expect to receive on inflation-protected bonds. Call this value "C", signified by the removal of the pink "negative inflation risk premium" box to arrive at the green "observed nominal yield on a nominal bond" box. That is, the observed nominal yield (green box) is equal to A + B – C (the observed real yield (A) plus unobservable expected inflation (B) less the (negative) inflation risk premia (C) on nominal bonds). (In the 20 days to 30 June 2017 the observed nominal yield on 4-year government bonds was 1.90%.)

55. If the regulator starts with this observed *nominal* bond yield (green box), this starting point will automatically include both expected inflation (B) and any inflation risk premium (C). Therefore, in order to get back the objective, which, in a regulatory regime that delivers *inflation-protected* returns is the required real return on an asset *with inflation protection*, the regulator must remove the effect of *both* expected inflation (B) and the inflation risk premium (C). That is, the regulator must remove B - C in inflation compensation from nominal returns.

56. It can be seen that this is equal to observed bond market inflation. That is, nominal yields (A+B – C) less inflation-protected yields (A) is equal to bond market inflation which is, in turn, equal to B – C. Thus, bond market inflation automatically removes the effect of both expected inflation *and* any inflation risk premia embedded in nominal bond yields.

57. However, if the regulator starts with the observed *nominal* bond yield (green box) and removes only expected inflation (B), but not the negative nominal risk premium (C) then the regulator will end up providing a real return of A – C (in the illustration this is negative because C exceeds A). (In the 20 days to 30 June 2017, this results in a negative real yield of -0.47% if inflation is removed based on the midpoint of ranges method with no adjustment for inflation risk premia).

3.5 Liquidity risk premia

58. The QCA, in its DBCT decision, also raises differences in liquidity risk between nominal and inflation-protected bonds as a potential reason for a divergence between bond market inflation and inflation actually expected by investors:[10]

> *Also, indexed bonds are materially less liquid than nominal bonds on the basis that the volume of outstanding indexed bonds is lower, and the ratio of turnover to outstanding bonds is lower.463 The implication is that yields on indexed bonds incorporate a premium for inferior liquidity relative to nominal bonds. This means that the indexed bond method may result in an*

10 QCA, DBCT decision, p. 169, p. 169.

underestimate of expected inflation, with the actual difference varying, depending on the specific bonds and time periods being considered.

59. However, the same logic applies to this hypothetical difference between nominal and inflation-protected bonds. Specifically, any unusual liquidity premia for nominal bonds is something that the regulator must attempt to correct for when it derives a real return for investors in Aurizon - an investment that is less liquid than both nominal and inflation-protected bonds. (Note that the impact of heightened liquidity premia is correctly described above. Heightened liquidity premia will depress the yields on both inflation protected and nominal government bonds (both of which are much more liquid than almost any other assets in the economy (including corporate debt and equity). Any impact on bond market inflation will be because the nominal bond yields are depressed by more than the inflation protected bond yields.))

60. This is the corollary of the logic set out earlier in this section where it is explained that inflation risk that is peculiar to inflation-protected bond yields must not be assumed to apply to investments in inflation-protected regulated assets. Appendix A provides a fuller description of the corollary between the appropriate treatment of liquidity and inflation risk premia in nominal government bonds.

4 The midpoint of ranges estimate is implausible in June 2017

61. This section sets out facts that lead me to conclude that it is implausible that expected inflation was 0.76% higher than bond market inflation over four years – even accounting for extreme estimates of inflation risk premia and differential liquidity premia.

4.1 Midpoint of RBA ranges

62. An alternative regulatory inflation estimate to bond market inflation is to derive an estimate of regulatory inflation based on the midpoint of:

- The range of any RBA published inflation forecasts (generally published within a 1.0% range where the top and bottom of those ranges move in a minimum of 0.25% increments). For example, published ranges might be 1.5% - 2.5% (or 1.75% - 2.75%) and the midpoint would be 2.0% (or 2.25%). Published ranges are never, for example, 1.60% to 2.60%.
- For years beyond the RBA forecast horizon, an assumption of 2.5% - which is the midpoint of the RBA target range of 2.0% to 3.0%.

4.2 Midpoint of RBA ranges is not a reliable estimate of expected inflation

63. Before discussing the properties of the midpoint of RBA ranges method it is important to note that, even if it was a perfectly accurate estimate of expected inflation, this does not mean it should be used as the value of regulatory inflation. As already explained in section 3, regulatory inflation should be set based on the best estimate of inflation compensation built into the nominal bond rates used to set the nominal cost of capital (and this is true even if this is different to inflation expectations).

64. Nonetheless, putting that observation aside, it is also my opinion that bond market inflation will be a better estimate of expected inflation than the midpoint of ranges approach. There is no reason to believe that investors believe the expected inflation (i.e., the probability weighted average of all possible inflation outcomes) falls in the middle of the two types of RBA ranges.

65. Indeed, there is no reason to believe that the RBA believes this. The RBA's use of a wide forecast ranges is precisely to encompass the level of uncertainty around possible inflation outcomes. There is no evidence that the RBA sets the middle of its range based on the probability weighted average of all possible inflation outcomes. It

is quite likely that it does not do this but, rather, sets the middle of its range based on the most likely inflation outcome. An asymmetric distribution of probabilities around the most likely outcome can easily mean that the (probability weighted) expected inflation is higher/lower than this.[11]

66. The case is even weaker for assuming investors expect inflation to be at the midpoint of the RBA target range immediately beyond the RBA forecast period. It might be reasonable to make this assumption over a very long period (e.g., 20+ years) when periods of high inflation can 'cancel out' on average with shorter periods.[12] However, over a shorter period of a handful of years it would be irrational for investors to assume that this would always occur.

67. By contrast, and as already noted, investors in nominal bonds have real 'skin in the game'. Nominal yields do not adjust for unexpected inflation and, consequently, higher inflation erodes real returns (and lower inflation delivers a real windfall). Therefore, nominal bond investors have strong incentives to buy/sell at yields that provide accurate compensation for expected inflation. This includes finely nuanced assessments of not just the most likely inflation but the probability distribution of possible inflation outcomes.

68. In the rest of this section I explain why the midpoint of ranges estimate does not result in a plausible estimate of expected inflation in June 2017 and why the bond market inflation is a better estimate of not just regulatory inflation but also expected inflation.

4.3 The size of the required risk premia

4.3.1 The size of risk premia at 4 and 10 year horizons

69. Table 4-1 below contrasts bond market inflation with the midpoint of the RBA range over the 20 trading days ending 30 June 2017.

11 I explained in Section 4.5 of my November 2016 report exactly why such an asymmetry does exist in the very low inflation/interest rate settings currently in place in Australia. Moreover, and as a separate point, the RBA only ever adjusts its forecast range by 0.25%. It is simply not credible to assume that the best estimate of expected inflation only ever moves in jumps of 0.25%.

12 However, even if this is true on an arithmetic basis it will almost certainly not be true on a present value basis – with any early loss/gain getting a high weight in a present value calculation (such that it is not offset by later values with the same magnitude but opposite sign).

Table 4-1: Midpoint of RBA ranges vs bond market inflation (June 2017)

Horizon	Midpoint of ranges	Bond market inflation	Nominal bond yields	Indexed yields	Real return on nominal bonds implied by midpoint of ranges
	#1	#2=(#3-#4)*	#3	#4	#5=(#3-#1)
Four years	2.37%	1.62%	1.90%	0.28%	-0.47%
Ten years	2.45%	1.83%	2.44%	0.59%	-0.01%

*Source: QCA, Bloomberg, RBA, CEG analysis. *The full formula used to derive bond market inflation is #2=(#3-#4)/(1+#4). CEG has estimated bond market inflation on each day and then averaged bond market inflation over the 20 days. If, instead, we estimated bond market inflation from average 20 day yields we would estimate 1.61%.*

70. It can be seen that, over the QCA's preferred horizon of 4 years, bond market inflation (1.62%) is 0.76% lower than the midpoint of ranges estimate (2.37%). In my view, this is a compelling reason to believe that bond market investors have lower expected inflation than delivered by the midpoint of ranges method.

71. If the alternative is true and bond market investors are expecting 2.37% inflation then this implies that they are expecting a negative 0.47% p.a. real return on their investment in a nominal bond. I don't regard this as credible given that the same investor could, instead, buy an inflation-protected government bond and earn a positive 0.28% pa return. That is, the investor could earn a guaranteed real return that is 0.76% pa higher.

72. That is, bond investors must:

- be willing to lend to the Australian government in nominal terms in the expectation of losing 0.47%pa (-1.91% over 4 years) in real terms; even though
- they could, in the same time period and for the same 4 year term, have lent to the Australian government in inflation-guaranteed terms at a rate of +0.28% (+1.11% over 4 years);
- implying that, bond investors lending in nominal terms were deliberately accepting a 0.76% p.a. (column #4 less column #5) lower return than the guaranteed (i.e., lower risk) return available when lending on inflation-indexed bonds.

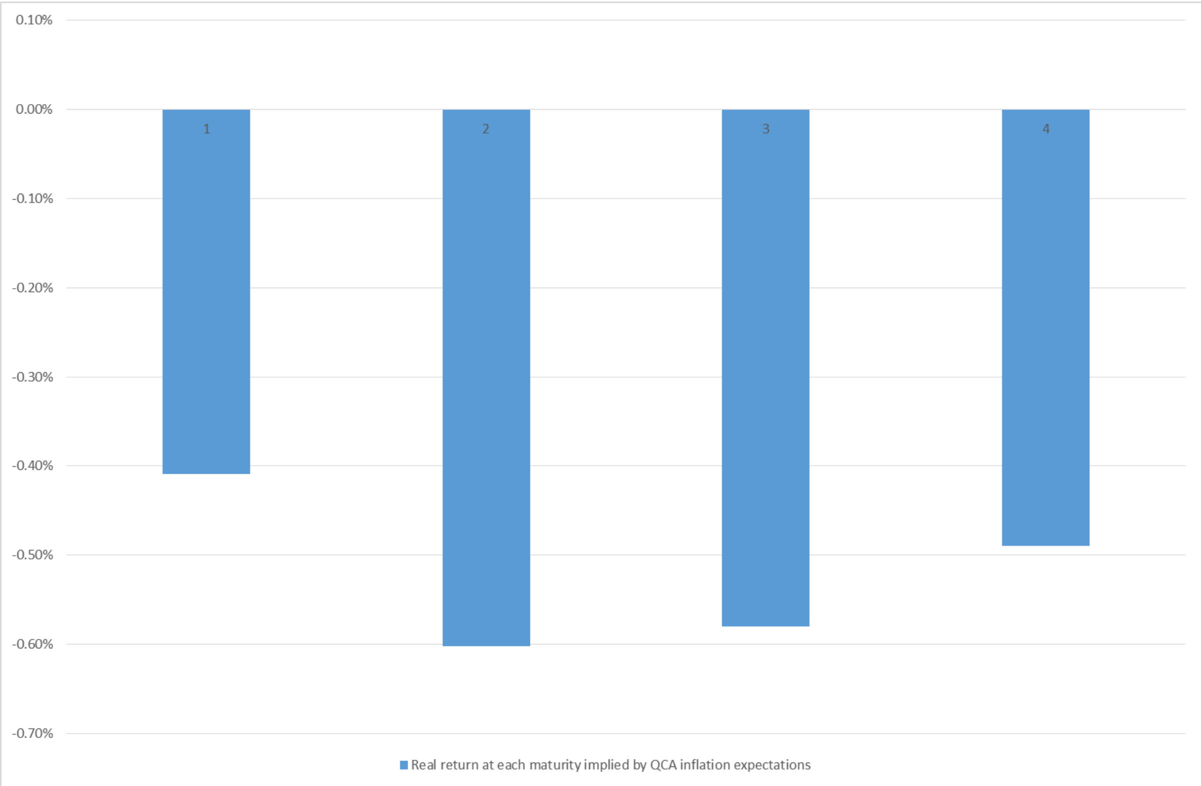
73. This is despite the fact that the loans being made are to the same entity (Australian Government) with the same default risk. Note that a 0.76% p.a. lower return is equivalent to a 3.04% lower return over 4 years.

4.3.2 Shorter horizons than four years

74. It is instructive to also look at the implied real rates of return on nominal bonds over shorter horizons than 4 years. The midpoint of ranges method, applied in June 2017, assumes that investors' expected inflation jumps from 2.0% in the first year to 2.5%

in the second year and stays at 2.5% thereafter. It is, therefore, possible to estimate the implied real return on nominal government bonds at each of 1 to 4 years maturity. This is done in the graphic below.

Figure 4-1: QCA implied real return on nominal bonds of 1 to 4 years maturity



Source: QCA, Bloomberg, RBA, CEG analysis

75. It can be seen that the lowest implied real return is on a 2 year nominal bond. At two years maturity, the midpoint of ranges method estimates inflation of 2.25% (2.0% for one year then 'jumping' to 2.5%). However, the interpolated two year bond rate averaged only 1.63% over this period. This implies a negative real return of 62 bp.

76. It is also especially revealing to apply the same analysis to the one year forward rate. The one year forward rate is the implied yield on a 1 year nominal bond in "n" years. For example, the one year rate one year forward is the expected one year interest rate in one year's time. The two year forward one year rate is the expected one year interest rate in two years' time (and so on).

77. The formula for estimating the implied x-year expected inflation in y-years is:

$$One\ year\ rate\ forward\ n\ years = \frac{(1+r_n)^n}{(1+r_{n-1})^{n-1}} - 1$$

78. The logic behind this equation is that an investor with an n year investment horizon has the option of, amongst others, of investing in an:

- "n" year bond; or
- "n-1" year bond followed by reinvestment in a 1 year bond at the maturity of the n-1 year bond.

79. In order for these strategies to have the same expected return, the above formulae must hold. That is, the expected rates in 1 years' time must account for the difference between the cumulative return on an n year bond ($(1+r_n)^n$) and the cumulative return on an n-1 year bond ($(1+r_{n-1})^{n-1}$). Applying this formulae to both nominal and inflation-protected government bonds, we have the following results.

Table 4-2: 1 year nominal rates n years forward: June 2017

Number of years forward	0	1	2	3
Nominal Government bonds	1.58%	1.69%	1.95%	2.28%
Midpoint of ranges inflation estimate (corresponding year)	2.0%	2.5%	2.5%	2.5%
Implied real return	-0.41%	-0.79%	-0.54%	-0.22%

Source: QCA, Bloomberg, RBA, CEG analysis.

80. These results show that the midpoint of ranges inflation forecast assumes that the implied 1 year nominal return in one years' time will deliver investors an expected real return of -0.79%. The reason is that, despite the midpoint of ranges inflation jumping 50 bp after one year, the yield curve implies an increase in one year interest rates of only 11 bp.

81. We have also estimated the one year rates n years forward for inflation-protected bonds. These are summarised in the table below, along with the difference between these rates and the implied real rates in Table 4-2 above.

Table 4-3: 1 year real rates n years forward: June 2017

Number of years forward	0	1	2	3
Guaranteed real return on inflation-protected bonds	0.03%	0.19%	0.35%	0.52%
Midpoint of ranges implied real return on nominal bonds	-0.41%	-0.79%	-0.54%	-0.22%
Difference	0.44%	0.99%	0.88%	0.73%

Source: QCA, Bloomberg, RBA, CEG analysis.

82. This table confirms that the most extreme conflict between implied market rates of inflation compensation and the midpoint of ranges estimates are in the second year. The QCA's forecasts imply a 99 bp difference between the real (after inflation) forward rate for a:

- guaranteed inflation-protected bond; vs
- a nominal government bond with the investor expecting inflation to jump to 2.5%.

83. This result underscores the unreasonableness of an assumption that investors inflation expectations jump by 50bp between the first and second years.

4.3.3 Inflation swaps

84. Another market that is relevant is the market for inflation swaps. In the June 2017 period, 4 year inflation swaps traded at an average of 1.91%. This is 0.46% below the midpoint of ranges estimate. Thus, it is not just bond investors but also investors in inflation swaps who require lower compensation for inflation than derived from the midpoint of ranges method.

85. This is particularly striking because, as was explained in section 4.3.2 of my November 2016 report for Aurizon, it is well understood that inflation swap rates tend to over-estimate expected inflation because the market is one-sided (with more parties wanting protection against inflation risk than exposure to inflation risk). Banks offering inflation swaps typically hedge their risk in the indexed government bond market. Consequently, a premium to bond market inflation must be charged to cover the bank's costs.

86. If banks trading in inflation swaps really expected 4 year inflation to be 2.37% then there would have been 0.46% p.a. expected loss from being paid the fixed leg of an inflation swap. That is, banks would expect to have to pay 2.37% (actual floating inflation) despite only being paid a fixed rate of 1.91% by their customers. This means that, not only must nominal bond investors be expecting to go backwards in real terms but so must banks (if the banks did not hedge their exposure in bond markets).[13]

[13] It is also the case that a bond investor could, should they wish, convert a 4 year nominal government bond into a real return by simultaneously entering into a 4 year inflation swap. Following this strategy in June 2017 the bond investors would have lent at 1.88% and then entered into the fixed leg of an inflation swap at 1.91% (i.e., they were paid if actual inflation exceeded 1.91% and vice versa). The bond investor would then have had an effective zero guaranteed real return (i.e. -0.03%). This is 0.44% higher than the -0.47% expected real return on a nominal bond if investors held the midpoint of ranges inflation expectation. That is, if the midpoint of ranges inflation estimate is shared by investors, a nominal bond with an inflation swap is a higher expected return (and lower risk) asset than just buying a nominal bond. It is, difficult to conceive this being an equilibrium. All nominal bond holders should, if they shared the midpoint of ranges

4.4 Extreme estimates of inflation/liquidity risk premia not justified in the context of June 2017

87. In its DBCT decision the QCA referenced a number of research papers that attempted to put a value on the inflation and liquidity risk premia. Before proceeding with a discussion of these papers, it is important to make a few high level observations about all studies of these phenomena. Specifically, any inflation or liquidity risk premia is unobservable. In all studies of the phenomenon the reported inflation risk/liquidity premium is, in reality, an error term in the analysis. It is the term given to the difference between bond market inflation compensation and the authors' own estimates of (the unobservable) expected inflation.

88. This means that the results of these studies can only be relied on as 'accurate' if one accepts that the authors' method for estimating expected inflation is 100% accurate. If this was the case then it begs the obvious question – why not just use the authors' method for estimating expected inflation? Put another way, if there existed an agreed best method for arriving at expected inflation there would not be multiple studies of the inflation/liquidity risk premia. Rather, we could all simply observe the difference between bond market inflation and the (agreed) best estimate of expected inflation.

89. The fact that there is no agreed estimate of expected inflation is the reason why there are multiple such studies and, simultaneously, is why such studies must be taken with a 'grain of salt'.

4.4.1 Grishchenko and Huang (2012)

90. Grishchenko and Huang (2012) state that their estimate that bond market inflation compensation exceeds expected inflation on average over time. This is the opposite of the QCA conclusion for DBCT's averaging period. The authors state, at page 30, that their preferred estimate of the inflation risk premium is +14bp to +19bp measured over the period 2004 to 2008 (i.e., a positive not a negative inflation risk premium). The authors also survey the wider literature which typically estimates a higher (more positive) inflation risk premium.

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view, simultaneously take out inflation swaps until the inflate swap rate was pushed up to the midpoint of ranges estimate.

Of course, this begs the question of why an investor might pursue this strategy in preference to simply buying a guaranteed inflation indexed bond (given that this delivers a higher still real return of 0.27%). One possible reason, is that the investor was not sure that they wanted to hold the asset to maturity and was concerned about liquidity in the indexed bond market. Even if this was the case (which is itself an implausible explanation of the difference between bond market compensation and the midpoint of ranges estimate) the regulator would still needs to explain why investors don't simply use the inflation swap strategy to hold nominal bonds but lock in higher real returns at lower risk.

91. The QCA DBCT decision states at footnote 462:

> *For the United States, in the more stable inflationary period of 2000–2008, estimates of the inflation risk premium are negative, statistically significant, and up to –0.50%. See: Grishchenko, OV & J Huang 2012, Inflation Risk Premium: Evidence from the TIPS Market, Finance and Economics Discussion Series Working Paper 2012–06, United States Federal Reserve Board.*

92. The final decision does not provide a page reference for this -0.50%. This value is in contrast to the articles' conclusion which states, at page 31:

> *"We find that the 10-year inflation risk premium varies between -16 and 10 basis points over the full sample depending on the proxy used for expected inflation".*

93. In any event, bond market inflation in June 2017 is a -76bp below the midpoint of ranges estimate. In order for this to be explained by an inflation risk premium that premium would need to be 26bp more negative to -0.50% (i.e., below the bottom of the range reported by Grishchenko and Huang (2012) on page 31 and below the -0.50% estimate referred to).

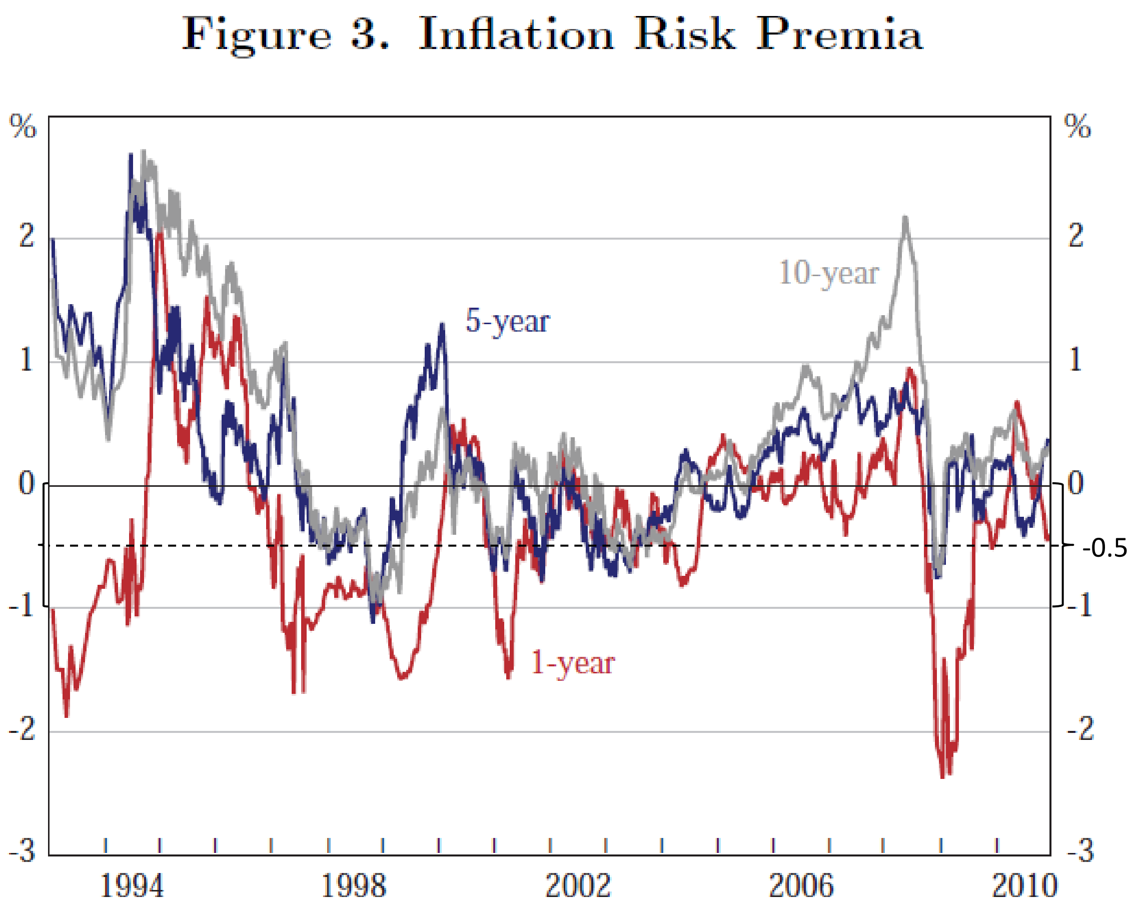
4.4.2 Finlay and Wende (2012)

94. The other study referred to by the QCA is Finlay and Wende (2012). This appears to be the study that the QCA is referring to when it states "…an inflation risk premium of –0.45 per cent on nominal bonds, for example, is well within the bounds of the estimates from the Australian data given above." This in turn appears to be a reference to the earlier statement by the QCA that:[14]

> *Based on Australian data over 1992–2010, Finlay and Wende (2012) estimate that the net impact of both the inflation risk and illiquidity effects varies from 2.5 per cent to –1.0 per cent over both five and 10-year periods. In addition to the variation being wide, the sign of this net effect is inconsistent.*

95. The QCA does not provide a specific reference in support of the 2.5% to -1.0% claim. However, it appears to be based on an interpretation of 5 year inflation risk premia from Figure 3 from Finlay and Wende (2012), reproduced below (modified to identify -0.50% more clearly on the vertical axis).

[14] QCA, DBCT decision, p. 169.



96. It can be seen that the 5 year rate has a maximum of around 2.5% in 1993 and reaches a minimum of around -1.0% in 1997. Thus, the QCA range appears to be determined by estimates from 1997 and earlier. Even so, over the entire range the average has been positive.

97. Moreover, the values in the above figure are inclusive of both inflation risk premium and liquidity costs/risk premia differentials.[15] Over the 20 trading days to 30 June 2017, the difference between bond market inflation and the midpoint of the ranges estimate is 76bp. Only in 1997 do the authors estimate a divergence of this magnitude on 5 year bonds, and a smaller divergence was observed during the height of the global financial crisis. Even if Finlay and Wende's methodology were to be accepted as perfectly accurate historically, a 76bp difference between bond market and expected inflation in June 2017 would be at the upper extreme of historical estimates.

15 Finlay and Wende (2012), p. 127.

98. If this did reflect reality it would raise further questions about what unusual events were occurring in bond markets in that period and whether that period was suitable as a base period to estimate the cost of capital.

4.4.3 Logical problems with focussing on extremes

99. It does not follow that the existence of extreme estimates from the past that exceed - or are similar to - a -76bp inflation/liquidity risk premium, demonstrates that this is the explanation for the difference between bond market and midpoint of ranges inflation in June 2017.

100. Proceeding as if this must be the explanation incorrectly assumes what should be the subject of inquiry. Specifically, it assumes that the midpoint of ranges method is best and that the alternative is only ever different because it is not a good measure of expected inflation. This approach implicitly rules out the possibility that the midpoint of ranges method itself might result in an imperfect measure of inflation expectations in a given period.

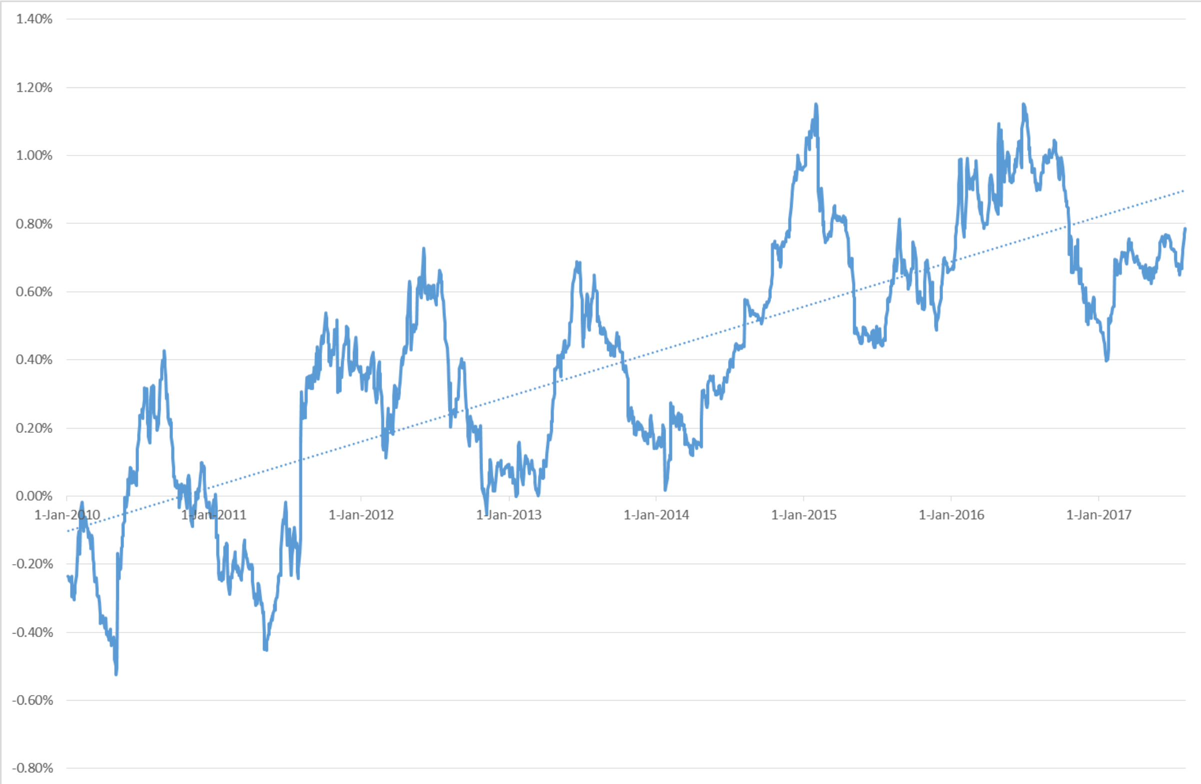
101. It assumes that the maximum negative difference between bond market inflation compensation and expected inflation identified in historical studies can be assumed to apply in the current period in question. If one was to have regard to historical studies then the correct approach would be to adopt the historical average values from those studies (i.e., a positive inflation risk premium) unless there was a reason to believe that the extreme observations from the historical studies were relevant to the period in question (e.g., because the current period was a period of financial market crisis).

102. I have examined the June 2017 period and find no evidence to suggest that an extreme negative inflation/liquidity risk premium should be embedded in nominal bond yields relative to inflation-protected bond yields.

4.5 No explanation for why inflation risk premium is suddenly so material

103. The following chart shows a time series for the difference between four year inflation forecasts based on the Midpoint of RBA Ranges method and contemporaneous bond market compensation with a 4 year horizon.

Figure 4-2: Midpoint of RBA Ranges inflation less bond market inflation (4 year horizon)



104. It can be seen that there is a very strong trend over the last 7 years for the difference between the midpoint of ranges inflation and bond market inflation to increase. If the midpoint of ranges estimate is the correct estimate then this implies that the inflation risk premium (or liquidity differences) were approximately zero over 2010/11 and then steadily increased over the next 5 years. If correct, then this is a peculiar trend.

105. There is no obvious reason to believe that such a dramatic increase in these alleged sources of difference between 'the best' estimate of expected inflation and bond market inflation has occurred. Indeed, the opposite is true. Since 1 January 2010 the number of inflation-protected bonds on issue has increased more than 5 fold from a low base– so one might have expected to see a decline in any liquidity difference between nominal and indexed bonds. [16] Similarly, if investors really believe that inflation will be 2.5% after 1 or 2 years (implicit in midpoint of ranges estimate) then

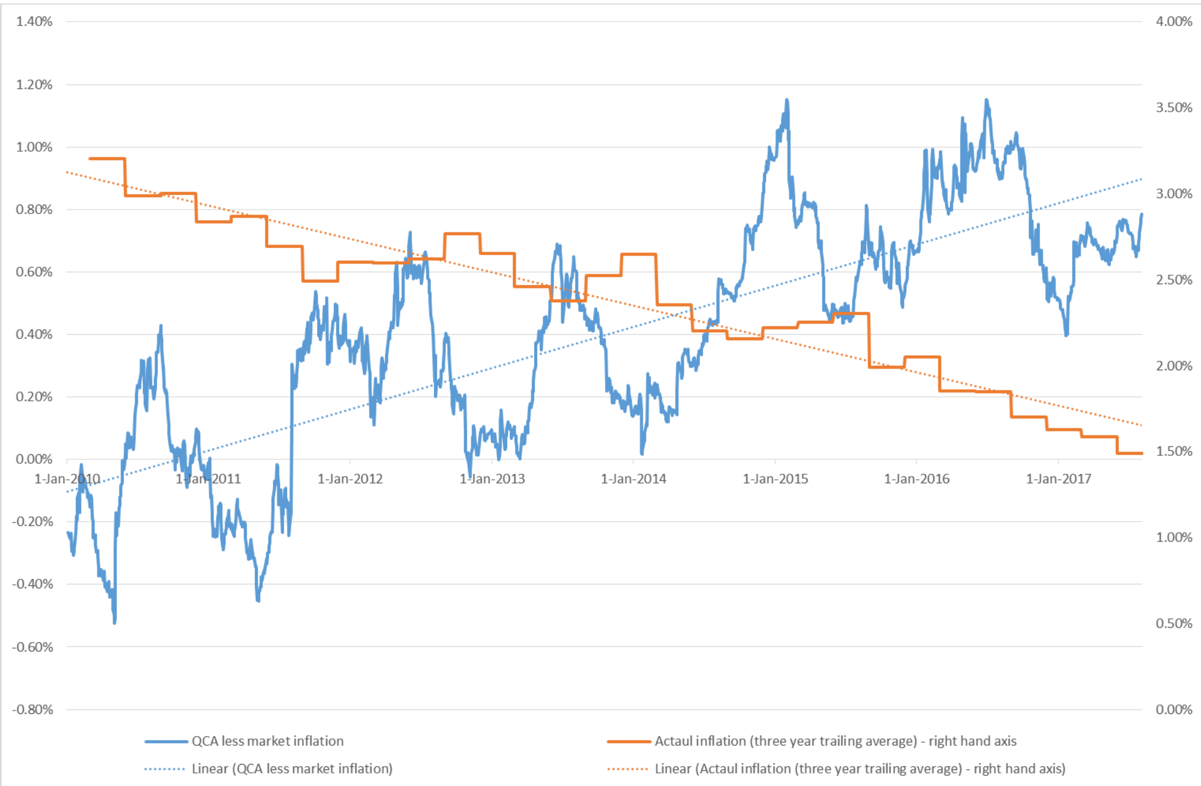
[16] AOFM, Table H13 Government securities on issue at 30 June 1983 to 2016. Nominal bonds have increase by a similar proportion but not from as low a base.

there is no reason to believe that inflation risk has increased materially over the relevant time period.

106. In summary, there is no good reason to believe that the above time series accurately reflects changes in the inflation/liquidity risk differences between nominal and inflation-protected government bonds.

107. However, there is a good reason to believe that investors have become increasingly wary about a quick return to 2.5% inflation. This can be seen from the fact that actual inflation has stayed below 2.5% for an extended period. Indeed, when actual inflation is superimposed on the above figure it is clear that there is a strong inverse relationship between actual inflation and the difference between the midpoint of ranges and bond market inflation.

Figure 4-3: Midpoint of RBA Ranges inflation less bond market inflation (4 year horizon) and actual inflation



108. Application of Occam's razor suggests that the explanation for the rising difference between bond market and midpoint of ranges inflation is that the midpoint of ranges methodology's assumption of a quick return to 2.5% inflation has, in the face of 6 years of below 2.5% average inflation, failed to track the decline in investors' medium

term inflation expectations. In this regard I refer again to all of the points made in section 4 of my November 2016 report for Aurizon.

5 Conclusion

109. In my view, the gap between the 'midpoint of ranges' and bond market inflation estimates cannot plausibly be explained by the existence of risk premia differentials between nominal and inflation protected bonds. The gap is simply too large and, in my view, the only plausible conclusion is that the 'midpoint of ranges' estimate is overestimating inflation expected by bond market investors.

110. However, even if the 'midpoint of ranges' estimate was an accurate measure of investors' expected inflation, it should not be used as the measure of regulatory inflation. This is because nominal bond investors would have to be demanding much less (76bp less) than expected inflation in compensation for exposure to inflation. This can only be because the inflation exposure for a nominal asset are highly valued (at 76bp) by investors.

111. However, the QCA regulatory regime is not offering a nominal investment – it is offering an inflation protected investment. Given that the QCA's nominal cost of capital is based on the yields on nominal bonds, it will have compensation for inflation that is depressed by 76bp – reflecting investors' desire to be exposed to inflation risk on nominal returns. Removing expected inflation from the nominal cost of capital will, therefore, deliver a real cost of capital that is 76bp below that demanded by investors in an asset that is inflation protected (i.e., does not offer inflation risk on nominal returns).

Appendix A The liquidity differential between government bonds

112. The QCA makes the following observation at page 169 of the DBCT decision:

> *We note DBCTM's observation that the liquidity of indexed bonds has been higher in recent years. However, this increase in liquidity applies to both nominal and indexed bonds, and it is the relativity that matters. In this context, the volume of indexed bonds remains small relative to the former. Over the period 2012–2016, the average volume of nominal bonds on issue was about 12.5 times the volume of indexed bonds on issue. Even more relevantly, based on data for 2014–15, the liquidity ratio of nominal bonds was 3.3 in comparison to a liquidity ratio of 2.0 for indexed bonds. This liquidity differential is substantial.*

113. This statement implies that the "substantial" difference in liquidity will lead a substantial difference in valuation/pricing of these bonds, which is incorrect.

A.1 What is liquidity risk?

114. In order to assess the potential role of differences in liquidity on pricing, one needs to define what "liquidity" means and why it might be valued by investors. Liquidity means the ability to trade in a market without moving the market against you (e.g., the ability to buy/sell an asset without forcing the price up/down in the process). 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 government bonds market against myself when trading, then I receive no advantage from higher turnover in the market. That is, I will not value government bonds any higher if the turnover in the market doubles or quadruples.

115. Both nominal and inflation-protected government bonds are homogenous products that are very easy to value. There are not the same 'inside information issues' that arise with trading corporate equity and debt. This fact, when combined with the very large size of the markets means that the potential value of incremental increases in turnover/liquidity when moving from inflation-protected government bonds to nominal government bonds are very small.

116. A parallel to this from the physical world is the size of Olympic diving pools. A very small diving pool would create a disturbance in the form of refracted waves after each dive or, if not deep enough, risk injury to the diver as a result of colliding with the bottom of the pool. Increasing the size of the pool improves both of these problems. However, beyond some point the marginal benefit of further increases in size become

very small/zero. A diving pool with 100m width/length/depth offers no better performance than a standard Olympic diving pool.

117. Inflation-protected government bonds had a turnover of $257bn in 2015/16 – or roughly $1bn per trading day.[17] The marginal investor would need to be forced to trade in extremely large volumes over extremely short periods in order to experience a high 'illiquidity' cost in this market. It is true that nominal government bonds had turnover of roughly 25 times that of the inflation-protected government bonds market (25bn per trading day). However, this does not mean that nominal government bonds have a materially different 'liquidity premium' to inflation-protected government bonds – both have approximately the same cost to trade (i.e., zero). For the same reason the illiquidity cost in the Australian nominal government bonds market is not 'very substantial' just because the US Treasury market turnover is many times larger again.

118. Consistent with this, Grishchenko and Huang (2012),[18] which the QCA references in support of its inflation risk argument, estimate the average liquidity premium for nominal versus indexed bonds in the US at just 6bp – with a maximum of 30-35bp "…between 2002 and 2003 when the number of outstanding TIPS issues was particularly small". TIPS stands for Treasury Inflation-protected Securities and the market was in its infancy in the early 2000s.

119. Campbell, Shiller and Viceira (2009),[19] at page 115, state that indexed bonds are "extremely cheap to trade". This is consistent with a 6bp or lower liquidity premium. As are the estimates of D'Amico, Kim, and Wei (2009), who, at page 64, show a time series for the liquidity premium which has hovered around zero since 2004.

A.2 The same logic applied to liquidity risk as to inflation risk premia

A.2.1 Differential liquidity premia are trivial for government bonds post GFC

120. As noted above, 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. If investors are already confident that they will not move the government bonds market

17 AFMA, AFMR, 2016, p. 27.

18 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

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

against themselves when trading, then they receive no advantage from higher turnover in the market. That is, they will not value government bonds any higher if the turnover in the market doubles or quadruples.

121. Given that both inflation-protected and nominal bonds are already extremely liquid markets the difference in liquidity between them will almost always be trivial.

A.2.2 If liquidity premia were material then the regulator should raise, not lower, returns for relatively illiquid corporate assets

122. The only conceivable situation in which this would not be true would involve a break-down in financial markets akin to the global financial crisis (GFC – although it must be acknowledged that at the time of the GFC the Australian government had ceased issuing inflation-protected bonds and the market was much less liquid than it is today following a resumption of issuance). That is, the only exception to the conclusion that that nominal and inflation-protected bonds have very similar cost to trade would be in a period of extremely high liquidity preference such as the global financial crisis, where an unusually high premium was placed on the ability to quickly trade at low cost.[20]

123. There was no financial crisis in June 2017 giving rise to elevated liquidity premiums, so this can safely be ignored as a cause of the 76bp difference between bond market inflation and the midpoint of ranges estimate. However, it is useful to ask what would be the nature of any adjustment if it was required (i.e., if there was period of extremely high liquidity preference)?

124. The answer is the same as for the existence of an inflation risk premia. That is, investments in Aurizon do not share the 'hyper liquidity' of government bond markets (just like they do not share the nominal inflation risk characteristics of nominal bonds). To the extent that the there is an unusually large premium placed on liquidity (or inflation risk) and this depresses the yield on nominal government bonds, this should not be passed onto allowed returns for investments in Aurizon.

125. To see why, imagine that there was, in fact, elevated liquidity premiums and that this depressed the yields on nominal bonds relative to less liquid assets (even the very liquid inflation-protected bonds). The end result would be that the nominal bond yields would cease to reflect the required return on assets with 'ordinary' liquidity. (Note that the impact of heightened liquidity premia is correctly described above. Heightened liquidity premia will depress the yields on both inflation protected and nominal government bonds (both of which are much more liquid than almost any other assets in the economy (including corporate debt and equity). Any impact on

[20] Note that the cost of trading that is relevant here is the potential for an investor to move the market against themselves in the process of buying or selling an asset.

bond market inflation will be because the nominal bond yields are depressed by more than the inflation protected bond yields.)

126. This includes Aurizon's equity and debt, which are much less liquid than nominal government bonds (and inflation-protected bonds for that matter). If there was an unusually high liquidity premium then the correct response from the regulator would be to raise the return allowed to investors in regulated assets like Aurizon (not to reduce it). Thus, to the extent that differential liquidity premia did depress bond market inflation below expected inflation, this is a strong reason to use bond market inflation instead of expected inflation. Indeed, doing so would likely require an additional "illiquidity premium" to be added to Aurizon's cost of capital – in order to adjust not just for the difference in liquidity to nominal government bonds but also to inflation-protected government bonds.