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ECONOMISTS
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Appendix C

Expected inflation estimate for Aurizon

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1 Executive summary

1.1 QCA draft decision to target nominal returns

1. The QCA draft decision has altered the treatment of inflation such that it now proposes the target a nominal return and not a real return. The new regime effectively uses the same value to remove inflation compensation from revenues as it uses to add inflation compensation to the RAB. The effect of this is that the two terms cancel out and Aurizon receives the nominal WACC irrespective of the level of actual inflation.

1.2 Implications for the estimate of expected inflation

2. This is a critical change to the way inflation compensation is provided and it has far reaching implications, including for the best estimate of expected inflation. The estimate of expected inflation no longer plays any role in determining the present value of compensation received by Aurizon (real or nominal). The only role that expected inflation the estimate of expected inflation the more back-loaded is compensation – with more being removed from current period revenues and more being added to future period RAB values.
3. Given that the estimate of expected inflation plays no role in determining the the present value of compensation, the best estimate of expected inflation is one that:
 - Is within a reasonable range; and
 - Promotes economically efficient outcomes.

1.3 Promoting efficient outcomes

4. The draft decision leaves the sole role of expected inflation to determine the profile of cost recovery across regulatory periods. Therefore, the most efficient outcome is to choose a value for expected inflation within a reasonable range that results in the most efficient profile of cost recovery across regulatory periods.
5. In the context of UT5 this is an estimate that is at the lower end of the reasonable range because:
 - Benchmark credit rating metrics are at the bottom or below the level required to achieve the benchmark credit rating. A lower estimate of expected inflation will alter the profile of compensation to raise near-term credit metrics to be within the BBB+ range;
 - A back-loaded compensation profile raises asset stranding risks for the benchmark entity. The QCA currently provides no compensation for asset stranding and, consequently, it should have bias against back-loaded

compensation. That is, the QCA should have a bias against adopting an estimate of expected inflation that is in the top half of the reasonable range;

- The (Ramsey) efficient profile of fixed cost recovery is to have higher fixed cost recovery now (when demand is insensitive to price) and lower fixed cost recovery in the future (when demand may be more sensitive to price).¹

1.4 Selecting a point estimate from a reasonable range

6. The widest possible range for expected inflation is **1.62% to 2.37%**. In the context of UT5 I consider that the reasonable range for expected inflation is **1.62% to 2.10%**. The top end of the widest range is the QCA estimate from its draft decision. I do not consider that this is a reasonable estimate for the following reasons:

- An estimate of 2.37% implies a highly negative (-0.48%) real risk free rate. I do not consider that this is a credible estimate of the real return that investors require to lend to the Australian government (especially when they can obtain a positive guaranteed real return on such a loan made via inflation indexed Government bonds);
- 2.37% is based on May 2017 RBA forecasts of inflation when the more recent February 2018 are to be preferred. Retaining all other elements of the QCA method and using February 2018 RBA forecasts results in an estimate of **2.25%**.
- Alternatively, using the RBA February 2018 forecast but adopting more reasonable assumptions regarding inflation beyond the RBA forecast results in a range for expected inflation of **2.06%/2.19%** depending on whether underlying/headline CPI is being forecast;
- RBA forecasts are themselves a biased estimate of what the QCA should be estimating. Namely, RBA forecasts most likely (median) inflation while the QCA should be estimating mean expected inflation. The only reliable way to estimate mean (actuarially expected) inflation is to use market based estimates of inflation – which represent the weighted average expectation of investors with ‘skin in the game’. To this end the best estimates are
 - **1.91% to 2.10%** based on four year inflation swap estimates in the QCA July 2017 averaging period and also more recently in the 20 days to 2 February 2018;
 - **1.62% to 1.80%** based on four year break-even inflation measured in the QCA July 2017 averaging period and also more recently in the 20 days to 2 February 2018.

¹ By the QCA’s own analysis, the CQCN producers are currently low on the international cost curve and, therefore, will not respond materially to higher haulage prices in UT5 (i.e., miners have low elasticity of demand for haulage). However, this cannot be presumed with certainty to remain the case indefinitely.



7. In my view the market based measures define the reasonable range of **1.62% to 2.10%**.
8. Of the two market based measures, inflation swap data has an increased salience under the new regime of targeting a nominal WACC. This is because inflation swaps are the financial instruments that Aurizon and customers can use to manage inflation risk under a nominal regime. That said, the considerations outlined in section 5 tend to support the selection of a value at the lower end of the range and, given that break-even estimates are at the lower end of the range, these considerations support the use of break-even inflation.

2 Introduction

1. I have been asked by Aurizon to provide a critique of the QCA's UT5 draft decision pertaining to its estimate of expected inflation. This report sets out my analysis of the QCA draft decision's treatment of expected inflation and provides my estimate of the reasonable range for expected inflation and a basis for selecting a midpoint. The analysis in this report is prepared explicitly to respond to the QCA Draft Decision approach to inflation under the assumption that a four year risk free rate is adopted and the QCA is targeting a nominal return (not a real return).
2. The remainder of this report is set out as follows:
 - Section 2 discusses the implications for estimating expected inflation of the QCA's decision to target a nominal WACC;
 - Section 3 provides a survey of estimates of expected inflation that may inform a reasonable range;
 - Section 4 describes the factors relevant to selecting a point estimate from within a reasonable range;
 - Section 5 provides our best estimate of the reasonable range; and
 - Section 6 concludes and determines that the overall best estimate of expected inflation falls in a range of range of 1.62% to 2.10%.

3 Implications of targeting a nominal WACC

3.1 Changes to the QCA inflation compensation regime

3. The QCA draft decision has altered the treatment of inflation. Previously, and as explained in my earlier two reports for Aurizon, the QCA's inflation regime was to:
 - Remove from revenues in the current regulatory period an amount equal to the QCA estimate of expected inflation over the current regulatory period multiplied by the RAB; and
 - Add to the opening RAB in the next regulatory period an amount equal to actual inflation multiplied by the RAB.

4. The effect under this regime to target a real return for Aurizon equal to the QCA nominal WACC less the QCA estimate of expected inflation – with Aurizon's actual inflation compensation matching actual inflation. Under this regime, Aurizon's nominal return actually received varied with actual inflation. For example, if actual inflation was 2% higher than the QCA's estimate of expected inflation then Aurizon's actual nominal return (inclusive of RAB escalation) would be 2% higher than the QCA's estimate of nominal WACC (where "π" represents inflation).

$$\begin{array}{l} \text{Actual nominal return} \\ \text{under **old** regime} \end{array} = \text{QCA nominal WACC} - \text{QCA Exp}(\pi) + \text{Actual}(\pi)$$

5. This equation illustrates why the nominal return actually received by Aurizon previously varied with the difference between QCA expected inflation and actual inflation.
6. In the draft decision, the QCA has determined that instead of escalating the RAB using actual inflation it will escalate the RAB using the same estimate of expected inflation that it used to reduce revenues within the regulatory period. That is:

$$\begin{array}{l} \text{Actual nominal return} \\ \text{under **new** regime} \end{array} = \text{QCA nominal WACC} - \text{QCA Exp}(\pi) + \text{QCA Exp}(\pi)$$

$$= \text{QCA nominal WACC}$$

7. The new regime effectively uses the same value to remove inflation compensation from revenues as it uses to add inflation compensation to the RAB. The effect of this is that the two terms cancel out and Aurizon receives the QCA nominal WACC.

8. This is a critical change to the way inflation compensation is provided and it has far reaching implications, including for the best estimate of expected inflation. Under the old regime the estimate of expected inflation (QCA $\text{Exp}(\pi)$) was a determinant of both the real and nominal return that Aurizon would receive. For any given level of actual inflation, a 1% lower value for “QCA $\text{Exp}(\pi)$ ” would raise the real and nominal returns received by Aurizon by 1%. This is because the inflation compensation removed from revenues would be lower by 1% of RAB but actual inflation added to the RAB would be unaffected.
9. Under the new regime a 1% lower estimate of QCA $\text{Exp}(\pi)$ lowers by the same amount both: a) revenues in the current regulatory period; and b) inflation escalation of the RAB to the next regulatory period. As a result, neither the nominal nor the real return received by Aurizon is affected by the choice of QCA $\text{Exp}(\pi)$. The nominal return is simply the QCA nominal WACC and the real return is simply the nominal return less actual inflation.
10. This means that under the new regime, and this is critically different to the old regime, the value of QCA $\text{Exp}(\pi)$ does not affect the present value of compensation received by (paid to) Aurizon. The only role that QCA $\text{Exp}(\pi)$ plays is to alter the profile of compensation across regulatory periods. That is, the value of QCA $\text{Exp}(\pi)$ determines how much compensation for inflation is removed from current period revenues and added to future period RAB values (and therefore future period revenues). The higher is QCA $\text{Exp}(\pi)$ the more back-loaded is compensation – with more being removed from current period revenues and more being added to future period RAB values.
11. A higher estimate of expected inflation simply shifts revenues from the current period into subsequent periods. Unlike in a regime where the real return is targeted, the value of expected inflation plays no role in determining either the real or nominal return actually realised.

3.2 Implications for my advice

12. This change in regulatory methodology has important and far reaching implications for how expected inflation should be estimated. The description of the regulatory regime in section 3.2 of my previous report is no longer valid. Consequently, the conclusions that flowed from that understanding of the regulatory framework must also be reconsidered.
13. In section 3.3 of my previous report I explained that, where the QCA is targeting a real return, then the only correct estimate of ‘expected inflation’ was the inflation compensation embedded in nominal Commonwealth Government Security (CGS) yields. This was the only reasonable basis on which to estimate expected inflation because, under the old regime, nominal CGS yields were used to arrive at nominal WACC and this was turned into a real WACC via removal of QCA $\text{Exp}(\pi)$. In that

context, these two variables had to be estimated in an internally consistent manner (i.e., QCA $\text{Exp}(\pi)$ had to be a measure of inflation compensation already incorporated in CGS yields by bond investors).

14. However, under the new regulatory framework of targeting a nominal return the estimate of expected inflation does not play the same role of determining the return (real or nominal) provided to investors in Aurizon. The only role expected inflation plays is in determining how much of nominal returns are earned in the form of revenue versus RAB escalation. Under the new regime, investors in Aurizon will receive (customers will pay) the same compensation in both real and nominal terms irrespective of the expected inflation estimate adopted by the QCA. Consequently, there is not the same strong imperative that expected inflation be based on bond investors' expectations.
15. Under the new regime there is both:
 - a wider variety of reasonable estimates of QCA $\text{Exp}(\pi)$; and
 - a different basis on which to select a value from within that range.
16. Section 4 below discusses the reasonable range for QCA $\text{Exp}(\pi)$ in a context where QCA $\text{Exp}(\pi)$ is no longer effectively determining the real return for Aurizon investors. Section 5 discusses the basis on which a point estimate should be selected from within the reasonable range. In doing so, account is taken of the fact that the only role of QCA $\text{Exp}(\pi)$ is to determine the distribution of compensation across regulatory periods.

4 Potential estimates of expected inflation

17. The rate of inflation that investors expect is, inevitably, a highly uncertain variable with a wide range of reasonable estimates. This is illustrated by the simple fact that different investors can, and certainly do, have different perceptions of expected inflation. That is, reasonable minds will differ in how the available information about future price movements is weighted and processed.
18. Moreover, not all investors will give the same weight as the ABS does to elements of the CPI. For example, if investors spend a smaller proportion of their income on cigarettes than the average Australian then they are likely to perceive a different (smaller) consequence for consumer inflation of the increases in tax on cigarettes than the ABS reports. This is a relevant issue because the RBA is forecasting ABS reported CPI to be higher than underlying inflation largely based on the impact of rising taxes on tobacco products.

Underlying inflation is expected to be around 2¼ per cent by mid 2020. Headline inflation is expected to remain a little higher than underlying inflation, boosted by ongoing increases in tobacco excise

19. All of these considerations imply that a wide range of reasonable estimates for investors' inflation expectations exists. This is also illustrated by a wide range of market and non-market measures of expected inflation. These include:
 - Break even inflation (**1.62% - 1.80%**² over a 4 year horizon);
 - Inflation swap rates (**1.91% - 2.10%**³ over a 4 year horizon);
 - Midpoint of RBA May 2017 forecasts followed by an assumption of 2.5% expected inflation:
 - **2.37%** using CPI inflation;
 - **2.37%** using underlying inflation.
 - Midpoint of RBA February 2018 inflation forecasts followed by an assumption of 2.5% expected inflation:
 - **2.25%** using CPI inflation;
 - **2.12%** using underlying inflation.

² The bottom end of the range is over 20 trading days ending 30 June 2017. The top end of the range is 20 days ending 2 February 2018.

³ The bottom end of the range is over 20 trading days ending 30 June 2017. The top end of the range is 20 days ending 2 February 2018.

20. These estimates fall into a range of 1.62% to 2.37%. It is worth noting that, at the top end of this range (2.37%), the estimate of four year expected inflation exceeds the four year nominal CGS yield (1.89%). For example, if expected inflation is set at 2.37% then this implies that bond investors expect a real return of -0.48%.
21. This is not necessarily impossible. However, there are good reasons to believe that it is unlikely (as discussed in section 6 below). If one ignores, or discounts, concerns about assuming investors accept a strongly negative real return then one might conclude that a reasonable range for expected inflation is 1.62% to 2.37%. However, if one gives weight to the above considerations then the top end of this range would be truncated to a value that is around or below the observed 4 year nominal risk free rate (1.89%).

4.1 Conclusion

22. There are two potential candidates for a reasonable range for expected inflation.
 - 1.62% to 2.37% if one gives no weight to concerns that expected negative real returns on CGS are unrealistic;
 - 1.62% to 1.89% if one discounts the prospect that investors in nominal CGS expected to make a real loss on their investment.

5 Choosing from within a reasonable range

23. Under a regime that targets nominal inflation, the only impact of adopting a higher/lower value for expected inflation is that it shifts revenues between regulatory periods. In this context, the best estimate of expected inflation is one that satisfies both of the following criteria:
- The parameter falls within a reasonable range for an estimate of expected inflation; and
 - The parameter results in the most efficient profile of cost recovery over regulatory periods.
24. I have already addressed the question of a reasonable range in section 4. In the remainder of this section I address the second issue.
25. There are three reasons why different profiles of compensation for inflation may have different efficiency consequences:
- **Imperfect capital markets.** Despite having the same present value of compensation when assessed at the regulatory WACC, different profiles of compensation may have different costs if financial markets are less than perfect. In particular, back-loaded compensation for inflation (associated with an inflation estimate at the top of the reasonable range) will require a regulated business to have greater access financial markets to, in effect, fund investment in RAB escalation associated with the higher inflation assumption. With imperfect capital markets this may cause the business to incur costs in excess of those assumed in the regulatory WACC.
 - **Asset stranding risks/costs.** It is also the case that lower revenues now in exchange for higher inflation escalation of the RAB will tend to increase asset stranding risks. This will be the case if: a) customers can, at current coal prices, afford to pay higher prices today; but b) it is uncertain what customers willingness to pay in the future is (because it is uncertain what future coal prices will be);
 - **Inter-temporal Ramsey efficient pricing.** A final consideration is whether there is any reason to assume that the demand elasticity of coal volumes will be different across time-periods. Ramsey efficient intertemporal pricing would support a front/back-loaded profile for inflation compensation to the extent that the price elasticity of demand is likely to be higher in near term versus future periods.

5.1 Imperfect capital markets and credit metrics

26. The concept of a 'perfect capital market' is sometimes invoked in the finance literature. In such a market there is assumed to be a deep and liquid market for all debt and equity funding instruments and it is assumed that this will always be the case. In addition, all investors and management share a common understanding of the current and future cash-flows of a business and the risks to those cash-flows (i.e., there are no information asymmetries between equity and debt investors). In such a market, it should be costless to back-load the profile of the expected cash-flows provided the present value of the cash-flows remains unchanged. This is because with deep and liquid markets and a common understanding of risks, firms can simply tap financial markets to fund the back-loaded cash-flows without doing so altering their cost of funding.
27. However, in reality, financial markets are imperfect and information asymmetries play an important role in defining how funds are allocated to businesses and at what price. In realistic (imperfect) capital markets potential investors do not have a common understanding of cash-flow risks as business management. In the more realistic world, potential investors in a business with low near-term cash-flows but the promise of a rise in future cash-flows will tend, rationally, to apply a level of scepticism to that future promise. This is because they do not have the same level of knowledge about the risks to the future cash-flows as management.
28. If management (and existing equity investors) have inside information about high downside risks to future cash-flows then they will have an incentive to bring in new investors (both debt and equity) to be exposed to the risk. Knowing this, potential new debt and equity funders will have an incentive to raise the price that they charge for funding (raise the interest rate or lower the valuation of a given equity stake) above the level that they would charge based solely on their own information.
29. It is also the case that this induces adverse selection amongst those seeking finance (i.e., the businesses willing to pay higher interest rates (accept low priced equity investments) will be, disproportionately, the businesses who know that their future cash-flow is subject to high risk). This means that the optimal strategy for debt and equity investors may be to non-price ration investment.⁴
30. Another response is for investors to focus on measures of near-term cash-flow health ("credit metrics") which are heavily weighted by credit rating agencies when arriving at credit ratings for a business. These credit metrics, which commonly forecast over only a few future years, serve as a 'hurdle' for businesses to jump in order to satisfy investors that they are low risk.

⁴ For example, see Jaffee, D . M. and F. Modigliani, (1969), "A Theory and Test of Credit Rationing," American Economic Review, 59, 850–872

31. The widespread use of credit ratings based on relatively crude assessments of near-term credit metrics provides an illustration of how imperfect markets respond to information asymmetry. In a perfect capital market, all parties have equally good understanding of cash-flow risks and there is no role for such mechanistic credit metrics, especially those looking out only a relatively short horizon of time. However, in real world (imperfect) financial markets such credit metrics are heavily relied on precisely because of their mechanistic nature. That is, they are independent of management speculation about longer term trends in cash-flows.
32. The above discussion is relevant in the context of a regulatory decision to adopt a high estimate of expected inflation (one that backloads compensation for inflation into future regulatory periods). If financial markets were perfect (and there was no risk of asset stranding – see section 5.2 below) adopting a back-loaded compensation profile would not alter the average cost of service provision. However, with imperfect capital markets a back-loaded profile of compensation can be expected to raise funding costs somewhat (other things equal) and this is especially so if it causes commonly used near-term credit metrics to deteriorate (e.g., such that a lower credit rating is likely to follow).
33. In this context, it is relevant to note that the QCA states that estimates of the credit metrics for the benchmark regulated rail provider are below those associated with the benchmark credit rating (BBB+).

For its credit metrics assessment, Incenta considered that Standard & Poor's approach to assessing Aurizon Network credit metrics is appropriate for estimating these benchmark credit metrics. Incenta advised that its simulated credit metrics were marginally below the BBB+ cut-off that has been identified by Standard & Poor's.

34. The QCA tends to downplay the significance of this for its own decision making by noting that:

However, Incenta noted that its assessment of regulatory cash flows did not incorporate revenues associated with the capital deferrals for WIRP Moura and NAPE being proposed by Aurizon Network, which depresses the outcome of this assessment.

...

The credit metrics, as assessed by Incenta, are marginally below a BBB+ threshold. However, this credit metrics assessment does not incorporate the deferred revenue that would otherwise be obtained from Aurizon Network's RAB, thus putting a downward bias on this assessment.

The revenue deferrals are proposed by Aurizon Network as a means to manage the lack of certainty in relation to railings and the associated cost recovery in these systems. The QCA does not consider that the cash-flow

adjustment resulting from Aurizon Network's proposal should have implications for the assessment of the appropriateness of the benchmark credit rating used to estimate the rate of return for its 2017 DAU. Similarly, the benchmark approach to estimating an appropriate rate of return is not intended to limit Aurizon Network's actual management strategies.

Incenta outlined that if the deferred RAB component were to be isolated from the calculation, it is likely that metrics consistent with a BBB+ credit rating would be achieved. Therefore, the QCA considers that the high-level credit metrics assessment undertaken by Incenta is not conclusive that the recommended rate of return for Aurizon Network's 2017 DAU is inappropriate for the BBB+ benchmark entity.

35. It is not obvious to me why the QCA considers that it is relevant that if revenue deferrals did not exist the credit metrics would be more likely to reflect a BBB+ credit rating. The deferrals are approved by the QCA and, moreover, are approved as a means to manage uncertainty "in relation to railings and the associated cost recovery in these systems". If the QCA approves a revenue deferral, especially one that is designed to reduce uncertainty in cash-flows, then it is my view that there is no basis to discount the impact of that decision on the benchmark rail provider. That is, the revenue allowance set by the QCA defines the revenues available to the benchmark provider. Any other approach would, in my view, make the credit metrics assessment meaningless.
36. Nonetheless, putting this view to one side, it is important to note that there are a range of factors that contribute to the credit metrics faced by the benchmark rail operator. The QCA's decision to allow revenue deferral is one such decision. However, so is the QCA's selection of an expected inflation rate. The QCA's draft decision adopts an expected inflation rate at the top of the reasonable range (or, above the top of the reasonable range if one discounts the reasonableness of materially negative risk free returns).
37. Relative to adopting a value in the middle (or bottom) of the reasonable range, the QCA's expected inflation decision likely have a much larger effect of credit metrics than its decision to approve revenue deferral. For example, the QCA could have chosen to use inflation swap estimates as the basis for its value of expected inflation. However, instead it chose to adopt a value for expected inflation that was 0.46% higher (1.91% vs 2.37%). The effect of this decision is to lower revenues in the current regulatory period by at least 0.46% of the value of the RAB.⁵ Relative to Aurizon's proposal for expected inflation (1.62%) the QCA's decision results in revenue deferral of 0.75% of RAB each year.

⁵ The actual reduction in revenues is higher than this because of consequential impacts on the estimated cost of tax.

38. These are highly material impacts on cash-flow metrics. Moreover, every dollar impact from this decision on cash-flow metrics is a relevant as any dollar impact from other decisions (such as other revenue deferral decisions made by the QCA). In my view it is not logical for the QCA to:
- argue that (small) revenue deferral proposals from Aurizon designed to mitigate risk, which the QCA approved, means that the QCA can discount poor credit metrics; while
 - much larger revenue deferrals are imposed on Aurizon due to the QCA's rejection of Aurizon's proposal for expected inflation.
39. In my view, there is a simple present value neutral⁶ mechanism to deal with the failure of the QCA regulatory decision to deliver benchmark credit metrics consistent with a BBB+ credit rating. Specifically, the QCA can simply adopt an estimate from within the reasonable range for expected inflation that is lower than 2.37%.
40. This will be efficient, in the sense that it will lower the total costs of providing regulated services. This is because a smoother profile of compensation (less back-loaded) that delivers a more stable BBB+ credit rating is likely to lower total financing costs.
41. The regulatory WACC is typically set on the assumption that limitless funding is available at that WACC to fund any given profile of cost recovery. That is, if cost recovery is deferred for, X years, it is assumed that the regulated business can simply raise more debt and equity at the regulatory WACC to fund that deferral. Put another way, the regulatory WACC is, typically, not set taking into account the interaction between capital market imperfections and the profile of regulatory compensation.
42. Indeed, it is on this assumption that deferrals of revenue have no impact on the present value of revenues across multiple regulatory periods (i.e., this is true when the deferral is assessed at the regulatory WACC). However, in reality, a more back-loaded profile of compensation will at some point, in the context of imperfect capital markets, raise the WACC above the regulatory WACC for the reasons set out above.
43. Indeed, the fact that credit metrics are inconsistent with the benchmark credit rating is evidence of this occurring. In my view the QCA should factor this consideration into its deliberations on the selection of an estimate of expected inflation from within a reasonable range.

5.2 Asset stranding

44. The QCA acknowledges the existence of stranding risk in a number of places in its draft decision and also describes measures that have the effect of mitigating this risk.

⁶ When assessed at the regulatory WACC.

In particular, the QCA acknowledges that large scale deferral of compensation into future regulatory periods raises stranding risks because the future demand for rail services is uncertain (and is increasingly uncertain the further into the future one projects). Examples of this discussion include the following excerpts from the draft decision.

In addition to the market outlook and characteristics that support the competitiveness of coal producers in the CQCN, the regulatory framework provides Aurizon Network with mechanisms that mitigate its exposure to the risk of demand deterioration. These include:

- ***accelerated depreciation—Aurizon Network is able to recover a greater proportion of the depreciation of its assets during the initial years of the asset life for investments made after 2009, as well as truncated asset lives implemented in the 2006 Undertaking***
- *access conditions—Aurizon Network has the ability to seek access conditions for expansion projects*
- *limited optimisation—mitigates the risk that capital expenditure previously undertaken by Aurizon Network is not included in the RAB used for pricing purposes*
- *security requirements for access holders and relinquishment fees—offsets the financial impact of an access holder reducing its access rights.*

The QCA considers that because of the measures proposed by Aurizon Network in the 2017 DAU, combined with the medium- to long-term market outlook for coal, and the highly competitive position of Queensland coal producers, Aurizon Network’s asset stranding risk is minimal.

...

Aurizon Network argued that the system-based regulated asset base (RAB) results in an increased risk of asset stranding.

System reference tariffs and allowable revenues, as proposed by Aurizon Network’s 2017 DAU, are determined based on individual coal systems, where such systems are readily apparent due to the mostly separable nature of the assets, operating mode and costs as well as the origin–destination combinations of traffic.

...

The QCA considers that the continuation of the depreciation methodology as applied in UT4 is appropriate in the interests of stability and predictability. The depreciation assumptions reflect the arrangements that existed at the time of the investments and this may have been relevant to

*Aurizon Network's decision-making. **Further, the rolling 20-year depreciation method for new assets provides some acknowledgement of asset stranding risk as it has the effect of bringing forward the return of capital for long-life assets.***

...

The QCA acknowledges that a structural change in the coal export market could materially affect the risk of long-term demand deterioration. However, Aurizon Network has not provided any evidence of a long-term structural decline in demand for coal from central Queensland. As outlined above, the competitiveness of CQCN producers and long-term market outlook for CQCN coal suggest that producers will remain competitive with other coal export markets in the foreseeable future.

45. In summary, the QCA's position appears to be that deferral of compensation into distant regulatory periods would expose Aurizon to some risk of stranding. However, the QCA is of the view that this concern is largely addressed by:
- an accelerated depreciation (return of capital) profile for new assets; and
 - the QCA's explicit assessment that CQCN producers will remain competitive with other coal export markets in the foreseeable future; and
 - the QCA's implicit assessment that:
 - only competition from other coal producers threatens CQCN producers future sales in the foreseeable future (i.e., not competition from technological substitution away from coal to other energy sources); and
 - the foreseeable future is sufficiently long to ensure that all current (and cumulative future) investments by Aurizon will be able to be recovered in that time period.
46. The QCA may, or may not, be correct in its explicit and implicit assumptions. However, what is clearly correct is that, for any given starting profile of cost recovery, a more back-loaded profile of compensation will raise asset stranding risk. This may only occur to a 'minimal' extent or it may involve a material increase. However, it appears to be common ground that there can be expected to be some impact.
47. The QCA is not providing any compensation for asset stranding risk. That is, the QCA points to factors, such as accelerated depreciation, that reduce asset stranding risk but there is no compensation provided for any residual stranding risk that may remain (i.e., for the actuarially expected costs of asset stranding).
48. In this context, it is appropriate that the QCA consider asset stranding risks in the context of its adoption of an estimate for inflation expectations. Relative to Aurizon's proposal (or inflation swap rates), the QCA's adoption of 2.37% removes from

regulated revenues in the current regulatory period roughly 0.75% (0.46%) of the value of the RAB. This amount is, instead, added to the value of the RAB at the beginning of the next regulatory period and is recovered over the remaining life of those assets (over many future regulatory periods).

49. This is a significant deferral of compensation. Indeed, it may largely or fully undo the effects of accelerated depreciation referred to by the QCA as a protection against asset stranding risks. Such a deferral of compensation must increase the potential risk of asset stranding – even if only slightly. Given that the QCA does not provide any compensation for asset stranding this imposes an uncompensated cost of Aurizon.
50. It may, or may not, be the case that this uncompensated cost is small or ‘minimal’. However, even if this is the case, there is no compelling reason for the QCA not to ameliorate this source of asset stranding risk by choosing a lower estimate of expected inflation from within a reasonable range. That is, given that the only role of expected inflation is to define the profile of compensation across regulatory periods, it is appropriate that the QCA choose a profile that minimises the uncompensated costs associated with deferred compensation. This can be done by choosing a value for expected inflation from the middle or lower end of a reasonable range.

5.3 Ramsey efficient intertemporal pricing

51. A final consideration relevant to the optimal profile of cost recovery is the elasticity of demand. This is related to, but separate from, asset stranding risks. Much of Aurizon’s costs are (and will continue to be) fixed costs associated with sunk infrastructure. Consequently, Aurizon must set charges in excess of marginal costs in order to recover these fixed costs.⁷ It follows that, at the margin, some coal transport will be discouraged that would otherwise be profitable if prices were set at marginal cost.
52. If the elasticity of demand for coal transport were likely to be higher in regulatory period A than in regulatory period B then (other things equal) it will be efficient to recover a larger proportion of sunk cost per service sold in period B (when elasticity of demand is lower). That is, cost recovery should be more heavily weighted to periods of low price elasticity of demand.
53. The QCA has, in a different context, considered the elasticity of demand for coal haulage on the Queensland network. It has concluded that in the recent past (and presumably in the near-term future) there is very low elasticity of demand. This is due to the QCA’s assessment that CQCN producers are currently low on the

⁷ The QCA does not allow Aurizon the flexibility to price discriminate such that some miners’ output (or some output of some miners) is transported at marginal cost.

international cost curve and, therefore, they have an incentive to maximise production even at low prices.⁸

54. This may well be correct. However, one cannot be confident that it will continue to be correct over the next 20+ years. There is some prospect that technological changes and other factors may drive substitution away from coal and that a 'low position' on the international coal cost curve will no longer guarantee the profitability of high levels of output.
55. This is, of course, why stranding risks are raised by virtue of back-loading of revenues. However, even if there will always be sufficient demand to cover Aurizon's sunk costs (i.e., no stranding risk) it still promotes economic efficiency to recover fixed costs now, when demand elasticity is known to be low, rather than the future when there is some prospect that demand elasticity may be high (and where access charges above marginal cost would play a greater role in discouraging coal transport).

5.4 Conclusion

56. The value of expected inflation purely determines the time profile of compensation across regulatory periods. Therefore, faced with a range of reasonable values for this parameter, the point estimate adopted should be the value that maximises efficiency.
57. There are three reasons why a lower estimate of expected inflation (less backloaded profile of cost recovery) will be efficient. Specifically, a less backloaded cost recovery profile will:
 - minimise financing costs;
 - minimise asset stranding risks; and
 - promote efficient intertemporal usage of the coal haulage system.

⁸ QCA draft decision, p. 102.

6 Narrowing the reasonable range

6.1 Most likely (median) and actuarially expected (mean) forecasts

58. In section 4.5.1 of my November 2016 report I explained the difference between the probability weighted assessment of inflation outcomes compared to the most likely outcome. This can be illustrated by imagining a highly simplistic scenario where investors believe that there is:
- a 2/3rd probability that Australia will escape the “low inflation trap”. In this state of the world, 10 year inflation may be expected to fall within the RBA target range (centred on, say, 2.5%);
 - a close to 0% probability of inflation being above the RBA target range; but
 - a 1/3rd probability of being, at least for a time, stuck in a “low inflation trap”. In this state of the world 10 year inflation might be expected to average only 1.0%.
59. Faced with these perceived probabilities an investor’s (actuarially) expected inflation will be 2.0% ($=0.67*2.5\% + 0.33*1.0\%$). This is the additional return that they will demand to compensate them for the probability weighted expected level of inflation. Therefore, investors will build a 2.0% inflation compensation into their required nominal risk free rate. This is notwithstanding the fact that the most likely outcome is 2.5% inflation.
60. However, the QCA methodology:
- automatically takes lower nominal CGS yields resulting from asymmetrical inflation expectations into account and reflects this in a lower nominal risk free rate as observed in bond markets; but
 - by virtue of using RBA ‘most likely’ inflation forecasts, fails to take the asymmetrical distribution of possible inflation outcomes into account when it estimates expected inflation.
61. In relation to the second dot point, I explained in section 4.5.1 that central bank forecasts of inflation are ‘most likely’ estimates not actuarially expected (mean) estimates of inflation expectations. I explained that 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).
62. I similarly, explained that the best way to arrive at a mean estimate of expected inflation is to use inflation forecasts derived from financial market prices which

automatically reflect investors' mean actuarial expectations across all possible outcomes.

63. The QCA acknowledged that I made the points set out above⁹ and the QCA has not disputed the veracity of these positions. However, neither has the QCA actually incorporated the implications of these points into its decision making. Had it done so the QCA would have acknowledged that:
- There is a bias in the use of RBA midpoint forecasts and that this bias is potentially very significant and varies through time (as the symmetry of the distribution of the possible inflation outcomes varies); and
 - This source of potential bias is at least as relevant to the sources of bias that the QCA postulates exist for market based measures of expected inflation (inflation risk bias and liquidity bias).
64. In this context, market based measures of expected inflation have a critical advantage over simple 'most likely' forecasts as they capture the market's probability weighted assessment of all possible inflation outcomes. This is something that is next to impossible for a single analyst to forecast.
65. Indeed, the equivalent would be to accept a single analyst's forecast of short term interest rates over the next 4 years instead of simply observing the yield on four year CGS. The observed yield on 4 year CGS reflects the market's probability weighted mean expectation of short term interest rates over the next 4 years plus a risk premium (given that investing in a 4 year term imposes a liquidity cost relative to the overnight cash market and also some risk in terms of capital appreciation/depreciation if interest rates fall/rise relative to expectations).
66. However, the QCA, quite rightly, does not seek out and use analyst forecasts of short term interest rates. The QCA uses market observed four year rates even though they will generally include a small and time varying risk premium. To do otherwise would be to give 100% weight to one analysts' forecast (which itself, will not likely reflect their mean actuarially expected forecast) while giving zero weight to the forecasts of thousands of market participants with 'skin in the game'.
67. In my view, it is no less unreasonable, when estimating expected inflation, to give zero weight to the opinions of thousands of bond and inflation swap market investors with 'skin in the game' in favour of giving 100% weight to RBA forecasts. Especially where the RBA forecasts do not capture the correct concept, i.e., mean expected inflation (and do not cover the full time horizon of interest and are not available in the same period the risk free rate is measured).
68. As was explained in my previous report, the difference between mean and median expectations is of critical importance in the current inflation environment. The risks

⁹ QCA, draft decision, 5th full paragraph, p. 56.

to the downside on inflation have been materially higher than the risks to the upside. As such, the mean inflation expectation can be expected to have been lower than the median. This is also consistent with the observation that market-based measures of expected inflation (break-even inflation and inflation swap rates) were materially lower than the RBA ‘most likely’ forecasts.

69. The QCA draft decision acknowledges that the risks to inflation are not always evenly distributed and that, importantly, the risks have recently been to the downside (i.e., deflation)¹⁰

Conversely, where deflation is a prevailing concern, the break-even method may underestimate inflation. Arguably, this has recently been the case, with inflation falling to below the RBA's target 2–3 per cent band since December 2014.

70. However, the QCA draft decision makes this point in the context of arguing that investors in nominal bonds may perceive some protection from deflation and that, consequently, may be willing to pay a premium for nominal bonds (depressing their yield). This is correct. However, the QCA draft decision incorrectly characterises this as a ‘risk premium’ and states that this varies “even though long-term inflation expectations are unchanged” arguing that this provides a reason why break-even inflation is biased.¹¹
71. This is wrong. The correct description of falling nominal CGS yields in the presence of greater deflation risk (i.e., heightened probability of deflation) is **not** to describe this as a negative risk premium in CGS. The correct description of this phenomenon is that nominal CGS yields fall because the mean (actuarially) expected inflation is lower when investors perceive a greater probability of deflation.
72. That is, the phenomenon that the QCA describes (one where heightened risk of deflation leads to falling nominal CGS yields and, therefore, falling break-even inflation) is a phenomenon that supports the use of break-even inflation. It also provides a useful description of why break-even inflation can be different to RBA forecasts. It is not because the latter is ‘wrong’. It is simply because the latter is not measuring the correct concept (i.e., it is measuring most likely (median) not actuarially expected (mean) inflation expectations).

¹⁰ QCA, Draft Decision, p. 52.

¹¹ QCA, Draft Decision, p. 52.

6.2 RBA forecasts

6.2.1 RBA forecasts from May 2017

73. The QCA draft decision bases its estimate of QCA Exp. (π) on the midpoint of RBA forecasts of expected inflation published in the May 2017 Statement on Monetary Policy followed by an assumption of 2.5% expected inflation thereafter.
74. There are a number of potential problems with this approach. In particular, as described in the previous section, one must not assume that the midpoint of the RBA published range is the actuarially expected level of inflation.
75. In any event, the change in the QCA's treatment of expected inflation means that the rationale for using the May 2017 RBA inflation forecasts is much weaker than it was. To the extent that RBA inflation forecasts are to be used then the February 2018 forecasts are superior.

6.2.2 RBA forecasts from February 2018

76. The QCA presumably used the May 2018 RBA forecasts in its draft decision because these forecasts were the most proximate to the Aurizon averaging period being the last 20 trading days in June 2017. This had some logical support when the rationale for the approach was to try and estimate the expected inflation rate most likely to influence bond market traders during Aurizon's averaging period.¹²
77. However, that rationale is only valid under the old regulatory treatment of inflation. Specifically, when the value of QCA Exp(π) determined the real return investors received it was necessary to attempt to estimate the inflation compensation built into the nominal WACC. However, under the new regime QCA Exp(π) no longer plays this role. The value of QCA Exp(π) has no impact on nominal or real returns received

¹² Although this logical support was still weak in the sense that:

- a) The RBA May SoMP was published on 4 May 2014 a month before the Aurizon averaging period started. Moreover, on 4 May 2014 4 year risk free rates were 2.02% but dropped by 0.22% by the time Aurizon's averaging period began. Given that inflation expectations are a primary driver of nominal bond yields it is reasonable to believe that inflation expectations fell by around 0.22% from the 4 May up to the beginning of Aurizon's averaging period. This is supported by the fact that breakeven inflation fell by 0.12% between 4 May 2017 and the beginning of Aurizon's averaging period.
- b) If one accepts that it is bond market investors inflation expectations that matter for expected inflation then one should use breakeven inflation as a direct estimate of bond traders compensation for bearing inflation risk and also as an estimate that can be exactly measured over Aurizon's averaging period.

by investors in Aurizon – its sole role is to determine the time profile of how that return is achieved.

78. In this context, attempting to estimate what was ‘in the heads’ of investors at the time is no longer obviously appropriate. Rather, one can reasonably argue that the objective should be to arrive at the most accurate estimate of inflation that will actually occur over the regulatory period. If one accepts this as the most appropriate objective then the most recent February 2018 RBA Statement on Monetary Policy (SoMP) contains the most relevant forecasts.
79. The February 2018 SoMP forecasts inflation are summarised in the following table. The February 2018 SoMP contains forecasts for three out of the four years of UT5.

Table 6-1: February 2018 SoMP inflation forecasts

	Year ended		
	June 2018	June 2019	June 2020
CPI inflation	2.00	2.25	2.25
Underlying inflation	1.75	2.00	2.25

80. When these are combined with an assumption of 2.5% inflation for the year ended June 2021 the resulting geometric mean inflation is:
- **2.25%** using CPI inflation; and
 - **2.12%** using underlying inflation.
81. If, instead, an assumption of 2.25% for the year ended June 2021 is adopted then the geometric average is:
- **2.19%** using CPI inflation; and
 - **2.06%** using underlying inflation.
82. There are four different four year averages presented above – forming a range of between 2.06% and 2.25%. In my view the top end of the range is problematic because it relies on an assumption that inflation will be 2.5% in the year to June 2021. In my view this is an upward biased estimate of expected inflation in that year given that:
- Actual CPI inflation over the last six years ended June 2017 has averaged just 1.85%; and
 - The RBA forecasts of inflation over the next three years ended June 2020 is just 2.17%.

83. In my view a preferable assumption would be that CPI inflation in the year ended June 2021 is expected to be the same as the RBA forecast for the year ended June 2020 (i.e., 2.25% based on RBA forecasts). This assumption is itself conservative in the sense that the forward inflation rate for the year ended June 2021 as at the beginning of February 2018 was 1.95%/2.13% using break-even/inflation swap market data. This narrows the range of geometric average inflation over UT5 based on RBA forecasts to 2.06% to 2.19%.
84. This narrower range is created by the difference between RBA forecasts of CPI and underlying inflation. Underlying inflation excludes or gives less weight to volatile items (such as fresh fruit and petrol prices). The RBA's focus of monetary policy is on underlying inflation.
85. The question then becomes which is more relevant for the QCA's purpose. This in turn comes down to whether the fact that the RBA believes that volatile items will add 13bppa to inflation over UT5 means that investors in Aurizon should accept a 13bppa lower return over UT5 and a commensurately higher return over subsequent regulatory periods. Other things equal, it is not obvious that there is any 'correct' answer to this question. However, given the considerations outlined in section 5, I consider that the lower value (2.06%) is the most reasonable.

6.2.3 Conclusion

86. The best estimate of expected inflation based solely on RBA forecasts of inflation is 2.06%.

6.3 Breakeven inflation

87. Breakeven inflation was 1.62% over the same period that the QCA has measured the cost of capital for Aurizon (i.e., the last 20 trading days of June 2017). There has been a slight rise in break-even inflation over the half year since the Aurizon averaging period and the most recent estimate based on the 20 days ending 1 February 2018 is 1.80%.

Figure 6-1: 4 year break-even inflation (20 trading day average)



Source: RBA, CEG analysis.

88. Based on the same logic set out in the previous section, given the change in regulatory regime it can be argued that the more recent estimates should be given more weight because they reflect the market's expectations after factoring more recent information. On that basis the best estimate based on break-even inflation would be 1.80%.

6.3.1 Alleged liquidity bias

89. As is explained in Appendix A, the term 'liquidity' is often used in economic discussions without a very clear definition. In this report, we define liquidity as the degree to which an asset or security can be quickly bought or sold in the market without affecting the asset's price. The more liquid a market the easier it is to observe the 'fair' market price and the less likely it is that an individual trader will move the market price against themselves by the act of trading in the instrument.

90. This definition is consistent with that commonly used in financial markets. For example Governor Kevin Warsh of the US Federal Reserve System defines liquidity as follows:¹³

The traditional concept of liquidity relates to trading: An asset's liquidity is defined by its ability to be transformed into another asset without loss of value. ...

As noted, 'liquidity' in the sense of "trading liquidity" reflects the ability to transact quickly without exerting a material effect on prices.

91. Another simplistic definition of 'liquidity' is the volume of trading in an asset. This simplistic definition is typically strongly correlated with true liquidity (as defined above). This is because high levels of trading are typically correlated with high levels of (marginal) interest in trading. However, it is important to keep in mind that this correlation is not causation. Specifically, that lower levels of actual trading do not always imply lower responsiveness of demand and supply to changes in price.
92. Inflation indexed CGS are one of the most liquid assets traded in Australia – with only the possible exception being nominal CGS. Yet, the QCA draft decision raises the potential for break-even inflation to be biased as an estimate of expected inflation due to a liquidity premium depressing inflation indexed CGS prices (raising inflation indexed CGS yields). In my view, there is no credible basis to conclude that such a source of bias could explain the difference between the QCA estimate and break-even estimates (i.e., around 70bp).
93. In order to argue that a 70bp liquidity premium to exist it must be the case that investors who hold the asset to maturity will receive a 70bp premium for investing in indexed CGS rather than nominal CGS. Over four years this is a 280bp (2.80%) premium. If all investors were certain of holding the bonds until maturity then this would be a 2.80% reward without any risk (liquidity or illiquidity only matters in the context of trading).
94. That is, for investors who expect to hold the asset until maturity this is, colloquially, 'money for jam'. However, financial markets do not deliver 280bp rewards to investors for no reason. Thus, in order for a 70bp liquidity cost differential to exist the majority of investors (or, at least, the marginal investors) must expect that they will want to sell the asset prior to maturity. At which point, they must expect to move the price of the asset against themselves by enough to fully offset the (supposed) 70bp premium they earn prior to that.
95. If the investor expects that they will want to sell the asset after two (2) years then by that time they will have received 140bp in 'illiquidity' compensation. In order for this

¹³ Governor Warsh, Speech, Market Liquidity: Definitions and Implications, March 2007. Available at <https://www.federalreserve.gov/newsevents/speech/warsh20070305a.htm>.

to be commensurate with illiquidity costs then the investor must expect their sale to depress the price that they receive for the asset by 1.40%. This is simply not a credible outcome even for the largest of potential sales.

96. At most, an individual investors' expectation would be that any basis point impact of selling their asset on the entire market would be in the single digits. In which case, the investors expected holding time would have to be measured in weeks and not years in order to justify a 70bpps liquidity premium. For example, if an investor expects to move the market against themselves by 2bp when they sell then they must expect to sell the asset in 1.5 weeks in order to justify a 70bpa liquidity premium. There is simply no credible basis to argue that such investors are the marginal price setters in the indexed bond market.¹⁴
97. It is true that indexed CGS are not as heavily traded as nominal CGS (expressed as a percentage of face value). However, 'liquidity' (defined as the benefits of not moving prices against oneself when one trades) is not linearly related to trade volumes. A very large difference in traded volumes does not necessarily imply any economically meaningful difference in liquidity.
98. Indeed, as explained in Appendix A, assets with zero trading can be perfectly liquid. Consider the amount of bids/offers one would receive if one stood ready to trade \$100 notes at face value? The answer is likely to be zero units traded. Now imagine that you dropped the price to \$99.5. There would be an explosion of trading in response to such mispricing. It is a mistake to assume that the level of liquidity of an asset is proportional in any sense to the level of trading.
99. There is a clear parallel here with the comparison between nominal and inflation indexed bonds. Inflation indexed bond yields are protected from unexpected inflation and, therefore, do not respond to inflation news in the same way that nominal bonds do. Put simply, inflation indexed bonds do not need to trade as commonly as nominal bonds in order to achieve the same liquidity because they are simpler products. Their value (just like the \$100 note in the above example) is more easily assessed because it does not depend on the uncertain level of future inflation. However, lower trading in inflation indexed bonds does not imply that they are less liquid (i.e., that the sensitivity of supply and demand to changes in price is lower).
100. In order for an asset to be liquid, market participants need to have a common valuation technique leading to broadly similar valuations. That is, unlike a piece of art or an individual suburban house, a large number of potential buyers and sellers must share a (broadly) common view of what the asset is worth. There also must be

¹⁴ Even if there were some such investors with such short expected holding times, it is not credible to believe that, in a competitive market, they would be the price setters. Such investors would, in reality, be outcompeted for the asset by investors with longer investment horizons and, therefore, higher valuations. Investors whose investment horizon is measured in weeks would naturally invest in cash or other similar products.

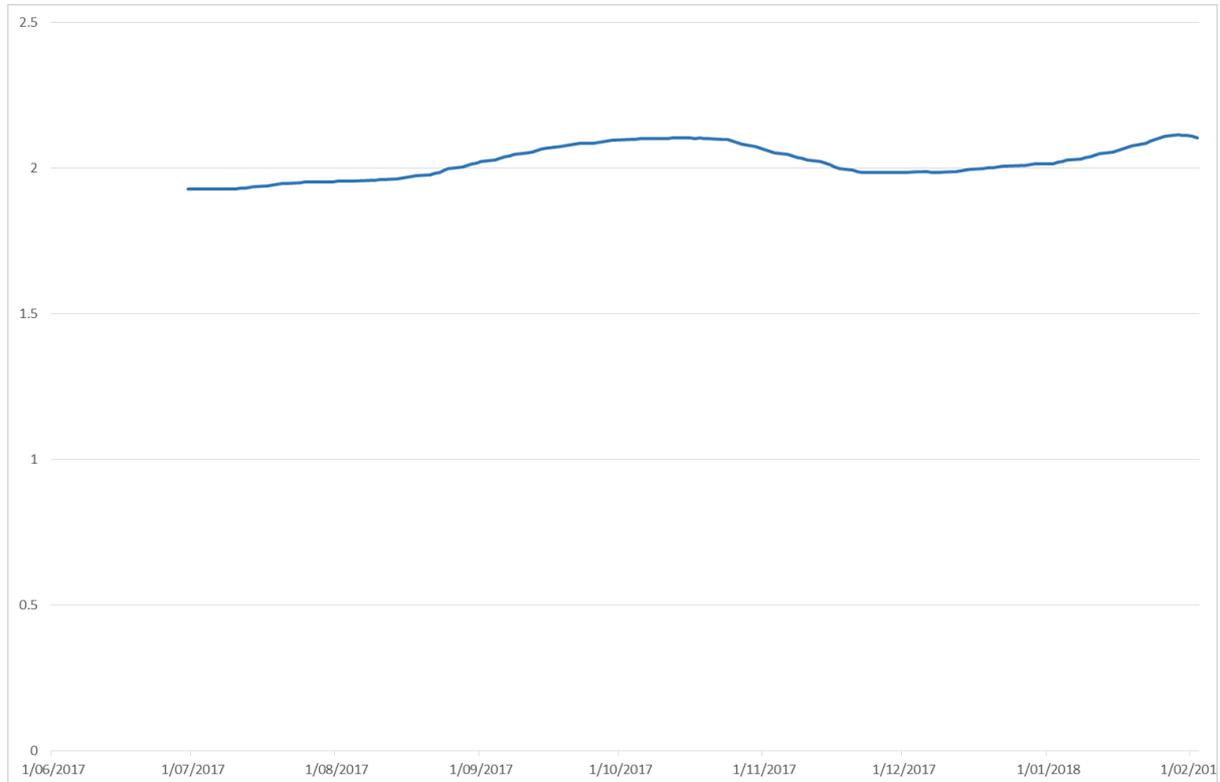
no material ‘inside information’ such that the act of buying/selling does not signal that the true valuation of the asset is different to the counterparty’s valuation (e.g., the true value of used cars is often inside information to the seller). If there are common valuations then the price of the asset cannot diverge materially from the common valuation without a large number of parties wishing to trade. It is this sensitivity of buyers and sellers to changes in prices that creates a liquid market.

101. Nominal and inflation indexed CGS have all of the above traits in common except that inflation indexed CGS are easier to value (because one does not need an estimate of future inflation to value them). On this basis one could reasonably expect inflation indexed CGS to be more liquid than nominal CGS and this is not necessarily inconsistent with lower levels of trading in indexed CGS.

6.4 Inflation swap rates

102. Four year inflation swap rates averaged 1.91% over the same period that the QCA has measured the cost of capital for Aurizon (i.e., the last 20 trading days of June 2017). There has been a slight rise in inflation swaps and they were around 2.10% at the beginning of February 2018.

Figure 6-2: 4 inflation swaps (20 trading day average)



Source: RBA, CEG analysis.

103. Based on the same logic set out in the previous section, given the change in regulatory regime it can be argued that the more recent estimates should be given more weight because they reflect the market's expectations after factoring more recent information. On that basis the best estimate based on inflation swaps would be 2.10%.
104. There is an additional rationale for focusing on inflation swaps and for focusing on inflation swaps measured in Aurizon's averaging period. Inflation swaps represent the market based mechanism available to Aurizon and, separately, to customers, for managing inflation risk created by the new regime of targeting a nominal return.
105. Under the new regime, if actual inflation is expectantly low (i.e., is low relative to the market expectations in Aurizon's averaging period) then Aurizon will earn a real return (i.e., customers will fund a real return) that is higher than investors required during the Aurizon averaging period.¹⁵ The opposite is true if inflation is expectantly high. This is 'inflation risk' is the natural result of adopting a regulatory regime that targets a nominal return. Put simply, relative to the previous regime (assuming that

¹⁵ Assuming that the QCA has accurately estimated all other WACC parameters.

the QCA estimate of expected inflation was unbiased in the previous regime) unexpectedly low inflation hurts customers and benefits Aurizon (and *vice versa*).

106. However, customers and Aurizon do not have to bear this risk. They can, if they prefer, trade in inflation swaps to eliminate this risk. Aurizon would enter into a pay fixed and receive floating four year inflation swap during its averaging period and customers would enter into receive fixed and pay floating four year swap.
107. Given that inflation swaps are the financial instruments that customers and Aurizon would need to use to manage inflation risk under a nominal regime there is a reasonable basis for believing that the QCA should give some, or even more, weight to inflation swap rates when forming its own point estimate of expected inflation.

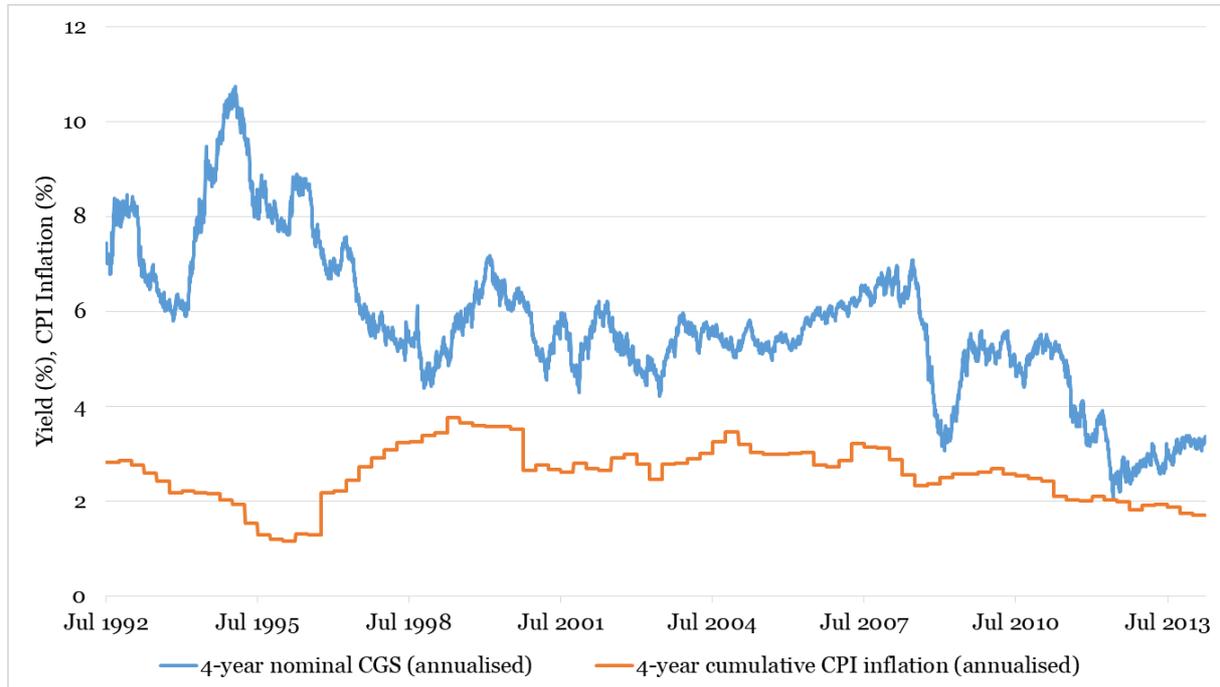
6.5 Negative real risk free rates

108. During Aurizon's averaging period the four year nominal CGS yield ("risk free rate") was 1.89%. If the QCA's estimate of expected inflation of 2.37% was accepted then this implies that bond investors expected a real return of -0.48%.

6.5.1 A -048% real return is inconsistent with historical experience

109. Such an expectation is not consistent with historical experience in that investors in 4 year nominal CGS have never realised a negative real return over the remaining life of their investment. This is illustrated in the below chart which shows that, since the inception of inflation targeting, 4 year nominal CGS yields have always exceeded realised inflation over the following four years.

Figure 6-3: Four year CGS yields versus subsequent four year inflation



110. In early June 2012 there was a period in which nominal CGS yields were very close, but still above, subsequently realised inflation. However, there has never been a period in which nominal yields were anywhere near 0.48% below subsequently realised inflation.
111. Of course, this does not prove that investors were not expecting to earn -0.48% real return on their investment. It is possible that, despite this never occurring in the past, investors did expect it to occur in the future. However, the historical experience does suggest that this is unlikely.
112. Other factors also suggest that a -0.48% expected real return on nominal CGS is unlikely. In particular, the fact that the same investors could, instead of buying a nominal bond, have bought an inflation-protected government bond and earned a positive guaranteed 0.28% pa real return. That is, the investors could earn a guaranteed real return that is 0.76% pa higher than the expected return on nominal bonds (if they truly expected inflation to be 2.37%).¹⁶

¹⁶ That is, bond investors must:

- be willing to lend to the Australian government in nominal terms in the expectation of losing 0.48%pa 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%pa;

6.5.2 A -0.48% real return would imply CGS have negative risk and the QCA is underestimating the risk free rate

113. Lending to an arm's length third party on the expectation of receiving less back than you lend (in real purchasing power) is very unlikely. While it is not impossible, the circumstances where one could imagine this realistically occurring is where the loan has negative risk (i.e., a negative beta). One could use such an argument to explain very low nominal government bond yields since the GFC given that measured betas on CGS have indeed been below zero (see IMF and CEG analysis below).
114. However, this explanation is not open to the QCA unless the QCA also accepts that its risk free rate proxy is based downward. That is, the QCA's adoption of CGS as the CAPM risk free rate assumes that CGS are a **zero beta** asset. If nominal CGS have negative risk then the QCA's estimate of the CAPM cost of equity will be underestimated. That is, even if the QCA's inflation estimate were right, and investors really were expecting materially negative real returns on nominal CGS – this would mean that the QCA's estimate of the risk free return was wrong.
115. In this regard I note that 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)...”¹⁷

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

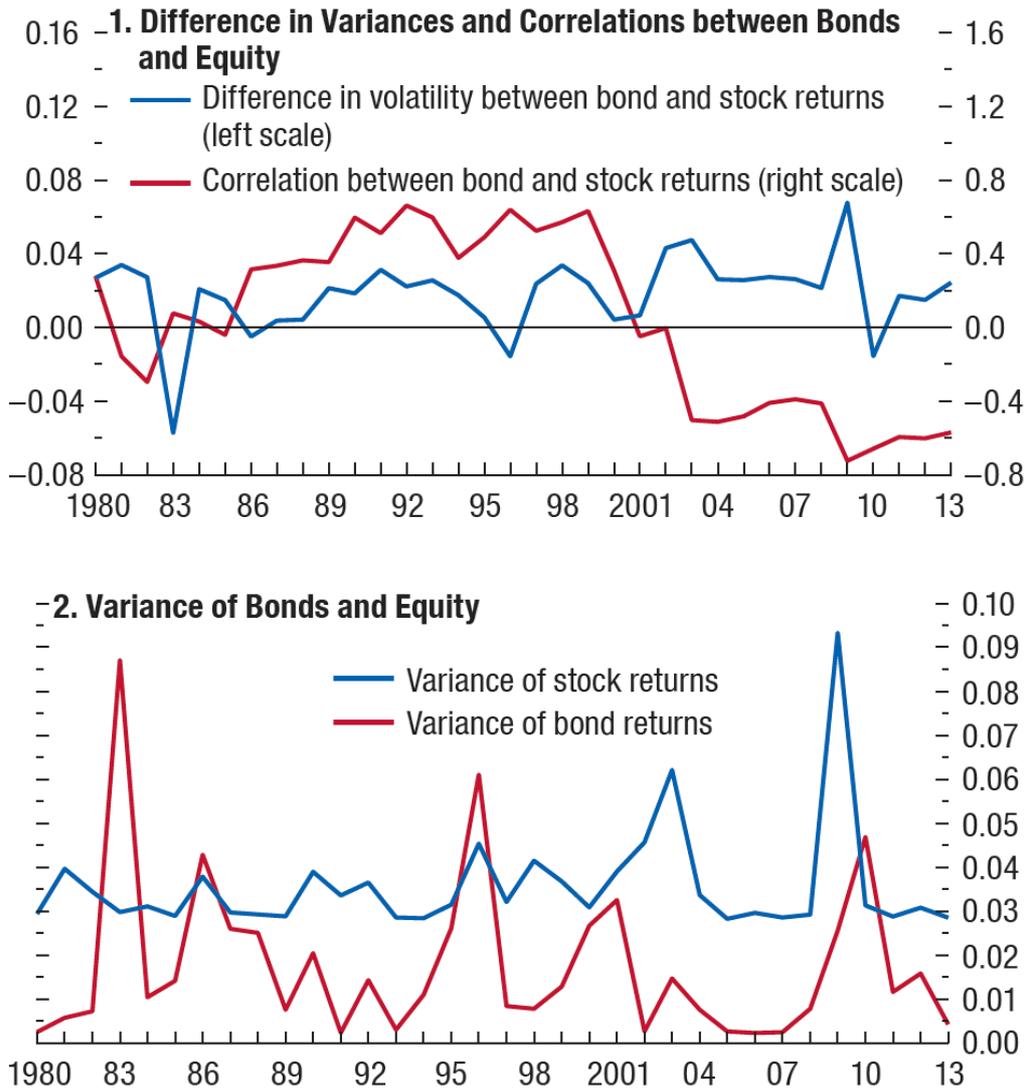
-
- implying that, bond investors lending in nominal terms were deliberately accepting a 0.76% p.a. lower return than the guaranteed (i.e., lower risk) return available when lending on inflation-indexed bonds.

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.

¹⁷ International Monetary Fund World Economic Outlook: April 2014, Chapter 3, Perspectives On Global Real Interest Rates p.13.

Figure 6-4: IMF estimates of correlation between bond and stock returns

Figure 3.13. Portfolio Shifts and Relative Riskiness of Bonds versus Equity, 1980–2013
(Percent)



Source: IMF

117. The beta on nominal government bonds implied by the above analysis is around negative 0.25.¹⁸ If one believes that the MRP is 6.5% this would imply that whatever

¹⁸ 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

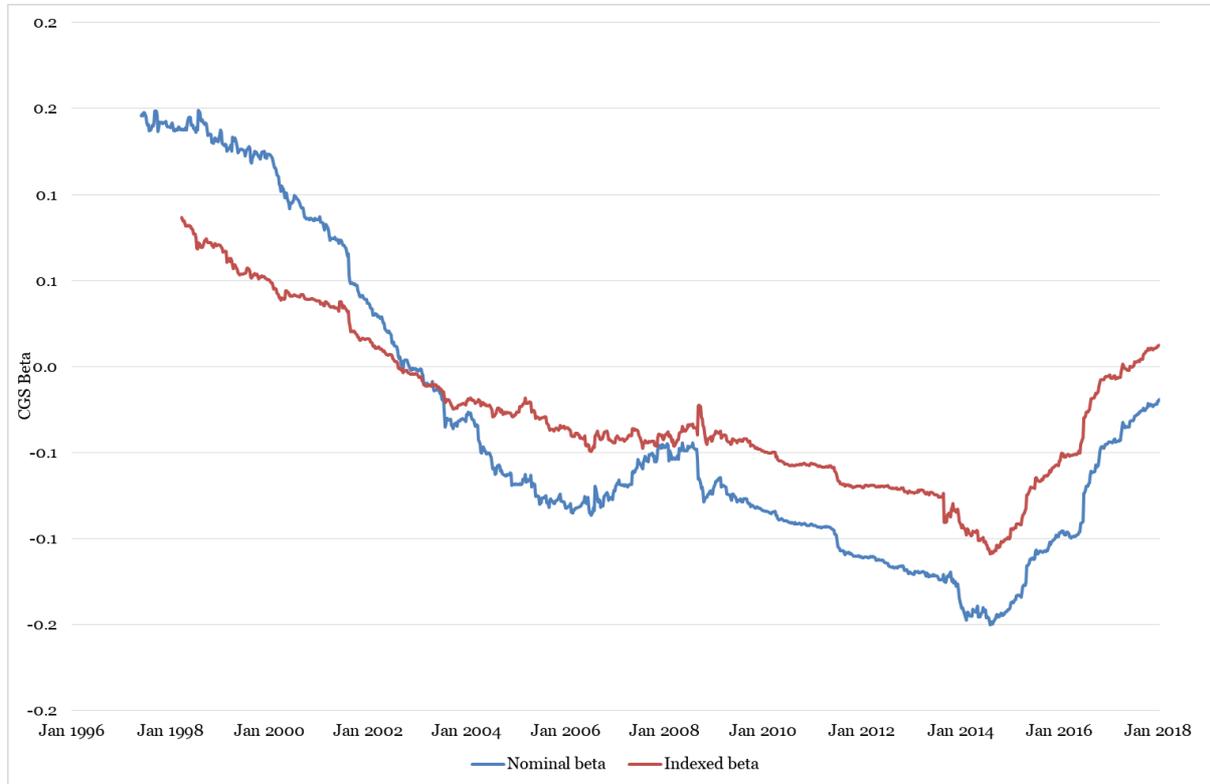
risk exposure is causing negative beta for nominal government bonds is around negative -1.25%.

118. The IMF's estimates are global but are similar to our own estimates for Australian CGS. An examination of the beta for Australian CGS clearly shows the same trend as reported by the IMF. Nominal and indexed CGS have had materially negative betas since around 2000. This is apparent in Figure 6-5 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.

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 ($\sqrt{0.25}=0.5$). This implies an asset beta of around -0.25 (=correlation $\times\sqrt{\text{ratio of variances}}=-0.5\times 0.5=-0.25$).

Figure 6-5: Weekly rolling 5-year betas for 10-year maturity – nominal and indexed CGS



Source: RBA, Bloomberg, CEG analysis

119. 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.¹⁹
120. One could use the above, or similar analysis, to argue that government bonds have negative risk and, therefore, it is reasonable to estimate that they offer materially negative yields.
121. However, under this logic, the reason for this is that nominal CGS yields are depressed below true risk free (zero beta) levels (and are more depressed than indexed CGS). Consequently, the QCA cannot reasonably argue that this ‘bias’ in break-even inflation is material without simultaneously accepting that the risk free rate it is using in its CAPM estimate is also downward biased.

¹⁹ 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 **Error!** **Reference source not found.**

²⁰ QCA, Draft Decision, p. 52.

7 Conclusion

122. A number of different methods for estimating expected inflation are surveyed in the preceding sections. These are based on RBA forecasts, inflation swap and break-even inflation estimates. They suggest an all-encompassing range of estimates from 1.62% to 2.37%.

7.1 RBA estimates – best estimate 2.06% to 2.19%

123. The top end of the all-encompassing range (2.37%) is based on RBA forecasts from May 2017. Under the QCA's new regime of targeting a nominal WACC the most recent RBA forecasts are the relevant forecasts. Using the RBA's from February 2018 SoMP the highest forecast based on the 'RBA method' is 2.25% if an assumption of 2.50% inflation for the year ended June 2021 (the single year not covered by those forecasts).
124. However, in my view, a preferable assumption would be that inflation is expected to be 2.25% for the year ended June 2021 (consistent with market estimates and RBA forecast for the year to June 2020). Adopting this assumption gives rise to a range of 2.06%/2.19% depending on whether underlying/headline CPI is being forecast.

7.2 Inflation swaps– best estimate 1.91% to 2.10%

125. Inflation swap estimates fall into a range of 1.91% to 2.10% depending on whether the 20 days of the Aurizon averaging period (1.91%) or a more recent estimate for the 20 days to 2 February 2018 (2.10%) is used.

7.3 Break-even inflation – best estimate 1.62% to 1.80%

126. Break-even estimates fall into a range of 1.62% to 1.80% depending on whether the 20 days of the Aurizon averaging period (1.62%) or a more recent estimate for the 20 days to 2 February 2018 (1.80%) is used.

7.4 Overall best estimate

127. An estimate based on break-even inflation in CGS markets was, in my view, the only credible estimate of expected inflation under a regime that targeted a real return based on CGS yields. This is because break-even inflation is the best estimate of expected inflation built into nominal CGS yields. However, the QCA's change in methodology to target a nominal return means that other considerations, namely, those outlined in section 5, become relevant.

128. An estimate based on RBA forecasts is at the top end of a reasonable range. In my view, the use of RBA forecasts results in a biased estimate of actuarially expected inflation because RBA forecasts are ‘median’ forecasts not ‘mean’ forecasts. As the QCA itself has noted, deflationary risk has been pronounced in recent times²⁰ (including in June 2017). This gives rise to an asymmetry in the distribution of possible inflation outcomes and leads to the use of median/most likely forecast to be biased measures of mean expectations.
129. In this regard, I note that the February 2018 inflation swap (2.10%) and break-even (1.80%) estimates fall within 0.50% of the estimate based on the February 2018 RBA forecast method (maximum value 2.25%). That is, these estimates are not inconsistent with the RBA forecasts. Rather, the differences are consistent with the RBA forecasts being median inflation forecasts and the market based estimates being mean inflation forecasts. This is because, by their nature, market based forecasts reflect a probability weighted average of all possible risks that the market participants perceive that they are exposed to.
130. In my view market based estimates of inflation forecasts are superior to the estimates based on RBA forecasts. This is for the reasons set out in the previous paragraph and also because there is no need to ‘insert’ an arbitrary assumption about inflation expectations for the year(s) beyond the period where the RBA actually provides forecasts.
131. Of the two market based measures, inflation swap data has an increased salience under the new regime of targeting a nominal WACC. This is because inflation swaps are the financial instruments that Aurizon and customers can use to manage inflation risk under a nominal regime. That said, the considerations outlined in section 5 tend to support the selection of a value at the lower end of the range and, given that break-even estimates are at the lower end of the range, these considerations support the use of break-even inflation.
132. In my view, an estimate of expected inflation within the range of 1.62% to 2.10% is most appropriate in the context of UT5 and the QCA’s draft decision to target a nominal WACC. The top end of this range would result in a modestly negative real risk free rate.

²⁰ QCA, Draft Decision, p. 52.

Appendix A Defining liquidity

A.1 What is liquidity?

133. The term ‘liquidity’ is often used in economic discussions without a very clear definition. In this report, we define liquidity as the degree to which an asset or security can be quickly bought or sold in the market without affecting the asset’s price. The more liquid a market the easier it is to observe the ‘fair’ market price and the less likely it is that an individual trader will move the market price against themselves by the act of trading in the instrument.

134. This definition is consistent with that commonly used in financial markets. For example Governor Kevin Warsh of the US Federal Reserve System defines liquidity as follows:²¹

The traditional concept of liquidity relates to trading: An asset’s liquidity is defined by its ability to be transformed into another asset without loss of value. ...

As noted, ‘liquidity’ in the sense of “trading liquidity” reflects the ability to transact quickly without exerting a material effect on prices.

135. Another simplistic definition of ‘liquidity’ is the volume of trading in an asset. This simplistic definition is typically strongly correlated with true liquidity (as defined above). This is because high levels of trading are typically correlated with high levels of (marginal) interest in trading. However, it is important to keep in mind that this correlation is not causation. Specifically, that lower levels of actual trading do not always imply lower responsiveness of demand and supply to changes in price. .

A.2 Liquidity in asset markets is achieved by traders altering their portfolio in response to price changes

136. Liquidity in an asset market depends on the willingness of buyers and sellers to adjust their portfolio for small changes in price. That is, a change in the desired portfolio of one party must be matched by offsetting changes in the portfolio of other parties. This is how a market achieves equilibrium in response to a change in one party’s desired portfolio. For example, if one party wants to hold more US Treasury bonds, it follows that other parties must, in aggregate, hold fewer (or the US Government must issue more (have a more negative portfolio)).

²¹ Governor Warsh, Speech, Market Liquidity: Definitions and Implications, March 2007. Available at <https://www.federalreserve.gov/newsevents/speech/warsh20070305a.htm>.

137. The question then becomes, how much do prices have to change in order to elicit the offsetting change in portfolios of other parties? In a liquid market, prices have to change only modestly. In an illiquid market, other parties require a large price change in order to elicit the offsetting change in their (aggregate) portfolios.

A.3 Do not confuse the correlation between infra-marginal trading and liquidity with causation

138. True market liquidity and the level of aggregate trading are strongly correlated. That is, typically the more of one in any given market the more of the other. For example, the US Treasury bond market has daily turnover measured in the hundreds of billions of dollars. It is also a very liquid market in the true sense of the term. That is, only small changes in price are required to elicit large changes in aggregate supply and demand – such that even large individual trades do not need to materially raise/lower prices in order to elicit the desired supply/demand for the trade.
139. This correlation between trading activity and liquidity is not purely coincidental. High trading activity is a sign that there are many market participants, many of whom have very large balance sheets, who are constantly monitoring prices and responding with countervailing trades as prices change.
140. However, the amount of trading activity should not be taken as the cause of liquidity. The driver of liquidity is the aggregate willingness of traders to respond to higher/lower prices with more sales/purchasers. Other things equal, this will be correlated with the aggregate turnover of the asset. However, it is perfectly possible to imagine a reduction or rise in the aggregate turnover in a market that is not associated with any change in the aggregate willingness of traders to respond to higher/lower prices with more sales/purchasers.
141. For example, imagine that the interest rate environment changed from one with a large amount of uncertainty to one with only minimal levels of uncertainty. In this case, there would be less scope for differences in valuation of US Treasuries between market participants and, consequently, less reason to trade. Aggregate trading in US Treasuries would fall but this would not be associated with a reduction in true liquidity. Indeed, true liquidity would likely increase because, with the same number of traders backed by the same balance sheets, and more commonly shared valuations of the underlying asset, the aggregate response to a change in price (true liquidity) will be larger.
142. There is a clear parallel here with the comparison between nominal and inflation indexed bonds. Inflation indexed bond yields are protected from unexpected inflation and, therefore, do not respond to inflation news in the same way that nominal bonds do. Put simply, inflation indexed bonds do not need to trade as commonly as nominal bonds in order to achieve the same liquidity because they are simpler products. Their value is more easily assessed because it does not depend on

the uncertain level of future inflation. However, lower trading in inflation indexed bonds does not imply that they are less liquid (i.e., that the sensitivity of supply and demand to changes in price is lower).

143. By way of illustration, note that assets do not need to be traded at all to be liquid. For example, I might offer to sell bundles of \$10,000 in AUD notes on Ebay for \$10,000. It is unlikely that I will ever trade at that price – precisely because there is a perfect common understanding of what its value is. There is no scope for differences in valuation and therefore no reason to trade. Yet, the asset is highly liquid. If I were to drop/raise the price by a fraction of a percent, there would be flood of orders/sales.
144. As already noted, liquid assets do, typically, tend to also be heavily traded assets. However, it is important to understand the direction of the causation. Liquid assets are heavily traded because they are liquid. It is not the case that liquid assets are liquid because they are heavily traded.
145. In order for an asset to be liquid, market participants need to have a common valuation technique leading to broadly similar valuations. That is, unlike a piece of art or an individual suburban house, a large number of potential buyers and sellers must share a (broadly) common view of what the asset is worth. There also must be no material ‘inside information’ such that the act of buying/selling does not signal that the true valuation of the asset is different to the counterparty’s valuation (e.g., the true value of used cars is often inside information to the seller). If there are common valuations then the price of the asset cannot diverge materially from the common valuation without a large number of parties wishing to trade. It is this sensitivity of buyers and sellers to changes in prices that creates a liquid market.
146. Nominal and inflation indexed CGS have all of the above traits in common except that inflation indexed CGS are easier to value (because one does not need an estimate of future inflation to value them). On this basis one could reasonably expect inflation indexed CGS to be more liquid than nominal CGS and this is not necessarily inconsistent with lower levels of trading in indexed CGS.