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Delivering meaningful real returns via the PTRM, RoRI and RFM

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Table of Contents

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List of Figures

List of Tables

1 Executive summary

1. The AER methods and models (RoRI, PTRM, revenue and RFM RAB indexation) together target and deliver a real return on capital. Currently, the PTRM deducts an estimate of future inflation to derive a real return on both debt and equity from the nominal values estimated pursuant with the RoRI. Then inflation indexation of debt and equity costs in the RFM and revenues provides compensation for actual inflation.

2. There is a proposal to instead use PTRM inflation to index the debt portion of the RAB in the RFM (the 'hybrid' approach). This proposal is not the subject of my report. Rather, I examine whether the current models and methods fit together to deliver economically meaningful estimates of the real cost of debt and equity?

3. My key conclusion is that debt and equity are estimated differently in the RoRI and have different inflation compensation built into their nominal values. It follows that the PTRM should treat them differently. Specifically, different values for inflation should be used to index the debt and equity portions of the RAB within the PTRM.

    i. Equity is incurred as a real cost and, therefore, the objective should be to remove the inflation compensation that is embedded in the nominal RoE (via the 10-year nominal risk-free rate (estimated pursuant with the RORI)). This means that PTRM inflation applied to the equity portion of the RAB should:

        a. continue to be 10-year estimate (consistent with the risk-free rate tenor); and

        b. seek to capture total inflation compensation embedded in the risk-free rate (i.e., both expected inflation and any inflation risk premium (IRP)). This conclusion is consistent with Sapere's advice to the AER.

    ii. Conclusion i.b., materially affects any assessment of 'bias'. Deloitte's view that market measures are biased because they include an IRP should be reconsidered.

    iii. Debt, by contrast, is incurred as a nominal cost. Consequently, any real cost of debt derived in the PTRM must be expected to deliver, when combined with subsequent inflation indexation, the nominal cost of debt estimated pursuant to the RoRI. This requires that the PTRM index the debt portion of the RAB using a 5-year expected inflation estimate (i.e., the objective of PTRM inflation applied to debt is to remove the inflation compensation that is expected to be provided by subsequent RAB RFM and revenue indexation). This is consistent with the proof of the same proposition provided by Lally (although I show that the Lally's proof applies differently to real equity and nominal debt costs).

4. These reforms should be considered even if the AER continues to target real returns.

2 Summary of the current regime

5. Within the PTRM inflation plays several roles. However, the key role that this report focusses on is to turn nominal returns on equity and debt into real returns. The mechanism by which this is done is via applying negative depreciation to the debt and equity portions of the RAB – effectively deducting PTRM inflation from the cash-returns over the regulatory period.

6. Even if the AER continues to estimate a real return on both debt and equity, its methods and models need to be reconsidered so that they fit together to deliver an economically meaningful real return for both debt or equity.

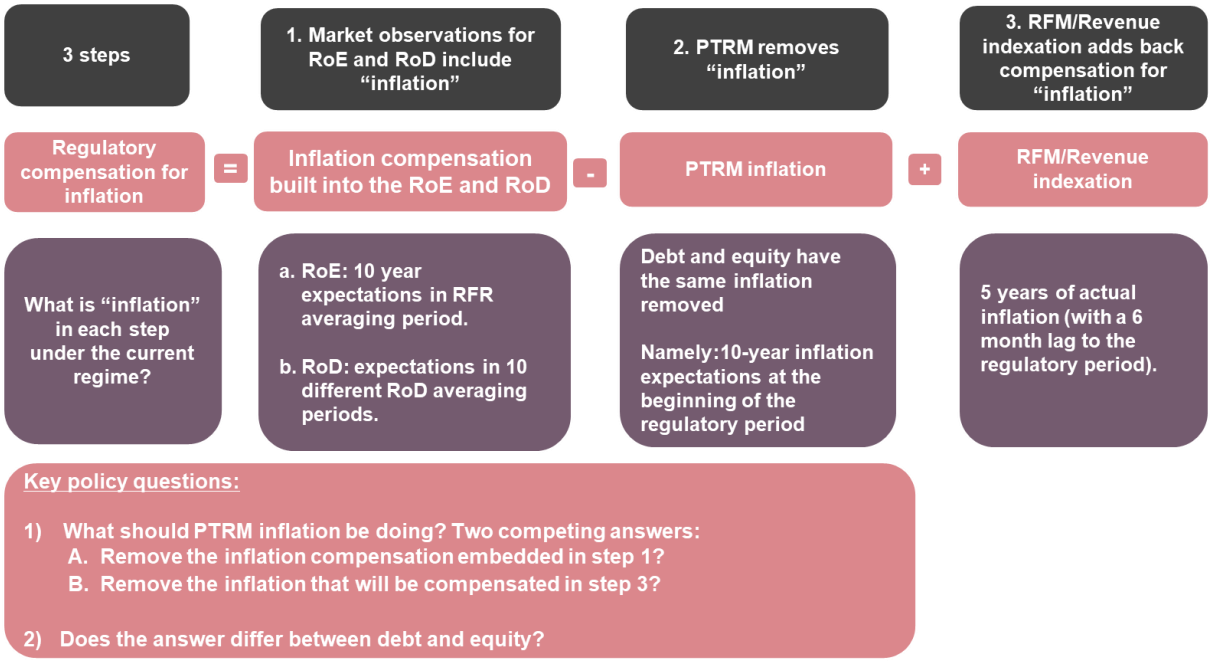
7. The AER's current regime is summarised in the graphic below. Inflation enters (and leaves) the regulated return in three places:

   i. Market rates of inflation compensation are embedded in nominal yields for the risk-free rate and trailing average cost of debt estimated pursuant to the RoRI;

   ii. PTRM derives real returns by removing inflation from debt and equity returns;

   iii. Compensation for actual inflation is added back via indexation of the RAB in the RFM (and, to a lesser extent, via indexation of revenues).

Figure 2-1: Summary of current regime



8. Only with this full structure of the regulatory regime in mind can one ask what the economically logical best estimate of PTRM inflation is. The key questions, as set out at the bottom of the figure, are:

   i. Should the PTRM inflation estimate be seeking to:

      A. Remove the inflation compensation embedded in step 1? Or

      B. Remove the inflation compensation expected in step 3?

   ii. Does the answer differ between debt and equity?

9. In this report I will explain that the answer depends on whether the costs estimated in the RoRI have been incurred in nominal or real terms. I will argue that if the costs are real (equity) then "A" is the correct objective but if the costs are nominal (debt) then "B" is the correct objective.

10. Dr Lally has provided a mathematical proof of the latter finding. Specifically, Lally shows that, if discount rates are nominal, the NPV=0 condition is only met if PTRM inflation is based on expected inflation over the regulatory period. I amend Dr Lally's proof to show that if equity costs are real then the NPV=0 condition is only met if the PTRM attempts to remove the inflation compensation embedded in the nominal risk free rate (which is a 10 year estimate). This analysis can be found in Appendix A.

11. A further key conclusion of this report is that the AER models and methods are currently doing neither A nor B. That is, the inflation being removed in the PTRM neither:

    A. Removes the inflation compensation embedded in the cost of equity or cost of debt estimated pursuant to the RoRI.

       nor

    B. Removes the inflation compensation *expected* to be provided via revenue and RAB indexation in the RFM.

12. This is true for both the cost of equity and the cost of debt (although, because these are estimated differently pursuant with the RoRI they need to be analysed separately). I note that none of my conclusions depend on there being a bias in the AER's method as an estimate of actuarially expected inflation.

3 Targeting a real cost of equity

13. The RoRI uses the CAPM to estimate the cost of equity and the CAPM is a real model – in the sense that all returns are specified in inflation adjusted terms. However, the application of the RoRI results in a nominal return on equity. To arrive at an economically meaningful estimate of the real cost of equity it is necessary that any inflation compensation embedded in the nominal return on equity (from the RoRI) is removed in the PTRM.

14. The only place that inflation compensation enters the nominal cost of equity from the RoRI is via the nominal risk-free rate. This means that the objective of the PTRM remove the same inflation compensation that is embedded in the nominal risk-free rate estimated pursuant with the RoRI.

15. The inflation compensation that is embedded in the nominal risk-free rate is the sum of both:

    - The actuarially expected level of inflation by bond investors; plus
    - Any inflation risk premium they demand due to being exposed to inflation risk (i.e., receiving a nominal return irrespective of actual inflation).

16. Both of these values will be 10-year values because that is the tenor of the risk-free rate. That is, a 10-year risk-free rate will have embedded in it a 10-year actuarially expected inflation estimate plus a 10-year inflation risk premium.

3.1 Why does an inflation risk premium exist and why does it vary

17. The economic literature documents a time varying and often material level of the inflation risk premium. When inflation is high the inflation risk premium is normally positive – meaning that bond investors typically demand an additional risk premium for investing in nominal assets. When inflation is low the opposite is true and investors typically accept a negative inflation risk premium nominal fixed return assets protect their portfolio from unexpectedly low inflation or deflation (which tends to be correlated with poor economic conditions).

3.1.1 Chen et. al. (2016)

18. US Federal Reserve researchers, (Chen et. al.) published a note in 2016,[1] that provides a helpful description of why there is an inflation risk premium in nominal risk-free rates and why it varies.

> *Inflation compensation is defined as the extra yield investors require to hold nominal assets that are exposed to inflation risk as opposed to those that offer a safe inflation-adjusted return such as Treasury inflation protected securities (TIPS).*

And

> *Measures of inflation compensation such as TIPS breakeven rates and inflation swap rates are related to market participants' expected rate of inflation by the relationship:*
>
> *Inflation compensation = expected inflation + inflation risk premium + other factors*

19. They then investigate, using a CAPM framework, the inflation risk premium as:

> *= market risk premium x beta (inflation compensation)*
>
> *where the function "beta" is the usual concept that is proportional to the correlation between inflation compensation and equity returns.*

20. Chen et. al. (2016) explain:

> *Conventional asset pricing theory suggests that the sign of risk premiums depends on the sign of the covariance of the returns of those assets with the typical investors' consumption or wealth. For example, stocks require a high positive risk premium because equity prices tend to fall during recessions, precisely when consumption also falls. Assets with payoffs tied to inflation are often modelled in this way too.*

21. The authors go onto explain that the beta for inflation exposure was typically positive in higher inflation periods but has fallen with the advent of inflation targeting and become negative in the post financial crisis period of low inflation.

[1] Chen, Engstrom and Grishchenko, *Has the inflation risk premium fallen? Is it now negative?* (2016) FEDS Note https://www.federalreserve.gov/econresdata/notes/feds-notes/2016/has-the-inflation-risk-premium-fallen-is-it-now-negative-20160404.html

> *To sum up, this note points out that standard consumption-based asset pricing models and the capital asset pricing model suggest that the long run inflation risk premium has trended down over time, and is likely to be negative in the current macroeconomic environment. Moreover, a nontrivial portion of the decline in far-forward inflation compensation over the past year may reflect a decline in the inflation risk premium rather than a drop in investors' expected inflation rate.*

3.1.2 Sapere (2020)

22. Sapere follow precisely the same logic in their advice to the AER. In para 81 and Appendix I Sapere make the following points:

    a. The CAPM is a real model and, therefore, the risk-free rate needs to be the expected return on a risk-free asset that has zero inflation risk (a real risk-free asset).

    b. The AER starts with a nominal risk-free rate and subtracts expected inflation as to arrive at a proxy for the real risk-free rate.

    c. This will not be accurate if there is any inflation risk premium embedded in the nominal risk-free rate..

    d. The correct adjustment to the nominal risk-free rate to derive the real risk-free rate requires the deduction of both:

        i. expected inflation; and

        ii. any the inflation risk premium.

23. Paragraph 81 states:

> *The method of estimating the nominal WACC and the AER's approach to estimating inflation are out of scope for this report and are taken as given.* ***However, it should be noted that the SLM-CAPM does not address uncertain inflation, which results in the nominally risk-free asset having a risky real rate of return.*** The CAPM with uncertain inflation is derived in Appendix I.. *(*Emphasis added)

24. Appendix I makes (algebraically) clear that the nominal risk-free rate less expected inflation is equal to the true real risk-free rate plus any inflation risk premium built into the nominal risk-free rate.

25. Equation (1) of Appendix I is the standard Sharpe CAPM formula – with a real risk-free rate and an inflation risk premium (IRP) relative the real risk-free rate. Equation

(2) applies equation (1) to the nominal risk-free rate. We set out Sapere's equation (2) in words below.

Expected real return on nominal RFR	=	*Nominal RFR*	-	*E(infl.)*	=	*True real RFR*	+	*IRP*

26. It follows that, to derive the true real return on equity the PTRM must remove both expected inflation (E(infl.)) and the inflation risk premium (IRP) built into the nominal risk free rate. That is, rearranging Sapere's equation (2) to solve for the true real RFR gives.

True real RFR	=	*Nominal RFR*	-	*E(infl.)*	-	*IRP*

3.2 Implication for regulatory models and methods

27. The current regulatory models and methods seek to protect NSP equity investors from inflation risk.

28. The inflation risk premium applies only to nominal assets - not real assets. The current regulatory design means that the equity portion of the RAB is unambiguously a real (inflation indexed) asset. That is, the equity portion of the RAB is subject to the risks of, and requires a return consistent with, a real asset. This does not include any exposure to inflation risk and, therefore, the targeted real return should not include any inflation risk premium.

29. Given that the nominal risk-free rate, estimated pursuant to the RoRI, includes both actuarially expected inflation and an inflation risk premium, it follows that the PTRM inflation should seek to remove both of these elements of inflation compensation from the nominal return on equity.

30. It would be economically illogical for the PTRM to remove more/less inflation from the nominal RoE than is actually embedded in the nominal risk-free rate. Failing to remove any inflation risk premium will result in equity investors being compensated 'as if' they face inflation risk when the regulatory regime explicitly does the opposite (i.e., delivers a real not a nominal return).

3.3 Bias relative to what?

31. There has, in current and past regulatory consideration of PTRM inflation, been much discussion of bias in various methods for estimating PTRM inflation. For example, Deloitte (2020) concludes that market-based measures, including inflation

swaps, are inferior to the AER method because inflation swaps, and bond break even inflation, have. [2]

"biases and risk premia may affect the resulting estimate"

32. This conclusion is, at least in part, based on the fact that market based estimates of expected inflation include the inflation risk premium built into low risk nominal rates (nominal risk-free rates and nominal fixed legs of a CPI swap).

33. By contrast, Deloitte concludes that the AER's method: [3]

Contains no significant biases and/or distortions.

34. While Deloitte's reasoning for this conclusion is not fully developed, this conclusion is clearly, in part, because the AER method is unaffected by movements in the inflation risk premium.

35. Deloitte is correct that the existence of inflation risk premia makes market measures biased estimates of actuarially expected inflation. However, it is equally clear that the existence of inflation risk premia makes the AER method, which ignores the inflation risk premium, a biased estimate of inflation compensation embedded in the nominal risk-free rate.

36. Deloitte proceeds on the basis that it is the former bias that is problematic. However, for the reasons explained in the previous section, it is my opinion that the latter bias is problematic. That is, PTRM inflation needs to include, not exclude, the inflation risk premium embedded in the nominal risk-free rate. This means that the alleged source of bias in market measures of inflation is not, in fact, a bias relative to what PTRM inflation should be estimating (consistent with the equity investment in the RAB being an inflation protected "real" asset).

37. I have reached this conclusion based on an understanding of: a) how the nominal cost of equity and debt is calculated pursuant to the RoRI; b) how the PTRM is structured; c) how inflation indexation is applied to revenues and in the RAB RFM; and d) how all of these elements combine to deliver a real return on equity.

38. Sapere has similarly had regard to the same factors and reached the same conclusion (as explained in section 3.1.2 above).

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[2] Deloitte, p.10

[3] Deloitte p.10

4 Targeting a real cost of debt

39. This section analyses how the regulatory models and methods can fit together to deliver economically meaningful real returns on debt dependent on whether:

    - Debt is incurred in nominal terms; or
    - Debt is, or can be assumed to be, incurred in real terms.

40. I conclude that the current models and methods do not result in an economically meaningful real return consistent with either of the above.

4.1 If debt is incurred in nominal terms – how should the real cost of debt be estimated?

41. In contrast to equity, the RoRI does not estimate the nominal cost of debt based on a single observed bond yield. Rather, the RoRI estimates the cost of debt based on the historical average of a number (up to 10) different observations of bond yields. Each of these observations embeds in it different inflation expectations and different inflation risk premia unique to the period the observation was taken.

42. If one accepts that NSP debt costs estimated in the RoRI are fundamentally nominal in their economic nature this has important implications for how PTRM inflation should be applied to the debt portion of the RAB. (Section 4.2 below will examine the correct approach in the alternative where NSPs do, or should be assumed to, fund themselves with real debt.)

43. One answer is that PTRM and RAB RFM inflation applied to debt should be set the same so that a nominal return is ensured no matter the inflation outcomes (i.e., the hybrid adopted). This will ensure that nominal debt costs are correctly compensated – even if PTRM inflation does not match actual inflation. However, as already stated, my focus is on any needed reforms to the current models and methods assuming the hybrid is not adopted (i.e., assuming the RFM remains unchanged).

44. Specifically, my focus is on how a real return on debt should be estimated from a nominal cost of debt in order that there is the expectation (not the certainty) that the nominal cost of debt will be compensated.

45. In this case, given we start with a nominal cost of debt (as the RoRI currently does) the question is what should the PTRM attempt to remove, step 2 of Figure 2-1 above, from the nominal cost of debt? I conclude that the answer is that the PTRM should attempt to remove the inflation compensation that is expected to be added back in

step 3 of Figure 2-1 (i.e., via revenue and RAB indexation to actual inflation over the next 5-years).

46. This means that PTRM inflation, as applied to the debt portion of the RAB, must be forecast at a 5-year horizon. This ensures that, in expectation if not in certainty,[4] the nominal compensation provided by the regime (RoRI, PTRM, and inflation indexation of revenues and RFM) will actually return us to the starting point (the nominal cost of deb estimated in the RoRI).

47. This is the approach applied by Ofgem which subtracts a 5-year inflation forecast from a 10-14 year trailing average of nominal debt costs to arrive at a real cost of debt for the regulatory period.[5] Lally also provides a mathematical proof that, if the PTRM discount rate is a nominal discount rate, then PTRM inflation, used to derive a real return, must anticipate inflation over the term of the regulatory period in order that the NPV=0 principle is satisfied. I examine this proof in more detail in Appendix A.[6]

48. The following stylised example describes how the AER's current regime results in any difference between 10 and 5-year inflation expectations being removed from the expected nominal compensation for the cost of debt.

4 After all, actual inflation may turn to different to the 5 year ex ante estimate.

5 Ofgem, RIIO-2 Draft Determinations – Finance Annex, 9 July 2020, See summary of "consultation position" on p.13

6 Where I also amend it to show that if the discount rate is real (as it is for equity) this conclusion does not hold and, instead, the objective of PTRM inflation should be to remove inflation compensation built into the nominal return on equity. Given that this is based on a 10 year nominal risk free rate, this implies PTRM inflation applied to the cost of equity should be 10 years.

Table 4-1: Stylised numerical example of current approach

Variable	Role in AER models	Algebraic designation	Value
Nominal TA RoD	Input to PTRM	A	3.0%
10-year expected inflation	Input to PTRM	B	2.0%
AER "real" RoD	Output of PTRM	C (=A-B)	1.0%
5-year expected inflation	Expected input to RFM/revenue indexation	D	-1.0%
Expected nominal RoD compensation	Expected output of AER models	E (=C+D=A-B+D)	0.0%
Difference "input" nominal cost of debt and output nominal compensation		F (=E-C=D-B)	-3.0%

49. This example illustrates that a +3% nominal cost of debt input into the PTRM is turned into zero expected nominal compensation for the cost of debt if the 10-year expected inflation is 3% higher than 5-year expected inflation.

50. That is, even if inflation turns out to be exactly as expected (zero forecast errors) the combined AER models will deliver nominal compensation for debt costs that is different to the estimate of nominal debt costs from the RoRI. This cannot be an appropriate outcome if the RoRI reflects efficient debt funding costs. It implies that an NSP will not recover their debt costs even if the NSP contracts at precisely the rates that the AER estimates are cost reflective and even if inflation is exactly as the AER predicts will occur.[7]

51. While the above example is hypothetical, the below example is a real-world application. In its 2020 regulatory decisions for SAPN, JGN and EQ the AER estimated 10-year inflation for to be 2.27%. However, the 5-year inflation forecast (using the AER method) would have been 1.80%.

52. Even if inflation follows exactly the AER method's predicted path, the 47bp difference between 5 and 10-year expected inflation will be removed from the nominal

[7] As already discussed, when expected inflation is lower over 5 years than 10 years it is perfectly appropriate that the expected nominal compensation for equity is lower than the PTRM nominal cost of equity input. This is because the nominal cost of equity input to the PTRM includes the 10 year inflation compensation embedded in it. Therefore, to derive a real risk free rate (one that is free from any inflationary impact) we must remove 10 year inflation compensation. Having done this, all we care about is the real return derived. It does not matter for that real return whether nominal returns over 5 years are different to those expected over 10 years.

compensation for these businesses over the 2020-25 regulatory period. That is, even if the AER's forecast method is perfectly accurate, 47bp greater inflation compensation will be removed in the PTRM than is added back in the RAB RFM and revenue indexation.

53. Because 60% of inflation on RAB is removed at 2.27% but only 1.80% of inflation is added back, the difference is lost forever and not compensated in the RAB at a later time.

Table 4-2: Real world (SAPN, JGN, EQ) numerical example

Variable	Role in AER models	Algebraic designation	Value (of return)
Nominal TA RoD	Input to PTRM	A	A
10-year expected inflation	Input to PTRM	B	2.27%
AER "real" RoD	Output of PTRM	C (=A-B)	A-2.27%%
5-year expected inflation	Expected input to RFM/revenue indexation	D	1.80%
Expected nominal RoD compensation	Expected output of AER models	E (=C+D=A-B+D)	A-0.47%
Difference "input" cost of debt and expected output compensation		F (=E-C=D-B)	-0.47%

54. There is nothing that these NSPs can do, or could have done, to avoid this loss. Even if the businesses had issued inflation indexed debt, it would still have been exposed to this loss of 47bp pa on its cost of debt (see section 4.3 below).

55. It is also worth noting that the current regulatory methods and models effectively impose a 5-year pay fixed/receive floating CPI swap on NSPs. NSPs pay the fixed leg of the swap in the form of PTRM inflation (removed from nominal debt returns) and receive the floating leg (in the form of indexation of debt costs in the RFM and revenues).

56. However, instead of the fixed leg of this regulatory swap contract reflecting market rates the fixed leg is whatever the PTRM inflation estimate is. To the extent the PTRM inflation estimate is different to the 5-year CPI swap rate the regulatory regime can reasonably be thought of as forcing NSPs to accept a CPI swap at non-market rates.

57. To the extent that the market price represents a fair price for taking on the same risks the NSPs are bearing, this would suggest that PTRM inflation applied to the debt portion of the RAB should give at least some weight to 5-year inflation swaps.

> **Key conclusion**
>
> If debt is a nominal cost that is, nonetheless, to be turned into a real cost, the PTRM must remove the same value of inflation compensation as the value it expects to add back in revenue/RAB indexation. That is inflation over the 5-year regulatory period.
>
> This differs from equity because equity is a fundamentally real cost. For equity, the objective is not to set a real return that is expected to yield the starting nominal cost. For equity, the objective is to estimate and target the real cost (based on the best estimate of the real risk-free rate)

4.2 If debt is incurred in real terms – how should the real cost of debt be estimated?

58. As it stands, the trailing average nominal cost of debt estimated in the RoRI is an average of up to 10 different nominal yields (each with different inflation expectations and inflation risk premia attached). There is no attempt within the RoRI to estimate the costs of NSPs issuing real (inflation indexed) debt.

59. By contrast, if debt is (or should have been) incurred by NSPs in real terms then the RoRI is not accurately reflecting this.

60. In this case, the objective must be to estimate the costs of issuing real (inflation indexed debt). If this were done in an internally consistent manner the RoRI would need to be amended to estimate a trailing average of the real cost of debt. That is, each debt observation in the trailing average would be a real yield observation.

61. PTRM inflation applied to the cost of debt in the RFM would then be zero. That is, there would be no need to subtract inflation from the cost of debt because it would already be in real terms.

4.2.1 Applied historically, the AER method underestimates real yields on inflation indexed corporate bonds

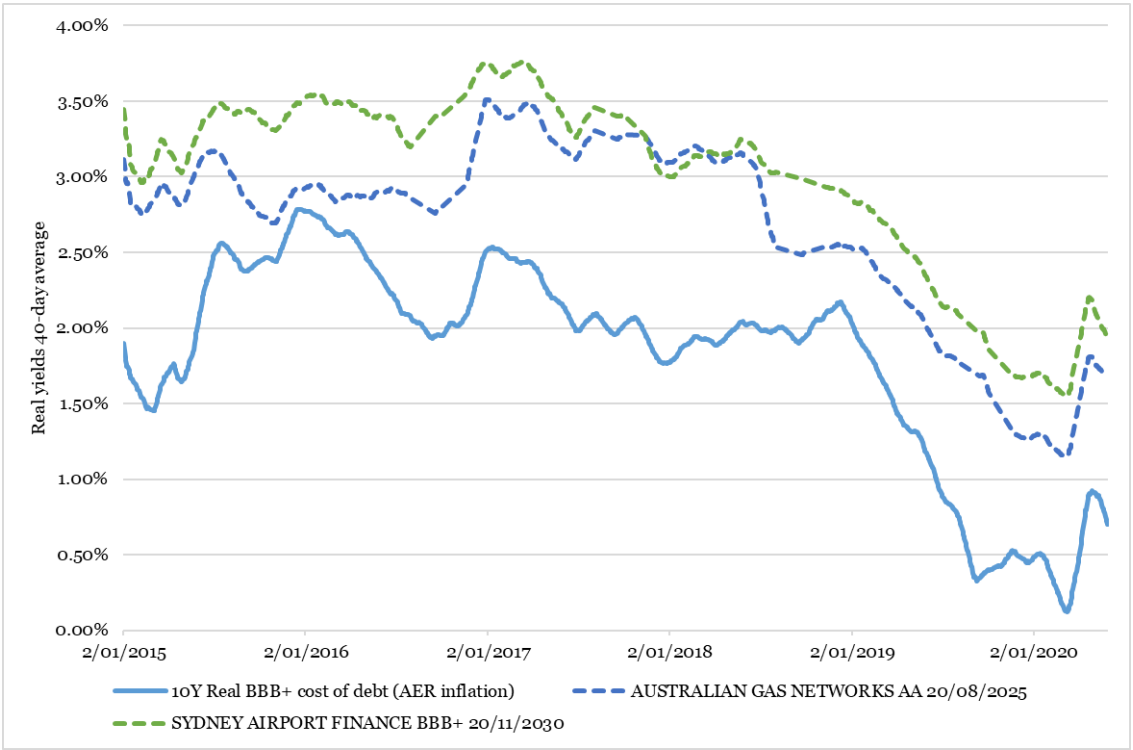
62. The paucity of corporate issues of inflation indexed debt suggests that there is little demand for such debt in credit markets and that, therefore, it would be more costly for NSPs to fund themselves in this way. This is borne out in Figure 4-1 below which compares time series for: the estimate of the real cost of debt applying current

methods historically; versus the real yields on the only two bonds, as reported by Bloomberg, issued by Australian infrastructure businesses with maturity beyond 2020. These two corporate bonds are:

- An AA rated bond maturing in 2025 issued by AGN; and
- A BBB+ rated bond maturing in 2030 issued by Sydney Airport.

63. The real yield on the former is typically 50-100bp higher yield than the real cost of debt estimated by the using the AER's current regulatory models and methods. This is despite it being much shorter maturity than 10-years over the period examined and a higher credit rating than BBB+. The real yield on the latter BBB+ rated bond is typically than 100+bp higher than the estimate of the real yield implied by regulatory practice.

Figure 4-1: Inflation indexed infrastructure yields vs estimate of real cost of debt implied by regulatory practice (40 day average)



64. The real yield estimated from regulatory practice is derived by assuming nominal BBB+ debt issues and then subtracting regulatory expected inflation. The fact that

this is universally lower than real yields actually observed on inflation indexed corporate bonds implies either:

- It would be higher cost to issue inflation indexed debt than nominal debt. This suggests issuing inflation indexed debt would be inefficient (if one assesses efficiency based solely on minimising costs).
- Second, if it is, nonetheless, efficient to issue inflation indexed debt[8] the AER's method does not appear to provide adequate compensation for the costs that would be incurred from pursuing that strategy.

65. If the first, this suggests that it should be accepted that NSPs efficiently issue nominal debt. If the second, the regulatory models and methods should be amended to raise the estimate of real debt costs materially in order to compensate for the higher costs of funding with real inflation indexed bonds.

4.3 The current methods and models achieve neither objective

66. The AER's current models and methods neither:

- Estimate the cost of a nominal debt issuance program and turns this into a real target return over the regulatory period; nor
- Estimate the cost of a real debt issuance program.

67. What the AER's models and methods actually do is start with a trailing average of nominal debt costs over 10 historical years then deduct a 10-year estimate of expected future inflation at the beginning of the regulatory period. This results in a real return that does not:

- bear any relation to the real debt costs that an NSP would incur if they funded themselves using inflation indexed debt. To achieve this objective the AER would have to remove a 10-year trailing average of expected inflation;[9]

nor does it

- result in an expectation that the nominal cost of debt estimated pursuant to the RoRI will be recovered. This is true even if actual inflation exactly matches the

8 For example, due to factors other than cost minimisation.

9 And the AER would need to add a liquidity premium to reflect the difference in real yields between nominal and inflation indexed corporate debt.

AER 10-year forecast. This is because actual compensation for inflation is provided in the AER models over 5-years not 10-years.

68. There is considerable misunderstanding on this point. The following passage from Sapere suggests a misunderstanding by both Sapere and the AER of what the current models and methods actually do when they are combined.

> *140. The AER observed that by targeting the overall rate of return, financing decisions remain the concern of the service provider, who bears the benefit or detriment of all such decisions (on the appropriate gearing level, whether to issue fixed or floating debt, whether to issue domestically or overseas, and so on) (Australian Energy Regulator, 2017, p. 88). The AER concluded that the current approach "appropriately assigns any risk arising from these financing decisions to the service provider, rather than consumers". It observed that when inflation causes the real return to equity holders to drop below the initial target, the real return to debt holders rises above the initial target-**noting that this outcome is a consequence of the decision of the NSP to issue nominal debt.*** (Emphasis added)

69. This passage assumes the current regime compensate NSPs based on a trailing average of real debt costs. As noted at paragraph 67 above, this is not the case.

70. The current methods and models do estimate and target a "real" level of compensation for the cost of debt. It is just that this "real" estimate will generally not be an economically meaningful estimate. The only circumstance in which the current methods and models do accurately compensate (in expectation) debt funding costs is where: a) debt funding costs are nominal in nature; and b) 10 year inflation expectations are, by coincidence, the same as 5 year inflation expectations.

4.4 Graphic summary of decision tree for the cost of debt

71. The above quote from Sapere suggests that both it and the AER believe that the current regime compensates for the costs of a real debt issuance program. In terms of Figure 4-2 below, this is a belief that the regime is sitting at position 2b. However, in reality, the current methods and models occupy the spot 4. in the below graphic.

72. In Figure 4-2, the move from 1. to 2a. follows from the RoRI estimating nominal debt costs. The move from 2a. to 3b. (rejecting the hybrid[10]) follows from the fact that the

[10] Which would ensure PTRM inflation equalled RFM inflation for the cost of debt portion of the RAB

current regime makes the recovery of the nominal debt costs dependent on the accuracy of PTRM inflation matching actual inflation.

73. Finally, the current PTRM forecast is for a 10-year horizon. Consequently, even if actual inflation in each year of the regulatory period exactly matches the AER predictions, the nominal cost of debt will be over/under compensated whenever 5-year expected inflation is above/below 10-year expected inflation. This shifts the current approach from 3b. to 4.

Figure 4-2: Summary of decision tree for the cost of debt

Appendix A Lally's proof that PTRM inflation should be 5 years

74. Dr Lally proves, on pages 4 and 5 of his report, that PTRM inflation must anticipate inflation over the regulatory period in order to satisfy the NPV=0 result.

75. I agree that Dr Lally's proof is well constructed and valid. However, I note that it implicitly assumes that the discount rate is a nominal discount rate. This means that for the cost of debt, which I agree is a nominal cost, Dr Lally and I agree that the PTRM inflation (used to index the debt portion of the RAB) should reflect expected inflation over the course of the regulatory period.

76. However, Dr Lally's proof does not apply to equity given that equity is a real cost. I use the framework established by Dr Lally to show that PTRM inflation applied to equity should be estimated over the same horizon as the risk-free rate (10 years).

A.1 Lally's proof applied to nominal costs

77. Dr Lally has a simplified model with no building blocks other than capital returns and zero depreciation/capex and with a single year regulatory period. In this model, the value of the opening RAB (A_o) must equal the present value of nominal expected revenues plus the expected indexed value of the opening RAB ($A_o[1 + E(i_1)]$).

$$A_o = \frac{E(REV_1) + A_o[1 + E(i_1)]}{1 + k_0} \qquad (1)$$

78. From this incontrovertibly correct position, Lally simply rearranges terms to derive the correct real rate of return consistent with the NPV=0 condition (equation 1).

$$E(REV_1) = A_o[k_0 - E(i_1)] \qquad (2)$$

79. Equation 2 is the cash return that the PTRM must deliver such that, in combination with indexation in the RFM (equation 1), the NPV=0 principle.

80. Lally's equation (2) proves that the NPV=0 principle requires that PTRM revenues must be derived by deducting the same inflation that is expected to be added to the RAB (i.e., $E(i_1)$).

A.2 Lally's proof applied to real equity costs

81. Lally's proof can also be applied to real costs. However, we need to replace k_0 with real discount rate k_0^r and we need to divide the right hand side of equation (1) by one plus expected inflation $(1 + E(i_1))$ to convert into real terms.

$$A_o = \frac{E(REV_1) + A_o[1 + E(i_1)]}{(1 + k_0^r)(1 + E(i_1))} \qquad \text{(1 real)}$$

82. Now, when we solve for $E(REV_1)$ by rearranging the real version of Lally's equation (1) we get the following.

$$E(REV_1) = A_o \cdot k_0^r \cdot [1 + E(i_1)] \qquad \text{(2 real)}$$

83. Equation "2 real" shows that the PTRM must deliver cash returns that are equal to the real discount rate (k_0^r) indexed by actual inflation over the course of the course of the regulatory period.

84. When costs and discount rates are real, Lally's amended proof simply requires that the PTRM delivers an economically sensible value for k_0^r. As described in section 3, this requires that the PTRM remove 10 year expected inflation from the nominal cost of equity because the nominal cost of equity has 10 year of expected inflation embedded in it (via the nominal risk free rate estimated pursuant with the RoRI).

A.3 Summary

85. This section shows that Lally's proof that PTRM inflation must match the term of the regulatory period only applies to debt. Lally's proof can be thought of as a mathematical framework similar to my Figure 2-1 in section 2. In that section I explained that, in terms of targeting a real return, there are only two valid objectives for PTRM inflation .

    A. Remove the inflation compensation embedded in the nominal cost estimated pursuant to the RoRI (step 1 in Figure 2-1)? or

    B. Remove the inflation compensation expected to be provided via revenue/RAB indexation (step 3 in Figure 2-1)?

86. In this report I have explained that the answer depends on whether the costs estimated in the RoRI have been incurred in nominal or real terms. I have argued that if the costs are real (equity) then "A" is the correct objective but if the costs are nominal (debt) then "B" is the correct objective.

87. Lally mathematically proves my position in relation to nominal costs. I amend Lally's proof to also prove my position in relation to real costs.