COMPETITION ECONOMISTS GROUP

Estimating the WACC under the IMs

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1 Executive summary

1. This report addresses a number of issues related to estimating the WACC under the IMs and proposes a number of reforms to the 2016 IMs. These can be summarised below.

1.1 Debt tenor and trailing average

2. The 2016 IMs involve a fundamental inconsistency between the asset beta estimate the debt tenor assumption which creates a downward bias in the WACC estimate. This inconsistency can, and should, be corrected by adopting a benchmark tenor of 10 years for debt (rather than the current 5 year benchmark).

3. This inconsistency is analogous to the "debt leverage anomaly" that the NZCC already recognises and which is the reason it sets the benchmark leverage in the WACC consistent with the average leverage in the asset beta sample. For precisely the same reasons, a "debt tenor anomaly" exists which the NZCC needs to address by adopting an average debt tenor consistent with the average debt tenor in the asset beta sample.

4. We also consider that the NZCC should adopt a trailing average estimate of the 10 year cost of debt. However, this issues is separable from the tenor assumption. That is, the NZCC could logically address the "debt tenor anomaly" without adopting a trailing average. If the NZCC does adopt a trailing average it would be reasonable to consult on applying a transition.

1.2 Term Credit Spread Differential (TCSD)

5. The TCSD compensates for the higher cost of long term debt for those EDBs that issue long term debt. The TCSD would not be necessary if the NZCC adopts a 10 year tenor. However, if the NZCC does not adopt a 10 year tenor the TCSD will need to be updated.

6. In the process of updating the TCSD we have attempted to replicate the NZCC's 2016 estimate. We have been unable to do so and consider that there is a high probability that the estimate was made in error. Our estimate of the NZCC 2016 methodology is that the TCSD:

   - The 2016 TCSD should have been estimated at 10bp (i.e., a 10bp increase in DRP per year of tenor above 5 years);
   - The updated application of this method also results in a 10bp estimate.

7. This compares to the NZCC stated estimate of around 5bp (which was increased to 7.5bp based on CEG estimates).

1.3 RAB indexation and CPI forecasting

8. We consider that new evidence since 2016 should lead the NZCC to reconsider its approach to targeting compensation for a real cost of debt. Given the cost of debt is efficiently incurred in nominal terms, targeting compensation to a real cost of debt creates risk for customers and EDBs that would simply not exist if a nominal cost of debt was targeted.

9. In the 2016 IM decision, the NZCC accepted that there would be risk mitigation advantages for EDBs but rejected reform on the basis that:

   a. The status quo was established and changing it would involve some effort and that the inflation forecasting errors were not so large as to warrant that effort; and

   b. Reducing EDB risk would "transfer" that risk to customers.

10. The first point has been demonstrated to be empirically wrong since 2016. The second point was always conceptually wrong (see paragraph 8 above) but has also been proved to be empirically wrong by recent high inflation outcomes. These have the effect of resulting in customers paying substantially more than the efficient costs for debt funding (even if we take the average over DPP1 to DPP3).

11. We also describe empirical evidence that suggests that, to the extent that the NZCC still needs a forecast of inflation, it should give some weight to break-even inflation estimates derived from the yields on inflation indexed government bonds.

1.4 Amortisation of issuance costs

12. In 2016 the NZCC determined that it would not amortise issuance costs on the grounds that:

    > *…suppliers typically issue some debt each year to manage refinancing risk. They therefore incur some debt issuance costs each year. Assuming that firms issue a consistent amount each year with similar costs, there is no need for a present value adjustment in respect of a portfolio of debt.*

13. We explain that this logic is flawed. It amounts to taking the money allocated to compensate for past costs and using it to fund current costs. It is true that this will "adequately" compensate for current costs but it does so by leaving past costs completely uncompensated. That is, if the NZCC hypothecates each year's total debt issuance compensation to the debt that has just been raised in that year (being one fifth of the RAB) then that leaves the other four fifths of the debt RAB uncompensated. That is, at any given time there is an "inventory" of old debt raising costs that is uncompensated.

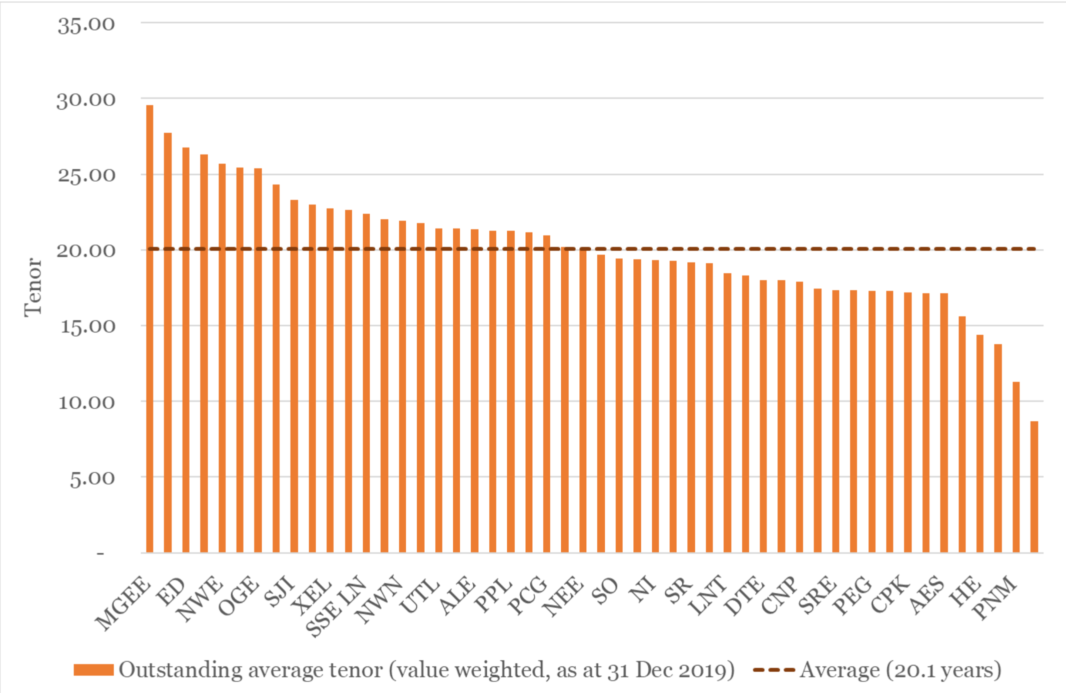
2 Tenor of debt and use of a trailing average

2.1 Internally consistent tenor of debt

14. The NZCC currently sets a cost of debt based on the baseline assumption that the EDB maintains a staggered portfolio of 5-year debt. Large EDBs that issue longer tenor debt receive compensation of the higher debt risk premium (DRP) on that debt via the TCSD (discussed in section 3).

15. However, the NZCC sets the asset beta for all EDBs based on benchmarking against businesses that universally have a longer average tenor of debt. In fact, in the updated NZCC asset beta sample from 2016, the value weighted average tenor of all bonds issues is over 20 years.

Figure 2-1: Average tenor of bonds issued for firms in asset beta sample



Source: Bloomberg and CEG analysis. 31 December 2019 is chosen to reflect pre Covid impacts. There is significant evidence that during the Covid period long term corporate debt was difficult to finance [Ref] and the subsequent rapid inflation escalation has also tended to the available of long term nominal debt funding.[1]

[1] Ropele, Gorodnichenko and Coibion, Inflation expectations and corporate borrowing decisions: new causal evidence, NBER working paper series, Working Paper 30537, October 2022.

16. The difference between the actual practice of the firms in the asset beta sample (20 years) and the NZCC's assumption (5 years) is highly material. In this context it is critical to understand why firms choose to issue longer dated debt even though this is typically associated with a higher cost of debt and, in particularly, a higher DRP.

17. There is only one reason why the equity owners of a firm would choose to issue higher cost long term debt rather than lower cost short term debt. This must be because doing so reduces the cost of equity. That is, any higher interest costs must be associated with an at least offsetting lower cost of equity – otherwise it would be irrational to incur the higher costs associated with issuing long term debt.

18. Moreover, in the capital asset pricing model (CAPM), used by the NZCC to estimate the cost of equity, this must manifest through a lower beta. That is, a firm specific decision to issue longer term debt can only reduce the cost of equity if it reduces the equity beta for any given gearing level (given that the market risk premium and risk free rate are market wide parameters).

19. Longer term debt reduces the equity beta precisely because longer term debt absorbs some of "equity like" risk. Equity is infinitely lived (or, at least, as long lived as the firm) while debt funding is made for discrete periods of time. The longer debt funding is provided for the more like equity funding it is. The longer a debt instrument is the more exposed is the lender to the long-term viability of the firm. That is exposure raises the "debt beta" for the debt instrument and, in doing so, the equity beta is reduced.

20. This is formalised in the following commonly used relationship between asset beta, equity beta and debt beta ().

$$\beta_e = \frac{\beta_a - \beta_d}{1 - L}$$

Where:
β_e is the equity beta
β_a is the asset beta
β_d is the debt beta
L is the leverage/gearing

21. This is at the well-known Modigliani Miller theorem that the WACC should be more or less invariant to the level of debt leverage.[2] This is also sometimes described as the "conservation of risk" theorem (drawing a parallel from the law of the conservation of energy in physics). It states that the fundamental risk of a firm cannot be changed by the funding strategy of the firm – it can only be allocated in different ways between

[2] The Modigliani Miller theorem is a cornerstone of modern finance theory. It states that if financial markets are efficient and there are no transaction costs, then a firm's WACC is not affected by its capital structure. Modigliani, F.; Miller, M. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment". American Economic Review. 48 (3): 261–297.

funders. In this context, this means issuing low cost short term debt rather than high cost long term debt cannot lower the WACC for a firm. All that is happening when a firm issues low cost short term debt is that it is retaining more of the risk for equity holders that it would otherwise have passed onto long term debt funders.

22. Such a relationship between debt beta and equity beta is well understood and accepted by the NZCC. Indeed, the NZCC carefully explains why the existence of positive debt betas means internal consistency requires it to use the same benchmark gearing as the sample average gearing from the asset beta sample of firms. Otherwise, using a debt beta of zero and a value for benchmark gearing above the sample average would tend to overestimate the equity beta and create "the leverage anomaly" whereby WACC increases with gearing when the Modigliani Miller Theorem argues that WACC should be independent of gearing (within reasonable ranges).

23. To this end the NZCC states:[3]

> *562. We continue to consider that using the average leverage of the asset beta comparator samples is the best way of dealing with the anomaly. As we have estimated a notional leverage in line with the companies in our asset beta comparator samples, the resulting WACC will be the same for those services regardless of the value assumed for the debt beta.*

24. But the same principle of internal consistency applies in the context where the NZCC uses the asset beta for firms with long term debt and applies it to a benchmark where it assumes short term debt is being used. Other things equal this will create precisely the same sort of bias that the NZCC is concerned about with the leverage anomaly.

25. That is, the "leverage anomaly" is a direct corollary of the "tenor anomaly". Choosing a different leverage to the sample average should not affect the WACC but, without accounting for debt beta it does. Similarly, choosing a different tenor to the sample average should not affect the WACC but, without accounting for debt beta it does. The NZCC has addressed the leverage anomaly but the same logic means it should also address the tenor anomaly.

3 NZCC, Input methodologies review decisions, Topic paper 4: Cost of capital issues, December 2016, p. 144.

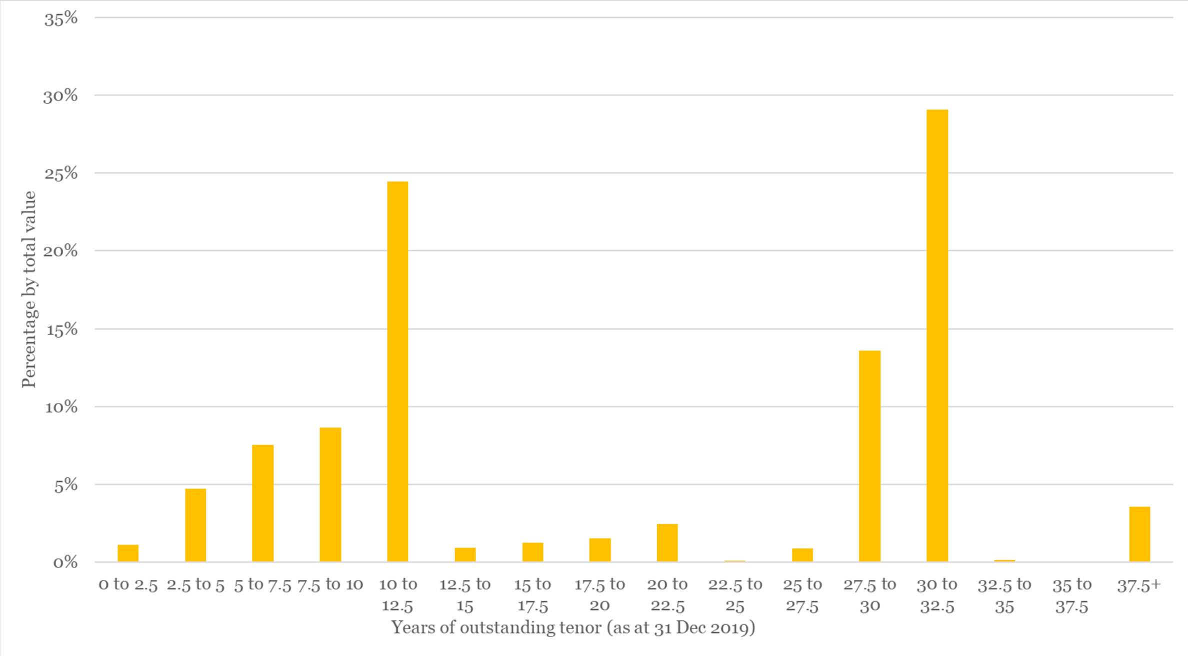
Table 2-1: Leverage anomaly vs tenor anomaly

	Leverage anomaly	Tenor anomaly
Problem	The sample average equity beta reflects the sample average **leverage** and its effect on the (unknown) sample average debt beta. Debt beta is important. Therefore, setting the **benchmark gearing** different to the sample average **gearing** would require an accurate estimate of the value of the debt beta (and how it changes with **leverage**) but this is not available.	The sample average equity beta reflects the sample average **debt tenor** and its effect on the (unknown) sample average debt beta. Therefore, setting the **benchmark debt tenor** different to the sample average **debt tenor** would require an accurate estimate of the value of the debt beta (and how it changes with **debt tenor**) but this is not available.
Solution	Set the **benchmark leverage** equal to the **sample average leverage** to avoid any adjustments that require an estimate of debt beta.	Set the **benchmark debt tenor** having regard to the **sample average debt tenor** to avoid any adjustments that require an estimate of debt beta.

26. The main difference between these two problem/solution sets is that adopting the sample average gearing for New Zealand is not viable. The market for very long dated New Zealand corporate debt is not sufficiently large for even actual or hypothetical large listed New Zealand EDBs to issue an average bond tenor of 20+ years.

27. In this context, it is worth noting that Vector is the only NZ business in the NZCC asset beta sample and it has the smallest average tenor (8.7 years) reported in Figure 2-1 above. In this context it is useful to present the data in Figure 2-1 as a histogram over all maturity profiles (i.e., combine all debts for all firms in the sample before reporting the distribution of those debts).

Figure 2-2: Histogram of all debts



Source: Bloomberg and CEG analysis

28. It can be seen that there are two poles of common debt issuance maturity – one at 10 years and one at 30 years. The 30 year maturity is not a realistic option for even a hypothetical large listed New Zealand EDB to issue a large proportion of their debt at. However, maintaining a 10 year average debt tenor is a realistic option for a hypothetical large listed New Zealand EDB.

29. This would also be consistent with the practice of regulators internationally. In the US and the UK regulators set the cost of debt with respect to the observed yields on 10+ year maturity debts. In Australia, being the most similar to New Zealand in terms of access to debt funding, the AER has estimated Australian EDBs have average debt tenor of between 8 and 11 years and concludes:[4]

> *Our decision is to maintain the benchmark return on debt term at 10 years. This aligns with the debt financing practices of regulated businesses to issue long term debt. Our analysis of industry debt data also does not show clear evidence that the current benchmark of 10 years is no longer an appropriate benchmark term, or that there is a materially better alternative.*

30. We note that the AER's estimate of the average tenor of debt is, if anything, biased downwards by excluding some long dated instruments (such as callable debts) and including some instruments that are better characterised as liquidity facilities rather than debt funding. In any event, its estimate of 8 to 11 years is broadly reflective of

4 AER, Draft Rate of Return Instrument Explanatory Statement, June 2022, p. 194.

actual practice. We also note that Australian EDBs often issue long term debt in USD (and other currencies) and swap the interest costs back into AUD. We would expect the same practice to be undertaken by the hypothetical benchmark large, listed NZ EDB.

2.1.1 Implementation of a 10 year tenor

31. If a 10-year tenor assumption was adopted then the TCSD allowance would no longer be needed. The NZCC would then have two options:

- Continue to assume that EDBs engage in an underlying swap strategy to reset the base rate of their debt portfolio to a 5 year rate at the beginning of each DPP. In this case it would need to:
  - Lengthen the number of observations for the DRP from 5 to 10 years into the past;
  - Re-estimate the DRP at 10 years rather than at 5 years;
  - Reconsider its assumed swap strategy to take into account that EDBs would need to now use a 10 year pay fixed/receive floating swap to convert a 10 year debt issue into a floating rate instrument.
- Adopt a trailing average approach to the cost of debt (as is the practice in Australian and internationally.

32. In either case it would be reasonable for the NZCC to consider and consult on imposing a transition arrangement.

33. In our view, the trailing average approach is to be preferred because it is simpler to hedge to and is more stable (which benefits both EDBs and customers).

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3 Term Credit Spread Differential

3.1 Overview

34. Term Credit Spread Differential (TCSD) refers to the increase in Debt Risk Premium (DRP) as the tenor of the bond increases. This parameter is used by the NZCC to capture the additional cost of network operators of holding bonds with tenor greater than 5 years.

35. The NZCC makes a TCSD adjustment to the allowed revenue for EDBs that have outstanding debt issued with an original tenor greater than the 5 year regulatory period.

36. In the 2016 IM final decision the NZCC reported an estimate of the TCSD of 4.5-6.0 bps using its own methodology. However, the NZCC also relied on CEG's estimate of 9.5-11.0 bps. The final decision chose a value in the middle of 7.5 bps.

37. The differences in our methods, as we understand them based on the NZCC's description, were relatively small. The most material difference is that we proposed to estimate the TCSD every month of the relevant historical period and then take an average of the monthly estimates. The NZCC determined that it would break the data up into 6 monthly periods rather than monthly periods. Otherwise, we understood that our methods were very similar.

3.1.1 Inability to replicate NZCC 2016 final decision.

38. In the process of preparing this report CEG attempted to replicate the NZCC's TCSD estimate of "4,5 to 6 bps" [5] from its final decision and are unable to do so. Subsequently, the ENA requested the data underlying Figure 31 from the NZCC final decision and was supplied with the NZCC's TCSD estimate for each of the NZCC's 6 monthly estimation windows (but not the underlying data/calculations for how that estimate was arrived at). [6]

39. We have also been unable to replicate those estimates. For example, following the methodology that the NZCC set out in its 2016 Topic Paper 4, we estimate an TCSD of 11 bps for second half of 2015, and NZCC estimate is only 4 bps.[7] While there is

5 See Paragraph 909 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

6 ENA_CEG_TCSD_Query (4502834.1).xlsx in email from Geoff Brooke to Keith Hutchinson 27 September 2022

7 ENA_CEG_TCSD_Query (4502834.1).xlsx in email from Geoff Brooke to Keith Hutchinson 27 September 2022

some uncertainty in the NZCC method, all the interpretations we that appear consistent with the NZCC description result in us estimating a TCSD of around 10bp.

40. We note that the NZCC did estimate a 6bp TCSD in their draft decision which we can replicate. However, the methodological changes agreed in the final decision[8] imply a materially higher TCSD.

3.1.2 Updated estimates

41. Our updated estimates to 2022 (using the NZCC description of its method and an updated sample of bonds) are very similar to our estimates in 2016 and our attempted replication of the NZCC method in 2016.

Table 3-1: Updated TCSD estimates*

	Excel software	R Software
Jan 2013 to June 2016	0.10%	0.11%
Jan 2013 to June 2022	0.09%	0.10%
Jan 2016 to June 2022	0.09%	0.10%
Jan 2018 to June 2022	0.10%	0.11%

* The use of NSS curve fitting applies an optimisation algorithm which can affect the result. We have tested the algorithms used within both R and Excel.

42. For completeness, we also report the result of aggregating monthly TCSD estimates which was the method we proposed in 2016 in response to the NZCC draft decision. The NZCC's response to that submission was to agree that the TCSD should be estimated as the average over multiple sub-periods rather than by pooling all data into a single period. but was to propose that 6 monthly estimates rather than monthly estimates be adopted.[9] However, in the final decision the NZCC concluded that 6 monthly estimates should be relied on because monthly estimates were prone to outliers in months with few data points.[10]

43. Table 3-2 compares the average of 6 monthly regression estimates of TCSD to the average of monthly regression estimates. In both cases we are using the last 6 years of data and using R software. It can be seen that the monthly average results in a higher estimate 0.16 vs 0.09 but that this is largely explained by two monthly

8 Para 902 to 908 of the 2016 Topic paper 4. The only way we can generate a TCSD closer to 6bp is if we include pre 2013 data – something that the NZCC explicitly agreed should not be done (see para 908 of Topic paper 4).

9 See Paragraph 902 of NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

10 See Paragraph 903 of NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

estimates of TCSD, between 2020 May and 2020 June, reached over 2%. Removing these two outliers results in similar estimates.

Table 3-2: Six versus one monthly TCSD estimates, R software

	6 monthly regression (NZCC)	Monthly regression (CEG)	Monthly regression (removing 2 outlier estimates)
Average TCSD from June 2016 July to 2022 June	0.091%	0.160%	0.094%

Source: Bloomberg, CEG analysis.

44. In our view, this analysis supports the Commission's decision to adopt a 6 monthly estimation period in preference to a monthly estimation period.

3.2 NZCC Methodology

3.2.1 Draft Decision

45. In NZCC's 2016 Input Methodology Draft Decision, the first step to determining the TCSD of Electricity Distribution Business is to calculate the DRP of a BBB+ 5 year bond. This is constructed using a sample of 17 BBB+ bonds issued by the following firms:[11]

- Genesis Energy,
- Mighty River Power,
- Vector,
- Meridian Energy, and
- Christchurch International Airport

46. To calculate the DRP of these bonds, the NZCC takes their yield estimates from Bloomberg and subtracts an estimate of the risk-free rate (interpolated from the yields on the nearest maturity NZ Government bonds).[12]

11 See NZCC Input Methodologies Review – Response to NSS data request, 27 July 2016

12 NZCC first estimates the risk-free rate for each of these bonds. This is achieved using the yields of NZ government bonds with the closest maturity before and after the maturity of each of these bonds. For example, to calculate risk-free rate for a bond maturing on September 15th 2016, the NZCC would first find the closest maturing government bond before September 15th 2016 and the closest maturing

47. The next stage is to estimate the DRP for a generic 5 year BBB+ bond. The estimation uses the sample of 17 bonds covering the periods January 2010 to March 2016. Bonds with maturity of less than 1 year are dropped.[13]

48. The estimation is achieved by regressing the DRP against tenor using a functional form known as Nelson-Siegel-Svensson (NSS). NSS is a very flexible function form allowing the yield curve to have a hump and trough in the yield curve structure. For example, it allows the DRP to increase, then decrease and then increase again as the tenor increases.

49. The estimated 5 year DRP in the draft decision is 1.69%.[14] This is a single estimate that is assumed to apply for the entire 6.25 year estimation period. (It was this aspect of the draft decision that CEG was most critical of. We argued that instead of estimating a single 5-year DRP for the whole period, the NZCC should break its estimation into a series of shorter periods and estimate separate 5-year DRPs and TCSDs for each of these periods.)

50. Once the 5 year DRP is calculated using the estimated parameters, the next step is to calculate the TCSD. This is done in the following steps

- exclude bonds with a tenor of less than 5 years.[15]
- calculate the differential in tenor and DRP for each of the remaining bonds relative to the previously estimated hypothetical 5 year BBB+ bond with 1.69% DRP.
- regress differential in DRP against the differential in tenor assuming a linear function form with zero intercept.

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government bond after September 15th 2016. This would be the NZ government bonds maturing on 15th April 2015 and 15th December 2017.

The next step is to calculate the risk-free rate. The risk free rate is calculated using a weighted average of the two government bonds with weight based on the differences between maturity dates. The NZ government bond with the closer maturity date will have the higher weight.

Using the daily yields of the government bonds, the daily risk-free rate with the same maturity as the BBB+ bonds is calculated. The difference between the daily yields of the BBB+ bonds and its associated daily risk-free rate is the DRP. The monthly average DRP of each BBB+ bond is calculated.

13 Paragraph 684 in NZCC Input Methodologies Review Draft Decisions – Topic paper 4 – Cost of Capital Issues, 16 June 2016

14 See NZCC Input Methodologies Review – Response to NSS data request, 27 July 2016

15 See NZCC Input-methodologies-Review-Draft-Decisions - Response-to-TCSD-data-requests,-15-July-2016

51. The estimated slope of the regression line is the TCSD and was 0.0559%(5.6bp) in the draft decision.[16]

3.2.2 NZCC adjustments in final decision

52. In NZCC's final determination, in response to comments by CEG[17], the NZCC removed bonds of firms that were 100% percent owned by the government.[18]

> *We also agree with CEG that the yields on bonds issued by companies with 100% government ownership appear to behave differently and have lower debt premiums than other equivalent bonds. Therefore, we have excluded bonds from the sample that were issued by 100% government-owned companies.*

53. The NZCC also agree that instead of estimating a single 5 year DRP and TCSD over the 6.25 year period from January 2010 to March 2016, NZCC adopted an alternative approach of estimating for every 6 months of data.[19]

> *We agree with CEG that there are some concerns with pooling across the whole sample. To account for these concerns, we have broken the full dataset into semi-annual periods to estimate spread premiums before calculating the average spread premium over the sample.*

54. In addition, NZCC estimation produced negative TCSDs in datasets prior to 2013, therefore it has focused its results from the period 2013 to 2016.[20]

> *We have focussed on the period from 2013-2016 due to some anomalously high debt premium's estimates prior to 2013 – leading to negative spread premium estimates on longer-term bonds.*

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16 Paragraph 734 in NZCC Input Methodologies Review Draft Decisions – Topic paper 4 – Cost of Capital Issues, 16 June 2016 and NZCC Input-methodologies-Review-Draft-Decisions - Response-to-TCSD-data-requests,-15-July-2016

17 CEG (report prepared for ENA) submission on IM review draft decisions papers "Review of the proposed TCSD calculations", 4th August 2016

18 Paragraph 904 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

19 Paragraph 902 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

20 See Paragraph 908 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

55. Based on these changes the NZCC final decision reported an estimated range of 4.5 to 6bps – similar or even lower than its draft decision estimate of 5.59 bps. However, the NZCC adopted a 7.5 bps estimate by giving some weight top CEG estimates.[21]

> *There is a common range between around 4.5 – 6 bps p.a. for the Commission estimates, and around 9.5 – 11 bps p.a. for the CEG slope. Giving a greater weight to the [sic] our estimates, we consider that a spread premium of 7.5 bps p.a. is a reasonable estimate.*

56. In Figure 31 of the final decision, NZCC produced two sets of estimates. One set of estimates is said to be based on NZCC's own estimate of 5 year semi-annual DRP and another set is based on what is claimed to be CEG's estimate of the 5 semi-annual year DRP.[22]

Figure 3-1: NZCC comparison of TCSD estimates

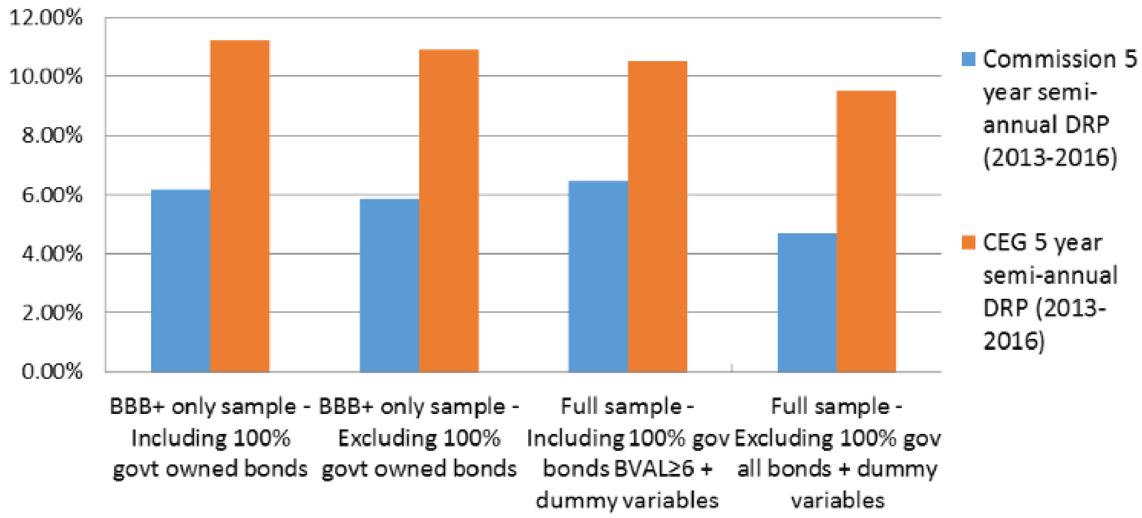

Figure 31: Comparison of spread premiums estimates using CEG and Commission estimates of the five-year debt premium. From NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016[23]. Note that we believe the vertical axis ought to be labelled as bps rather than %

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[21] See Paragraph 909 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

[22] See also paragraph 908 in NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016 which refers to "comparison between spread premium estimates using the Commission and CEG's five-year debt premium estimate in regard to four different samples".

[23] *Figure 31: Comparison of spread premiums estimates using CEG and Commission estimates of the five-year debt premium. From NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016*

57. However, there were no semi-annual 5 year DRP estimates in the CEG report.[24] The orange bars in the above figure are similar to the TCSD estimates we would derive when implementing what we understand to be the NZCC's method for estimating the TCSD. Under our understanding of the NZCC method:

- a 5 year DRP is estimated for each 6 month ("semi-annual") period (using the NSS curve); and
- a linear regression is fitted through this 5 year DRP value and the DRPs for the sample of bonds with maturity greater than 5 years in that 6 month period;
- the resulting slope is the TCSD for that period.

58. This is essentially the method from our report but applying that method over 6 monthly periods rather than over monthly periods. We should, therefore, get the same result so long as we are using the same sample (which appears to be being assumed in Figure 31). We do not understand what the methodology might be that gives rise to the blue bars in Figure 31 from the final decision.

3.2.3 Replication of final results

59. We asked the NZCC for the calculations underlying Figure 31 but were only provided with a hard-coded series 6 monthly estimates of the TCSD. We were not provided with the underlying calculations The table below presents those estimates for each semi-annual period in a NZCC response to our data request. The first and second columns of data in relate back to the first and second blue bars in Figure 31 from the final decision. The third and fourth columns of data relate to the first and second orange bars shown in the Figure 31 from the final decision.

24 CEG (report prepared for ENA) submission on IM review draft decisions papers "Review of the proposed TCSD calculations", 4th August 2016

Table 3-3: NZCC final decision TCSD estimates

	NZCC estimate based on NZCC 5 year DRP *BBB+ only sample; Including 100% govt owned bonds*	NZCC estimate based on NZCC 5 year DRP BBB+ only sample; excluding 100% govt owned bonds	NZCC estimate based on CEG 5 year DRP BBB+ only sample; Including 100% govt owned bonds	NZCC estimate based on CEG 5 year DRP BBB+ only sample; excluding 100% govt owned bonds
2013 Jan-Jun	0.01%	-0.02%	0.07%	0.07%
2013 Jul-Dec	0.04%	0.02%	0.09%	0.08%
2014 Jan-Jun	0.08%	0.03%	0.11%	0.10%
2014 Jul-Dec	0.06%	0.06%	0.10%	0.10%
2015 Jan-Jun	0.03%	0.04%	0.10%	0.10%
2015 Jul-Dec	0.04%	0.08%	0.13%	0.13%
2016 Jan-Mar	0.16%	0.13%	0.19%	0.19%
Average	0.06%	0.05%	0.11%	0.11%

ENA CEG TCSD Query (4502834.1).xlsx in email from Geoff Brooke to Keith Hutchinson 27 September 2022

60. In order to understand the large discrepancies in the estimated TCSDs between the two ranges, we have attempted to replicate the TCSD estimates produced by the NZCC.

61. We first attempt to replicate semi-annual NZCC's results which includes 100% government owned bonds because this approach has the least number of modifications from NZCC's draft decision. Then we attempt to replicate the set of results with 100% government owned bonds remove because this is the approach in which NZCC has accepted in its final decision to modify from the draft report.

62. The first column of Table 3-4 shows the TCSDs reported by the NZCC.[25] The remaining columns are replications estimated by CEG using the debt premium data provided by the NZCC in its draft decision information release.[26] The NZCC data is used to reduce the number of possible varying factors. The first set of results calculates the TCSD using bi-annual estimates of the 5 year DRP. The second set of results uses a single pooled estimate of the 5 year DRP (1.62%) using data from 2013 to 2016.[27]

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25 ENA_CEG_TCSD_Query (4502834.1).xlsx in email from Geoff Brooke to Keith Hutchinson 27 September 2022

26 NZCC Input Methodologies Review – Response to NSS data request, 27 July 2016

27 This is replicated by first calculating a 5 year DRP of 1.62% using all the data for the period from 2013 to 2016. Then we, in every 6 month period, place 1.62% it into cell M36 of the "Figure 23" sheet in the NZCC Input methodologies review draft decisions – Response to TCSD data requests – 15 July 2016.xlsx for each of the bi-annual periods.

Table 3-4: CEG replication of NZCC final decision (Incl 100% govt owned)

	NZCC estimate based on NZCC 5 year DRP	CEG replication of Bi-annual approach		Alternative replication assuming constant 5 year DRP	
	BBB+ only sample; Including 100% govt owned bonds	5 year DRP	TCSD	5 year DRP (2013-2016)	TCSD
2013 Jan-Jun	0.01%	1.85%	0.08%		0.15%
2013 Jul-Dec	0.04%	1.73%	0.08%		0.12%
2014 Jan-Jun	0.08%	1.75%	0.10%		0.14%
2014 Jul-Dec	0.06%	1.56%	0.09%	1.62%	0.07%
2015 Jan-Jun	0.03%	1.51%	0.09%		0.05%
2015 Jul-Dec	0.04%	1.48%	0.11%		0.04%
2016 Jan-Mar	0.16%	1.62%	0.17%		0.17%
Average	0.06%		0.10%		0.11%

CEG Analysis using data from NZCC

63. Table 3-5below shows the same comparison when bonds issued by 100% government owned firms are removed. This attempted replication has an even larger gap between our attempted replication and the estimates provided by the NZCC.

Table 3-5: CEG replication of NZCC final decision (Excl 100% govt owned)

	NZCC estimate based on NZCC 5 year DRP	CEG replication of Bi-annual approach		Alternative replication assuming constant 5 year DRP	
	BBB+ only sample; excluding 100% govt owned bonds	5 year DRP	TCSD	5 year DRP (2013-2016)	TCSD
2013 Jan-Jun	-0.02%	1.77%	0.12%		0.20%
2013 Jul-Dec	0.02%	1.74%	0.06%		0.12%
2014 Jan-Jun	0.03%	1.72%	0.09%		0.14%
2014 Jul-Dec	0.06%	1.56%	0.09%	1.58%	0.07%
2015 Jan-Jun	0.04%	1.51%	0.09%		0.05%
2015 Jul-Dec	0.08%	1.48%	0.11%		0.04%
2016 Jan-Mar	0.13%	1.62%	0.17%		0.17%
Average	0.05%		0.11%		0.11%

CEG Analysis using data from NZCC

64. In order to clearly illustrate our method, the following describes the modifications to the NZCC published spreadsheets[28] for the draft decision that we have used to attempt to replicate the NZCC's final decision. The description below describes the attempt to replicate the results for the second half of 2015. However, we've conducted the same replication for the other bi-annal periods.

65. First, we use the NZCC Input methodologies review – Response to NSS data requests – 27 July 2016.xlsx model to generate a 5 year NSS DRP for the 2nd half of CY2015 using the "NSS – BBB+ only" sheet by:

   a. Sorting the data by column E and D;

   b. Removing all data not from the 2nd half of CY2015 (There are 60 bonds remaining in the spreadsheet after removing the bonds from other periods. The number of bonds remaining for each bi-annual period is shown in Table 3-6); and

   c. For estimates with 100% government owned bonds removed, the data are sorted by column B and additional bonds are removed:

      i. Genesis 2014 June and prior

      ii. Mercury 2013 May and prior

      iii. Meridian 2013 October and prior

   d. Rerunning the Commission's solver function to generate NSS parameters in cells L6 to L13 that are specific to 2nd half of CY2015 and which generate the new 1.48% 2nd half of CY2015 5-year DRP found in cell H67. The starting parameters of the solver are the parameters estimated by the NZCC in its draft decision.

66. When we repeat this same process in all other half year periods from January 2015 (and one quarter year period to March 2016) we have the following bonds used in each of the NZCC spreadsheets.

28 NZCC Input Methodologies Review – Response to NSS data request, 27 July 2016 and NZCC Input-methodologies-Review-Draft-Decisions - Response-to-TCSD-data-requests,-15-July-2016

Table 3-6 Number of bonds in each bi-annual period in the NZCC spreadsheet

	Number of bonds in NSS spreadsheet		Number of bonds in TCSD spreadsheet	
	Incl 100% govt owned bonds	Excl 100% govt owned bonds	Incl 100% govt owned bonds	Excl 100% govt owned bonds
2013 Jan-Jun	68	12	38	9
2013 Jul-Dec	78	44	54	36
2014 Jan-Jun	84	54	56	38
2014 Jul-Dec	84	84	51	51
2015 Jan-Jun	76	76	36	36
2015 Jul-Dec	60	60	24	24
2016 Jan-Mar	31	31	13	13

CEG Analysis using data from NZCC

67. Returning to our 2nd half of CY2015 illustration, we the 1.48% 5 year DRP estimated value and input it into cell M36 of the "Figure 23" sheet in the NZCC Input methodologies review draft decisions – Response to TCSD data requests – 15 July 2016.xlsx. We then apply the same steps from 65.a and 65.b above to remove all data not from the 2nd half of CY2015.

68. This leaves us with a slope value in cell M38 of the "Figure 23" sheet of 11 bps per year of maturity above 5 years. This contrasts with the corresponding 4bps value in the spreadsheet provided by NZCC in the information request.[29] We note that the estimate of 11bp using the above NZCC models is similar to the 13 bps NZCC estimated based on CEG debt premium estimates.

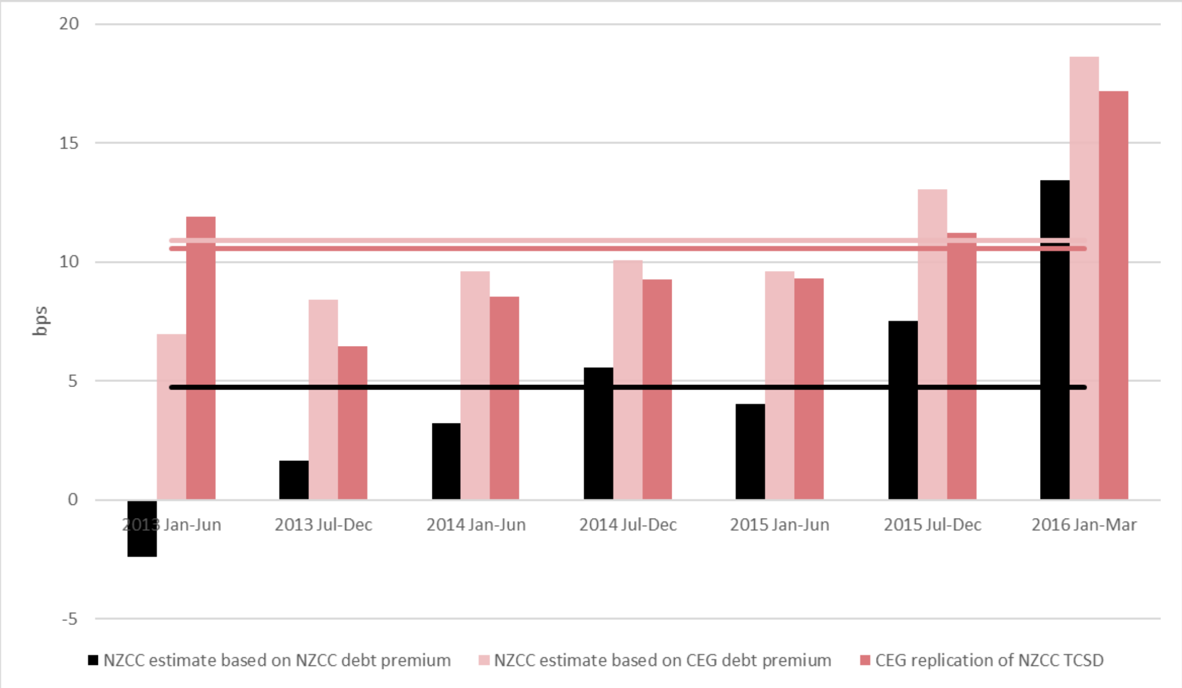
69. The results in Table 3-5 are shown graphically in the Figure 3-2 below. Figure 3-2 shows the 6 monthly NZCC TCSD estimates

- **Black bars**: that the NZCC describes as using its 5-year DRP in the 2016 final decision (sourced data provided to us following the ENA data request in this process);
- **Light pink bars**: that the NZCC describes as using CEG's 5-year DRP in the 2016 final decision (sourced data provided to us following the ENA data request in this process); and
- **Dark pink bars**: that are our attempted replication (using the method described above) of these results.

[29] cell C11 of the "Semi-annual slope results" sheet in ENA_CEG_TCSD_Query (4502834.1).xlsx in email from Geoff Brooke to Keith Hutchinson 27 September 2022. This value can also be seen in the 2015 Jan-Jun row of Table 3-4.

70. The horizontal lines are the averages for each of the three sets of results with the relevant colours matched. .

Figure 3-2: Replication comparison against estimates in final decision (BBB+ only, excl 100% govt owned bonds)



CEG Analysis using data from NZCC

3.3 Updated TCSD result to 2022

71. In this subsection, we update the TCSD results based on recent data and our best understanding of the NZCC stated methodology (noting that this fails to replicate NZCC estimates)

72. In the 2016 determination, the bond with the latest maturity is due to mature in March 2023. Therefore, the 2016 sample of bonds is no longer capable of calculating a TCSD in recent years given a tenor of 5 year is required to form the sample to calculate the TCSD. We update the sample based on the criteria set out previously by the NZCC. This results in a sample that includes all the bonds the NZCC identified in its August 2022 cost of capital update.[30]

73. However, the August 2022 update did not include a number of recently issued bonds. As a result, the three longest dated bonds in the August 2022 update sample had only

30 NZCC Cost of capital determination for disclosure year 2023 for information disclosure regulation

one bond with a maturity greater than 5 years as at June 2022. The three longest dated bonds were:

- MCYNZ 1.56 14/09/27,
- MCYNZ 2.16 29/09/26, and
- CHRINT 5.53 05/04/27

74. For our analysis we have included a number of additional bonds and, most importantly for the analysis, three additional bonds maturing in 2028 (2 from Genesis and 1 from Christchurch International Airport) and one additional bond maturing in 2030 (Mercury). The longer tenor of these bonds provides a more robust estimate of how DRP increases with tenor when the tenor is beyond 5 years.

Table 3-7: List of additional BBB+ bonds

Additional BBB+ bonds	Issue Date
GENEPO 4.17 03/14/28	14/03/2022
CHRINT 5.18 05/19/28	19/05/2022
MCYNZ 1.917 10/09/30	9/10/2020
GENEPO 1.32 07/20/22	20/07/2020
GENEPO 3.65 12/20/28	20/12/2021

75. It can be seen that with the expanded sample the estimated TCSD is relatively stable but with the sample from the NZCC's August 2022 disclosure year 2023 cost of capital update the estimated TCSD is very unstable (consistent with having very few bonds more than 5 year maturity).

Table 3-8: TCSD estimation based on NZCC stated method

	Excel software		R Software	
Estimation window	**NZCC (incomplete) August 2022 sample**	**CEG expanded sample**	**NZCC (incomplete) August 2022 sample**	**CEG expanded sample**
2010 1st Half	0.067%	0.067%	0.0347%	0.0347%
2010 2nd Half	0.052%	0.052%	0.0192%	0.0192%
2011 1st Half	-0.054%	-0.054%	-0.0552%	-0.0552%
2011 2nd Half	-0.025%	-0.025%	-0.0407%	-0.0407%
2012 1st Half	0.035%	0.035%	0.0089%	0.0089%
2012 2nd Half	0.135%	0.135%	0.1645%	0.1645%
2013 1st Half	0.064%	0.064%	0.0961%	0.0961%
2013 2nd Half	0.087%	0.087%	0.0777%	0.0777%
2014 1st Half	0.102%	0.102%	0.1131%	0.1131%
2014 2nd Half	0.096%	0.096%	0.0920%	0.0920%
2015 1st Half	0.091%	0.091%	0.0878%	0.0878%
2015 2nd Half	0.121%	0.121%	0.1146%	0.1146%
2016 1st Half	0.141%	0.144%	0.1574%	0.1610%
2016 2nd Half	0.077%	0.077%	0.0746%	0.0735%
2017 1st Half	0.066%	0.067%	0.0626%	0.0670%
2017 2nd Half	0.050%	0.049%	0.0547%	0.0456%
2018 1st Half	0.060%	0.060%	0.0560%	0.0589%
2018 2nd Half	0.107%	0.110%	0.1045%	0.1088%
2019 1st Half	0.106%	0.111%	0.0931%	0.1059%
2019 2nd Half	0.083%	0.100%	0.1299%	0.1337%
2020 1st Half	0.238%	0.204%	0.2255%	0.2131%
2020 2nd Half	0.192%	0.042%	0.1664%	0.0382%
2021 1st Half	0.025%	0.052%	-0.0249%	0.0514%
2021 2nd Half	0.009%	0.097%	-0.0387%	0.0934%
2022 1st Half	-0.139%	0.112%	-0.1426%	0.1065%
Average of last 6 years	**0.073%**	**0090%**	**0.063%**	**0.091%**

Source: Bloomberg, CEG analysis

76. In our view, sole focus should be given to the "CEG expanded sample".

77. Our updated estimates to 2022 (using the NZCC description of its method and an updated sample of bonds) are very similar to our estimates in 2016 and our attempted replication of the NZCC method in 2016.

Table 3-9: Updated TCSD estimates*

	Excel software	R Software
Jan 2013 to June 2016	0.10%	0.11%
Jan 2013 to June 2022	0.09%	0.10%
Jan 2016 to June 2022	0.09%	0.10%
Jan 2018 to June 2022	0.10%	0.11%

* The use of NSS curve fitting applies an optimisation algorithm which can affect the result. We have tested the algorithms used within both R and Excel.

78. For completeness, we also report the result of aggregating monthly TCSD estimates which was the method we proposed in 2016 in response to the NZCC draft decision. The NZCC's response to that submission was to agree that the TCSD should be estimated as the average over multiple sub-periods rather than by pooling all data into a single period. but was to propose that 6 monthly estimates rather than monthly estimates be adopted.[31] However, in the final decision the NZCC concluded that 6 monthly estimates should be relied on because monthly estimates were prone to outliers in months with few data points.[32]

79. Table 3-2 compares the average of 6 monthly regression estimates of TCSD to the average of monthly regression estimates. In both cases we are using the last 6 years of data and using R software. It can be seen that the monthly average results in a higher estimate 0.16 vs 0.09 but that this is largely explained by two monthly estimates of TCSD, between 2020 May and 2020 June, reached over 2%. Removing these two outliers results in similar estimates.

Table 3-10: Six versus one monthly TCSD estimates, R software

	6 monthly regression	Monthly regression	Monthly regression (removing 2 outlier estimates)
Average TCSD from June 2016 July to 2022 June	0.091%	0.160%	0.094%

Source: Bloomberg, CEG analysis.

80. In our view, this analysis supports the Commission's decision to adopt a 6 monthly estimation period in preference to a monthly estimation period.

31 See Paragraph 902 of NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

32 See Paragraph 903 of NZCC Input Methodologies Review Decisions – Topic paper 4 – Cost of Capital Issues, 20 December 2016

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4 CPI forecasting and RAB indexation

81. At high level, there are two issues associated with the treatment of inflation in a regulatory model:

- To what extent should the model target a real versus a nominal return; and
- To the extent that the model targets a real return, and assuming the regulator starts with an estimate of returns based on observed returns on nominal bonds, how should expected inflation be estimated (i.e., what inflation value should be removed from those nominal returns to arrive at an estimate of real returns?

4.1 The mechanics of targeting a real vs nominal return

82. By way of example, if the prevailing cost of debt is 5% in nominal terms at the beginning of a DPP and a business borrows (enters into interest rate swap contracts) at this rate then the business is bound to pay its lenders (counterparties) 5%. However, the current IMs do not provide a 5% return in cash-flows. Rather the current IMs provide:

- a 5-X% return in cash-flows - where "X"% is the Commission's forecast of inflation; plus
- a "Y"% indexation of the RAB at the time of the next DPP – where "Y"% is actual inflation.

83. The business will consequently receive actual nominal compensation that is equal to 5% plus Y%-X% - where Y%-X% is the Commission's inflation forecast error. For example, if inflation is forecast to be 2%, but is actually 0%, then the business will only receive a nominal return of 3% - despite having nominal contracts that require it to pay 5%.

84. This inflation forecast error can be eliminated by simply setting both X and Y to be equal to zero. That is, removing revaluations for the RAB in both the Commission's financial model and the RAB roll forward. However, this is not the only way to remove inflation forecast error. So long as the rate of revaluation provided in the RAB roll-forward is the same as that assumed in the Commission's financial model inflation forecasting will be removed.

85. We consider that removing inflation forecasting error is unambiguously the correct approach for that portion of the RAB which is debt funded - assuming that businesses fund themselves with nominal debt. In addition, funding with nominal debt appears to be the standard practice of businesses and, therefore, can be assumed to be efficient. On this basis, we recommend that inflation forecast error should be removed from the RAB.

86. We also note that the case for eliminating inflation forecast error is more ambiguous for that portion of the RAB that is equity funded. Equity contracts do not promise either a real or a nominal return and, consequently, do not provide guidance as to what the regulatory policy should be.

4.2 The 2016 IM position

4.2.1 Targeting a real versus nominal return

87. In the 2016 IM the NZCC determined that it should target real returns for EDBs and GPBs (but nominal returns for Transpower). The reason for the different treatment of EDBs/GPBs vis-à-vis Transpower appeared to come down largely to a preference for the *status quo*. EDBs/GPBs (Transpower) were already regulated under a regime that targeted a real (nominal) return and the NZCC did not consider the potential benefits of a change outweighed the costs, including transaction costs, of a change in regime.

88. When explaining its decision not to apply the EDB/GPB regime to Transpower the NZCC stated:

> *Following submissions we decided not to introduce the annual capital charge adjustment. This is because we consider it would be an additional complication that is unlikely to result in significant benefits to suppliers or consumers in the current low inflation environment.*

89. When describing why the NZCC would not target a nominal return on debt for EDBs/GPBs (even though EDBs/GPBs cost of debt is incurred in nominal terms) the NZCC stated (emphasis added):

> *257. Our approach also exposes equity holders to some risk that they will not achieve a real return when inflation outcomes are different to forecast and the supplier has issued debt in fixed nominal terms. This is true even if our inflation forecast and the forecast inherent in the WACC are aligned. However, we consider that:*
>
> *257.1* ***over the long-term this risk is small*** *and will wash out over time if the forecast of inflation is unbiased; and*
>
> *257.2 the risk does not expose* [sic] *affect equity and debt holders collectively (ie, the total return to all capital is an ex-post real return) and suppliers can potentially manage any inflation risk to some extent through their debt-financing practices.*

And

298. An alternative potential option put forward by CEG (on behalf of the ENA) would be to apply a 'weighted average approach' in which the compensation for the cost of equity would be based on a real return and compensation for the cost of debt would be based on a nominal return.188

299. This approach has some attraction in that it reduces the potential for equity holders not to achieve a real return. However, we have not been convinced to introduce the weighted average approach because we consider:

*299.1 **It adds complexity to the overall approach both conceptually and in practice which is not justified by the existence of significant problems with the existing methodology**.*

*299.2 We consider that pricing that remains constant in real terms over time is consistent with allocative efficiency in workably competitive markets. A change in our approach which provides compensation for debt fixed in nominal terms **would transfer inflation risk from suppliers to consumers**. However, because debt-financing practice is in the control of suppliers we consider that it is most appropriate for suppliers to bear this risk, and be incentivised to undertake efficient financing arrangements.*

4.2.2 Estimating expected inflation

90. The 2016 IM determined that expected inflation should be estimated by using the RBNZ CPI forecast produced at the time closest to the determination window used to estimate the risk-free rate and then trend to the mid-point of the RBNZ inflation target by the end of year 5.

91. The NZCC decided that it would not give weight to measures of expected inflation derived from the difference in yields between nominal and inflation indexed NZ government bonds on the grounds that:

there are a number of issues which mean that this does not necessarily provide a more appropriate estimate of inflation than the RBNZ forecasts. For example:

294.1 The shortest dated NZ government inflation-linked bond matures in 2025. Therefore any implied inflation would be an average over the period until the bond matures and would not necessarily correspond to the five-year regulatory period;

294.2 Yields on nominal government bonds can include a premium for bearing inflation risk which can distort the implied inflation forecast; and

294.3 Yields on CPI-indexed government bonds can include a liquidity premium, given the relative scarcity of this type of bonds. This can distort the implied inflation forecast.

4.3 Evidence since 2016 relevant to the NZCC decisions

92. In this section we examine evidence on the magnitude of inflation forecast error since 2016. This evidence shows larger inflation forecast errors since 2016 than pre-2016. The NZCC may wish to recalibrate its assessment that the existing methodology creates only "small" inflation forecast risks. We also critique the belief expressed in the above quote that targeting a nominal cost of debt transfers inflation risk from suppliers to consumers.

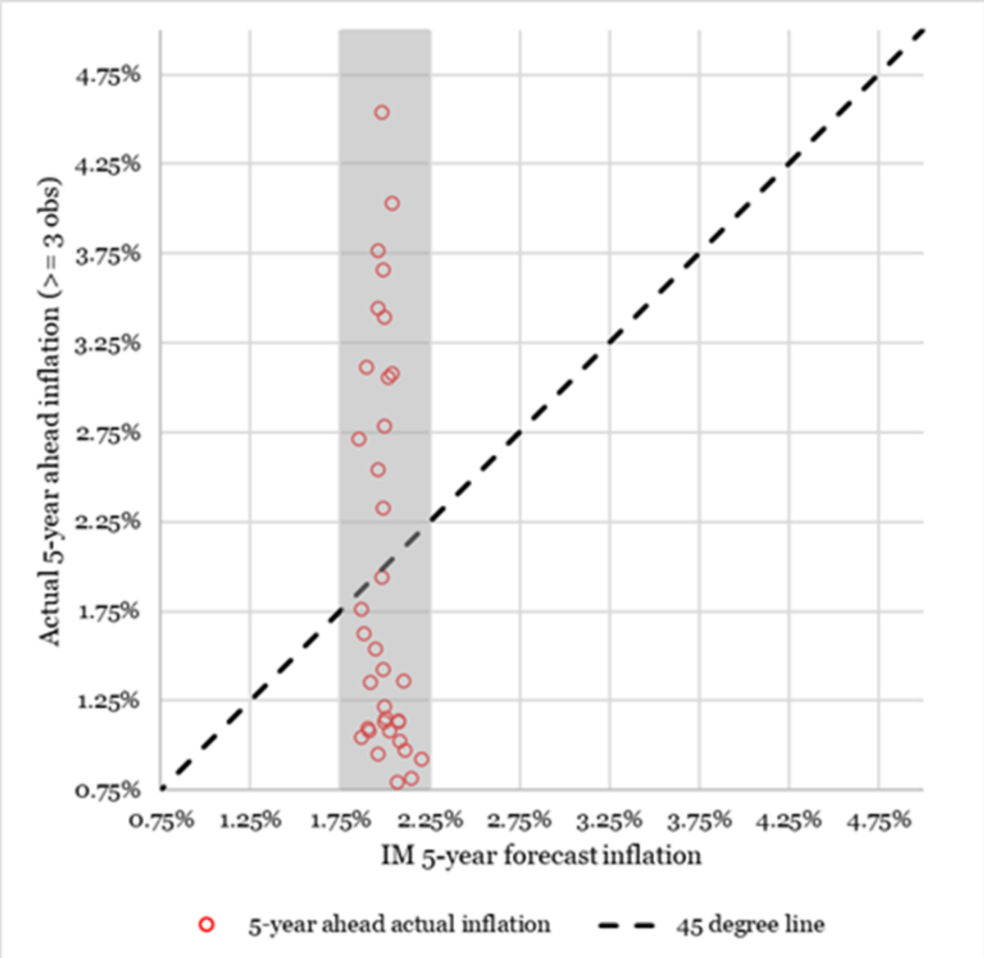
4.3.1 Accuracy of the NZCC inflation forecast method

93. In the 2016 IM process the NZCC expressed the view that inflation forecasting error was relatively small and would tend to "wash out" if it was unbiased. However, recent experienced tends not to support such a conclusion. In summary, the NZCC five year inflation forecasts have:

- Either
  - wildly overestimated actual inflation; or
  - wildly underestimated actual inflation; but
- almost never accurately estimated actual inflation.

94. This is illustrated in Figure 4-1 below. This figure shows the NZCC's 5 year forecast inflation on the horizontal axis and actual 5 year inflation (over the same forecast period) on the vertical axis. If forecast inflation was accurate then the "red dots" would be spread up and down the dotted 45 degree line.

Figure 4-1: NZCC forecast vs actual 5 year inflation since 2010

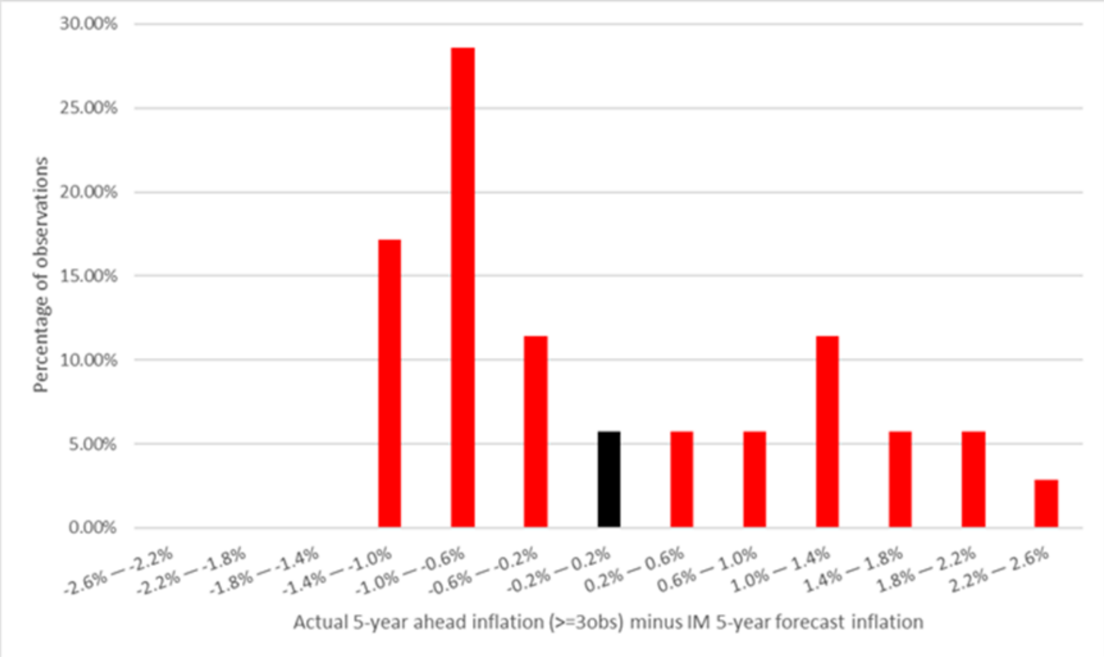


Source: NZCC forecast methodology, RBNZ quarterly inflation forecasts, CEG analysis.

95. It can be seen that the NZCC 5 year forecast is universally (100%) within a narrow band of 1.75% to 2.25%. By contrast, actual inflation is only twice (5.6%) within that narrow band and, instead, is spread relatively evenly from 0.75% to 4.75%.

96. Consistent with this, a histogram of forecast errors shows that not only is the distribution not bell shaped, it is, if anything, more heavily weighted to the extremes. This histogram is provided in Figure 4-2 below.

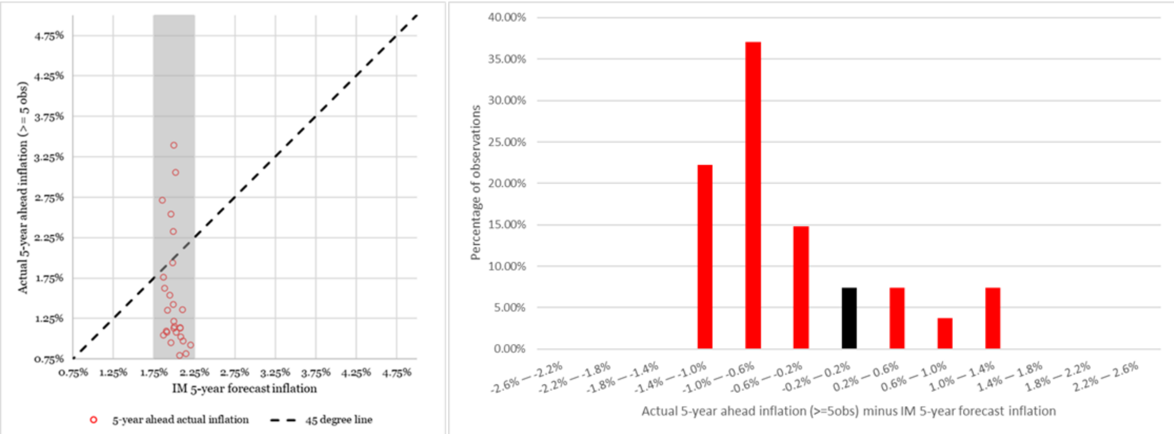
Figure 4-2: Histogram of forecast errors



Source: NZCC forecast methodology, RBNZ quarterly inflation forecasts, CEG analysis.

97. The latest actual inflation is to June 2022. In the above analysis we require that at least 3 years of actual inflation be available – which means our forecasts stop at June 2019. For forecasts made between June 2017 and June 2019 we assume that actual inflation beyond June 2022 will match the latest (August 2022) RBNZ forecast. However, a very similar outcome results when we require that 100% of actual inflation must be available (which means all forecasts stop in June 2017). This can be seen in

Figure 4-3: Figure 4-1 and Figure 4-2 with forecasts stopping in 2017



Source: NZCC forecast methodology, RBNZ quarterly inflation forecasts, CEG analysis.

98. The experience of actual inflation since 2016 is clearly inconsistent with any view that inflation forecast error is likely to be small – which was the NZCC view in 2016.

99. We now turn to the NZCC's 2016 IM view that forecast errors "will wash out over time" provided that the forecast of inflation is unbiased. In what follows we focus on the fact when the NZCC over-estimates inflation this means that customers end up undercompensating EDBs for their nominal debt costs and *vice versa*. That is, when we talk about "under" and "over" compensation for costs we are focussed on the cost of debt – which all parties agree is efficiently incurred in nominal terms.

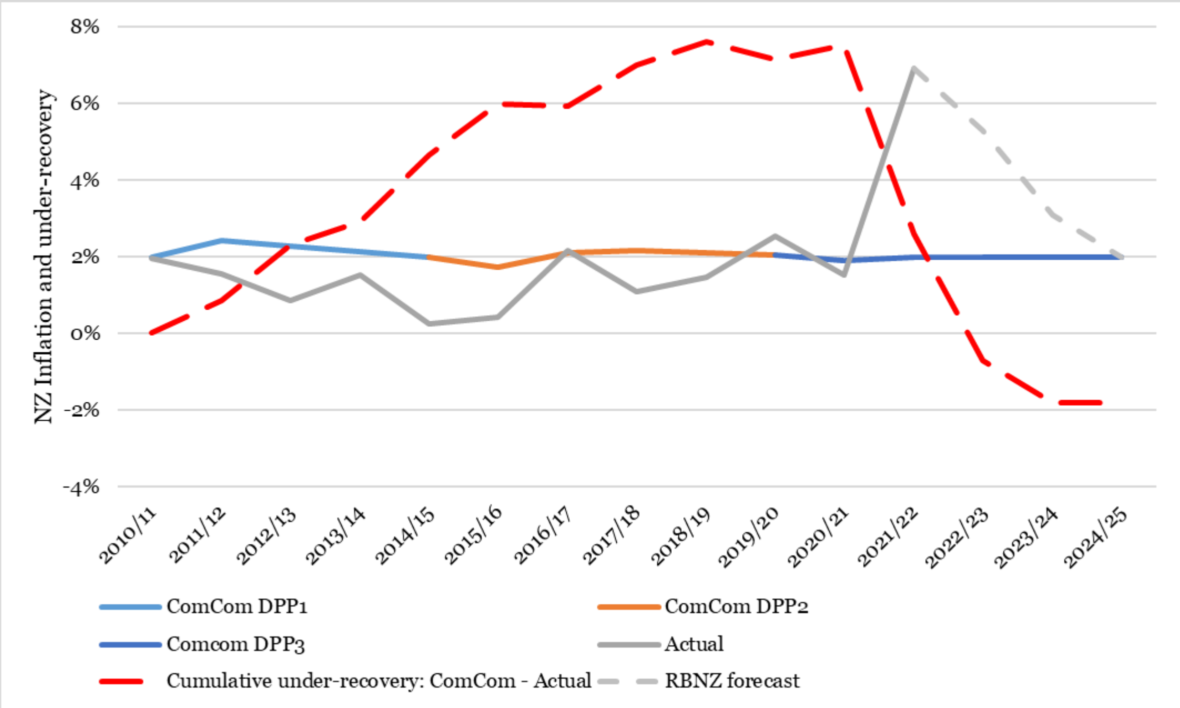
100. First, the statement that forecast errors "wash out" in the long run can only ever be true the period of "time" being referred to is the very long run. This is because the NZCC only makes one forecast every 5 years. Thus, after 50 years there will only be 10 sets of forecasts to average over. Even if the NZCC forecast is unbiased with no autocorrelation with previous forecast errors, it will still take many decades before the law of large numbers takes effect and one can confidently talk about errors "washing out". For many customers/investors this would not be expected to occur over their remaining life/investment horizon.

101. As it happens, when looked at over the last 15 years from 2010 to 2025 (DPP1 to DPP3) there has been an approximate "wash out" with:

- very large cumulative under-recovery of inflation for EDBs (over-recovery for customers) over the 10 years to 2020-21 has been almost fully offset by:
- a single year of very high over-recovery of inflation for EDBs (under-recovery for customers) in 2021-22; and
- current forecasts until the end of DPP3 in 2024-25 imply more material over-recovery for EDBs such that over 15 years they can expect to have substantially over-recovered actual inflation (without adjusting for discounting or changes in RAB).

102. This can be seen in Figure 4-4 below.

Figure 4-4: Cumulative forecast error over DPP1 to DPP3



Source, RBNZ, NZCC and CEG analysis

103. Figure 4-4 shows forecast CPI used by the NZCC (colour coded by DPP) and actual inflation (grey line) extended out to 2024-25 by the current RBNZ forecasts (4.5% to June 2023, 2.64% to June 2024 and 1.93% to June 2025). The dotted red line is the sum of the difference between NZCC forecasts and actual CPI over past years. (Geometrically, the height of the dotted red line is the area between the NZCC forecast and actual inflation series over past years).

104. The path of the dotted red line illustrates how easy it can be for forecast errors to accumulate over time. Over the 10 years to 2020/21 the cumulative forecast error was over 7% (implying that debt costs during that period went uncompensated by over 7% of the debt portion of the RAB). As it happens this period is likely to be followed by massive overcompensation for debt costs in DPP3 which is expected to more than fully reverse the previous 10 years forecast errors.

105. However, rather than providing comfort that the current regime can be assumed to inevitably result in forecast errors “washing out” the opposite lesson can be drawn. If DPP3 looked more like DPP2 and DPP1 (which could easily have occurred if the forecasts are unbiased) then cumulative under-compensation would be over 10%. If DPP4 and DPP5 look like DPP3 then customers will overcompensate EDBs by more than 20% of the debt portion of the RAB.

4.3.2 The current regime does not protect customers from inflation risk

106. If there was a good economic reason for exposing customers and EDBs to this risk then that would be one thing. However, other than preserving the *status quo*, there is no good reason for exposing customers and EDBs to inflation forecasting error on the cost of debt. That is, there is no reason to target a real return on debt when it is universally agreed that debt is efficiently incurred as a nominal cost.

107. As noted above, in the 2016 IMs the NZCC did proffer one reason (apart from *status quo* bias) for why the regulatory regime should target a real return on debt. This was that targeting a nominal cost of debt woul*d "would transfer inflation risk from suppliers to consumers".*

108. We do not consider that this is correct. The only economically correct conclusion is that targeting a nominal cost of debt eliminates risk that is otherwise borne by both consumers and EDBs. That is, targeting a real cost of debt when debt costs are not incurred in real terms creates risk for all stakeholders – where risk is defined in terms of whether customers pay (EDBs receive) an amount different to efficiently incurred costs.

109. Over, DPP3 customers are expected to over-compensate EDBs by almost 10% of the debt portion of the RAB. Moreover, this is occurring when (and precisely because) their daily expenses are running at a much higher rate than previously expected. It is difficult to understand how such a regime is protecting customers from "inflation risk".

110. In truth, the current treatment of debt costs is creating inflation risk for both EDBs and customers. Changing the regime from targeting real to nominal debt costs would eliminate this risk for both parties (not transfer it from one to the other).

111. This is no different from if the NZCC set regulatory revenues in USD rather than in NZD. This would create currency risk for EDBs and customers. Changing the regulatory regime to target NZD costs instead of USD would not "transfer" currency risk from suppliers to consumers – it would eliminate currency risk for all stakeholders. That is, it would eliminate an artificially created currency risk – one that only existed because the regulatory regime incorrectly targeted compensation in a form that was not tied to efficient costs.

4.4 Correct measure of forecast inflation

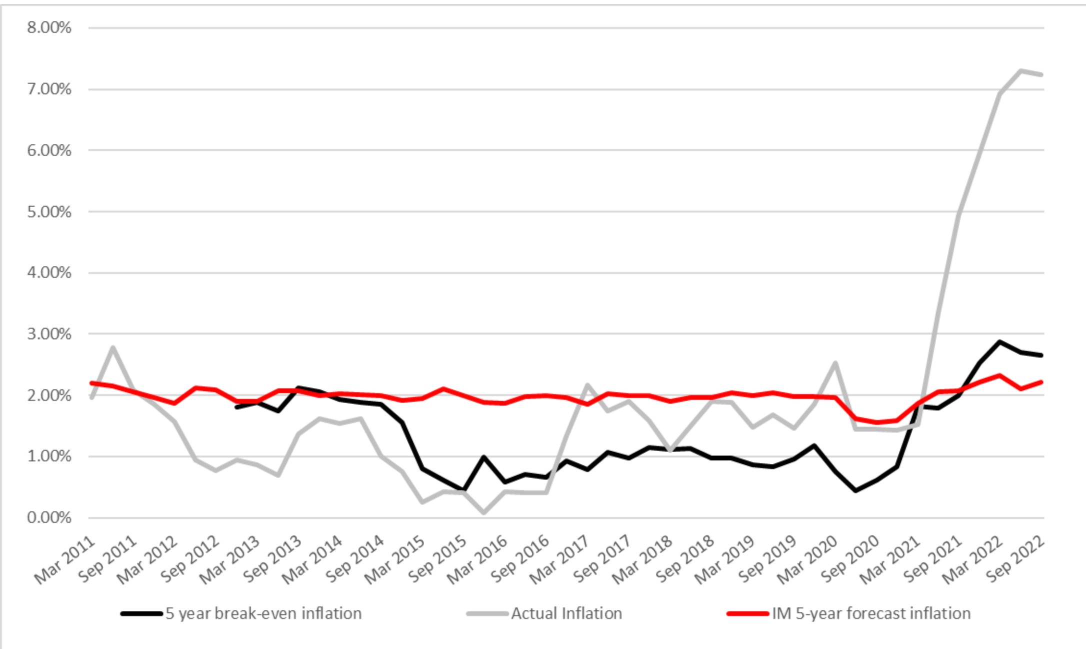
112. The assumption in the IMs that inflation will return to the midpoint of the RBNZs target range over the short term is at odds with the evidence surveyed above. Since the global financial crisis, actual inflation in developed countries have been below central bank targets until the post Covid period when it has been materially above target.

113. Market-based estimates of expected inflation derived from the difference between the yield on nominal and inflation indexed debt issued by the New Zealand Government provide an alternative to the NZCC mechanically assuming inflation always is expected to trend to 2% beyond the RBNZ forecast period. .

114. This difference is a measure of investors' inflation expectations because, if investors believed that inflation would be higher/lower than this difference, they would rationally sell/buy nominal debt and buy/sell inflation indexed debt. For this reason, the difference between nominal and CPI indexed debt is known as the 'break even' inflation rate - the rate at which there is no difference between a strategy of holding nominal as opposed to CPI indexed debt.

115. Pre Covid, 5-year break-even inflation rates were well below the mid-point of central bank target ranges globally, and New Zealand was no exception. This was a more accurate predictor of actual inflation which was also below the midpoint of central bank targets. Post Covid, 5-year break-even inflation responded more aggressively to the high inflation outbreak than did the NZCC method for forecasting 5 year inflation and now sits above the forecast from the NZCC method. This is illustrated in Figure 4-5 below.

Figure 4-5: Break even inflation vs midpoint of RBNZ target range



Source: RBNZ hb2 daily publication, CEG analysis.

116. This evidence is not conclusive because, ultimately, we do not know what inflation expectations investors have (and nor do we know what actual inflation will be over the next 5 years). However, it is at least *prima facie* evidence that some weight should be given to break-even inflation (noting that an average to the two series would more accurately have predicted pre Covid inflation than either series alone).

117. In the 2016 IM's the NZCC argued that:

> *294.1 The shortest dated NZ government inflation-linked bond matures in 2025. Therefore any implied inflation would be an average over the period until the bond matures and would not necessarily correspond to the five-year regulatory period;*

118. However, there is currently four inflation indexed NZ government bonds (maturing in 2030, 2035 and 2045). This means that in 2025, at the time of the DPP4 reset, there will be an approximately 5 year maturity bond as will be the case at the DPP5 reset. The above argument against giving any weight to breakeven inflation falls away.

119. The NZCC has also argued that breakeven inflation might be biased by other factors (such an illiquidity premium in inflation indexed bonds and an inflation premium in nominal bonds). This may be true but there is no theoretical reason to believe that the net effect of these results in a material net expected bias (noting that the former would increase indexed yields and the latter would increase nominal yields).

5 Amortisation of issuance costs

120. We consider that the NZCC has made an error which lowers compensation for debt transaction costs by around 0.5bp (assuming a 5 year tenor and a 5% discount rate).

121. While minor, the 2016 IM final decision made what is, effectively, a mathematical error which should be simple to clarify and correct. In the final Topic 4 paper the NZCC states:

> *Amortisation of upfront costs*
>
> *CEG submitted that upfront debt costs need to be amortised over time using a cost 241.of capital to take into account the time value of money.*
>
> *We disagree with this conclusion because suppliers typically issue some debt each year to manage refinancing risk. They therefore incur some debt issuance costs each year. Assuming that firms issue a consistent amount each year with similar costs, there is no need for a present value adjustment in respect of a portfolio of debt.*

122. In this passage the NZCC's correctly noting that:

- a firm operating a trailing average debt 5-year tenor strategy will refinance 20% of total debt each year;
- every year it will incur 20% of the total transaction costs associated with raising its entire debt RAB; and
- if the NZCC simply provides an ongoing annual allowance for 20% of the total transaction costs associated with raising its entire debt RAB then the allowance will fully cover ongoing debt issuance costs.

123. This is mathematically correct (assuming a constant value for the RAB). However, it does not follow that this means no NPV adjustment is required. If the NZCC were correct it would imply that in a competitive market there is no need for a firm to earn a return on its investment in inventory (no holding cost of inventory).

124. To see why, imagine a firm that is importing $1m of product every year and selling it with an average one year lag. In effect, in every year the firm is selling stock imported the previous year and then replenishing those sales with new imports.

125. The Commissions logic would imply that, so long as that firm's price is covering its costs of importing the product in that year it is being fully compensated. This is clearly wrong; the firm needs to recover its costs of importing in the previous year *plus* the time value of money (and any other holding costs) over the time since it imported the stock it is selling.

126. In our context, we can think of the entire debt RAB as the inventory of debt that is being used up (maturing) and replenished (refinanced) at a rate of 20% per year. The NZCC's proposal to only compensate for the costs of new debt as it is incurred amounts to, in effect, refusing compensate for the costs of prior building and holding of that debt inventory.

127. Put another way, it amounts to taking the money allocated to compensate for past costs and using it to fund current costs. It is true that this will "adequately" compensate for current costs but it does so by leaving past costs completely uncompensated. That is, if the NZCC hypothecates each year's total debt issuance compensation to the debt that has just been raised in that year (being one fifth of the RAB) then that leaves the other four fifths of the RAB uncompensated. That is, at any given time there is an "inventory" of old debt raising costs that is uncompensated.

6 Equity Raising Cost

128. Equity raising costs are transaction costs incurred when EDBs fund capital investment through equity. According to the AER when it first applied equity raising cost in 2009:[33]

> *In raising new equity capital a business may incur costs such as legal fees, brokerage fees, marketing costs and other transaction costs. These are upfront expenses, with little or no ongoing costs over the life of the equity. Whilst the size of the equity a firm will raise is typically at its inception, there may be points in the life of a firm—for example, during capital expansions—where it chooses additional external equity funding (instead of debt or internal funding) as a source of equity capital, and accordingly may incur equity raising costs.*
>
> *The AER has accepted that equity raising costs are a legitimate cost for a benchmark efficient firm only where external equity funding is the least–cost option available.*

129. CEG has implemented an equity raising cost model based on the AER's current approach[34] to equity raising costs within the context of the NZCC financial model. The AER's current approach was formulated as part of its own revenue model to provide transparency and consistency.[35]

130. If applied in the current DPP period we estimate the following equity raising costs would have been estimated.

Table 6-1: Equity raising costs associated with AER method aggregated over 2021-2025 ($thousands, real 2019/20)

	Aurora	Orion	Unison	Vector	Wellington
Total Equity Raising Cost	628	1,141	402	2,003	126

Powerco not available due to lack of data on Powerco capex in the NZCC financial model.

131. In order to fund its capital expenditure, the first option for an EDB is to fund the equity portion of RAB growth utilising retained earnings but with increases in

33 AER TransGrid transmission determination 2009-10 to 2013-14, Final decision 28 April 2009

34 Page 90 in AER, "Electricity Distribution Network Service Provider – Post-Tax Revenue Model, Version 4, April 2019

35 Page 5 in AER, "Electricity transmission network service providers, Post-tax revenue model - Amendment - Final Decision," December 2010

retained earnings constrained by the need to maintain a minimum rate of dividend payout to shareholders (assumed by the AER to be 63% of taxable profit).

132. This source of funding is assumed to be costless by the AER. However, if this source of equity raising is exhausted, the EDB has the option of either:

- seeking reinvestment of dividends from its existing equity holders using a "dividend reinvestment program" often referred to as a DRP. The AER assumes that up to 30% of dividend is available for reinvestment and that the cost of this option is 1% of the size of the amount reinvested ("Dividend Reduction").
- seek new equity investors via what is known as a "seasoned equity offer" (or "SEO" - which simply distinguishes equity raising for an existing listed firm from the initial public offering for a newly listed firm). The AER assumes that the cost of an SEO is 3% of the amount of equity raised.

133. The AER assumes that higher cost funding is only relied on once the available lower cost funding is exhausted.

6.1 Methodology

134. This section demonstrates how the equity raising cost are calculated by us within the NZCC's existing financial model.[36]

135. Whenever the RAB grows equity must grow in proportion to the RAB in order to maintain the NZCC target gearing. Some of this growth in equity can be funded at zero cost via retained earnings. However, beyond some point costly forms of equity raising must be undertaken. Namely:

- dividend reinvestment program (DRP) – incentives are provided to existing equity holders to reinvest some of the dividend paid out to fund capital expenditure; and
- seasoned equity offerings (SEOs) – in which fresh equity are sought publicly from potential investors.

6.1.1 Estimating maximum retained earnings available

136. The first step is to calculate the minimum dividend payout for each year of the regulatory period and the amount of profit that is available to be retained. The minimum dividend payout is calculated based on a percentage of taxable income (loss).

36 NZCC Electricity Distribution Business Price-Quality Regulation 1 April 2020 DPP Reset Financial model Final Determination, 27 November 2019

137. The model sets a normal distribution rate and assumes it is costless for firms to lower dividends down to that level. We have adopted a 63% of taxable profit, based on AER assumption[37], as the minimum dividend payout ratio. This is approximately equal to 65% to 80% of post-tax profit.[38] This range is reasonable based on a survey of industry averages. According to Damodaran, its survey of "General Utilities" industries in US finds the average dividend payout ratio to be 81%.[39] It also finds the dividend payout ratio for "Power" related industries to be 82%.

138. The next step is to calculate the retained cashflow available to the network operator in each year of the regulatory period after its dividend payout.

139. Retained Cashflow of the network operator is calculated as follows

$$Retained\ Cash - flow = Revenue - Opex - Interest\ Payment - Tax\ Payable - Dividend$$

The data for revenue, opex, interest payment and tax payable are obtained from NZCC's existing financial model.

140. Retained Cash-flow is assumed to be costless for the EDB to use to fund its capital expenditure.

6.1.2 Estimating the equity raising requirement

141. The next step is to calculate the equity funding required.

142. Capex Funding Requirement is the amount of capex expenditure forecasted by EDB according to the NZ financial model.[40]. The Capex Funding Requirement is funded through two sources, Debt Component and Equity Component. Debt Component is calculated following the AER approach:

$$Debt\ Component = (Closing\ RAB - Opening\ RAB) * Leverage$$

143. Equity Component is the remaining value of Capex Funding Requirement that is not funded through Debt Component. This methodology ensures that the network operator maintains its leverage of 42% in its regulatory asset base while its capex funding requirements are met.

144. Retained Cash Flow for each year in the regulatory period is used as the first option to fund the equity component. This option is assumed to be costless. The remaining

37 See AER Electricity post-tax revenue models (transmission and distribution – April 2021 amendment.

38 The range for Aurora, Orion, Unison, Vector and Wellington.

39 https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/divfund.htm

40 Discounted by 6 months using the vanilla WACC

amount is the unfunded component of the Equity Component. This is component is called Equity Required.

145. The Equity Required component is aggregated over the 5 year regulatory period after discounting. By aggregating the Equity Required across the 5 years, the cost of equity raising is reduced because it implies that the capex in one of the years of the regulatory period can be funded using the retained cash flow from the other years in the same regulatory period. (Implicitly this assumes a temporary deviation from the target gearing is occurring.)

146. Table 6-2 below illustrate the cash flow analysis for the 5 largest network operators for the years from 2020/21 to 2024/25. Explanation of the table is provided as follows:

- Dividend at Assumed Payout Ratio show the amount of dividend each operator pays at the 63% dividend payout ratio of its taxable income.
- Dividend Reinvested Available shows the maximum amount of dividend that is available for reinvestment (assumed to be 30% of dividend).
- Capex Funding Requirement shows the amount of capex forecasted by the network operator. Debt component is assumed to be 42% of the growth in RAB (based on NZCC leverage assumption). The remaining component is assumed to be funded through equity.
- Retained Cashflow Available for Reinvestment under Regular Payout Ratio shows the retained cashflow available to the network operator assuming the operator pays out dividend at the regular payout ratio of 63% of earning.
- Equity Required shows the amount of equity required to be funded through some of the equity raising approaches: dividend reduction, dividend reinvestment and equity offering.

Table 6-2: Cash flow analysis for equity raising cost aggregated over 2021-2025 ($thousands, real 2019/20)

	Aurora	**Orion**	**Unison**	**Vector**	**Wellington**
Dividend at Assumed Payout Ratio	57,532	143,566	72,605	373,779	75,734
Dividend Reinvested Available	17,260	43,070	21,781	112,134	22,720
Capex Funding Requirement	199,796	332,590	209,793	892,929	164,829
Debt Component	64,751	90,062	45,306	235,282	35,861
Equity Component	135,045	242,528	164,487	657,647	128,967
Retained Cashflow Available for Reinvestment under Assumed Payout Ratio	94,992	163,932	133,507	501,428	116,362
Equity Required	40,053	78,596	30,980	156,219	12,605

Value for Powerco not available due to lack of data on Powerco capex in the NZCC financial model.

6.1.3 Estimating equity raising costs

147. Table 6-3 below illustrates the equity raising cost calculation for the 5 largest network operators for the years from 2020/21 to 2024/25. Explanation of the table is provided as follows:

- Equity Component of Capex shows the portion of network operators' capex forecast that is funded through equity (based on 42% leverage assumption).
- Retained Cashflow Available for Reinvestment under Assumed Payout Ratio shows the retained cashflow available to the network operator assuming the operator payouts dividend at the ratio of 63% of its taxable income
- Equity Required shows the amount of equity required to be funded through some of the equity raising approaches: dividend reduction, dividend reinvestment and equity offering.
- The rows Dividend Reinvestment and Equity Offering shows the amount of equity required raised through each of the three channels.
- The next two rows show the cost of equity raising associated with each of the two channels.
- The last row shows the total equity raising cost.

Table 6-3: Equity raising cost aggregated over 2021-2025 ($thousands, real 2019/20)

	Aurora	Orion	Unison	Vector	Wellington
Equity Component of Capex	135,045	242,528	164,487	657,647	128,967
Retained Cashflow Available for Investment at Assumed Payout Ratio	94,992	163,932	133,507	501,428	116,362
Equity Required	40,053	78,596	30,980	156,219	12,605
Dividend Reinvestment	17,260	43,070	21,781	112,134	12,605
Equity Offering	22,794	35,526	9,199	44,085	-
Cost of Dividend Reinvestment	173	431	218	1,121	126
Cost of Equity Offering	456	711	184	882	-
Total Equity Raising Cost	628	1,141	402	2,003	126

Powerco not available due to lack of data on Powerco capex in the NZCC financial model.