ceg COMPETITION ECONOMISTS GROUP

Response to the further draft determination

Jason Ockerby
Dr. Tom Hird

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COMPETITION ECONOMISTS GROUP

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1 Executive summary

1. We have been asked by Chorus Limited (Chorus) to review aspects of the further draft determination released by the Commerce Commission (the Commission) in relation to the pricing of copper lines and the wholesale broadband services. In particular, we have been asked to review and provide our opinion on:

   a. The Commission's draft determination in relation certain WACC parameters, including:

      i. the risk free rate and the tax adjusted market risk premium (TAMRP); and

      ii. the asset beta and leverage.

   b. A report by Oxera considering the case for an uplift in the WACC for the unbundled copper local loop (UCLL) and the unbundled bitstream access (UBA) services[1] and the review of the report prepared by Professor Vogelsang[2].

   c. The price trend for trenching costs as recommended in reports by NZIER[3] and Beca[4].

   d. The recommendation by Sapere to backdate the final pricing principle (FPP) price[5].

2. The report's structure is such that each of the areas we have been asked to review is self-contained within its own chapter. Chapter 1 and 2 were authored by Dr Tom Hird and chapters 3, 4 and 5 by Jason Ockerby. An executive summary for each chapter is provided below.

3. The authors of this report have read the High Court Code of Conduct for expert witnesses and have complied with its requirements when preparing the relevant sections of this report.

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1 Oxera, *Is a WACC uplift appropriate for the UCLL and UBA?*, Prepared for the New Zealand Commerce Commission, June 2015.

2 Review of Oxera's Report, Is a WACC uplift appropriate for UCLL and UBA? *By Ingo Vogelsang, Boston University*, June 29, 2015.

3 Price Trends for UCLL and UBA final pricing principle Advice on response to submissions NZIER report to the Commerce Commission May 2015.

4 Beca, *FPP Corridor Cost Analysis – Report 3, New Rates and General Recommendations,* Prepared for Commerce Commission (Client) By Beca Ltd (Beca) 5 June 2015.

5 Sapere, *Economic Comment on UCLL and UBA Pricing Issues*, 10 August 2015.

1.1 Risk free rate and TAMRP

4. In my view the best way to arrive at an internally consistent estimate of the risk free rate and TAMRP is to give 100% weight to prevailing estimates of both. However, to the extent that weight is to be given to historical average excess returns on the market, I consider that the methodology developed by the Belgian regulator (BIPT) of giving the same weight to forward-looking and historical information in the estimates of both TAMRP and the risk free rate provides a well-constructed and transparent methodology for arriving at internally consistent estimates.

1.1.1 Analysis to date

5. The Commission's further draft determination provides important analysis with respect to the risk free rate and tax adjusted market risk premium (TAMRP) parameters. In my view, the further draft determination does not adequately takes account of the potential for interdependency between these two parameters. This shortcoming might not always lead to a material error in the final estimate of the WACC but, in current market circumstances, it is my view that it does lead to a material error.

6. My March 2014 report[6] set out why I believed that there was the potential for both the risk free rate and the TAMRP to vary over time. On this basis, I suggested that the Commission should give some weight to estimates of the prevailing TAMRP. I further provided evidence that it was common for the prevailing TAMRP to move in the opposite direction to the prevailing risk free rate. Consequently, if low weight is given to a prevailing estimate of the TAMRP while 100% weight is given to the prevailing risk free rate then the cost of equity will tend to be underestimated when risk free rates are low (as they are now) and *vice versa* when risk free rates are high.

7. The Commission engaged Dr Lally to review, *inter alia*, this aspect of my report.[7] Dr Lally did not reject my advice that there was an inverse relationship between the risk free rate and the TAMRP. Indeed, Lally advised the Commission to include my preferred estimate of the forward looking TAMRP as one of five different measures of the TAMRP that it should have regard to. When Lally included my preferred estimate as one of the five measures of TAMRP, he arrived at an estimate of the TAMRP of 7.0%. Lally's estimate of the five year risk free rate, based on the average rate over April 2014, was 4.23%. Consequently, Lally's estimate of the market return on equity was 10.0% ($7\% + (1 - 0.28) \times 4.2\%$).

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6 CEG, *Response to Commerce Commission UCLL/UBA WACC consultation paper*, March 2014.

7 Dr Martin Lally, *Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, 13 June 2014.

1.1.2 The Commission's further draft determination

8. The Commission has continued to rely on a TAMRP of 7.0% in its further draft determination. This is despite the fact that risk free rates have fallen materially since the time that Lally provided his advice (from 4.2% to 3.3% at the time of the analysis in the further draft determination, and to 2.9% at the time of writing this report).

1.1.3 Why the further draft determination is problematic

9. In my view, the Commission should either:

   - increase the TAMRP by giving greater weight to prevailing estimates of the TAMRP, and less weight to historical average estimates. Doing so would offset in part or full the fall in the risk free rate. This would be consistent with the available evidence that suggests that investors are applying (and tend to apply) a higher than historical average TAMRP in circumstances where risk free rates are materially below historical levels; and/or
   - use a risk free rate in its CAPM formula better reflects historical average rates. This would be consistent with the Commission's reliance on a historical average TAMRP estimate.

10. In support of this position I note the following:

    a. The Commission's assumption in the further draft determination that the cost of equity has fallen one-for-one with falls in the risk free rate over the last six years is very unusual compared to economic regulators in other jurisdictions. We have surveyed telecommunications and energy regulators in Australia, the US, the UK and continental Europe, and all have implemented one or both of the adjustments proposed in paragraph 9 with only one exception (the an Australian Competition and Consumer Commission (ACCC) draft decision).

    b. I have applied Lally's 2014 methodology to the most up-to-date data (using updated risk free rate data, updated 2014 stock return data, and the 2015 survey from Fernandez *et al* rather than the 2013 survey relied on by Lally). Making no other changes, the median TAMRP estimate (being the estimate that Lally relies on) has risen by 0.5% to 7.4%;

    c. Application of the same Dividend Growth Model (DGM) as used by the Australian Energy Regulator (AER), endorsed by Lally and as previously supplied by CEG to the Commission, shows that the prevailing cost of equity has not fallen with the fall of risk free rates between 2014 and 2015. Rather, the prevailing TAMRP has increased to offset the fall in risk free rates.

    d. The overwhelming evidence is that the fall in global risk free rates over the last 6 years has been associated with a 'flight to safety'. Moreover, the International Monetary Fund (IMF) has estimated that much of the fall in global risk free rates reflects the fact that post 2009 the asset beta of "risk free" (actually default risk

free) government bonds has been materially negative. That is, government bond prices have tended to rise (and yields have tended to fall) when equity prices fall and *vice versa*. Consequently, government bond rates are below the risk free rate due to the insurance (negative beta) value that they have been providing against equity market volatility. I have performed the same analysis as the IMF for New Zealand government bonds and I find the same pattern.

e. Consistent with the IMF analysis, declines in government bond yields between 2014 and 2015 have been strongly influenced by heightened risks to global financial markets associated with the potential for a Greek Government default on its debt and a subsequent exit from the Euro. It is not appropriate to assume that reductions in risk free rates that are due to heightened global risks are not also associated with heightened risk premiums.

11. I discuss each of the supporting arguments outlined above briefly in the following sections.

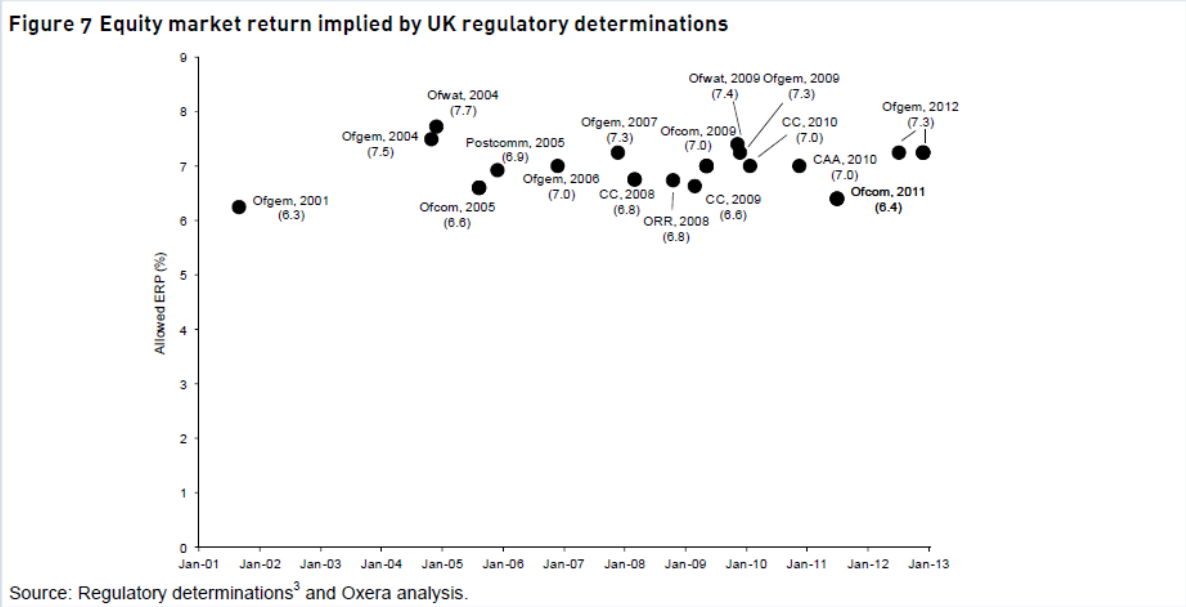
1.1.3.1 Regulatory precedent

12. I have surveyed decisions by telecommunications and energy regulators in Australia, the United States, the United Kingdom and continental Europe. In all cases I find that the cost of equity allowed by these regulators has either not fallen, or has fallen by less than the fall in risk free rates since the global financial crisis. My analysis is discussed in section 2.1 of this report.

13. I note that Oxera has performed the same analysis on a sample of UK regulators and has reached the same conclusion.[8] This is well illustrated in Figure 1 below, which shows a steady or, if anything, rising allowance for the total cost of equity allowed by UK regulators. This is despite the real five year UK government bond yield falling by over 4% during the same period.

[8] Oxera - What WACC for a crisis?, Figure 7, available at http://www.oxera.com/oxera/media/oxera/downloads/agenda/what-wacc-for-a-crisis_.pdf?ext=.pdf

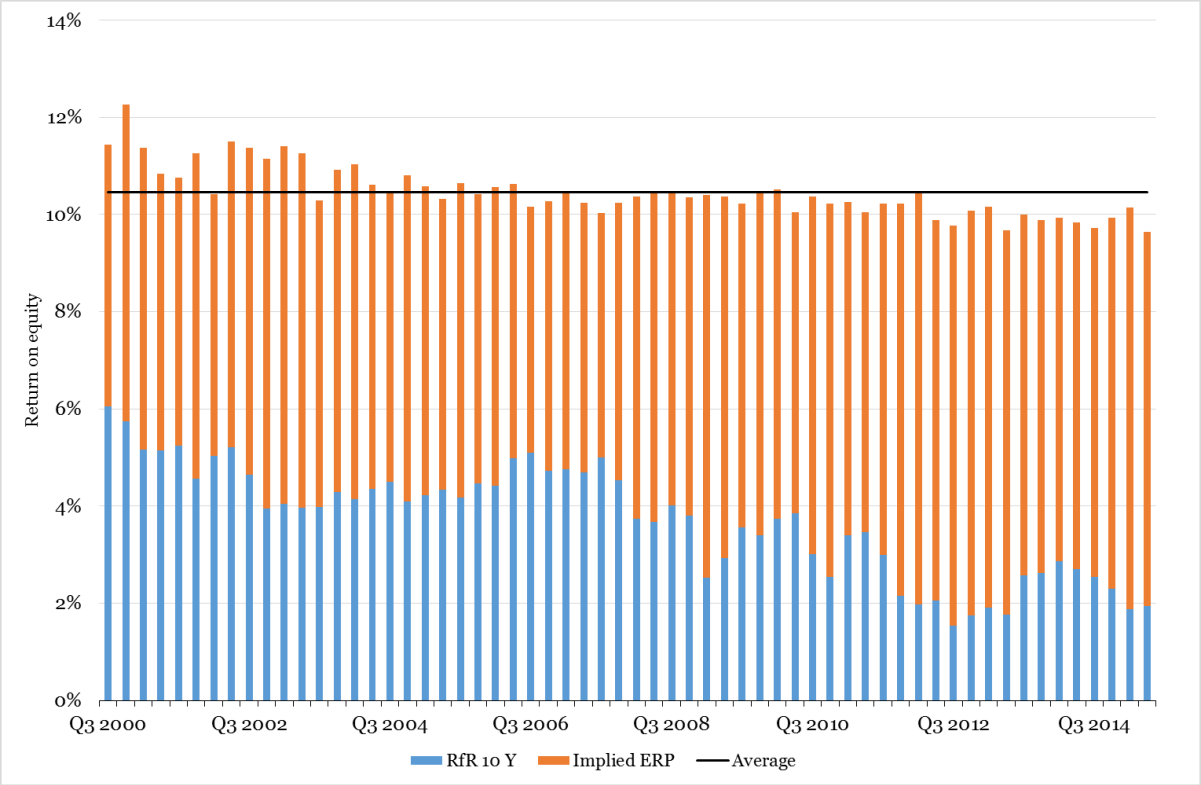
Figure 1: Oxera reporting of UK regulator return on equity time series



Source: Oxera

14. I note that in the UK, as in the rest of Europe, the stability in the market cost of equity allowance has been, in part, achieved by the regulator setting the risk free rate above the prevailing risk free rates based on the historical average risk free rates. By contrast, in the US and Australian regulatory decisions the market risk premium tends to have been increased largely based on the results of DGM analysis. This fact is captured in the summary of US regulatory decision in Figure 2 below which shows that the average allowance for the cost of equity, while falling to some extent over the period analysed, has not fallen by anything like the fall in government bond yields.

Figure 2: Cost of equity in US regulatory decisions over time



Source: SNL Financial, US Federal Reserve, CEG analysis

15. The West Australian Economic Regulation Authority (ERA) has, consistent with the above, set its estimate of the market risk premium 1.5% above its estimate of the historical average of excess returns on the following basis:[9]

> *Most significantly, the Authority has now concluded that it is not reasonable to constrain the MRP to a fixed range over time. The erratic behaviour of the risk free rate in Australia to date, and more particularly, its pronounced decline in the current economic environment, leads to a situation where the combination of a fixed range for the MRP and prevailing risk free rate may not result in an outcome which is consistent with the achievement of the average market return on equity over the long run.*
>
> *Specifically, the estimate of the upper bound for the forward looking MRP of 7.5 per cent that was based on the DGM will fluctuate in line with the risk free rate. So for example, at times when the risk free rate is low, as it currently is, the upper bound for the MRP should be higher. There will be*

9 Economic Regulatory Authority (2015), *Final Decision on Proposed Revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution Systems*, p. 249

times – such as during the GFC – when the Authority would be more likely to select a point estimate of the MRP which is close to the upper bound. The resulting required return on the market in that type of situation could possibly exceed the long run average return on equity indicated by the historical data.

For this reason the Authority considers it appropriate to determine a range for the MRP at the time of each decision.

16. The ERA's views are consistent with the statements and actions from all other regulatory decisions we have surveyed – with the sole exception of a 2015 ACCC draft decision.

17. The Commission's approach of leaving the risk premium constant and fully passing through the fall in risk free rates is, therefore, highly unusual amongst regulators internationally.

1.1.3.2 Update to Lally's estimate

18. Lally's estimate of the TAMRP, which was accepted by the Commission, was based on the median of five different estimates of the TAMRP in April 2014. If I do nothing but apply Lally's methodology to up-to-date data (the latest survey data (from the same source), 2014 New Zealand stock returns, and risk free rates as at July 2015) the median TAMRP estimate rises from 7.0% to 7.4% (and the mean rises to 7.5%). The updated estimates are summarised in the second column of Table 1 below.

19. Moreover, I propose a change to Lally's methodology for arriving at a historical average TAMRP relative to the five year risk free rate. This is reflected in the third column of numbers in Table 1 below. However, this does not alter the median or mean estimates (to one decimal place).

Table 1: Updating and adjusting Lally's TAMRP estimates

	Lally estimate (13 July 2014)	Updated estimate no change in method	Updated estimates and CEG method
Ibbotson	7.1%	7.2%	7.3%
Siegel (version 1)	5.9%	6.0%	6.1%
Siegel (version 2)	6.9%	7.8%	7.8%
DGM	8.2%	9.1%	9.1%
Survey	6.7%	7.4%	7.4%
Median	**6.9%**	**7.4%**	**7.4%**
Mean	**7.0%**	**7.5%**	**7.5%**

Source: Lally, Bloomberg, CEG analysis.

1.1.3.3 Updated DGM time series

20. In my view, the best estimate of the TAMRP is derived from the DGM. Figure 3 shows up-to-date results based on the DGM methodology set out in my previous report.

21. Figure 3 illustrates that the clear inverse relationship between the risk free rate and the TAMRP that was present up until February 2014 (when I last ran this model) continues into 2015. The approximately 1% fall in the five year risk free rate since the start of 2015 has been largely offset by a rise in the TAMRP relative to the five year risk free rate. With the most recent DGM TAMRP estimate being 9.1% (averaged over the period 1 to 27 July 2015).

Figure 3: Updated DGM time series

Source: Bloomberg, CEG analysis

1.1.3.4 IMF analysis of negative betas for government bonds

22. This report is written in the context of unprecedented low government bond yields both in New Zealand and amongst developed countries internationally. Given that New Zealand government bond yields are used by the Commission as a proxy for the risk free rate in the capital asset pricing model (CAPM) it is important to understand:

- what factors are driving government bond yields to be at historic low values; and

- what effects, if any, these factors are having on the CAPM parameters and the cost of capital for private corporations.

23. The IMF has examined precisely these issues in recent publications. The IMF (2012)[10] foreshadowed that it expected there would be persistent forces pushing down the yield on AAA rated sovereign government debt. In particular:

    - shrinking supply of AAA rated sovereign debt globally and shrinking supply of substitutes in the form of safe private sector debt;
    - heightened relative risk aversion and increased levels of perceived relative risk for equity vis-à-vis government debt; and
    - heightened demand for liquid assets post GFC - including due to changes to banking regulations.

24. None of these factors can be expected to lower the cost of equity for private corporations. Consequently, to the extent that these factors do explain, at least in part, unprecedented low government bond yields, it follows that the cost of equity will not have fallen in line with falling government bond yields. This is just another way of saying that the risk premium, measured relative to government bond yields, will have risen.

25. More recently, the IMF (2014)[11] has attempted to quantify the impact of different forces pushing down government bond yields and the extent to which the cost of equity (and the weighted average cost of capital) for private corporations has fallen.

26. The IMF concludes that the cost of equity has actually risen slightly with falling government bond rates although the cost of debt has fallen. (This is consistent with my own DGM analysis and the analysis of foreign regulators surveyed above). The net impact on the weighted average cost of capital, as estimated by the IMF, is that around half of the reduction in government bond rates has flowed through into a lower cost of capital. This has occurred via a reduction in the cost of debt rather than the cost of equity.

27. Consistent with this, the IMF estimates that the asset beta for government bonds has become materially negative in recent years – suggesting that these assets are perceived as not only much lower risk than in the past but actually materially negative risk. This means that the yield on government bonds will be depressed below the yield on the risk free rate in the CAPM.

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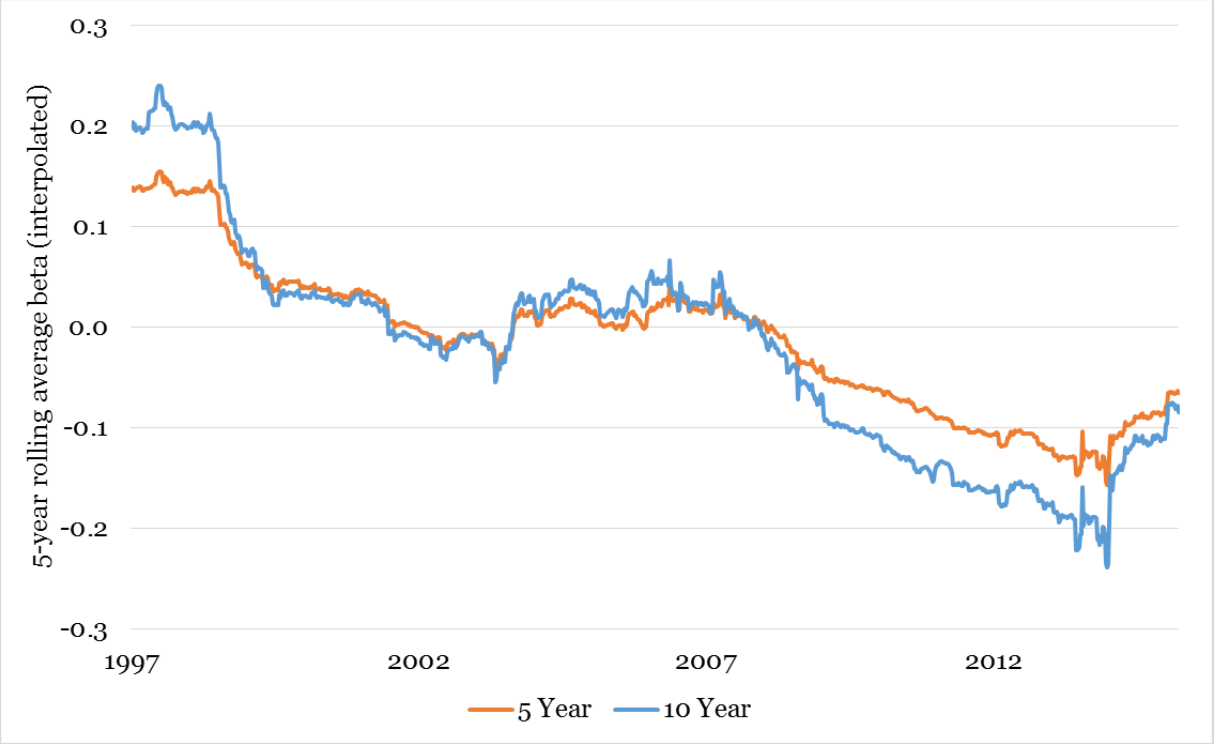
[10] IMF, Global Financial Stability Report, April 2012, Chapter 3, Safe assets: Financial System Cornerstone. Available at http://www.imf.org/external/pubs/ft/gfsr/2012/01/pdf/c3.pdf. See IMF summary at: http://www.imf.org/external/pubs/ft/survey/so/2012/POL041112A.htm.

[11] IMF, World Economic Outlook: April 2014, Chapter 3, Perspectives on Global Real Interest Rates.

28. Negative risk exists when government bonds do not just provide a safe haven from equity risk, but actually provide a hedge against equity risk. This occurs when the return on government bonds tends to be positive when the return on equities is negative (and vice versa).

29. I have conducted analysis on New Zealand government bonds following the IMF analysis and found the same pattern. This is illustrated in Figure 4 below. The figure shows that the beta on New Zealand government bonds have been significantly negative since around 2007.

Figure 4: Weekly rolling 5-year betas for 10 and 5-year maturity New Zealand Government bonds



Source: RBA, Bloomberg, CEG analysis

1.1.3.5 An illustration: Risk of Grexit and risk free rates over 2015

30. In my March 2015 report[12] I noted that the fall in risk free yields globally was clearly linked to the ongoing Eurozone sovereign debt crisis and, in particular, fears about Greek exit from the Eurozone ("Grexit"). In particular, I noted that the fall in developed country government bond yields in 2015 was coincident with heightened fears of Greek default and Grexit. I also noted that the (then) lowest yields on New

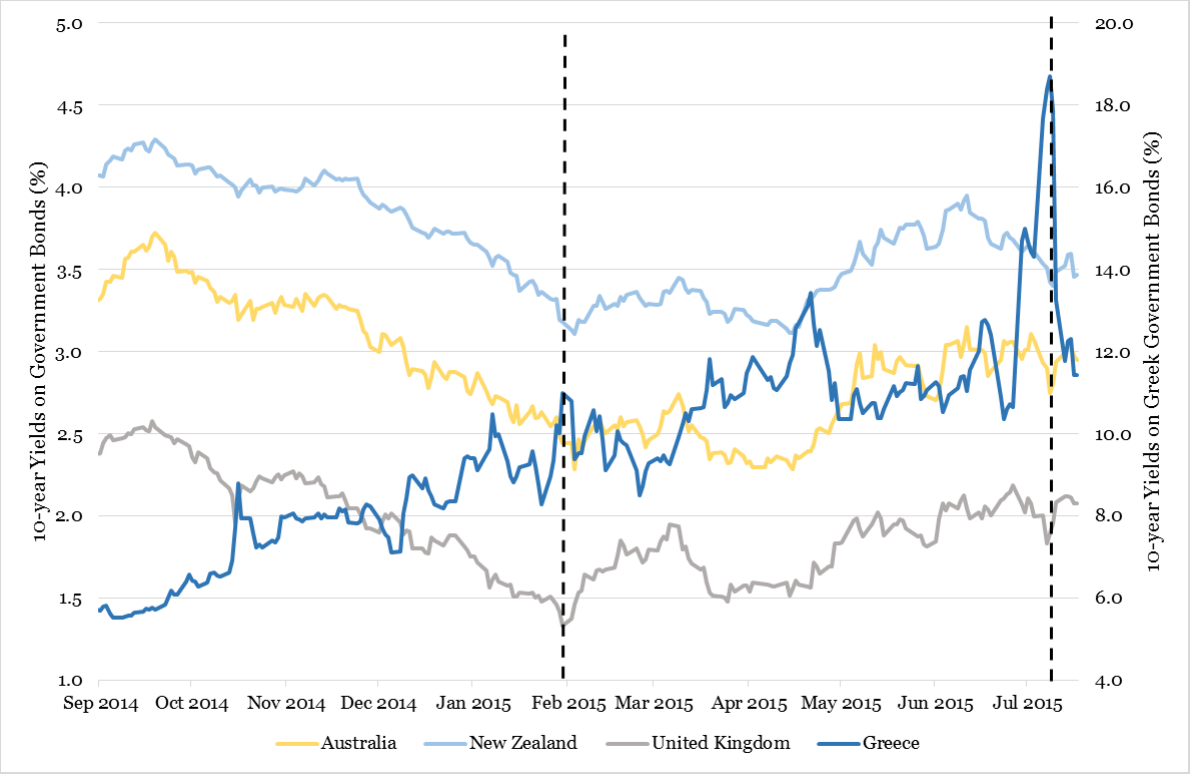
[12] CEG, *Issues from submissions UCLL and UBA*, March 2015.

Zealand, Australian and UK 10 year Government debt occurred on the same day that the yields on Greek debt reached their (then) maximum. Figure 4 from my March 2015 report provided a graphical representation of this.

31. The Greek debt crisis continued after my March 2015 report was filed, and reached new heights with the closing of Greek banks and a referendum on 5 July 2015 announced and was announced in late June 2015. This raised the expected probability of default and Grexit, especially after the referendum result appeared to provide some internal political support for such a course of action.

32. Greek bond yields reached a new peak on 8 July 2015. Figure 5 below clearly shows that UK, Australian and New Zealand bond yields all had a local minimum on the same day (or, in the case of Australian and New Zealand bonds, due to time differences, the next day).

Figure 5: Yields on New Zealand (and other low risk sovereign) debt vs yields on Greek government debt UPDATED



Source: Bloomberg, CEG analysis

33. The overall negative correlation between Greek and New Zealand debt is clear in the above updated figure. In 2015 so far there has been a correlation of -0.22 between the yield on Greek and New Zealand government bond yields.

34. Heightened fear of "Grexit" is clearly one factor influencing global capital markets causing a flight to safety in 2015. The behaviour of safe government bond prices is consistent with the IMF's finding of negative beta. When perceived risk is high, then government bond prices (yields) are high (low), and this is at precisely the opposite effect of heightened risk on equity prices.

35. As I noted in my March 2015 report, it is impossible to tell whether this will be a temporary bout of heightened uncertainty, or more long lived. However, there is no reason to believe heightened fears of global shock to financial markets would lead to lower cost of equity in New Zealand. Yet this is what the Commerce Commission's proposed cost of equity methodology gives rise to in its further draft determination.

1.1.4 Proposed solution

36. The Commission has available to it a range of solutions to the problems identified above. All solutions involve ensuring that the way that the TAMRP and the risk free rate are estimated are internally consistent. The Commission could choose to estimate both the risk free rate and the TAMRP over the longer term, resulting in a relatively higher risk free rate and a lower TAMRP than if purely prevailing estimates were used. Alternatively, the Commission could estimate both the risk free rate and the TAMRP using prevailing estimates, resulting in a relatively lower risk free rate and higher TAMRP than if historical averages were used. All regulators in our survey have addressed the problems identified above using some combination of these approaches.

1.1.4.1 Recommended approach: 100% weight to the DGM

37. I continue to consider that the best approach is to give 100% weight to prevailing estimates of the risk free rate and the TAMRP. Using the five year government bond rate over the period 1 to 27 July 2015 as the proxy for the risk free rate results in a (2.1%) 2.9% (tax adjusted) risk free rate and TAMRP of 9.1%. This results in an estimate of the market cost of equity of 11.2%. This is, in large part, the approach adopted by the ERA in Australia described above (paragraph 15).

1.1.4.2 Alternative approach: BIPT methodology

38. An alternative solution is to follow the precedent of the Belgian regulator, the Belgian Institute for Postal services and Telecommunications (BIPT). The BIPT recognises, as do the vast majority of regulators, the potential for internal inconsistency if a prevailing risk free rate is combined with a historical average MRP. I believe that the BIPT has set out a robust and very useful framework for ensuring that risk free rate and TAMRP are estimated in an internally consistent manner – with the same mix of prevailing and historical data used to determine each.

39. BIPT issued a decision regarding the WACC for operators with significant market power in Belgium on the 26 February 2015.[13] The WACC will apply in several upcoming decisions, including for the incumbent Belgacom's upcoming reference offers for interconnection, unbundled access, bitstream access and leased lines.

40. BIPT uses a very similar range of methodologies to those used by Lally/the Commission to arrive at a point estimate of the TAMRP. BIPT's methodologies include the DGM, historical return data and survey estimates.

41. BIPT assigns explicit weightings to each estimate to determine a weighted average market risk premium (BIPT uses the term equity risk premium or "ERP"). BIPT also assigns each estimate a "% LT", which is a variable that estimates the extent to which each ERP estimate is based on historical average "long term" data. For example, the DGM would have a "% LT" of 0%, and if it were given 100% weighting in determining the ERP then the "% LT" would be 0%. However, if weight was given to sources with a higher "% LT" value then the weighted average "% LT" would increase.

42. The BIPT weightings, individual ERP estimates and % LT values for each methodology are shown in Table 2, together with the weighted average ERP and weighted average % LT.

43. The ultimate result of this analysis is twofold:

    - a weighted average ERP estimate of 6.0%; and
    - a weighted average "% LT" of 36%. This is the weighted average of each individual methodologies "% LT". This is BIPT's estimate of the weight that it has, in estimating the ERP, given to historical average excess returns from prior to its averaging period for the "prevailing" risk free rate.

[13] BIPT (2015), *BIPT decision of 26 February 2015 regarding the cost of capital for operators with significant market power in Belgium,* available here: http://www.bipt.be/en/operators/telecommunication/Markets/price-and-cost-monitoring/cost-accounting/bipt-council-decision-of-26-february-2015-regarding-the-cost-of-capital-for-operators-with-a-significant-market-power-in-belgium

Table 2: BIPT ERP and % LT estimates and weightings

	Weightings for ERP estimate	ERP	% LT
Implied ERP (DGM)	50%	7.1%	0%
Historical ERP	25%	4.0%	84%
Survey of regulators	15%	5.8%	67%
Survey by Fernandez	10%	5.8%	50%
Weighted average		6.0%	36%

Source: BIPT 28 February 2015 decision, accompanying spreadsheet #1.

44. In order to estimate a risk free rate that is internally consistent with its ERP, BIPT estimates a risk free rate which also gives 36% weight to historical average yields of government bonds. As a result, BIPT arrives at an estimate of the risk free rate that is 0.5% higher than the prevailing rate.

45. In summary, BIPT estimates an ERP that is 2.0% higher than its estimate of the historical average ERP. As BIPT gives weight to historical average ERP estimates, this is still 1.1% lower than the purely forward looking ERP of 7.1%. However, BIPT raises the risk free rate by 0.5% above the "prevailing" (itself a 3 year average) risk free rate in recognition of the fact that the historical average ERP is associated with a higher risk free rate than the prevailing risk free rate. The ultimate impact is that the market cost of equity is set 2.5% higher than if the BIPT inconsistently combined a historical average ERP with a prevailing risk free rate.

46. To the extent that any weight is to be given to historical average estimates of the TAMRP, I would commend BIPT's methodology to the Commission. It has the advantage of being transparent in how the TAMRP is estimated (with specific weights being given to different estimates) and, most importantly, this allows for the potential to arrive at an internally consistent estimate of the risk free rate. In the following section I demonstrate how BIPT's method could be applied in New Zealand. Obviously, this is just one of numerous possible implementations. However, it is one that I consider results in a reasonable estimate of the overall market cost of equity.

1.1.4.3 Implementation of BIPT method in New Zealand

47. I have implemented the BIPT approach using Lally's estimates of the TAMRP (including updated estimates). Table 3 shows the calculation of the weighted average TAMRP using what are essentially the same weights as the BIPT (50% for DGM, 25% for surveys and 25% (spread evenly) across the remaining three historical average methods). This results in a TAMRP estimate of 8.1% to 8.2%.

48. The same weightings give rise to a "% LT" estimate of 33.3%. This is used to calculate a tax adjusted risk free rate of 2.79% which, because it gives weight to the historical average from 2001 onwards (as per BIPT precedent), is 68bp above the prevailing tax

adjusted risk free rate (2.11%) that was estimated over the period 1 to 27 July 2015. This tax adjusted risk free rate is added to the TAMRP of 8.2% to derive an estimate of the total market cost of equity.

Table 3: BIPT method applied to New Zealand

	Lally estimate (2014)	Updated estimate (no change in method)	Updated estimates and CEG method
Ibbotson	7.1%	7.2%	7.3%
Siegel (version 1)	5.9%	6.0%	6.1%
Siegel (version 2)	6.9%	7.8%	7.8%
DGM	8.2%	9.1%	9.1%
Survey	6.7%	7.4%	7.4%
Weighted average TAMRP*	**7.43%**	**8.15%**	**8.17%**
TA RFR	**2.79%**	**2.79%**	**2.79%**
Estimate of the market cost of equity	**10.2%**	**10.9%**	**11.0%**

*Source: CEG analysis. *Using weights from Table 2 above.*

49. It can be seen that the estimated market cost of equity is 10.9% to 11.0% (using the updated 2015 TAMRP estimates). This is similar to giving 100% weight to the DGM estimate of the market cost of equity 11.2% (=9.1%+2.1%). By comparison, simply combining the further draft determination TAMRP (7.0%) with the prevailing tax adjusted risk free rate (2.1%) results in a market cost of equity estimate of only 9.1%.

1.2 Asset beta and leverage

50. The Commission has revised its estimate of the asset beta up from 0.40 to 0.45 largely as a result of giving greater weight to data from before the most recent five year period. I consider that this change in methodology is likely to go some way to leading to a materially better estimate of the asset beta.

51. In this section, I demonstrate that correcting for the bias associated with assuming an invariant zero debt beta for all firms in the sample raises the average monthly five year asset beta over the 2009 and 2015 samples from 0.45 to 0.485. This assumes that the remainder of the Oxera/Commission's methodology is retained. Adopting this value would not only remove the bias but also align the Commission's estimate with regulatory precedent.

52. Note that my best and preferred approach is still to have regard to a longer time series and a larger sample of comparators when estimating the asset beta, consistent with the analysis and views presented in my July 2014 report. When this is done the

estimated asset beta is above 0.59.[14] Restricting the analysis to Oxera's sample but continuing to use a long run historical average beta, the best estimate is 0.53.[15]

1.3 Oxera's modelling of uplift

53. In our February report[16] we explored the merits of erring on the high side in setting prices for the UCLL/UBA services in order to avoid negative consequences of setting the price too low. In our later March report, we considered the empirical evidence in support of an uplift in the price/WACC to address the negative consequences of less incentive to invest in new and innovative services using a model developed by Professor Dobbs.[17]

54. The Commission subsequently presented its own cost-benefit framework designed to explore the empirical evidence in support of an uplift. This framework proposed to weigh the welfare costs of a higher price against the benefits from greater investment in new and innovative services in the long term and faster migration to fibre services over the next decade.[18] Oxera was engaged to consider the Commission's framework.

55. In addition, the Commission engaged Oxera to undertake its own empirical analysis and present its views with respect to an uplift in the price of the UCLL/UBA services.

56. In our view, the Commission is in error to conclude from the Oxera modelling that the link between a WACC uplift for UCLL/UBA and incentives to invest in innovative new telecommunications services is too uncertain to justify an uplift. Whilst Oxera do urge caution on the strength of the evidence, Oxera conclude that:[19]

> *All in all, the set of assumptions one would have to believe in order to conclude that a modest WACC uplift is justified seems quite plausible and can be used to inform the Commission's decision.*

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14 See the first column of numbers in Table 2 on page 22 of my July 2014 report Review of Lally and Oxera reports on the cost of capital.

15 See the second column of numbers in Table 2 on page 22 of my July 2014 report Review of Lally and Oxera reports on the cost of capital.

16 CEG, *Uplift asymmetries in the TSLRIC price*, Public Version, February 2015

17 CEG, *Welfare effects of UCLL and UBA uplift*, Public Version, March 2015

18 Commerce Commission, Agenda and topics for the conference on the UCLL and UBA pricing reviews Date: 2 April 2015

19 Oxera page 3.

57. We agree with this. Moreover, our review of the Oxera modelling indicates a number of areas where the modelling could be strengthened, the effect of which are to further support the case for a WACC uplift. The areas for further improvement include:

    i. more realistic sizing of the regulated asset base;

    ii. an improved interpolation of investors' probability weighting; and

    iii. accounting for the probability of underinvestment.

58. First, Oxera has assumed the regulated asset base (RAB) for the new investment to be of the same size ($7.4 billion) as the existing UCLL/UBA asset base. This assumption has effectively doubled the cost from a WACC uplift. In our view, this is inappropriate because the new investment in fibre technology (or any large scale future innovation) is expected to replace a significant proportion of the existing copper networks. It is reasonable to expect a customer to terminate existing copper subscriptions before signing up for the new fibre services. Consequently, the RAB of the old product should be declining once the new product is introduced.[20] We consider that a 100% increase in RAB will result in significant overestimation of the costs from a WACC uplift.

59. Second, the linear projection adopted by Oxera assumes that investors weight probabilities linearly. However, economic evidence indicates that the decision makers weight probabilities in a non-linear manner. We recommend the Oxera model reflect the behaviour of investors more realistically in response to a WACC uplift.

60. Third, and most significantly, Oxera has assumed that at the midpoint WACC there is a zero probability of innovation acceleration, which is not consistent with the assumed probability distribution of the true WACC by the Commission.[21] However, this does not mean the results will necessarily be biased upward. Oxera, as well as Professor Vogelsang, have neglected the probability of underinvestment when the true WACC is below the allowance by too much.

61. To address this, we have modelled a unified framework which assumes (symmetrically) that acceleration will happen when the true WACC is below the allowance by more than 1%, while underinvestment will occur when the true WACC is above the allowance by more than 1%; if the true WACC resides within ±1% of the allowance, the innovative investment will be successful in achieving its targeted penetration and uptake.

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[20] This would be consistent with the 100% demand assumption used in the TERA model, in which Chorus is only expected to recover the proportion of the RAB that reflects the demand it will actually achieve from copper services.

[21] This point was identified by Professor Vogelsang in his review of the Oxera report.

62. Under our framework, the marginal benefit of the WACC uplift includes not only an improvement in the chance of the investment to be put forward, but also a reduction in the potential risk of underinvestment that would lead to lower uptake/penetration. Our framework is more comparable to the Commission's initial approach, which places emphasis on the risk of losing the potential benefits from new investment resulted from underinvestment or lower uptake. Based on this framework, an optimal WACC uplift is between the 65th and 75th theoretical percentiles.

1.4 Estimating the long term price trend for trenching costs

63. The Commission asked NZIER and Beca to estimate a long term price trend for the cost of trenching for the FPP pricing review. NZIER estimated a long term price trend of 3.3 per cent, whereas Beca estimated a price trend of 2.635 per cent. In our view, the NZIER estimate could be improved by estimates based on weighted averages of Capital Goods Price Index series (CGPI series) and Labour Cost Index series (LCI series) specifically tailored to the cost of trenching.

64. Based on our analysis, we conclude that a reasonable range for the long term price trend ranges from 1.99 per cent to 2.77 per cent, with the lower end of this range representing our preferred estimate.

2 Risk free rate and TAMRP

2.1 Regulatory precedent

65. The Commission has available to it a range of solutions to the problems identified above. All solutions involve ensuring that the way that the TAMRP and the risk free rate are estimated are internally consistent. The Commission could choose to estimate both the risk free rate and the TAMRP over the longer term, resulting in a relatively higher risk free rate and a lower TAMRP than if purely prevailing estimates were used. Alternatively, the Commission could estimate both the risk free rate and the TAMRP using prevailing estimates, resulting in a relatively lower risk free rate and higher TAMRP than if historical averages were used. With the exception of the ACCC, all regulators in our survey have addressed the problems identified above using some combination of these approaches.

66. The yields on government bonds have fallen dramatically since the onset of the global financial crisis in 2007/08. This has created a problem for regulators in determining how this fall in risk free interest rates has affected the return on risky equity that investors demand for investing in regulated businesses.

67. Specifically, regulators have had to consider whether it is reasonable to assume that the risk premium relative to risk free interest rates is independent of the level of risk free interest rates – such that the equity risk premium is unchanged from its pre-crisis levels. If a regulator concludes that this is the case, then the cost of equity allowed by that regulator will fall one-for-one with the fall in risk free rates post crisis. However, if the regulator concludes that investors' risk premiums have risen such that some, or all, of the fall in risk free rates has been offset by rising risk premiums, then the cost of equity allowed by that regulator will not fall one-for-one with the fall in the risk free rates.

68. The Commission's further draft determination adopts the former approach. That is, the Commission adopts an equity risk premium (TAMRP) that is the same as the TAMRP adopted prior to the post-crisis fall in risk free rates.

69. I have surveyed decisions by telecommunications and energy regulators in Australia, the United States, the United Kingdom and continental Europe. Only one of the regulatory decisions I have surveyed has adopted the same position as the Commission (an Australian draft decision by the ACCC). All other regulatory decisions surveyed have not passed through the full impact of falling risk free interest rates into a lower cost of equity allowance. This has been achieved through some combination of either increasing the regulator's estimate of the equity risk premium, and/or adopting an estimate of the risk free rate that is above rates prevailing in the markets.

2.1.1 Australia

70. A very recent (June 2015) Australian precedent is from the Economic Regulation Authority (ERA) in Western Australia, which issued its final decision on the Access Arrangement for the Mid-West and South-West Gas Distribution Systems.

71. In this final decision, the ERA determined a five year forward looking MRP of 7.6%. This was substantially higher than the MRP set previous regulatory decisions by the ERA (e.g., for the Access Arrangement for Western Power, of 6%). The ERA's previous estimate of 6% was based on regulatory precedent and analysis of the historical average MRP. The ERA noted that the view implicit in the 6% estimate was that the MRP is mean reverting, such that historic averages provide a robust estimator for future outcomes on average.

72. In the context of the Access Arrangement for the Mid-West and South-West Gas Distribution Systems, the ERA established that the MRP is non-stationary, and that the long-term historical average estimate can be a poor predictor of the MRP in future regulatory periods – especially in a context where the risk free rate differs from historical average market levels. Instead, the ERA determined that its range for MRP will be set in each decision taking into account the level of the risk free rate at the time of each decision. The ERA stated:[22]

> *Most significantly, the Authority has now concluded that it is not reasonable to constrain the MRP to a fixed range over time. The erratic behaviour of the risk free rate in Australia to date, and more particularly, its pronounced decline in the current economic environment, leads to a situation where the combination of a fixed range for the MRP and prevailing risk free rate may not result in an outcome which is consistent with the achievement of the average market return on equity over the long run.*
>
> *Specifically, the estimate of the upper bound for the forward looking MRP of 7.5 per cent that was based on the DGM will fluctuate in line with the risk free rate. So for example, at times when the risk free rate is low, as it currently is, the upper bound for the MRP should be higher. There will be times – such as during the GFC – when the Authority would be more likely to select a point estimate of the MRP which is close to the upper bound. The resulting required return on the market in that type of situation could possibly exceed the long run average return on equity indicated by the historical data.*

[22] Economic Regulatory Authority (2015), *Final Decision on Proposed Revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution Systems,* p. 249

> *For this reason the Authority considers it appropriate to determine a range for the MRP at the time of each decision.*

73. Another example of not allowing the full fall in the risk free rate to be passed on to the cost of equity is evident in a case from 2009 when the Australian Competition Tribunal (the Tribunal) found error in the AER's approach to estimating the cost of equity. The Tribunal found that the prevailing risk free rate used by the AER in the CAPM formula, when combined with a 6% MRP based on an estimate of historical average excess returns, resulted in a cost of equity which was too low. This was during a time when the yield on Commonwealth Government Securities (CGS) was at (then) unprecedented low levels.

74. The Tribunal found that estimating the risk free rate at historic lows, whilst keeping the MRP constant at historic levels, was likely to underestimate the cost of equity. The Tribunal stated:[23]

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

75. The AER subsequently has adopted an MRP estimate of 6.5% which is 0.5% higher than its estimate of the historical average level of excess returns. The AER describes its decision in this way: [24]

> *As at December 2013, our market risk premium (MRP) point estimate is 6.5, chosen from within a range of 5 to 7.5 per cent. The MRP compensates an investor for the systematic risk of investing in a broad market portfolio. Analysis of historical estimates of the MRP show a long term average of about 6 per cent. We also have regard to another financial model, the dividend growth model, to determine whether we should adopt an estimate above, below or consistent with the historical estimate. This is a symmetric*

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23 Australian Competition Tribunal (2009), *Application by EnergyAustralia and Others (includes corrigendum dated 1 December 2009) [2009] ACompT 8 (12 November 2009),*Para 112, 114

24 AER, Better regulation fact sheet – rate of return guideline – December 2013, p. 2.

consideration. As at December 2013, the dividend growth model is above the historical average—leading to an estimate above 6 per cent.

76. There is also precedent from the Independent Pricing and Regulatory Tribunal (IPART) of New South Wales, the Essential Services Commission of Victoria (ESCV) and the ACCC of not setting the risk free rate based on observations that are affected by abnormal conditions in the Government bond market.

77. In its Review of Water Prices for Sydney Desalination Plant in 2012, IPART stated that:[25]

For this review, we consider that the value of the risk free rate is currently well below long term averages and that there is a high level of market uncertainty. We consider the risks in setting a 5-year determination in the current conditions are more significant than under normal market conditions.

We acknowledge the argument that there may be greater stability in the sum of the market risk premium and the risk free rate (ie, the expected market return) than in the individual components. In the current market circumstances, there is some evidence, as SDP noted, to support the view that expectations for the market risk premium have risen as bond yields have fallen.

78. Consistent with this analysis, IPART set a WACC towards the top of its range – where that top end of the range was determined using historical average risk free rates, rather than prevailing risk free rates. Its stated reason for doing so was as set out below:[26]

We determined the values for the parameters of the WACC based on market conditions over the 20 days to 28 October 2011. The risk free rate and debt margin have been affected by market volatility and the prolonged weak market following the credit crisis of 2008. The change in these factors has potentially created a disparity between these parameters (for which we use short term average data) and the market risk premium (for which we use long term average data).

However, the effects of this disparity are mitigated by our decision to use a point estimate of 6.7%, which is 80 basis points higher than the midpoint of our estimated WACC range. ***In doing so, we had strong regard to the calculated WACC using longer term averages for market parameters***. (Emphasis added)

25 IPART (2012), *Review of water prices for Sydney Desalination Plant Pty Limited,* p. 93 - 94

26 Ibid. p. 80

79. The ACCC's March 2015 draft decision for fixed line telecommunication services is the exception to this pattern. In that decision the ACCC rejected Telstra's proposal that the MRP be increased to reflect the fact that, with historically low risk free rates, DGM estimates of the MRP are materially higher than the historic average of excess returns. The ACCC determined not to increase the MRP from 6% on the basis that it gave most weight to historical average excess returns; these were consistent with survey estimates; regulatory precedent; and the ACCC's view that DGM models suffer from 'practical limitations'.[27]

80. It is notable that there is Australian precedent for not adopting the prevailing risk free rate in exceptional market circumstances that extends back to before the global financial crisis. In a 2001 decision for Powerlink, the ACCC adjusted its averaging period in order to exclude the impact of the events of 11 September 2001. The events of 11 September had a similar impact to other financial crisis in the sense that they cause a 'flight to safety'. This had the effect of pushing up prices for Government bonds (and pushing yields down), and equity prices fell dramatically. That is, the fall in the risk free rate fell simultaneously to the perceived riskiness of equities (i.e. the cost of equity) increasing.

81. The ACCC determined that it would be inappropriate to capture a lower risk free rate due to a crisis when that same crisis was likely causing the prevailing MRP to rise (and to risk by more than the decline in the risk free rate). The ACCC stated:[28]

> *The Commission recognises that the events of 11 September have impacted on the risk free rate, however it believes that it is still too early to fully quantify this impact. Given this uncertainty, the Commission will adopt a forty-day moving average ending on 11 September rather than a forty-day moving average ending on the date of this decision.*
>
> *The Commission acknowledges that as a result of 11 September there may be an increase to the level of risk experienced by the market. If such an increase in risk exists, it is unclear to what extent CAPM parameters will be effected. However, any movement in the MRP can only be accurately determined by accessing changes in the market over an extended period of time.*
>
> *Therefore, the Commission will continue to examine the impact of the 11 September events over time and it will take into account any evidence identified for future regulatory decision.*

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27 ACCC (2015), Draft Decision, *Public inquiry into final access determinations for fixed line services – primary price terms*, pp. 84 to 88.

28 ACCC (2001), *Queensland Transmission Network Revenue Cap 2002 – 2006/07,* p. 13.

2.1.2 United States

82. US regulators tend to use the DGM to estimate required equity returns. Figure 6 illustrates that the allowed cost of equity has not moved in synchronicity with the risk free rate. The figure shows average quarterly figures for regulated electricity and natural gas businesses in the US calculated by US-based data provider SNL Financial. It demonstrates that the allowed cost of equity for energy businesses has been relatively stable at around 10.5% over the last 15 years, despite volatility in the government bond rates (proxied by ten year Treasury bond rates).

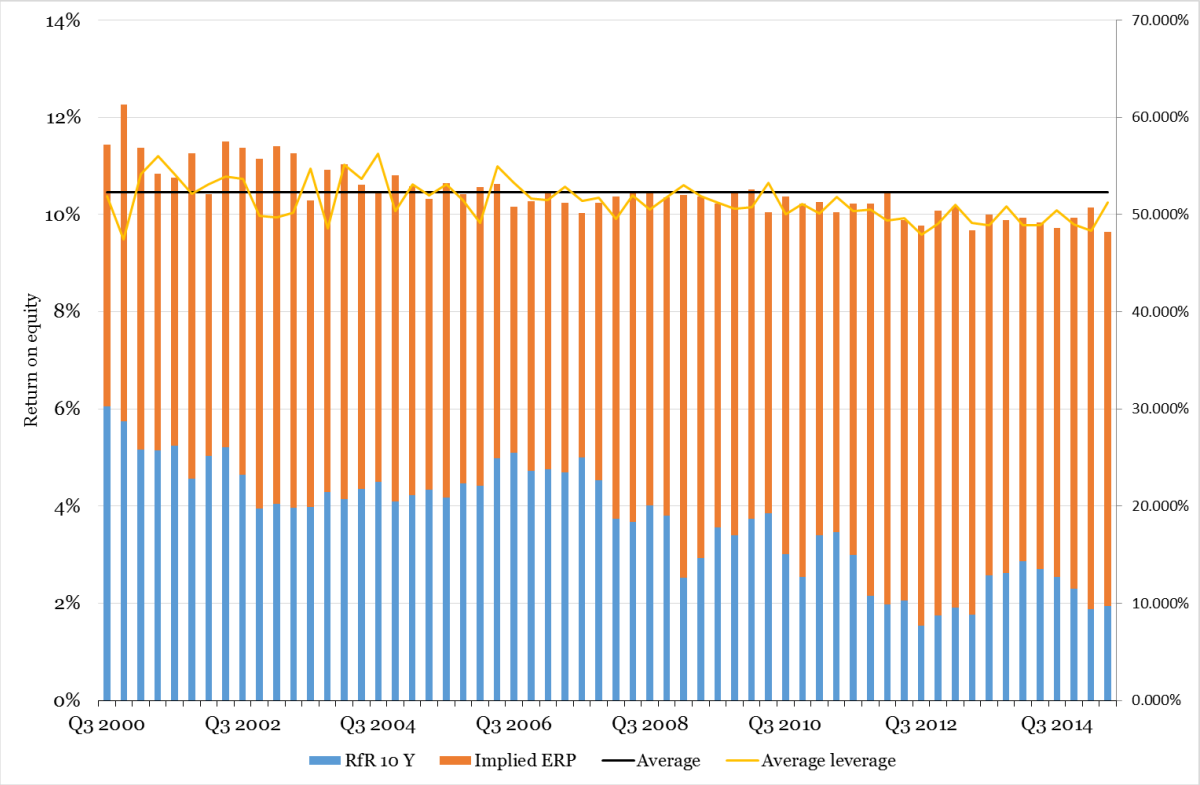
83. That said, there has been a decline in the average allowed cost of equity in the order of around 0.5% since the year 2008.[29] Over the same period, risk free rates have fallen by around 1.6%[30] - suggesting around 1/3 of the fall in risk free rates has translated into lower cost of equity allowances. However, it should be noted that even this overstates the likely role of lower risk free rates in regulatory decisions because the average level of leverage declined over this period – which one would expect to be associated with a lower cost of equity.[31]

[29] In 2008 the average allowed return on equity was 10.4%. In the most recent four quarters (2014/15) the average allowed return on equity was 9.9%.

[30] In 2008 the average 10 year government bond rate was 3.8%. In the most recent four quarters (2014/15) the average 10 year government bond rate was 2.2%.

[31] In 2008 the average leverage was 51.0%. In the most recent four quarters (2014/15) the average leverage was 49.7%.

Figure 6: Cost of equity in US regulatory decisions over time



Source: SNL Financial, US Federal Reserve, CEG analysis

2.1.3 United Kingdom

84. UK regulators have largely accepted this advice and they do not, as a rule, use a prevailing estimate of the risk free rate when applying the CAPM. For example, in an annexure report entitled "Decision on strategy for the next transmission and gas distribution price controls - RIIO-T1 and GD1 Financial issues" Ofgem adopted the following approach, in March 2011:[32]

> *3.69. Market measures of the real risk-free rate, such as the yield on ILGs, have risen slightly since the data cut-off point for EE's December report. However, they remain near historical lows, partly due to the Bank of England's official interest rate being held at 0.5 per cent and the impact of Quantitative Easing. We, therefore, do not consider it appropriate to rely on spot rates or short-term averages to set the risk-free rate.*

[32] Ofgem (2011), *Decision on strategy for the next transmission and gas distribution price controls – RIIO-T1 and GD1 Financial issues*, p. 33

> *3.70. Our revised range for the risk-free rate is, therefore, 1.7-2.0 per cent. The lower bound matches the 10-year average yield on 10-year ILGs, while the upper bound corresponds to regulatory precedent in the UK.*

85. The market level of the ILG's (Index Linked Gilts) reported in the EE report (and referred to above) were around 0.4%. Consequently, Ofgem's decision involved an increase of between 1.3% and 1.6% relative to this value.

86. In a 2014 Ofcom statement on the Fixed Access Market Reviews for wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30, Ofcom stated that:[33]

> *These factors [historical averages of the yields for RPI linked gilts and forward rates of those gilts] inform our estimate of the real RFR, but we are cautious when interpreting the data because of the level of uncertainty that has persisted and the potential impact of temporary distortions such as quantitative easing. There is no straightforward answer to the question of what interest rates will do in the future and we need to be mindful of current rates, historical rates, and future expectations.*

87. In February 2013, Oxera published a paper titled "What WACC for a crisis?"[34], which included some empirical research on the real risk free rate and equity risk premium determined by regulators in the United Kingdom over time. The findings of their research demonstrates empirically the views presented above.

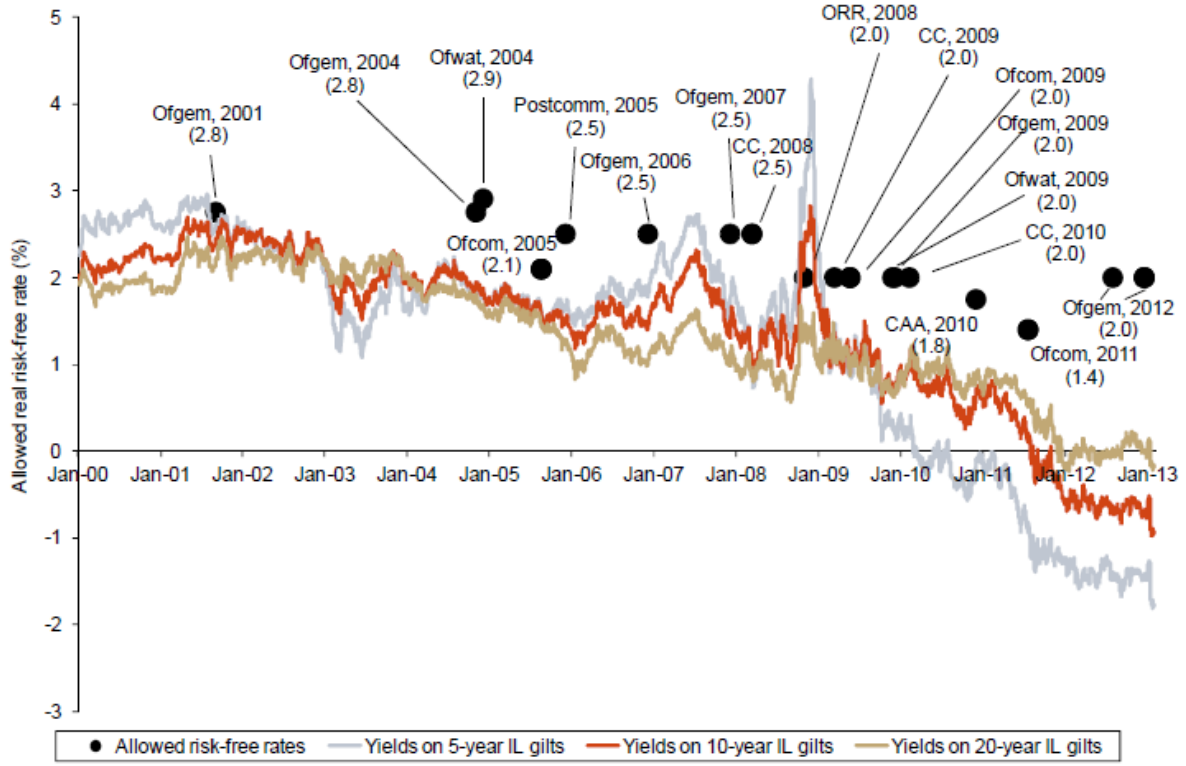
88. Oxera observed that, although there has been a decrease in the real risk free rate determined by regulators since the peak of the financial crisis (1.4 – 2.0% compared to 2.1 – 2.9% prior to late 2008), the gap between the determination and the yields observed in the market has widened significantly. Oxera's presentation of this is reproduced in Figure 7 below.

33 Ofcom (2014), *Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 – Annexes*, p. 170

34 Oxera (2013), *Agenda – Advancing economics in business - What WACC for a crisis?*

Figure 7: Reproduction of Oxera Figure 5: Real risk free rate determination by UK regulators

Figure 5 Real risk-free rate determinations by UK regulators

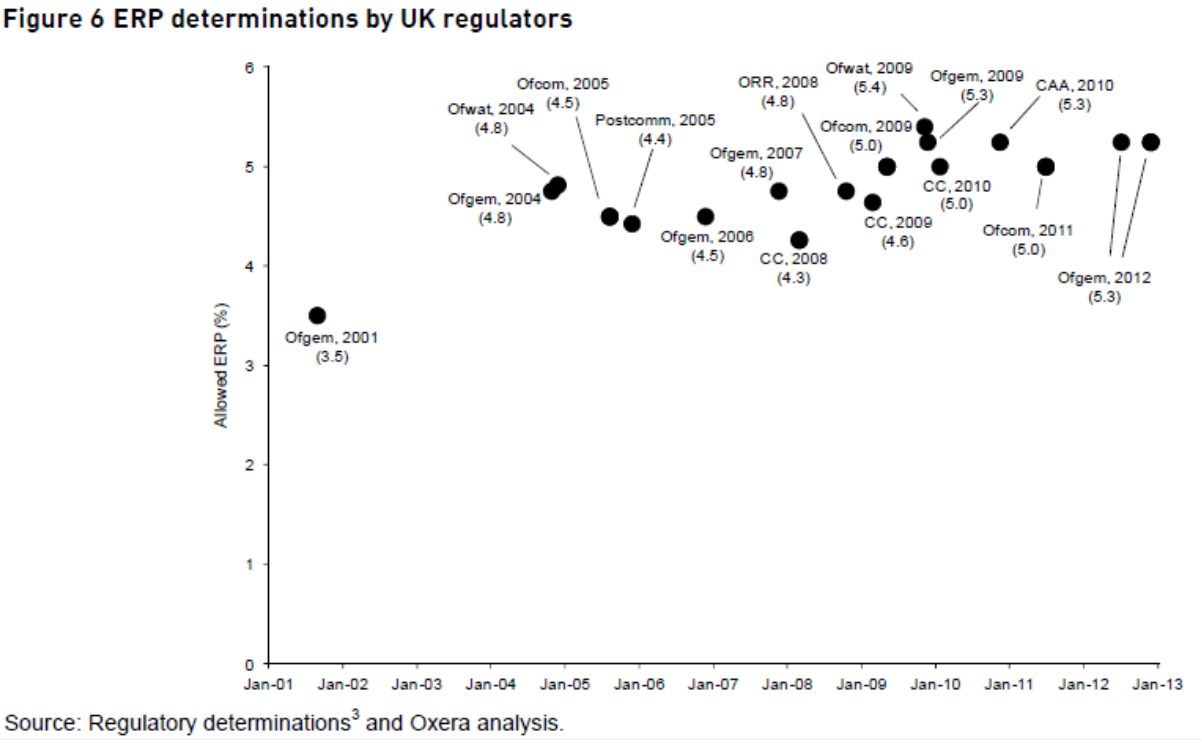


Note: To facilitate comparability of regulatory precedents across parameters, in determinations where a nominal rate of return is applied, as in telecoms, a real risk-free rate is estimated using inflation assumptions. CAA, the UK Civil Aviation Authority; CC, the UK Competition Commission; ORR, the GB Office of Rail Regulation; Postcomm, the UK Postal Services Commission (now part of Ofcom).
Source: Regulatory determinations,[3] Bank of England, and Oxera analysis.

Source: Oxera analysis

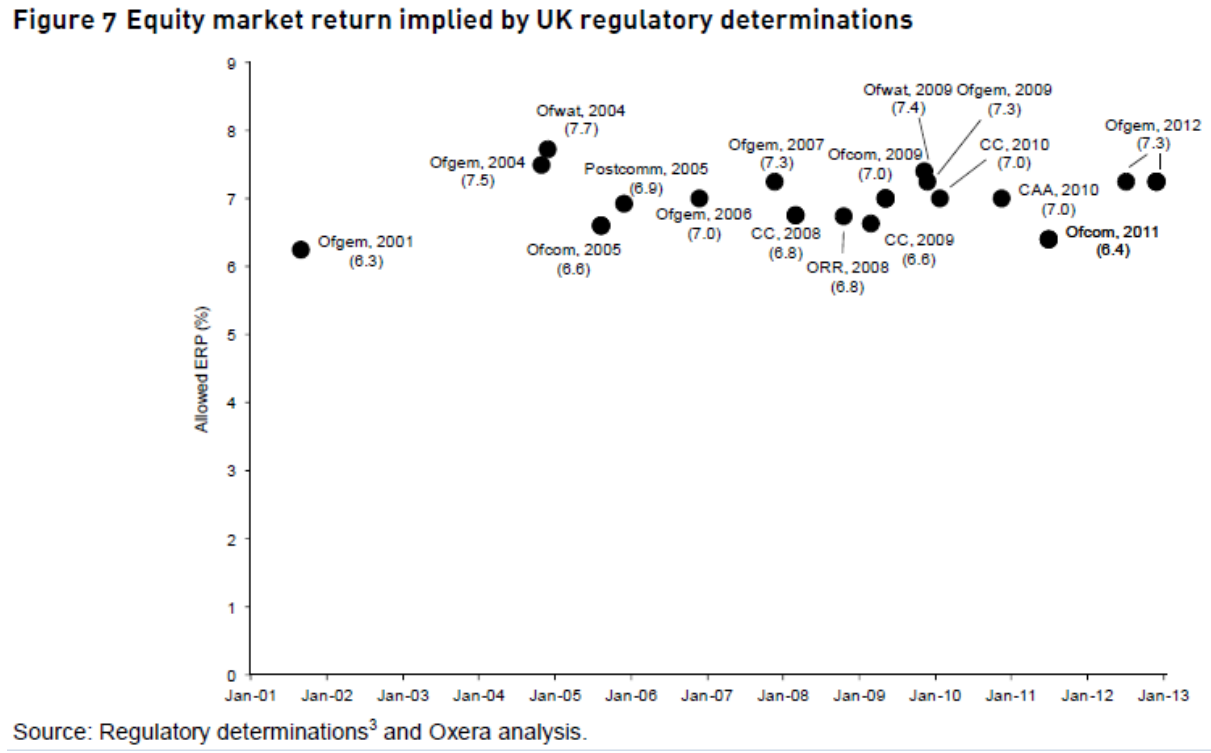
89. Further, Oxera observed that the ERP estimated by regulators had increased from between 3.5 – 4.8% prior to late 2008, to 4.6 – 5.4% after late 2008 (Figure 8). This, they note, is consistent with an investor perception that equity has become less attractive relative to debt since the financial crisis. Taken together, this the fall in the real risk free rate in determinations after late 2008 have been offset by an increase in the ERP. The overall cost of equity is the sum of the risk free rate and the ERP, it has, as a consequence, remained relatively stable over time (Figure 9).

Figure 8: Reproduction of Oxera figure 6: ERP determinations by UK regulators



Source: Oxera analysis

Figure 9: Reproduction of Oxera figure 7: Equity market return implied by UK regulatory determinations



Source: Oxera analysis

2.1.4 Continental Europe

90. All the telecommunications regulators in continental Europe that we have surveyed have regard to a longer time period when estimating the risk free rate, as opposed to a short time period immediately preceding the decision. This has resulted in the allowed risk free in all recent regulatory decisions we have surveyed being higher than the corresponding prevailing risk free rate at the time of the decision.

91. Table 4 shows the allowed risk free rate for each surveyed country, as well as the prevailing risk free rate at the time (on ten year government bonds[35]) and the difference between these two numbers. It also contains a brief summary of the basis for the allowed risk free rate in each country. It can be seen that regulators have, notwithstanding material falls in prevailing risk free rates, tended to adopt a stable estimate of the risk free rate. The reasoning provided is consistent with a belief that the cost of equity is relatively stable in the fact of movements in the prevailing risk free rate and that adopting a fixed MRP along with a prevailing risk free rate would,

35 Most regulators use or have regard to Government bonds with 10 years to maturity to estimate the risk free rate, see Table 4. For countries which have the Euro as their currency, we have used the 10 year yield on Euro bonds (GECU10YR Index).

in the opinion of the Belgium and other regulators, create 'consistency problems' for the cost of equity estimate.

Table 4: Allowed RfR and prevailing RfR in continental Europe

Country	Decision	Allowed RfR – Prevailing RfR	Basis for RfR estimate
Denmark	December 2014	2.08% - 0.93% = 1.15%	The Danish regulator, Erhvervsstyrelsen, has estimated a 10 year RfR over a five year period. The regulator observes that an increase in the period used to estimate the risk free rate results in more stable prices.
Italy	December 2013	4.72% - 1.85% = 2.87%	The Italian regulator, Agcom, has estimated a 10 year RfR over a period from January 2009 to November 2013. In its previous decision (2010), the regulator set a RfR of 3.9% based on the spot 10 year rate on December 20 2010.
Sweden	December 2013	3.07% - 2.40% = 0.67%	The Swedish regulator, PTS, consulted on the WACC in 2010 – 2011 and at that time moved from estimating the 10 year RfR based on a six month averaging period to using a seven year averaging period. An important reason for this change was to ensure that the RfR on an entire economic cycle. PTS continued to implement this approach in its December 2013 decision, and noted the large variability in the RfR during the year leading up to the decision.
Finland	May 2015	0.96% - 0.58% = 0.38%	The Finnish regulator, Viestintävirasto, has set the 10 year RfR by using an average of the period 1 May 2014 to 30 April 2015. They note that the RfR has fallen from 1.94% in the previous decision to 0.96% in the current decision.
Belgium	February 2015	2.63% - 1.40% = 0.54%	The Belgian regulator, BIPT, introduced a new parameter, % LT, in its RfR calculation in February 2015. This is because the RfR can vary widely whilst the MRP remains relatively stable, which imposes an overall consistency problem for the cost of equity. BIPT has estimated a 10 year RfR as a three year average (2.15%) plus the difference between the average since 2001 and the three year average (3.48% – 2.15% = 0.48%). This results in an estimated RfR of 2.63%.
France	January 2013	3.70% - 1.56% = 2.14%	The French regulation has set the RfR using the 10 year average of the 10 year RfR. The long-term average, it notes, will result in smaller variations than estimations from one year to another.
Ireland	December 2014	3.63% - 0.60% = 3.03%	The Irish regulator, ComReg, advises a point estimate for the nominal risk free rate based on a point estimate for the real risk free rate of 2.3%. The regulator has regard to the

Country	Decision	Allowed RfR – Prevailing RfR	Basis for RfR estimate
			yield on 10 year Government bonds from various European countries over time.
Norway	December 2013	4.50% - 1.19% = 3.31%	The Norwegian regulator has assumed a real RfR of 2.0% and an expected inflation of 2.5%. The regulator's consultant appears to have considered the yield on 5 and 10 year Norwegian government bonds as far back as December 2002. The consultant notes that a RfR based on a long term average is preferable for regulated businesses who make long-term capital investments and the WACC allowance is an important parameter for investors when deciding whether to invest.

Denmark: *Erhvervsstyrelsen (2014), Høringsnotat for LRAIC-fastnet, p. 3 – 4.*

Italy: *Agcom (2013) Delibera N. 747/13/CONS, p. 97 - 100*

Sweden: *PTS (2013),* PTS konsultationssvar på samråd om uppdaterad kalkylränta för det fasta nätet, *p. 6 – 7.*

United Kingdom: *Ofcom (2014),* Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 – Annexes, *p. 170 – 173.*

Finland: *Viestintävirasto (2015), Kohtuullinen sitoutuneen pääoman tuotto kiinteässä televerkkotoiminnassa, matkaviestinverkkotoiminnassa ja digitaalisten televisiolähetyspalvelujen toiminnassa, p. 1*

Belgium: *BIPT (2015), Decision du conseil de l'BIPT du 26 Fevrier 2015 concernant le cout du capital pour les opérateurs puissants en Belgique, p. 33 – 34.*

France: *ARCEP (2013), Décision n° 2013-0001 du 29 janvier 2013 fixant le taux de rémunération du capital employé pour la comptabilisation des coûts et le contrôle tarifaire des activités fixes régulées de France Télécom pour les années 2013 à 2015.*

Ireland: *Europe Economics (2014), Cost of Capital for Mobile, Fixed Line and Broadcasting Price Controls – Report for ComReg, p. 17 - 26*

Norway: *Professor Thore Johnsen (2013), Kapitalkostnad for norsk telekom fastlinjeviksomhet, p. 5 – 8.*

2.2 Low risk free rates: implications for regulatory policy

92. There exists sufficient evidence that the fall in global risk free rates over the last 6 years has been associated with a 'flight to safety'. Moreover, the IMF has estimated that much of the fall in global risk free rates reflects the fact that post 2009 the asset beta of "risk free" (read *default* risk free) government bonds has fallen to be materially negative. That is, government bond prices have tended to rise (yields fall) when equity prices fall and *vice versa*. Consequently, government bond rates are below the risk free rate due to the insurance (negative beta) value that they have been providing against equity market volatility. I have performed the same analysis as the IMF for New Zealand government bonds and I find the same pattern.

93. If the IMF is correct, then this means that it cannot be presumed that the fall in government bond yields is an accurate measure of the change in (CAPM) risk free

rates. This is because some, or all, of the fall in government bond yields is explained by a fall in the perceived (CAPM) risk associated with government bonds.

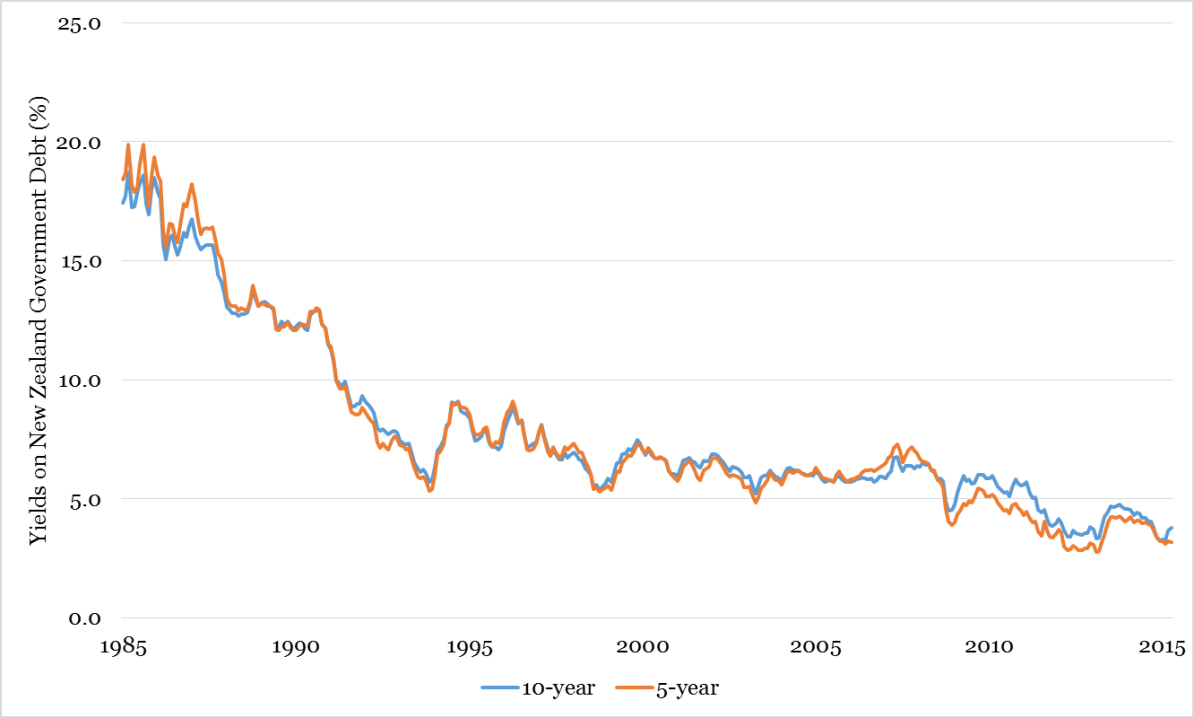
94. The IMF analysis also highlights an important reason why it is not necessarily safe to estimate the prevailing TAMRP (measured relative to prevailing government bond yields) on the basis of historical average measures of market excess returns relative to (then) government bond yields. Implicit in this approach is that the average perceived CAPM risk of government bonds historically is the same as the prevailing perceived CAPM risk. However, as noted by the IMF, this is not a sound assumption.

95. By way of concrete example consistent with the IMF analysis, declines in government bond yields between 2014 and 2015 have been strongly influenced by heightened risks to global financial markets associated with the potential for Greek Government default on its debt and exit from the Euro. It is not appropriate to assume that reductions in risk free rates that are due to heightened global risks result are not also associated with heightened risk premiums.

2.2.1 Forces affecting global government bond yields

96. Yields on New Zealand government debt are currently at near historic low levels, as illustrated in Figure 10 below.

Figure 10: Yields on 5 and 10 year New Zealand government bonds



Source: RBNZ, CEG analysis

97. Given that the Commission's cost of equity is determined by adding, what has until now, been a more or less fixed 7% estimate of the tax adjusted market risk premium (TAMRP) to the yields of New Zealand government debt, the Commission's estimated cost of equity falls more or less at a rate of one-for-one with the yield on 10 year New Zealand government debt. It is therefore important to understand what has driven the falls in ten year government debt yields and to what extent it would be reasonable to assume that the cost of capital has fallen in line with risk free rates.

98. It can be seen from Figure 10 that, in the period of stable inflation expectations (since roughly 1992),[36] nominal yields averaged around 6.7% up to the period of the global financial crisis (GFC) in 2008/09, when they plunged precipitously to what was, then, unprecedented levels. However, after a brief recovery, nominal NZ government bond yields fell again during the period of the "Euro crisis". They reached their next low in mid-2012 in a period which the June 2012 Monetary Statement the Reserve Bank of New Zealand (RBNZ) described as follows:

> *Since the March Statement, global equity markets, commodity prices and the New Zealand dollar have fallen sharply.* ***Investor preference towards lower risk assets*** *has driven government bond yields in many countries to fresh lows, including the United States, Germany, Australia and New Zealand, while government bond yields for troubled nations like Italy and Spain have risen sharply.* (Page 9)
>
> *Ten-year government bond yields reached fresh lows for Germany, United States, United Kingdom, Australia and New Zealand, among other countries,* ***reflecting the flight to perceived low risk assets***. (Page 11, emphasis added)

99. Echoing these statements, the Reserve Bank of Australia (RBA) Governor (Glenn Stevens), observed a similar phenomenon in Australian government bond yields, described in the following manner:[37]

> *But, as we said at the last hearing, sorting out the problems in the euro area is likely to be a long, slow process, with occasional setbacks and* ***periodic bouts of heightened anxiety****. We saw* ***one such bout of anxiety*** *in the middle of this year, when financial markets displayed increasing nervousness about the finances of the Spanish banking system and the Spanish sovereign. The* ***general increase in risk aversion*** *saw yields on bonds issued by some European sovereigns spike higher, while those for Germany, the UK and the US* ***declined to record lows****. This '****flight to***

[36] RBNZ, The Costs and Benefits of Disinflation, 1995.

[37] RBA, *Opening Statement to the House of Representatives Standing Committee on Economics*, Glenn Stevens, Governor, Reserve Bank of Australia, Canberra – 24 August 2012.

> ***safety'*** *also saw market yields on Australian government debt decline to the* ***lowest levels since Federation***. (Emphasis added)

100. It is clear from these remarks that neither the RBNZ nor the RBA viewed the then-historic lows in government bond yields as being associated with a similarly low market cost of equity. On the contrary, low yields were directly associated with raised risk aversion and a 'flight' to low risk assets. That is, the causal mechanism went from heightened perceived risk of equities (and other risky assets) causing a 'flight' to government bonds and driving down risk free rates.

101. After a recovery in yields over 2013 and 2014, New Zealand government bond yields have fallen again over 2015 to only marginally above the previous lows. The important issue for estimating the cost of equity involves two questions:

- What is driving the low yields of NZ government bonds post-GFC (in general or in any specific averaging period)?
- Can the same factors be expected to drive similarly low returns on risky equities?

102. If the answer to the second question is no, then this underscores the need to ensure that the expected return on the equity market (and therefore the MRP) is tailored to the specific market circumstances from which the risk free rate estimate (based on NZ government bond yields) is taken.

103. Both the RBNZ and the RBA have clearly set out views that the previous historic lows in yields were driven by factors that, if anything, could be expected to raise the cost of equity rather than lower it (i.e., heightened risk aversion – a side effect of which was a flight to safety that lowered yields on safe assets).

104. More generally, the IMF (2012)[38] have observed a number of persistent factors that would be expected to lower government bond yields after the GFC but which cannot be expected to lower the required returns on risky assets. In summary:

- shrinking supply of AAA-rated sovereign debt globally and shrinking supply of substitutes in the form of safe private sector debt;
- heightened relative risk aversion and increased levels of perceived relative risk for equity vis-à-vis government debt; and
- heightened demand for liquid assets post-GFC - including due to changes to banking regulations.

105. This evidence is discussed in more detail in Appendix A. However, none of these factors can reasonably be described as causing the yield on risky assets to fall. These

[38] IMF, Global Financial Stability Report, April 2012, Chapter 3, Safe assets: Financial System Cornerstone. Available at http://www.imf.org/external/pubs/ft/gfsr/2012/01/pdf/c3.pdf. See IMF summary at: http://www.imf.org/external/pubs/ft/survey/so/2012/POL041112A.htm.

factors do not necessarily explain all of the fall in New Zealand government bond yields, but to the extent that they explain at least part of the fall, then the cost of equity should not be assumed to have fallen one-for-one with NZ government bond yields. The important issue from the perspective of estimating the cost of equity then involves quantifying the extent to which the reduction in NZ government bond yields has been associated with a reduction in the cost of capital. I turn to this issue in the next section.

2.2.2 IMF analysis of the impact of falling government bond yields on the cost of capital

106. The IMF (2014) has recently published analysis attempting to understand the global reduction in yields on safe government debt (which the IMF refers to as "bonds"). The IMF concludes: [39]

> *Since the early 2000s, three factors have contributed to the declines in real rates and in the cost of capital:*
>
> - *Saving shifts: The substantial increase in saving in emerging market economies, especially China, in the middle of the first decade of the 2000s contributed to a modest decline in the cost of capital. High income growth in emerging market economies during this period seems to have been the most important factor behind the saving shift.*
> - *Portfolio shifts: About half of the reduction in real rates in the first decade of the 2000s can be attributed to an increase in the* ***relative*** *demand for bonds, which, in turn, reflected an increase in the riskiness of equity and the resulting higher demand for safe assets among emerging market economies to increase official foreign reserves accumulation. In the aftermath of the global financial crisis, these factors, though more moderate, have continued to contribute to the decline in real rates.*
> - *Investment shifts: The post-crisis reduction in the cost of capital has been driven mainly by a collapse in the demand for funds for investment in advanced economies.* (Emphasis in original)

107. The IMF argues that the first and third effects (saving shifts and investment shifts) can be expected to have reduced the cost of capital. However, the second effect (portfolio shifts) cannot. That is, the IMF argues that there has been a shift in demand away from equities and into government bonds as the perceived relative riskiness of government bonds vis-à-vis corporate assets has declined.

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39 International Monetary Fund World Economic Outlook: April 2014, Chapter 3, Perspectives on Global Real Interest Rates p.18.

108. In order to understand the IMF's analysis of portfolio shifts it is important to distinguish between the narrowly defined risk of default on long-term government bonds and the broader definition of "risk" relevant to the CAPM. In order to be "risk free" in a CAPM sense it is not sufficient to have zero default risk. Instead, what is required is that the value of the bond must have zero covariance with the return on the market portfolio. Even if government bonds have zero risk of default, they still expose the holder to interest rate risk. This is because the price of a bond varies over time with variations in the level of interest rates.

109. For example, if interest rates rise while an investor is holding the bond, then its value will fall because the discounted value of future payments will also fall. This occurs even though the value of those payments is certain. Similarly, if interest rates fall while an investor is holding a bond then the value of the bond will rise because the discounted value of future payments will also rise.

110. Consequently, there is no reason to assume that either New Zealand government bonds are perceived by investors as having a beta of zero. Investors will perceive a government bond as having a positive or a negative beta if they believe that the value of said government bond will positively or negatively co-vary with the value of the market portfolio. Neither is there any reason to believe that the perceived beta on these bonds is always restricted to be constant or positive. Negative asset betas mean that, consistent with the predictions of the CAPM, investors will treat these assets as having negative risk. That is, they will demand a return on these assets that is lower than the risk free (zero beta) rate in the CAPM.

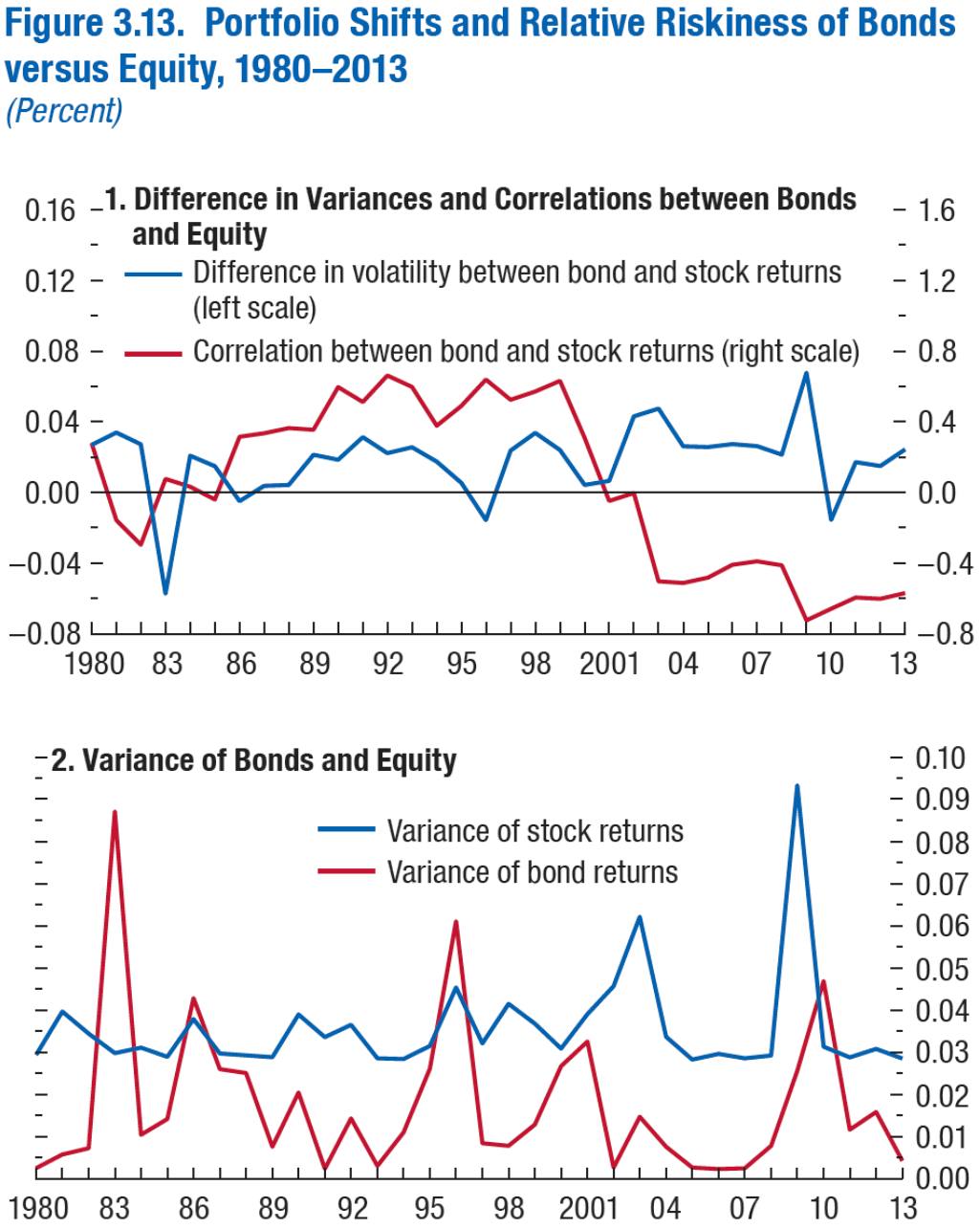
111. The IMF considers that the reduction in the asset beta of government bonds to negative levels has been an important contributor to the fall in government bond yields. That is, government bonds now exhibit not just low or zero risk, but have become negative risk in the CAPM sense: [40]

> *[…] a change in the relative riskiness of bonds and equities has made bonds relatively more attractive. In particular, the evidence summarized in Figure 3.13 (panel 1) shows that the correlation between bond and equity returns has steadily declined (similar results have been found in Campbell, Sunderam, and Viceira, 2013) […]*

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

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

Figure 11: IMF estimates of correlation between bond and stock returns



Source: IMF

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

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

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

115. The paper by Campbell, Sunderam, and Viceira, (2013) referred to by the IMF has a longer time series of beta estimates for US government bonds. Their time series analysis is reproduced in Figure 12 below.

Figure 12: Campbell et al. estimate of beta on US 10 year nominal bonds

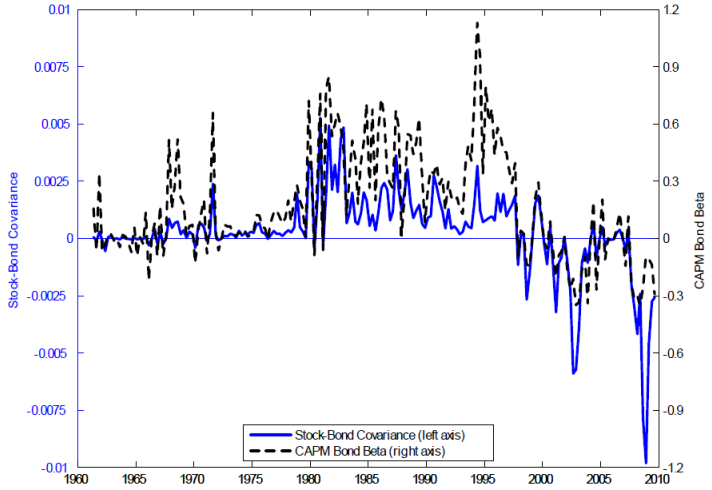


Figure 1: Time series of the stock-bond covariance and the CAPM β of the 10-year nominal bond.

Source: Campbell et al. (2013)

116. It can be seen that the post-2000 period of negative betas follows a much longer period in which betas on US Treasuries were materially positive – averaging around 0.2 or more. The authors provide a compelling theoretical explanation for the observed decline in asset betas post-2000: [41]

[41] Campbell, Sunderam, and Viceira, "Inflation Bets or Deflation Hedges? The Changing Risks of Nominal Bonds", *Harvard Business School Working Paper*, January 2013, p. 11.

> *Intuitively, at times when inflation is procyclical as might be the case if the macroeconomy moves along a stable Phillips Curve— nominal bond returns are countercyclical, making nominal bonds desirable hedges against business cycle risk. At times when inflation is countercyclical— as might be the case if the economy is affected by supply shocks or changing inflation expectations that shift the Phillips Curve in or out— nominal bond returns are procyclical and investors demand a positive risk premium to hold them.*

117. The authors argue that credible inflation targeting by central banks may have created a 'stable Phillips Curve'[42] – whereby the 'Phillips curve' describes an inverse relationship between the rate of unemployment and the rate of inflation.

118. Specifically, where long term inflation expectations are anchored around a central bank target then variability in long term expected inflation is not a driver for bond price movements. Rather, investors will expect sustained strong/weak demand in the economy to predictably result in higher/lower official interest rates - such that bond prices will fall/rise (noting that bond prices depend inversely on the level of interest rates). The beta for long-term nominal government bonds will thus be negative because positive/negative shocks to the economy will result in negative/positive shocks to bond prices.

119. However, in the alternative state of the world, where expected inflation is not anchored, then the link between economic activity (which drives stock price movements) and inflation and interest rates (which drive bond price movements) is weaker and potentially becomes pro-cyclical. From the 1970s to the 1990s, high inflation coexisted with periods of weak economic activity in much of the Western World. In this period, the correlation between stronger economic activity (which is good for stock prices) and higher interest rates/inflation (which is bad for bond prices) was weaker than it is now. Indeed, in such a world, increases in inflation expectations may be driven by factors such as labour strikes and industrial unrest – shocks which are bad for both bond and stock prices.

120. This explanation for the decline in the beta for government bonds in the late 1990s is generally consistent with the adoption of inflation targeting by central banks around

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[42] Ibid, p. 27:

> *Within a new Keynesian paradigm, one possibility is that a positive covariance corresponds to an environment in which the Phillips Curve is unstable, perhaps because supply shocks are hitting the economy or the central bank lacks anti-inflationary credibility, while a negative covariance reflects a stable Phillips Curve. It would be desirable to use data on inflation and output, and a structural macroeconomic model, to explore this interpretation.*
>
> *The connection between the bond-stock covariance and the state of the macro- economy should be of special interest to central banks. Many central banks use the breakeven inflation rate, the yield spread between nominal and inflation-indexed bonds, as an indicator of their credibility. The bond-stock covariance may be appealing as an additional source of macroeconomic information.*

the world in the 1990s. In the case of New Zealand, a formal 0-2% inflation target was set out in the June 1993 Monetary Policy Statement. As is set out in Figure 14 on page 43, asset betas on New Zealand government bonds began falling materially beginning in 1997 (noting that even the 1997 5 year beta estimates include some data from before 1993).

2.2.2.1 The IMF estimates around half of the reduction in bond rates is due to portfolio shifts

121. The IMF considers that this reduction in the risk of government bonds to materially negative levels is an important explanation for the decline in government bond yields as observed over the last 15 years and, therefore, the current unprecedentedly low levels of return offered on those bonds:[43]

> *About half of the reduction in real rates in the first decade of the 2000s can be attributed to an increase in the* ***relative*** *demand for bonds, which, in turn, reflected an increase in the riskiness of equity and the resulting higher demand for safe assets among emerging market economies to increase official foreign reserves accumulation. In the aftermath of the global financial crisis, these factors, though more moderate, have continued to contribute to the decline in real rates.* (Emphasis in the original)

122. The IMF notes that the cost of capital for businesses has not, and would not be expected to have, fallen by the same magnitude as the yield on government bonds:[44]

> *The past 15-year period is divided by the global financial crisis. Before the crisis real interest rates declined even as the global investment-to-GDP ratio increased, suggesting that a shift in the global saving schedule took place. However, if the outward shift in global saving was the only factor driving the decline in the real rate, a similar decline in the cost of capital should have been observed, but it was not. More precisely, whereas real interest rates declined by about 1.2 percentage points, the cost of capital decreased only by 0.6 percentage point. This difference in declines suggests that portfolio shifts contributed about 0.6 percentage point to decreases in real bond yields (Table 3.2).*
>
> *In the aftermath of the global financial crisis, real rates have continued to decline, but equilibrium saving and investment have decreased. The analysis above suggests that an inward shift in the global investment schedule (of about 2 percentage points) was the primary factor–while*

43 International Monetary Fund World Economic Outlook: April 2014, Chapter 3, Perspectives on Global Real Interest Rates, p. 18.

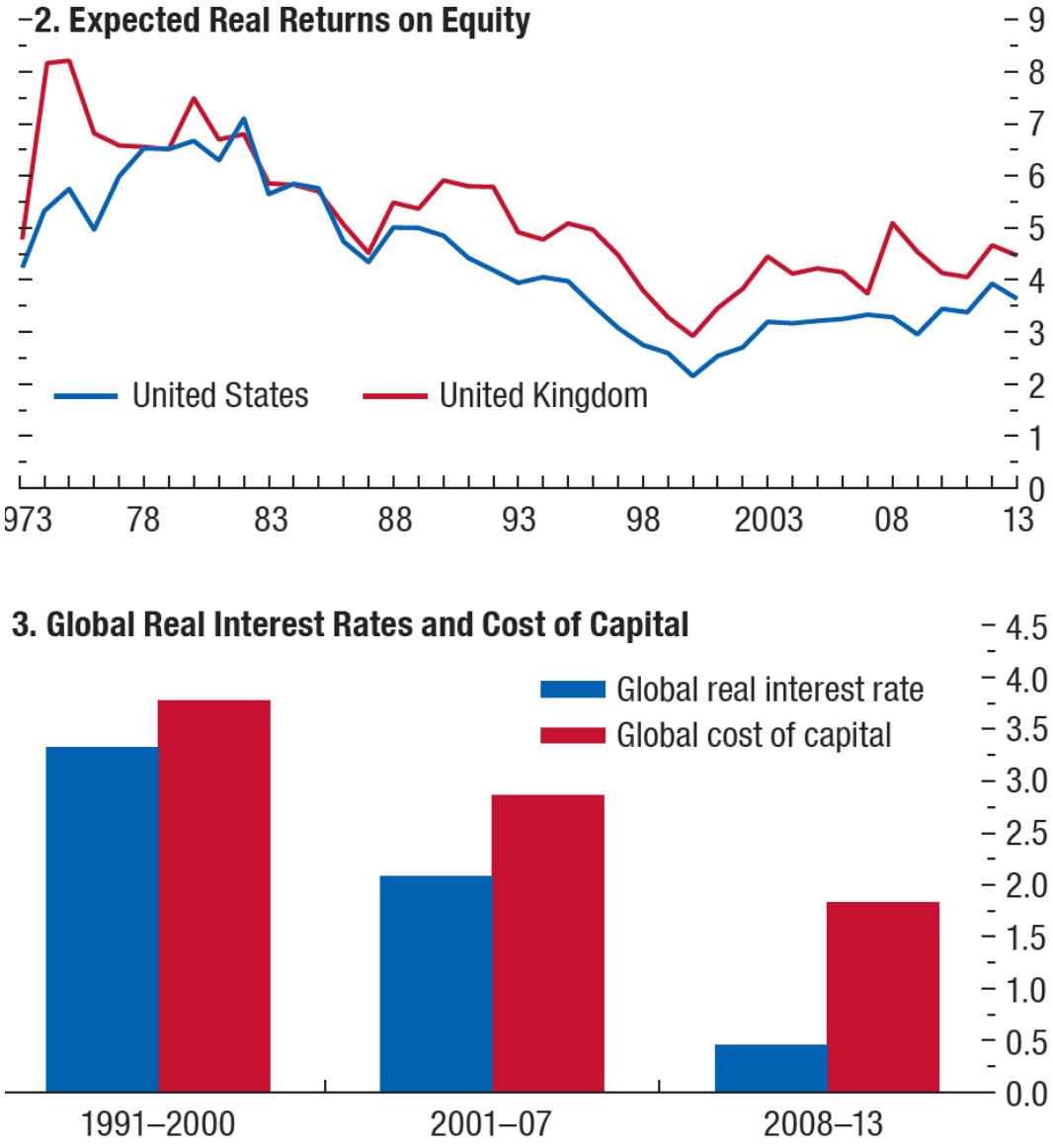
44 International Monetary Fund World Economic Outlook: April 2014, Chapter 3, Perspectives on Global Real Interest Rates, p. 16.

> *saving responded to the change in yield. Again, there was a difference in declines between the real rate and the cost of capital. The former declined by about 1½ percentage points, whereas the latter declined only by 0.7 percentage point, suggesting that portfolio shifts contributed about 0.8 percentage point to decreases in real bond yields.*

123. That is, the IMF estimates that, over the last 15 years, around 1.4% (0.6% before the GFC and 0.8% afterwards) of the reduction in government bond rates was due to reductions in the perceived risk of government bonds, and is therefore not associated with a consequent reduction in the cost of capital for private sector investors. This is illustrated in Figure 13.

124. The first panel shows the IMF's estimate that the real cost of equity was relatively stable between 2003 and the onset of the GFC but has, on average, risen since the beginning of the GFC in 2007/08. This occurred in spite of significant declines in real government bond yields. The second panel shows the impact on the weighted average cost of capital, with the rising cost of equity offset somewhat by falling cost of debt but with the cost of capital falling much more slowly than government bond yields.

Figure 13: IMF estimates of changes in the cost of equity and the cost of capital



Source: IMF

2.2.3 Application of the IMF framework to New Zealand

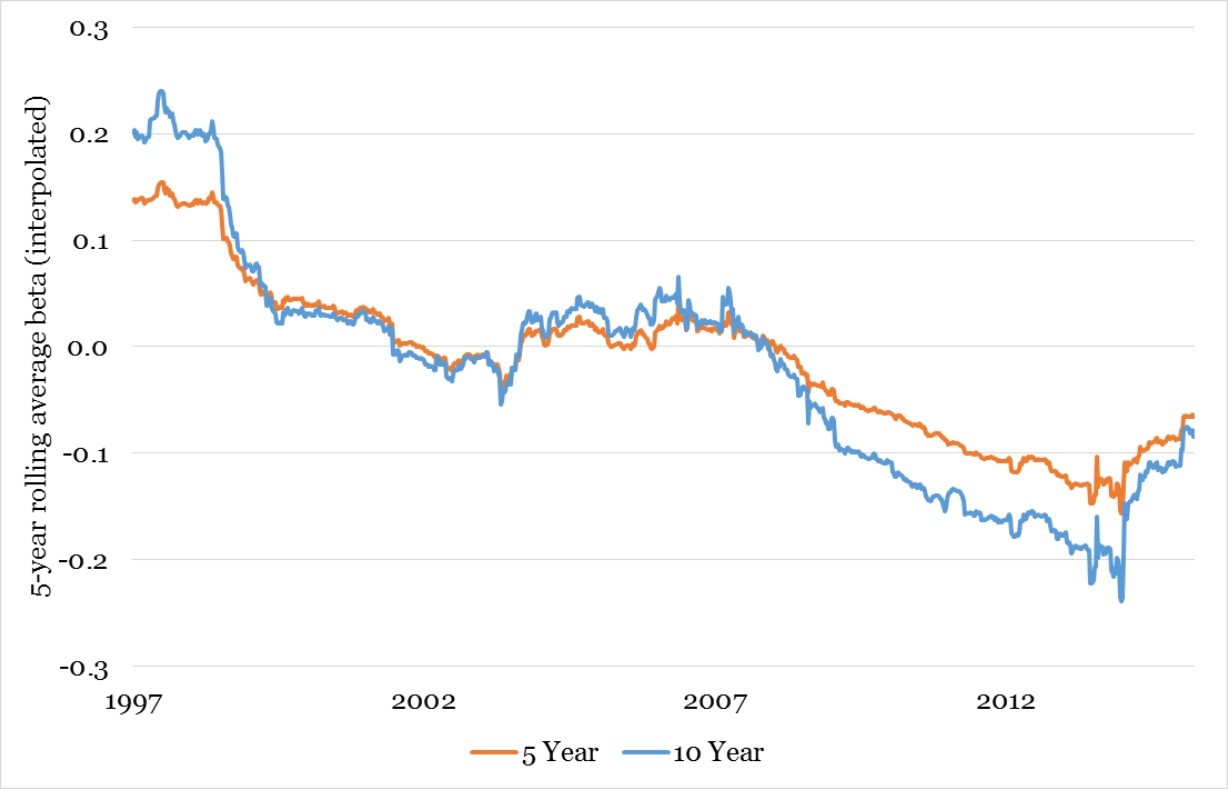
2.2.3.1 Beta on New Zealand government bonds has fallen material from positive to negative yields

125. An examination of the beta for New Zealand government bonds clearly shows the same trend as reported by the IMF (see Figure 14). The five and ten year government bonds first had negative betas from around 2002 and have been negative since 2008.

126. I have obtained historical weekly values of the betas for individual New Zealand nominal government bonds from Bloomberg based on a five year rolling average window. I then obtained historical betas for the five and ten year tenors by taking the beta of the bond with a time to maturity that most closely matches the target five and ten year tenors as at each observation date. If, as is generally the case, there is no bond with exactly five/ten years to maturity on that date I have interpolated between the betas for the two bonds with maturity closest to, but on either side, of the target maturity.

127. The resulting weekly series of five and ten year betas are shown in Figure 14, whereby it can clearly be seen that the betas of five and ten year government bonds have been negative since 2008.

Figure 14: Rolling 5-year betas for New Zealand government bonds with 5 and 10-year maturities



Source: Bloomberg, CEG analysis

128. The fall in betas for New Zealand government bonds is similar to the global average fall in safe government bond betas estimated by the IMF. The dramatic and sustained reduction in the asset betas associated with New Zealand government bonds can, similarly, be expected to depress the yields on these assets *relative* to other assets. Moreover, the negative beta on government bonds can be expected to depress the yield on these assets to a level that is below the risk free (zero beta) rate in the CAPM.

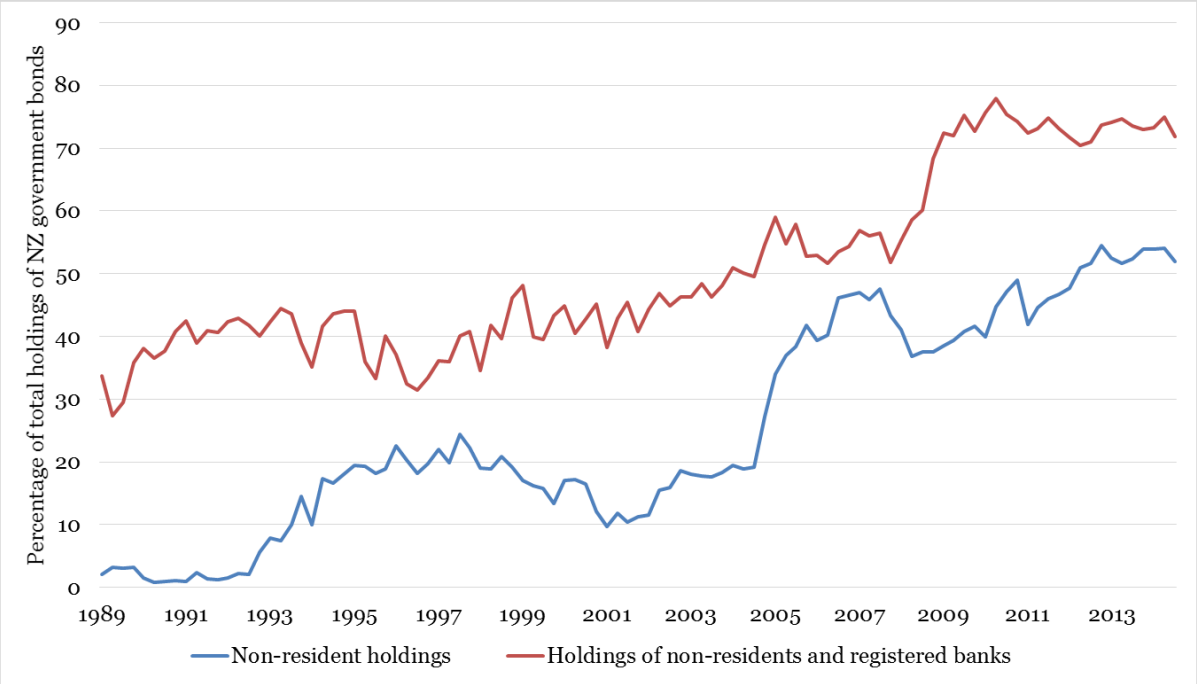
129. Based on the data presented in Figure 14 above, betas for New Zealand government bonds have fallen by around 0.3% and 0.2% since the 1990s and 2000s levels respectively. If the true CAPM TAMRP was 7.0%, then this would imply a fall of around 2.1% and 1.4% respectively in the yield on government bonds that would be unrelated to any fall in the true underlying CAPM risk free (zero beta) rate. Moreover, to the extent that the historical average beta on government bonds was positive, this means that the historical average excess return will underestimate the historical average excess return relative to the true (zero beta) CAPM risk free rate. These effects are quantified in section 2.2.4 below.

2.2.3.2 Holdings of New Zealand government bonds by foreigners and banks has risen materially

130. The IMF also noted the increase in holdings of developed country government bonds by the central banks of developing countries running large current account surpluses. This has also been reflected in a dramatic increase in the holdings of New Zealand government bonds by foreign entities (largely foreign central banks). This is illustrated in Figure 15 below, which shows how holdings of New Zealand government bonds by non-residents and non-residents plus registered banks have changed over time.[45]

45 This is calculated from RBNZ statistics Table D2 as the amount held by "Non-resident holders identified" and "Registered banks" divided by (the total holdings less the holdings by "Government accounts and public organisations", "Earthquake Commission", "Local authorities and public administrative organisations", "Statutory marketing and primary producer organisations", and the Reserve Bank of New Zealand").

Figure 15: Holdings of domestic government bonds by non-residents



Source: RBNZ statistics Table D2

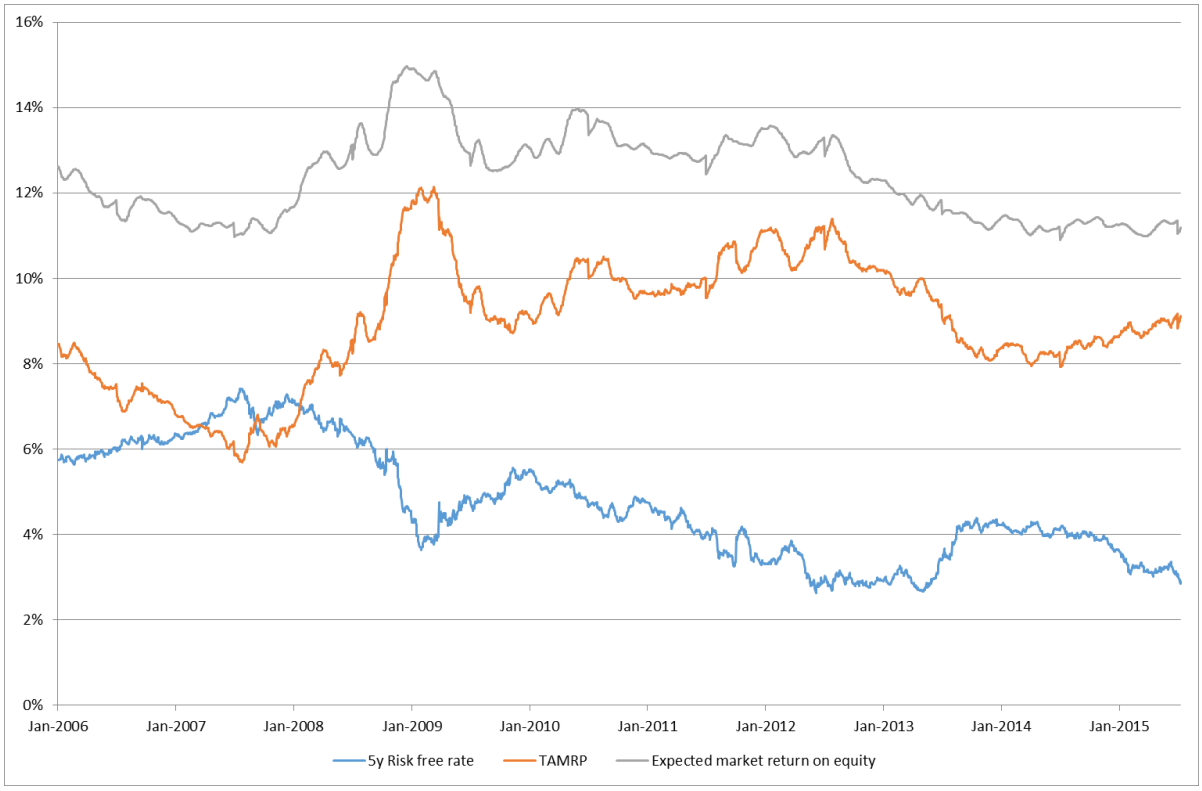
131. The increase in bank holdings of New Zealand government bonds in the wake of the GFC and then, more recently, in the run up to implementation of post crisis banking liquidity standards, is substantial. However, a much more significant increase has been in the form of demand from foreign investors. This is consistent with statements from the IMF that the demand for safe bonds, such as New Zealand government bonds, has increased materially given the global shortage of safe liquid assets.

2.2.3.3 Forward looking estimates of the cost of equity have not fallen with falling New Zealand government bonds

132. The IMF's global analysis found that falling government bond yields was not associated with a fall in the global cost of equity. The IMF concluded that at least part of the explanation for this was the fact that falling government bond yields reflected falling betas for government bonds.

133. The same analysis applied to New Zealand equity markets gives rise to the same conclusion. Forward looking estimates of the cost of equity have not declined since the GFC, in spite of falling yields on government bonds. This is illustrated in Figure 16 below, which shows the DGM estimated expected return on the market and TAMRP on the New Zealand equity market versus the yield on five year New Zealand government bonds.

Figure 16: Expected market return on equity and TAMRP of the New Zealand equity market vs 5 year risk free rate



Source: Bloomberg, CEG analysis

134. This DGM model uses the same assumptions as set out in my March 2014 report for Chorus, which were used to generate Figure 7 of that report. These assumptions were drawn in large part from the AER's implementation of the DGM and were endorsed by Lally in his advice to the Commission[46] and formed the basis of Lally's own estimate of the DGM estimate of the TAMRP.

135. Since March 2014 the DGM cost of equity has remained relatively stable; notwithstanding a marked decline in five year government bond yields over 2015. The corollary of this is that the TAMRP (which is simply the difference between the return on equity and the government bond yield) has risen by an approximately offsetting amount to the fall in the government bond yield. This is consistent with the observed behaviour of the DGM cost of equity estimate in the period up to March 2014 which, as noted in my March 2014 report, demonstrated a strong inverse relationship between the TAMRP and the risk free rate.

46 Lally, Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services, June 2014, Section 6.4.

136. Taking a broad view of the entire period from 2006 to July 2015, as New Zealand government bond yields fell post-GFC,[47] the corresponding TAMRP of New Zealand equities rose, such that the overall level of yields for New Zealand equities have remained fairly similar to pre-GFC levels (i.e., pre-2008). Far from low government bond yields being associated with decreases in the required return on equity, the MRP measured relative to government bond yields has risen by an amount that offsets the fall in government bond yields. Indeed, until recently, the rise in TAMRP has been greater than the fall in government bond yields such that the cost of equity was elevated from 2008 to 2013 relative to its pre-2008 levels.

137. I have also implemented an alternative conservative version of the DGM which allows for the potential that term structure of the cost of equity follows the same term structure as do government bond yields. If the prevailing term structure of interest rates is flat then this will give the same result as the core DGM model. However, in the current circumstances, with a steeply upward sloping yield curve for government bonds, the TAMRP will be lower under this approach. This is because this approach assumes that TAMRP, rather than the required return on equity, is constant at all horizons. Therefore, lower short horizon interest rates flow through into lower short horizon cost of equity estimates. Under this approach TAMRP is 8.6%; still well above 7.0%. Further details are provided in Appendix C.

2.2.3.4 Summary

138. In short, the very same forces and observations that the IMF made in relation to a global analysis are also present in the New Zealand market for government bonds.

2.2.4 Implications for setting the regulated cost of equity

139. The first critical point to note is that the fall in New Zealand government bond yields cannot be mechanically assumed to have been associated with a fall in the cost of equity. Instead, the cost of equity must be estimated directly and not assumed to fall or rise with government bond yields. This is true irrespective of whether some or all of the fall in government bond yields are explained by a fall in the beta of government bonds.

140. However, a falling beta for government bonds lends itself to straightforward quantification and the calculations that follow apply to implementation of the CAPM where the TAMRP is based on the historical average of excess returns relative to the historic average risk free rate (in Lally's terminology this applies to the Ibbotson and Siegel (version 1) estimates of TAMRP). The adjustments are different, and much smaller, if the DGM or the Siegel (version 2) estimates are used because these

47 Or even prior to the GFC.

methodologies base the estimate of the TAMRP on the prevailing risk free rate and not the historic average risk free rate.

141. The pattern of beta for New Zealand government bonds and those of other governments internationally gives rise to two critical implications for the use of NZ government bond yields as the proxy for the risk free rate in CAPM. That is, two adjustments to regulatory practice are required to account for the pattern of observed betas on New Zealand government bonds through time:

- The prevailing risk free rate must be adjusted upwards from the prevailing nominal bond yield by around 0.8% to account for the fact that that the best estimate of the prevailing nominal government bond beta is around -0.1. This implies that the tax adjusted risk free rate is 0.6% (0.8% × (1 – 0.28)) above the estimate based on five year government bond yields;
- The historical average excess returns needs to be adjusted upwards by around 0.8% to account for the fact that historical average betas for government bond yields (against which excess returns have been measured) were likely around 0.1 (i.e., 0.1 above the true risk free level of zero).

142. In short, factoring in both positive betas for government bonds historically and negative betas for government bonds currently results in an approximate 1.4% increase in the estimated market cost of equity. This is comprised of a 0.8% increase in the historical average TAMRP (from 7.2% to 8.0%) plus a 0.7% increase in the risk free rate above prevailing levels of government bond yields.

2.2.4.1 Prevailing New Zealand government bond yields underestimate prevailing zero beta returns

143. Negative risk for government bonds means that their yields will be a downward-biased proxy for the risk free rate in the CAPM (the expected return on a zero beta asset). This means that if the CAPM is implemented using New Zealand government bond yields as a proxy for the risk free rate, then a premium of around 0.8% would need to be added to prevailing government bond yields to arrive at an unbiased estimate of the true (zero beta) risk free rate.

144. I arrive at this 0.8% estimate by:

a. assuming that investors' perceived asset beta on a NZ government bonds is -0.10 (based on the levels observed in Figure 14); and

b. multiplying this by the prevailing DGM estimate of the CAPM TAMRP relative to the true risk free rate of 8.3%. This is calculated from the 9.1% estimate of the DGM in July 2015 in the following manner.[48]

[48] Appendix B shows how the formula is derived.

$$TAMRP_{Rel\ to \beta=0} = \frac{TAMRP_{Rel\ to\ NZ\ govt\ bonds}}{1 - \text{beta of NZ gov bonds}}$$

$$= \frac{9.1\%}{1.0 - (-0.1)} = \frac{9.1\%}{1.1} = 8.3\%$$

145. This gives rise to an estimate of a 0.8% ($0.1 * 8\%$) negative risk premium embedded in New Zealand government bond yields. Such an estimated adjustment is low relative to the asset beta for government bonds globally that flows from the IMF data, which I have estimated at around -0.25 (see paragraph 114).

2.2.4.2 Historical excess returns relative to New Zealand government bonds underestimate excess returns relative to zero beta returns

146. To the extent that the MRP estimate is based largely on historical estimates of excess returns relative to historical government bond yields over a long period (of around 80 years), then a further adjustment is required for this historical average MRP estimate. This is because the best estimate of the historical average asset beta for New Zealand government bonds is that beta was above zero for the majority of this time, thereby elevating government bond yields above the true (zero beta) risk free rate. Therefore, any historical estimate of the TAMRP relative to government bonds will be less than the TAMRP relative to the true (unobserved zero beta) risk free rate.

147. Daily New Zealand government bond yields are not available prior to 1985, however, as shown in Figure 14, the oldest beta estimate is around 0.15. A much longer time series is available from the US, and Campbell et al. provide evidence that suggests an average value in excess of 0.1 for 10 year nominal US Treasury bonds. Using 0.1 as the estimate of the historical average beta for 5 year nominal government bonds and using equation (1) above this implies that the true excess return relative to the zero beta rate is:[49]

$$TAMRP_{Rel\ to \beta=0} = \frac{TAMRP_{Rel\ to\ NZ\ govt\ bonds}}{1 - 0.1}$$

148. Consequently, if the best estimate of the historical average TAMRP relative to government bond yields is 7.2% (the updated value of Lally's Ibbottson estimate as per section 2.3.1.1) then the best estimate of the TAMRP relative to the true (unobservable) zero beta asset is 8.0%.

[49] Appendix B shows how the formula is derived.

2.2.4.3 Adjustments not required (or less important) if MRP estimate is not based on historical excess returns relative to government bonds

149. If the cost of equity is being estimated using a prevailing estimate derived from the DGM then a much smaller adjustment is required to the New Zealand government bond yield. This is because the DGM will automatically 'pick up' any downward bias in government bond yields in the form of a higher estimated TAMRP relative to those yields.

150. To see why, note that the cost of equity estimated using this methodology is as follows.

$$R_e^{Firm\ i} = \text{RFR} + \beta_i \cdot (R_e^{Market} - \text{RFR})$$

151. It can be seen that the same risk free rate (RFR) estimate enters twice in the above equation – once with a positive sign and once with a negative sign. Therefore, any mis-estimation of the risk free rate will tend to cancel out. If the value of β_i=1, then it will cancel out perfectly and mis-estimation of the risk free rate will not affect the estimate of the cost of equity for firm "i". If the value of β_i is less than (more than) 1 then mis-estimation of the risk free rate will result in an error but it will be much smaller than the original mis-estimation for values of β_i close to 1. For example, if β_i=0.8 then even if the risk free rate is underestimated by 1% then the cost of equity will only be underestimated by 20bp (=(1-β_i)*1%).

2.2.5 The European sovereign debt crisis: an illustration

152. In my March 2015 report I noted that the fall in risk free yields globally was, in part, linked to the ongoing Eurozone sovereign debt crisis and particularly, at that time, fears about Greek exit from the Eurozone ("Grexit"). This provides a good illustration of one of the factors that drive equity and safe government bond yields in opposite directions (i.e., contribute to a negative beta and the inverse relationship between government bond yields and TAMRP).

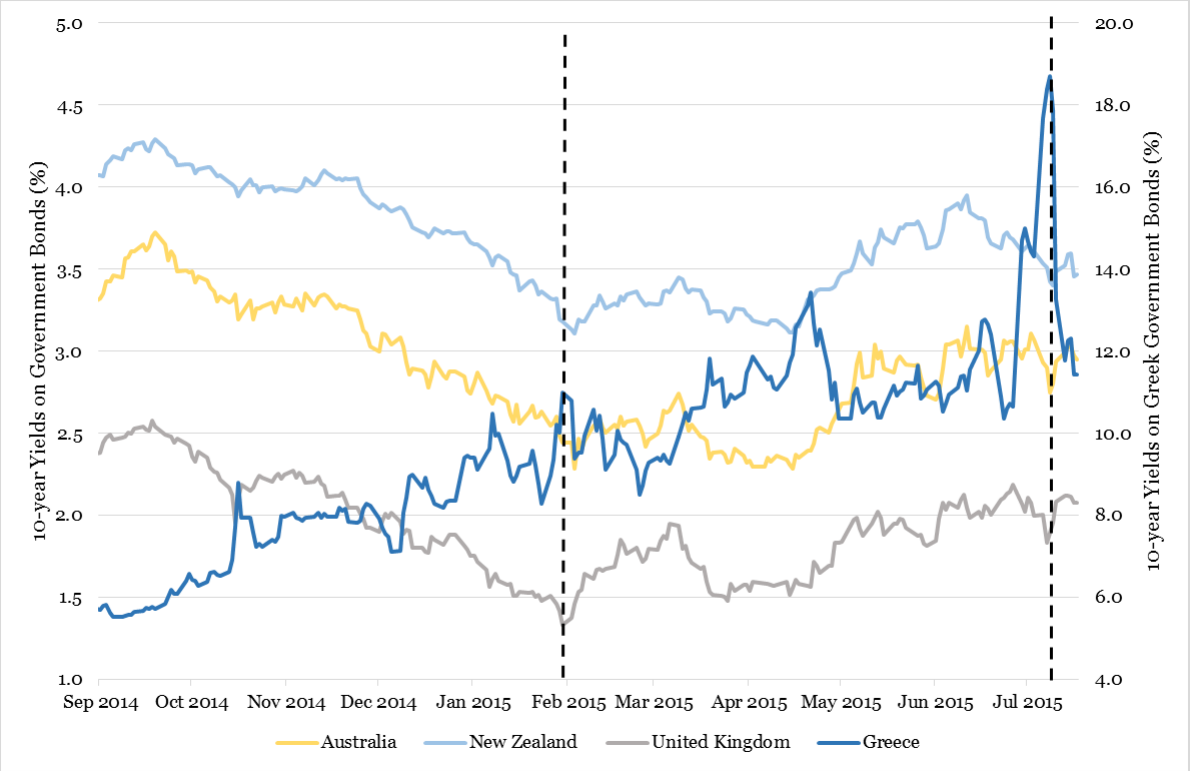
153. In my earlier report I noted that the fall in developed country government bond yields in 2015 was coincident with heightened fears of Greek default and Grexit. I also noted that the (then) lowest yields on New Zealand, Australian and UK ten year Government debt occurred on the same day that the yields on Greek debt reached their (then) maximum. Figure 4 from that report provided a graphical illustration of this.

154. The Greek debt crisis continued to evolve after that report was submitted and reached new heights with the closing of Greek banks and a referendum announced in late June 2015 (held 5 July 2015) that raised the expected probability of default and Grexit – especially after the referendum result appeared to provide some internal political support for such a course of action.

155. Greek bond yields reached a new peak on 8 July 2015 and it can be clearly seen in Figure 17 below that UK, Australian and New Zealand bond yields all had a local minimum on the same day (or, in the case of Australian and New Zealand bonds, due to time differences, the next day).

156. The overall negative correlation between Greek and New Zealand debt is clear in Figure 17. Over 2015 there was a correlation of -0.22 between the yield on Greek and New Zealand government bond yields. Heightened fear of "Grexit" is clearly one factor influencing global capital markets causing a flight to the safety over 2015. As I noted in my March 2015 report, it is impossible to tell whether this will be a temporary bout of heightened uncertainty or more long lived. However, there is no reason to believe heightened fears of global shock to financial markets would lead to lower cost of equity in New Zealand. Yet this is what the Commerce Commission's proposed cost of equity methodology gives rise to in its further draft determination.

Figure 17: Yields on New Zealand (and other low risk sovereign) debt vs yields on Greek government debt UPDATED



Source: Bloomberg, CEG analysis

2.3 Update of Lally's methodology

2.3.1 Update of Lally's TAMRP estimate

157. Lally's paper of 13 June 2014 sets out his view that TAMRP should be determined as the median of five separate measures. For a TAMRP measured relative to the five year risk free rate, the median of these measures was 6.9% at the time Lally performed his analysis.[50] The Commission has ultimately relied on Lally's advice in support of its 7.0% estimate for the TAMRP in its further draft determination.[51]

158. I have applied Lally's 2014 methodology to 2015 data (updated risk free rate data, the full year of 2014 market return data, and the 2015 survey from Fernandez *et al* rather than the 2013 survey relied on by Lally). This results in a median TAMRP of 7.4%, 0.5% higher than at the time of Lally's analysis, and is summarised in Table 5.

Table 5: Updating Lally's TAMRP estimates

	Lally estimate (13 July 2014)	Updated estimate (no change in method)
Ibbotson	7.1%	7.2%
Siegel (version 1)	5.9%	6.0%
Siegel (version 2)	6.9%	7.8%
DGM	8.2%	9.1%
Survey	6.7%	7.4%
Median	6.9%	7.4%
Mean	7.0%	7.5%

Source: Lally, Bloomberg, RBNZ, Google Finance, CEG analysis

2.3.1.1 Purely historical estimates (Ibbotson and Siegel (version 1)

159. Table 5 shows that the Ibbotson and Siegel (version 1) estimates of TAMRP have only increased modestly between mid-2015 and the present time. This reflects the nature of these methods as purely historically focused estimates. Nonetheless, the 2014 returns for the New Zealand stock market were materially above average in 2014 such that the average for these measures has increased by 0.1% each.

160. In order to make this update we have sourced 2014 equity market growth estimates for the NZX50 Gross Index and the NZX50 Capital Index from Google Finance, which indicates growth of 16.8% and 11.9% respectively in these indices. We have followed

50 Lally, *Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, 13 June 2014, p. 39

51 Commerce Commission, *Cost of capital for the UCLL and UBA pricing reviews: Further draft determination*, 2 July 2015, p. 45

Lally in sourcing risk free rate and inflation estimates for 2014 from the RBNZ, which reports average ten year government bond yields in 2014 of 4.3% and CPI inflation over the year of 0.8%. Based on these inputs and using Lally's formulae, we estimate an Ibbotson estimate of the 2014 TAMRP of 12.5% and a Siegel estimate of the 2014 TAMRP of 12.6%. The real market return over the year was 14.9%. These results give rise to:

- an average Ibbotson TAMRP over 1931 to 2014 of 7.2%, up from Lally's estimate of 7.1% over 1931 to 2013; and
- an average Siegel (version 1) TAMRP over 1931 to 2014 of 6.0%, up from Lally's estimate of 5.9% over 1931 to 2013.

2.3.1.2 Historical return on the market less the prevailing risk free rate (Siegel (version 2))

161. The Siegel (version 2) estimate changes by more than the other two historical average estimates because it depends on the prevailing risk free rate which has fallen. The Siegel (version 2) methodology starts with the historical average real return on the market (Lally estimates this at 7.7%) plus forward looking expected inflation (Lally estimates this at 2%) to arrive at an estimate of the prevailing expected nominal return on market of 9.9% $((1 + 7.7\%) \times (1 + 2\%) - 1)$.

162. Lally estimates TAMRP using an average of real market returns over a long period from 1900 to 2013 based on data sourced from Dimson, Marsh and Saunton. Assuming that real market returns of 7.7% are stable over time and combined with expected inflation of 2.0%, Lally calculated a nominal return on the market of 9.9% $((1 + 7.7\%) \times (1 + 2\%) - 1)$. This implied a TAMRP of 6.9% in April 2014 by subtracting the tax adjusted five year risk free rate of $4.23\% \times (1 - 0.28)$ prevailing in April 2014. Lally called this TAMRP estimate the Siegel (version 2) approach.

163. This methodology involves deducting the prevailing tax adjusted risk free rate. At the time of his 2014 report this was $4.23\% \times (1 - 0.28)$. However, most recently, over the 1 July to 27 July period, yields on five year New Zealand government bonds averaged 2.93%. This indicates a TAMRP of 7.74% relative to the five year risk free rate $((1 + 7.7\%) \times (1 + 2\%) - 1 - 2.9\% \times (1 - 0.28))$.

164. In addition, as noted above, the 2014 real market return was 14.9%. Including 2014 data raises the historical average return from 7.70% to 7.76% and raises the resulting TAMRP by 0.06% to 7.80%.

2.3.1.3 DGM

165. Lally estimates TAMRP based on a DGM of 8.2% based on data in November 2013. Lally reviews CEG's implementation of the DGM and endorses a long run growth rate of dividends (4.0%) and an uplift for the value of imputation credits of 38.9%.[52]

166. We have implemented an updated DGM for the period 1 July to 27 July with the same assumptions. In this recent period, we estimate a TAMRP of 9.1%, calculated relative to tax adjusted five year New Zealand government bond yields.

2.3.1.4 Survey estimates

167. Lally's estimate of TAMRP from survey evidence relies upon the results of a single survey, that of Fernandez, Aguirreamalloa and Linares of the IESE Business School.[53] That survey was updated in 2014 to include 88 countries,[54] and again in 2015 to include 41 countries, each time with some changes to the authors.[55] In the most recent 2015 survey, the average MRP reported for New Zealand is 6.6%, higher than the 2013 survey in which the reported average was 5.4%. I note that in 2015 the sample size for the New Zealand dataset is 31 respondents. This is a considerably larger sample size than the 8 that responded in 2013, but it still a very small sample upon which to place such reliance.

168. Lally calculates a TAMRP by adding the corporate tax rate multiplied by the risk free rate. In his calculation, Lally used a risk free rate of 4.55% sourced in April 2014. However, given the fall in risk free rates since Lally perform his analysis I make this adjustment using a lower risk free rate (the effect of which is to make the estimated TAMRP smaller than it would have been if risk free rates had not fallen and the survey data was otherwise the same).[56]

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52 Lally, *Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, 13 June 2014, pp. 32-35, 38-39

53 Fernandez, P., Aguirreamalloa, J. and Linares, P., *Market Risk Premium and Risk Free Rate used for 51 countries in 2013: a survey with 6,237 answers*, 26 June 2013

54 Fernandez, P., Linares, P. and Acin, I.F., *Market Risk Premium used in 88 countries in 2014:a survey with 8,228 answers,* 20 June 2014

55 Fernandez, P., Ortiz, A. and Acin, I.F., *Discount Rate (Risk-Free Rate and Market Risk Premium)used for 41 countries in 2015: a survey*,

56 I also note that Lally's use of a 2014 risk free rate to adjust a 2013 MRP estimate into a TAMRP estimate is problematic. Specifically, if the survey evidence was forward-looking at that time, the April 2014 risk free rate would not be consistent with the prevailing risk free rate in May and June 2013 that set expectations reported in the survey.

169. In updating Lally's estimate, we adjust the MRP reported in the 2015 survey with a risk free rate provided in the same survey of 2.9%. This gives rise to a TAMRP of 7.4%, higher than Lally's estimate of 6.7% based on the 2013 survey evidence.

2.3.2 Modifications to Lally's methodology

170. In my view there are also some modifications to Lally's methodologies that will make them more accurate. I explain these in detail in Appendix D but simply present the results here. I note that neither the median nor the mean change.

171. Appendix D also sets out reasons why I would recommend only relying on two methods: Siegel (version 2) and DGM. If this is implemented the median and the median estimate would be 8.5% (not shown in the table below).

Table 6: Updating and adjusting Lally's TAMRP estimates

	Lally estimate (13 July 2014)	Updated estimate no change in method	Updated estimates and CEG method
Ibbotson	7.1%	7.2%	7.3%
Siegel (version 1)	5.9%	6.0%	6.1%
Siegel (version 2)	6.9%	7.8%	7.8%
DGM	8.2%	9.1%	9.1%
Survey	6.7%	7.4%	7.4%
Median	6.9%	7.4%	7.4%
Average	7.0%	7.5%	7.5%

Source: Lally, Bloomberg, CEG analysis.

2.4 Policy recommendation

172. The Commission has available to it a range of solutions to the problems identified above. All solutions involve ensuring that the way that the TAMRP and the risk free rate are estimated are internally consistent. The Commission could choose to estimate both the risk free rate and the TAMRP over the longer term, resulting in a relatively higher risk free rate and a lower TAMRP than if purely prevailing estimates were used. Alternatively, the Commission could estimate both the risk free rate and the TAMRP using prevailing estimates, resulting in a relatively lower risk free rate and higher TAMRP than if historical averages were used. All regulators in our survey have addressed the problems identified above using some combination of these approaches.

173. I consider that the best approach is to give 100% weight to prevailing estimates of the risk free rate and the TAMRP. Using the five year government bond rate over the 1 July to 27 July as the proxy for the risk free rate results in a (2.1%) 2.9% (tax adjusted) risk free rate and TAMRP of 9.1%. This results in an estimate of the market cost of

equity of 11.2%. I note that this is, in large part, the approach adopted by the ERA in Australia.

2.4.1 BIPT methodology as an alternative

174. An alternative solution is to ensure that the TAMRP and risk free rate estimates give the same weight to historical (long term) and prevailing (future) information when determining the risk free rate as when determining the TAMRP. In this regard, the Belgian telecommunications regulator (BIPT) has provided a very useful framework for ensuring that risk free rate and TAMRP are estimated in an internally consistent manner – with the same mix of prevailing and historical data used to determine each.

175. BIPT issued a decision regarding the WACC for operators with significant market power in Belgium on the 26 February 2015.[57] The WACC will apply in several upcoming decisions, including for the incumbent Belgacom's upcoming reference offers for interconnection, unbundled access, bitstream access and leased lines.

176. BIPT estimated a risk free rate of 2.63%, a MRP of 6.0%. Table 7 compares the 2010 WACC parameters to the most recent parameters.

Table 7: BIPT WACC parameters 2010 and most recent

	2010	2015 Decision
Risk free rate	4.00%	2.63%
Market risk premium	5.25%	6.03%

Source: BIPT 28 February 2015 decision

177. BIPT notes in its decision that an overall consistency problem is created by the virtue of that the risk free rate can vary considerably over time while the historical average market risk premium remains relatively stable. BIPT also notes that different methodologies for estimating MRP rely to varying degrees on historical averages. For example, historical average measures of excess returns (i.e., Lally's Ibbotson and Siegel (version 1) measures) are predominantly estimated using data that is 'long term'; from periods that are outside the period over which a short term risk free rate is estimated. By contrast, DGM estimates of the prevailing MRP are estimated purely using prevailing data (prevailing during the period that the short term risk free rate is estimated).

[57] BIPT (2015), *BIPT decision of 26 February 2015 regarding the cost of capital for operators with significant market power in Belgium,* available here: http://www.bipt.be/en/operators/telecommunication/Markets/price-and-cost-monitoring/cost-accounting/bipt-council-decision-of-26-february-2015-regarding-the-cost-of-capital-for-operators-with-a-significant-market-power-in-belgium

178. Somewhere between these measures are survey estimates (such as the Fernandez survey used by Lally which the BIPT also relies on). The BIPT determines that these survey measures reflect a 50/50 mix of respondent's views about the historical average MRP and the prevailing MRP.

179. Using this logic BIPT assigns each MRP estimate (referred to as equity risk premium (ERP) by BIPT) a value for "% LT", which is used to determine the weight that is given to "long-term" historical average data in arriving at a TAMRP estimate. These can be seen in the rightmost column of Table 8 below[58].

180. BIPT also transparently sets out the weight that it has given to each source of estimate for the TAMRP. This is shown in the middle column of Table 8. The ultimate result of this analysis is twofold:

- a weighted average ERP estimate of 6.0%; and
- a weighted average "% LT" of 36%. This is the weighted average of each individual methodologies "% LT". This is BIPT's estimate of the weight that it has, in estimating the ERP, given to historical average excess returns from prior to its averaging period for the "prevailing" risk free rate.

Table 8: ERP estimates and weightings

	Weightings for ERP estimate	ERP	% LT
Implied ERP	50%	7.1%	0%
Historical ERP	25%	4.0%	84%
Survey of regulators	15%	5.8%	67%
Survey by Fernandez	10%	5.8%	50%
Weighted average		6.0%*	36%**

*Source: BIPT 28 February 2015 decision, accompanying spreadsheet #1. *Cell reference c359 in ERP sheet. **Cell reference I359 in ERP sheet. Note that the BIPT subsequently decomposes the 6.0% ERP in Belgium into a 5.4% ERP for the world plus a 0.6 additional Belgium specific risk premium (see J12 in the "CRP & Rnot" sheet).*

181. The % LT factor is used to calculate a % LT premium, which is added to the estimate of the risk free rate. Specifically, BIPT estimates a "prevailing" rate of 2.15%. This is a three year average of government bond yields (the BIPT uses ten year German bond yields). It also estimates a long term risk free rate of 3.48%; which is the average risk free rate on Euro bonds since November 2001. The difference between the long term

[58] Note that the Historical ERP is less than 100% because even BIPT's short term risk free rate is estimated over 3 years so some part of the historical average ERP is measured concurrently with the short term risk free rate.

rate of 3.48% and the recent rate of 2.15% is 1.32%. BIPT sets the risk free rate equal to the short term estimate (2.15%) plus 36%*1.32% (=0.48%).

182. In summary, the BIPT estimates its risk free rate using the same combination of long run average data as is used in the estimate of the ERP.

183. Ultimately, the ERP is set 2.0% above the historical ERP because most weight (64%) is given to prevailing estimates and these are materially higher than the historical average ERP. However, in recognition of the fact that the BIPT has given 36% weight to the historical average ERP it also, in an attempt to ensure internal consistency between its estimates, also gives 36% weight to historical average risk free rate estimates.

184. To the extent that any weight is to be given to historical average estimates of the TAMRP, I would commend the BIPT's methodology to the Commission. It has the advantage of being transparent in how the TAMRP is estimated (with specific weights being given to different estimates) and, most importantly, this allows for the potential to arrive at an internally consistent estimate of the risk free rate. In the following section I demonstrate how the BIPT method could be applied in New Zealand. Obviously, this is just one of numerous possible implementations. However, it is one that I consider results in a reasonable estimate of the overall market cost of equity.

2.4.2 Implementation of BIPT method in New Zealand

185. In Table 9 I propose weightings for each of Lally's five estimation methods, which are broadly consistent with those applied by the BIPT. Specifically, consistent with the Belgian precedent, the DGM is given 50% weight and a "% LT" of 0%. Surveys are given 25% weight (all of this weight falls in the Fernandez survey in this case)[59] and a "% LT" of 50%. The remaining three estimates that are explicitly based on historical average market returns are each given one third of the remaining 25% weight (i.e., 8.3%). The Ibbotson and Siegel (version 1) estimates are assigned "% LT" of 100% reflecting their sole reliance on historical data. The Siegel (version 2) estimate of the TAMRP is assigned a "% LT" of 50% reflecting the fact that this estimate is equal to the historical return on the market (% LT of 100%) less the prevailing risk free rate (% LT of 0%).

186. The weighted average MRP estimates resulting from the weightings in Table 9 are summarised in Table 10.

[59] The BIPT also gave 25% weight to surveys but divided this between 10% to Fernandez and 15% to its survey of European regulators.

Table 9: Proposed weightings of MRP approaches

	Weighting in MRP	% LT
Ibbotson	8.3%	100%
Siegel (version 1)	8.3%	100%
Siegel (version 2)	8.3%	50%
DGM	50%	0%
Survey	25%	50%
Weighted average		33.3%

Source: CEG analysis based broadly on Belgian precedent

187. The Commission estimated a prevailing risk free rate in March 2015 of 3.26%. As at July 2015 the updated corresponding estimate is 2.93%.[60] By contrast, the long term 5 year risk free rate is estimated as the average 5 year yield since November 2001 is 5.77%. Combining these values with a 33% value for "% LT" results in a risk free rate of 3.88% $(2.93\% + 33.3\% \times (5.77\% - 2.93\%))$. The tax adjusted risk free rate is 2.79% $(3.88\% \times (1 - 0.28))$. This is a 68bp premium to the prevailing tax adjusted value of the five year government bond rate of 2.11% $(2.93\% \times (1 - 0.28))$.

188. I note that, if the Commission choses to implement the Belgian precedent in full, it would use the ten year risk free rate as the "underlying" or "prevailing" rate. This would add a further 36bp to the risk free rate estimate.[61] In addition, the Commission would use the 3 year average of the risk free rate as the prevailing rate. This would add a further 44bp to the risk free rate (or 80bp in combination with the use of a 10 year rate).[62] For the purpose of clarity, the below analysis does not follow BIPT precedent in this regard.

189. Table 10 shows the calculation of the weighted average TAMRP when using the weights set out in Table 9. The values for each of the individual TAMRP estimates are taken from Table 6. These are combined with the tax adjusted risk free rate of 2.79% derived in paragraph 187 above to provide an estimate of the total market cost of equity.

60 This is the average annualised yield estimated by interpolation between yields for bonds with maturity either side of 5 years as reported by Bloomberg over the period 1 July to 27 July.

61 It would increase the "prevailing" risk free rate from 2.93% to 3.37%. When combined with a historical average risk free rate of 5.97% the resulting risk free rate estimate would be 4.24% (a 1.31% premium to the prevailing 5 year bond rate).

62 The "prevailing" risk free rate would be 4.04%. When combined with a historical average risk free rate of 5.97% the resulting risk free rate estimate would be 4.69% (a 1.76% premium to the prevailing 5 year bond rate).

Table 10: Weighted average TAMRP estimates

	Lally estimate (2014)	Updated estimate (no change in method)	Updated estimates and CEG method
Ibbotson	7.1%	7.2%	7.3%
Siegel (version 1)	5.9%	6.0%	6.1%
Siegel (version 2)	6.9%	7.8%	7.8%
DGM	8.2%	9.1%	9.1%
Survey	6.7%	7.4%	7.4%
Weighted average TAMRP*	**7.43%**	**8.15%**	**8.17%**
TA RFR	**2.79%**	**2.79%**	**2.79%**
Estimate of the market cost of equity	**10.2%**	**10.9%**	**11.0%**

*Source: CEG analysis. *Using weights from Table 9 above.*

190. It can be seen that the estimated market cost of equity is 10.9% to 11.0% (using the updated 2015 TAMRP estimates). This is similar to giving 100% weight to the DGM estimate of the market cost of equity 11.2% (9.1% + 2.1%). By comparison, simply combining the further draft determination TAMRP (7.00%) with the prevailing tax adjusted risk free rate (2.1%) results in a market cost of equity estimate of 9.1%.

2.4.3 Summary

191. In my view the best way to arrive at an internally consistent estimate of the risk free rate and TAMRP is to give 100% weight to prevailing estimates of both. However, to the extent that weight is to be given to historical average excess returns on the market then I consider that the BIPT's method provides a well-constructed and transparent methodology for arriving at internally consistent estimates.

3 Asset beta and leverage

192. The Commission has revised its estimate of the asset beta up from 0.40 to 0.45 largely as a result of giving greater weight to data from before the most recent five year period. I consider that this change in methodology is likely to go some way to leading to a materially better estimate of the asset beta.

193. In this section, I demonstrate that correcting for the bias associated with assuming an invariant zero debt beta for all firms in the sample raises the average monthly five year asset beta over the 2009 and 2015 samples from 0.45 to 0.485. This assumes that the remainder of the Oxera/Commission's methodology is retained. Adopting this value would not only remove the bias but also align the Commission's estimate with regulatory precedent.

194. Note that my best and preferred approach is still to have regard to a longer time series and a larger sample of comparators when estimating the asset beta, consistent with the analysis and views presented in my July 2014 report. When this is done the estimated asset beta is above 0.59.[63] Restricting the analysis to Oxera's sample but continuing to use a long run historical average beta, the best estimate is 0.53.[64]

195. In this section I work only with the asset betas that Oxera has presented and on which the Commission relies. That is, I put aside my views on the use of a longer time series and sample selection. I do this in order to illustrate and quantify a bias that exists in the Commission's methodology that results from the assumption of a zero debt beta and the adoption of sample average leverage. I estimate that the impact of this is to understate the allowed equity beta by at least 0.05 and up to 0.15.

3.1 Bias in the Commission's estimate

196. The further draft determination recognises that, in reality, debt absorbs systemic risk and the higher the level of gearing the higher the systemic risk (debt beta) that is attached to debt issuance:[65]

> *We recognise that the greater the riskiness of debt, the more it resembles equity. Therefore, the greater the systematic risk of debt due to market conditions, the greater is the debt beta. Consequently, in principle, debt betas should be included in the cost of capital calculation. The use of non-*

63 See the first column of numbers in Table 2 on page 22 of my July 2014 report Review of Lally and Oxera reports on the cost of capital.

64 See the second column of numbers in Table 2 on page 22 of my July 2014 report Review of Lally and Oxera reports on the cost of capital.

65 Commerce Commission (2015), *Further draft determination*, paragraph 211 on pp. 48-49.

zero debt betas is theoretically more sound than using notional leverage as the use of non-zero debt betas would reduce or eliminate the extent to which the post-tax WACC estimate for each service varies with leverage.

197. Debt betas associated with highly levered (geared) businesses will be greater than debt betas associated with businesses with low gearing. This is because as gearing increases debt becomes more like equity until, as gearing approaches 100%, debt becomes indistinguishable from equity.

198. The further draft determination acknowledges this fact when it summarises Oxera's approach to estimating an asset beta for Chorus. However, the Commission incorrectly concludes, at the end of the following passage, that it can ignore the impact of debt betas because it is not placing primary weight on the beta for (the highly geared) Chorus and because it is setting benchmark leverage equal to sample average leverage: [66]

In its original report, Oxera proposed using a positive value for debt beta. In particular, Oxera noted that Chorus' actual gearing of over 60% (which had consistently risen over the period of analysis), was materially above a notional gearing assumption of 40%, that Chorus' gearing had risen over the period, and Chorus had a credit rating below Oxera's recommended credit rating (of BBB+/A-). Accordingly, Oxera considered there might be a sufficiently material impact on the analysis and proposed using a debt beta of between 0.05 and 0.10.

By contrast, we do not place primary weight on Chorus' beta, and Chorus' leverage has a much lesser influence on our analysis (which uses a sample of comparator companies with average leverage much lower than Chorus), than it does on Oxera's analysis of beta (which focused on Chorus).

Further, as demonstrated in the IMs reasons papers, if we assume a value of leverage in line with that observed for the respective sample of comparator companies, then the cost of capital estimated will be the same for those services regardless of the value assumed for the debt beta.

Accordingly, we do not think there is any need for us to estimate an appropriate value for debt beta if we adopt the average leverage of the revised comparator sample (37%).

199. The last statement is not correct. A correct statement is as follows:

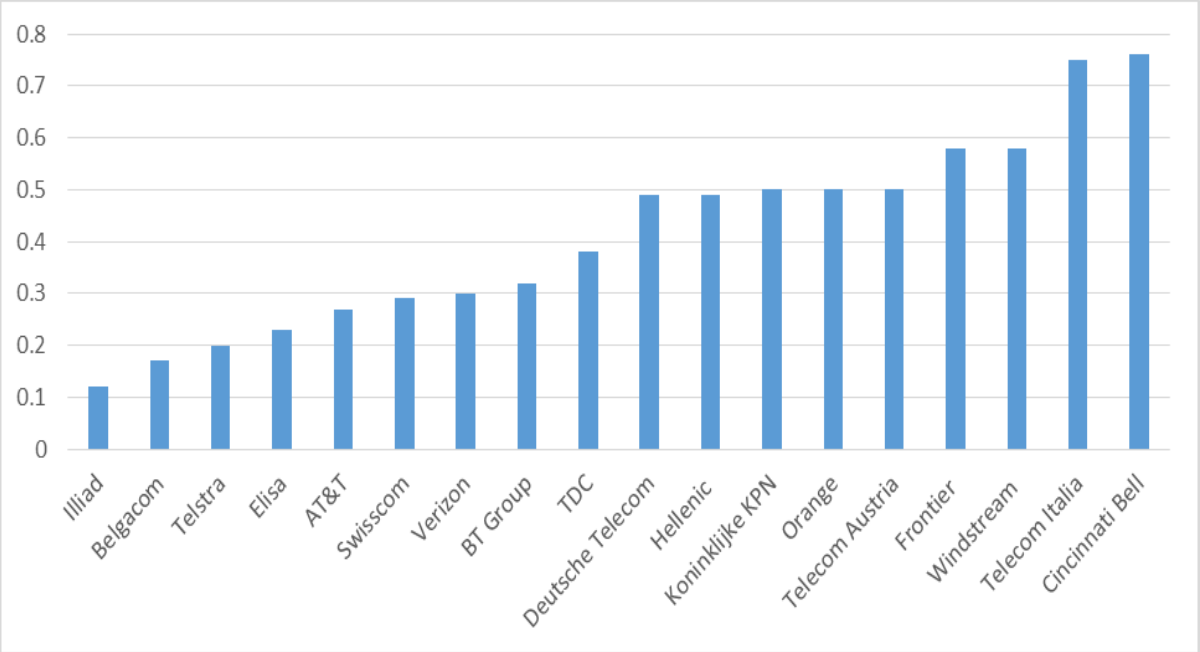
- if the assumed 'benchmark' leverage is set equal to the average leverage of all firms; then

66 Commerce Commission, *Further draft determination*, paragraphs 213-216 on p. 49.

- the benchmark equity beta (associated with the benchmark leverage) will be largely insensitive to the debt beta assumed; provided
- the same debt beta is used to 'de-lever' observed equity betas to asset beta as is used to 're-lever' the average asset beta back to the benchmark equity beta estimate.

200. However, this is only a justification for ignoring the role of debt betas if it is assumed that all firms in the sample have the same debt beta. This is a reasonable assumption only if all firms in the sample have similar leverage and, therefore, similar debt beta. In that case, the choice of debt beta is relatively unimportant – subject to the caveat outlined in the last dot point. However, all firms in Oxera's sample do not have similar leverage, as illustrated in Figure 1 below.

Figure 18: Oxera sample five-year leverage (2015)



Source: CEG illustration of data in Table A1.1. of Oxera (2015)

201. Clearly, the firms on the right hand side of this chart have materially higher gearing than the firms on the firms on the left hand side, and can be expected to have higher debt betas. This will lead to a downward bias in the estimated asset betas and, importantly, the re-levered benchmark equity beta.

202. The bias that I am describing can be illustrated by a simple example. Let the debt beta be zero at levels of gearing below 40% but rise as gearing goes above 40% and is 0.2 at 60% gearing. Now, consider two otherwise identical firms both with an asset beta of 0.50 but one with gearing of zero and another with a gearing of 60%. Using the standard leverage formula adopted by Oxera the observed equity betas for these firms will, putting aside measurement error, be 0.50 and 0.95.

203. If we estimate the asset beta assuming a zero debt beta for both firms then the first firm's asset beta will be correctly estimated at 0.5 but the second firm's asset beta will be underestimated at 0.38 (i.e., underestimated by 0.12). That is, the asset beta associated with the highly geared firm is underestimated but there is no offsetting overestimate of the lowly geared firm's beta. Consequently, the average asset beta is underestimated by 0.06 and this is not corrected by re-levering using a zero debt beta to the sample average leverage (30%).

204. Specifically, the average asset beta will be 0.44 (0.38 + 0.5)/2), the average leverage will be 30%, and the associated debt beta of zero. Using the average gearing and average asset beta (along with a zero debt beta) will result in an estimated equity beta of 0.63 (0.44/(1 – 0.3)). However, the correct equity beta at 30% gearing would be 0.71 (0.5/(1 – 0.3)). This demonstrates that even if the same (zero) debt beta is used to derive an average asset beta and then re-lever to (sample average) leverage the resulting equity beta is below the true equity beta at the gearing.

205. Oxera noted precisely the potential for this bias in its June 2014 report. In that report Oxera estimated the potential magnitude of this bias at 0.01 to 0.03 for the asset beta: [67]

> *The analysis indicates that the assumption of a non-zero debt beta value for firms with relatively moderate to high levels of gearing leads only to a marginal increase of 0.01–0.03 for the average comparator asset beta. This would not affect our conclusion that the Chorus beta analysis remains an appropriate focal point for the selection of an equity beta for UCLL and UBA.*

206. This was based on the assumption that, below 40% leverage, debt betas were zero but, above 40% leverage, debt beta was 0.05 or 0.10.

207. I have repeated the same analysis on Oxera's 2015 five year asset beta sample – using only asset beta and leverage data presented in Oxera's 2015 report and Oxera's leverage formula as set out below:[68]

$$\beta_a = \beta_e \times \left(\frac{E}{D+E}\right) + \beta_d \times \left(\frac{D}{D+E}\right)$$

where E is the market capitalisation of the firm and D is the market value of debt.

208. When I do this I estimate that the average monthly five year 2015 asset beta of 0.430 to 0.444. This is 0.020 to 0.034 higher than the 0.41 value that the Commission relies on for the 2015 asset beta estimate (based on the assumption that all firms in the

67 Oxera, Review of the beta and gearing for UCLL and UBA services, June 2014, p. 50

68 Ibid, p. 48.

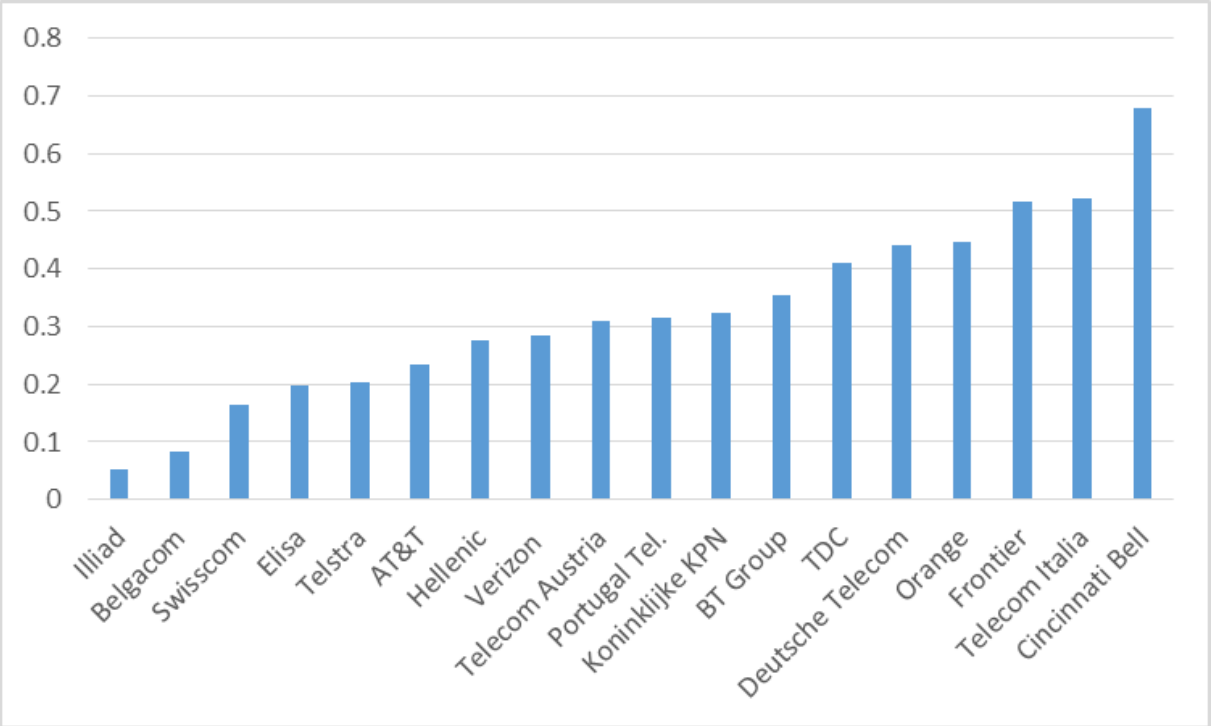
sample have a zero debt beta).[69] Such an increase in asset beta will, at the Commission's benchmark gearing of 37%, increase the estimated equity beta by 0.03 to 0.05.

209. In my view this is material and should be taken account of in the Commission's final estimate. Moreover, this is a highly conservative assumption. It assumes that the debt beta of Cincinnati Bell (with leverage of nearly 80%) is the same as the debt beta of Deutsche Telecom (with leverage of less than 50%). A more realistic assumption is that debt beta is 0.075 (the middle of Oxera's range) for leverage between 40% and 55% and double this (0.15) for leverage greater than 55%.

210. If this assumption is implemented the average five year asset beta in 2015 rises to 0.45. Oxera has not provided its firm specific leverage values for the 2009 asset beta sample. However, I have sourced by own estimates and, when combined with Oxera's asset beta estimates, the same assumptions lead to an asset beta of 0.52. This is only 0.1 higher than the 0.51 estimate of the 2009 average monthly five year asset beta that the Commission is relying on. The smaller increase in the 2009 asset beta reflects the lower average leverage in that sample and fewer firms with high leverage (only one firm with greater than 55% leverage compared to four firms in the 2015 sample).

69 Commerce Commission (2015), *Further draft determination*, Table 3.

Figure 19: Oxera sample five year leverage (2009)



Source: Bloomberg, CEG analysis

211. The results described above are summarised in the below table. The underlying data used in the calculations is provided in Appendix E.

Table 11: Five year monthly asset betas estimated with various debt beta assumptions

Bd is 0% for G<=40%	**2009 sample**		**2015 sample**		**Average**	
and:	Asset beta	Equity beta*	Asset beta	Equity beta*	Asset beta	Equity beta*
0.075 for 40%<G<55%; and 0.15 for G>55%.	0.522	0.770	0.448	0.711	0.485	0.741
0.05 for G>40%	0.514	0.760	0.430	0.682	0.472	0.721
0.10 for G>40%	0.523	0.772	0.444	0.705	0.483	0.739

Source: Oxera, Bloomberg, CEG analysis

212. In summary, correcting for the bias associated with assuming a zero debt beta raises the average monthly five year asset beta over the 2009 and 2015 samples from 0.45 to 0.485. This assumes that the remainder of the Oxera/Commission's methodology is retained. Adopting this value would not only remove the bias but also align the Commission's estimate with regulatory precedent.

213. Note that my best and preferred approach is still to have regard to a longer time series and a larger sample of comparators when estimating the asset beta, consistent with

the analysis and views presented in my July 2014 report. As noted at the start of this report, when this is done, the estimated asset beta is above 0.59. Restricting the analysis to Oxera's sample but continuing to use a long run historical average beta, the best estimate is 0.53.

4 WACC uplift

4.1 Oxera's modelling of uplift

4.1.1 Overview

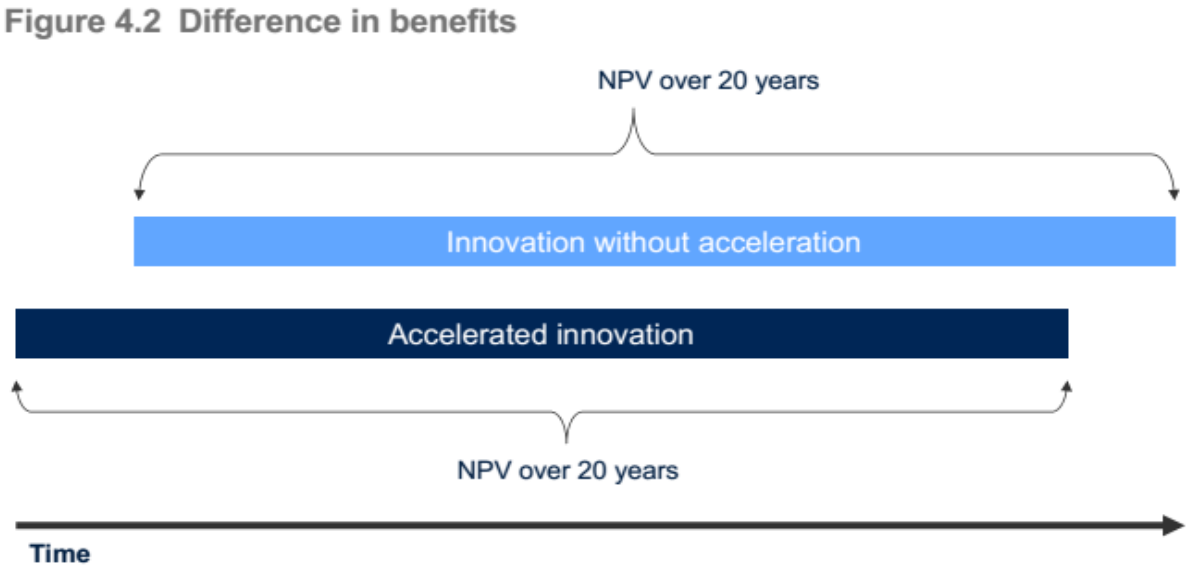
214. Oxera has established a framework to assess the link between the allowed WACC[70] for UCLL and UBA services and the level and/or pace of investment across the value chain.

215. According to the Oxera framework, the cost of an uplift in the WACC is the direct increase in return to investors from the higher WACC allowance, which when reflected in higher prices results in a transfer of surplus to investors.[71] In addition, there is a loss of surplus from reduced consumption at higher prices from an uplift in the WACC. These two elements combined result in the direct cost of the uplift. Against this, the benefit from an uplift in the WACC is calculated as the increase in the present value (PV) of consumer benefits from future investment as a result of the acceleration of investment decisions.

[70] Whilst Oxera's analysis focuses on uncertainty in the WACC and an uplift in the WACC, as we have previously noted, there is uncertainty in the estimate of other parameters that creates risk that the price is set too low for the UCLL/UBA services. We note that Professor Dobbs agreed with CEG that such uncertainty could be incorporated within a model by allowing for greater variance in the WACC. This is noted but not pursued in our review of the Oxera model. See Dobbs (2015), page 20.

[71] In our view these transfers should not be weighted the same as a loss in total surplus. This is particularly important when considering marginal changes in price around a reasonably robust cost estimate. We note the Commission has given lip service to not relying solely on consumer surplus, however we do not see this reflected in any of its assessment of the empirical work.

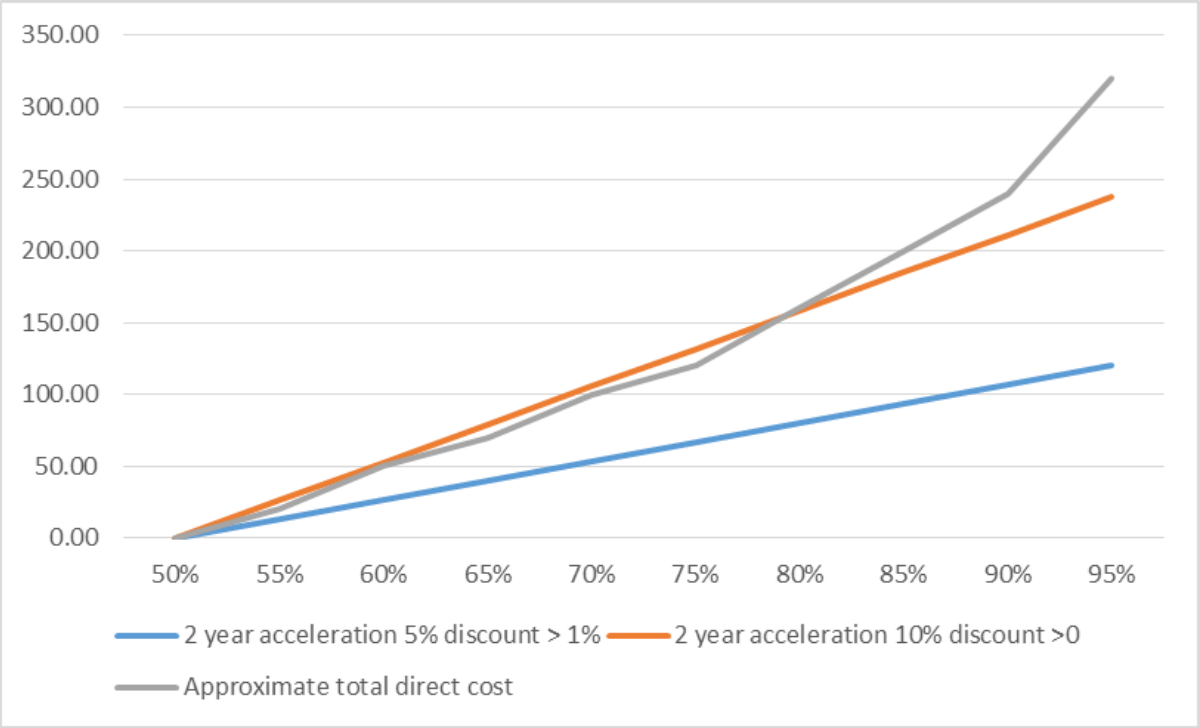
Figure 20: Representation of Oxera modelling framework



Source: Oxera

216. The key finding from Oxera is summarised in Figure 2 below (a reproduction of figure 6.1 from the Oxera report). In Oxera's framework, the benefits and costs are equal to zero at the status quo (i.e., a midpoint WACC), but both increase with the uplift in the WACC. A key difference is that the costs of an uplift increase exponentially with higher uplifts (convex) while the benefits from a higher uplift increase linearly with the uplift.

Figure 21: Oxera model results for two-year acceleration scenario



Source: CEG analysis

217. The effect of this is that in Oxera's most conservative case the costs of a higher uplift exceed the benefits. In most other cases, the benefits of a higher uplift exceed the costs. In this report, we focus on the two-year acceleration scenario as this is supported by data on the acceleration of deployment of broadband technologies in the New Zealand. In the Oxera report, figures are rounded to the nearest NZ$5m to reflect the 'high-level' nature of the calculation.

4.1.2 Correcting cost estimation

218. As noted above, Oxera calculates the cost of an uplift in the WACC based on both:

- the asset base for the regulated service; and
- on the 'new' asset base.

219. Oxera assumes the new asset base to be of the same size ($7.4 billion) as the existing UCLL/UBA asset base, which has effectively doubled the cost for the entire period of its results. Oxera states in its report this was undertaken for simplicity:

> *For simplicity, it is assumed that the new 'asset base' would be of the same size as the existing UCLL/UBA asset base.*

> *In practice … it is more likely that the new technology will either* ***displace*** *some of the existing asset base, or will* ***represent a fraction*** *of the existing asset base. The cost estimates presented in this report are therefore relatively conservative (i.e. err on the high side).*

220. Oxera acknowledges that this assumption is not likely to be reasonable:

> *In practice, an assumption of doubling of the asset base is likely to overstate the costs.*
>
> *A new technology of this size would be likely to displace some of the existing asset base, i.e. consumers are* ***unlikely*** *to be paying for both the existing and the new asset base in full.*

221. In its conservative case Oxera has essentially overestimated the cost by a factor of two. In our view, the doubling of the asset base should not be regarded as a conservative assumption, but rather as an error in understanding the form of regulation for the UCLL and UBA that in effect depreciates the existing asset to reflect the migration of customers from copper services to fibre services. That is, because the TERA model adopts the 100% demand assumption, the effect of an uplift to the WACC on the existing RAB is reduced by the proportion of customers who migrate to fibre.

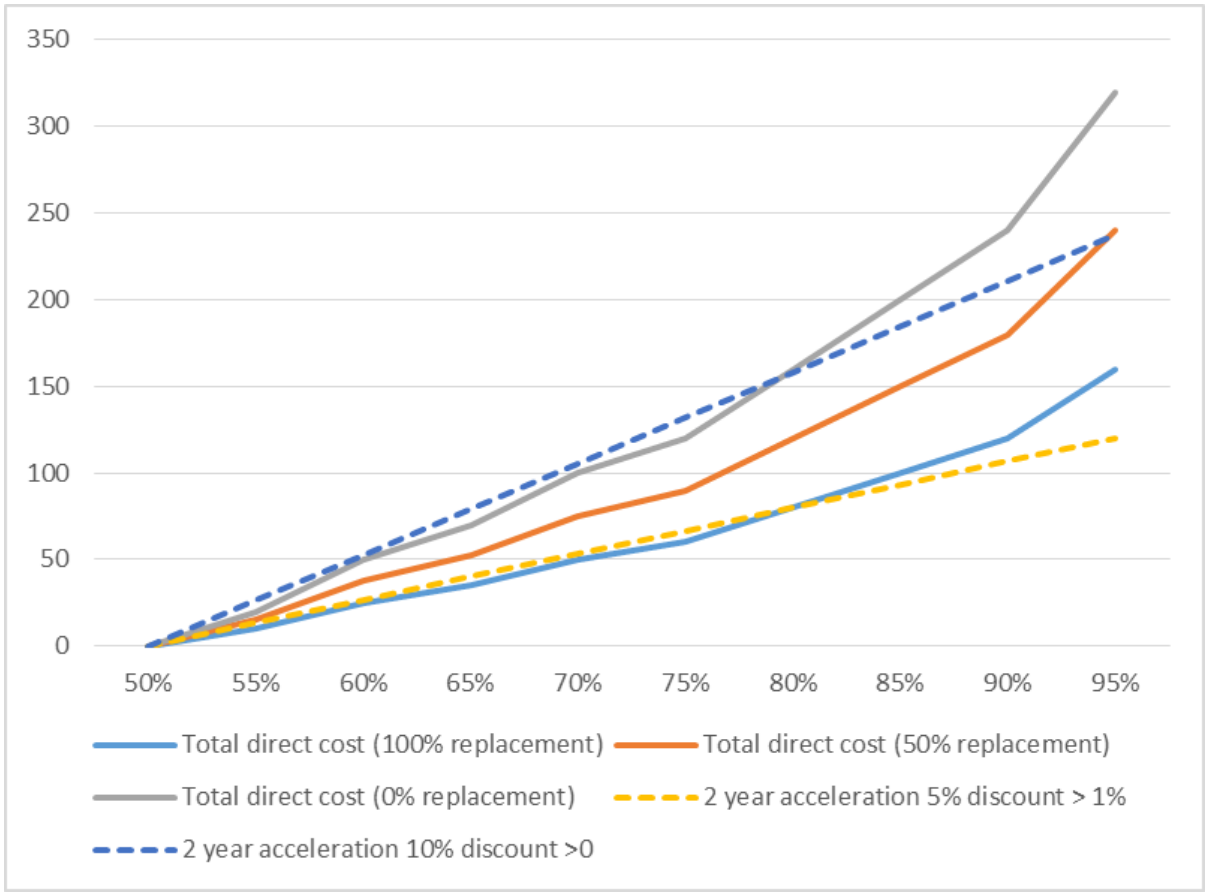
222. Whilst this economic depreciation is acknowledged as a subtlety by Professor Vogelsang,[72] he appears to regard the assumption of doubling the asset base as a sensible simplification.[73] We disagree and consider that it will give rise to a significant overestimate of the costs of a WACC uplift.

223. This is demonstrated in Figure 22 below. It illustrates the cost curve assuming new assets will replace 100%, 50% and 0% (Oxera's assumption) of the old asset base, together with the benefit curve in the two year acceleration scenario constructed using Oxera's method.

[72] Vogelsang (2015), Review of Oxera's Report, paragraph 15.

[73] Vogelsang (2015), Review of Oxera's Report, paragraph 6.

Figure 22: Oxera cost curves with revised asset base assumptions



Source: CEG analysis

224. In Figure 3, the grey solid line corresponds to Oxera's direct cost curve where the new asset base is of the same size as the old asset base. By allowing new assets to replace existing assets, the cost curve will 'shift down' clockwise. A 100% replacement means that cost would stay below the lower bound benefit curve when the uplift is moderate.

225. We also note that Oxera does not adjust its estimate of cost with the probability of the innovation occurring (i.e., it is assumed to always be 100%), while benefits are effectively weighted by probabilities. This is not consistent with the Commission's approach where costs and benefits are both weighted by the probability of the innovation occurring (p) in the formula:

$$\min f(w) = RAB(w - w_0) + p[RAB(w - w_0) + c(1 - CDF(w)]$$

226. As noted above, indirect cost is associated with the deadweight loss resulting from the decrease in consumption (foregone consumer surplus) due to price increases caused by the WACC uplift. Oxera illustrated the calculation of deadweight loss based on elasticity of demand and Chorus's total number of subscriptions. Oxera's estimate of these indirect costs of the uplift is conservative (errs on the higher side) because a

constant elasticity is assumed for broadband services. In reality, the elasticity of demand for broadband would be expected to decline as broadband becomes increasingly a necessity. Over time therefore, a constant uplift would be expected to have a smaller effect on consumption decisions and hence a declining cost.

227. Finally, we note that Oxera has assumed a 100% pass through in calculating the increase in retail price. This is true only if the retail market is perfectly competitive. A lower pass through would proportionally lower the resulting retail price, which would be a useful sensitivity given the reasonably high level of concentration among retail service providers (RSPs).

4.1.3 Improving the estimate of benefits

228. The Oxera framework for assessing benefits is simply to draw a straight line connecting zero and the point of maximum benefit. The two elements to review are therefore:

- the assumed maximum benefit; and
- the linear relationship between benefits and the uplift in the WACC.

4.1.3.1 Maximum benefit

229. It is unclear how Oxera has precisely calculated the benefit estimates in its Table 4.2. Oxera states:[74]

> *[...] the Criterion estimate was converted into 2003 NZ dollars using a Purchasing Power Parity estimate... then converted into 2014 NZ dollars using an inflation calculator [...]*

230. The NZ$352 benefit (per person per year) in Table 4.2 corresponds to NZ$270 in 2003 terms. At an exchange rate of 0.6 United States dollars to the New Zealand dollar at that time, this would result in a figure of around US$162 per person per year. By contrast, in Table A3.2 Oxera cites the effect of ubiquitous broadband uptake on consumer surplus of US$1,000 per person per year.

231. In any event, the maximum benefit figure relied on by Oxera is sourced from benefit figures provided in Criterion:[75]

> *Consumer surplus for 50 percent broadband penetration falls to between $17.0 billion and $37.7 billion per year, and for 95 percent penetration to between $32.3 billion and $71.9 billion. These more* ***conservative***

74 Oxera (2015), *Is a WACC uplift appropriate for the UCLL and UBA?*, Prepared for the New Zealand Commerce Commission, p. 24.

75 Criterion (2003), pp. 6-7.

> *estimates are based, however, on the assumption that the price elasticity of demand for a ubiquitous service, or "necessity," is equal to* ***–1.0 to –1.5****, surely far greater than the elasticity of demand for other necessities.* [Emphasis added]

232. The maximum benefit sourced from Criterion aligns with New Zealand figures from Alcatel.

4.1.3.2 Linear or non-linear relationship

233. Oxera has assumed a linear relationship between benefits and the WACC percentile:[76]

> *The probability of the investment being brought forward is to increase from zero at 50th percentile of the WACC range to 95%, 89% and 80% respectively at the 95th percentile.*

234. However, Oxera has also acknowledged that this assumption is not likely to be justified:[77]

> *In reality, the acceleration probability is unlikely to increase linearly as the size of the WACC uplift is increased. Rather, it seems more likely that the increase in the incentive to bring investment forward is* ***bigger for modest values*** *of the uplift than implied by the linear projection.*

235. In light of this, we believe it is appropriate to adopt a more realistic functional form for the link between the amount of WACC uplift and the probability of acceleration in each of the scenarios established.

236. A non-linear relationship between benefits and the uplift might be suitable because:

- the benefit function may be non-linear; and/or
- the valuation placed by investors and consumers on probabilities of different outcomes being achieved is not linear.

237. The benefit curve is likely to be convex against uplift percentile because we assume that the true WACC is drawn from a normal distribution. It is the possibility of being allowed a WACC that is significantly more than the true WACC that drives the potential for accelerated investment. However, as we discuss below, the probability that the allowed WACC is significantly greater than the true WACC is not a linear function of the uplift percentile. Assuming a straight line relationship where one does not exist does not appear reasonable.

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76 Oxera (2015), *Is a WACC uplift appropriate for the UCLL and UBA?*, Prepared for the New Zealand Commerce Commission, p. 35.

77 Ibid. p. 37.

238. Furthermore, the valuation that investors and consumers place on the probability of an outcome occurring is not likely to be linear in any case. This is one of the outcomes from the prospect theory of Kahneman and Tversky (1979). Prospect theory proposes that people do not value probability linearly due to two effects:

- the certainty effect: people value a probability increase from 90% to 100% (certain) probability way more than, say, from 80% to 90%;
- the low probability effect: people value a probability increase from 1% to 10% way more than, say, from 11% to 20%.

239. Consistent with Oxera's framework, we assume that at 50th percentile WACC, there is no incentive for players to accelerate investment. In other words, investors regard the chance of making profit out of triggering additional investment as zero. However, at the 95th percentile WACC, as the probability that the allowed WACC being greater than the true WACC is quite high, investors will have a material incentive to accelerate investment.

240. The projection adopted by Oxera assumes that investors weight probabilities linearly. This is an assumption of expected utility theory. However, the evidence suggests that decision-makers weight probabilities in a non-linear manner. For instance al-Nowhaihi and Dhami summarise one of Kahneman and Tversky's insights as follows:[78]

> *Under expected utility theory (EU) decision makers weight probabilities linearly. However, the evidence suggests that decision makers weight probabilities in a non-linear manner. Consider, for instance, the following example from Kahneman and Tversky (1979, p. 283). Suppose that one is compelled to play Russian roulette. One would be willing to pay much more to reduce the number of bullets from one to zero than from four to three. However, in each case, the reduction in probability of a bullet firing is 1/6 and, so, under EU, the decision maker should be willing to pay the same amount. One possible explanation is that decision makers do not weight probabilities in a linear manner as under EU. There is also emerging evidence of the neuro-biological foundations for such behaviour.*

241. The probability weighting function with the strongest empirical support appears to be that of Prelec (1998).[79] It was also the first axiomatically derived probability weighting function,[80] which is given by:

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78 Ali al-Nowaihi and Sanjit Dhami, (2010) Probability weighting functions, University of Leicester, UK, Working Paper No. 10/10.

79 Prelec, D., (1998), The probability weighting function. Econometrica 60, 497-528.

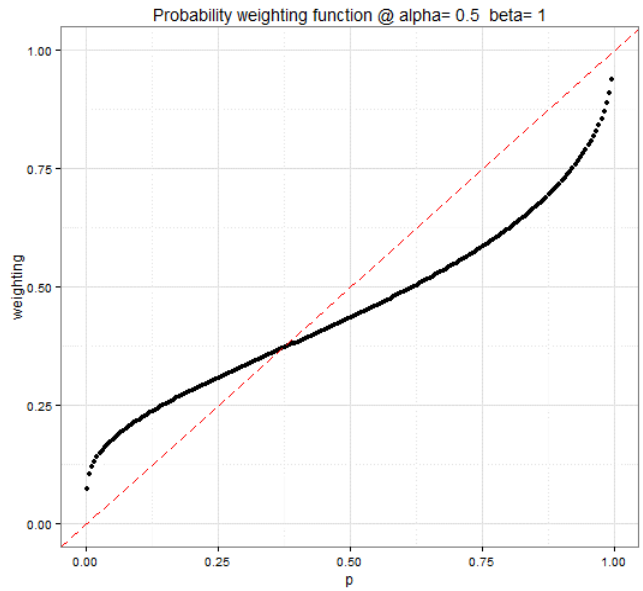
80 Ali al-Nowaihi and Sanjit Dhami, (2010) Probability weighting functions, University of Leicester, UK, Working Paper No. 10/10.

$$w(0) = 0, w(1) = 1,$$
$$w(p) = \exp(-\beta(-\ln(p))^{\alpha}), 0 < p \leq 1, \alpha > 0, \beta > 0.$$

242. The parameter α controls the convexity/concavity of the weighting function while β controls the point of inflexion ($w'' = 0$). Prelec (1998) gives an axiomatic derivation of the above based on 'compound invariance'.

243. Following is a plot of the standard Prelec (1998) function, $w(p) = e^{-(-\ln(p))^{0.5}}$. The shape is an inverse-S, indicating higher weight given to low probability events and lower weight given to high probability events.

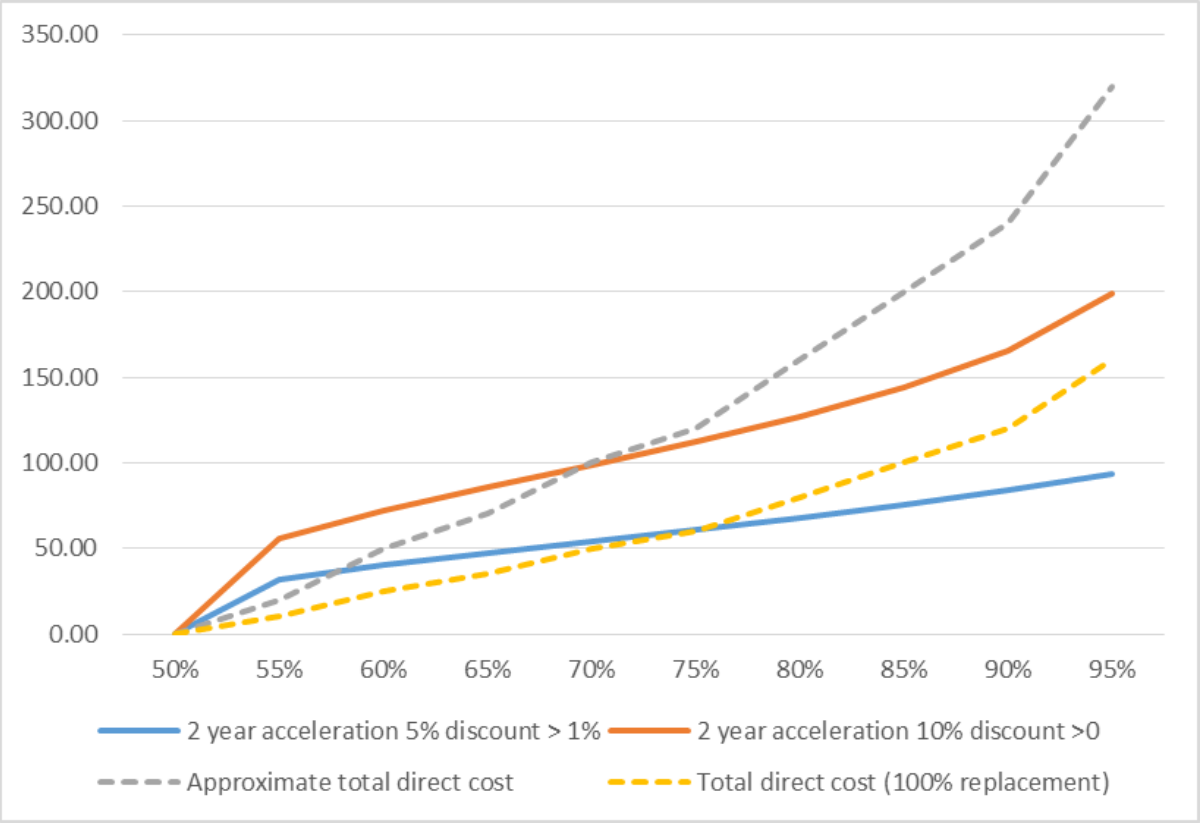
Figure 23: Standard Prelec weighting function



Source: Prelec, CEG analysis

244. Applying this probability weighting function above to Figure 6.1 from Oxera's report would result in a benefit curve that exhibits the same inverse-S shape (see below). It is clear that an uplift at 55% yields the maximum benefit (to achieve the largest vertical distance between the grey and blue/orange line).

Figure 24: Oxera modelling with non-linear benefit curve



Source: CEG analysis

4.2 Balancing acceleration and delay

245. As observed by Professor Vogelsang, the probability of the true WACC being above the midpoint is already 50%, instead of 0%, as is implicit in Oxera's modelling. Professor Vogelsang states:[81]

> *Oxera now assumes that at the midpoint WACC there is a zero probability of innovation acceleration. This strongly simplifying assumption triggers further deviations from a straightforward probabilistic approach to the WACC uplift effects on innovation benefits. Oxera now only uses the 50th and 95th percentiles and interpolates linearly in between. This purposely generates "wrong" probabilities for the in-between percentiles and can therefore only be seen as a rough approximation.*

[81] Vogelsang (2015), Review of Oxera's Report, paragraph 7.

246. However, both Oxera and Vogelsang have overlooked the probability of a delay in UFB investment/penetration as a result of the possibility that the true WACC might be less than the allowed rate.

247. This section aims to extend the existing work of Oxera as well as taking into account the comments from Professor Vogelsang.

4.2.1 A unified framework

248. The starting point of this unified framework is the underlying normality assumption for the true WACC, which is consistent with the Commission's approach to measuring uncertainty. According to Table 5.1 from Oxera's report, the true WACC is normally distributed with 6.47% mean and 1.23% deviation. We agree with Oxera that:

> *The probability of the true WACC is as low as 3% or as high as 10% is so small that it can be discounted. However, there is a reasonably material probability that the true WACC is **1% above or below** the allowed WACC.*

249. Based solely on the normality assumption, we have calculated the probability of the true WACC being less than or greater than the allowed WACC by 0%, 0.5% and 1% for each percentile. Results are shown in the following two tables:

Table 12: Probability of acceleration by WACC percentile

WACC percentile	Implied allowed WACC	Probability allowed WACC is greater than true WACC	Probability allowed WACC is greater than true WACC by more than 0.5%	Probability allowed WACC is greater than true WACC by more than 1%
50%	6.47%	50%	34%	21%
55%	6.62%	55%	39%	25%
60%	6.78%	60%	44%	29%
65%	6.94%	65%	49%	33%
70%	7.12%	70%	55%	39%
75%	7.30%	75%	61%	44%
80%	7.51%	80%	67%	51%
85%	7.74%	85%	74%	59%
90%	8.05%	90%	81%	68%
95%	8.49%	95%	89%	80%

Source: CEG analysis

Table 13: Probability of delay by WACC percentile

WACC percentile	Implied allowed WACC	Probability allowed WACC is less than true WACC	Probability allowed WACC is less than true WACC by more than 0.5%	Probability allowed WACC is less than true WACC by more than 1%
50%	6.47%	50%	34%	21%
55%	6.62%	45%	30%	17%
60%	6.78%	40%	25%	14%
65%	6.94%	35%	21%	12%
70%	7.12%	30%	18%	9%
75%	7.30%	25%	14%	7%
80%	7.51%	20%	11%	5%
85%	7.74%	15%	7%	3%
90%	8.05%	10%	5%	2%
95%	8.49%	5%	2%	1%

Source: CEG analysis

250. As discussed at section 4.1.3.2 above, we believe it is unreasonable for Oxera to model the probability of the investment being brought forward or delayed as a linear function against WACC percentile. By assumption a key driver for accelerating investment is the probability associated with the allowed WACC being significantly greater than the true WACC. This probability is not itself linear against the WACC percentile, and nor is the net effect (taking into account the probability that the allowed WACC is significantly less than the true WACC) linear against the WACC percentile. A full representation of the probability of the allowed WACC being /above/below the true WACC by 0%, 0.5%, or 1% as shown at Table 12 and Table 13 above is a reasonable alternative to this assumption.

251. In the context of a disruptive new investment (which is informed in part by developments in fibre as well as future investment), we make the following assumptions as the premise of our framework:

- The benefit stream of $1.5 billion per year to consumers in New Zealand from the new investment as estimated by Oxera[82] will only arrive after 2019. This is more consistent with Criterion's (2003) estimates based on ubiquitous broadband adoption.
- The cost of the WACC uplift is modelled as being incurred immediately, but the increase in RAB would not be 100% of the existing copper asset. Rather, it would

82 Oxera (2015), *Is a WACC uplift appropriate for the UCLL and UBA?*, Prepared for the New Zealand Commerce Commission,, p. 2.

be 60% on average based on an assumption of 20% annual increase in RAB over 5 years.

- We assume three states of the world, given the probability distribution of the true WACC:
  1. **95% broadband penetration** will be reached at the end of the **fifth year**, which is regarded as the status quo at the current midpoint WACC (the 'base case' scenario);
  2. **95% broadband penetration** will be reached at the end of the **third year**, which is advanced by two years, if the allowed WACC is greater than the true WACC by more than 1% (the 'acceleration' scenario); but
  3. Only **50% broadband penetration**[83] can be reached at end of the **fifth year**, if the allowed WACC is less than the true WACC by more than 1% (the 'delay' scenario).

252. Both Oxera and Vogelsang have been vague about the possibility/risk of the allowed WACC residing below the true WACC. The 50% penetration assumption above attempts to fill this void. This assumption is more realistic than Oxera's claim that innovation would come about in any case but would arrive later without an uplift, while less radical then the Commission's assumption that the size of the uplift affects whether the investment would happen at all. In fact, Oxera has acknowledged in its 2014 report that: [84]

> *Investors will require a certain level of return or 'hurdle rate', below which they will become more likely to* ***reduce investment****.*
>
> *The risks of per-specified downside events, which could have an impact on investment incentives,* ***are measurable****, and can be assessed for different choice of WACC.*
>
> *The impact of measuring the probability of loss is to demonstrate that there is a material probability, for example under the 50th percentile, that investors* ***will not invest*** *unless absolutely forced to, as they will be destroying value in the short and medium term;*
>
> *It is not feasible to identify a specific point that will definitively trigger underinvestment, but it is likely to be linked to a* ***material differential*** *between the assumed and actual WACC. Our assessment is that a range of* ***0.5%-1%*** *is a plausible starting point for this differential;*

83 We have chosen 50% because Criterion (2003) has a direct estimate of the benefit at this penetration rate. Here, broadband penetration refers to the uptake of the fibre network, not merely availability.

84 Oxera (2014), "Input Methodologies – Review of the '75th percentile' approach", Report prepared for the New Zealand Commerce Commission.

253. We also note the assumption that broadband penetration may only reach 50% with an allowed WACC which is materially lower than the true WACC is consistent with potential outcomes on the UFB. Some local fibre companies (LFCs)[85] are predicting that the penetration rates of around 45% could be achieved by the end of the UFB contract, although we note that the current uptake among UFB users is under 15%[86]. After the contract, the level of uptake will be dependent on prices that are yet to be determined. We would expect that LFCs willingness to spend the incremental capital expenditure to connect customers (which is estimated by Chorus to be approximately $1,000 to $1,200 per standard residential premises, in FY15 dollars)[87] will depend on the WACC which is implicit in prices post-2020.

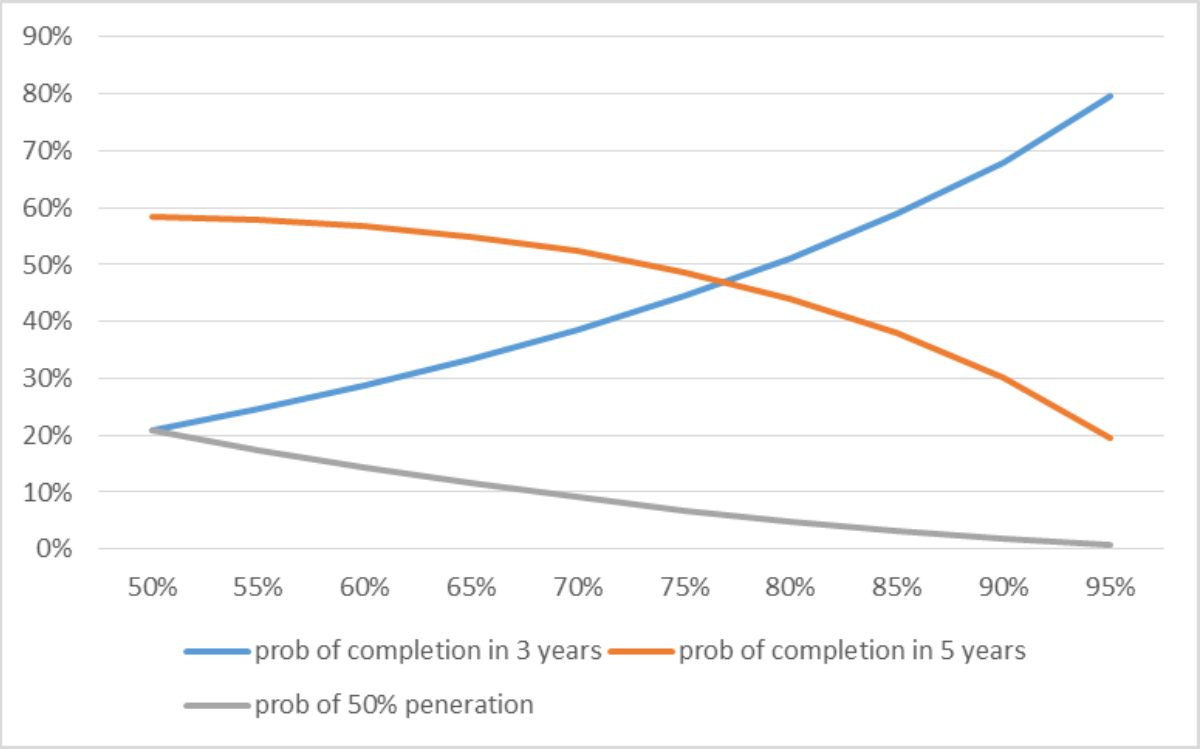
254. As such, we do not consider that it is reasonable for Oxera to simply assume away the possibility of underinvestment and the potential consequences, particularly given there is approximately a one in five chance of a shortfall of 1% below the allowance if WACC is set at the 50th percentile. Our framework assumes that the probability of underinvestment will decrease, while the probability of acceleration will increase, as the uplift increases. This is illustrated at Figure 25 below.

85 WEL Networks Limited, Annual Report 2014, p. 62, available at: http://www.wel.co.nz/UserFiles/WelNetworks/File/WEL%20AR%202014%20WEBSITE.pdf.

86 MBIE, Broadband deployment update 1 April to 30 June 2015, p. 1, available at: http://www.med.govt.nz/sectors-industries/technology-communication/fast-broadband/pdf-and-documents-library/ultra-fast-broadband-intiative/quarterly-broadband-deployment-update-june-2015.pdf.

87 Chorus Half Year Report for the six months ended 31 December 2014, p. 5, available at: https://www.chorus.co.nz/file/59042/208448.pdf.

Figure 25: Probability of acceleration and delay



Source: CEG analysis

255. Table 14 below demonstrates the present value of the future benefits converted into an annuity over a 20-year period for three different scenarios. Figures in the sixth column representing the lower bound benefit are based on Table 4.2 of Oxera's report and Criterion's (2003) estimate of the benefit at 50% broadband penetration, which is roughly half of the benefit at 95% penetration. In practice, we would not expect 50% penetration to have as much as even half the benefit from the 95% scenario because the realisation of the benefits from fast broadband will rely on the data transmission speed from other parties. For example, video-conferencing between doctors and patients will not be possible if the patient does not have fast internet access at home, no matter how fast broadband at the hospital is.

Table 14: Present value of benefits in a unified scenario over 20 years (NZ $ million)

Discount rate	Actual benefit per year ($ billion)	Future value of 20 year benefit stream in 2019 ($ billion)	Annual benefit in acceleration scenario ($ million)	Annual benefit in base case scenario ($ million)	Annual benefit in delay scenario ($ million)
5%	$1.50	18.69	1,295.76	1,175.29	587.64
10%	$1.50	12.77	1,126.97	931.38	465.69

Source: CEG analysis

256. Table 15 below further calculates the expected benefit using the estimated benefits in Table 14 above combined with the probabilities in Table 12 and Table 13, and compares this against costs to calculate the expected net benefit.

257. The probability weighted benefits under the 5% and 10% discount rate, as well as the associated cost, at different levels of allowed WACC is illustrated in the table below. The calculated cost includes both the direct cost and deadweight loss from a WACC uplift assuming 100% pass-through. As mentioned earlier, the calculation of deadweight loss is potentially biased on the higher side as it has assumed a constant price elasticity. It is more sensible to assume the elasticity to decline (deadweight loss to decrease) as broadband becomes increasingly a necessity.

Table 15: Estimated benefits and costs by percentile uplift

Percentile uplift	Expected benefit at 5% discount rate	Expected benefit at 10% discount rate	Total cost of allowed WACC uplift	Net benefit at 5% discount rate	Net benefit at 10% discount rate
50%	1078	875	766	312	109
55%	1103	898	784	318	114
60%	1126	921	803	323	118
65%	1148	943	822	326	121
70%	1169	965	842	326	122
75%	1189	987	864	324	122
80%	1208	1009	894	314	115
85%	1227	1031	922	305	109
90%	1247	1056	958	289	98
95%	1267	1084	1016	252	68

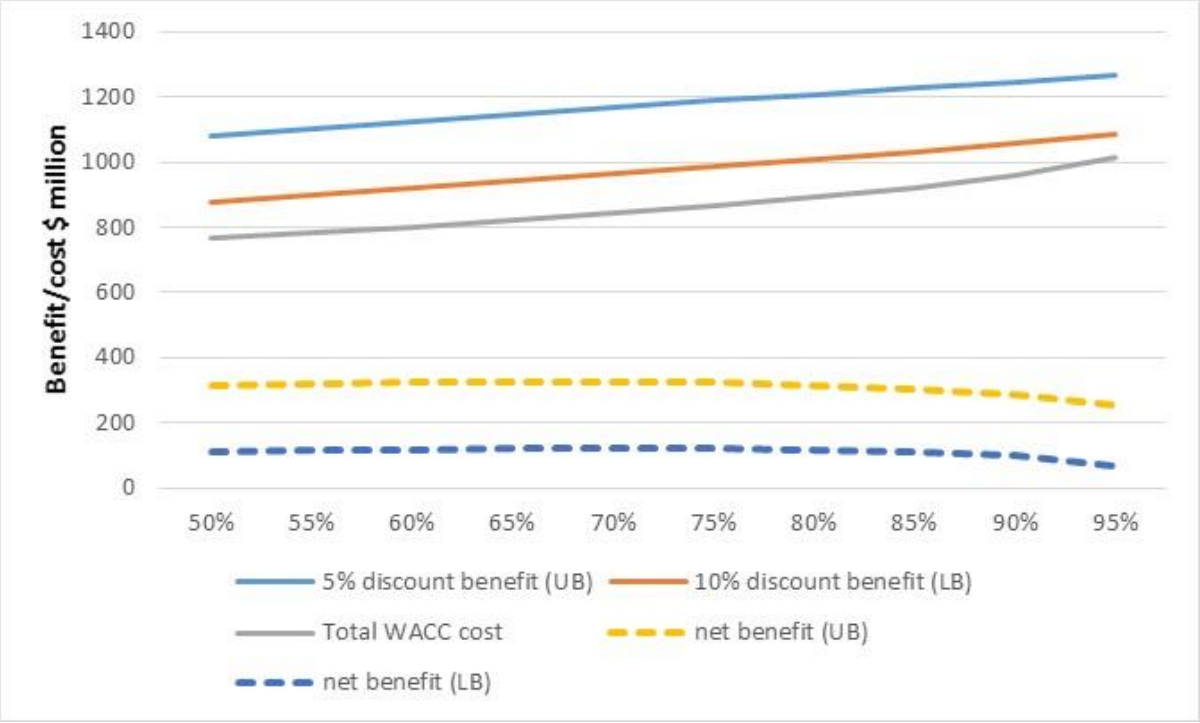
Source: CEG analysis

258. The calculation of such probability weighted benefits addresses the comments from Vogelsang (2015)[88] that:

> *The approach for calculating expected benefits would have been to multiply the probabilities with the benefit annuities, resulting in weighted benefits and then compare these to the costs of each level of WACC uplift.*

259. Based on this analysis, a WACC uplift between the 65th and 75th percentile is optimal, depending upon the discount rate. The results of Table 15 above are shown graphically in Figure 26 below.

Figure 26: Unified benefit and cost framework results



Source: CEG analysis

4.2.2 Consistency with Commission's approach

260. The Commission's framework as outlined in the Conference Agenda proposed to minimise the following objective function:

$$\min f(w) = RAB(w - w_0) + p[RAB(w - w_0) + c(1 - CDF(w))]$$

261. It is quite clear from the equation above that an important reason to consider a WACC uplift is to avoid the potential foregone benefits in case the new investment does not

88 Vogelsang (2015), Review of Oxera's Report, p. 7.

occur, or does not occur to the same extent as could otherwise be assumed. Oxera has set aside this concern by assuming that the new investment will occur in any event. In our view, this is an unrealistic assumption that causes Oxera to underestimate the benefits of a WACC uplift. It also represents a divergence from the Commission's framework.

262. The framework established in this report is comparable to the Commission's approach, albeit being more conservative by assuming that a cost of the WACC uplift will be incurred (on 160% of the RAB) regardless of whether the benefit arrives. If we populate the Commission's framework with these assumptions, then the objective function becomes:

$$\min f(w) = RAB(w - w_0) + 0.6 * RAB(w - w_0) + p * c(1 - CDF(w))$$

263. Oxera sets 'p' equal to 5% based on its assumption that a major innovation occurs every 20 years, which implicitly interprets 'p' as the probability of any innovation happening. This does not conform with the Commission's definition of 'p' as:[89]

> *Probability that a major innovation occurs, when it occurs, and whether the WACC for UCLL/UBA is influential on the investment in new technology.*

264. In this populated framework, 'p' is multiplied by $(1 - CDF(w))$, which is the probability that the allowed WACC is less than the true WACC. Therefore it is sensible to define 'p' as the probability of underinvestment happening, *given that the allowed WACC is less than the true WACC*. This definition ensures that the framework captures the expected foregone benefits of underinvestment.

265. Based on this assumption, underinvestment will occur when the allowed WACC is below the true WACC by more than 1%. The probability of the allowed WACC being below the true WACC by more than 1%, *given that the allowed WACC is less than the true WACC*, is 42%.[90]

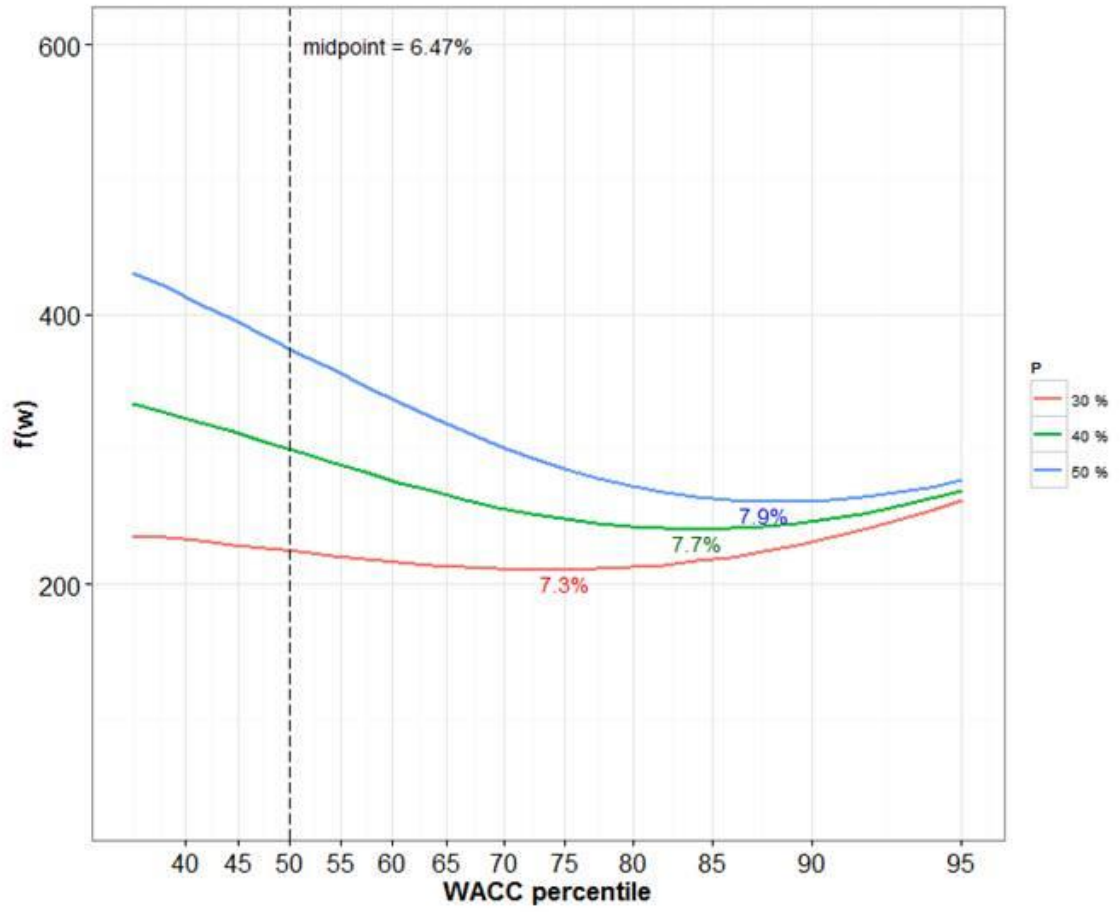
266. Figure 27 below shows that an uplift above the 50th percentile would be optimal in terms of decreasing the objective function as 'p' increases.[91] The optimal WACC percentile when p equals to 30%, 40% or 50% is at the 75th, 84th and 88th percentiles respectively (corresponding to WACC estimates of 7.3%, 7.7% and 7.9% respectively).

89 Commerce Commission, *Agenda for FPP Conference*, June 2015.

90 0.21/0.5 = 42%, see Table 13 above.

91 Consistent with Oxera's approach, we have used a RAB of $7.4 billion and foregone benefit from accelerated investment of $1.5 billion per year.

Figure 27: Objective function against WACC percentile for different p



Source: CEG analysis

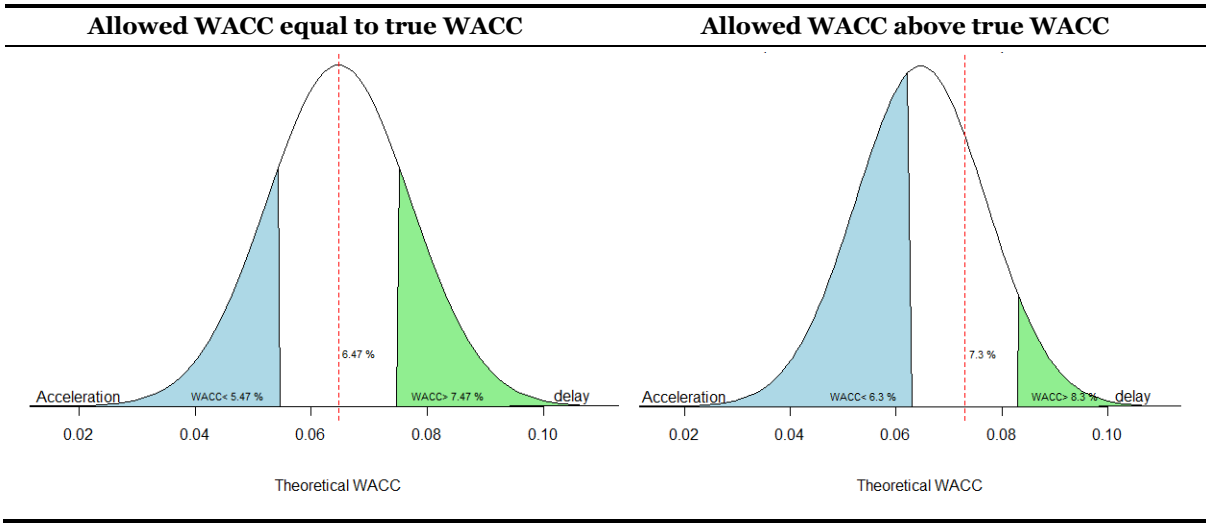
4.2.3 Statistical intuition behind the optimality for a WACC uplift

267. Based on our analysis in this section, we consider that a material WACC uplift is optimal. The benefit of a WACC uplift comes from:

- the reduction in the probability of a delay (or underinvestment) caused by the allowed WACC being less than the true WACC by more than 1%; and
- the increase in the probability of acceleration caused by the allowed WACC exceeding the true WACC by more than 1%.

268. The comparison of the two charts below (WACC at midpoint vs at 75th percentile) illustrates that an uplift in WACC from the midpoint would significantly improve the probability of acceleration while reducing the probability of delay, under the normality assumption.

Figure 28: Illustration of the effect of uplift on the probabilities of acceleration and delay



Source: CEG analysis

269. The blue area in each chart corresponds to the probability of acceleration while the green area corresponds to the probability of delay. By lifting the allowed WACC up to its 75th percentile from the midpoint, the probability of delay has been reduced and the probability of acceleration increased from 20.8% each to 6.84% and 44.5%, respectively.

4.3 Regulatory precedent

270. As noted by Oxera (2014), the regulators in UK have adopted WACC values above the midpoint of their estimated range in nearly all recent price control determinations. In particular, there is one precedent case for the telecommunication sector – the UK Ofcom's 86th percentile decision on wholesale broadband access in 2011. Ofcom emphasized the term "asymmetric loss function" in reaching its conclusion that "the risks associated with setting the WACC too low may be greater than those of setting the WACC too high".

271. In addition, the Irish telecommunications regulator has applied an uplift in the WACC used to set regulated fixed line service charges for Eircom. The ComReg refer to this as "aiming up" the WACC which is implemented in choosing conservative[92]

92 That is, choosing a parameter that leads to a higher WACC.

WACC parameters and points above the median where the range is quantifiable. ComReg states:[93]

> *ComReg considers that choosing a value for the WACC that is above the regulator's expected value for the WACC has been standard practice for regulators for many years, across many regulated sectors and in particular in the communications sector, both in Europe and the rest of the world. The process by which this is done has often been implicit – via the choice of a "conservative" estimate of a particular parameter such as the beta or the equity risk premium. In other situations, it is done by choosing, as a point estimate, a value above the mid-point of quoted range for the WACC as a whole or some key building block thereof.*

272. The pre- and post-aimed up WACC parameters adopted by ComReg are set out in the table below.

Table 16: ComReg uplifted WACC parameters

Parameter	Pre-uplift	Post-uplift
Nominal risk free rate	3.36%	3.73%
Notional gearing	40%	40%
Asset beta	0.55	0.60
Debt premium	1.45%	1.75%

Source: ComReg

273. We note that the Commission has also engaged Economic Insights to provide a report summarising overseas regulatory decisions on the use of WACC estimates above, below, or at the mid-point estimate. According to their report[94], the Federal Communications Commission has allowed a WACC for rate of return regulated local carriers at the 75th percentile (of a uniform) distribution) since 1990. A recent staff report has recommended a materially lower point estimate, reflecting changes in market conditions, but still at the 75th percentile. The methodology in the staff report has been used to approve WACC's for the telecommunications universal service fund to support for price cap regulated carriers to maintain universal voice service and expand broadband.

93 ComReg (2014), *Cost of Capital,* p. 74, available at: http://www.comreg.ie/_fileupload/publications/ComReg14136.pdf.

94 Economics Insights (2014), *Regulatory Precedents for Setting the WACC within a Range, Report prepared for New Zealand Commerce Commission*, available at: http://www.comcom.govt.nz/dmsdocument/11974.

5 Estimating the long term price trend for trenching costs

274. In this chapter, we suggest four alternative bespoke PPI series that the Commission could rely on for the purpose of determining the long term price trend for trenching. Based on our analysis, we conclude that a reasonable range for the long term price trend for trenching ranges from 1.99 per cent to 2.77 per cent, with the lower end of this range representing our preferred estimate.

5.1 Analysis to date

275. The Commission has asked NZIER to estimate long term price trends for the FPP pricing review. The NZIER report was published together with the further draft determination in July 2015.

276. NZIER estimated a long term price trend for trenching costs of 3.3 per cent. NZIER based its forecast trend growth on estimated (econometric) long run relationships between the annual average growth in the Producer Price Index series (PPI series) Heavy and Engineering Civil Construction and two predictive series:

- general inflation in operating costs captured in PPI All Industries; and
- labour costs captured by the labour cost index (LCI) Construction.

277. The Commission also asked Beca to revisit its estimate for civil works in New Zealand and to expand its research to include past price trends over the last 20 to 25 years, and to forecast long term rates to 2035. Beca estimated a long term price trend of 2.635 per cent based on the compound annual growth rate (CAGR) for the period Q4 1989 to Q4 2014 for a weighted average of capital good price index (CGPI) Pipelines (25 per cent), CGPI Electrical Works (25 per cent) and CGPI Earthmoving and Site Work (50 per cent).

278. In our February 2015 report, we expressed the view that the Commission should rely on CGPI All Groups to approximate the growth in the cost of trenching. We noted that, while it is unlikely to provide a very precise approximation for changes in the costs of ducting and trenching, it is likely to capture these activities without any false precision arising from a narrow definition. Further, we observed that Chorus' field services agreements gave heavy weight to CGPI All Groups, suggesting that it may be reasonable to place significant weight upon the expected growth in this index. We estimated a price trend of 1.83 per cent using the trend rate of growth methodology between December 1989 and March 2019 in the CGPI All Groups series.

279. We further suggested that the Commission could construct its own PPI series that ensures that the long term price trend aligns with changes in the cost of trenching

over time. Specifically, we suggested that the Commission could construct a PPI series using the indices and weights contained in Chorus' field services agreements to approximate the long term price trend for trenching. This series is, in our view, the most suitable basis for the Commission to rely on for this purpose. We estimate a long term price trend of 1.99 per cent based on this series. The Commission should use a bespoke index tailored to the cost of trenching

280. NZIER relied on a PPI series for Heavy and Civil Engineering Construction to approximate the cost of trenching. This particular PPI series is a "level 3" index contained under the broader "level 2" index PPI Construction, as defined in the Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006. NZIER noted that CGPI indices only measure asset and plant and machinery prices, and not operational and labour costs, whereas PPI series measures the 'factory gate' prices and captures all costs of production except taxes and subsidies.

281. Beca considers that three of the CGPI sub-groups are most relevant to estimate the long term price trend for the cost of trenching – CGPI Earthmoving and site works, pipelines and electrical works - and therefore constructs an index based on the weighted average of these indices:[95]

> *The black lines are pipelines, electrical works and earthmoving and site work which are three price indices that we feel are the most relevant […].*
>
> *Because there are three relevant indices we have chosen to use a weighted average. The largest cost to trenching and ducting is earthmoving and site works, therefore we have given a 50% weight to this and 25% each to pipeline and electrical works.*

282. In our view, it is preferable to construct a bespoke index as opposed to rely on a in index which has been constructed for a purpose unrelated to estimating the long term price trend of the cost of trenching.

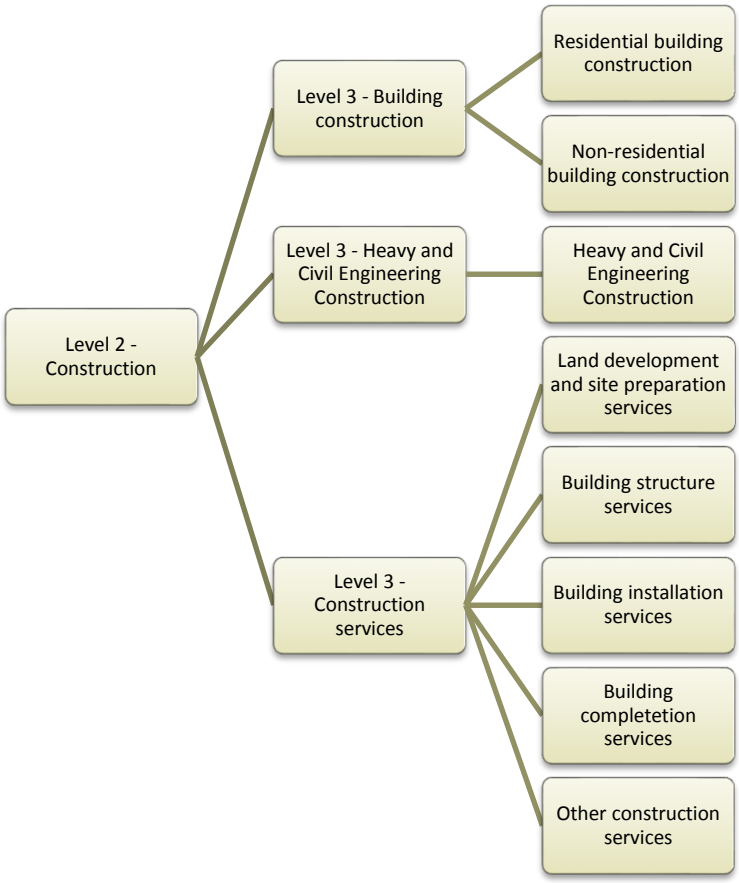
283. NZIER's preferred index, PPI Heavy and Civil Engineering Construction, reflects road and bridge construction, as well as other heavy and civil engineering construction. Whilst a small proportion of this category does reflect "cable laying", it also reflects, among other things, aerodrome runway construction, asphalt surfacing, breakwater construction, furnace construction, golf course construction, mine site construction and swimming pool construction.

284. One of the other level 3 categories that falls under PPI Construction is PPI Construction Services. This category contains a sub-category called "site preparation services". This sub-category lists "trench digging" as one of the primary activities. This suggests that, whilst the cost of trenching is likely captured in these indices, they also capture a myriad of unrelated activities which have nothing to do with digging

95 Beca (2015), *FPP Corridor Cost Analysis – Report 3, New Rates and General Recommendations,* p. 14

trenches. The break-down of the New Zealand Statistics PPI series which fall under PPI Construction in the ANZSIC 2006 are illustrated in Figure 29 below.

Figure 29: ANZSIC 2006 Division E - Construction



Source: ANZSIC 2006, CEG illustration

285. We agree with Beca that the CGPI series for earthmoving and site work, electrical work and pipelines are relevant to the cost of trenching, and that these should be reflected in a bespoke index tailored to the cost of trenching. We note that these three indices represent the majority of the sub-indices under the second level heading of CGPI Civil Construction. The only other sub-index under CGPI Civil Construction is "transport ways". It is our view that the higher level index of CGPI Civil Construction is also likely to be highly relevant to the cost of trenching, and that the outcome of relying on this index is not likely to generate a significantly different outcome from using Beca's weighted average index.

286. In addition to the CGPI series, the bespoke index should capture operational and labour costs associated with trenching. That is, the index should include a labour component in addition to the specific CGPI indices.

5.2 Estimating price trends based on bespoke indices tailored to the cost of trenching

287. We have estimated the long term price trend for five different bespoke indices using different combinations of CGPI and LCI indices. For two indices we have relied Statistics New Zealand for a full history, and NZIER for forecasts. For the remaining three series we have used fully modified ordinary least squares to forecast future values using one or two predictive series.[96]

288. We note that NZIER has estimated a long term trend growth in trenching costs of 3.3 per cent *"[…] based on estimated (econometric) long run relationships between annual average growth in the Producers Price Index for outputs of the Heavy and Engineering Civil Construction sector […]"*. This implies that NZIER does not explicitly rely on the historical information of the same series in coming to its estimate.

289. This appears inconsistent with the view of the Commission, who noted in the further draft determination that:[97]

> *We consider that a combination of both past and future trends provides the most robust indication of forward-looking trends for our TSLRIC model. We recognise that past trends could also be used as a proxy for long-term trends unless any material change in the future trend can be anticipated. In the latter case future trends should be used. For example, if there was a structural break in historical data, future trends may be more appropriate.*

290. We agree with the Commission that a combination of past and future information should be used. In section 2 of our February 2015 report, we noted that, to be consistent with the rationale for using the tilted annuity formula, the price trend must be based on a long term average. We considered that, in order to estimate a long term average, the Commission should have regard to as long a time series of price data as possible, including both historical observations and forecasts of future values. Estimating the price trend using a shorter period (for example using only forecasts) may not generate the best estimate of a long term price trend to be used in a tilted annuity formula because it is likely that these estimates would be expected to change over time. The issues associated with this were discussed in detail in section 2.2 in our February 2015 report.

---

96 FM-OLS regression was originally designed by Phillips and Hansen in 1990 to provide optimal estimates of co-integrating regressions. This methodology modifies the least squares to account for serial correlation effects and for the endogeneity in the regressors caused by the existence of a cointegrating relationship.

97 Commerce Commission (2015), *Further draft determination*, p. 282

291. NZIER has not provided any basis upon which to conclude that past trends cannot be used to contribute to estimates of long-term trends. In light of this, we have estimated the long-term price trend based on all available history as well as forecasts.

292. The bespoke indices we consider are based on the following weighted averages of CGPI and LCI indices:

    a. Bespoke PPI series constructed from Statistics New Zealand history of average annual growth in series underlying Chorus' field service agreements, weighted according to the field service agreement weights.[98] CGPI All Groups and Labour All Groups are used as the predictive series.

    b. Bespoke PPI series constructed Statistics New Zealand history of average annual growth in Beca's preferred CGPI series (Earthmoving and Site Works, Electrical Works and Pipelines) and LCI Construction, weighted equally. CGPI Civil Construction and LCI Construction are used as predictive series.

    c. Bespoke PPI series constructed from Statistics New Zealand history of average annual growth in Beca's preferred CGPI series (Earthmoving and Site Works, Electrical Works and Pipelines), weighted according to Beca's suggestion (50/25/25 respectively). CGPI Civil Construction is used as the predictive series.

    d. Statistics New Zealand history and NZIER forecasts of average annual growth in CGPI Civil Construction and LCI Construction, weighted 50/50 and 75/25 respectively.

293. We have estimated the long term price trends resulting from approaches (a) to (d) outlined above. The results are summarised in Table 5 below. We provide estimates based on only forecast values for comparison purposes.

Table 17: Long term price trend estimates

	Data availability	Average annual price trend – all data	Average annual price trend – forecasts only
Option a)	Q1 1996 – Q1 2020	1.99%	2.57%
Option b)	Q3 1994 – Q1 2020	2.73%	2.62%
Option c)	Q1 1990 – Q1 2020	2.73%	2.57%
Option d) version 1	Q3 1994 – Q1 2020	2.63%	2.47%
Option d) version 2	Q3 1994 – Q1 2020	2.77%	2.54%

Note: CGPI All Groups forecasts were provided to CEG from NZIER in November 2014

294. In our view, both option (b) and option (d) represent reasonable alternatives to option (a). The CGPI indices which make up the underlying series for option (b) have

98 Weights are sourced from confidential Appendix A of our previous price trends report. See CEG (2015), Evidence on price trends, p. 30.

been endorsed as appropriate to estimate the inflation in cost for trenching by Beca and also reflect the inflation in labour costs. Option (d) captures the broader index of CGPI Civil Construction, and results in very similar long term price trends to option (b).

295. We conclude that an appropriate long-term price trend for trenching costs lies within a range from 1.99 per cent to 2.77 per cent, with the lower end of the range representing our preferred estimate.

COMPETITION ECONOMISTS GROUP

6 Review of Sapere's recommendation on the commencement date of the determination

296. We have been asked by Chorus to review the recommendation of Sapere to backdate the final pricing principle (FPP) price.

297. We agree with Sapere that time consistency is critical in regulatory decision making and that backdating will facilitate the Commission developing a reputation for making time consistent decisions. The question of whether backdating would promote competition for the LTBEU is one answered by understanding the effect of that on the conditions and environment of rivalry amongst firms, relative to the situation where the backdating did not occur. Ensuring regulated prices reflect efficient costs may affect the network owner's abilities and incentives to engage in desirable competitive conduct, e.g., invest in new products. That is, if the regulated price cap is below the efficient cost of providing services over the long-run, an efficient operator would not invest.

298. A policy of backdating will ensure that prices reflect the efficient estimate of costs at most points of time and, in the context of an industry with investors sinking capital as both access seekers and access providers, is likely to be more important than considerations of promoting competition or efficiency solely (or primarily) through a price signal for the consumption of fibre, copper or layer2 choices. A decision to backdate now cannot reverse the errant consumption signals of the past but may influence longer term investment decisions for access providers and access seekers.

299. At conference, we offered a solution to establishing the asset base for backdating the FPP to a date in the past. This method essentially involved 'following back the tilt' established based on the current asset valuation and price trends in the Commission's model. Operating expenditure may be similarly deflated using an appropriate price trend. We agree with Sapere that a contemporaneously determined WACC would be used to set prices in the early period and going forward. In our view this would be the least arbitrary approach to setting prices for the five-year regulatory period from the proposed backdate.

Appendix A Factors lowering safe bond yields post GFC

A.1 RBA and Treasury/AOFM letters

300. In response to a report written for the Victorian gas businesses in 2012,[99] the Australian Energy Regulator (AER) sought two letters from the RBA and Treasury/Australian Office of Financial Management (AOFM).[100] In our view, these letters in the Australian context provide analogous support for our firm view that the factors driving down New Zealand government bond yields cannot be presumed to be driving down equity yields.

301. The content of these letters is strongly supportive of our views. Specifically:

- Increased demand for government bonds are driven by increased levels of risk/risk aversion leading to a 'flight to quality'.
  - RBA paragraph 2 on page 1, first sentence.
  - Treasury/AOFM paragraph 3 on page 1. Also, paragraph 2 under the first question answered on page 2.
- A factor contributing to the elevated demand for government bonds are the reduced supply of alternative AAA-rated liquid government bonds. Hence, there has been heightened demand for government bonds by foreigners.
  - RBA paragraph 2 on page 1, second sentence.
  - Treasury/AOFM paragraphs 3 and 4 under the first question answered on page 2. The AOFM states:

> *The weak and fragile global economy has put downward pressure on benchmark global long-term bond yields, and is driving investors into high quality government debt.* ***As a result, Australia is reaping the benefits of a deep and liquid AAA-rated CGS market that is attracting strong demand from international investors****. (Emphasis added)*

99 CEG, 'Internal consistency of risk free rate and MRP in the CAPM', March 2012.

100 RBA, *Letter regarding the Commonwealth Government Securities Market*, Guy Debelle, Assistant Governor, Financial Markets, Reserve Bank of Australia, 16th July 2012, p. 1–2.

Australian Government, The Treasury, *Letter to Joe Dimasi, ACCC, regarding the Commonwealth Government Securities Market, 18th July 2012*.

- Risk premiums for other assets, including but not restricted to equities, measured relative to the CGS have increased as part of the same 'flight to quality'.
  - RBA paragraph 2 on page 1, in particular the last two sentences. Note the last sentence:

"This widening indeed confirms the market's assessment of the risk-free nature of CGS and reflects a general increase in risk premia on other assets."

I regard this as a clear statement in support of our central position.

  - Treasury/AOFM final paragraph under the first question answered on page 2.
- As a general rule market risk premia are unstable, such that adding a fixed MRP to a floating government bond yield cannot be presumed to give accurate results. An important cross-check is provided by asking whether the assumption of a fixed MRP is consistent with the observed changes in risk premiums on debt.
  - RBA last two paragraphs on page 1 (including overleaf to page 2).

A.2 IMF assessment of factors driving down safe asset yields

A.2.1 Shrinking supply of safe sovereign debt

302. In April 2012, the IMF released a detailed analysis of factors driving down the yields on safe assets worldwide (i.e., not just in New Zealand). The IMF summarised its analysis in the following manner: [101]

On the supply side, concerns about high government debts and deficits in some advanced economies have reduced the perceived safety of government debt. Recent rating downgrades of sovereigns, previously considered to be virtually riskless, show that even highly-rated assets are subject to risks.

The number of sovereigns whose debt is considered safe has fallen. IMF estimates show that safe asset supply could decline by some $9 trillion—or roughly 16 percent of the projected sovereign debt—by 2016. Private sector issuance of safe assets has also contracted sharply on poor securitization practices in the United States.

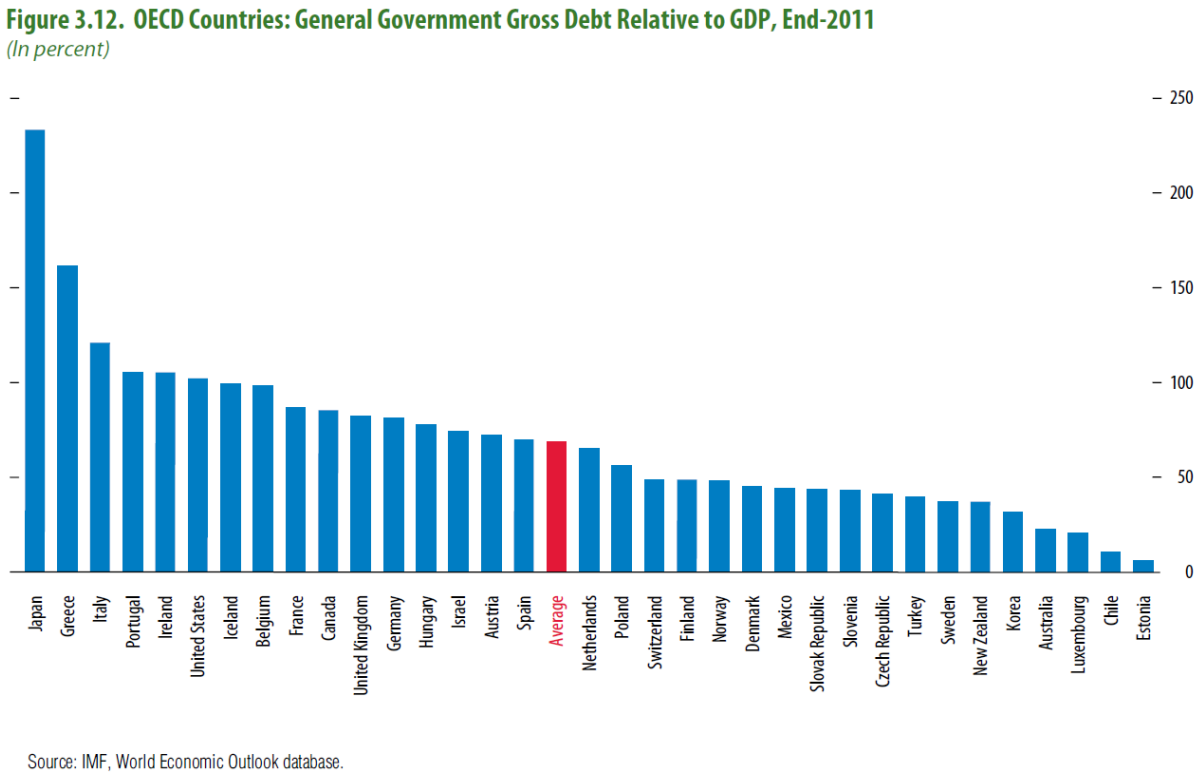
[101] See IMF summary at: http://www.imf.org/external/pubs/ft/survey/so/2012/POL041112A.htm.

Safe asset scarcity will increase their price, with assets perceived as the safest affected first. Investors unable to pay the higher prices would have to settle for assets that have higher levels of risk.

303. Put simply, the amount of sovereign debt that investors perceive as safe has dramatically declined with the Eurozone debt crisis.

304. The demand for New Zealand government bonds has benefited from this reduction in the perceived safety of other sovereigns' debts. The relatively strong fiscal position of the New Zealand Government is illustrated in the IMF chart below.

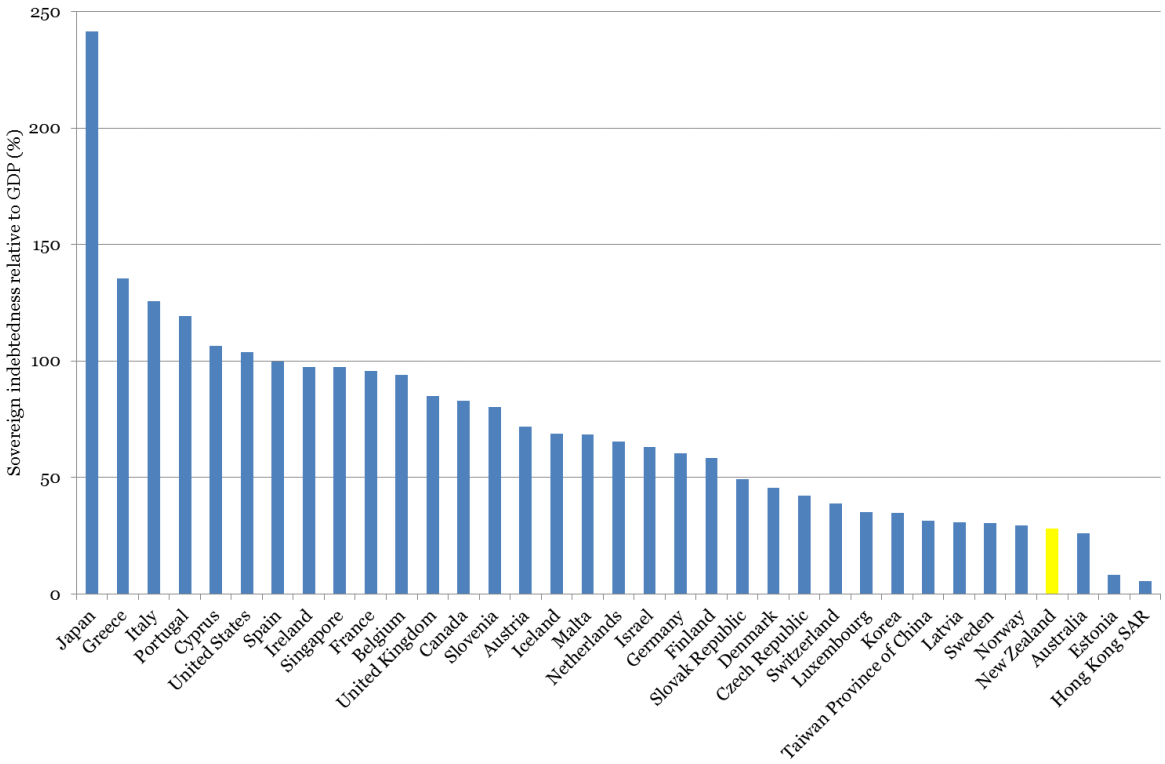
Figure 30: IMF estimates of Sovereign indebtedness relative to GDP



Source: IMF

305. We have accessed the latest IMF forecasts of gross debt to GDP from the IMF 2014 World Economic outlook, and have created the same chart as forecast by the IMF in 2019 – see Figure 31 below (with New Zealand highlighted). This tells essentially the same story – gross Government debt in New Zealand is a very small fraction of GDP relative to other developed countries and is expected to remain so for the foreseeable future.

Figure 31: IMF estimates of Sovereign indebtedness relative to GDP



Source: IMF, CEG analysis

306. New Zealand government bonds are strongly rated by credit rating agencies. Downgrades to most Eurozone Government debt increases the relative attractiveness of New Zealand government bonds to investors.[102] This has been associated with a significant increase in demand for New Zealand government bonds by foreign institutions looking for strongly rated sovereign debt.

307. In the case of Australia, the head of the Australian Office of Financial Management (AOFM) has been quoted in the press explaining the fall in yields of Australian government securities as not just a flight from equities but also as a spill-over from the reduction in the availability of strongly rated government debt in the rest of the developed world. RBA Assistant Governor, Guy Debelle, was quoted in the same article commenting on increased demand for Australian government securities from foreigners:[103]

[102] The others being Canada, Denmark, Finland, Germany, Luxemburg, Netherlands, Norway, Singapore, Sweden, Switzerland and the UK.

[103] The Age, *Australia reaps bond windfall*, Tim Colebatch, 16 February 2012, available at: http://www.theage.com.au/opinion/political-news/australia-reaps-bond-windfall-20120215-1t6q2.html#ixzz1oQQsnHCl.

> *"It's the product of a whole lot of influences," he said. "Australia is an AAA-rated sovereign, and that's a shrinking club. Investors might be taking money out of equity markets and putting it into the safety of bonds paying fixed interest."*
>
> *"There have been changes in currency level and hedging costs. It's not surprising that demand for Australian government securities should have risen in the current circumstances."*
>
> *Reserve Bank assistant governor Guy Debelle said this week the demand for Australian bonds was coming largely from the sovereign wealth funds of foreign governments.*
>
> *Mr Debelle said the Reserve estimated that 75 per cent of Australian bonds were owned offshore. He said foreign demand for Australian bonds could be partly responsible for the recent strength of the Australian dollar.*

308. It is clear that the IMF, the AOFM and the RBA[104] all believe the shrinkage in the supply of safe sovereign debt globally is raising demand for the 'shrinking pool' of remaining safe sovereign debt – of which New Zealand government bonds are a part. However, the key question is whether this is also leading to heightened demand for New Zealand listed equities. If the answer is 'no' then it is wrong to assume that historically depressed NZ government bond yields are associated with historically depressed required equity returns (i.e., with a constant spot MRP).

309. In my view it is clear that this is not the case and this view is consistent with the commentary of the IMF, AOFM and RBA.[105]

A.2.2 Shrinking supply of safe private debt (and inability to manufacture more)

310. The IMF also notes that the shrinking supply of safe sovereign debt has happened at the same time at which the perceived supply of safe private sector debt has also collapsed. Prior to the GFC there was a large supply of highly rated private sector debt which investors regarded as substitutable for safe sovereign debt. However, as the IMF notes:[106]

> *The production of safe assets by the private sector largely collapsed with the onset of the global crisis. Total private sector securitization issuance declined from more than $3 trillion in the United States and Europe in 2007*

104 In addition to the above quote from RBA Assistant Governor Guy Debelle, see also section A.1.

105 See also section A.1.

106 IMF, Global Financial Stability Report, April 2012, Chapter 3, Safe assets: Financial System Cornerstone, p. 108.

> *to less than $750 billion in 2010 (Figure 3.14). The extraordinary volume of pre-crisis issuance was driven by the perception that the instruments were nearly risk-free while offering yields above those of the safest sovereigns. By construction, the high risk levels inherent to the lowest-rated (equity) tranches of the structured securities were expected to be offset by the near risk-free senior AAA-rated tranches. In reality, as the global financial crisis showed, the losses in the underlying portfolios were sufficiently large to threaten the solvency of even senior AAA-rated tranches. Moreover, the lack of information on the quality of the underlying assets made estimations of true asset value difficult and hence sensitive to sudden bad news. As a result, investors are still generally unwilling to invest much in these types of assets.*

311. Consistent with this analysis, not only has the crisis led to a reduction in the supply of privately created safe assets, it has also constrained the ability of the private sector to manufacture new assets perceived as safe.

A.2.3 IMF summary

312. The following table is the IMF's summary of the influences on the global supply and demand for safe assets. It summarises the reasons why the IMF believes: [107]

> *The price of assets regarded as safe is on the rise, with supply dwindling and demand rising amid uncertainty in financial markets, regulatory reforms, and increased demand from central banks in advanced economies.*
>
> *…*
>
> *While the "price of safety" will inevitably rise, a smooth adjustment process can be ensured if policymakers are aware of their actions and their potential consequences.*

[107] See IMF summary at: http://www.imf.org/external/pubs/ft/survey/so/2012/POL041112A.htm.

Table 18: IMF Table 3.3 (reproduced)

Table 3.3. Demand and Supply Factors and Their Anticipated Impact on Safe Asset Markets

Source of Demand	Investor Type	Important Short- to Medium-Term Factors	Expected Impact on Demand
Stable store of value in a portfolio management context	Reserve managers	Importance of safety considerations in strategic asset allocation and rising overall reserves, partly mitigated by increasing diversification and reallocation to sovereign wealth funds	↑
	Insurance companies and pension funds	Demand related to overall investment policy, but low-interest-rate environment may limit safe asset allocation by putting pressure on profitability	→
	Nonbank financial institutions	Flight to safety due to the European sovereign debt crisis (temporary effect related to the market turmoil)	↑
High-quality collateral for financial transactions	Banks and other financial institutions	Gradual shift of over-the-counter derivatives to central counterparties	↑
		Limits on the reuse of collateral and decreasing velocity of collateral	↑
		Increasing importance of secured funding sources for financial institutions with more differentiation in terms of applied haircuts in repo transactions[1]	→
Cornerstone in prudential regulations	Banks	Introduction of the liquidity coverage ratio (Basel III) (temporary effect)	↑
		Higher risk weights for riskier or downgraded sovereign debt	2
	Insurance companies	Treatment of sovereign debt and covered bonds under Solvency II	↑
Part of crisis-related liquidity provision	Central banks	Crisis-related monetary easing	↑
Benchmark for other assets	Banks and other financial institutions	Shift in the structure of demand toward assets that are perceived as relatively safer (e.g., U.S., U.K., Germany)	3

Source of Supply	Important Short- to Medium-Term Factors	Expected Impact on Supply
Sovereign issuers	Considerable deterioration of fiscal profiles in some advanced economies	↓
Private sector	Reduced effectiveness of traditional hedging instruments	↓
Central banks	Crisis-induced extension of liquidity provision	↑
Emerging markets	Restricted ability to generate safe assets (financial development, legal institutions, etc.) and lower degree of financial depth than advanced economies	→

Source: IMF staff.

Note: → indicates no impact; ↑ indicates an increase; ↓ indicates a decrease.

[1]Temporary effect due to disruptions of funding markets but possibly a more structural trend in the future.

[2]Possibly less demand for riskier or downgraded sovereign debt and higher demand for relatively safer or higher-rated sovereign debt as substitute.

[3]Overall impact will depend on evolution of perceptions of safety for benchmark assets.

Source: IMF

Appendix B Derivation of MRP relative to β=0

313. The CAPM equation for the return on government bonds (GB) is:

$$R_{GB} = R_{\beta=0} + \beta_{GB} \times MRP_{\beta=0}$$

314. Where R_{GB} is the return on government bonds, R_f is the true risk free rate, β_{GB} is the beta on government bonds and $MRP_{\beta=0}$ is the MRP relative to the true risk free rate. If β_{GB} is equal to zero, the second term on the right hand side is eliminated, such that the return on CGS is equal to the risk-free rate. Using CGS returns as the risk-free rate, the observed market risk premium is the difference between the market rate of return and the CGS returns:

$$MRP_{obs} = R_M - R_{GB}$$

315. Substituting the first equation into the second, the observed market risk premium can be written as:

$$MRP_{obs} = R_M - \left(R_{\beta=0} + \beta_{GB} \times MRP_{\beta=0}\right)$$

316. Recognising that the first two terms on the right hand side of the above equation equal $MRP_{\beta=0}$, the equation can be simplified as follows:

$$MRP_{obs} = (R_M - R_{\beta=0}) - \left(\beta_{GB} \times MRP_{\beta=0}\right)$$

$$= MRP_{\beta=0} - \left(\beta_{GB} \times MRP_{\beta=0}\right)$$

$$= MRP_{\beta=0} \times (1 - \beta_{GB})$$

317. Making $MRP_{\beta=o}$ the subject of the formula:

$$MRP_{Rel\ to\beta=0} = \frac{MRP_{Obs}}{1 - \beta_{GB}}$$

318. The same set of calculations can be performed on the tax adjusted risk free rate and MRP to arrive at the following formula:

$$TAMRP_{Rel\ to\beta=0} = \frac{TAMRP_{Obs}}{1 - \beta_{GB}}$$

Appendix C Alternative DGM estimate

319. Lally also comments that the methodology estimates the market return over an infinite horizon and then deducts the risk free rate at a term of five (or ten) years.[108] Lally provides an example in which he assumes that the market return on equity is 10.5% over the next ten years and then 11.3% beyond that period. Under these assumptions, calculating the market return on equity over an infinite horizon will give rise to an estimate that is an average of these two values (and therefore higher than the expected market return on equity over the next 10 years).

320. In my view there is no bias in the methodology we used. The example provided by Lally shows how, if one believes that equity investors value future dividends at different discount rates, the methodology may give rise to an estimate that is too low or too high but does not show that it is biased. I do not consider that there is clear evidence on which to form an opinion that equity investors discount future dividends at different rates. However, even if this was the case, there is no clear evidence to assume that near term dividends are discounted at a lower rate than long term dividends. If a higher discount rate were applied to near term dividends then Lally's critique would imply our DGM underestimated TAMRP over the near term.[109]

321. However, to address the issue raised by Lally for the DGM methodology, I have also estimated an alternative measure of TAMRP that assumes investors discount expected dividends in future year "t" using a risk free rate with a horizon of "t" years and a constant TAMRP. This approach implies that the term premium structure for equity discount rates mirrors those for risk free rates – which is an assumption that I do not endorse as reflecting reality but which appears to be the kind of assumption that Lally is suggesting should be made.

322. This is in contrast to the DGM estimates discussed above, where Lally and I both assume a constant market return on equity over time, at a level which solves to set the present value of expected future dividend cash flows equal to the current market capitalisation. In this alternative methodology, we instead solve for a constant TAMRP over time, and calculate the discount rate in each year as that TAMRP plus the zero coupon yield on New Zealand government bonds for that tenor. [110]

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108 Lally, *Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, 13 June 2014, p. 35; Lally, *Review of responses to review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, 20 August 2014, pp.25-27, 30

109 I also note that that Lally does not identify this as an issue in respect of the historical average excess returns that he relies upon, which use together an excess return calculated in a single year with a 10 year measure of the risk free rate.

110 We source zero coupon New Zealand government bond yield estimates from Bloomberg, using for example I04905Y Index.

323. Over the period 1 to 27 July, we estimate a TAMRP on this basis of 8.6%. This is lower than the TAMRP measured against the 5 year risk free rate that we calculated over the same period of 9.1%. However, it does not materially change the core conclusion that any reasonable DGM estimate of the TAMRP is well above the Commission's estimate of 7.0%.

Appendix D Proposed amendments to Lally's methodologies

D.1 Combining the Ibbotson and Siegel (version 1) estimates

324. I have previously stated that, in my opinion, the TAMRP and the risk free rate should be determined concurrently. In my view, if the Commission is to use a prevailing measure of the risk free rate, then it should determine a TAMRP consistent with that risk free rate. I proposed the use of a DGM, which gives use to a forward-looking measure of the TAMRP that is prevailing during the same average period as the risk free rate.[111] The DGM remains the only methodology proposed that is *both* forward-looking and prevailing during the averaging period.

325. I continue to hold this view. However, if the Commission is to continue to use a version of Lally's averaging of different estimates, then I consider that only two of these should be used: namely the Siegel (version 2) and the DGM method. The average of these two estimates is 8.5%.

326. In my view, the Siegel (version 2) methodology is the most effective and accurate way in which historical average market return data can be used to determine a forward looking risk free rate. The reasons for this view are set out in detail in Hird and Grundy (2013). Essentially, rather than using the historical average excess return as the estimate of investors expected excess return, this approach uses the historical total real return as the estimate of investors expected total real return. The TAMRP is derived by subtracting from this the prevailing risk free rate.

327. The Siegel (version 2) estimate reacts to changes in current market conditions due to its direct reliance on prevailing estimates of the risk rate. However, it does not react to changes in the expected market return and is, therefore, not wholly forward-looking. In this respect, it is inferior to the DGM.

328. However, to the extent that the Commission continues to rely on the historical average excess returns (Ibbotson and Siegel (version 1)) and survey evidence I consider that the former should be combined into a single estimate.

329. From Lally's own presentation of the Ibbotson and Siegel (version 1) estimates, it is clear that these are two alternative measures for a single number – namely the historical average of excess returns relative to 10 year bond rates. The Siegel (version 1) is proposed as a correction to the Ibbotson methodology to adjust for what may, or

[111] CEG, *Response to Commerce Commission UCLL/UBA WACC consultation paper*, March 2014, section 6

may not, be an accurate estimate of unexpected inflation over the relevant historical time period. But for this adjustment the Siegel (version 1) estimate is the same as the Ibbotson estimate.

330. Including both as separate estimates in the sample doubles the weight given to measures based on historical average excess returns. This would be inappropriate even if one considered that these estimates were superior to the other estimates. However, for the reasons set out above, I consider that they are inferior which strengthens the case for combining them into a single estimate. Lally does not state his own opinion as to which is preferable.

331. In my view the Siegel (version 1) methodology involves a highly speculative adjustment – assuming that investors persistently overestimated inflation on average in history – to the tune of over 1.0% pa on average. In addition to being speculative, I do not regard this as a plausible assumption especially when noting that inflation has both fallen and risen in history and there is no a priori reason to believe that investors failed to predict rising inflation but accurately predicted falling inflation. [112]

332. For this reason, I prefer to rely solely on the Ibbotson estimate of the TAMRP as the best estimate of the historical average TAMRP.

D.2 De-weighting survey evidence

333. However, we do not consider that this updated estimate should be given as much weight as either the DGM or the Siegel (version 2) estimates. The basis for the selection of the Fernandez *at al* survey is set out by Lally as follows:[113]

> *The most important characteristics of survey results are that they are recent, that they are the product of very careful consideration, and that they contain results for other markets. No available survey satisfies all three requirements but the Fernandez (2013) survey satisfies the first and last requirements.*

334. As we have previously stated, we do not consider that survey evidence on the TAMRP is generally a reliable source of information. Lally's view, accepted by the Commission, is that the Commission should set the TAMRP by having regard to five estimates, one of which is a number sourced from a single survey of eight (in 2013)

[112] NERA (2013) provides evidence from two long-running US surveys of inflation forecasts that there was a tendency to under-estimate inflation up until the appointment of Paul Volcker as Chairman of the Federal Reserve in 1979 and then overestimated over the first half of the 1980s before actual inflation and inflation expectations stabilized under the inflation targeting regime introduced by Volcker. See NERA, The Market, Size and Value Premiums, a report prepared for the Energy Networks Association, June 2013, pp. 21-22.

[113] Lally (2014), *Review of submissions on the cost of debt and the TAMRP for UCLL and UBA services*, p. 35.

people that Lally himself does not regard as the "product of very careful consideration". In our view, this is not a robust estimate.

335. There are other problems with relying upon survey evidence. Survey evidence may or may not be forward-looking. Whether it is depends upon the survey questions asked and how these are treated by the researchers. The Fernandez *at al* survey in 2015 asked recipients to nominate the "Market Risk Premium that I am using in 2015". Similar questions were asked in 2013 and 2014. The surveys did not ask recipients for the MRP that they expected to prevail in 2015 and it appears open for recipients to respond with estimates based on historical average excess returns. Therefore we do not agree with Lally that the survey evidence is forward-looking.

336. We also note that even if it were forward-looking (which the Fernandez *et al* survey cannot be assumed to be) the survey evidence relied upon by Lally is not prevailing during the averaging period used to determine the risk free rate for the cost of equity. The results of the 2013 survey were collected over May and June 2013, while the 2015 survey was conducted over March 2015. Therefore, one cannot consistently add together the risk free rate determined in the averaging period and the TAMRP estimated from survey evidence and produce a coherent forward-looking estimate of the expected market return, as Lally attempts to do. At best one can determine an estimate prevailing during the survey period. This further calls into question the useability of the survey evidence. (Of course, precisely the same issue exists for the Ibbotson and Siegel (version 1) methodologies where the risk free rates underpinning the TAMRP estimates are not the prevailing risk free rates.)

337. However, we note that the further draft determination of the Commission, by accepting Lally's advice, is that it currently proposes to consider the results of the Fernandez *et al* survey as one of the five measures that it relies upon to determine TAMRP. It is therefore important that we consider how this estimate should be used and how it would change if it were to be updated for the most recent information, as we do above.

D.3 Adjusting Lally's method to account for differences between the historical average and prevailing term structure in risk free rates

338. For determining the cost of equity, the Commission prefers to use a TAMRP estimated relative to the five year risk free rate. Lally calculates this value by estimating that the average difference in five year and ten year New Zealand government bond yields between 1931 and 2013 has been 0.08%.

339. The first point to note is that Lally's basis for estimating a 0.08% historical average difference between five and ten year yields is unreliable. The historical average TAMRP estimate is measured relative to ten year New Zealand risk free yields over the period 1931 to 2013. However, Lally only has data for both the five and ten year

yields over the period 1985 to 2013 (where the difference is 0.07%). This represents only 29 out of the total 83 years (around one third). Lally attempts to augment his estimate by adding the average spread between US 10 and 5 year government bond yields over 1953-1985 which was 0.08%. However, this still leaves 22 years of data unaccounted for (1931 to 1952 inclusive) which Lally assumes to be the same as for the US over the period 1953-1985.

340. The way in which Lally's has used US data to infer a New Zealand historical average is, in my view, highly problematic. First, over the period since 1985 the spread between ten and five year US risk free rates has averaged 0.54%. That is, the spread has been very strongly positive and much more positive than in New Zealand over that period. Lally does not disclose, and so gives no weight, to this evidence.

341. This demonstrates that the term structure of interest rates, unlike the level of interest rates in general, is not strongly linked internationally. Over the period post 1985 New Zealand had strong positive as well as negative yield curves, resulting in an apparent flat yield curve with average spread close to 0%; which appears to be unusual not just relative to the US but also relative to Australia and the UK (as illustrated in Table 19). There is no reason to believe that the US experience over the period 1953 to 1985 was the same as the New Zealand experience and there is no reason to believe that the term structure in either the US or NZ pre 1953 was the same as the average term structure in the period 1953 to 1985.[114]

Table 19: Average 10- to 5-year spreads post May 1985

Country	Start date	End date	Total Obs.	Average spread (%)
US	1 May 1985	21 Jul 2015	7821	0.54
UK	1 May 1985	21 Jul 2015	6099	0.33
NZ	1 May 1985	21 Jul 2015	7714	0.08
AU	1 May 1985	21 Jul 2015	7227	0.27

Source: Bloomberg, CEG analysis

342. The simple fact is that there is not sufficient historical data on five year rates in New Zealand to estimate the historical average excess return relative to five year rates.

343. Even if there was a reliable estimate of the average five year risk free rate in New Zealand, Lally's approach would be highly problematic. Lally's approach is to, in essence, assume that there is a term structure in TAMRP that is the same as the historical average term structure in risk free rates. For example:

- If the one year risk free rate was, on average, 1.5% below the 10 year risk free rate, then the one year TAMRP would be 1.5% above the 10 year TAMRP. In this

[114] If an assumption was to be made it would appear a more reasonable assumption would be that the term structure pre 1953 was the same on average as the term structure post 1953 – including the year after 1985.

regard I note that 1.7% is the average difference between 10 and 1 year US government bond yields over the longest time period available from Bloomberg (1983 to 2015);

- If the if the five year risk free rate was, on average, 0.4% below the 10 year risk free rate then the five year TAMRP would be .4% above the 10 year TAMRP. In this regard I note that 0.4% is the average difference between 10 and 5 year US government bond yields over the longest time period available from Bloomberg (1962 to 2015).

344. I do not consider that this is a reasonable way in which to arrive at a forward looking TAMRP estimate – especially in the context where the prevailing term structure of interest rates is materially different to the historical average estimate of the term structure of interest rates.

345. The Ibbotson and Siegel (version 1) estimates are constructed by measuring the difference between the return on the market portfolio over a given year and the 10 year bond rate prevailing in that year and then averaging these single year 'excess returns' over a long time horizon. The historical estimates have a horizon of 1 year notwithstanding that the ten year risk free rate is used. This is because the return on the market is estimated over a single year and compared to the return on a ten year bond in that same year. In my view, consistent with the construction of the estimate, if investors use past excess returns as a guide to the future then the 6.9%/5.7% will reflect investors' expectation of the market return relative to the ten year bond rate in any given year.

346. By way of concrete example let us take the Ibbotson estimate of the TAMRP of 6.9% adjusted up to 7.0% to include 2014 data. This is constructed as the average annual difference between market returns and 10 year risk free rates over 80 odd years. If it is the case that this is a good estimate of the expected difference between market return and 10 year risk free rates over the current year then the expected market return is 7.0% plus the prevailing 10 year risk free rate.

347. Over the period 1 to 27 July 2015 the 10 year risk free rate was 3.37%; implying an expected annual return on the market of 9.43% ($7.0\% + 3.37\% \times (1 - 0.28)$) over the subsequent year. This is consistent with the construction of the 7.0% estimate which is an average of single year returns on the market less the (tax adjusted) prevailing 10 year risk free rate in that same year.

348. However, the Commission's preferred measure of the risk free rate is not the ten year risk free rate but the five year risk free rate. If investors' expect a market return in the current year of 9.6% then subtracting the (tax adjusted) 5 year risk free rate of $2.93\% \times (1 - 0.28)$ (measured over the same 1 to 27 July period) from the estimated return on the market results in an estimate of the TAMRP relative to the five year risk free rate of 7.32%.

349. The 7.32% TAMRP relative to the five year risk free rate is 0.32% (3.37% – 2.93%) × (1 – 0.28)) higher than the 7.0% TAMRP relative to the tax adjusted ten year risk free rate because the tax adjusted five year risk free rate is 0.32% lower than the ten year risk free rate. It follows that if equity investors demand a 7.0% premium to the prevailing ten year bond rate in the next year then they must demand a 7.3% premium to the prevailing five year bond rate. By the same logic, the Siegel (version 1) estimate of 5.8% (Lally's 5.7% estimate relative to the ten year risk free rate increased to 5.8%% to take into account 2014 data) becomes 6.1% when measured relative to the five year risk free rate. The average of the two becomes 6.7%.

350. This differs from Lally's methodology which is essentially to assume that the five and 10 year TAMRPs are only 0.08% different because his estimate of the historical average of five and ten year risk free rates is only 0.08%.

351. In the current market circumstances this difference in methodology results in a very different estimate of the TAMRP relative to the five year risk free rate. This is because the prevailing term premium is strongly positive (44bp between five and ten years) while the historical average term premium (as estimated by Lally) was flat (only 8b between five and ten years).

352. Both Lally and I start with the same historical average excess return relative to 10 year rates risk free rates. However, I assume that if prevailing five year risk free rates are below ten year risk free rates the risk premium relative to five year risk free rate will be higher (and *vice versa*). There is no economic or mathematical logic that says that this must be true. However, it is economically plausible based on the assumption that equity investors required returns on (long lived) equity reflects long term interest rates. Moreover, my approach does not give rise to mathematically impossible (internally inconsistent) results.

353. By contrast, Lally assumes that the historical average data defines a series of different excess returns for each maturity of the risk free rate and that these can be used to estimate investors' prevailing TAMRP over the same horizon. Moreover, Lally assumes that this can be done even if the prevailing term structure of interest rates is different to the historical average term structure of risk free interest rates. This allows Lally to ignore the prevailing term structure or risk free rates when arriving at an estimate of both the ten and five year TAMRP.

354. It is relatively easy to demonstrate by way of example that this cannot be correct in general. Imagine that the historical average term structure was upward sloping such that the 1 year risk free rate was 1% below the 2 year risk free rate on average. Consequently, the historical average excess return relative to the one year rate would be 1% higher than the historical average excess return relative to the two year rate. Let the latter be 7% and the former be 8%. Lally's methodology would results in the one year horizon market cost of equity being estimated as the one year risk free rate plus 8% while the two year horizon market cost of equity would be the two year risk free rate plus 7%.

355. Now, let the prevailing term structure of interest rates vary from its historical average and be perfectly flat at 4%. That is, short and long term interest rates are identical due to the fact that investors expect short term interest rates to be maintained at their current levels indefinitely. That is, the one year risk free rate is 4%, the one year risk free rate expected in 1 years' time is 4% which means that the two year risk free rate demanded today is also 4%. Applying Lally's methodology will give rise to:

- A one year cost of equity of 12% for the first year (4% plus 8%);
- A one year cost of equity of 12% for the second year (4% plus 8%); and
- A two year cost of equity of 11% (4% plus 7%).

356. However, these estimates are clearly internally inconsistent. Investors' required return cannot simultaneously be 8% for the first two years (based on prevailing and expected one year rate risk free rates (4%) plus one year TAMRP (6%)) while being 7% over the two year period (based on prevailing two year rate risk free rate (4%) plus two year TAMRP (7%)).

357. The problem is created because the term structure of the TAMRP estimated from the historical data reflects the historical average term structure of interest rates. Applying this to a prevailing term structure of interest rates that is different to the historical average will result in internally inconsistent predictions.

358. In addition to this internal inconsistency issue, there is an empirical regularity, documented in the finance literature, such that the excess return relative to short term interest rates is higher when the term structure of interest rates is positively sloped. Early papers in this field are Campbell (1988)[115] and Chen (1991)[116] both point out the empirical regularity that the term structure of interest rates can be used to predict economic activity. The Federal Reserve Bank of New York maintains a web page devoted to this topic entitled "The Yield Curve as a Leading Indicator" which begins with the statement

> *Research beginning in the late 1980s documents the empirical regularity that the slope of the yield curve is a reliable predictor of future real economic activity.*[117]

[115] Campbell, The real term structure and consumption growth, Journal of Financial Economics, V. 22, 1988.

[116] Chen, Financial investment opportunities and the macroeconomy. Working paper no. 266 (Centre for Research in Security Prices. University of Chicago. Chicago. IL).

[117] See: http://www.newyorkfed.org/research/capital_markets/ycfaq.html

359. Fama and French (1989)[118] report that a higher term spread[119] predicts higher excess returns relative to short term interest rates over horizons of between one month and four years. That is, the excess return relative to short term interest rates is higher when long term interest rates are above short term interest rates. This result has been confirmed by subsequent researchers most recently by Rapach, Strauss and Zhou (20120)[120] and Dangl and Halling (2012).[121] This and other relevant literature is discussed in Hird and Grundy (2013).[122]

360. In summary, estimating a term structure for the TAMRP based on the historical average risk free rate term structure cannot be reliably applied in circumstances where the prevailing term structure of interest rates is different to the historical average. Moreover, the best estimate, consistent with the finance literature, is that, when the risk free rate yield curve is upward sloping, as it is at the moment, the TAMRP relative to the five year rate will be more than the TAMRP relative to the ten year rate.

361. In this context, it is my view that the best method for arriving at a TAMRP relative to the five year risk free rate that is consistent with the historical average estimate of the excess return relative to the ten year rate is to add prevailing term spread between ten and five year risk free rates. The Commission may want to adopt this approach or consider alternatives; such as to add some portion of the prevailing term spread. However, in my view simply ignoring the prevailing term structure of interest rates when arriving at a term structure for the TAMRP is not reasonable.

D.4 Conclusions

362. Lally's estimate of the TAMRP proposed and accepted by the Commission was based on the median of 5 different estimates of the TAMRP in April 2014. If I do nothing

118 Fama and French (1989), Business conditions and expected returns on stocks and bonds, Journal of Financial Economics, v. 25 1989.

119 The difference between the long term (10 years or greater) and short term (one-month) AAA rated yields.

120 Rapach, David E., Jack K. Strauss and Guofu Zhou, 2010, *Out-of-sample equity premium prediction: Combination forecasts and links to the real economy*, Review of Financial Studies 23, 821-862. The authors' document the statistical and economically significant predictability of excess returns based on the term spread amongst other variables.

121 Dangl, Thomas and Michael Halling, 2012, *Predictive regressions with time-varying coefficients*, *Journal of Financial Economics* 106, 157–181. The authors focus on what they see as flaw in a critique of other studies that concluded that excess returns could not be reliably predicted. The failure to impose a structure on the time-varying relation between predictor variables and the expected excess return in those studies meant that the authors were unable to reject the null of no predictability. Dangl and Halling explicitly model the time-varying relation and thereby document statistically significant predictability of the E[MRP]. Echoing the results in Fama and French (1989), Dangl and Halling document that the relation between the E[MRP] and predictor variables, such as interest rates, spreads and yields, varies across the business cycle.

122 Hird and Grundy, *Estimating the return on the market*, a report for the Australian ENA, 2013.

else but apply Lally's methodology updated for changes in the risk free rate between April 2014 and July 2015 the median TAMRP estimate rises to 7.4%. Moreover, I propose a change to Lally's methodology for arriving at a historical average TAMRP relative to the five year risk free rate. However, this does not alter the median estimate. I also propose a change to the number of estimates used; combining the two pure historical average estimates and excluding survey data. The effect of these changes is raise the median TAMRP from 7.4% to 8.5%.

Table 20: Updating and adjusting Lally's TAMRP estimates

	Lally estimate (13 July 2014)	Updated estimate no change in method	Updated estimates and CEG method	Updated estimate combine historical estimates and exclude survey
Ibbotson	7.1%	7.2%	7.3%	n.a.
Siegel (version 1)	5.9%	6.0%	6.1%	
Siegel (version 2)	6.9%	7.8%	7.8%	7.8%
DGM	8.2%	9.1%	9.1%	9.1%
Survey	6.7%	7.4%	7.4%	n.a.
Median	6.9%	7.4%	7.4%	8.5%
Average	7.0%	7.5%	7.5%	8.5%

Source, Lally, Bloomberg, CEG analysis

Appendix E Data used

363. The data in this appendix was used along with the following Oxera leverage formula to derive the results reported in the main body of the report:

$$\beta_a = \beta_e \times \left(\frac{E}{D+E}\right) + \beta_d \times \left(\frac{D}{D+E}\right)$$

where E is the market capitalisation of the firm and D is the market value of debt.

Table 21: Data from 2015 sample

	Oxera leverage	Oxera asset beta	Implied Oxera equity beta before de-levering
Illiad	0.12	0.59	0.67
Belgacom	0.17	0.52	0.63
Telstra	0.2	0.48	0.60
Elisa	0.23	0.45	0.58
AT&T	0.27	0.43	0.59
Swisscom	0.29	0.38	0.54
Verizon Communications	0.3	0.51	0.73
BT Group	0.32	0.69	1.01
TDC	0.38	0.26	0.42
Deutsche Telecom	0.49	0.38	0.75
Hellenic Telecommunications	0.49	0.68	1.33
Koninklijke KPN	0.5	0.24	0.48
Orange	0.5	0.44	0.88
Telecom Austria	0.5	0.22	0.44
Frontier Communications	0.58	0.39	0.93
Windstream Holdings	0.58	0.27	0.64
Telecom Italia	0.75	0.19	0.76
Cincinnati Bell	0.76	0.33	1.38

Source: Oxera (2015)

Table 22: Data from 2009 sample

	CEG leverage	Oxera asset beta	Implied Oxera equity beta before de-levering
Illiad	0.05	1.26	1.33
Belgacom	0.08	0.45	0.49
Swisscom	0.16	0.50	0.60
Elisa	0.20	0.65	0.81
Telstra	0.20	0.36	0.45
AT&T	0.23	0.66	0.86
Hellenic Telecommunications	0.28	0.55	0.76
Verizon Communications	0.28	0.61	0.85
Telecom Austria	0.31	0.38	0.42
Portugal Telecom	0.32	0.51	0.75
Koninklijke KPN	0.32	0.45	0.67
BT Group	0.35	0.53	0.82
TDC	0.41	0.25	0.42
Deutsche Telecom	0.44	0.24	0.43
Orange	0.45	0.26	0.47
Frontier Communications	0.52	0.56	1.16
Telecom Italia	0.52	0.37	0.77
Cincinnati Bell	0.68	0.52	1.62

Source: Oxera (2015), Bloomberg, CEG analysis