COMPETITION ECONOMISTS GROUP

Estimating the debt risk premium: update report

October 2013

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1 Introduction

1. My name is Tom Hird, and I have a Ph.D. in Economics from Monash University and over 20 years' experience as a professional economist. My curriculum vitae is attached at Appendix C to this report.

2. I have been commissioned by the Victorian electricity distribution businesses ('the businesses') to estimate the debt risk premium pursuant to the AMI Cost Recovery Order in Council (CROIC) (which in turn engages the National Electricity Rules (NER)) for application in the advanced metering infrastructure (AMI) charges revision application for 2014. This report is in large part an update to the report that I produced for the businesses in August of this year.[1] To avoid excessive replication between the two reports I refer readers to my earlier report describing the approach and assumptions that I adopt in undertaking my analysis.

3. In this report I update my previous analysis for the averaging period from 16 September 2013 to 11 October 2013 (the 'actual averaging period'). I provide commentary on the new results and describe any differences in approach that I have taken from my previous report and, where I have done so, why I have adopted a different approach.

4. Based on my analysis of the data, my view is that the extrapolated Bloomberg BBB fair value curve is a reasonable, albeit conservative, basis upon which to estimate a 10 year cost of debt for BBB+ rated bonds during the actual averaging period.

5. The Bloomberg BBB fair value curve provides a reasonable fit to the data up to a maturity of 7 years. Beyond 7 years, it is necessary to extrapolate the Bloomberg fair value curve from 7 to 10 years maturity. There is sufficient market data available with which to estimate a robust extrapolation from 7 to 10 years. Based on a bond pairing analysis, the extrapolated 10 year Bloomberg BBB fair value DRP is 2.62%. Combined with the interpolated 10 year CGS yields during the actual averaging period of 4.02%, I estimate a total cost of debt of 6.64%.

6. Reliance on the Bloomberg BBB fair value curve is supported by a broad selection of bond yield observations. The curve fitting techniques performed upon these data in this report produce results at a maturity of 10 years that are similar, albeit above, the extrapolated Bloomberg BBB fair value curve. The BBB+ 10 year DRP estimate based on the widest sample of bonds - which includes BBB to A- bonds issued by Australian companies in any currency or in Australian dollars in any country - is 3.04%.

7. Methods that have previously been applied by the ERA and IPART for the purpose of estimating a cost of debt have resulted in estimates that in some cases have been

[1] CEG, *Estimating the debt risk premium*, August 2013

below the Bloomberg fair value curve. I do not consider that these methodologies are accurate or reliable. In section 5 of my previous report I set out my specific views on those methodologies. I continue to remain of the general view that either reliance on the Bloomberg fair value curve or yield curve fitting as implemented in this report is preferable to these approaches. Specifically, in respect of the actual averaging period, I consider that the Bloomberg fair value curve or yield curve fitting approaches are appropriate for measuring the debt risk premium.

8. The remainder of this report is set out as follows:

- **Section 2** examines the population of relevant bond yields. I compare these to the Bloomberg BBB fair value curve and use them to empirically estimate alternative yield curves for BBB+ rated debt; and
- **Section 3** assesses the evidence available to inform extrapolation of the Bloomberg fair value curve. I examine bond pairing analysis and the results of curve fitting as sources of information.

9. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia"*. I have made all inquiries that I believe are desirable and appropriate to answer the questions put to me. No matters of significance that I regard as relevant have to my knowledge been withheld. I have been provided with a copy of the Federal Court of Australia's *Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia*, and confirm that this report has been prepared in accordance with those Guidelines.

10. I have been assisted in the preparation of this report by Daniel Young and Annabel Wilton in CEG's Sydney office. However the opinions set out in this report are my own.

Thomas Nicholas Hird

21 October 2013

2 Analysis of debt risk premium

11. In this section, I follow the approach in my previous report by analysing observed yields on bonds issued by Australian or foreign companies:

- to assess the consistency of the Bloomberg BBB fair value curve with publicly available bond yield estimates; and
- to implement Nelson-Siegel curve-fitting techniques to estimate a benchmark DRP for BBB+ rated bonds at 10 years maturity.

12. I find that the observed yield data support the level and shape of the Bloomberg BBB fair value curve. I examine a number of alternative criteria for defining which bond yield data to use. Under all reasonable approaches to defining the relevant data set, the level of the Bloomberg BBB fair value curve is consistent with the underlying data at its longest maturity of 7 years.

13. Application of Nelson-Siegel yield curve fitting techniques to the same data generates 10 year BBB+ yield estimates that are consistent with or higher than the Bloomberg BBB fair value curve. However, particular criteria applied to the selection of bond yields are capable of producing fitted results that are significantly lower at 10 years than the extrapolated Bloomberg BBB fair value curve. I note that these estimates coincide with very small sample sizes and consequently I do not consider that any material weight should be attached to these results as they are unlikely to be reliable.

14. The Nelson-Siegel approach is discussed in more detail in Appendix A to our previous report for the businesses. Consideration of information that has come to light since my previous report was published has resulted in some revisions to my modelling approach. I discuss these revisions in more detail at section 2.2 below.

2.1 Identifying a bond yield population

15. As with my previous report, I analyse bonds that are:

- rated BBB to A- by Standard & Poor's; and
- issued by any firm in Australian dollars, or issued by an Australian firm in foreign currency, swapped to Australian dollar yields.

16. Applying these criteria in Bloomberg's bond search function results in a total population of 453 bonds that were active and satisfied these criteria for at least part of the period from 16 September 2013 to 11 October 2013. Only 389 of the 453 bonds have yield data available from either Bloomberg or UBS during this period, so in effect the analysis in this report is based on a bond population of 389 bonds.

17. In my previous report I assessed the effect of different bond characteristics and source data availability on DRP. I systematically analysed the effect of varying five binary options, being:

- rating (BBB+ only vs. BBB to A-);
- type (excluding bonds with optionality features other than make-whole callable vs. all);
- currency (AUD only vs. all[2]);
- country of issuer (AU only vs. all[3]); and
- data source (Bloomberg only vs. average of Bloomberg and UBS).

18. The five binary options result in 32 unique combinations of characteristics, i.e. 32 different but overlapping samples. While I report the results for all 32 possible samples/sub-samples, I do not believe that they are all of equal relevance. This is partly because the rationale for analysing particular sub-groups is weak and partly because some sub-samples simply have too few observations to be reliable.

19. I stated in my previous report that the most relevant bond samples are ones that:[4]

- include A- and BBB bonds;
- include bonds issued with optionality features;
- include bonds issued by Australian companies in foreign currency;
- exclude bonds issued in Australian dollars (AUD) by foreign companies.

20. This leaves only two core samples, namely, the full sample excluding foreign companies using either both UBS and Bloomberg or just Bloomberg data. The rationale for using Bloomberg only data is that it is publicly available (albeit at a cost) while UBS data is not (UBS must make a decision to provide it albeit at no cost). However, I note that these two samples give very similar results (the curve fitting estimates a DRP of 3.08% including UBS data and 3.07% excluding it) so very little turns on this issue, at least in the period analysed.

2.2 Changes to modelling approach

21. The scope of this report is to undertake the analysis that I provided to the businesses in my previous report of August this year in respect of the actual

2 ‘All’ in this context includes bonds issued in a non-AUD currency by Australian companies.

3 ‘All’ in this context includes bonds issued in AUD by companies that are not Australian.

4 CEG, *Estimating the debt risk premium*, August 2013, pp. 13-14

averaging period. The August report was based on analysis conducted on bond yield data sourced during February 2013.

22. Since the analysis in that report was conducted, I have revised my approach in a number of respects in response to new information that has come to light. In summary, the changes I have made in assessing the reasonableness of the Bloomberg fair value curve are with regard to:

- the treatment of callable bonds by including such bonds in my analysis using yield to next call and with tenors calculated to next call; and
- the optimisation process used to estimate Nelson-Siegel curves. Specifically, I now:
  - minimise the sum of squared deviations based on the average yields on each bond over the averaging period;
  - implement constraints on the optimised parameters to ensure the resulting yield curves satisfy basic requirements;
  - exclude two bonds as outliers; and
  - select starting values for each optimisation run using parameter values solved for on the full sample of bond data.

23. A full discussion of these changes and the reasons for them follows.

2.2.1 Treatment of callable bonds

24. In my opinion it is highly desirable to take into account yields on callable bonds in assessing the cost of debt and DRP. This is because regulated businesses commonly issue callable debt so the cost of callable debt should be incorporated in any estimate of debt costs for the purpose of setting regulatory allowances.

25. Moreover, the cost of equity for the Victorian electricity distribution businesses is calculated based on the systemic risks of similar businesses. It is the normal practice of such businesses to issue callable debt. The ability of a firm to issue callable debt may act to reduce its systemic risk, since it gives it the option to redeem its debt and seek lower interest rates in the future. Given that the cost of equity is measured in a way that takes into account any possible quantitative effect of the issue of callable bonds, then the cost of debt should be estimated on a consistent basis.

26. On this basis I consider that it would be preferable to avoid either:

- excluding callable bonds from a quantitative analysis of the cost of debt; or
- including callable bonds but re-estimating their yields based upon simulated removal of their call options.

27. Neither of the methodologies above is capable of estimating the effect that the issuance of callable bonds has on the cost of debt and both are likely to have the effect of underestimating the cost of debt.

28. Having regard to the statements of principle above, I note that there are difficulties in assessing how callable bonds should be included in a quantitative analysis of the cost of debt. In my previous report I included callable bonds at their maturity dates and sourced yields to maturity for these bonds from Bloomberg. I sourced yields for these bonds from UBS on the assumption that they should be interpreted as yields to maturity, or that reported trading margins on floating rate bonds were calculated based on the eventual maturity date. Since that report, additional information has come to light which has led me to review and revise these assumptions.

29. As part of its development of rate of return guidelines in its Better Regulation reform program, the AER released a report by Chairmont Consulting. Much of the scope of the Chairmont report addresses the issue of callable bonds. In particular, the Chairmont report refers to UBS yields for callable bonds being expressed on a "yield to next call" basis.[5]

30. Having revisited the UBS data over the current averaging period, I am satisfied that it is reasonable to conclude that UBS yields are expressed as yields to call. I have confirmed this by calculating yields based on the price and maturity dates listed in the UBS rate sheets and comparing these to the yields estimated by UBS, both for fixed rate and floating rate bonds.[6]

31. In reviewing the use of callable bonds from the UBS data I have considered the difficulties in dealing with callable bonds more generally. Take for example a bond that has a single call date before maturity. The market price for this bond is determined based upon a (implicit) probability that this bond will be called at the call date, with the remaining probability that it will be redeemed at maturity. It is clear that:

- if the probability of the bond being called at the call date were assessed at zero, then it would be reasonable for analytical purposes to calculate a yield to maturity and calculate a tenor based on the time to maturity; and
- if the probability of the bond being called at the call date were assessed at one, then it would be reasonable for analytical purposes to calculate a yield to call and calculate a tenor based on the time to call.

5 Chairmont Consulting, *Debt risk premium expert report*, February 2012

6 My earlier analysis implicitly assumed that the price of a bond would not change in trading before and after a call date. In retrospect this is not likely to be the case if the bond was assessed by the market as having a material probability of being called. The updated information provided by the bond not being called could have a significant effect on the price of that bond.

- If the probability of the bond being called lies strictly between zero and one then neither representation is entirely accurate.

32. In this report, I address the uncertainty associated with the correct representation of callable bonds in two ways:

    - where I include callable bonds in my analysis, they are included at yield to next call and with a tenor calculated to the next call date; and
    - for every sample that I examine with callable bonds, I examine the same sample excluding callable bonds (but including those make-whole callable bonds which are not also callable).

33. The representation of callable bonds with yields and tenors to call is made upon the assumption that the price for these bonds is determined on the basis that they will be called at the next call date. This may not be an accurate assumption for some callable bonds. However, I believe it may be a preferable assumption to including them with yields to maturity and tenors calculated to maturity because:

    - bonds are most likely to be called when interest rates are low, so that issuers can refinance more cheaply and interest rates are currently at historically low levels; and
    - UBS provides yields calculated to next call and since yield to next call data can easily be sourced from Bloomberg this representation is consistent with the source data that is available.

34. With respect to the first point, I note that although DRPs are yet to return to the lower levels that prevailed prior to the global financial crisis, long term bond yields have steadily fallen since the beginning of 2011 and are currently at levels as low as they have been over the past decade. This is demonstrated in Figure 1 below, where I proxy these yields with the Bloomberg BBB 7 year fair value estimate since this provides an uninterrupted source of fair value yield data since 4 December 2001.

Figure 1: Bloomberg BBB 7 year fair value yields

Source: Bloomberg

2.2.2 Nelson-Siegel analysis

35. My previous report for the businesses has been reviewed by Diamond, Brooks and Young.[7] The purpose of the review report was to perform statistical inference on the results of the Nelson-Siegel analysis and to estimate spot and par yield curves.

36. The review report undertook its own estimate of Nelson-Siegel yield curves using an alternative software package. These were substantially similar to the curves that I estimated in my previous report. Some differences between the results in the review report and my previous results are due to the different software package used, but others are due to other aspects of the optimisation process that was followed.[8]

37. After reviewing the report of Diamond *et al.* I have made four amendments to my own approach to estimating Nelson-Siegel yield curve that I believe will provide slight improvements on the approach that I applied in my previous report.

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7 Diamond, N., Brooks, R. and Young, D., *The development of yield curves, zero coupon yields, and par value yields for corporate bonds*, October 2013.

8 Diamond *et al.* discuss the different software packages used at section 3.2 of their report. The difference in results is not material for large samples – see for example Tables 1, 2 and 6.

38. For completeness, I summarise the effect of these revisions on the four bond samples that I consider to be most relevant for the Nelson-Siegel analysis.

2.2.2.1 Calculation of average yields

39. In my previous report I calculated the sum of squared deviations as across each yield on each day of the averaging period. Diamond *et al.* prefer to calculate the sum of squared deviations using the average yields recorded over the averaging period because to do so gives rise to improved estimates for standard errors.[9]

40. In this report I do not estimate standard errors for the Nelson-Siegel parameters. However, I consider that there is some value in maintaining consistency between the assumptions made in this report and that of Diamond *et al.* Furthermore, I note that the complexity of the optimisation task appears to be significantly reduced when I apply it to average yields. As discussed in section 2.2.2.4, computer algorithms are used to solve for the best fit to the data. A reduction in complexity can help ensure that the algorithmic solutions are robust.

2.2.2.2 Constraints on optimisation

41. Diamond *et al.* also impose a system of constraints on the yield curves that they estimate. These can be summarised below:

- the A- yield curve should lie below the BBB+ yield curve;
- the BBB yield curve should lie above the BBB+ yield curve;
- the lowest yield curve (the A- curve) should have a positive intercept;
- the lowest yield curve (the A- curve) should have a positive long run value; and
- the short and medium term components of the yield curves should decay to zero over the long term.

42. I re-express these further in terms of the underlying parameters of the Nelson-Siegel yield curve. That is, based on the yield curve formula:

$$Yield_t = \beta_1 + (\beta_2 + \beta_3)\frac{1 - e^{t/\beta_0}}{t/\beta_0} - \beta_3 e^{t/\beta_0} + \beta_4 A - +\beta_5 BBB$$

- $\beta_4 \leq 0$
- $\beta_5 \geq 0$
- $\beta_1 + \beta_2 + \beta_4 > 0$

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9 Although Diamond *et al.* do make use of the daily observations on yields when applying a non-linear mixed effects model (section 4.2 of their report).

- $\beta_1 + \beta_4 > 0$
- $\beta_0 > 0$

43. In my previous report I did not implement these constraints. I considered the first two relating to the order of the yield curves, but did not apply them because it was not necessary – all of the yield curves that I estimated were in the order that would normally be expected. However, I agree with Diamond *et al.* that it is useful to apply the final three constraints, although this appears to make minimal difference to the yield curves that are estimated.

44. I note for completeness that these are not the only constraints that could be implemented. For example, the constraints above do not prevent the A- curve estimating negative yields at some maturities. However, none of the yield curves that I estimate in this report are affected by negative yields.

2.2.2.3 Exclusion of outliers

45. In my previous report I did not take any action in respect of outliers in the bond yield data. In this report, I have excluded two bonds from the yield curve fitting process.

46. I exclude the yields of a bond issued by National Australia Bank (ISIN GB0006241326) on the basis that they are clearly unreliable and are unlikely to even represent yields. The yield data reported by Bloomberg peaks at 891% on 23 September before settling at between 105% and 120% for the remainder of the period.

47. I exclude a further bond issued by Morgan Stanley (ISIN XS0549367455). This bond was called immediately after the averaging period on 15 October 2013. This call was announced during the averaging period on 7 October 2013.

48. The average yield of this bond during the averaging period was reported as 15.60% in Bloomberg at a tenor of just 0.05 years. This is not a realistic estimate of a yield for a bond at such a short maturity, particularly one that is being called with certainty. The presence of such a high outlier at a tenor so close to zero is likely to have detrimental effect on the robustness of implementing Nelson-Siegel yield curves. In particular, it is likely to result in a very high short term component combined with a large decay factor, outweighing other short and medium term effects.

49. The Nelson-Siegel analysis in the remainder of this report excludes the bonds issued by National Australia Bank and Morgan Stanley.

2.2.2.4 Starting values

50. In my previous report I estimated the Nelson-Siegel parameters in Excel Solver. In common with all optimisation algorithms, Solver requires initial parameter values which it iteratively improves until it achieves a set of estimates that it can no longer improve. Previously, I set starting values of one for β_0 and zero for other parameters.

51. On some occasions, particularly with non-convex optimisation problems, the choice of starting values can result in the true global optimum not being reached. Instead, a point of local optimisation may be achieved.

52. To reduce the likelihood of this occurring, Diamond *et al.* used starting values equal to the Nelson-Siegel parameter values estimated on the full data set of bond yields. I consider that the use of starting values that are equal to the parameter estimates derived from the estimation of a Nelson-Siegel yield curve across the entire dataset represents an improvement on the approach that I applied in my previous report.

53. In implementing this approach, I run a "multiple descent" optimisation algorithm within Solver on the full bond dataset to solve for the starting values that I apply to all other runs. Multiple descent algorithms take into account the effect that poor starting values may have on optimisation outcomes by varying starting values and running multiple iterations of the full optimisation algorithm. This provides reassurance that the starting values that I apply to all subsequent optimisation runs are not affected by poor starting values in this initial implementation.

2.2.2.5 Effect of revisions on DRP results

54. Table 1 below shows the effect of the revisions that I have implemented to the Nelson-Siegel methodology on four samples that I believe are most relevant for the reasons I set out at section 2.1 above. These samples include bonds issued by Australian companies, rated between BBB and A- and include bonds with options.

Table 1: Effect of revisions to Nelson-Siegel methodology

	All, AU only, BB and UBS	**All, AU only, BB only**	**All, All countries, BB and UBS**	**All, All countries, BB only**
All changes	3.08%	3.07%	3.04%	3.02%
All changes excluding:				
Use of average yields	3.07%	3.07%	3.03%	3.02%
Use of constraints	3.08%	3.07%	3.04%	3.02%
Exclusion of outlier	3.08%	3.07%	3.00%	2.93%
Change to starting values	3.05%	3.03%	3.00%	2.97%

55. The results in Table 1 show that the individual effect of making any of these changes is small. In some cases, such as for the addition of constraints, there is no effect at all. The most significant effect is of 9 basis points for the exclusion of the Morgan Stanley bond in the final sample with Bloomberg data only.[10]

2.3 Analysis of observed bond yield data

56. In this section I form samples of observed bond yield data based on the criteria set out in section 2.1 and:

- compare these to the yields estimated in the Bloomberg BBB fair value curve reported out to 7 years;[11] and
- fit Nelson-Siegel yield curves to the yield data in order to estimate the DRP on 10 year BBB+ rated debt.

57. The functional form of the Nelson-Siegel yield curve and the methodology that I use to fit bond data to this curve is described in greater detail at Appendix A to my previous report. The revisions that I have made to this approach are discussed at section 2.2.2 above.

58. The inclusion or exclusion of bonds with different characteristics will influence the results of the analysis to varying degrees. I have systematically explored how taking particular samples of the total bond population based on specific bond characteristics influences the comparison between the Bloomberg BBB fair value curve and my own DRP estimates.

59. I present figures demonstrating the result of three of the binary options: currency, country of issuer and type (options 2 – 4 in the bullet list in section 2.1 above). I focus on these binary options because it is already possible to identify in each chart the rating of a bond, as well as the data source (i.e. Bloomberg or UBS). These three binary options are associated with 8 unique combinations.

60. I also present in Table 2 below the DRP at 10 years resulting from curve fitting analysis for each of the 32 overlapping combinations of these five binary options. I conclude that whilst the average DRP does vary by sample, the variations are within a relatively small range. For samples with more than 15 bonds, the BBB+ DRP at 10 years to maturity falls in a range from 2.38% to 3.12%. However, for some samples with fewer than 30 bonds the BBB+ DRP is much lower. The reliability of results with such small sample sizes is highly questionable.

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10 I do not investigate the inclusion of the National Australia Bank bond since this clearly does not represent yield data.

11 In this section I do not seek to extrapolate the Bloomberg fair value curve to 10 years. I discuss alternatives for extrapolating the Bloomberg BBB fair value curve to 10 years at Section 3 below.

61. The large sample results are consistent with the Bloomberg fair value curve extrapolated using bond pair and curve fitting methods, which fall in the range 2.32% to 2.90% (these results are presented in chapter 4).

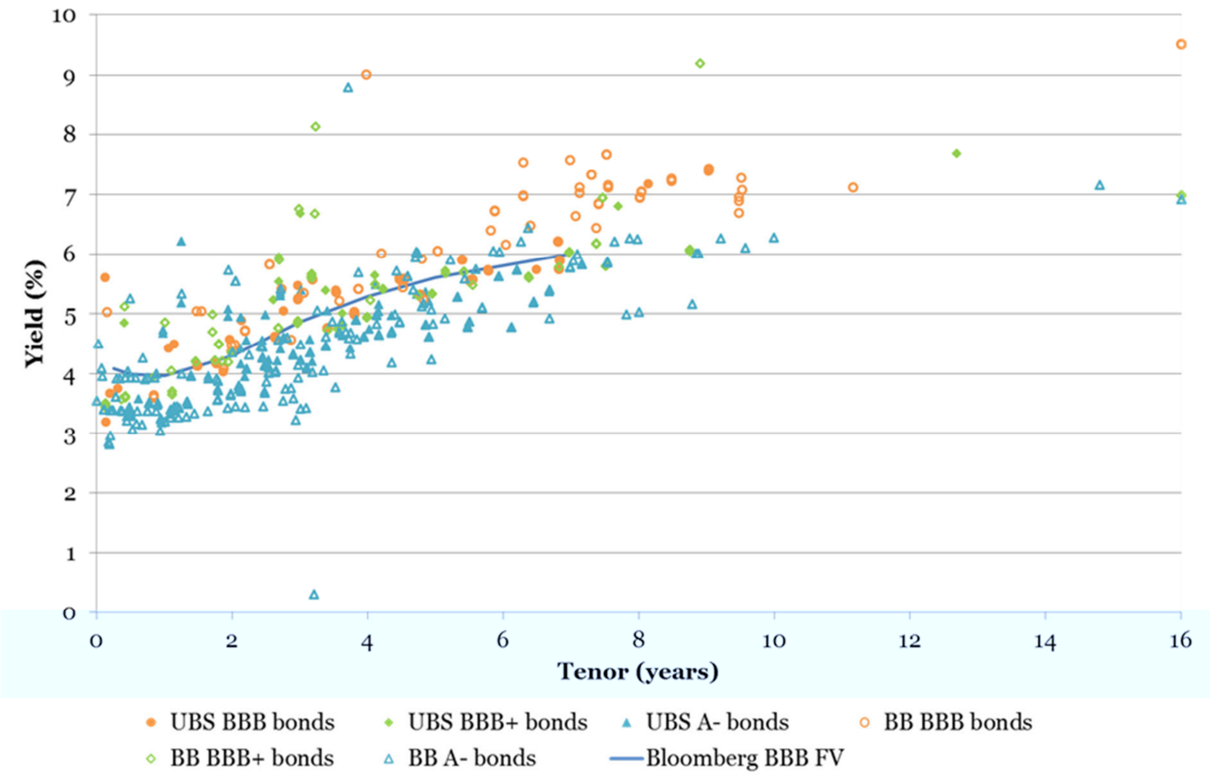
62. The results of varying country are presented in the remainder of this section, while the results of varying currency and type are presented in Appendix B to this report. The first set of figures in section 0 (and Figure 9 to Figure 14 in Appendix B) presents the bonds associated with each sample, overlaid with the Bloomberg fair value curve to 7 years. The second set of figures in section 2.3.2 (and Figure 15 to Figure 20 in Appendix B) presents the results of the Nelson-Siegel yield curve fitting analysis using the bonds from each of the 8 samples.

2.3.1 Bonds contained in samples with different characteristics

63. Figure 2 shows the yields on BBB to A- bonds issued in Australian dollars by any company or in any foreign currency by Australian companies, swapped to Australian dollar yields. This sample contains 389 bonds and represents the entire bond population for which yields are available from either Bloomberg or UBS (or both).[12]

64. There are a small number of bonds that have tenors that are materially longer than other bonds in my sample. To ensure that these can be easily viewed, I have included them in Figure 2 and Figure 3 below with tenors truncated at 16 years. In the Nelson-Siegel analysis that follows I ensure that these bonds are accorded their actual tenors.

Figure 2: BBB to A- bonds issued in AUD by any company plus all foreign currency bonds issued by Australian companies

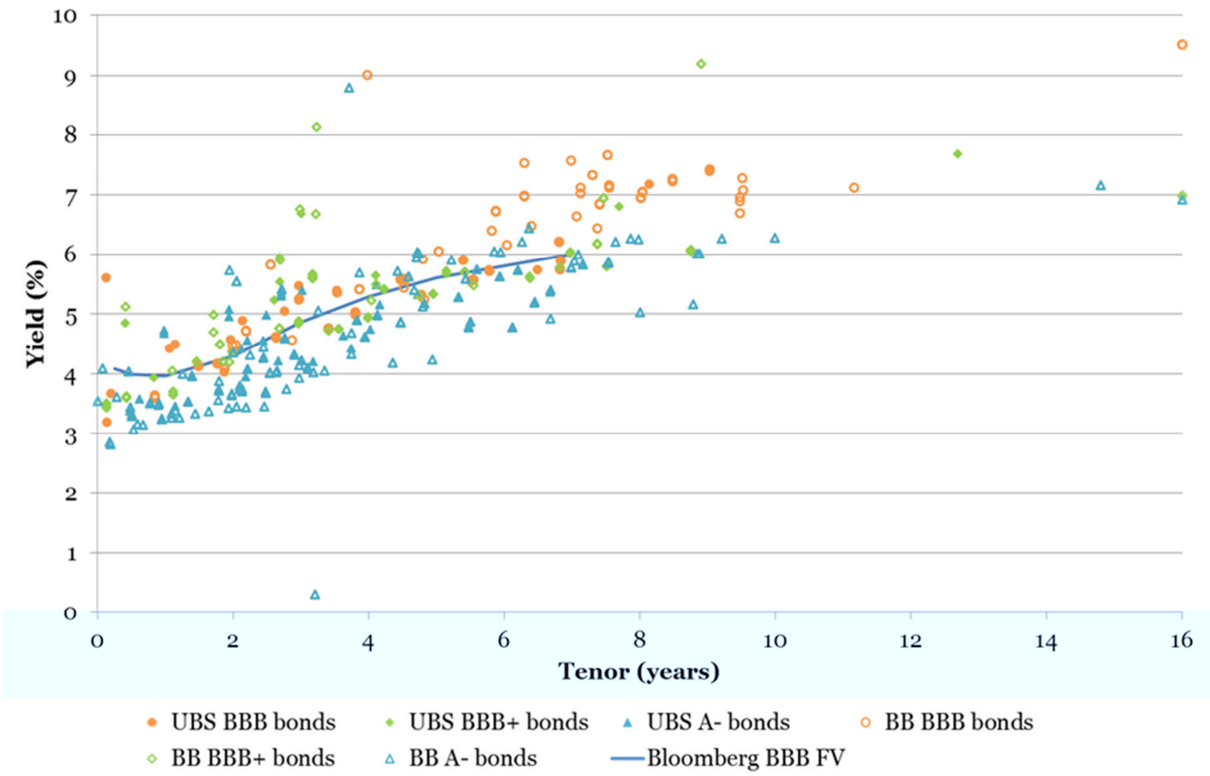


Source: Bloomberg and UBS data, CEG analysis

12 This and all other figures exclude the bonds issued by National Australia Bank and Morgan Stanley as noted at section 2.2.2.3 above.

65. Figure 3 illustrates BBB to A- bonds issued by Australian companies in any currency (i.e., does not include AUD bonds issued by foreign companies). This sample contains 285 bonds. That is, Figure 3 contains a subset of the bonds in Figure 2, excluding bonds issued in Australian dollars by foreign companies.

Figure 3: BBB to A- bonds issued in any currency by Australian companies



Source: Bloomberg and UBS data, CEG analysis

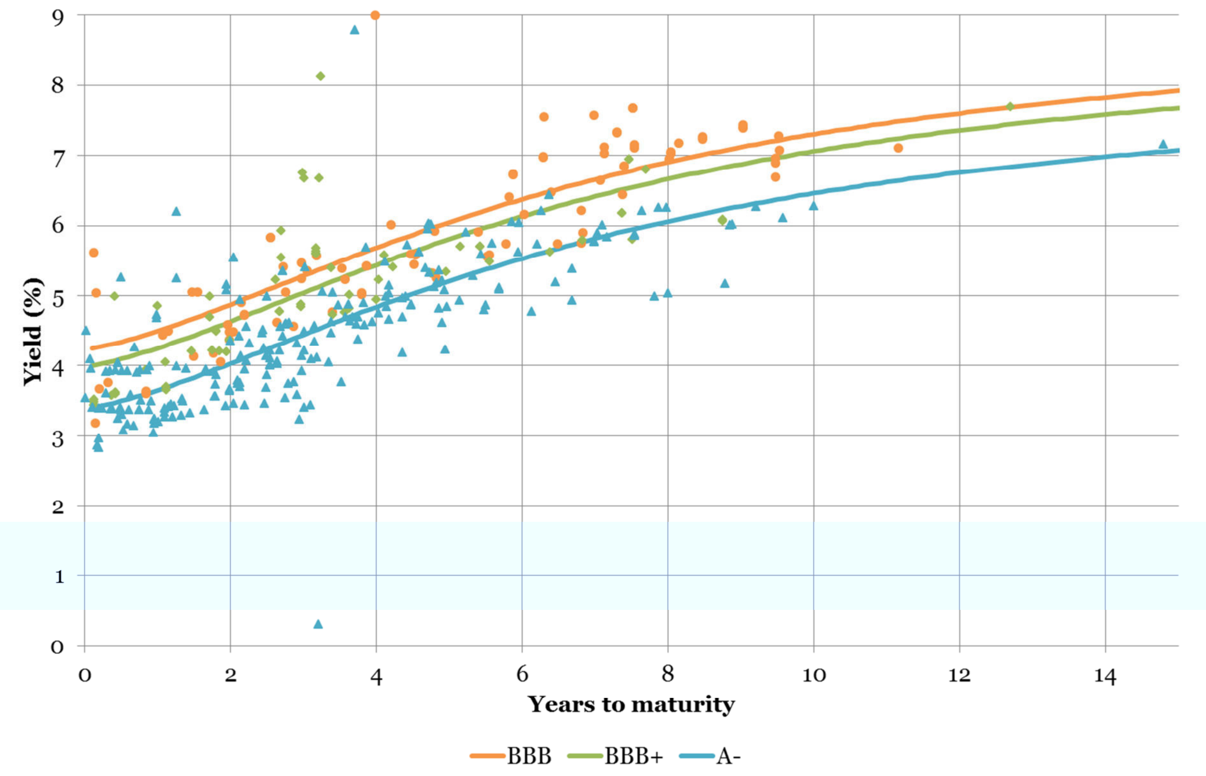
66. I provide similar graphical representations of the Bloomberg curve against a range of other subsamples of the larger dataset in Appendix B. The Bloomberg fair value curve remains a good fit to the data in these subsamples.

2.3.2 Curve fitting results

67. Figure 4 and Figure 5 show the Nelson-Siegel yield curve fitting results when relying on the same bond samples as in Figure 1 to Figure 2 above. At the end of this section I present a more systematic analysis (in tabular form) of the impact of each binary option used to define the bond sample on the estimated 10 year DRP for BBB+ rated bonds.

68. Figure 4 illustrates the result of fitting a Nelson-Siegel curve to the daily Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by any company or in any foreign currency by Australian companies over 16 September 2013 to 11 October 2013. This figure is based on the bonds in Figure 2 in the previous section. The BBB+ 10 year yield is 7.06%, and the corresponding DRP is 3.04%.

Figure 4: BBB to A- bonds issued in AUD by any company or in any currency by Australian companies



Source: Bloomberg and UBS data, CEG analysis

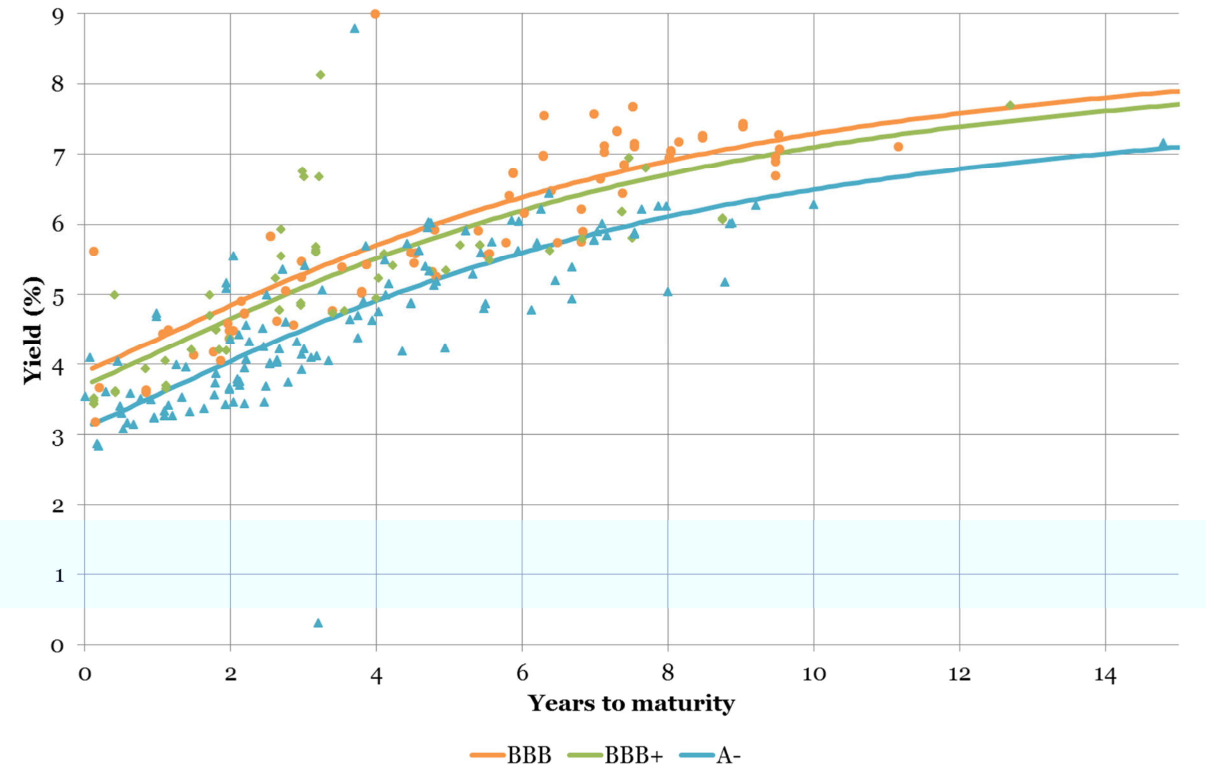
69. As explained in more detail in Appendix A, the curve fitting approach uses yields on bonds of all credit ratings to determine the shape of the fair value curves and uses yields on the bonds of each credit rating to determine the level of each curve – subject to the requirement that the A- curve be below the BBB+ curve and the BBB+ curve be below the BBB curve.

70. The BBB+ curve has a similar shape to the Bloomberg BBB fair value curve. The level of the BBB+ curve is 40 basis points above the Bloomberg BBB fair value yield at 7 years. Both curves have a convex shape at short maturities and a positive concave slope as maturity lengthens.

71. The upward sloping but concave shape of the curve at longer maturities is consistent with the standard shape of most estimated yield curves – with investors demanding higher (annualised) returns for holding longer lived, and hence riskier, securities. However, the rate of increase in the required annualised compensation for risk reduces with maturity (i.e., the shape of the curve is concave).

72. Figure 5 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued by Australian companies in any currency. This figure is based on the bonds in Figure 3 in the previous section. The BBB+ 10 year yield is 7.10%, and the corresponding DRP is 3.08%.

Figure 5: BBB to A- bonds issued in any currency by Australian companies



Source: Bloomberg and UBS data, CEG analysis

73. Appendix B provides the results of curve fitting applied to other sub-samples of the wider data set.

74. The debt risk premiums for all 32 combinations are presented in Table 2 below. In summary, the DRP at 10 years for the 32 unique combinations which I have considered ranges from 1.89% to 3.12%. The mean (median) across the 32 samples is 2.72% (2.78%). For the reasons already set out in section 2.1, I consider that the two most relevant samples are those highlighted purple in Table 2 below (being the widest available sample that excludes bonds issued by foreign companies in AUD) with either both UBS and Bloomberg or just Bloomberg data. It can also be seen that including bonds issued by foreign companies in AUD makes no material difference (the relevant rows are highlighted orange).

75. Table 2 below includes estimates using small bond samples such as those with fewer than 30 bonds. These results are provided for completeness only. I do not consider that the results of regression analysis using such a small sample should be given any weight when considerably larger samples are available and when the some results from using a small subset differ materially from the results using larger samples.

76. As mentioned at the beginning of this section, the results of the curve fitting in this report, using all but the smallest sub-samples, are consistent with, albeit above, extrapolating the Bloomberg fair value curve to 10 years using a variety of methods (the results of which are outlined in the next chapter). Therefore, I conclude that the evidence presented in this section supports the conclusion that the Bloomberg fair value curve does not overestimate the cost of 10 year BBB+ debt during the actual averaging period.

Table 2: Average DRP at 10 years across all 32 samples

Ratings	Currency	Source	Country	Type	# Bonds	Average DRP
BBB+	AUD	BB	AU	No options	12	1.89
BBB+	AUD	BB	AU	All	16	1.92
BBB+	AUD	BB	All	All	20	2.14
BBB+	AUD	BB	All	No options	16	2.20
All	AUD	BB	AU	No options	69	2.38
All	AUD	BB	All	No options	155	2.41
All	AUD	BB	All	All	179	2.42
All	AUD	BB	AU	All	90	2.45
BBB+	All	BB	AU	All	56	2.62
BBB+	All	BB	All	All	60	2.62
BBB+	All	BB & UBS	All	All	68	2.72
BBB+	All	BB & UBS	AU	All	62	2.72
BBB+	AUD	BB & UBS	AU	All	22	2.73
BBB+	AUD	BB & UBS	All	All	28	2.74
All	AUD	BB & UBS	All	No options	190	2.77
BBB+	All	BB	All	No options	49	2.78
BBB+	All	BB	AU	No options	45	2.79
All	AUD	BB & UBS	All	All	230	2.85
All	AUD	BB & UBS	AU	All	126	2.86
BBB+	All	BB & UBS	All	No options	55	2.87
BBB+	All	BB & UBS	AU	No options	49	2.88
BBB+	AUD	BB & UBS	AU	No options	16	2.90
BBB+	AUD	BB & UBS	All	No options	22	2.92
All	AUD	BB & UBS	AU	No options	91	2.96
All	All	BB	All	All	338	3.02
All	All	BB	All	No options	290	3.03
All	All	BB & UBS	All	All	389	3.04
All	All	BB & UBS	All	No options	325	3.06
All	All	BB	AU	All	249	3.07
All	All	BB & UBS	AU	All	285	3.08
All	All	BB	AU	No options	204	3.10
All	All	BB & UBS	AU	No options	226	3.12

Source: Bloomberg, UBS and RBA data, CEG analysis

3 Extrapolation of the Bloomberg fair value curve

77. The Bloomberg BBB fair value curve is produced for terms to maturity of up to seven years. To use the curve as a 10 year benchmark it is necessary to extrapolate it to 10 years.

78. The method most recently used by the AER to extrapolate the Bloomberg BBB fair value curve is "bond pair analysis". See section 4.1 of my previous report for a brief description of the history of extrapolation approaches for the Bloomberg fair value curve. My previous report also considered the extrapolation from 7 to 10 years implied by the fitted BBB+ curves estimated from my Nelson-Siegel analysis.

79. In this section I update the results of the bond pair and curve-fitting analysis as they inform the extrapolation of the Bloomberg BBB fair value curve. I find that applying the bond pairing methodology results in an estimated increase of DRP of 10.2 bppa and a 10 year DRP of 2.62%. The DRP increase is supported by the results of the Nelson-Siegel analysis. However, I find that the implied 10 year yield of 2.62% is lower than most of the 10 year Nelson-Siegel estimates in Table 2 above, including the largest samples that I place most weight upon.

80. In order to derive a 10 year BBB+ cost of debt from a 7 year BBB+ cost of debt it is necessary to extrapolate both the risk free rate and the DRP from 7 years to 10 years. This is described mathematically in the formula below (where the symbol "Δ" signifies a change in the variable).

$$\Delta yield\ 7\ to\ 10\ years = \Delta riskfree\ rate\ 7\ to\ 10\ years + \Delta DRP\ 7\ to\ 10\ years$$

81. Equivalently, one can express the 10 year cost of debt in term of the 7 year cost of debt (7 yr Rd) as follows:

$$10\ yr\ Rd = 7\ yr\ Rd + (10\ yr\ RFR - 7\ yr\ RFR) + (10\ yr\ DRP - 7\ yr\ DRP) \qquad (1)$$

82. As this formula makes clear, the extrapolation of the 7 year cost of debt to the ten year cost of debt is comprised of the sum of:

- extrapolation of the risk free rate *(10 yr RFR-7 yr RFR)*; and
- extrapolation of the DRP *(10 yr DRP- 7 yr DRP)*.

83. The following two sections describe the results of each component (CGS and DRP) of my extrapolation estimate.

3.1 Increase in the cost of debt associated CGS extrapolation

84. The increase in CGS between 7 and 10 years is straightforward to calculate and averaged 10.7 bppa over the period.

3.2 Increase in DRP - bond pair analysis

85. In order to estimate the increase in the DRP I have conducted analysis on the total bond sample of 453 bonds to identify suitable bond pairs which can be used to extrapolate the Bloomberg BBB fair value curve from 7 to 10 years.

86. Applying the same criteria that I used in my previous report, I identify from the total bond population six issuers with multiple bonds meeting the following criteria:

- are between 5 and 12 years from maturity;
- are issued by the same issuer;
- have the same credit rating;
- are issued in Australian dollars;
- do not have any optionality features other than make whole callable bonds;
- are either both fixed bonds or both floating rate notes; and
- have yields from the same source (i.e. yields from the same Bloomberg price source or from UBS).

87. The selection of 5 to 12 years to maturity as a criterion excludes bond pairs for which one bond is outside this maturity range. Whilst this involves a choice of 'bright line' cut offs, I believe that it is reasonable to determine the rate of increase in DRP between 7 and 10 years based on bonds with similar maturities to this range.

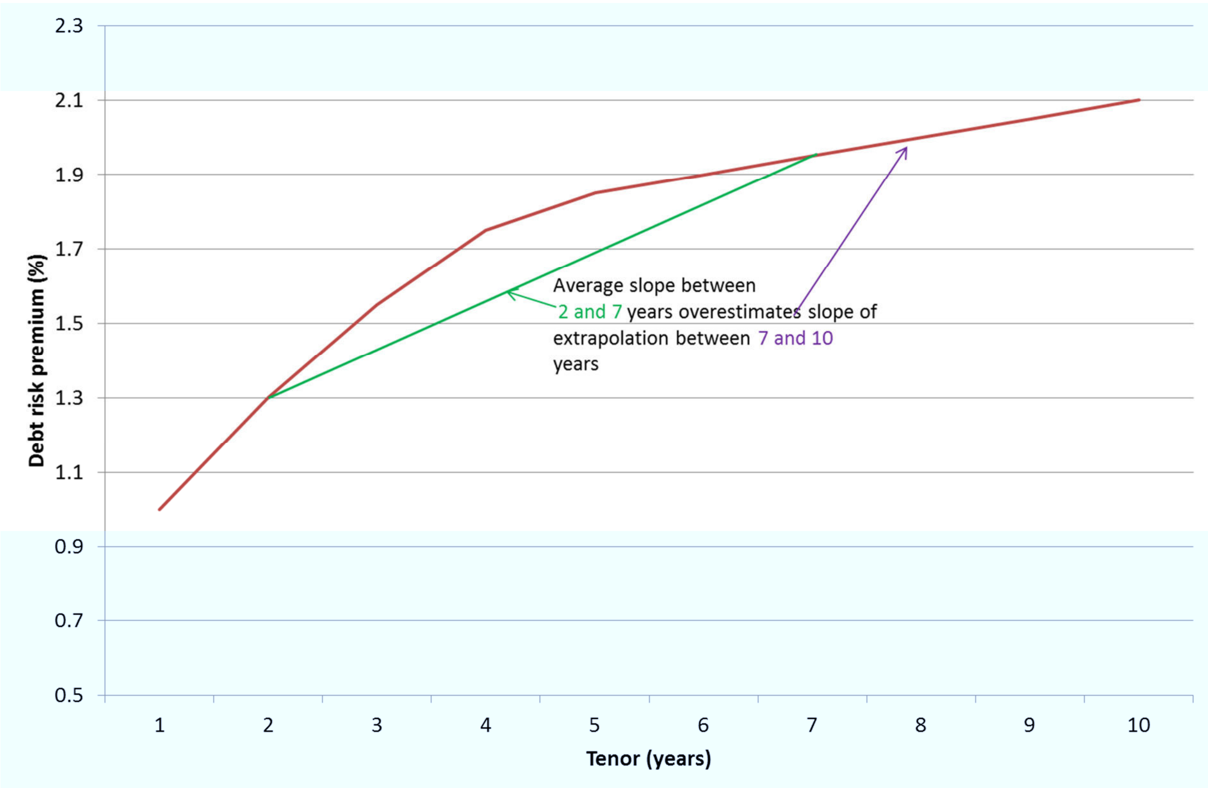
88. In my view, applying the 5 to 12 year time to maturity criteria is a superior approach to pairing one bond with time to maturity in excess of 7 years with a bond that has less than 5 years maturity. This is because the shape of the fair value curve, and the underlying DRP curve, is not a straight line. That is, it cannot be assumed that DRP premium is constant over all maturity ranges. Therefore, it is important that each of the bonds in the bond pair be in the vicinity of the 7 to 10 year maturity zone of interest.

89. If there were a very large number of possible bond pairs then it would be reasonable to restrict bond pairs to have one or both of the bonds within this zone. However, this is not the case and, therefore, it is appropriate to widen the maturity zone from which bond pairs are chosen while still ensuring that no single bond is more than 2 years maturity outside the target maturity zone.

90. For example, consider a pair of bonds with 7 and 3 years maturity. This bond pair has one bond within the target maturity zone but the other is well below it (4 years below it). This means that the DRP term premium on this bond pair will be heavily influenced by the DRP term premium at maturities well below the target maturity zone. If the DRP curve is concave or convex (as opposed to a straight line) this will cause it to be an unreliable estimate of the DRP term premium between 7 and 10 years maturity.

91. It can be seen that when the DRP curve is concave in maturity as illustrated above, that a bond pair involving a 3 year maturity can give rise to a overestimate of the DRP term premium between 7 and 10 years. This is because most of the increase in DRP term premium is due the term premium between 3 and 5 years rather than the term premium in or near the target maturity zone of 7 to 10 years.

Figure 6: Demonstration of fair value curve concavity



92. Application of these criteria results in the identification of bonds issued by Citigroup, Coca-Cola, Commonwealth Property Office Fund, Stockland, Sydney Airport and Wesfarmers. I find two bonds by each issuer, except for Coca-Cola for

which I have identified four bonds that satisfy the criteria specified above. Information about these bonds is detailed at Table 3 below.[13]

Table 3: Bond pairs in Australian dollars

Pair	Issuer	ISIN	Maturity date	Time to maturity	DRP BB (BGN)	DRP BB (BVAL)	DRP UBS
1	Citigroup	XS0972042500	16/09/2018	4.97	n.a.	1.525	N/A
	Citigroup	XS0787319408	6/06/2019	5.69	n.a.	1.665	N/A
2	Coca-Cola	AU3CB0201747	13/11/2019	6.12	1.241	1.215	1.220
	Coca-Cola	XS0938014742	4/06/2020	6.68	1.277	1.273	N/A
	Coca-Cola	XS0680309191	27/09/2021	8.00	n.a.	1.214	N/A
	Coca-Cola	XS0803234094	11/07/2022	8.78	n.a.	1.261	N/A
3	Commonwealth	AU3CB0202901	13/12/2019	6.21	2.167	2.163	2.174
	Commonwealth	AU3CB0202919	13/12/2022	9.21	n.a.	2.323	N/A
4	Stockland	AU3CB0213247	6/09/2019	5.94	2.119	2.109	2.115
	Stockland	AU3CB0164820	25/11/2020	7.16	2.107	2.104	2.127
5	Sydney Airport	AU3FN0001244	20/11/2021	8.15	n.a.	n.a.	3.334
	Sydney Airport	AU3FN0001251	11/10/2022	9.03	n.a.	n.a.	3.451
6	Wesfarmers	AU3CB0192128	28/03/2019	5.49	1.460	1.445	1.450
	Wesfarmers	AU3CB0206134	12/03/2020	6.45	1.586	1.581	1.574

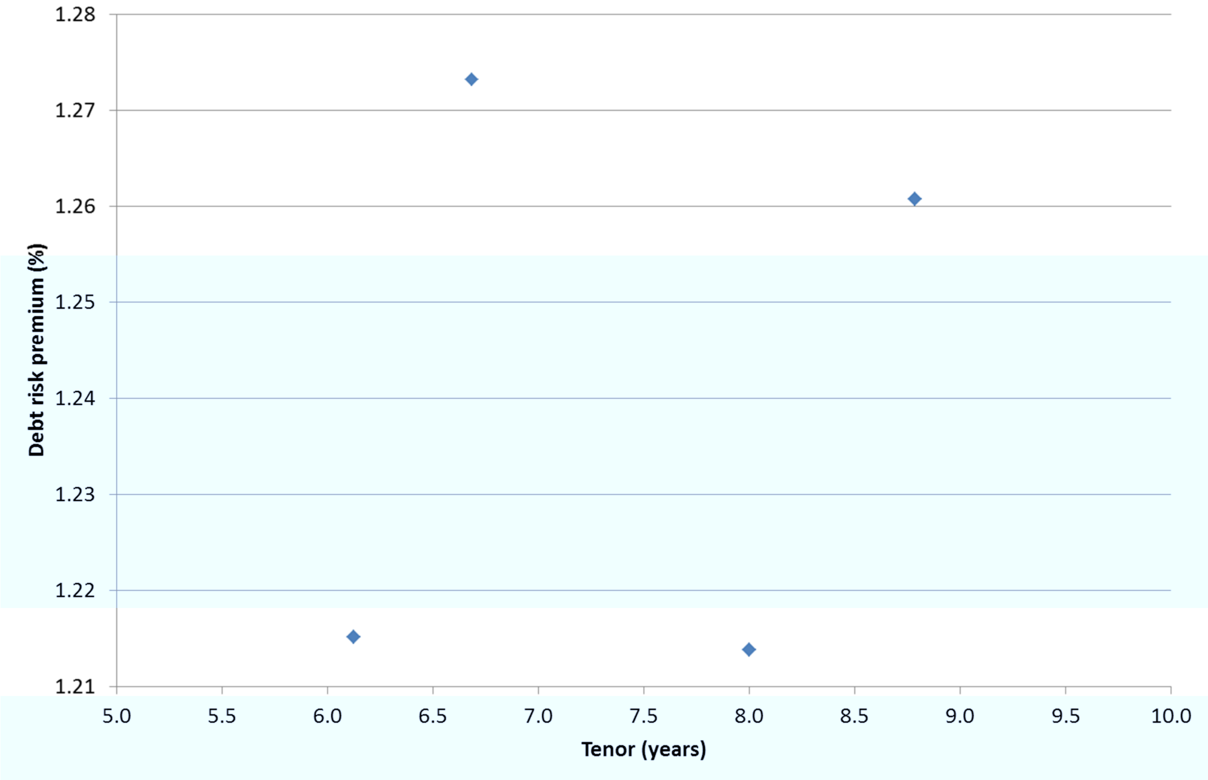
Source: Bloomberg, UBS, RBA, CEG analysis

93. The four Coca-Cola bonds exhibit unusual DRP characteristics. Based on the BVAL source for which they all report data, DRP is not increasing with maturity, contrasting with the results that I found for Coca-Cola bonds at Table 2 of my previous report.

94. Figure 7 plots the debt risk premiums on the Coca-Cola bonds against time to maturity. The results resemble a skewed parallelogram – such that for any selection of pairs from the four, it could be possible to find both positive and negative slopes, including potentially extreme values. This was not an issue that affected the DRPs on Coca-Cola bonds in my previous dataset based on data sourced over February 2013.

[13] I note that the Citigroup bond maturing on 16 September 2018 only satisfies the criterion of 5 years maturity for one day during the averaging period. On average, it has less than five years to maturity. I believe that it is reasonable to include it at its average maturity and DRP in this analysis rather than seeking to represent it based only on its 16 September 2013 information.

Figure 7: Debt risk premiums on Coca-Cola bonds with 5 – 12 years maturity



Source: Bloomberg and RBA data, CEG analysis

95. Figure 7 demonstrates that the four Coca-Cola bonds do not have a logical pattern of DRPs. Of the six possible pairs that could be formed from these four bonds, the increase in DRP ranges from -4.5 bppa to +10.4 bppa. However, in my opinion relying on any of these values is likely to be unreliable and I do not utilise information from the Coca-Cola bonds in my bond pair analysis.

96. Table 4summarises the information provided for the increase in DRP per year of maturity by each issuer from Table 3. The average implied increase in DRP reported in Table 4 below is 10.2 bppa.

Table 4: Bond pair analysis and implied increase in DRP (bppa)

Issuer	BGN	BVAL	UBS	Average
Citigroup	N/A	19.5	N/A	19.5
Commonwealth	N/A	5.3	N/A	5.3
Stockland	-1.0	-0.4	1.0	0.0
Sydney Airport	N/A	N/A	13.2	13.2
Wesfarmers	13.2	14.2	12.9	13.0
Average				**10.2**

Source: Bloomberg, UBS, RBA, CEG analysis
Note: Average calculated as the average of Bloomberg and UBS. BGN is preferred to BVAL as a Bloomberg source.

3.3 Curve fitting results

97. Another approach to using bond pair analysis is to extrapolate the Bloomberg BBB fair value curve to 10 years using the Nelson-Siegel curve fitting results presented in this report.

98. There are two ways in which the information from the curve fitting process could be used to extrapolate the Bloomberg fair value curve:

    a. The shape of the Nelson-Siegel curve between 7 and 10 years could simply be superimposed on the Bloomberg fair value curve; or

    b. The Bloomberg fair value curve could be extrapolated so that it transitioned to be equal to the Nelson-Siegel curve over some period (e.g., over "N" years).

99. Which of these is most appropriate depends on the extent to which one wants to give weight to the level of the Nelson-Siegel curve as well as the shape of the Nelson-Siegel curve in extrapolating the Bloomberg fair value curve. The first method gives no weight to the fact that the Nelson Siegel curve is above the Bloomberg curve. Under this approach the difference in levels between the two curves should be reduced in the extrapolation process. The second method is appropriate if one believes that the Nelson Siegel curve is a robust estimate of the cost of debt and it is desirable that the extrapolation method leads to a reduction in the difference between the Bloomberg and Nelson Siegel estimates.

100. In the previous chapter, I present a range of different 10 year DRP values based on different sample scenarios. These results are re-iterated in Table 5 below, together with an estimate of the DRP at 7 years (using the same curve fitting method).

Table 5: Change in DRP derived from curve fitting scenarios

Ratings	Currency	Type	Source	Country	# Bonds	7y DRP	10y DRP	Δ DRP (bppa)
All	All	BB	All	All	338	2.71	3.02	10.5
All	All	BB	All	No options	290	2.68	3.03	11.8
All	All	BB	AU	All	249	2.77	3.07	10.1
All	All	BB	AU	No options	204	2.75	3.10	11.7
All	All	BB & UBS	All	All	389	2.72	3.04	10.8
All	All	BB & UBS	All	No options	325	2.71	3.06	11.8
All	All	BB & UBS	AU	All	285	2.78	3.08	10.2
All	All	BB & UBS	AU	No options	226	2.78	3.12	11.6
All	AUD	BB	All	All	179	2.29	2.42	4.3
All	AUD	BB	All	No options	155	2.36	2.41	1.5
All	AUD	BB	AU	All	90	2.33	2.45	4.2
All	AUD	BB	AU	No options	69	2.36	2.38	0.7
All	AUD	BB & UBS	All	All	230	2.42	2.85	14.4
All	AUD	BB & UBS	All	No options	190	2.56	2.77	6.9
All	AUD	BB & UBS	AU	All	126	2.45	2.86	13.8
All	AUD	BB & UBS	AU	No options	91	2.54	2.96	13.8
BBB+	All	BB	All	All	60	2.58	2.62	1.6
BBB+	All	BB	All	No options	49	2.64	2.78	4.5
BBB+	All	BB	AU	All	56	2.60	2.62	0.7
BBB+	All	BB	AU	No options	45	2.67	2.79	4.0
BBB+	All	BB & UBS	All	All	68	2.65	2.72	2.2
BBB+	All	BB & UBS	All	No options	55	2.71	2.87	5.4
BBB+	All	BB & UBS	AU	All	62	2.67	2.72	1.7
BBB+	All	BB & UBS	AU	No options	49	2.74	2.88	4.8
BBB+	AUD	BB	All	All	20	2.11	2.14	0.8
BBB+	AUD	BB	All	No options	16	2.18	2.20	0.5
BBB+	AUD	BB	AU	All	16	2.08	1.92	-5.2
BBB+	AUD	BB	AU	No options	12	2.07	1.89	-5.9
BBB+	AUD	BB & UBS	All	All	28	2.36	2.74	12.6
BBB+	AUD	BB & UBS	All	No options	22	2.46	2.92	15.3
BBB+	AUD	BB & UBS	AU	All	22	2.32	2.73	13.4
BBB+	AUD	BB & UBS	AU	No options	16	2.44	2.90	15.4

Source: Bloomberg, UBS, RBA, CEG analysis

101. The increase in DRP from 7 years to 10 years based on curve fitting techniques for the broadest sample of 389 bonds is 10.8 bppa. Excluding bonds issued by overseas corporations but denominated in Australian dollars the figure is 10.2 bppa. Only relying on Bloomberg data these figures are similar (10.5 bppa and 10.1 bppa). These rows are highlighted in Table 5 with the corresponding rows highlighted in

Table 2. If foreign currency issues are excluded, the estimates which rely on Bloomberg data only are lower than those relying on both Bloomberg and UBS data.

102. There are some larger increases (and decreases) implied by some sub-samples, however these samples are very narrow and contain only a very limited sub-set of bonds. As has already been discussed, I believe that it is more reliable to rely on broader rather than narrower samples of bonds.

103. The results in Table 4 are broadly consistent with the increase in DRP resulting from the bond pairing analysis in the previous section of 10.2 bppa.

3.4 Summary

104. In sections 3.2 and 3.3 I present the outcome of two different extrapolation methods:

- the alternative bond pair method; and
- the use of results from alternative curve fitting scenarios.

105. Table 6 shows a summary of these outcomes. The outcomes for bond pairing range from 0.0 bppa to 19.5 bppa whereas the curve fitting analysis produces more stable results of between 10.2 bppa and 14.4bppa.

Table 6: Summary of outcomes of different extrapolation methods

Extrapolation methodology	Average increase in DRP (bppa)	Implied 10 year DRP
Bond pair analysis		
Citigroup	19.5	2.90%
Commonwealth	5.3	2.48%
Stockland	0.0	2.32%
Sydney Airport	13.2	2.71%
Wesfarmers	13.0	2.71%
CEG curve fitting analysis		
BBB to A- bonds issued in AUD by any issuer and bonds in any currency by Australian issuers including UBS data and bonds with options (1)	10.8	2.64%
(1) excluding foreign bonds issued in AUD (2)	10.2	2.62%
(1) excluding all foreign currency bonds (3)	14.4	2.75%

Source: Bloomberg, UBS, RBA, CEG analysis

106. Extrapolating the Bloomberg BBB fair value curve to 10 years based on the average bond pair estimate of 10.2 bppa gives rise to a 10 year DRP of 2.62%.

107. I note that the bond pair analysis relating to the actual averaging period has volatile results – with the DRP increase ranging from 0.0 bppa to 19.5 bppa. This need not be problematic while there are a sufficient number of these bond pairs such that the average of the observations is not susceptible to the variability from observation to observation. However, with a small sample this may not be the case.

108. The sample of bond pairs in Table 6above has only five observations and while the average is close to the estimates derived from the Nelson-Siegel curve, this conclusion is sensitive to the composition of the sample. For example, if the Citigroup bond pair were removed, then the average DRP increase from the bond pair analysis would be significantly lower than the results from the Nelson-Siegel analysis.

109. The Nelson-Siegel extrapolation is more robust, being based on a regression using hundreds of bonds. However, since both extrapolation methods are giving very similar results little turns on which extrapolation method is used.

Appendix A Cross currency swaps

110. Bloomberg's SWPM function estimates cross-currency swap rates between any pair of currencies for given characteristics, such as maturity, coupon payments and payment frequency.[14]

111. In my previous report I set out the approach that I take to use cross-currency conversions taken from Bloomberg in order to swap yields into Australian dollar terms for all foreign currency bonds in my dataset. The methodology that I applied was to create a mapping by yield and tenor from each foreign currency into Australian dollars. I use this mapping to interpolate Australian dollar yields given a foreign currency yield and tenor. This overall approach that I have taken is unchanged from that described in more detail at Appendix A of my previous report.

112. Table 7 below shows the Australian dollar yields that I have used in this process over the current averaging period of 16 September 2013 to 11 October 2013. I have conducted conversions to Australian yields for CAD, CHF, EUR, GBP, HKD, JPY, NZD and USD. I performed this calculation for two dates: immediately before the averaging period at 13 September 2013 and for the final day of the averaging period at 11 October 2013. The final swapped yields are the average of those calculated using these mappings.

Table 7: Australian dollar yield-maturity pairs used for cross-currency swap calculations

Maturity	Yield (1)	Yield (2)	Yield (3)	Yield (4)	Yield (5)
0.25	2.700	3.500	4.300	5.100	5.900
0.5	2.800	3.600	4.400	5.200	6.000
1	3.000	3.800	4.600	5.400	6.200
2	3.200	4.000	4.800	5.600	6.400
3	3.400	4.200	5.000	5.800	6.600
4	3.600	4.400	5.200	6.000	6.800
5	3.800	4.600	5.400	6.200	7.000
7	4.100	4.900	5.700	6.500	7.300
8	4.300	5.100	5.900	6.700	7.500
10	4.500	5.300	6.100	6.900	7.700
15	5.000	5.800	6.600	7.400	8.200

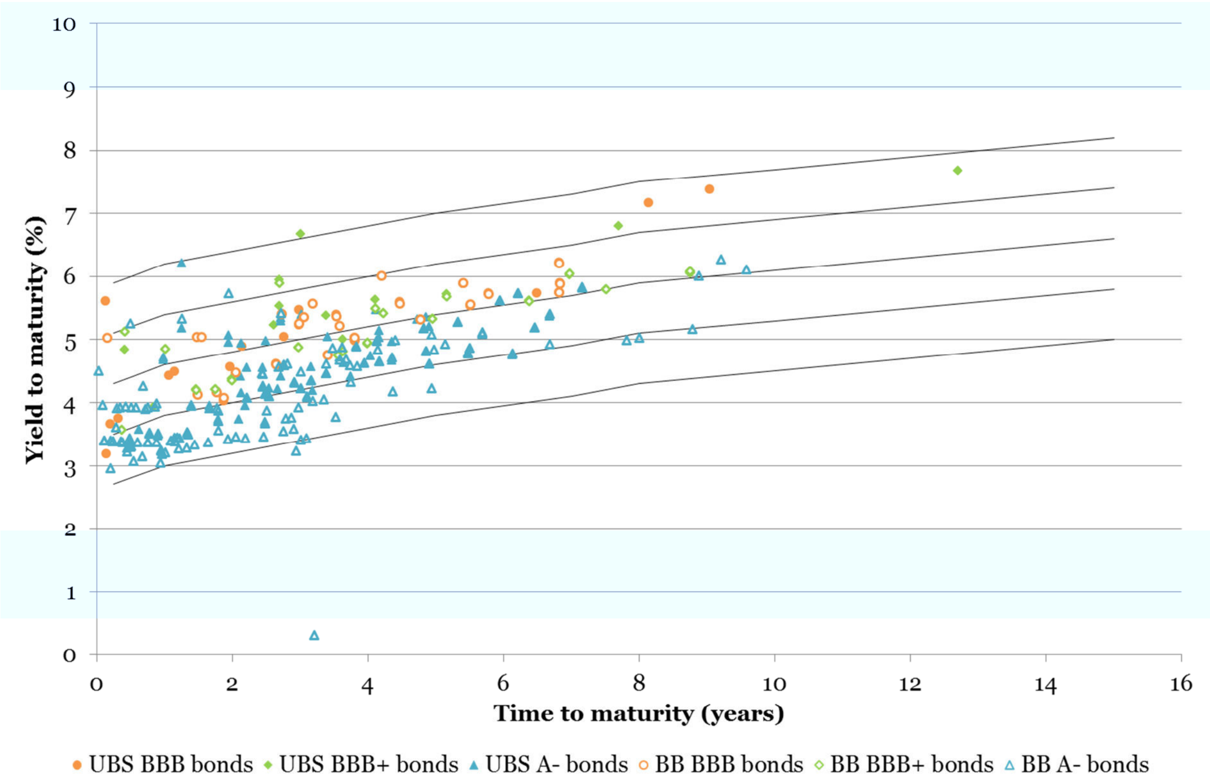
Source: CEG analysis

14 The default options of the SWPM function have changed and for this report I accessed my preferred settings for generating cross-currency swaps using the XCCY function to access a previous version of SWPM.

113. As was the case in my previous report, the yields in Table 7 above have been chosen based on typical yields observed at each maturity in Australian dollar terms in order to establish a range that will encompass the majority of bond yields once they are swapped into Australian dollar terms.

114. Figure 8 below shows the yield-maturity pairs from Table 7 charted against the yields on the population of Australian dollar bonds rated BBB to A- shown at Figure 11 below. As Figure 8 indicates, these yield-maturity pairs have been chosen to reflect the range of likely outcomes from the swapping process, with only a small number of outlying bond yields not captured within their bounds.

Figure 8: Cross-currency yield-maturity pair matrix against BBB to A- Australian dollar bond yields



Source: Bloomberg, UBS and RBA data, CEG analysis
Note: Data sourced as an average over 16 September 2013 to 11 October 2013

115. Table 8 below summarises the results sourced from Bloomberg swapping the Australian yields shown in Table 7 above into United States dollar terms. The yields shown are the average of the United States dollar yields calculated for 16 September 2013 and 11 October 2013 respectively.[15]

15 Table 8 is provided for illustrative purposes to demonstrate a typical swap calculation because in implementing the swap calculations I perform these separately using foreign currency yields calculated

Table 8: United States dollar yield-maturity pairs used for cross-currency swap calculations

Maturity	Yield (1)	Yield (2)	Yield (3)	Yield (4)	Yield (5)
0.25	0.265	1.062	1.859	2.656	3.453
0.5	0.375	1.162	1.948	2.734	3.520
1	0.556	1.342	2.127	2.913	3.698
2	0.596	1.372	2.147	2.922	3.698
3	0.783	1.549	2.315	3.080	3.846
4	1.083	1.839	2.596	3.352	4.108
5	1.438	2.186	2.935	3.683	4.431
7	1.932	2.666	3.400	4.134	4.869
8	2.215	2.943	3.671	4.399	5.127
10	2.538	3.255	3.972	4.688	5.405
15	3.200	3.894	4.588	5.282	5.976

Source: Bloomberg

116. Similar tables of swapped Australian yields are produced for the other seven currencies for which bond yield data was found.

117. In order to swap bonds from foreign currency yields into Australian dollar yields, the tables are used to interpolate five foreign currency yields and five equivalent Australian dollar yields at the maturity of the bond. Then the foreign currency yield is used to interpolate across the five Australian dollar yields to give the resulting estimate in Australian dollar yield terms.

118. For example, the following table of foreign currency and Australian dollar yields can be constructed for a United States dollar bond with maturity of 9 years.

Table 9: Example of swap calculation

	Yield (1)	Yield (2)	Yield (3)	Yield (4)	Yield (5)
AUD	4.400	5.200	6.000	6.800	7.600
USD	2.376	3.099	3.821	4.544	5.266

Source: CEG analysis

119. If the bond in question has a yield in United States dollars of 3.00%, then by interpolating between the first and second columns in the table above it is possible to show that the approximately equivalent Australian dollar yield is 5.09%. Yields

for 13 September 2013 and 11 October 2013 and average the Australia yield results of these swap calculations, rather than averaging the foreign currency yields first.

for other foreign currency bonds are converted into Australian dollar yields in the same way.[16]

16 All cross-currency swaps from Bloomberg have been calculated in semi-annual terms, so annualisation is applied after the swap is performed.

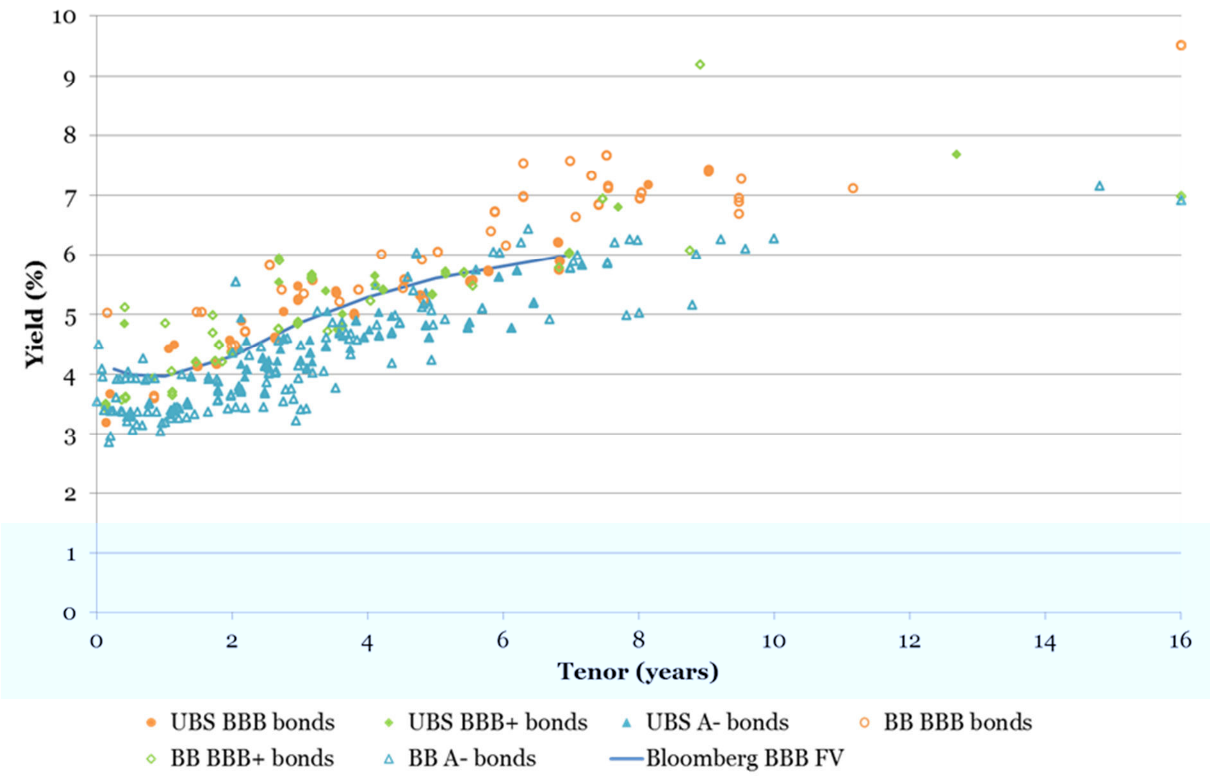
Appendix B Analysis of bond sub-samples

120. Figure 9 to Figure 14 show other sub-samples of the wider data set plotted against the Bloomberg fair value curve. The Bloomberg fair value curve remains a good fit to the data in these subsamples. As with Figure 2 and Figure 3 above, I truncate the tenors of long dated bonds at 16 years maturity for easier viewing.

121. Figure 15 to Figure 20 provide the results of curve fitting applied to these sub-samples, additional to section 3.2.2.

122. Figure 9 illustrates BBB to A- bonds issued in Australian dollars by any company and in any foreign currency by Australian companies, excluding bonds with optionality features. This sample contains 325 bonds. Figure 9 contains a subset of the bonds in Figure 2 in section 2.3.1, excluding bonds which have optionality features.

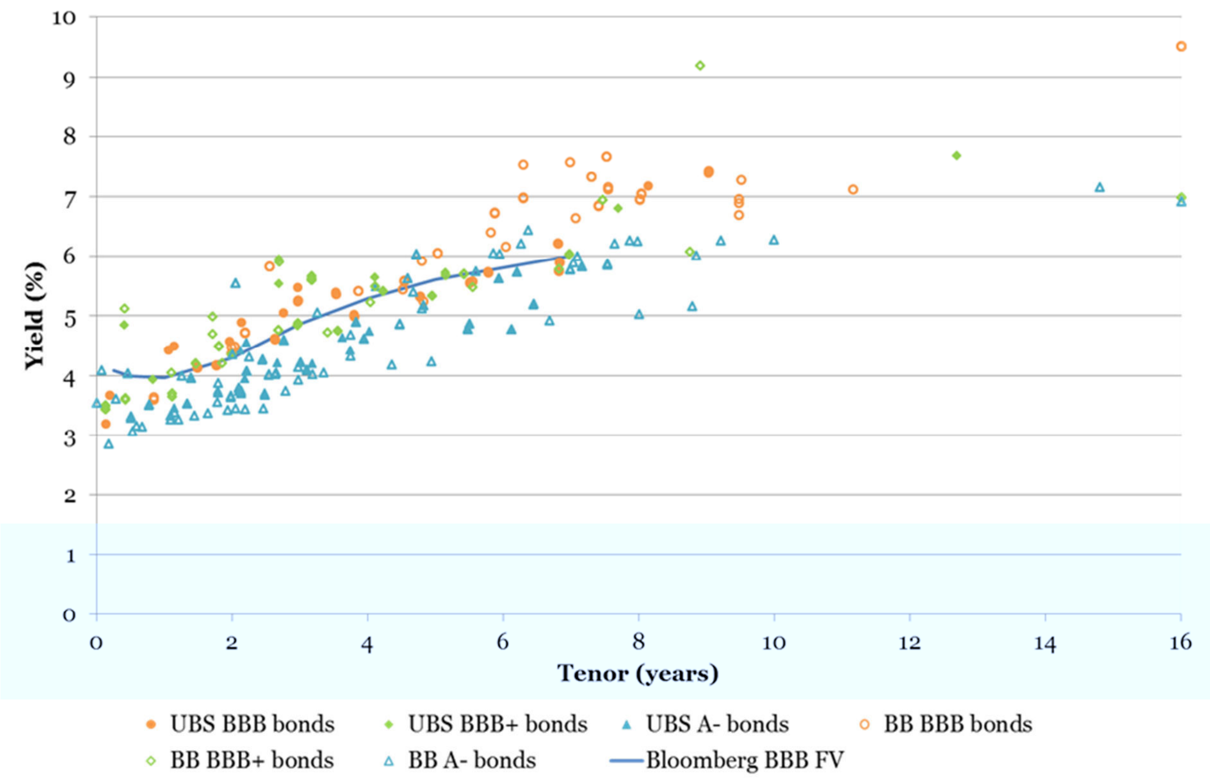
Figure 9: BBB to A- bonds issued in AUD by any company or in any currency by Australian companies, excluding bonds with optionality features but not excluding make whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

123. Figure 10 illustrates BBB to A- bonds issued in any currency by Australian companies, excluding bonds with optionality features except make-whole callable bonds. This sample contains 226 bonds. These figures contain a subset of the bonds in Figure 3 in section 2.3.1, excluding bonds which have optionality features.

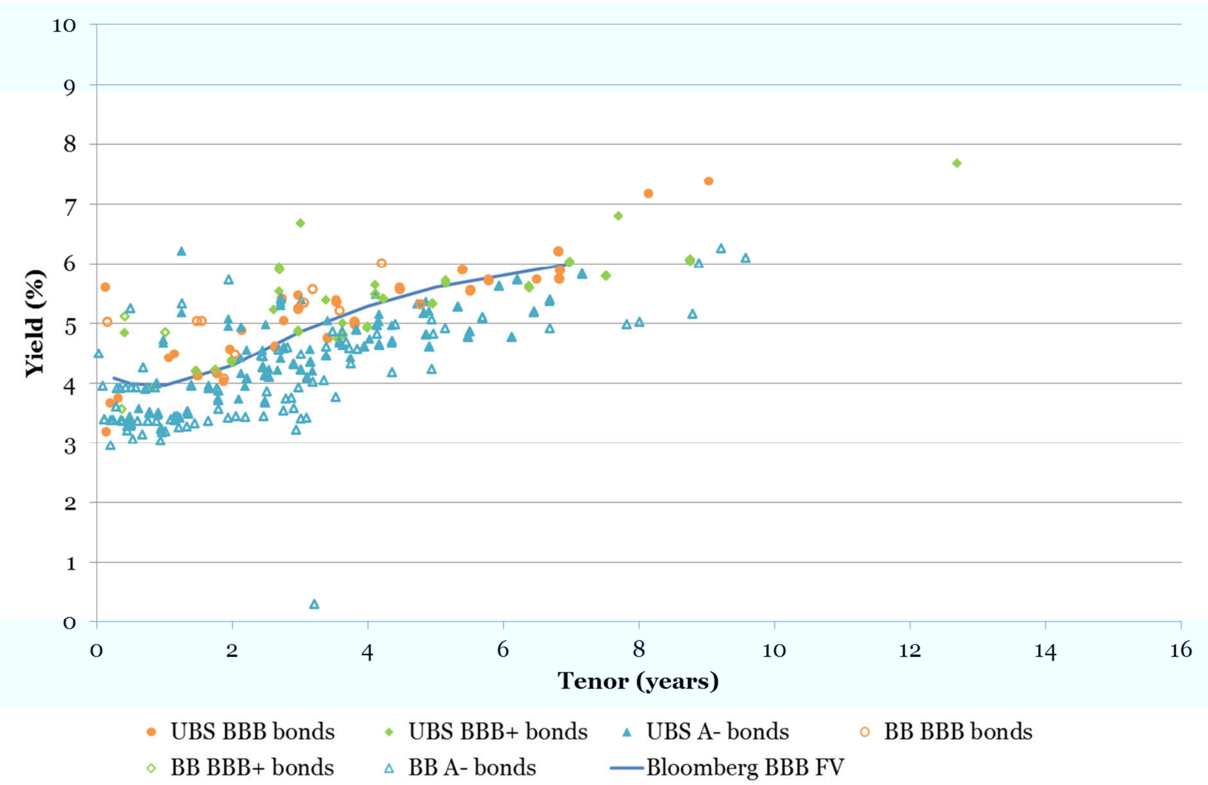
Figure 10: BBB to A- bonds issued in any currency by Australian companies, excluding bonds with optionality features not excluding make whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

124. Figure 11 illustrates BBB to A- bonds issued in Australian dollars by Australian or foreign companies. This sample contains 230 bonds. Figure 11 contains a subset of the bonds in Figure 2 in section 2.3.1, excluding bonds which have been issued in foreign currencies by Australian companies.

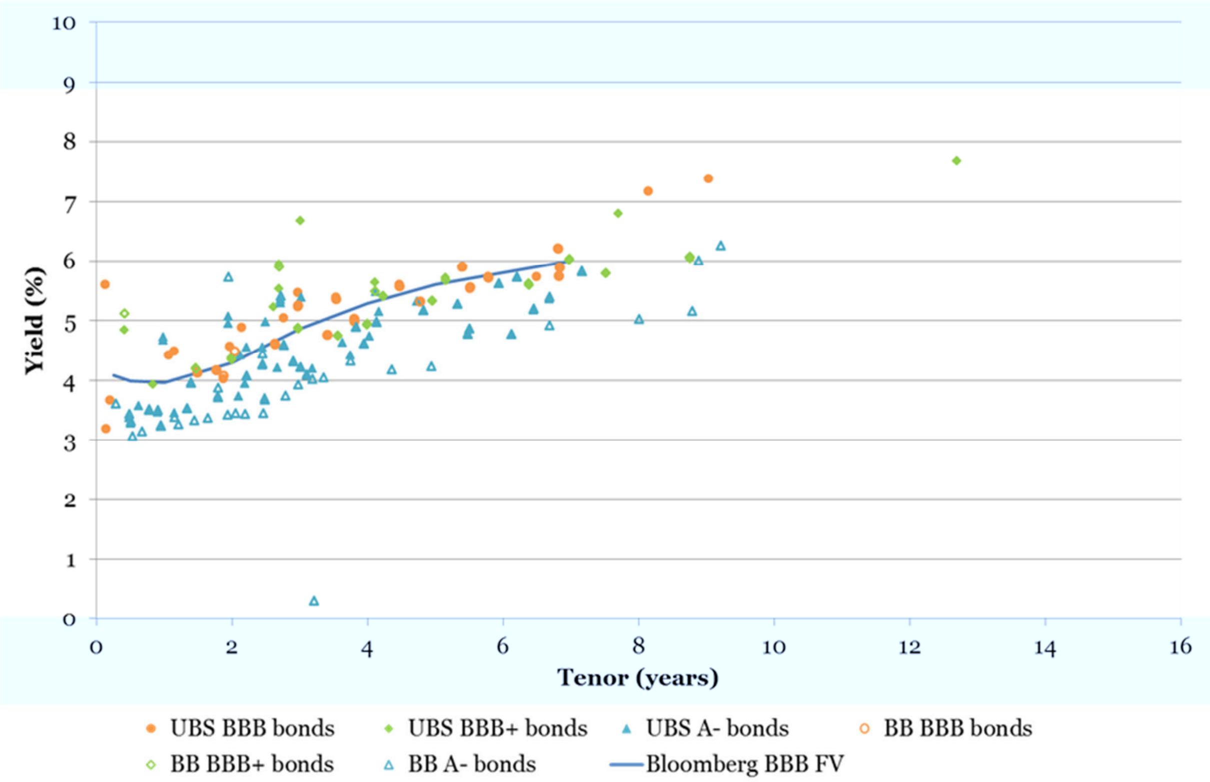
Figure 11: BBB to A- bonds issued in AUD by any company



Source: Bloomberg and UBS data, CEG analysis

125. Figure 12 illustrates BBB to A- bonds issued in Australian dollars by Australian companies. This sample contains 126 bonds. Figure 12 contains a subset of the bonds in Figure 3 in section 2.3.1, excluding bonds which have been issued in foreign currencies by Australian companies.

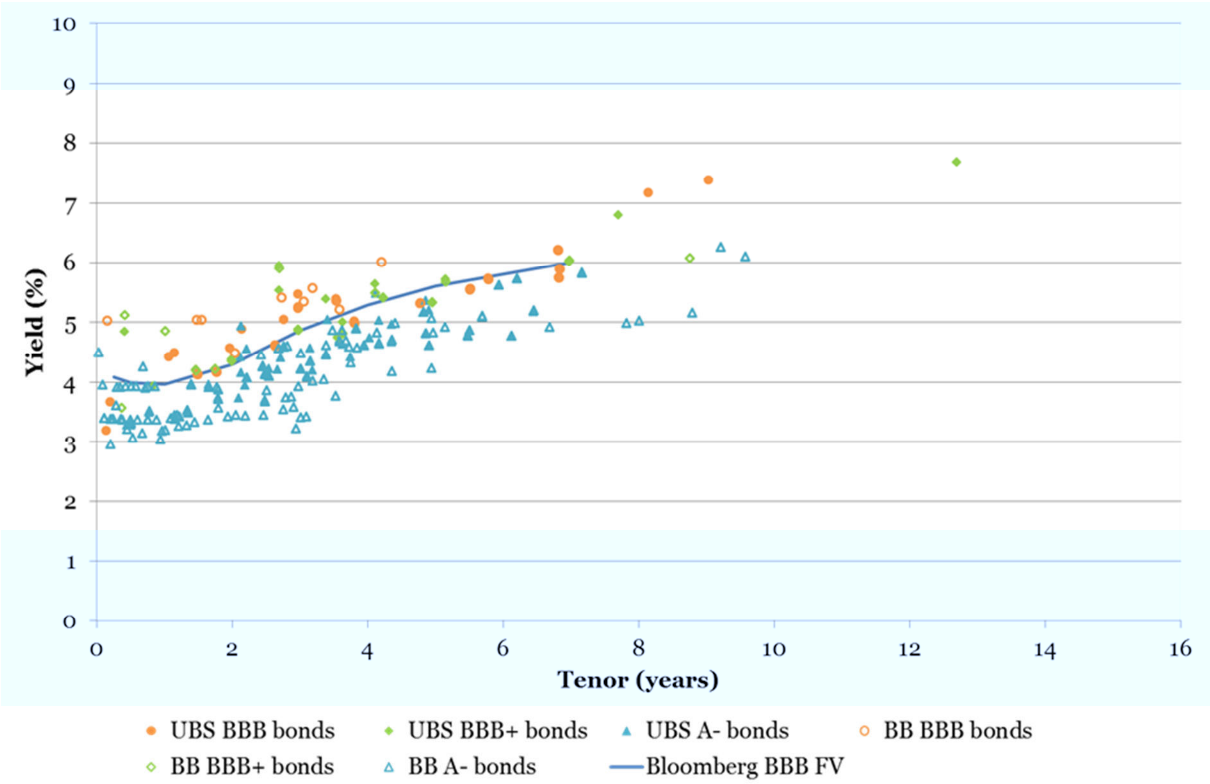
Figure 12: BBB to A- bonds issued in AUD by Australian companies



Source: Bloomberg and UBS data, CEG analysis

126. Figure 13 illustrates BBB to A- issued in Australian dollars by Australian or foreign companies, excluding bonds with optionality features except make-whole callable bonds. This sample has 190 bonds. This figure contains a subset of the bonds in Figure 11 above, excluding bonds with optionality features.

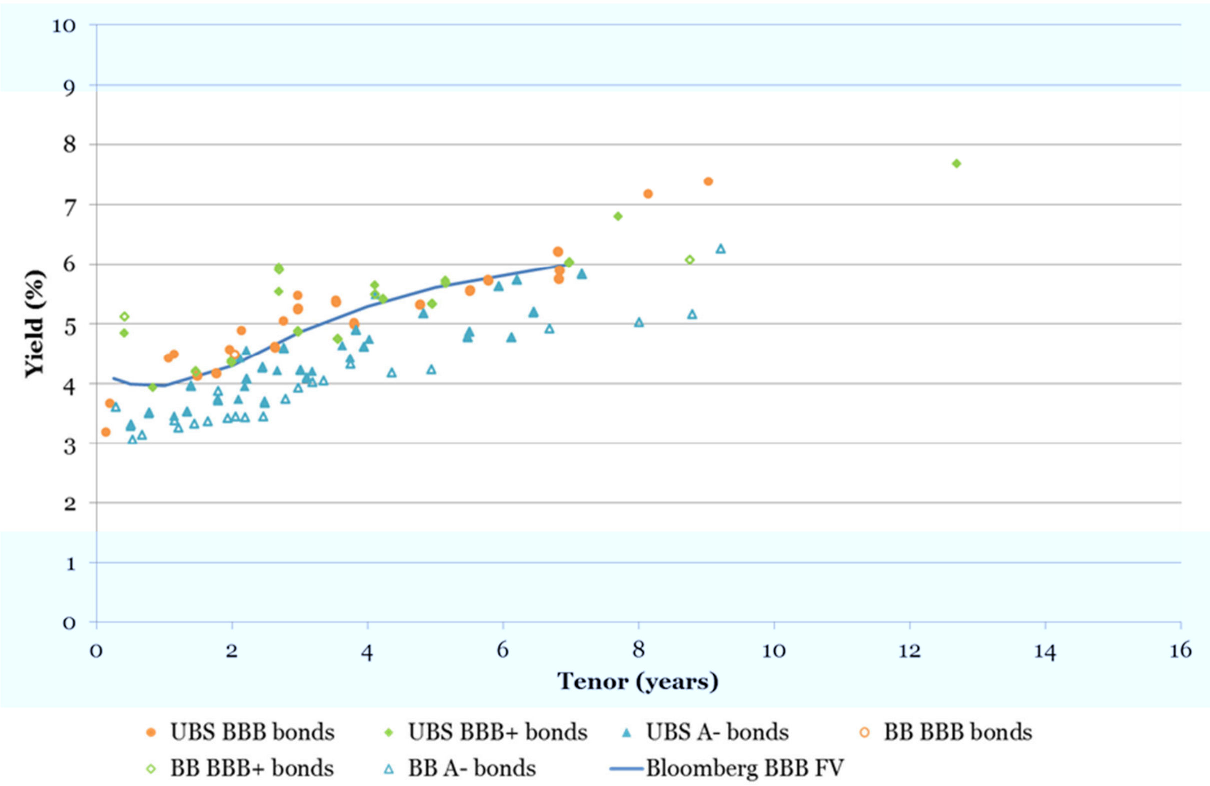
Figure 13: BBB to A- bonds issued in AUD by any company, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

127. Figure 14 illustrates BBB to A- bonds issued in Australian dollars by Australian companies, excluding bonds with optionality features. This sample contains 91 bonds. These figures contain a subset of the bonds in Figure 12 above, excluding bonds with optionality features other than make-whole callable bonds.

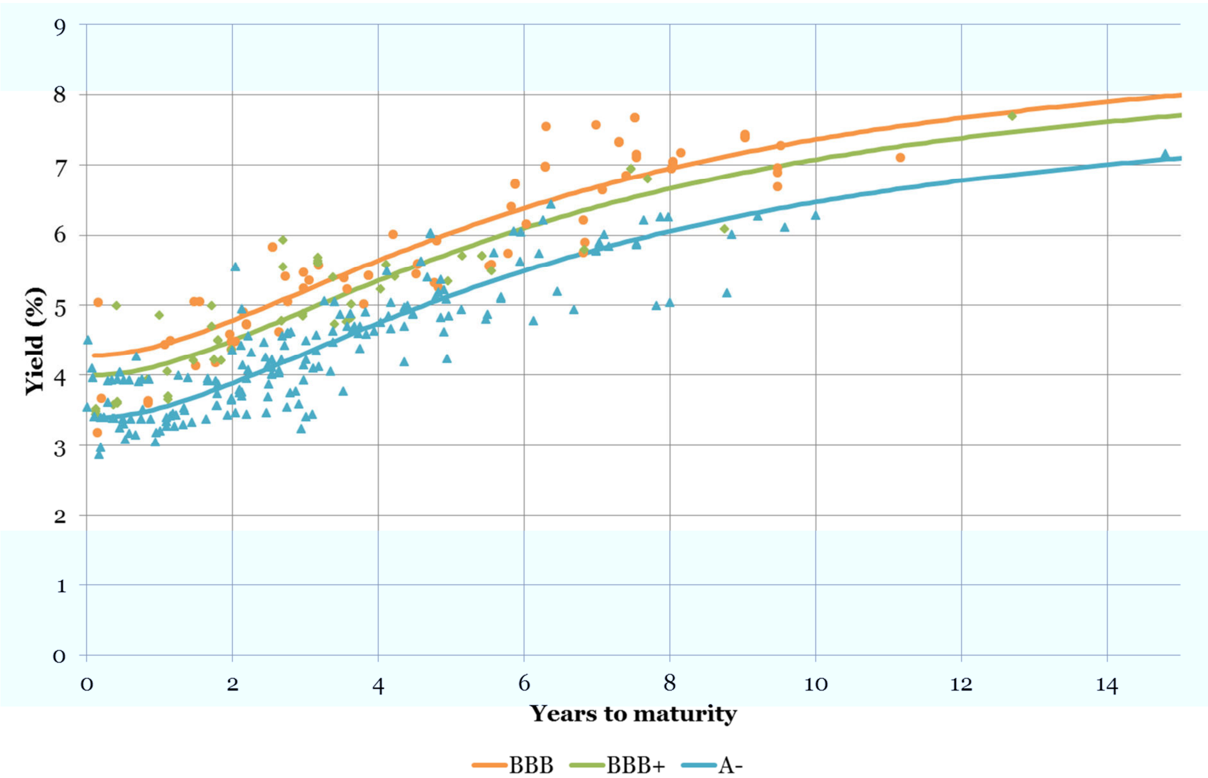
Figure 14: BBB to A- bonds issued in AUD by Australian companies, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

128. Figure 15 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by any company or in any foreign currency by Australian companies, but excluding bonds with optionality features. These figures are based on the bonds in Figure 9. The BBB+ 10 year yield is 7.08%, and the corresponding DRP is 3.06%.

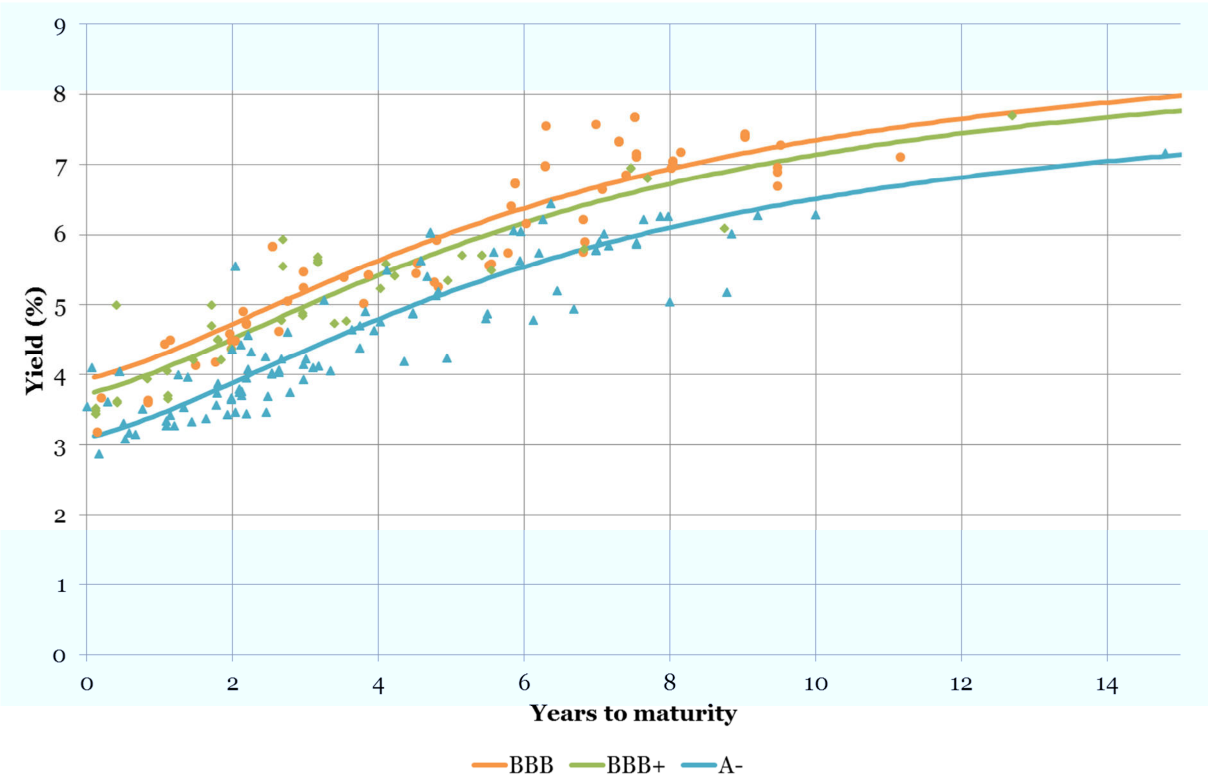
Figure 15: BBB to A- bonds issued in AUD in any country or in any currency by Australian companies, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

129. Figure 16 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in any currency by Australian companies, excluding bonds which have optionality features. This figure is based on the bonds in Figure 10. The BBB+ 10 year yield is 7.14%, and the corresponding DRP is 3.12%.

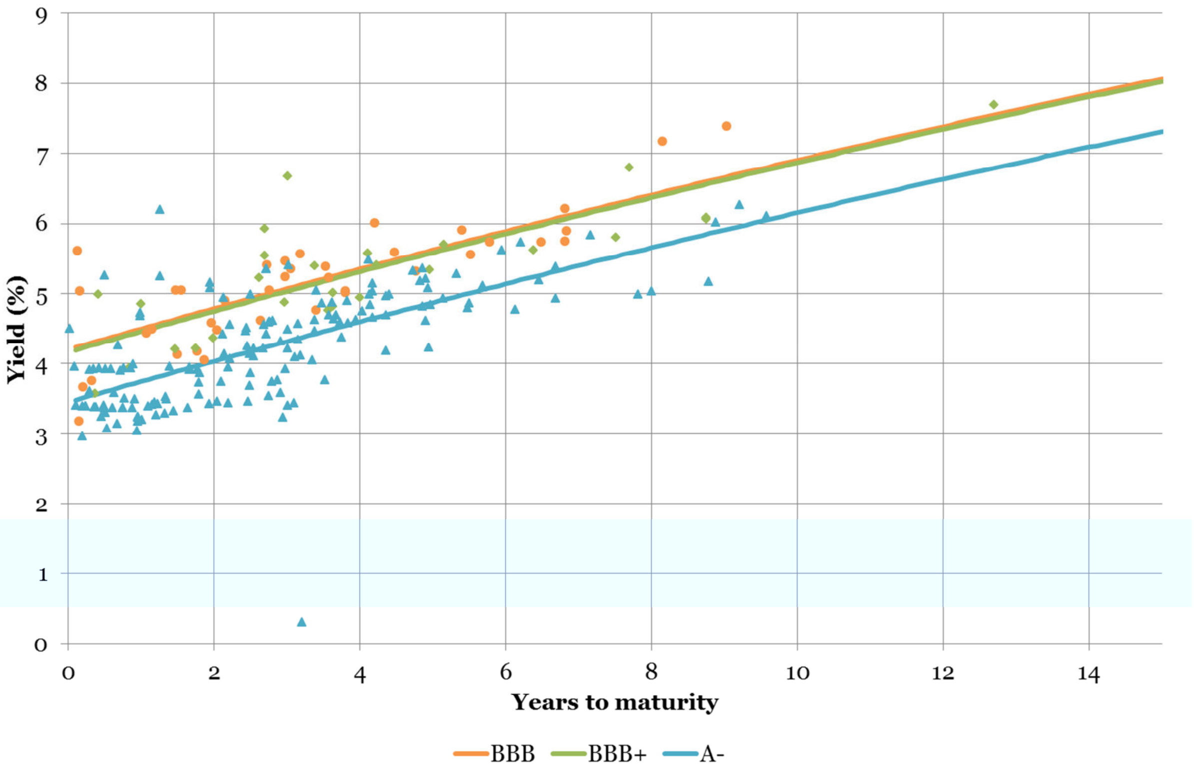
Figure 16: BBB to A- bonds issued in any currency by Australian companies, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

130. Figure 17 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by any company. This figure is based on the bonds in Figure 11. The BBB+ 10 year yield is 6.87%, and the corresponding DRP is 2.85%.

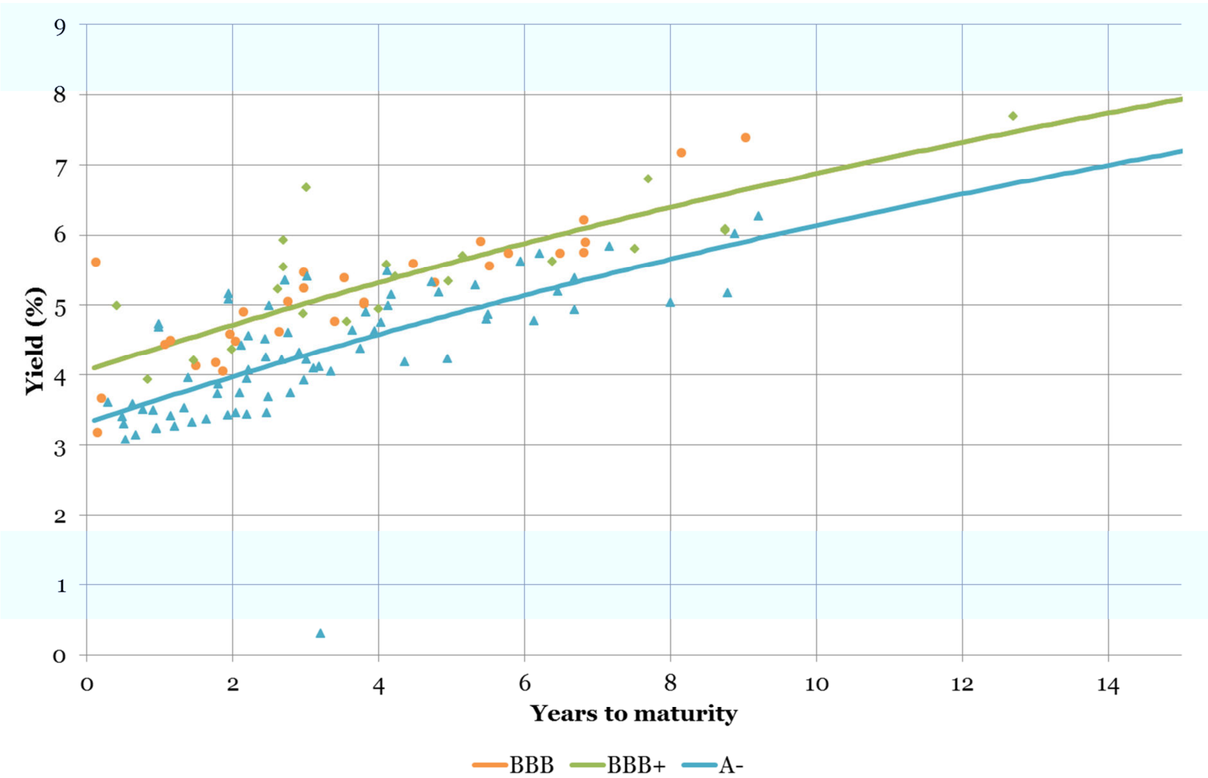
Figure 17: BBB to A- bonds issued in AUD by any company



Source: Bloomberg and UBS data, CEG analysis

131. Figure 18 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by Australian companies. This figure is based on the bonds in Figure 12. The BBB+ 10 year yield is 6.88%, and the corresponding DRP is 2.86%.

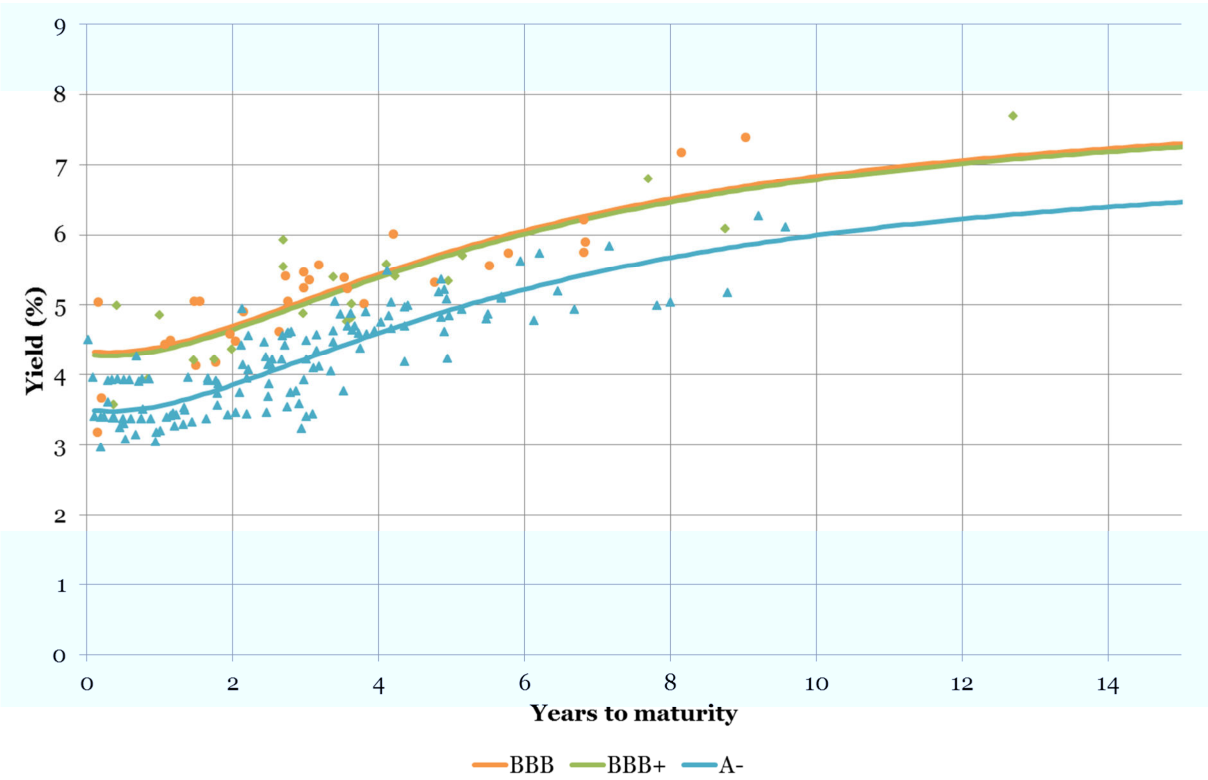
Figure 18: BBB to A- bonds issued in AUD by Australian companies



Source: Bloomberg and UBS data, CEG analysis

132. Figure 19 illustrates the result of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by Australian or foreign companies, excluding bonds which have optionality features. This figure is based on the bonds in Figure 13. The BBB+ 10 year yield is 6.79%, and the corresponding DRP is 2.77%.

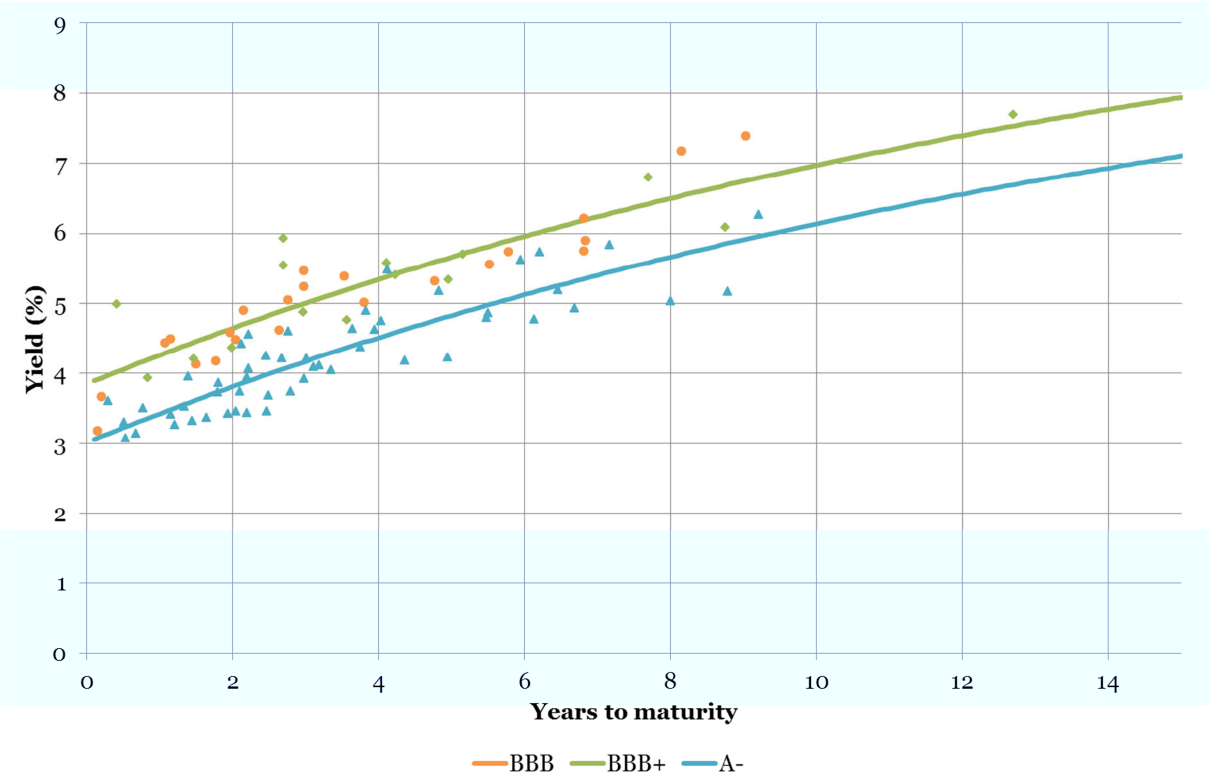
Figure 19: BBB to A- bonds issued in AUD by any company, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

133. Figure 20 illustrates the results of curve fitting the average Bloomberg and UBS yields for BBB to A- bonds issued in Australian dollars by Australian companies, excluding bonds with optionality features. This figure is based on the bonds in Figure 14. The BBB+ 10 year yield is 6.98%, and the corresponding DRP is 2.96%.

Figure 20: BBB to A- bonds issued in AUD by Australian firms, excluding bonds with optionality features not excluding make-whole callable bonds



Source: Bloomberg and UBS data, CEG analysis

Appendix C Curriculum vitae

COMPETITION
ECONOMISTS
GROUP

Curriculum Vitae

Dr Tom Hird / Director

Contact Details

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M / +61 422 720 929

E / tom.hird@ceg-ap.com

Key Practice Areas

Tom Hird is a founding Director of CEG's Australian operations. In the six years since its inception CEG has been recognised by Global Competition Review (GCR) as one of the top 20 worldwide economics consultancies with focus on competition law. Tom has a Ph.D. in Economics from Monash University. Tom is also an Honorary Fellow of the Faculty of Economics at Monash University and is named by GCR in its list of top individual competition economists.

Tom's clients include private businesses and government agencies. Tom has advised clients on matters pertaining to: cost modeling, valuation and cost of capital.

In terms of geographical coverage, Tom's clients have included businesses and government agencies in Australia, Japan, Korea, the UK, France, Belgium, the Netherlands, New Zealand, Macau, Singapore and the Philippines. Selected assignments include:

Selected Projects

- Advice to Chorus New Zealand on the estimation of the cost of capital.
- Advice to Wellington Airport on the estimation of the cost of capital.
- Advice to Vector on appeal of the New Zealand Commerce Commission decision on the cost of capital.
- Expert evidence in relation to the cost of capital for Victorian gas transport businesses.
- Advice to Everything Everywhere in relation to the cost of capital for UK mobile operators - including appearance before the UK Commerce Commission.
- Expert evidence to the Australian Competition Tribunal on the cost of debt for Jemena Electricity Networks.
- Advice to Integral Energy on optimal capital structure.
- Advice to ActewAGL on estimation of the cost of debt
- Advising NSW, ACT and Tasmanian electricity transmission and distribution businesses on the cost of capital generally and how to estimate it in the light of the global financial crisis.
- Advice in relation to the appeal by the above businesses of the Australian Energy Regulator (AER) determination.

- Expert testimony to the Federal Court of Australia on alleged errors made by the Australian Competition and Consumer Commission (ACCC) in estimating the cost of capital for Telstra.
- Advice to T-Mobile (Deutsche Telekom) on the cost of capital for mobile operators operating in Western Europe.
- Advising Vivendi on the correct cost of capital to use in a discounted cash flow analysis in a damages case being brought by Deutsche Telekom.
- Advising the AER on the cost capital issues in relation to the RBP pipeline access arrangement.
- Advising the ENA on the relative merits of CBASpectrum and Bloomberg's methodology for estimating the debt margin for long dated low rated corporate bonds.
- Advising the Australian Competition and Consumer Commission, Australia on the correct discount rate to use when valuing future expenditure streams on gas pipelines.