Estimating the cost of 10 year BBB+ debt

A report for ActewAGL

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1. Terms of reference

1. ActewAGL has asked me to advise on an appropriate method for estimating the cost of issuing debt with ten year maturity and a credit rating of BBB+ from Standard and Poor's. In particular, ActewAGL has asked that I advise on the relative merits of fair value estimates published by Bloomberg and CBASpectrum and on potential alternative estimates.

2. Criteria for estimating the cost of

2.1. General criteria

2. In my view a methodology for estimating the cost of debt should as far as possible:

   i. result in an unbiased estimate of the cost of issuing debt and a small standard error (ie, when the method does misestimate the benchmark rate it should only do so by a small amount);

   ii. incorporate all relevant information and not rely on irrelevant information;

   iii. produce results that are consistent with accepted academic finance theory and empirical research;

   iv. produce results that are timely and responsive to changes in market conditions; and

   v. be transparent including transparency about how and to what end discretion has been employed.

2.2. Relevant economic issues

3. In this report I will present evidence and discussion of how one would estimate the interest rate that would typically be incurred by a firm issuing a bond that has:

   - no put/call/conversion options attached to it;
   - a maturity of 10 years where the issuer makes fixed payments to the bond holder over the ten years and those payments are denominated in Australian dollars; and
   - a credit rating of BBB+ from Standard and Poor's.

4. For these type of bonds, there are other features that may affect its yield. These include:

   - whether the coupon payment is high or low. The higher the coupon payment the shorter the "duration" being the average timing of payments associated with the bond. For a "bullet" bond with a single payment at the time of maturity and no intervening coupons then the duration of the bond is equal to its maturity. For all other bonds the duration is shorter than its maturity. If the yield curve is upward sloping then, other things equal, for two bonds with identical maturity the bond with the shorter duration will have a lower yield to maturity – reflecting the fact that

shorter duration bonds pay more of their value in earlier periods (over which the required yield to that point in time is lower when the yield curve is upward sloping);

- whether there is likely to a liquid[1] secondary market for the bond. The more liquid the secondary market for a bond the more attractive will be the bond at the time of issuance (lower the yield to maturity) because investors will know that the cost of selling the bond, should they need to do so in the future, will be lower; and
- whether the probability of default for a bond is higher or lower than the average for bonds with a BBB+ rating.

5. I will assess different estimates of the cost of debt against a 'benchmark rate' where that benchmark rate reflects and 'average' of bonds with differing duration, liquidity and default risk but which nonetheless have a BBB+ rating.

6. Finally, it is relevant to note that the cost of debt to a firm is the interest rate incurred by the firm at the time of issue. There are sound economic reasons for believing that the interest rate at which bonds trade at in the secondary market will be lower than the interest rate at which those bonds are issued initially (other things constant). This reflects the fact that the initial sale of the bonds represents the sale of 100% of the relevant bonds over a short period (often over a single day in a book build process). By contrast, secondary trades of the bond are almost always for much smaller parcels of the bond (a few percent of the total amount outstanding). Unless the corporate bond market is perfectly liquid then an initial sale of a large volume of bonds will always, other things equal, result in a lower bond price (higher yield) than subsequent secondary sales.[2]

7. Of course, determining the actual level of this premium is very difficult because it is very rare for an investor to participate in an initial bond sale and then immediately turn around and sell that bond in the secondary market. By the time secondary market sales are recorded it is not possible to know definitively whether the price change reflects a new issue premium or other factors that have affected the cost of debt since the initial issue was made.

2.3. Consideration of current market conditions

8. Following the onset of the global financial crisis, the market for corporate bonds has changed materially. The impacts of these changes are summarised in the below quotes from various sources:

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[1] A liquid secondary market is one where a buyer or seller could, over a short period, accumulate/liquidate a large value of the relevant asset without raising/depressing its price.

[2] Of course, this does not mean that the first secondary trades after an initial issue will always occur at a lower yield to maturity. Changes in market conditions between the time of initial issue and the time of subsequent secondary trade may cause the observed yield on some secondary trades to be higher than the yield at time of issue.

9. Before the crisis was fully developed the International Monetary Fund (IMF) stated in April 2008:

> *"The financial market crisis that erupted in August 2007 has developed into the largest financial shock since the Great Depression, inflicting heavy damage on markets and institutions at the core of the financial system,"*[3]

10. Since then, the crisis has progressed further and reached a new level in September 2008.[4] The IMF in its October 2008 World Economic Outlook clearly identified the events of September 2008 as signalling a 'new phase' for the crisis:

> *"The financial crisis that first erupted with the U.S. subprime mortgage collapse in August 2007 has deepened further in the past six months and entered a tumultuous new phase in September. The impact has been felt across the global financial system, including in emerging markets to an increasing extent. Intensifying solvency concerns have led to emergency resolutions of major U.S. and European financial institutions and have badly shaken confidence."*

11. Similarly, the Organisation for Economic Cooperation and Development (OECD) states in the context of its November 2008 Economic Outlook No. 84:

> *"This Economic Outlook represents a substantial downward revision from just a few months ago: many of the downside risks previously identified have materialised. The financial turmoil that erupted in the United States around mid-2007 has broadened to include non-bank financial institutions and rapidly spread to the rest of the world. Following the collapse of Lehman Brothers in mid-September, a generalised loss of confidence between financial institutions triggered reactions akin to a 'blackout' in global financial markets."*[5]

12. An important consequence of this is that there has been a significant flight of capital to the safety and liquidity of nominal Government bonds. This has been described by the US Federal Reserve as an "extreme rush to liquidity".

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3 IMF, World Economic Outlook, April 2008 page xv.

4 On the 7th of September the two largest buyers and securitisers of US mortgages ('Fannie Mae' and 'Freddie Mac') were placed in conservatorship. On Sunday 14th September the bankruptcy of investment bank Lehman Brothers and the sale of Merrill Lynch to Bank of America (with US government guarantees attached) were both announced. On Tuesday the 16th of September it was announced that the US Government would effectively take over 80% of the equity in one of the world's largest insurers (AIG) which had suffered a liquidity crises and was unable to find lenders to save it from insolvency. The US Government provided an $85 billion credit facility in exchange for taking over 80% of the equity in AIG.

5 OECD, Economic Outlook No. 84, Editorial, Managing the global financial crisis and the economic downturn and summary of projections, Klaus Schmidt-Hebbel, OECD Chief Economist, page 3.

"We have discontinued the liquidity-adjusted TIPS expected inflation estimates for the time being. The adjustment was designed for more normal liquidity premiums. ***We believe that the extreme rush to liquidity is affecting the accuracy of the estimates****."*[6]

13. Australian credit markets have been similarly affected. Deloitte in a November 2008 report for the AER has stated:

> *The market for non-financial institutions corporate bonds, similar to the assumed BBB+ grade used in the WACC model, effectively vanished from capital markets in the first half of 2008 against a total for $6.5 billion for the whole of 2007*[7]
>
> *The small volume of corporate bond issues that has taken place in 2008 has been in the main restricted to large financial institutions, and credit spreads have increased significantly*
>
> *In the past, 5 and 10 year bonds were widely issued, but in the current market, the little volume that is being issued is primarily 3 year bank debt, with very little liquidity in 5 year facilities.*
>
> *In the current market it would be difficult (if not impossible) to attempt to refinance billions of dollars of debt in a 5-40 day [sic]*
>
> *From published research and discussions with market makers, the expectations are for the domestic corporate bond market to remain illiquid, possibly into 2010 and beyond. Given the historic events in credit markets, market makers were reticent to make any predictions… Their expectations are for the corporate bond market to have a very slow recovery, particularly for BBB+ issuances.*[8]
>
> *As per discussions with Market Makers there is currently no liquidity in the domestic corporate bond market, and international banks and fund managers are withdrawing funds from the market, restricting the size of the pool of money available to invest.*
>
> *The recent financial crisis demonstrates that in times of severe market conditions, liquidity in the primary and secondary markets can decline or even disappear. The lack of liquidity in the primary debt market implies business entities cannot raise finance via debt issuance without paying higher borrowing*

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6 http://www.clevelandfed.org/Research/data/TIPS/lpremium.cfm.

7 Page 5.

8 Page 9.

costs… On the other hand, the lack of liquidity in the secondary market implies capital providers in the primary market (investors) cannot convert debt securities to cash quickly at reasonable prices and hence would demand a higher rate of return from investments in the debt market. In both cases, the lack of liquidity will result in the addition of a liquidity premium to the investors' required rate of return and hence will increase the costs of accessing debt.[9]

14. Similarly, the Reserve Bank of Australia's (RBA) November Statement on Monetary Policy states:

> *"World financial markets have come under severe stress in the period since the last Statement [in August 2008]. Strains in credit markets escalated in early September, and the period since then has been marked by further large declines in equity prices and exceptional volatility across a range of markets…*
>
> *The renewed turmoil was sparked by the failure or near-failure of a number of financial institutions in the United States and Europe…*
>
> *These events saw an intensification of the credit tightening that was already beginning to take hold in a number of countries. While this had previously been mainly apparent in increased funding costs, which were typically passed on to borrowers in the form of higher lending rates, the renewed turmoil saw this develop into a serious tightening in credit availability. As confidence in the financial sector deteriorated, banks became more uncertain about their ability to sustain their funding, and this in turn made it more difficult for them to lend to sound borrowers in the non-financial sector.*[10]
>
> *The deterioration of credit market conditions and the failure of several large financial institutions saw corporate debt yields increase significantly through September and October as default risk concerns escalated. Spreads on corporate debt surpassed their mid-March highs and 2000 peaks…*[11]
>
> *Corporate bond issuance in the United States was very weak in the September quarter and well below the already subdued level of issuance seen earlier in 2008; issuance was around three times less than in the June quarter for both financials and non-financials, reflecting the current very difficult conditions for longer term funding.*[12]

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9 Page 18.

10 RBA, *Statement on Monetary Policy*, 10 November 2008, page 1.

11 Ibid, Page 13.

12 Ibid, page 14.

15. The RBA's February 2009 statement noted:

> *While the global financial system remains under considerable strain, there have been some signs of an improvement in financial conditions recently. The extreme volatility that affected all markets in October and November following the Lehman's collapse has abated in the past two months. There have also been some signs of improvement in the functioning of credit markets in response to the substantial assistance measures taken by authorities in a number of the major economies. These measures have included injections of capital into financial institutions, the provision of government guarantees and various actions taken by central banks to improve market liquidity. While spreads in money markets remain high, yields have fallen to historically low levels in many countries. Debt issuance at longer terms has picked up, dominated by bonds issued by banks using government guarantees…*[13] *However, global issuance of unguaranteed debt remains weak."*[14]

16. In a speech on 31 March 2009,[15] the RBA Assistant Governor (Financial Markets) commented on the effects of the global financial crisis on Australian financial markets as follows:

> *"Funding markets shut completely following the collapse of Lehman Brothers [in September 2008]. All global financial markets were dislocated by this event, but not surprisingly term debt markets were about the most affected…*
>
> *In the wake of the dislocation induced by Lehman's, many countries, including Australia, moved to guarantee bank debt issuance. Soon after the introduction of the guarantee, Australian banks were able to once again access term debt markets… There has, however, been little investor appetite for unguaranteed debt, despite other indications of an improvement in credit market conditions."*

17. In summary, the current conditions in the secondary market for corporate bonds (which is the market covered by Bloomberg and CBASpectrum) are such that:

- there are few, if any, actual transactions in the secondary bond market;
- there are no long dated BBB+ fixed coupon bonds and there have been very limited issue of new bonds (especially at the BBB+ credit rating); and

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13 RBA, *Statement on Monetary Policy,* 6 February 2009, page 1.

14 Ibid, page 22.

15 Speech titled *Some Effects of the Global Financial Crisis on Australian Financial Markets,* delivered by Guy Debelle, RBA Assistant Governor (Financial Markets) to Finance Professionals Forum, Sydney, 31 March 2009.

- there is very low liquidity (in the sense that it is difficult to buy and sell without affecting prices) and there is a high premium associated with liquidity.

18. I discuss these conditions in turn below and identify the issues that they raise for estimating an average benchmark yield on 10-year, BBB+ corporate debt. I use the term "the benchmark rate" as a short hand for this concept.

2.3.1. Few trades in corporate bonds

19. As noted above, I understand that there are currently few, if any, actual transactions in the secondary bonds market. In any case, given that such bonds are not generally traded in a centralised exchange but are bought and sold 'over the counter' it can be difficult to observe the prices on the trades that actually take place.

20. Both Bloomberg and CBASpectrum source pricing data from a range of contributors such as banks and brokers that arrange trades in bonds. However, I understand that they do not, in general, distinguish between 'indicative prices' quoted by the source and 'executable prices' that are the result of an actual trade. There is no guarantee that the price attributed to a bond by either of the services will represent the results of actual trading. Indeed Bloomberg has stated in 2007, before the full onset of the financial crisis, that up to 90% of the prices in its bonds database were indicative, not executable.[16] In a very real sense therefore, the prices reported by both Bloomberg and CBASpectrum represent, to a large extent, the informed opinion of industry players about a fair price for a particular bond.

21. It comes as no particular surprise then, to note that the prices and yields that Bloomberg and CBASpectrum estimate are very different, even for the same bonds. This is likely to be reflective of the extent to which these services collect their pricing data from different sources. I sampled prices reported by Bloomberg and CBASpectrum on 6 May 2009 and observe that the yields reported by Bloomberg are generally, although not universally, lower than those reported by CBASpectrum. A comparison of BBB+ bonds that are covered by both services is shown in Table 1 below.

[16] Bloomberg, *Bloomberg Fair Value Market Curves*, International Bond Market Conference, Taipei, 2007.

Table 1: Comparison of estimated yields on BBB+ bonds, Bloomberg and CBASpectrum

Issuer	Maturity	Bloomberg	CBASpectrum
Dexus	04/02/2010	6.331	6.510
Snowy (wrapped)	25/02/2010	5.924	7.719
Bank of Queensland	02/12/2010	6.052	5.870
Dexus	08/02/2011	6.309	7.960
Tabcorp	13/10/2011	6.639	7.440
Coles	25/07/2012	7.445	7.000
Snowy	25/02/2013	7.461	9.260
Santos	23/09/2015	7.968	8.920

Source: Bloomberg, CBASpectrum

22. The fact that there are few if any recent trades in these bonds and that it is not possible to know what the prices were for any trades that actually occurred means that one must rely on observed estimates of prices that would exist if there were trades. Naturally it is very difficult to 'test' the accuracy of such estimates in the absence of data on actual trades. On this matter it is important to be very clear – on any given day most, if not all, the quoted yields listed in Bloomberg and CBASpectrum do not reflect yields at which the bonds were traded. Rather they reflect yields at which somebody estimates that the bonds would have traded had there been willing buyers and sellers on that day.

2.3.2. No long-dated BBB+ bonds

23. It is not necessarily the case that two bonds with the same time to maturity and same credit rating will attract the same price and, in fact, one may often observe very different prices for such bonds (eg, if the market for those bonds have different levels of liquidity).

24. From the data published by Bloomberg and CBASpectrum, it is clear that there are no bonds that have attributes that make them directly comparable with a 10-year BBB+ rated bond. The longest dated bond with price information in either database is for the General Electric Corporation, at 9.86 years from 6 May 2009 (yield of 13.2% reported in CBASpectrum). However, this bond is rated AA+. The longest dated BBB+ rated bond is for Santos, for which pricing information is reported by both services (yield of 8.9% reported by CBASpectrum). This bond matures on 23 September 2015, giving it a time to maturity of 6.38 years from 6 May 2009.

25. Both the bonds described above are similar to the required 'benchmark' bond in one required attribute, but not the other. Clearly, if one were to choose the estimated General Electric bond yield as the proxy for the benchmark rate one would end up with

a much higher yield than if one chose the Santos yield (13.2% rather than 8.9%). As discussed later, there are good reasons to regard the GEC yield as an overestimate and the Santos yield as an underestimate of the benchmark rate.

26. This highlights a more general proposition that even if there were a bond that just happened to have exactly 10 years to maturity and be rated at BBB+, this does not mean that we can, or should, rely completely upon the yield reported for this bond to serve as the benchmark rate. Selecting the yield from a single bond, uncorroborated by other evidence, is not likely to give a result that is representative r average of all bonds.

27. Furthermore, using a single observation as the required 'benchmark' means that all the information embodied in all other bond prices is thrown away, under the implied assumption that this is not useful in explaining the yield on 10-year BBB+ rated bonds. As a general rule it is wasteful and inefficient to exclude data that may potentially assist to improve an estimate of a benchmark yield for 10-year BBB+ corporate debt.

28. The AER's methodology for estimating a 10-year yield on BBB+ corporate bonds using Bloomberg's fair value estimate provides an example of how this principle can be used in practice. Since Bloomberg no longer reports yields for BBB debt of 10-year maturity, rather than simply accepting the yield on 8-year BBB debt as the best estimate for this value the AER sought to improve on this estimate by using information about the relative yields on 8-year and 10-year A rated debt, as estimated by Bloomberg. In theory, this adjustment makes efficient use of the information that is available to achieve a better estimate for the yields on 10-year BBB+ rated corporate bonds.[17]

2.3.3. Low liquidity and high liquidity premium

29. In a financial crisis there is heightened uncertainty about the returns on both corporate debt and equity. As discussed below, this tends to create what is known as a 'flight from risk' or a 'flight to safety'. As a consequence, investors reduce their demand for illiquid products and increase their demand for liquid instruments, such as government bonds, increasing demand for these products. This is partly because of the uncertainty about when major investors are going to need quick access to cash to settle other obligations and partly because the heightened uncertainty about the value of corporate assets tends to make these markets less liquid. Moreover, the collapse of investment banks (and investment banking generally) has meant there are fewer players with less deep pockets willing to 'make the market' for a particular bond or stock by buying/selling it when they believe it is being mispriced.

[17] In practice, as I show in section 3, the Bloomberg estimates that the AER relies upon in calculating this revised estimate are not themselves founded upon actual data and hence each of the estimates that the AER relies upon are problematic.

30. All things being equal, this means that in general investors are likely to seek to sell out of corporate bonds, thus reducing the prices and increasing the yields. However, for the reasons described above, bonds that retain some liquidity will be less affected by this trend and will retain higher prices and lower yields than the majority of bonds, which have been left illiquid. That is, in the context of the current financial crisis, the premium for liquidity is considerably higher than it has been historically, and this effect will cause more liquid bonds to have materially lower yields than illiquid bonds.

31. Because there is little trading in corporate bonds at the moment, it is also the case that many bonds are traded infrequently. Methodologies that estimate a benchmark cost of debt that have reference to only the most liquid bond yields will be biased, to the extent that these bonds are not representative of their class and, as described above, may have lower yields than the average bond.

32. In a market where there are many bonds that are traded liquidly (and a minority that are not) this bias is not likely to be material. That is, as long as there is a relatively large pool of liquid bonds, particularly of the type that closely approximate the benchmark we require, this can give some confidence that the average yield over these bonds is a good approximation for the benchmark, relative to other methodologies that might use more information.

33. However, in the current market, there are only a few bonds that give rise to sufficient pricing information to be described as liquid and, even then, as explained earlier it is not necessarily the case that this pricing information is based on actual trading information. Since there are even fewer liquid bonds that are both BBB+ and long dated, methodologies that rely only upon the most liquid pricing information may, in effect, rely on a very small pool of bonds that are not representative generally of bonds at that maturity or in that credit class.

34. To the extent the that the concept of the *benchmark rate* is one that reflects the typical characteristics of a 10 year BBB+ bond then a consistent fair value estimate, in the current market conditions, would not be one that restricted itself to the most liquidly traded bonds.

2.4. Consistency with accepted finance theory

35. I describe above how the current market conditions for corporate bonds mean that there are few trades and that most prices are 'indicative'. A further problem associated with making fair value estimates from a very small sample is that selection bias or simply random chance may give rise to fair value estimates that are inconsistent with accepted finance theory.

36. For example, if no restriction is placed on fair value curves for different credit ratings crossing then it is quite possible that the vagaries of the yields on particular bonds

within each credit rating may cause the fair value yields to cross if those fair value yields are solely fitted to the data in that credit rating. Clearly, this would be an undesirable theoretical property for fair value yields to have (eg, for a BBB 6 year fair value yield to be less than an A 6 year fair value yield). I understand that both Bloomberg and CBASpectrum impose constraints such that this never occurs (at least inspection of historical data suggests that this is the case).

37. A further restriction that one may wish to impose is that credit spreads (ie, differences between corporate bond and Commonwealth Government bond yields) change smoothly over time and that they tend to increase with maturity of a bond (at least for investment grade bonds). At attachment A to this report there is a note from Professor Grundy which concludes:

> ***Conclusion on the term structure of debt margins based on an implementation of the extant theoretical finance literature****: While a downward sloping term structure of debt margins beyond 6 years cannot be ruled out in a setting with an alternate stochastic process for changes in firm value, an extended Merton (1974) model incorporating coupon payments and bankruptcy costs implies a flat or upward sloping term structure of debt margins when the model is evaluated at realistic values for the asset volatility and recovery rate parameters.*

38. Professor Grundy also concludes that this theoretical property is consistent with empirical observations. Therefore, one may wish to use discretion to impose a constraint on the fair value estimates that captured this property of credit spreads – especially if there was a paucity of data in the relevant region of the term structure.

2.5. Specific criteria when selecting data sources

39. Consistent with the five general criteria listed above I incorporate into these criteria more detailed criteria reflecting the above observations. The methodology should, as far as is practical:

i. reflect an unbiased estimate of the representative yield at the time of issue for 'typical' corporate bonds with a maturity of 10 years and a BBB+ long-term credit rating from Standard & Poor's;

ii. utilise a methodology that is not unnecessarily reliant on a single or small number of observations and/or individual views but efficiently uses the totality of information available, particularly where the available information is sparse;

iii. gives rise to estimates that are consistent with standard predictions of finance theory and past empirical relationships;

iv. give rise to estimates that are consistent with current market conditions and those estimates should change as market conditions change; and

v. be transparent including in relation to how discretion is applied. If that discretion results in yield estimates that are inconsistent with other potential proxies for the benchmark rate this inconsistency should be able to be explained in terms of why the alternative proxies are worse estimates for the benchmark rate.

40. There is also possibly a sixth criterion that would be desirable. This criterion does not flow from consideration of finance issues but more from consideration of process issues. Specifically, given that parties to regulatory proceedings may have vested interests in the outcome of the estimated benchmark corporate bond rate then ideally:

vi. the source of the estimate would be as independent as possible from interested parties to the regulatory proceedings.

3. Comparison of Bloomberg, AER and CBA Spectrum methodologies

41. Bloomberg and CBASpectrum are, to the best of my knowledge, the only data services that produce 'fair value' estimates for debt with a specific credit ratings and maturities for Australian corporate bonds. A 'fair value' estimate is an estimate of some form of 'average' or 'representative' yield for a bond of a specific credit rating and yield to maturity. In this sense an accurate or unbiased 'fair value' estimate can be equated with the concept of a 'benchmark rate'.

42. This makes a close examination of both Bloomberg and CBASpectrum estimates particularly relevant in the context of this paper. It is also the case that Australian regulators have relied heavily on Bloomberg and CBASpectrum fair value estimates when setting the cost of debt for regulated businesses (including the AER's current methodology which relies solely on Bloomberg fair value estimates).

43. In this section I compare the methodologies used by Bloomberg (and implicitly the AER) and CBASpectrum in arriving at fair value estimates. I then assess these against the criteria described in section 2. At the outset, I note that both Bloomberg and CBASpectrum estimate the fair value for trades of existing bonds on the secondary market. Other things constant, one would therefore expect both CBASpectrum and Bloomberg to have downward biased estimates of the benchmark rate which I interpret to be the interest rate on newly issued debt (see discussion in section 2.1 and criteria i at paragraph 39 above).

44. This view is supported by Bloomberg staff in a response to Victorian electricity distribution businesses who have asked whether a new domestic corporate BBB+ bond might be issued at a margin over the "BBB" fair market yield. Bloomberg advised that:

> *"I am afraid that this is a question better asked of a Debt Capital Markets Desk. Bearing in mind that the curves are representative of secondary market prices and trading sizes, new issues have nearly always been issued at a premium to this curve. My experience has been that the premium has increased during this period of market turbulence as both Buy and Sell side clients have demanded a greater risk premium."*[18]

[18] *Debt Risk Premium for use in the Initial AMI WACC Period*, A paper jointly prepared by the Victorian Electricity Distribution Businesses, 1 June 2009.

45. An overall conclusion of the rest of this section is that methodology employed by both Bloomberg and CBASpectrum relies heavily on the discretion and judgement of each service. At any given time, it is possible to form an opinion about the accuracy of that discretion and judgment in the context of providing an estimate of the benchmark rate. However, precisely because it involves an exercise of judgement and discretion, it is not possible to compare this aspect of each service's methodology outside the context of a specific output from each service on a particular day.

3.1. Bloomberg methodology

3.1.1. Discretion used in estimating 'consensus' bond yields

46. Each day Bloomberg publishes a fair value corporate bond curve for each of the credit ratings AAA, AA, A and BBB. It also publishes the bonds and their estimated yields it had regard to when estimating that fair value curve. Bloomberg does not fully disclose how it determines which bonds are included and which bonds are excluded from the construction of the fair value curve. Rather, Bloomberg simply states in relation to the BBB fair value curve:[19]

> *"The curve is populated with Australian dollar denominated fixed-rate bonds issued by Australian companies. The bonds have ratings of BBB+, BBB, BBB- from S&P, Moody's Fitch and/or DBRS. The yield curve is built daily with bonds that have either Bloomberg Generic (BGN) prices, supplemental proprietary contributor prices or both. The bonds are subject to option-adjusted spread (OAS) analysis and the curve is adjusted to generate a best fit."*

47. It is not transparent what is meant by *supplemental proprietary contributor prices*. It would appear that Bloomberg's methodology allows for the possibility that it would use a specific pricing estimate (supplemental proprietary contributor prices) in preference to other pricing estimates or would rely solely on that specific pricing estimate when no other pricing estimates are available. However the source and nature of those estimates are not disclosed.

48. Similarly, the nature of the process for determining whether a bond has Bloomberg Generic Pricing (and what that Bloomberg Generic Price is) is determined using judgement and discretion exercised by Bloomberg. With respect to these prices Bloomberg states:[20]

> *"Bloomberg Generic Price (BGN) is Bloomberg's market consensus price for corporate and government bond.* [sic] *Bloomberg Generic Prices are calculated*

[19] This statement is made on the Bloomberg screen when it describes its bond prices.

[20] Sourced from Bloomberg terminal on 26 May 2009.

by using prices contributed to Bloomberg and any other information that we consider relevant. Bloomberg does not make a market in any of the securities that we price. The actual methodlogy we use is proprietary and depends on the type of pricing and the markets involved. The goal of the pricing is to produce "consensus" pricing. To the extent that we are not comfortable that a bond can be assigned a consensus price at any time, we will mark it "not priced". We constantly and vigorously review the performance of the system and alter it as we determine necessary to achieve our goal."

49. In summary, Bloomberg states that it uses discretion in arriving at what it considers are "consensus" bond yields and in determining whether a "consensus" bond yield exists.

3.1.2. Discretion used in excluding outliers

50. Finally, even for prices that have Bloomberg Generic Pricing (ie, which Bloomberg regards as reflecting 'consensus pricing') Bloomberg appears to exercise further discretion in excluding 'outliers' from this sample when building its fair value curves. [21] I am unaware of the criteria Bloomberg applies when determining that a bond constitutes an outlier.

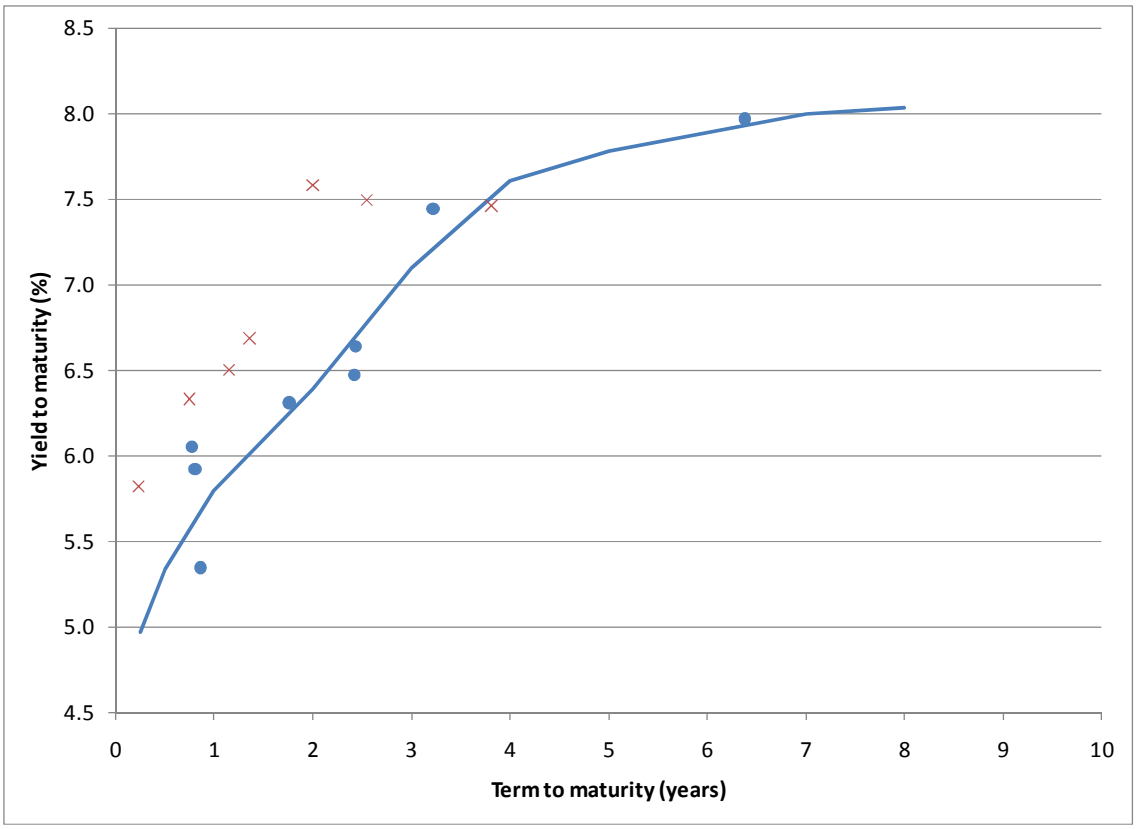
51. I illustrate the exercise of this discretion below. Figure 1 below shows the Bloomberg fair value curve for BBB on 6 May 2009. Each dot in that figure represents the yield to maturity and the term to maturity of a particular bond for which there was pricing on Bloomberg on that day.[22] However, only the blue dots represent the bonds that Bloomberg used to determine the fair value curve. The orange crosses represent bonds that were excluded by Bloomberg from the generation of that curve.[23]

[21] See page 9 of a presentation by Michael Lee to the International Bond Market Conference 2007, Taipei. Available at http://taipeibond.gretai.org.tw/cv/Bloomberg%20Mr.%20Lee(panel%203-1).ppt.

[22] I have not shown two bonds that Bloomberg excludes from its BBB fair value estimation process on this graph. These two bonds each have yields of 18.6% (GPT) and 21.3% (Fairfax) and to show them would require a scale of the graph that would prevent closer examination of the area of interest around Bloomberg's BBB fair value curve.

[23] Appendix B provides screen shots from Bloomberg that describe which bonds were included and which were excluded. Only 9 out of 17 BBB bonds were included.

Figure 1: Bloomberg BBB fair value curve and included/excluded bonds on 6th May 2009

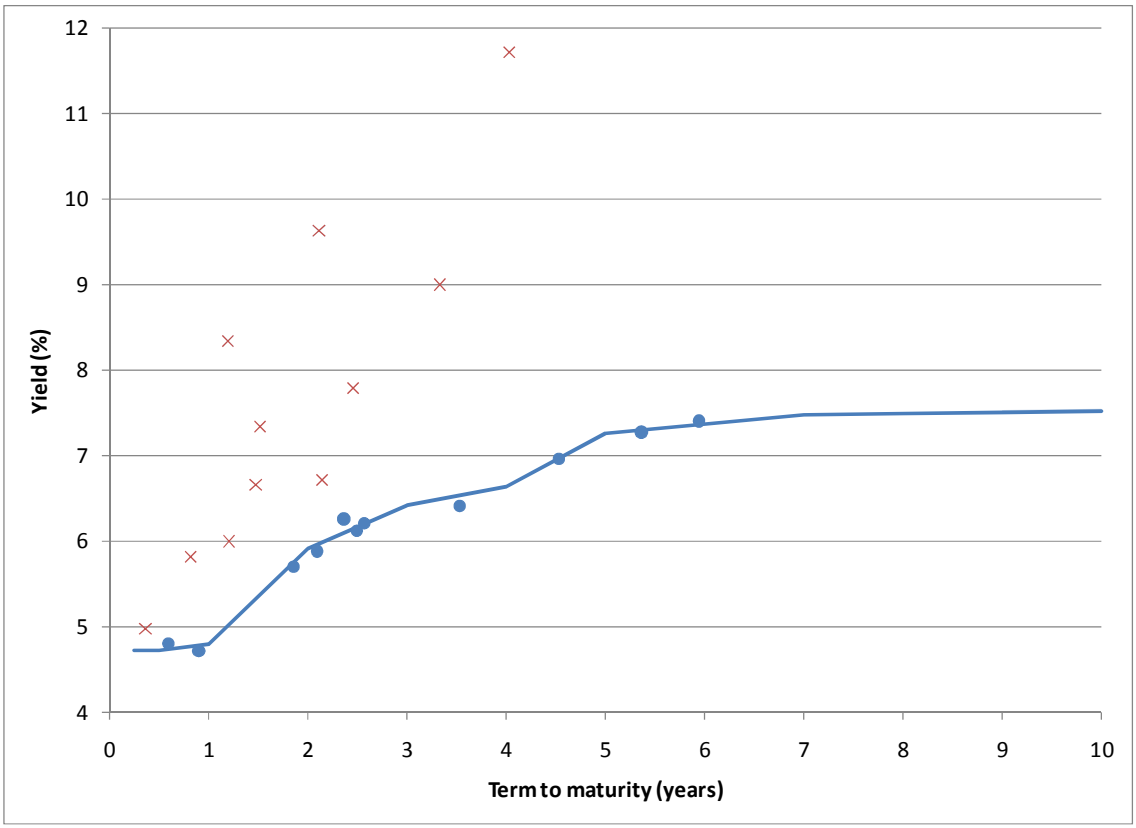


Source: Bloomberg

52. The above graph illustrates that seven bonds with pricing in the vicinity of the Bloomberg fair value curve have been excluded by Bloomberg. Of these, six have pricing that is above the Bloomberg fair value curve and one has pricing that is slightly below. It appears clear that the impact of including these bonds would have been to result in a higher fair value curve.

53. Given the AER also uses the Bloomberg A fair value curve to determine its estimate of the cost of debt, I provide a similarly formatted graph for Bloomberg's A fair value curve. I also supply the relevant data in tabular form in Appendix B to this report.

Figure 2: Bloomberg A fair value curve and included/excluded bonds on 6 May 2009



Source: Bloomberg

54. In this case all of the excluded bonds had higher yields. Had some or all of these bonds been included then it is reasonable to assume that the fair value curve for A would have been both higher and steeper than the actual fair value curve estimated by Bloomberg.

55. It is also relevant to note that Bloomberg's methodology may be such that it excludes illiquid bonds from its methodology. Specifically, a presentation by Bloomberg staff states:

> *"The availability of BGN price for a bond is an indication of good liquidity for that bond"*[24]

[24] See page 9 of a presentation by Michael Lee to the International Bond Market Conference 2007, Taipei. Available at http://taipeibond.gretai.org.tw/cv/Bloomberg%20Mr.%20Lee(panel%203-1).ppt . This presentation predates the global financial crisis and it is general in nature so we cannot know to what extent it reflects current practice.

56. In the current circumstances I consider that this would make the Bloomberg fair value curve a biased estimate of the 'average' or 'typical' cost of debt for BBB bonds. Bloomberg appears to only use bonds with Bloomberg Generic Pricing (BGN) to determine its fair value curve. However, the above quote implies that its BBB fair value curve is, in reality, a fair value curve for *liquid* BBB bonds. In ordinary circumstances where there is a relatively small liquidity premium then this may be less problematic. But in the current circumstance of a large number of illiquid corporate bonds, by focussing only on the most liquid bonds the Bloomberg methodology would give rise to a biased estimate of the true average cost of debt for bonds of any given credit rating.

3.1.3. Discretion used in fitting curves

57. Once Bloomberg has settled on a set of bonds used to generate its fair value curves Bloomberg uses further discretion to generate a 'best fit' to that data. The methodology employed by Bloomberg has been described in a 2005 NERA report which the AER has referenced as informing its understanding of the Bloomberg methodology in the context of its NSW electricity distribution decisions[25]. The NERA report (authored by the author of this report) describes the Bloomberg methodology as follows:

> *"For each credit rating, Bloomberg nominates a number of predetermined maturity points on the yield curve (3 and 6 months, 1, 2, 3 4, 5, 7, 8, 9, 10, 15, and 20 years – or fewer if there are limited long dated observations). Bloomberg then estimates the yields to maturity on the set of bonds that would both sell at par and have maturity dates exactly equal to the predetermined maturity points. The estimation procedure minimises the sum of squared deviations between actual observed yields and fair yields on bonds, assuming that the fair yields on bonds selling at par with maturity dates between two nominated maturity points are determined from a straight line joining the fair yields on the two immediately surrounding bonds with maturities equal to the predetermined maturity points.*
>
> *As such, there is no predetermined mathematical relationship (functional form) linking the values on the yield curve at each predetermined point."*

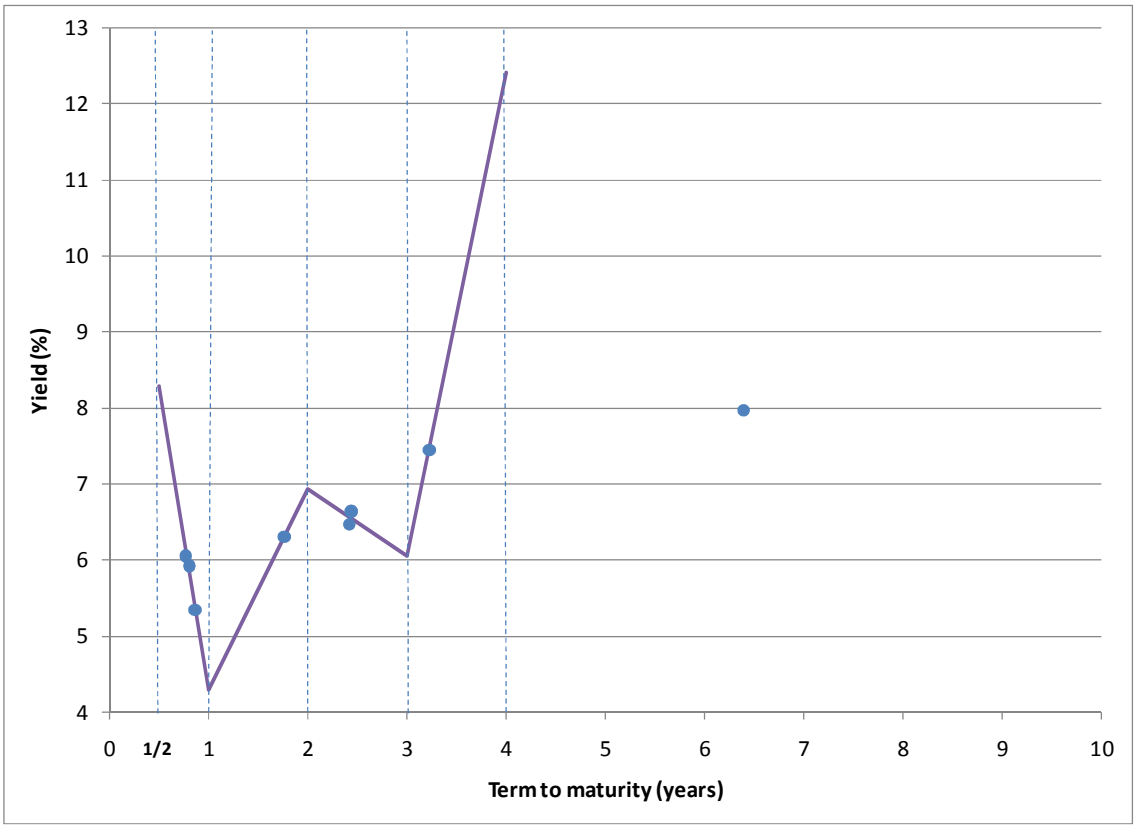
58. This methodology has an important potential advantage in that it does not specify a particular shape for the yield curve (mathematical functional form). Rather, it lets the available data determine the shape of the yield curve. For example, the shape of the yield curve could be upward sloping in some maturities and downward sloping in other maturities if that was what the data actually showed to be the case.

25 Page 230 of NSW distribution determination 28 April 2009 references: NERA, *Critique of available estimates of the credit spread of corporate bonds*, May 2005.

59. However, this potential strength of the above methodology is a weakness in situations where there are only a small number of bonds being used to estimate the yield curve. Specifically, the Bloomberg methodology described above will only give rise to a well defined yield curve when there are multiple bonds between each predetermined maturity point. When there are a limited number of bonds between each predetermined maturity date it will give a very poor estimate of the true yield curve for a *representative* bond of that credit rating. In the extreme, where there is one bond between each of the relevant maturity dates then the above methodology will be able to perfectly fit all the data points but will do so by taking on a highly unrealistic shape to the yield curve.

60. This is demonstrated in the below figure which shows the outcome of using this methodology on 6 May 2009 to derive the best fit between the bonds identified by Bloomberg as underlying its BBB fair value curve.

Figure 3: Fair value BBB curve based on 2005 NERA description of Bloomberg methodology using data from 6 May 2009



Source: NERA, Bloomberg, CEG analysis

61. The reason the fitted curve takes the above 'zig-zag' shape is that there are insufficient observations of bonds between any given predetermined maturities such that the best fit is given by extreme slopes between those predetermined maturities – with those extreme slopes going 'un-penalised' because they can simply be reversed to fit the next data point. The 6 May 2009 is described in Table 2 below.

Table 2: Bonds and yields underlying the Bloomberg BBB Fair value curve on 6 May 2009

	Years to maturity	Yield to maturity
Bank of Queensland	0.77	6.052
Snowy Hydro	0.81	5.924
Fosters Group	0.86	5.347
Dexus Property	1.76	6.309
Origin	2.42	6.473
Tabcorp	2.44	6.639
Wesfarmers	3.22	7.445
Santos	6.38	7.968

62. As Table 2 shows, the first three bonds in the Bloomberg sample have a maturity between 0.5 years and 1.0 years. Of these three bonds, the shortest maturity bond (Bank of Queensland) has the highest yield, the middle maturity bond (Snowy) has a lower yield and the longest maturity bond (Fosters) has a significantly lower yield still. Also, despite having significantly different yields the term to maturity for each bond are actually very close – all are within seven weeks of each other. As a consequence, the straight line that best fits the data between a predetermined maturity of a half year and the predetermined maturity of one year has a significantly negative slope (starting at a high yield of 8.3% at a maturity of one half of a year and ending at 4.3% at a maturity of one year).

63. Between one and two years to maturity there is only one bond (Dexus Property Group) which has a yield of 6.3%. Naturally, with only one point between one and two years it is possible to draw a line that directly passes through this point (which clearly minimises the sum of squared differences). As it happens this requires a steep upward slope between one and two years. To fit the next two points (Origin and Tabcorp) between two and three years (which are very close together) a downward slope is required. To fit the next point (Wesfarmers is only one bond with maturity between three and four years) it is necessary to impose a significantly upward sloping line (which can obviously fit the single data point between three and four years).

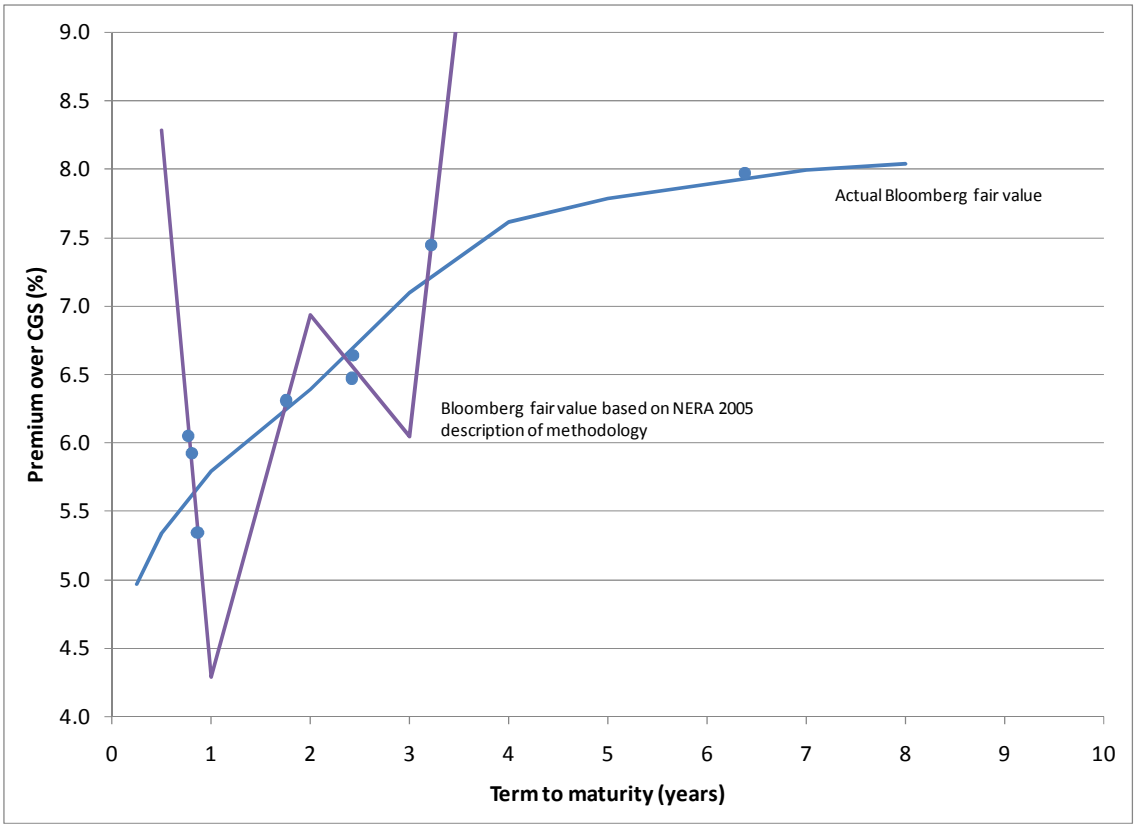
64. This is the unique set of straight lines between the Bloomberg predetermined maturities that best fits the underlying data points (ie, minimises the sum of squared

differences). The final data point (Santos at 6.38 years to maturity) could be fitted by an infinite number of straight lines. This point is the only data point with a maturity of more than 4.0 years. Given Bloomberg has predetermined maturity points at five and seven years one could draw any straight line between four and five years maturity and still be able to draw another straight line between five and seven years to exactly cross through the Santos observation.

65. As the above discussion demonstrates, application of the methodology described by NERA in 2005 results in an extremely unusual "fair value" curve – one that falls and rises dramatically at different maturity levels. This would not be the case if there were more bonds between each predetermined maturity level. The key point to note here is that when there are a limited number of bonds for which Bloomberg has prices the above methodology gives rise to shapes for the fair value curve that, despite fitting the data almost perfectly, are inconsistent with any theoretical prior beliefs about what the shape of BBB+ yield curve would be. I am unaware of any theoretical basis for expecting a yield curve to behave in the manner consistent with the application of the methodology described in the NERA report.

66. I assume that Bloomberg also finds the above outcomes undesirable as its fair value curves do not reflect the above shape. The difference between the actual Bloomberg fair value curve on 6 May 2009 and the above curve (derived according to the methodology described in the NERA 2005 report) is demonstrated in the below graph (the scale of this graph has been reduced to enable some further observations about the Bloomberg actual methodology on 6 May 2009)

Figure 4: Actual vs NERA Bloomberg BBB fair value on 6 May 2009



Source: Bloomberg, CEG analysis

67. Bloomberg can only achieve the more standard shape to its yield curve by imposing restrictions other than that the fair value curve simply be the best fit of the underlying data. In my view it is appropriate to impose restrictions that prevent the shape of the estimated fair value curve from being materially inconsistent with the properties predicted by both finance theory and/or empirical studies. This is especially true when there is a paucity of the underlying data. Clearly, the shape of the actual Bloomberg yield curve is a more credible description than the curve implied by a strict reading of the methodology reported by NERA of how yield to maturity changes with maturity for BBB rated bonds.

68. It is unclear what the further restrictions are that Bloomberg is imposing but a number of observations are possible:

- Bloomberg extends the curve beyond the points where it has data. In particular, the longest dated bond underlying the Bloomberg curve on 6 May 2009 was the Santos bond with 6.38 years to maturity. Yet Bloomberg reports fair value for both

seven and eight years maturity – despite not having any BBB bond data to support a view on how fair value should move beyond seven years;

- The same is true at the low maturity end. Bloomberg has no data points with maturity shorter than one half of a year but still reports a fair value at one quarter of a year maturity.

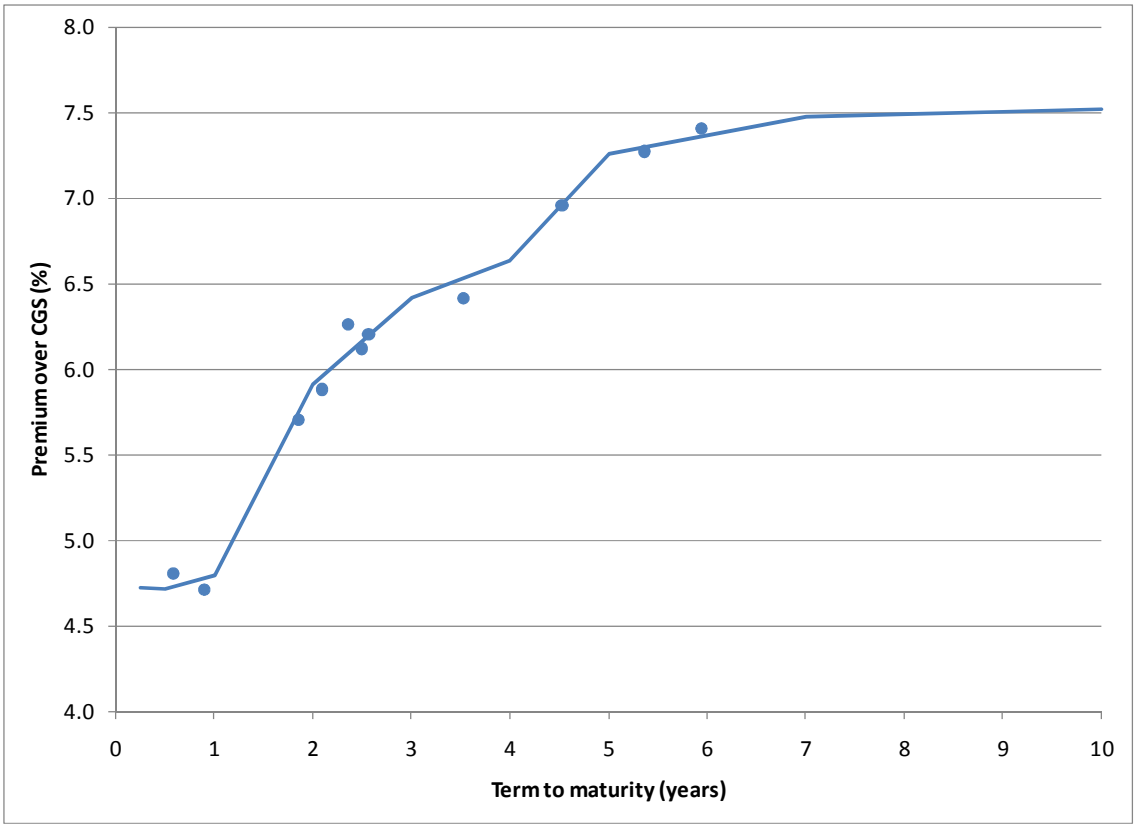
- Bloomberg uses its discretion to impose a nearly flat shape of the BBB fair value yield curve beyond seven years (as I shall discuss this is actually flatter than the CGS yield curve in that region – implying that credit risk falls with increases in maturity); and
- Bloomberg essentially fits the fair value curve at the long end to the single observation of the Santos data point (at 6.38 years to maturity).

69. The last dot point above is important as it suggests that, in the absence of other BBB+ bonds of similar maturity, Bloomberg's methodology is not sufficiently nuanced to enable it to distinguish between a 'typical' BBB+ fair value at that maturity and the Santos BBB+ bond yield.

70. Alternatively, it could be that Bloomberg has consciously decided that the Santos bond is 'typical' and it is only because of this conscious decision that it fits the fair value curve to this point. However, I do not find this a credible alternative explanation because Bloomberg's fair value curves always closely approximate any single observation used to build the curve. The only time Bloomberg's methodology does not do this is when there are multiple observations with similar maturity but different yields (ie, the only time that Bloomberg's fair value yields do not fit to the underlying data is when it is impossible to do so). It is clear that once a bond is included by Bloomberg in its sample to build the curve then it is treated 'as if' it is typical. It follows that a single observation will drive the shape of the curve unless there are other observations in the sample with a close maturity. Of course, this would not be problematic if there were a large number of bonds at all maturities. However, in the current circumstances it means that the estimated Santos bond yield entirely drives the Bloomberg BBB fair value estimate beyond 6 years.

71. It is also relevant to examine the Bloomberg estimation of the fair value for the A credit rating as this curve is also used by the AER to determine its estimate of BBB+ 10 year fair value. The following figure summarises the Bloomberg A rated fair value curve and the underlying data points Bloomberg reports that the curve is based on (ie, after removal of 'outliers').

Figure 5: Bloomberg A fair value on 6 May 2009



Source: Bloomberg

72. The same sort of observations can be made about the exercise of discretion in Bloomberg developing this curve. For example:

- Bloomberg extends the curve beyond the points where it has data. In particular, the longest dated bond underlying the Bloomberg curve on 6 May 2009 was a Telstra bond of 5.94 years to maturity. Yet Bloomberg reports fair value for both seven, eight, nine and ten years – despite not having any A rated bond data to support a view on how fair value should move beyond six years. The same is true at the low maturity end. Bloomberg has no data points with maturity shorter than one half of a year but still reports a fair value at one quarter of a year maturity.
- Bloomberg uses its discretion to impose a nearly flat shape of the A fair value yield curve beyond seven years.

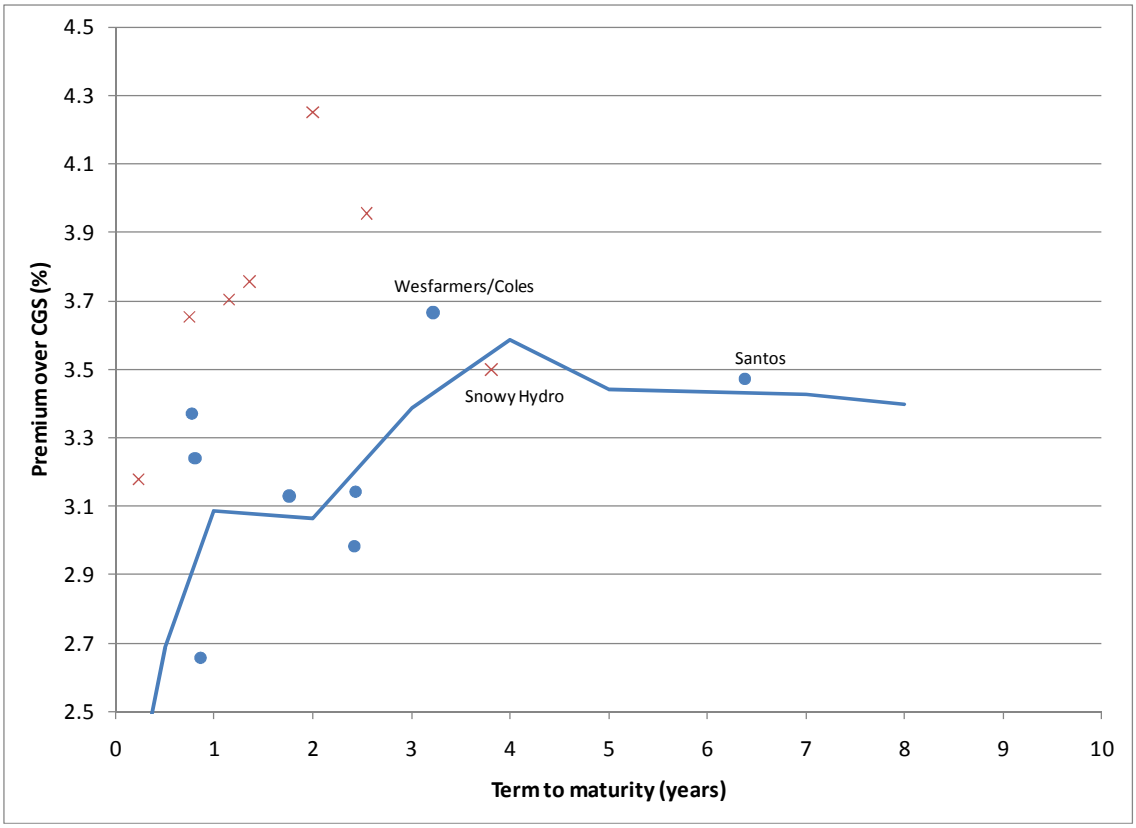
73. Bloomberg's current assumption of falling credit spreads is generally at odds with what one would expect both on a theoretical and historical empirical basis. When Bloomberg imposes a flat yield curve at long maturities it is actually imposing a flatter

yield curve than the underlying CGS yield curve. Consequently, Bloomberg is actually imposing an assumption that the spread to CGS falls as the maturity of a bond increases. As is discussed by Professor Grundy in attachment A to this report, this is generally at odds with what one would expect both on a theoretical and historical empirical basis:

> ***Conclusion on the term structure of debt margins based on an implementation of the extant theoretical finance literature****: While a downward sloping term structure of debt margins beyond 6 years cannot be ruled out in a setting with an alternate stochastic process for changes in firm value, an extended Merton (1974) model incorporating coupon payments and bankruptcy costs implies a flat or upward sloping term structure of debt margins when the model is evaluated at realistic values for the asset volatility and recovery rate parameters.*

74. The declining spread to CGS implicit in the Bloomberg long term fair value curves is illustrated in the below figures (which have the same coding for bonds used to build the fair value curve and bonds not used to build that curve).

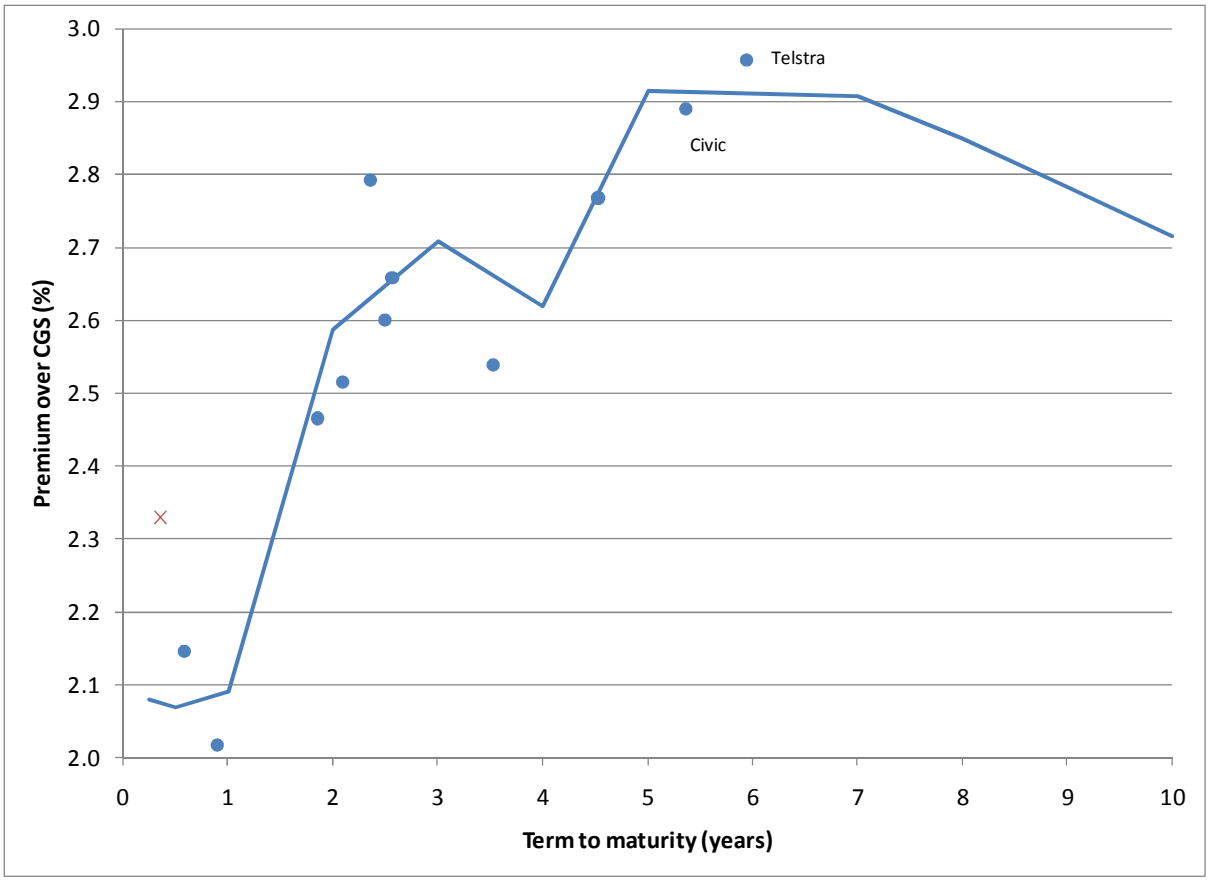
Figure 6: Bloomberg BBB fair value spread to CGS on 6 May 2009



Source: Bloomberg

75. As can be seen Bloomberg's fair value BBB curve is associated with a relatively steep increase in implied credit risk (spread to CGS) where Bloomberg has the most data (ie, zero to four years). However, beyond four years, Bloomberg imposes a reduction in credit spreads as maturity increases. This appears to be purely driven by an attempt to fit the fair value curve to the Santos observation at 6.38 years to maturity. However, even between 7 and 8 years where Bloomberg has no data it still imposes a declining spread to CGS as maturity increases.

Figure 7: Bloomberg A fair value spread to CGS on 6 May 2009



Source: Bloomberg

76. Once more, Bloomberg's fair value A curve is associated with a relatively steep increase in implied credit risk (spread to CGS) where Bloomberg has the most data (ie, zero to six years). However, beyond six years, Bloomberg imposes a reduction in credit spreads as maturity increases. This is most steep between 7 and 10 years despite Bloomberg having no data between 7 and 10 years.

Summary of conclusions

i) Bloomberg uses discretion and a proprietary approach in arriving at its pricing for individual bonds. The effect of the exercise of this discretion on its estimated pricing for individual bonds is unknown;

ii) Bloomberg appears to limit the construction of its fair value curves to rely solely on information contained in bond prices within that credit rating. This can be advantageous where that bond pricing data is plentiful. However, in the current market circumstances when bond pricing data is scarce it can be problematic.

iii) Bloomberg uses discretion in determining which of these bonds it will use to determine the fair value curves. The basis for this discretion in unknown. The effect of this discretion in the current environment appears to be to reduce estimated fair value curves.

iv) To the extent that this reflects a Bloomberg policy of estimating fair value curves for liquid corporate bonds then it is likely to make the Bloomberg fair value curves an inappropriate proxy for the benchmark rate in a market where most corporate bonds are illiquid.

v) Bloomberg uses discretion in the construction of the fair value curves (both within periods it has data and beyond the periods for which it has data). The effect of this discretion is to reduce the estimated fair value spread to CGS for long dated bonds. It is unclear what basis Bloomberg might have for assuming that this is appropriate.

3.2. AER method based on Bloomberg estimates

77. The AER's most recent methodology[26] is such that it estimates the yield to maturity for a 10 year BBB+ bond equal to:

AER 10 year BBB+ yield	=	Bloomberg 8 year BBB fair value	+	Bloomberg 10 year A fair value	-	Bloomberg 8 year A fair value

[26] See for example the 2009 NSW Electricity Distribution Final Decision.

78. Consequently, the accuracy of the AER methodology depends entirely on:

- The accuracy of the Bloomberg 8 year BBB fair value estimate as a proxy for the 8 year BBB+ benchmark rate;
- The accuracy of the Bloomberg A fair value curve between 8 and 10 years as a proxy for the shape of the benchmark BBB+ yield curve.

79. However, given the nature of Bloomberg's methodology this is equivalent to simply:

- adopting the Santos yield to maturity as the benchmark 6.38 years BBB+ yield to maturity;[27] and
- then applying a trivial increase in yield to maturity (of only 10bp or so) to arrive at an estimate of the benchmark 10 years BBB+ yield to maturity.[28]

80. The trivial increase in estimated yield from 6.38 to 10 years is a function of the Bloomberg assumption that the BBB and A fair value curves are flat in the region where Bloomberg has no data – and are flatter than the CGS yield curve. Consequently, the AER methodology arrives at an estimate of the debt risk premium that is less than the DRP on the Santos bond. This is illustrated in the below table.

Table 3: AER method compared to Santos bond on 6 May 2009

	Yield (%)	Spread to CGS (%)
Santos	7.97	3.47
AER BBB+ 10 year	8.07	3.26
Difference	0.10	-0.21

81. This is not a result that is peculiar to the 6 of May 2009. Bloomberg appears to consistently adopt the assumption that the yield curve is flat beyond the maturity for which it has data. Given that the Santos bond is the longest dated bond in its data base (for any credit rating) and provided that Bloomberg always fits its fair value curve to the Santos bond then it follows that the AER's method will always result in an estimate of 10 year BBB+ fair value that is only marginally above the Bloomberg estimate for the Santos bond. I note that from the 20th of March to the 20th of May the AER method always resulted in a BBB+ 10 year estimate of DRP that was less than

[27] See Figure 1 above and note, in the absence of any other BBB data points in that vicinity, that the Bloomberg BBB fair value curve at 6.38 years to maturity is driven by the Santos observation.

[28] See Figure 1 and Figure 2 and note that Bloomberg imposes the assumption of a flat yield curve beyond the points for which it has data in both the BBB and A fair value curves.

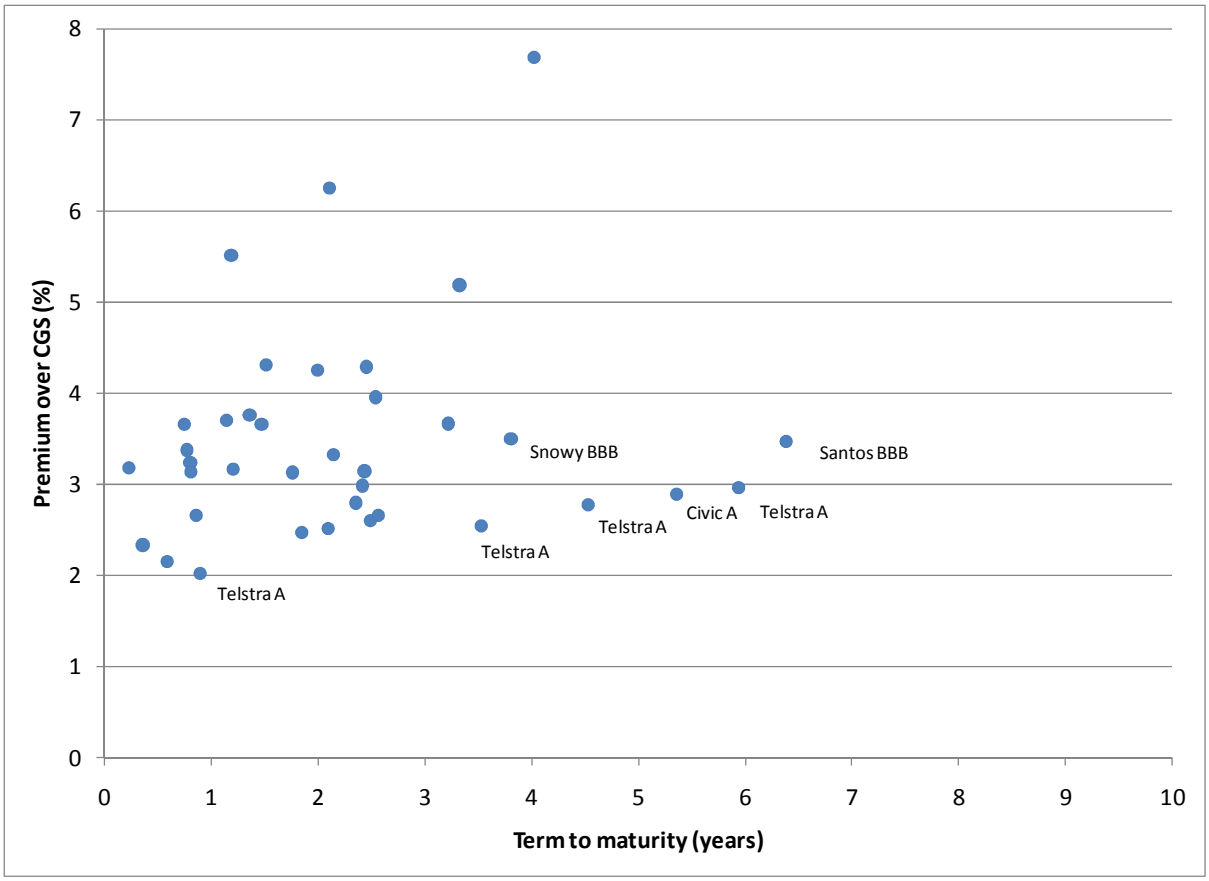
the Bloomberg estimate of spread to CGS for Santos and that this averaged at 0.22bp – suggesting the analysis of the 6 May was typical of other days during this period.

82. The AER's methodology effectively makes the following assumptions:

- that the Bloomberg estimate for the yield on the 6.38 year Santos bond is essentially the BBB+ benchmark rate at that 6.38 year maturity; and
- that Bloomberg is correct in imposing an assumption (with no apparent basis in the data) that the spread to CGS falls as maturity increases from 6.38 years to 10 years.

83. To illustrate why I regard these assumptions as problematic consider the following figure that reports the spread to CGS on all bonds in the Bloomberg data base that had a credit rating of BBB to A on 6 May 2009.

Figure 8: All Bloomberg yields for bonds rated BBB and A on 6 May 2009



84. Notably, the relatively low yielding bonds with longer maturities are all A rated and are mostly issued by Telstra. Also notably the credit spread curve for the Telstra bonds is steadily upward sloping at approximately the same rate. This provides a good indication that when one holds factors other than the credit rating constant one observes an upward sloping credit spread curve.

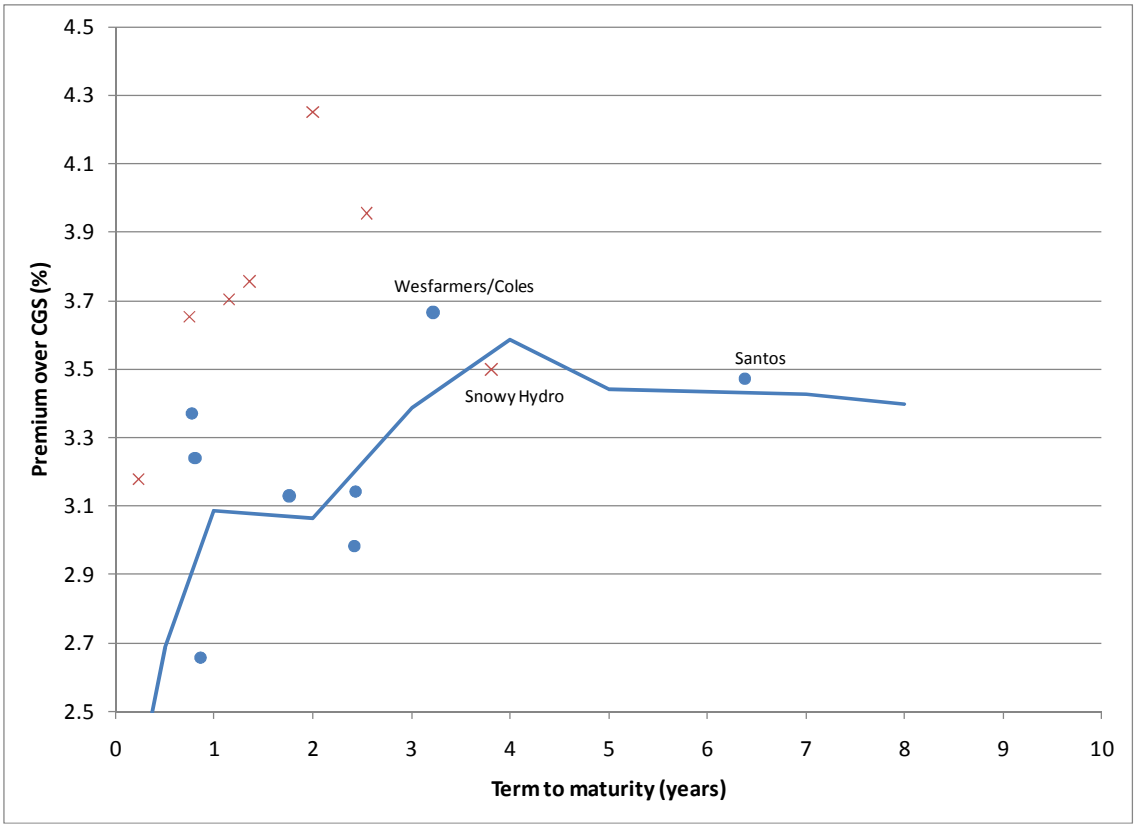
85. Given that the Santos bond is in the low end of the credit rating range BBB to A and given that it has the longest maturity of any bond then one would expect that it would have the highest spread to CGS. However, it has a relatively low spread to CGS being approximately the same as the mean spread to CGS in this sample (3.47% vs 3.48%)[29] and with 40% of observations having a higher estimated spread to CGS. This is despite the sample having on average a yield to maturity only 2.3 years, just

[29] The average for the same has been calculated excluding the GPT and Fairfax outliers and include only those bonds shown on the chart.

over a third of the maturity of the Santos bond, and an average credit rating above the Santos bond. Given that there are so many higher rated bonds with a shorter time to maturity but a higher spread to CGS this is reason to be concerned that the Santos bond is not a 'typical' BBB+ rated bond.

86. This is also consistent with the fact that the Bloomberg BBB+ fair value spread to CGS curve needs to behave in a discontinuous fashion in order to fit the Santos observation as is described in Figure 6 above and reproduced for convenience here.

Reproduction of Figure 6: Bloomberg BBB fair value spread to CGS on 6 May 2009



Source: Bloomberg

87. As can be seen, after rising steeply to fit the other BBB+ bond observations the Bloomberg fair value curve suddenly drops and then 'flat lines' in order to meet the lone Santos observation at 6.38 years to maturity. A more continuous shape to the credit term structure would lead to the fair value estimate passing above the Santos observation. The discontinuous shape to a credit term structure appears to be driven by a paucity of data at the long end and the lack of nuance in the Bloomberg methodology that would allow it to pass materially above the Santos observation

(despite it being the only observation in the region). That is, the Bloomberg methodology does not appear to allow for the shape of the term structure at lower maturities (where there is more data) to influence the shape of the term structure at longer maturities (where there is only one data point). The fact that fitting the Santos observation requires this sort of discontinuity in the fair value spread to CGS suggests that the Santos bond is in some important characteristics different to the bonds used to determine the earlier part of the curve.

88. In order to illustrate the idiosyncratic characteristics of individual bonds that can affect their required yield it is useful to quote from a Commonwealth Bank of Australia 11 May Credit Strategy research note summarising relevant considerations for debt investors in Santos (note that this is written in a perfunctory style typical of analyst summaries):

> *Policy not to hedge FX or commodity risks is hurting prospective oil earnings but the credit profile changed materially upon receipt of $USD2bn from Petronas for GLNG deal in July 2008. Has subsequently spent $300m on a share buyback but at 31 December cash stood at $1.5bn and net debt at $1.2bn. Nevertheless lower oil earnings add to the uncertainty about how Santos will fund its 60% share of the USD$7bn+ GLNG capex in the 2010-2014 period (FID in H1 CY10), albeit we think the project represents a strong incentive to retain IG ratings. Following abolition state based limits on individual shareholdings, takeover speculation has soared with interest driven in part by its substantial gas reserves and resources (management moving to commercialise by moving downstream into generation). Government sanctioned divestment of interest in Indonesian 'mud-flow' project in December has reduced contingent liabilities and therefore uncertainty for prospective bidders (albeit third party claims are still possible). The range of potential domestic acquirers might be limited by regulatory (competition) issues but the likes of Woodside (A-) and BHP (A+) offer rating upside. Interest from offshore parties is likely to be extensive and could include some of the group's existing JV partners but any bid from a foreign company may face approval resistance at the Federal Government level. With CY08 result management outlined a range of possibilities for the FUELS hybrid and indicated it might elect to implement a combination of redemption, conversion and allowing the coupon to step up. CY09 Production guidance of 53-56mboe implies 2P reserves of 1,013mboe represents ~18.6 years of supply. Production likely to remain flat until CY14, when LNG projects are due to come on line.*

89. It is relevant to note that with net debt at $1.2bn and an average market capitalisation in May 2009 of around $12bn Santos' gearing as a proportion of total assets is less than 10%. Other things equal this would ordinarily be associated with a higher than BBB+ credit rating. However, as noted, Santos has a large capex program of around

4.2bn upcoming and, if funded with debt, will tend to increase gearing into the future.[30] Of course, as is the case with any specific company, there are a range of other considerations that are relevant to debt holders in that company (such as the prospect of takeover by specific other entities and those entities credit ratings). In my view it is not reasonable to presume that the yield on the debt of any one BBB+ rated company, such as Santos, is equal to the benchmark rate.

Summary of conclusions

The AER's methodology, in combination with Bloomberg's methodology, has the effect of setting the 10 year BBB+ benchmark rate almost exactly equal to the Bloomberg estimate of the yield on the Santos 6.38 year bond. The effect of this is that the AER methodology adopts the yield on a single bond (the Santos bond) as the benchmark yield. Given an upward sloping yield curve for CGS between 6.38 and 10 years this has the effect of setting the debt risk premium at less than the Bloomberg estimate of the spread to CGS for the Santos bond. In my view this is inappropriate as there is no reason to presume the Santos bond yield is representative of a benchmark BBB+ bond yield and there is evidence to suggest it is not (given its very low gearing and its low yield relative to other BBB and A rated bonds).

3.3. CBASpectrum methodology

90. I have had access to the detailed credit rating equations used by CBASpectrum in the past. Professor Bruce Grundy and I have described those equations in our 2005 paper for NERA referenced earlier in relation to the Bloomberg methodology.[31] In that paper we were critical of certain aspects of those equations which we regarded as resulting in a downward bias to long term and low rated fair value estimates. Since then, I understand that CBASpectrum has amended its methodology to remove the bias. For example, the Essential Services Commission of Victoria[32] states:

> *Since the release of the NERA paper, CBASpectrum has reviewed its methodology. The new approach as applied is summarised in a Commonwealth Bank Credit Research note. The note emphasised the proprietary nature of the models used to estimate fair value curves, which it deemed to be superior to competitors:*

[30] Although, even if this was entirely debt funded and added nothing to the market capitalisation of Santos total gearing would only rise to around 30% of total assets.

[31] NERA, *Critique of available estimates of the credit spread of corporate bonds*, May 2005, page15.

[32] ESCV 2008-2012 Gas Access Arrangement Review, Draft Decision.

Unlike commercial data providers, our fair-value indices are not simply interpolated estimates from a given rating category. Instead, CBASpectrum's curves are derived from a system of credit rating equations. This methodology allows for more efficient estimates, especially given relatively sparse data on lower-rated corporate bonds.

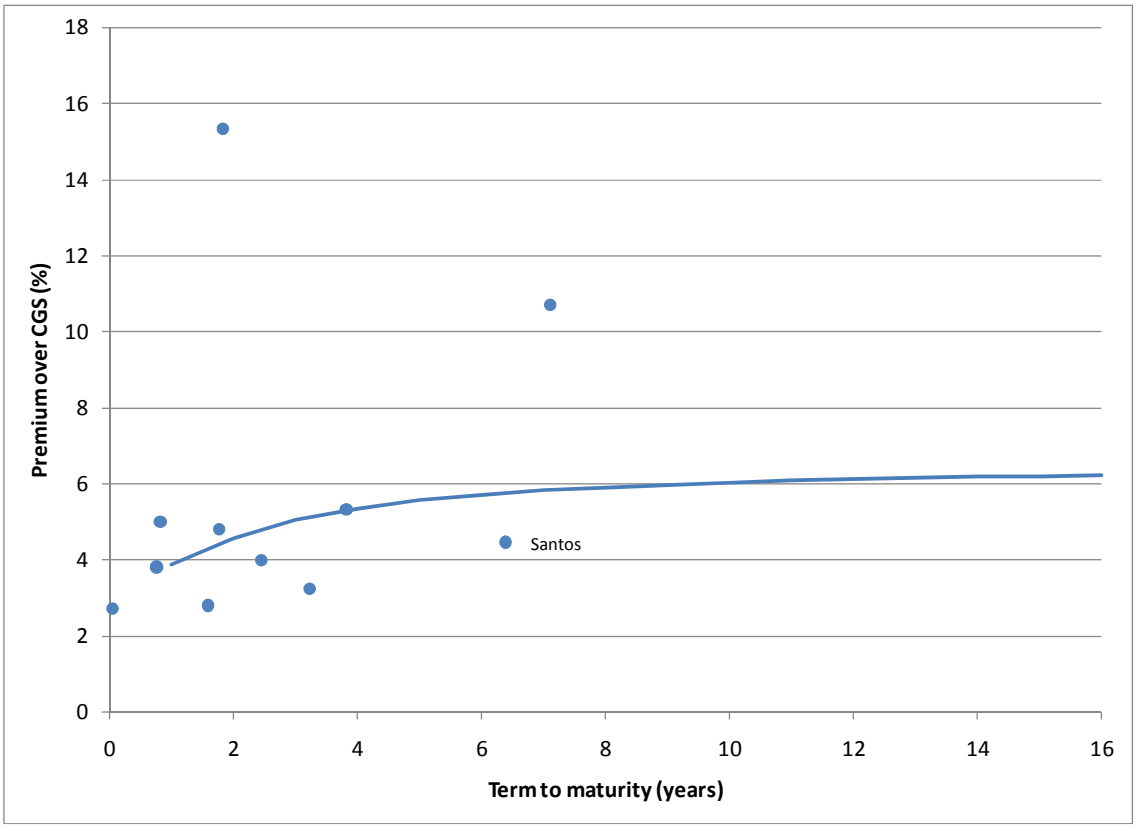
91. In its final decision the ESC adopted a debt premium that was equal to the CBASpectrum estimate.

92. Notwithstanding the changes to CBASpectrum's equations it is clear from my inspection of the fair value curves currently reported by CBASpectrum that it continues to impose a broadly similar functional form on the data as was the case in 2005. I note that the source of the bias identified in the NERA report was not the functional form but rather the optimisation process for fitting that functional form to the data.

93. Nonetheless, as noted in the NERA 2005 report, in a data rich environment a potential weakness of the CBASpectrum methodology may be that the pre-conceived functional form is not sufficiently flexible to represent the actual shape of the yield curve suggested by the data. On the other hand, this can be an advantage if these restrictions preserve characteristics of the fair value curve that are consistent with finance theory in the face of a paucity of available data.

94. Figure 9 below illustrates the curve for BBB+ bonds fitted by CBASpectrum relative to all of the BBB+ bonds in its data base on 6 May 2009.

Figure 9: Fair value BBB+ curves estimated by CBASpectrum on 6 May 2009



95. This figure demonstrates that, for BBB+ bonds in its database, CBASpectrum's BBB+ fair value curve provides a reasonable fit – underestimating the yield on some bonds and overestimating the yield on other bonds. It also demonstrates an important difference between the Bloomberg and CBASpectrum methodology is that the CBASpectrum methodology does not require its fair value estimate for BBB+ to cross through the Santos observation. That is, the CBASpectrum BBB+ fair value estimate passes above rather than through the Santos observation at 6.38 years to maturity.

96. It is worth noting that CBASpectrum's methodology arrives at this conclusion by simultaneously solving for the set of fair value curves that best fit all of the data used in its regressions – not just the BBB+ data. This means that the BBB+ curve will be informed by data for BBB+ bonds as well as data for bonds of other credit ratings. This is an attractive property of the methodology in the current circumstances where there is a relative paucity of data. For example, imagine a scenario where there were only one BBB+ bond and 10 A rated bonds. With only one BBB+ observation it is impossible to draw a curve for that credit rating having regard only to that observation. However, the 10 observations for the A rated bonds can be used to infer a shape for

both the A and BBB+ rated curve which does allow a curve to be drawn for the BBB+ rating.

97. The fact that CBASpectrum determines that the Santos bond is not typical of a BBB+ bond is consistent with the discussion at paragraph 84 and 85 above which similarly concluded that there was evidence to suggest that the Santos bond did not have a yield that is typical of a BBB+ bond with its maturity.

98. In 2008, the Essential Services Commission of Victoria concluded that it would be inappropriate to place a high weight on the Santos bond yield estimate for the same reasons identified in this report, namely, that one can not presume that its yield is representative of the typical BBB+ bond (although interestingly at the time the Santos bond yield was higher than the CBASpectrum fair value yield).

> *While Santos has the longest term to maturity of any bond in the sample, the fact that it is only one estimated value with no effective comparison (i.e. no equivalent bond of similar maturity to compare with), and as the methodology applied by Envestra to derive the ten year maturity adjustment is unknown, there are no grounds for weighting the Santos estimate to the extent advocated. Furthermore, the Santos corporate bond may be a special case in terms of its high yield with respect to its tenor, due to Santos facing greater cash flow volatility when compared to other BBB+ rated bonds.*[33]

99. I agree with the sentiments of ESCV that just because the only BBB+ bond with a long maturity has a particular yield does not mean that one can assume that the bond is representative of the typical or benchmark BBB+ bond with that yield. At the time the Santos bond had a relatively high yield and the ESCV rejected giving it undue weight. Currently the Santos bond has a relatively low yield and the same logic applies. The logic applies more so in the current context as there is evidence that the Santos bond currently *is* a special case (not just that it *may* be a special case as was posited by the ESCV).

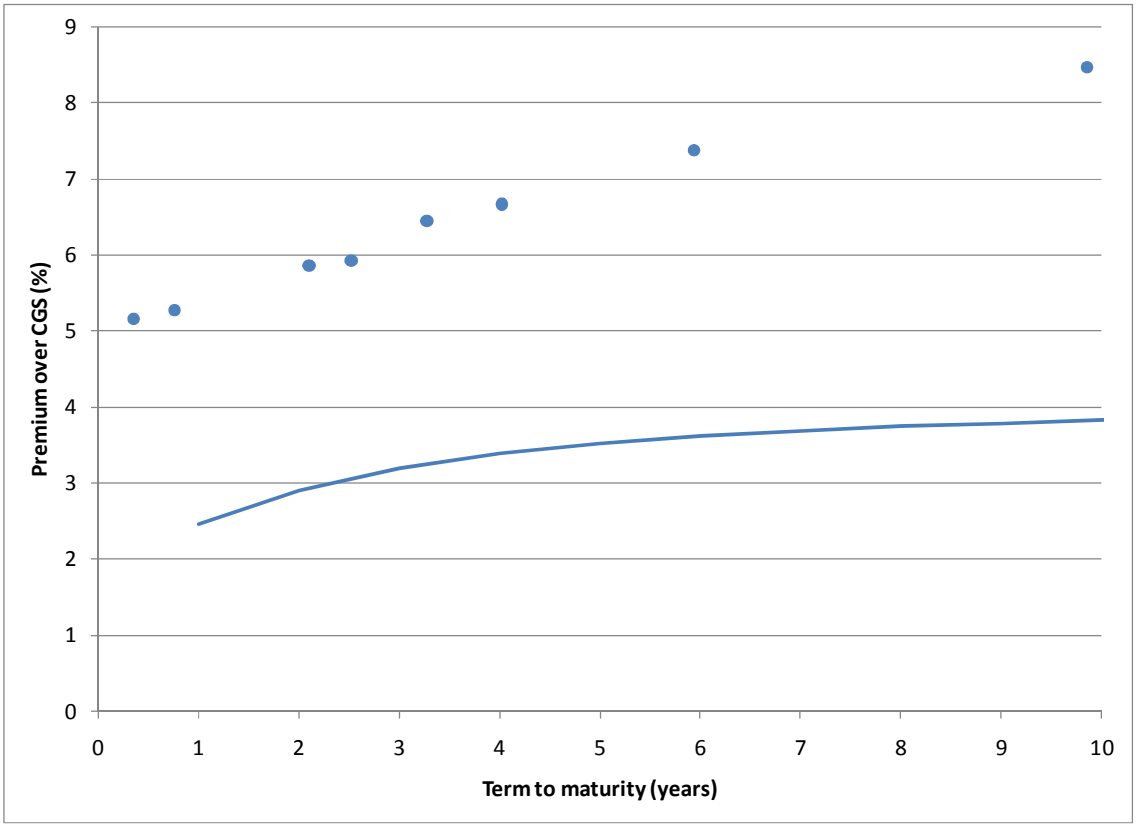
100. The imposition of the upward sloped credit spread term premia also suggests that CBASpectrum has formed a judgment that finance theory and/or past empirical studies justify such a shape – a view that is consistent with the views expressed by Professor Grundy in the attachment to this paper and is also consistent with the observation of the Telstra credit spread term premia discussed above.

101. Similarly, as demonstrated in Figure 10 below, the CBASpectrum fair value estimate for AA+ lies wholly below the observations for AA+ bonds in its database. That is, CBASpectrum uses information from other bond yields to conclude the typical AA+

[33] Page 487 of the 2008 ESCV 2008-2012 Gas Access Arrangement Review, Final Decision.

bond would trade at a lower yield than the estimated yield on a small sample of AA+ bonds in its database (which all happen to be associated with a single issuer being GEC).

Figure 10: Fair value AA+ curves estimated by CBASpectrum on 6 May 2009



102. I do not have an in-depth understanding of the current proprietary methodology that CBASpectrum uses to estimate its fair value curves (just as I do not have an in depth knowledge of Bloomberg's proprietary method). However, it is possible to conclude on the basis of its estimates and the data underling them that CBASpectrum also applies judgement in using and interpreting the data available to it. In particular, I can clearly see that CBASpectrum:

a. Does not allow the very highest yielding bonds to drive its fair value estimates for any given credit rating (as per Figure 10 above);

b. predetermines a functional form that the fair value curves must fit, and this functional form:

   i. assumes increasing and diverging yield curves that asymptotically become parallel; and

ii. assumes that fair value spreads to CGS are increasing with maturity.

c. uses bond information from all credit ratings to determine the level and relativities of the various fair value yield curves; and

d. extends forward its fair value estimate out beyond the longest dated bonds in its database.

103. Items b and c together from the above imply that CBASpectrum's fair value estimates for any particular credit rating may not necessarily closely track the data available from bonds at that credit rating, because the shape and level of the yield curve also relies on yields on bonds at other credit ratings. In the case of the AA+ bonds described above CBASpectrum's estimation technique clearly identifies these bonds as 'outliers' and sets its AA+ fair value estimate at materially less than this.

104. An important potential advantage of this methodology is that it can allow CBASpectrum to use more of the information available to it in order to fit fair value curves over all credit ratings. The accompanying limitation is that, while the method is powerful in its application and allows CBASpectrum to estimate yield curves for each credit rating between BBB and AAA, it depends on the appropriateness of its assumed functional forms for its yield curves.

105. I note at 102.d above that CBASpectrum must be exercising some degree of discretion in estimating fair value curves out to 16 years maturity, whereas the data that it relies upon contain bonds of maturity no greater than 10 years. CBASpectrum is either constructing the shape of the yield curve at this point based on exogenous assumptions or it is assuming that it can extend forward the curves it has estimated between 1 and 10 years.

106. I also note that on some dates there are significant changes in CBASpectrum estimates of fair value yields that are transient in that they are immediately reversed - with fair value yields falling/rising back to the levels previously estimated within one or two days. The fact that CBASpectrum reverses these changes suggests that they should be regarded as aberrant. I do not know what causes these aberrant estimates. I recommend that, should they occur in a particular measurement period, then they should be excluded from any estimate of the average CBASpectrum estimate of fair value over that period.

107. Whether published by CBASpectrum or Bloomberg, a reasonable practical filter would be to define an observation as aberrant if that observation is more than 5% different from the average of both the preceding and following five days of non-aberrant observations.[34] Applying this rule would have excluded eight CBASpectrum

[34] Implementation of this filter requires that the observations in the ten surrounding days (the days used to test whether the observation in question is aberrant) are an appropriate benchmark from which to test for aberrance. This requires that any potentially aberrant days are excluded from the average of the five preceding/following days – otherwise 'false positives'

observations over the period 1 January 2008 to 22 June 2009.[35] However, four of those days occurred in a 19 day period from 20 May 2009 and 15 June 2009.

Summary of conclusions

i) CBASpectrum uses discretion and a proprietary approach in arriving at its pricing for individual bonds. The effect of the exercise of this discretion on its estimated pricing for individual bonds is unknown;

ii) CBASpectrum appears to use information from all of its bond pricing data to determine shapes and levels for all of its fair value curves. This may be a significant advantage of the CBASpectrum methodology in the current circumstances with limited bond pricing data.

iii) CBASpectrum uses discretion and a proprietary approach in determining fair value curves from its individual bond data. In doing so it exercises its discretion.

iv) CBASpectrum uses discretion in the construction of the fair value curves beyond the periods for which it has material data available. The effect of this discretion is to impose a slight increase in spreads to CGS for longer dated bonds. This assumption has support in the theoretical/empirical finance literature.

3.4. Comparison

108. It is important to note at the outset that in 'normal' market conditions the differences between CBASpectrum fair value estimates and AER fair value estimates (based on Bloomberg fair value estimates) have been relatively small. It is only since the advent of the global financial crisis and, in particular, the collapse of Lehman Brothers in September 2008 that the differences have become large.

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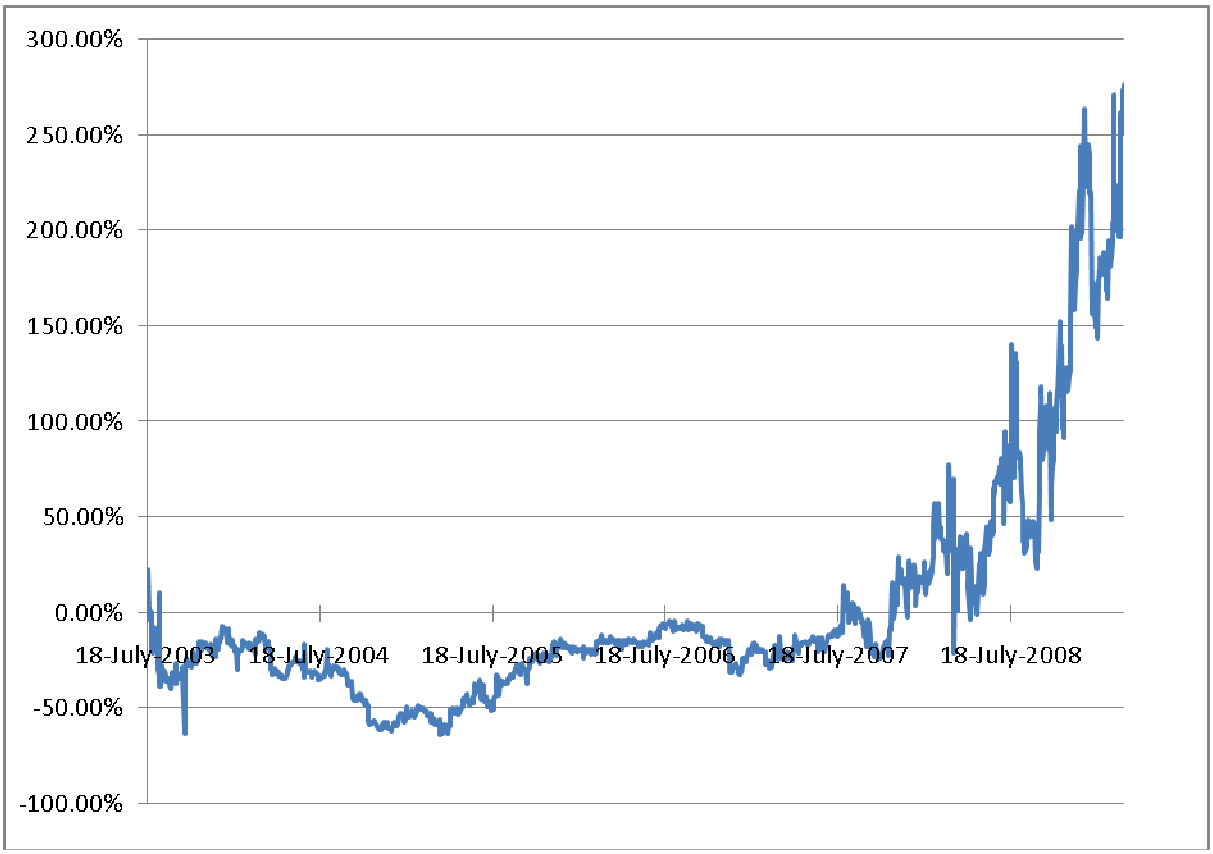
will result with some observations being found to be aberrant only because the benchmark period is distorted by the existence of an aberrant observation. One way to remedy this problem is by identifying any potentially aberrant observations, including false positives, on the first pass of the test (ie, where no data is excluded). The test can then be rerun excluding all of these observations from the calculation of the five day average benchmarks. For example, when I do this I find the dates between the 9th and 12th of June 2009 to be false positives in that the first pass of the test causes them to be more than 5% lower than the average of both the preceding five days and the following five days. However, this is only because they are sandwiched between truly aberrant days (5th and 8th of June and 15th of June 2009). On the second pass of the test the dates between the 8th and 15th of June are found not to be aberrant while the 5th, 8th and 15th of June are confirmed as aberrant.

[35] 17 July 2008, 19 September 2008, 9 October 2008, 19 February 2009, 20 May 2009, 5 8 and 15 June 2009.

Figure 11: Absolute difference between CBASpectrum BBB+ yield and AER/Bloomberg BBB yield for 10 year maturity



Source: CBASpectrum, Bloomberg, CEG analysis. Note that CBASpectrum data for the 19 September (the week of the Lehman Brothers collapse, Merrill Lynch and AIG bailout) spiked to 16.56%. Similarly, data for 17 July 2008 also shows a 1.6% fall followed by a 2.2% rise the next day. Data for both dates (17 July and 19 September 2008) has been excluded from the above figures.

109. Consistent with the above graph I note that the level of disagreement between the two methods is clearly somehow related to the advent of the global financial crisis.

110. Both CBASpectrum and Bloomberg:

- rely on proprietary methods and information; and
- engage in non-transparent exercises of discretion and judgement when developing their fair value curves.

111. Bloomberg's methodology appears set the Bloomberg fair value curve for each credit rating based solely on bonds with that credit rating (albeit with Bloomberg excluding a large number of these bonds from its analysis for reasons that are not transparent).

By contrast, CBASpectrum uses data from all credit ratings and an assumed relationship between each of its fair value curves to simultaneously determine the shape and level of all of its fair value curves. This is an advantage of CBASpectrum's fair value estimate in the current market circumstances with limited bond pricing due to illiquidity and few new issues into the Australian corporate bond market in recent years.

112. The effect of Bloomberg's exclusion of some bonds from its analysis has the effect of lowering its estimate of fair values for BBB and for A credit ratings and to lower the slope of the fair value yield curve. It is difficult to establish the reasonableness Bloomberg's exercise of discretion as the basis for it is not transparent. However, to the extent that it reflects a desire by Bloomberg for its fair value curves to reflect fair value for liquid corporate bonds only[36] then Bloomberg fair value curves are, in my view, an inappropriate proxy for the benchmark rate in the current corporate bond market which is characterised by illiquidity.

113. The AER's methodology is likely to give rise to a biased estimate because it relies very heavily on the estimated Santos bond yield and that yield does not appear to be typical of BBB+ bonds. Neither CBASpectrum nor Bloomberg services contain data relating to bonds with 10 years to maturity and a BBB+ credit rating. Bloomberg attempts to bridge this impasse by assuming that a bond with a 10-year maturity will require approximately the same or lower premium that the longest dated BBB+ bond in its database, Santos. CBASpectrum moderates the shape and level of its BBB+ yield curve by reference to bond yields at other credit levels. Both of these approaches rely on the exercise of discretion in the face of a lack of data.

114. In this respect, Bloomberg's methodology, and by extension, the AER's methodology, currently relies almost exclusively on the observed yield of the Santos bond of 6.3 years maturity. In my view there is evidence that this bond is unrepresentative of long dated BBB+ bonds in general and, consequently, the AER's methodology will give rise to a biased estimate of the benchmark rate. Similarly, to the extent that Bloomberg's assumption that corporate bond spreads to CGS fall with maturity is incorrect then the AER's methodology will give rise to a biased estimate of the benchmark rate. Consistent with the advice of Professor Grundy at Attachment A, I consider that this may currently be the case.

115. Against this I note that CBASpectrum occasionally publishes aberrant estimates of fair value which CBASpectrum reverses almost immediately. I do not understand why this is the case but note that provided they are removed the existence of such aberrant estimates is not a basis for rejecting the reliance on CBASpectrum fair value estimates.

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[36] As might be suggested by page 9 of a presentation by Michael Lee to the International Bond Market Conference 2007, Taipei. Available at http://taipeibond.gretai.org.tw/cv/Bloomberg%20Mr.%20Lee(panel%203-1).ppt.

116. In summary, the two data services use proprietary information and their own discretion to develop their fair value curves. Without having regard to any other evidence, it is not possible to definitively conclude that one data service is superior to the other. Both data services bring expert judgment to bear and it is difficult to second guess the accuracy of these judgements in the absence of transparency in relation to where discretion has been used and what facts and objectives have guided the exercise of that discretion.

117. Nonetheless, there are reasons to consider that the AER's methodology for deriving a 10 year BBB estimate (from Bloomberg 8 year BBB, 10 year A and 8 year A fair value estimates) may be problematic in the current market conditions. This is because:

- Bloomberg's methodology works best where there are multiple bonds with similar maturity profiles within a given credit rating. This is not currently the case for BBB bonds in Australia with Bloomberg having only one pricing observation beyond 4 years (the Santos bond). By contrast, CBASpectrum's methodology uses information from all credit rating categories to simultaneously determine all credit rating fair value curves. This has the potential advantage of not relying solely on pricing for the limited set of BBB rated bonds to determine BBB rated fair value curves. (In periods with richer data sets it has the potential disadvantage of imposing a structure on term premia for a given credit rating that is inconsistent with the term structure implied by the bonds in that credit rating.)
- A reflection of the above point is that Bloomberg's fair value estimate of BBB at 8 years is unduly influenced by a single observation (being the Santos 6.38 year bond yield);
  - The above two dot points are reasons why CBASpectrum methodology may be preferred to AER/Bloomberg in meeting criterion ii listed at paragraph 39 above.
- Bloomberg's projection of fair value curves beyond the maturities for which it has data does not appear consistent with the shape of the fair value curves in earlier maturities where it does have data. In the absence of supporting data it is problematic to impose a falling spread to CGS as maturity increases. CBASpectrum's assumption of a flat to slightly increasing term structure for credit spreads appears more consistent with standard predictions from the finance literature.
  - The above dot point is a reason why CBASpectrum methodology may be preferred to AER/Bloomberg in meeting criteria ii and iii listed at paragraph 39 above.
- Bloomberg's exclusion of relatively high yielding BBB and A rated bonds from its curve construction may represent a desire by Bloomberg for its fair value curves to reflect the fair value for liquid corporate bonds - as opposed to fair value for the typical bond which in the current corporate bond market is not a liquid bond.

- The above dot points is a reason why CBASpectrum methodology may be preferred to AER/Bloomberg in meeting criterion i listed at paragraph 39 above (given that illiquidity is currently typical on bonds in the Australian corporate bond market).

118. Based on the analysis of this section it is my view that CBASpectrum estimates of BBB+ 10 year fair value are to be preferred to the AER's estimates of BBB+ 10 year fair value (based on Bloomberg BBB and A fair value curves). However, this is not a strong enough preference to suggest that zero weight should be given to the AER's methodology. However, I do conclude that the Bloomberg's estimates should not be given more weight than CBASpectrum's estimates.

119. While CBASpectrum's fair value methodology and estimates have properties that tend to make it relatively more desirable, the entirety of the difference between CBASpectrum and AER methods cannot necessarily be attributed to these desirable properties of the CBASpectrum method/outputs. It is possible that most of the difference reflects differences in expert judgement that is simply not possible to comment on given the nature of the proprietary methods used by each.

120. It cannot be ruled out that, were it possible to have regard to the proprietary methods and information, I would reverse the preference for CBASpectrum. For this reason it is important to have regard to other information external to the two data services. I do this in the next section.

4. Other considerations

121. This section has regard to other sources of information that provide further insight into the relative merits of CBASpectrum and AER/Bloomberg fair value estimates – and potentially alternative ways of arriving at an estimate of the benchmark rate.

4.1. Response to the global financial crisis

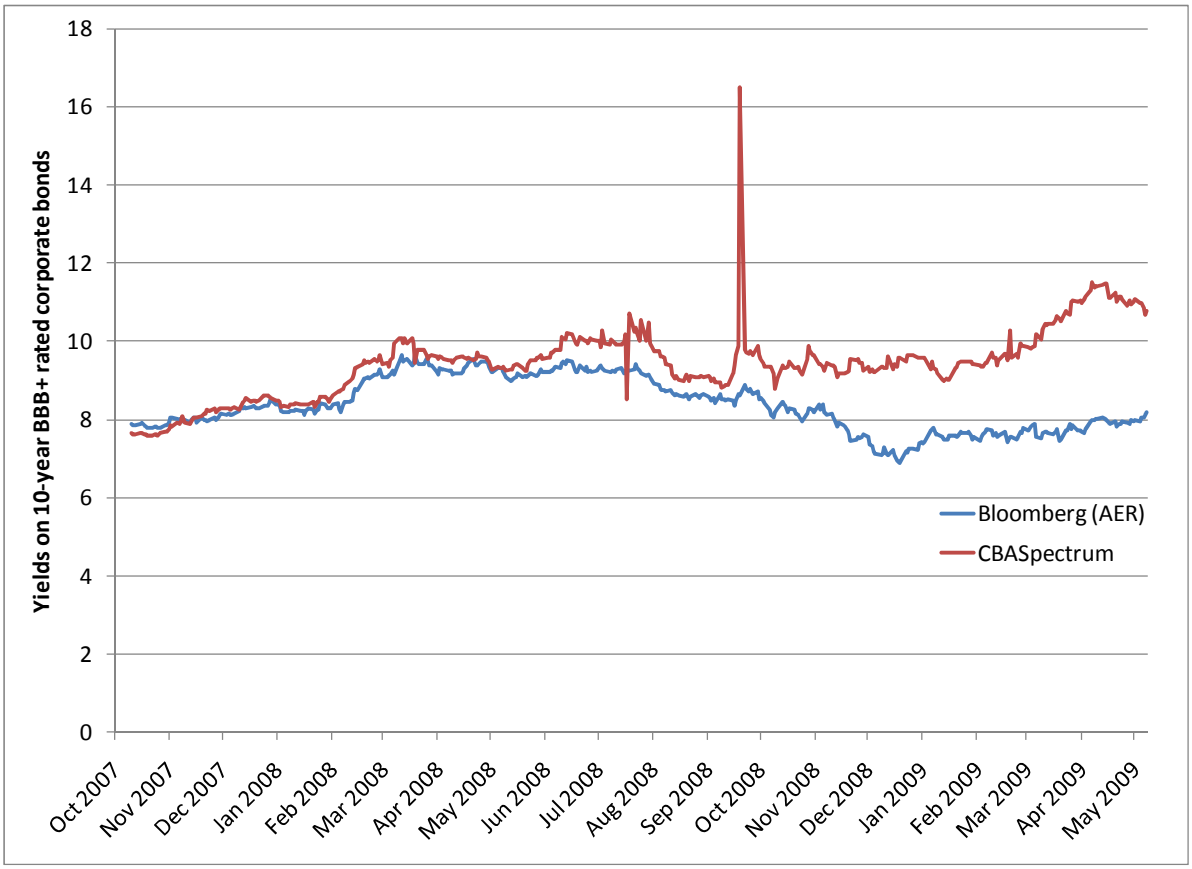
122. A relevant test of the appropriateness of the fair value estimates produced by Bloomberg and CBASpectrum is to compare the effect that the global financial crisis has had on these estimates. As discussed previously, it is widely agreed by market participants and commentators that the financial crisis has caused the yields and the premia on corporate bonds to increase. For example, the RBA noted in its November Statement of Monetary Policy that:

> *The deterioration of credit market conditions and the failure of several large financial institutions saw corporate debt yields increase significantly through September and October as default risk concerns escalated. Spreads on corporate debt surpassed their mid-March highs and 2000 peaks…*[37]

123. One would therefore expect fair value BBB+ bond yields to increase over the period September and October 2008. The following two figures allow one to compare the movements in both estimates of 10 year BBB+ fair value yields and the associated spreads to CGS yields.

[37] RBA, Statement on Monetary Policy, November 2008, page13

Figure 12: Estimated yields on 10-year BBB+ corporate bonds

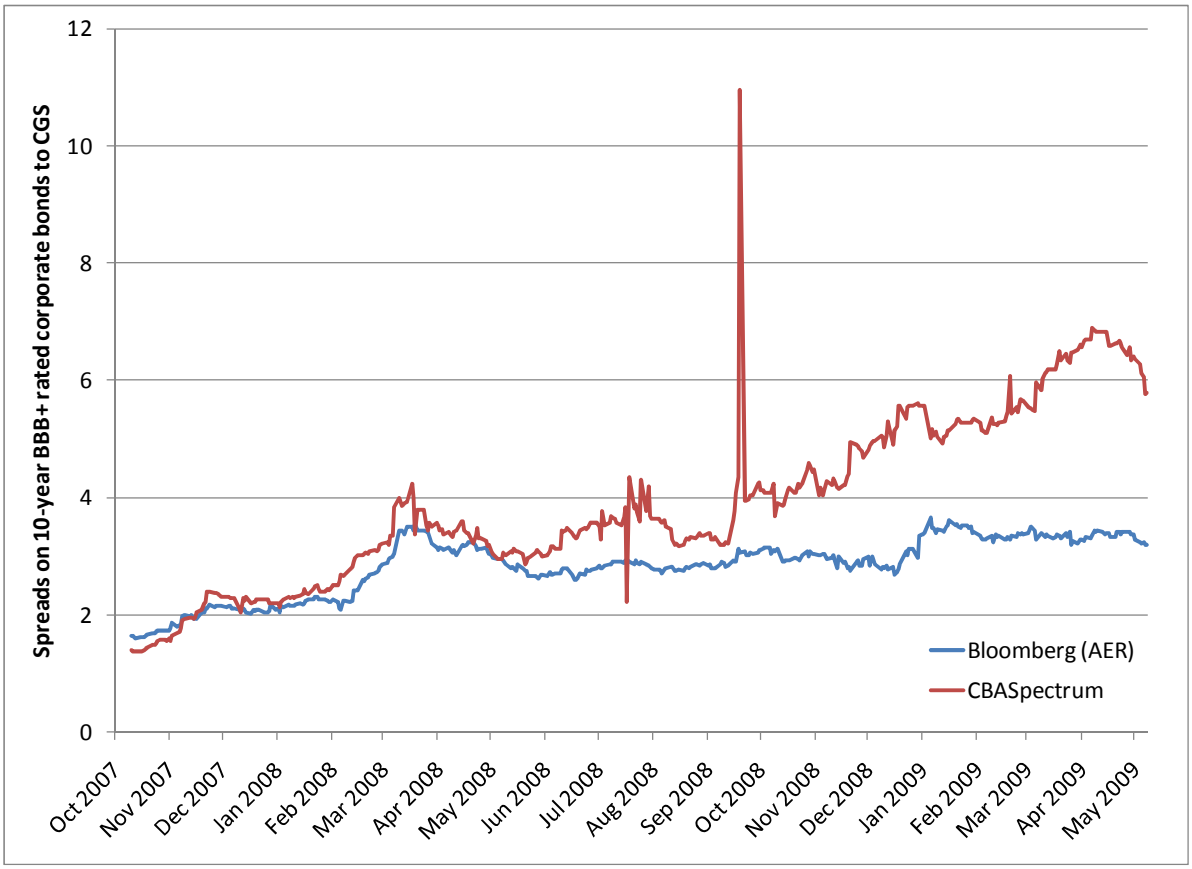


Source: Bloomberg, CBASpectrum

124. Figure 12 shows that yields on 10-year BBB+ corporate debt, as measured by the Bloomberg/AER methodology, gradually declined from a peak in March 2008 to the their lowest levels in December 2008, and have since increased slightly. On the other hand, CBASpectrum estimated that, on average, yields were approximately constant between March and December and have increased since then.

125. Figure 13 below shows a recent history of the debt premia over CGS estimated by Bloomberg and CBASpectrum for 10-year BBB+ bonds.

Figure 13: Estimated spreads to CGS on 10-year BBB+ corporate bonds



Source: Bloomberg, CBASpectrum

126. This figure shows that debt premia as estimated by Bloomberg did not change, or even decreased slightly, over the period between March and December 2008 and have since experienced a slight increase. There appears to be no significant reaction to the events of September and October 2008. On the other hand, the premia estimated by CBASpectrum have increased strongly since September 2008, with this trend only recently reversing.

127. On the basis of Figure 12 and Figure 13 above, I consider it reasonable to conclude that CBASpectrum's fair value estimates better reflect the understanding of market participants about the effects of the financial crisis on the cost of debt. Specifically, although CBASpectrum shows yields to be approximately constant following September 2008, this represents an increase in the debt premium, given the contemporaneous decline in yields on CGS. Bloomberg's estimates show yields on 10-year BBB+ debt to be falling since the escalation of the crisis in September 2008, with the result that debt premia have been largely unchanged over this period.

128. This appears to be an example where the movement in (as opposed to level of) CBASpectrum fair value estimates was more consistent with reflecting current market conditions as per criteria iv at paragraph 39.

4.2. Consistency with actual recent BBB+ debt issued by Tabcorp

129. Tabcorp announced the issue of a 5 year BBB+ rated bond on 24 March 2009. The Tabcorp bond issue is significant because it is the first issue of an Australian non-financial corporate bond in more than a year.[38] It is also highly relevant because it is a 5 year Standard and Poor's BBB+ rated bond.

130. While the Tabcorp bond issue is a 5 year issue and not a 10 year issue, based on the then upward sloping yield curve the yield on the Tabcorp bond is reasonably interpreted as a lower bound estimate of the yield Tabcorp would have to offer on a 10 year BBB+ issue. The current Tabcorp bond issue therefore provides important current information on the yield demanded by investors at the initial issue of BBB+ debt in the current environment.

131. Tabcorp is a BBB+ rated entity and is issuing debt which Standard and Poors has confirmed will also be rated at BBB+.[39] This bond will have a five year maturity.[40] It will pay a floating interest rate which is reset every three months to be equal to the then prevailing 3 month bank rate plus a margin of 400bp to 450bp.[41] On 1 April 2009 Tabcorp announced the results of a bookbuild process that set the margin in the middle of this range at 425bp.[42] Tabcorp will also pay a 'bonus' interest payment of 0.25% for the first year to some retail investors.[43] The issue size is expected to be around $200m.[44]

4.2.1. Interest costs on the Tabcorp BBB+ debt issue

132. The Tabcorp offer is a floating rate offer referenced to the 3 month BBSW rate. This means that in order to estimate the full yield of the Tabcorp issue one must add the five year swap rate.

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38 http://www.reuters.com/article/rbssConsumerGoodsAndRetailNews/idUSSYU00622420090320.

39 See ASX announcement at http://www.asx.com.au/asxpdf/20090325/pdf/31grrc2xd1nf59.pdf.

40 See page 6 of the Prospectus for the issue of Tabcorp bonds at http://www.asx.com.au/asxpdf/20090324/pdf/31gqwq62d8gqvs.pdf.

41 See section 1.15 of the Prospectus for the issue of Tabcorp bonds.

42 See http://www.asx.com.au/asxpdf/20090401/pdf/31gvxc5xsd8t2c.pdf.

43 See page 6 of the Prospectus for the issue of Tabcorp bonds.

44 See ASX announcement http://www.asx.com.au/asxpdf/20090330/pdf/31gtthwsynzsry.pdf.

133. The actual process that Tabcorp would follow (and may well have followed) to achieve this fixed rate would be to hedge its floating rate liability associated with the bond by entering into a contract with a third party to pay that third party a fixed yield over 5 years in exchange for the third party paying Tabcorp a floating liability based on the 3 month bank bill rate. This is termed a 'fixed for floating swap'. In effect, Tabcorp would promise to pay a fixed coupon to the third party over five years and the third party would promise to pay Tabcorp the bank bill rate over those five years.

134. By entering into this transaction Tabcorp would be able to use the bank bill payments from its swap agreement to pay the bank bill related costs on its floating rate bond. This would leave Tabcorp with a net liability equal the fixed component of its swap agreement plus the fixed margin above the bank bill rate on its floating rate bond. That is, the net position would be identical to having issued a fixed coupon bond.

135. Such transactions are commonplace in financial markets and it is quite possible that this is precisely what Tabcorp did. Of course, Tabcorp does not have to enter into a 5 year swap. It can leave itself exposed to variations in the bank bill rate over the five years. However, the market price of bearing this risk itself is given by the 5 year swap rate.

136. There are two sensible dates on which to measure the swap rate for this purpose. The first is 24 March 2009 (the day of the announcement of the offer) which is the day Tabcorp committed to issue the debt at a specified margin (between 400bp and 450bp) above the swap rate. The 5 year swap rate was 4.34% on that day. The second is 1 April 2009 being the date that the margin was established in the middle of this range. The swap rate was 4.36% on that day.

137. The table below provides the relevant calculations to come to a five year estimate of the cost of debt. It also compares this with the Bloomberg and CBASpectrum estimates of the cost of debt for a 5 year BBB+ bond.

Table 4: Cost of debt based on 432bp margin above the swap rate

Date	24 March 2009	1 April 2009
Swap rate	4.34%	4.36%
Tabcorp 5 year issue (swap rate plus 4.25%)	**8.59%**	**8.61%**
5 year BBB+ fair value estimated		
Bloomberg	7.47%	7.48%
CBASpectrum	9.65%	9.94%

*Source: CBASpectrum, Bloomberg and CEG analysis. Note the figures in this table are not annualised and so differ slightly from the estimates used in the AMI submission by Victorian electricity distributors.

138. This table states that Tabcorp is issuing at a 5 year equivalent fixed annualised yield in excess of 8.59% (I say in excess because Tabcorp will also have to pay bonus interest on some proportion of its offer). The immediate next observation from this table is that Tabcorp is issuing at a yield that is very close to the middle of Bloomberg and CBASpectrum estimates for fair value at a BBB+ rating. On this basis the Tabcorp issue would tend to support the use of an average of CBASpectrum and Blooomberg fair value estimates at 5 year maturity.

139. However, this logic presumes that Tabcorp is regarded by both data services as having the average risk for a BBB+ issuer. In reality both data services treat Tabcorp as being lower risk than average for a BBB+ bond. Tabcorp has another bond on issue with a 2.5 year to maturity covered by both Bloomberg and CBASpectrum.[45] On the 24th of March 2009 CBASpectrum estimated that this bond's fair value was 1.47% less than the average fair value for a BBB+ bond.[46] On the same day, Bloomberg estimated its fair value to be 0.20% lower than the average. (On 1 April CBASpectrum/Bloomberg estimated this bond to have a fair value yield that was 0.85%/0.05% lower than the average).

140. When this fact is taken into account it follows that consistency of estimates would predict that both data services' 5 year fair value BBB+ estimates would overestimate the yield on the Tabcorp 5 year bond (just as they overestimate the yield on the 2.5 year Tabcorp bond). This makes the fact that Bloomberg underestimates the 5 year Tabcorp bond yield more surprising. It also suggests that CBASpectrum's 5 year BBB+ fair value estimate may be more reliable than Bloomberg's 5 year BBB fair value estimate (to the extent that one accepts that both Bloomberg and CBASpectrum's classification of Tabcorp's 2.5 year bond as lower than average risk implies that Tabcorp's 5 year bond should also be regarded as having lower than average risk).

[45] There is only one Tabcorp bond covered by Bloomberg and CBASpectrum and this bond matures in 2.53 years time (on 13 October 2011). This maturity is associated with a 2.53 year time to maturity from 1 April 2009.

[46] This involves a comparison of the fair value estimate for the 2.53 years to maturity Tabcorp bond with the interpolation between 2 and 3 year fair value maturity for BBB+.

141. It is also worth noting that the AER average BBB+ 10 year fair value estimate[47] is well below the actual issue yield for the 5 year Tabcorp issue. That is, not only does the Bloomberg 5 year BBB+ fair value estimate underestimate the 5 year Tabcorp issue yield but so does the Bloomberg 10 year BBB+ fair value estimate. The magnitude of this underestimate is described in the below table.

Table 5: Bloomberg 10 year underestimates Tabcorp 5 year

Date	24 March 2009	1 April 2009
Tabcorp 5 year issue (annualised)	8.59%	8.61%
Bloomberg 10 year estimate (annualised	7.73%	7.70%
Difference to actual yield of Tabcorp 5 year issue	-0.86%	-0.91%

Source: Bloomberg and CEG analysis

4.2.2. Direct costs of debt issuance

142. A further reason to believe that Bloomberg 5 year estimate is an underestimate of the cost of debt is the fact that the Tabcorp issue was a retail issue rather than a wholesale issue. That is, the Tabcorp issue was open to small investors as well as institutions. The direct costs of staging and marketing a retail issue are materially higher than a wholesale issue but the 'pay off' for doing so is that a lower interest rate needs to be paid. (This is the only reason a firm would rationally opt for a higher cost retail issue).

143. Consequently, the interest rate paid by Tabcorp should be treated as an underestimate of the interest rate Tabcorp would pay on a wholesale issue by at least the different in direct costs. Section 7.6 of the Tabcorp prospectus details the fees and expenses associated with the debt issue. These fees and expenses include:

- up to 1.5% of the total issue value in Arranger fees;
- up to 0.75% of the total issue value in fees to the 3 other Joint Lead Managers who are not Arrangers;
- fees of 2.0% on the total value of bonds allocated in the Broker Firm Offer;
- Out of pocket expenses. These include the expenses incurred by Joint Lead Managers (eg, legal expenses, transaction taxes, the cost of operating and staffing a 1300 information line Monday to Friday between 8.30am and 5.30pm).

[47] As calculated by the AER. That is, Bloomberg does not publish a 10 year BBB+ fair value yield but it is the AER's practice to add to the 8 year BBB+ yield Bloomberg's estimate of the difference between 10 and 8 year A rated fair value yields.

- Fees paid to and expenses incurred by the Trustee (who holds the bonds on trust for the borrowers) (see section 7.5 of the prospectus).

144. Assuming that the maximum fees are paid to the Arrangers and other Joint Lead Managers then these alone would represent 2.25% of the amount raised. A payment of 2.25% of the total amount raised amortised at 8%[48] over the five years of the bonds life amounts to a 56bp per annum cost.

145. However, the estimate of 2.25% (56bp per annum) must be increased to reflect fees for placements through Broker Firm Offers and out of pocket expenses (such as legal expenses etc). If one assumes that only 25% of the debt is issued through Broker Firm Offers then this fee will still amount to 0.5% of the total value of the issues. This raises the total direct cost of the issue to 2.75%.

146. One must also add to this an estimate of other direct costs. The AER NSW distribution draft decision estimates this to be around $200,000 in total (including legal and roadshow costs, credit rating fees and other minor costs) which represents around 0.1% of a total issue value $200m. Reviewing the documentation for the Tabcorp issue and noting the use of a staffed information phone line it appears likely to us that the other out of pocket expenses are likely to be well in excess of that allowed in the draft decision. Nonetheless, adding 0.1% to 2.75% gives a total upfront cost of 2.85%.

147. A 2.85% upfront cost means that for every $100 raised there is only $97.15 raised in net. A 2.85% upfront cost therefore translates to 2.93% of the net proceeds. Amortising 2.93% over 5 years at an 8% discount rate gives an annual debt raising cost of 0.73% pa. This is 0.65% higher than the AER's estimate of around 0.08% direct costs for a wholesale issue (based on wholesale issue into the US market).[49] If we add 0.65% to the Tabcorp issue yield we find that it is much closer to the CBASpectrum fair value estimate than the Bloomberg fair value estimate.

4.2.3. Conclusion

148. The Tabcorp bond is the best observation available of a recently traded BBB+ bond with a medium term maturity. Importantly, it is also an observation of the cost of debt *to an issuer* and therefore is desirable as a source of information on the benchmark rate (see criterion i at paragraph 39). The yield at issue on the Tabcorp bond issue can reasonably be viewed as an underestimate of the benchmark rate because:

[48] I conservatively assume a cost of capital of only 8%.

[49] See page 187 of the AER 28 April 2009 Final Decision for NSW electricity distributors.

- The issue was a retail issue and, as such, incurred higher direct transaction costs in reaching retail customers with the pay-off for incurring these costs being lower interest costs paid by Tabcorp;
- Tabcorp's pre-existing 2.5 year to maturity bond is treated by both data services as lower than average risk for a BBB+ entity.

149. This observation provides a clear basis for believing that Bloomberg fair value estimates underestimate the benchmark rate. The fact that CBASpectrum 5 year BBB+ fair value estimate overestimates the yield on the 5 year Tabcorp bond provides some evidence that CBASpectrum may overestimate the benchmark yield. However, this is ambiguous because, for the reasons provided above, the yield on the 5 year Tabcorp bond can be regarded as itself an underestimate of the average BBB+ bond yield.

150. Of course, the Tabcorp issue is only one observation for one bond. However, the AER/Bloomberg methodology is also effectively based on a single bond (as described above, Santos drives the value of the Bloomberg BBB 8 year fair value). There is also no evidence that the Blooomberg Santos price reflects an actual trade of the bond as opposed to an estimate of its yield. In addition, the Bloomberg estimate for Santos is based on an estimate of the yield associated with a trade in the secondary market not the interest costs to the issuer (as is the case for the Tabcorp observation).

151. On this basis, to the extent that one was required to set the benchmark on the basis of a single observation it would be preferable for that observation to be based on the actual traded price for the Tabcorp new issue than on a Bloomberg estimate of the hypothetical secondary market traded price for Santos.

4.3. RBA estimates of debt risk premiums

152. The Reserve Bank of Australia reports estimated of spreads between corporate bonds and CGS. The most recent of these estimates is for 31 March 2008. This is compared with CBASpectrum and AER/Bloomberg estimates on the same day.

Table 6: RBA vs AER vs CBASpectrum on 31 March 2009

	BBB Credit rating
AER 10 years BBB	3.27%
CBASpectrum 10 years BBB+	6.60%
RBA (1 - 5 years)*	5.74%

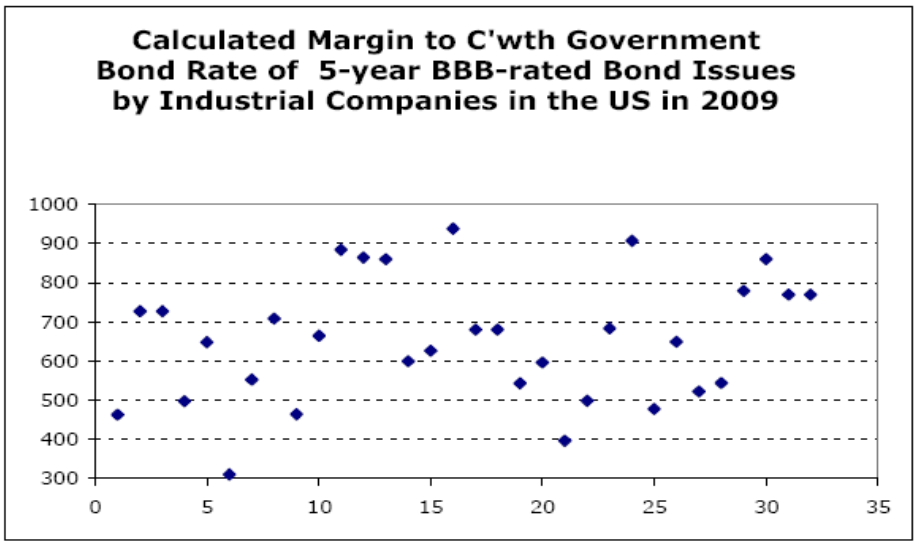
**Source: RBA, Table F.3 Capital Market Yields and Spreads – Non-government Instruments.*

153. Clearly, the RBA reported credit spreads are closer to, although still below, CBASpectrum estimates than AER/Bloomberg estimates. However, it must be noted that the RBA estimates are an average over bonds that have one to five years to maturity. Consequently, these can be expected to be an underestimate for the credit spread at 10 years based on an upward sloping term premia for credit spreads exists.

4.4. BBB new issue premiums to Bloomberg fair value

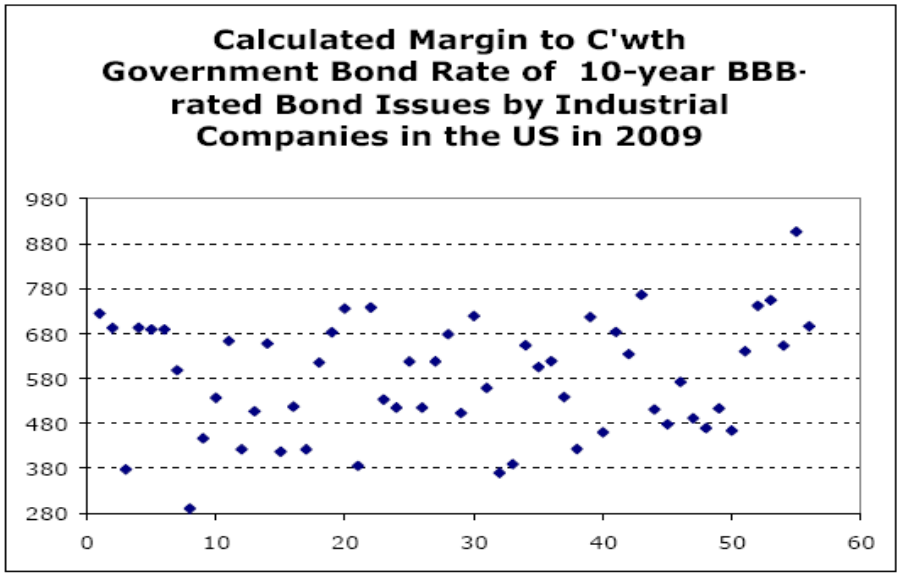
154. A recent analysis by Victorian electricity distribution businesses[50] suggests that in the US the Bloomberg fair value curves significantly underestimate the cost of interest to the bond issuer. I reproduce this analysis in full here.

> *The graphs below show yields (swapped to A$ at the time of issuance) on BBB and BBB+ rated bonds issued in the US by industrial companies this year, as a spread to Commonwealth bonds. There have been many issues in the US so far this year so it is a reasonably deep and liquid market in which to observe new issue spreads.*
>
> *The graph below shows the calculated margin to the Commonwealth Government bond rate of 5-year BBB/BBB+ rated bond issues by industrial companies in the US in 2009. The average 5-year BBB/BBB+ rated debt margin (over the Commonwealth bond rate) is 663 basis points.*

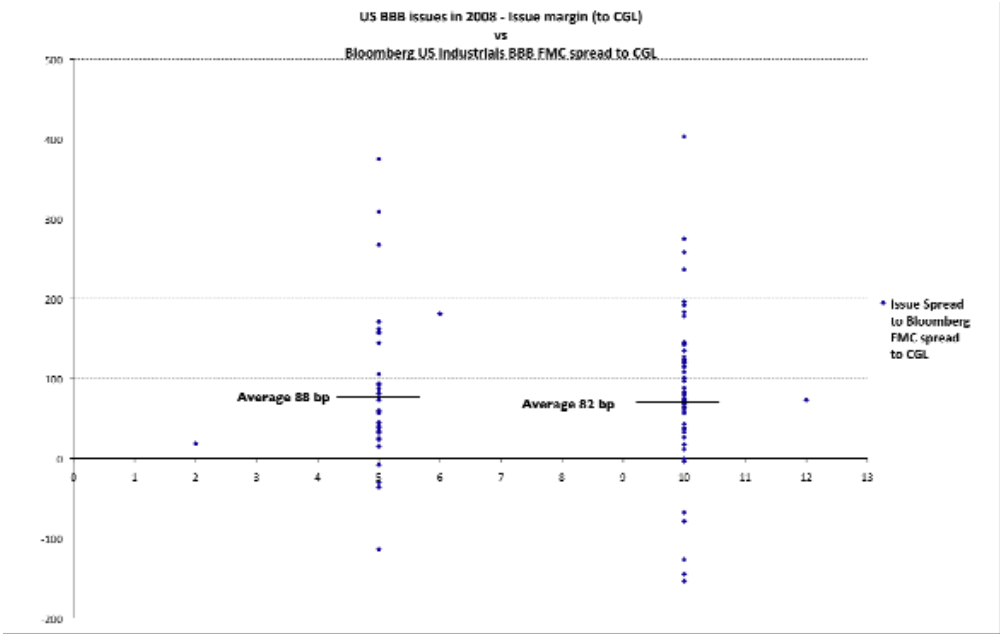


[50] *Debt Risk Premium for use in the Initial AMI WACC Period*, A paper jointly prepared by the Victorian Electricity Distribution Businesses, 1 June 2009. See attachment 3.

The graph below shows the calculated margin to the Commonwealth Government bond rate of 10-year BBB/ BBB+ rated bond issues by industrial companies in the US in 2009. The average 10-year BBB/BBB+ rated debt margin (over the Commonwealth bond rate) is 581 basis points.



The chart below shows approximately 100 US bond issues in 2008 as a spread to the Bloomberg US fair yield curve. As is the case in Australia, the US fair yield curves imply spreads to the risk-free that are materially lower that the new issue spreads observed for corporate bonds.



155. Two important observations can be made about this data. First, the cost of issuing 5/10 year BBB/BBB+ rated debt into the US market and converting those interest rates into Australian dollars is around the same or higher than the cost of issuing 10 year BBB+ debt predicted by CBASpectrum and higher than the cost predicted by Bloomberg.[51]

156. Second, there is a significant new issuance premium evident in the US data. That is, debt is mostly issued at a yield that is higher than the equivalent Bloomberg fair value estimate in the US. This is consistent with the advice received from Bloomberg by the Victorian businesses that precisely the above was to be expected for new issues.

> *Bearing in mind that the curves are representative of secondary market prices and trading sizes, new issues have nearly always been issued at a premium to this curve. In settled market conditions, the premium required to 'get away' a new issue might have been quite small. My experience has been that the premium has increased during this period of market turbulence as buyers have demanded a greater risk premium.*[52]

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51 The average spread to CGS from a 5/10 year US issuance strategy in 2009 is reported as 663bp/581bp. This compares to an average Bloomberg fair value BBB estimate of 336bp and an average CBASpectrum BBB+ fair value estimate of 586bp over the period 1 January 2009 to 20 May 2009.

52 *Debt Risk Premium for use in the Initial AMI WACC Period*, A paper jointly prepared by the Victorian Electricity Distribution Businesses, 1 June 2009, page 17.

157. Given that the criteria i at paragraph 39 requires that the benchmark rate reflect the cost to the issuer of debt, this is further evidence that the AER/Bloomberg methodology will underestimate this cost for typical BBB+ 10 year debt.

4.5. Bonds issued by Australian corporates into the US market

158. An alternative to issuing BBB+ debt in Australia is to issue BBB+ debt in the US and to enter into a currency swap to convert that US dollar debt liability into Australian dollar liability. A recent analysis by Victorian electricity distribution businesses has undertaken this analysis and I reproduce their results here.

The table below shows 5, 7 and 10-year US dollar bond issues by Australian non-bank companies in the US, with the effective swap back to A$ as a spread to the Commonwealth bond rate, had the issuers entered into a cross-currency swap to fixed rate A$ at the time of the issue.

5-year maturity						
Company	**Spread at issue**	**Effective Spread over Aus CGL (annualised)**	**Launch/ Announcement Date**	**Issue Type**	**Issue Amount**	**Rating**
QBE Insurance	770	821	30-Dec-08	144a reg S	US$210mn	A3/A-
Woodside	625	633	24-Feb-09	144a reg S	US$400mn	Baa1/A-
Brambles	550	5	18-Mar-09	144a reg S		NAIC-2
BHP Billiton	400	418	14-Apr-09	US Public - SEC registered	US$1.55bn	A1/A+
Rio Tinto	752	813	25-May-09	US Public - SEC registered	US$2bn	Baa1/BBB
Woodside	602	633	25-May-09	144a reg S	US$400mn	Baa1/A-
Westfield	549	602	27-May-09	144a reg S	US$400mn	Baa1/A-

7-year maturity						
Company	**Spread at issue**	**Effective Spread over Aus CGL (annualised)**	**Launch/ Announcement Date**	**Issue Type**	**Issue Amount**	**Rating**
Brambles	550	607	15-Mar-09	USPP		NAIC-2
APA Pipelines	575	641	14-May-09	USPP	US$65m	BBB

10-year maturity						
Company	**Spread at issue**	**Effective Spread over Aus CGL (annualised)**	**Launch/ Announcement Date**	**Issue Type**	**Issue Amount**	**Rating**
BHP Billiton	400	499	18-Mar-09	US Public - SEC registered	US$1.75bn	A1/A+
Woodside	613	686	24-Feb-09	144a reg S	US$600m	A-
Brambles	550	652	15-Mar-09	144a reg S		NAIC-2
Rio Tinto	658	804	14-Apr-09	US Public - SEC registered	US$1.5bn	Baa1/BBB
APA Pipelines	575	754	14-May-09	144a reg S	US$75m	BBB
Woodside	551	686	25-May-09	144a reg S	US$600mn	Baa1/A-

159. This table has six 10 year bond issues into the US market by Australian businesses between 15 March and 25 May. The average credit rating is above BBB. The average estimated credit spread on these issues is 680bp (median is 686). By contrast, over the same period the average credit spread predicted by the AER/CBASpectrum was 3.35%/6.58%. This evidence provides further support for the view that the AER method underestimates the cost of issuing BBB debt in the current market conditions.

5. AER analysis in 2009 NSW Electricity Distribution Decision

160. The AER concluded that its method, based on Bloomberg fair value estimates, was superior to the CBASpectrum fair value estimates for 10 year BBB+ bond yields. The AER analysis did not address the range of considerations examined in the previous two sections.

161. In addition, the AER analysis was based on a number of factual errors including:

- That prices quoted by Bloomberg reflected actual trades (multiple references, eg, see note (b) to table 11.4 suggesting that unlike other bonds the BBI Bloomberg estimates were not a traded price);
- That CBASpectrum but not Bloomberg imposes the condition that fair value curves for different ratings do not cross;[53]
- That the Babcock and Brown Infrastructure (BBI) bond was rated, as at March 2009, as A- in CBASpectrum despite being re-rated as BBB+ by Standard and Poor's on 6 June 2008.[54]

162. In addition, I consider that the AER analysis involved important methodological flaws including:

- The proposed tests (in Tables 11.4 and 11.5 on page 228) of the accuracy of Bloomberg versus CBASpectrum's fair value estimates were not properly constructed in that:
  - the tests do not measure what is important – which is the accuracy of the AER's method of deriving a *10 year* BBB+ yield from Bloomberg fair value estimates against that of CBASpectrum's 10 year BBB+ fair value estimate; and
  - the tests actually measured the accuracy of each data service's fair value estimate in predicting the yield on the *lowest yielding* bonds in each data service. It is only to be expected Bloomberg, with the lowest fair value estimate, is the most 'accurate' when measured against this benchmark.

[53] page 230.

[54] page 231, had the AER searched in CBASpectrum by sorting bonds into credit rating it would have seen this BBI bond was listed under BBB+, ie, CBASpectrum had correctly categorised the bond by rating. It is correct that once this bond is brought up in CBASpectrum an A- rating is still reported for it which is a past credit rating. However, this is not how this bond is actually stored in CBASpectrum's data base (it is stored as a BBB+ bond).

However, for this test to be of any relevance one must have already determined that the lowest yielding bonds are the relevant benchmark against which the data services should be tested. In my view the AER did not establish this and, therefore, the tests are not relevant.

- That it is appropriate to introduce a concept of 'market perceived credit rating'[55] that differs from the 'Standard and Poor's credit rating'. The 'market perceived credit rating' is not well defined by the AER but appears to be used by the AER rule out having regard to high yielding BBB+ rated (and even higher rated) bonds. This methodology appears to have a strong flavour of 'catch 22' logic. Namely, if a bond has a high yield then it will be defined as having a 'market perceived credit rating' that is below BBB+ even if its actual Standard and Poor's credit rating is BBB+ or above.
- That even if one accepted that it was appropriate to stop having regard to Standard and Poor's credit ratings and instead attempt to derive a 'market perceived credit rating' there is no reason to simply presume that high yielding bonds in a particular credit rating have a 'market perceived credit rating' that is lower than their credit rating. The opposite could equally be true and low yielding bonds could be construed as having a 'market perceived credit rating' that is above their Standard and Poor's credit rating. Credit ratings are by their nature relative and the AER has no basis for assuming that only the low yielding bonds in a Standard and Poor's credit rating 'belong' in that rating.

[55] page 231.

6. Conclusion

163. On the basis of the evidence in this report, I do not consider that sole reliance on the Bloomberg fair value estimates for estimating the benchmark rate (as per the AER methodology) is reasonable. Such a method, when measured against the criteria developed in section 2 would perform poorly.

    i. It would not reflect a representative yield at the time of issue for 'typical' corporate bonds with a maturity of 10 years and a BBB+ long-term credit rating from Standard & Poor's. Rather, it would in effect rely almost entirely on the Bloomberg estimate of the fair value for a single bond being the Santos bond;

    ii. It would utilise a methodology that is unnecessarily reliant on a single or small number of observations and/or individual views and would not efficiently use the totality of information available, particularly given that the available information is sparse;

    iii. It would give rise to estimates that are inconsistent with standard predictions of finance theory in that it would impose a downward sloping term structure for credit spreads (and inconsistent with a clear upward slope where there is available data);

    iv. It would not give rise to estimates that are consistent with current market conditions and would not have captured the impact of clear changes in market conditions in September and October 2008; and

    v. It would give rise to yield estimates that are not consistent with other potential proxies for the benchmark rate as described in Section 4 of this report.

164. The CBASpectrum BBB+ 10 year fair value yield performs better against these criteria. It does not rely on a single observation but rather employs a method that uses all the available bond data – a method that will work relatively better than the Bloomberg methodology in the presence of limited data. It gives rise to estimates that are more consistent with other information and it did capture the expected movement in credit spreads following the events of September and October 2008. However, this does not imply that 100% weight should be given to this source for an estimate of the benchmark rate. The CBASpectrum estimate tended to overestimate the only recent observed issue price for a BBB+ Australian bond (the Tabcorp issue) and also was higher than the rates reported by the RBA (although the difference in both cases was less pronounced than for the Bloomberg under-estimates).

165. For these reasons, if one was required to rely on one or the other of the two estimates of fair value as a proxy for the benchmark rate then I would rely on CBASpectrum's 10 year BBB+ estimate. I do not believe it would be reasonable to rely solely on the

Bloomberg estimate of fair value. However, absent a requirement to select a single data service then a conservative approach would be to give weight to the facts and expert opinions embodied in both services. However, in my view it would not be appropriate to give more weight to the Bloomberg estimates than the CBASpectrum estimates.

166. I note that an alternative approach would be to rely on neither data services estimate of fair value. In theory it may be possible to develop an alternative procedure for estimating the benchmark rate that does not rely on either Bloomberg nor CBASpectrum fair value estimates.

167. A problem with this approach is that it will inevitably require the exercise of significant judgment and this is especially true in the current market conditions with little in the way of observations of actual trades or issue of Australian BBB+ bonds. Ultimately this is likely to score poorly against criteria vi at paragraph 40:

    vi the source of the estimate would be as independent as possible from interested parties to the regulatory proceedings.

168. In this context, the fact that Bloomberg and CBASpectrum develop their estimates independently of parties to the proceedings may actually be a sufficiently important advantage to outweigh the disadvantage that they are not specifically designed for the purpose of estimating the cost to be used in regulatory determinations.

169. One option that would score well against all criteria at the current time would be to adopt an estimate of the debt risk premium based solely on the observed debt risk premium in the Tabcorp issue. However, as time passes and market conditions evolve this estimate will tend to lose relevance.

Attachment A: Grundy Note

Theoretical and Empirical Models of the Term Structure of Debt Margins
Bruce D. Grundy
26 May, 2009

This Note examines the theoretical link between debt margins and debt maturity. Part 1 develops a simple model of the link between debt maturity and debt margins. Part 2 estimates the theoretical shape of the term structure of debt margins by implementing an extension of the seminal Merton (1974) model of the pricing of risky zero-coupon debt. The extension includes both coupon payments and bankruptcy costs. Theoretical debt margins are calculated for bonds of varying maturity and debt-to-asset ratios of 60%. Part 3 reviews the available empirical evidence on the term structure of observed debt margins for BBB bonds.

Part 1 A simple model of the link between debt maturity and debt margins

Assume that the term structure of default-free rates is flat.

$\delta \equiv$ the bond's recovery rate; i.e., the fraction of the contractual amount due that bondholders receive in the event of a default. $\delta = 0$ corresponds to the situation where bankruptcy costs consume the entirety of a firm's remaining assets.

$y(T;\delta) \equiv$ yield on a par-valued coupon-paying bond promising to pay annual coupons and the principal amount *K* at time *T.*

$B(c,T,K;\delta) \equiv$ market value of a *T*-period bond with principal outstanding of *K* and an annual coupon rate of *c* given a recovery rate of δ .

$r_f \equiv$ the annual risk-free rate.

$\Pr(T,t) \equiv$ the risk-neutral probability that default on the *T*-period bond first occurs at time *t*. $\left[1-\Pr(T,t)\right]$ is then the risk-neutral year *t* survival rate given that the bond has not defaulted prior to year *t*.

The value of a bond is the sum of the bond's risk-neutralized expected future payoffs discounted at the risk-free rate.

$$B(c,T,K;\delta)=\sum_{t=1}^{T}\frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T,\tau)\right]\right]\times\left[\left[1-\Pr(T,t)\right]+\Pr(T,t)\times\delta\right]\times c\times K}{\left[1+r_f\right]^t}$$

$$+\sum_{t=1}^{T}\frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T,\tau)\right]\right]\times\Pr(T,t)\times\delta\times K}{\left[1+r_f\right]^t}+\frac{\left[\prod_{\tau=1}^{T}\left[1-\Pr(T,\tau)\right]\right]\times K}{\left[1+r_f\right]^T}. \quad (1)$$

In general $\Pr(T,\tau)\neq\Pr(T)\,\forall\,\tau\leq T$. But we can approximate the market value of a bond by replacing each of the $\Pr(T,\tau)$ in (1) by a constant amount $\Pr(T)$ defined such that $1-\Pr(T)=\left[\prod_{\tau=1}^{T}\left[1-\Pr(T,\tau)\right]\right]^{1/T}$ i.e., such that the corresponding annual risk-neutral survival rate $\left[1-\Pr(T)\right]$ is equal to the *T*-period geometric average of the set of risk-neutral annual survival rates $\left[1-\Pr(T,\tau)\right],\tau=1,\ldots,T$. The approximate relation is

$$B(c,T,K;\delta)\approx\sum_{t=1}^{T}\frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T)\right]\right]\times\left[1-\Pr(T)(1-\delta)\right]\times c\times K}{\left[1+r_f\right]^t}$$

$$+\sum_{t=1}^{T}\frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T)\right]\right]\times\Pr(T)\times\delta\times K}{\left[1+r_f\right]^t}+\frac{\left[\prod_{\tau=1}^{T}\left[1-\Pr(T)\right]\right]\times K}{\left[1+r_f\right]^T}.$$

When in fact $\Pr(T,\tau)$ is equal to $\Pr(T)\,\forall\,\tau\leq T$ then the yield on a par-valued bond $y(T;\delta)$ satisfies

$$K = \sum_{t=1}^{T} \frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T)\right]\right]\times\left[1-\Pr(T)(1-\delta)\right]\times y(T;\delta)\times K}{\left[1+r_f\right]^t}$$
$$+\sum_{t=1}^{T} \frac{\left[\prod_{\tau=1}^{t-1}\left[1-\Pr(T)\right]\right]\times\Pr(T)\times\delta\times K}{\left[1+r_f\right]^t} + \frac{\left[\prod_{\tau=1}^{T}\left[1-\Pr(T)\right]\right]\times K}{\left[1+r_f\right]^T}.$$

Cancelling K from both sides gives

$$1 = \sum_{t=1}^{T} \frac{\left[1-\Pr(T)\right]^t \times y(T;\delta)}{\left[1+r_f\right]^t} + \frac{\left[1-\Pr(T)\right]^T}{\left[1+r_f\right]^T}$$
$$+\sum_{t=1}^{T} \frac{\left[1-\Pr(T)\right]^{t-1}\times\Pr(T)\times\delta\times\left[1+y(T;\delta)\right]}{\left[1+r_f\right]^t}. \qquad (2)$$

Relation (2) can be rewritten as

$$1 = \sum_{t=1}^{T} \frac{\left[1-\Pr(T)\right]^{t-1}\times\left[\left[1-\Pr(T)\right]\times y(T;\delta)+\Pr(T)\times\delta\times\left[1+y(T;\delta)\right]\right]}{\left[1+r_f\right]^t} + \frac{\left[1-\Pr(T)\right]^T}{\left[1+r_f\right]^T}$$
$$= \sum_{t=1}^{T} \frac{\left[y(T;\delta(T))+\frac{\Pr(T)\times\delta}{\left[1-\Pr(T)\right]}\times\left[1+y(T;\delta)\right]\right]}{\left[\frac{1+r_f}{1-\Pr(T)}\right]^t} + 1\Big/\left[1+\frac{\Pr(T)+r_f}{1-\Pr(T)}\right]^T$$

$$= A\left(\frac{\Pr(T)+r_f}{1-\Pr(T)},T\right)\left[y(T;\delta)+\frac{\Pr(T)\times\delta}{\left[1-\Pr(T)\right]}\times\left[1+y(T;\delta)\right]\right] + 1\Big/\left[1+\frac{\Pr(T)+r_f}{1-\Pr(T)}\right]^T,$$

where $A(i,T)$ denotes the present value of an annuity of $1 to be received at the end of each of *T* years with the first payment due in one year's time given a per annum discount rate of *i*. Solving for $y(T;\delta)$ gives

$$y(T;\delta)=\frac{\frac{\Pr(T)+r_f}{\left[1-\Pr(T)\right]}-\frac{\Pr(T)\delta}{\left[1-\Pr(T)\right]}}{1+\frac{\Pr(T)\delta}{\left[1-\Pr(T)\right]}}=\frac{\Pr(T)+r_f-\Pr(T)\delta}{1-\Pr(T)+\Pr(T)\delta}. \qquad (2)$$

$$1+y(T;\delta)=\frac{1+r_f}{\left[1-\Pr(T)\right]+\Pr(T)\delta}.$$

Now consider the yield given the two extremes of the recovery rate, $\delta=1$ and $\delta=0$. A recovery rate of $\delta=1$ corresponds to a situation where despite (technical) default the bondholder still receives 100% of the principal and accrued interest owed him or her. Not surprisingly, substitution in (2) yields the result that $y(T;1)=r_f$. At the other extreme a zero recovery rate corresponds to a situation where default costs consume the entirety of any potential payoff to the bondholders. In this case substitution in (2) yields the simply and logical result that $y(T;0)=\frac{r_f+\Pr(T)}{1-\Pr(T)}$; i.e., $1+r_f=\left[1-\Pr(T)\right]\left[1+y(T;0)\right]$. Since the risk-neutral probability of the bond <u>not</u> defaulting in any year is $\left[1-\Pr(T)\right]$, the risk-neutral expected one-plus-annual yield on risky debt of $\left[1-\Pr(T)\right]\times\left[1+y(T;0)\right]$ is equal to the one-plus-annual risk-free rate.

Let $M(T;\delta)$ denote the debt margin on a *T*-period par-valued coupon-paying bond; i.e., $M(T;\delta)\equiv y(T;\delta)-r_f$.

$$M(T;\delta)=\frac{\Pr(T)+r_f-\Pr(T)\delta}{1-\Pr(T)[1-\delta]}-r_f=\frac{\left[1+r_f\right]\Pr(T)[1-\delta]}{1-\Pr(T)[1-\delta]}. \qquad (3)$$

For a 100% recovery rate $y(T;1)=r_f$ and the debt margin is $M(T;1)=0\ \forall\ T$. For a 0% recovery rate the debt margin is $M(T;0)=\left[1+r_f\right]\left[\frac{\Pr(T)}{1-\Pr(T)}\right]\forall\ T$.

Relation (3) can be used to examine how debt margins change with maturity:

$$\frac{\partial M(T;\delta)}{\partial T}=\frac{\partial \Pr(T)}{\partial T}\frac{\left[1+r_f\right][1-\delta]}{\left[1-\Pr(T)[1-\delta]\right]^2}.$$

$\frac{\partial M(T;\delta)}{\partial T}$ has the same sign as $\frac{\partial \Pr(T)}{\partial T}$ and we obtain the fundamental result:

> *The term structure of credit spreads mirrors the term structure of the risk-neutral probability of per period bankruptcy: If the per annum probability of default increases (decreases) with maturity, so to does the debt margin.*

A non-technical variant of this result was first formulated in Johnson (1967) as the "crisis-at-maturity" hypothesis.[56] Johnson observed that firms with speculative-grade debt outstanding can face severe problems in meeting their coupon and principal repayment commitments if the debt is about to mature. In consequence, the probability of default in the short term can be very high and the margin on short-term debt can be very high. But survival for some period of time can mean that the firm has overcome its immediate problems and now faces a lower risk of default in the subsequent periods. The term structure of credit spreads on this bond will be downward-sloping.[57]

[56] Johnson, Ramon E., 1967, "The term structure of corporate bond yields as a function of risk of default," *Journal of Finance* 22 (2), 313-345.

[57] Using the formal model in (3) and defining $\Pr(T)$ via the geometric average of the per annum survival rates it follows that the firm that would currently be facing a crises-at-maturity if its debt were short-term has a term structure of $\Pr(T)$ that is declining with *T*. As a consequence this firm's term structure of credit spreads is downward-sloping.

In contrast, investment grade bonds have little chance of immediate default and have correspondingly low short-term debt margins. But consider an investment grade bond with, say, 10 years to maturity. After a number of years there is a chance that firm conditions will have deteriorated and the owners of the bond may then be facing a higher likelihood of default. In fact there is some chance of a crises-at-maturity and the probability of default in year 10 need not be low. The geometric average of the series of the 10 individual one-year survival rates applicable to this bond may be lower than the survival rate over the first year of its life. In this case the credit spread on 10-year debt will exceed that on one-year debt.

In general, the term-structure of credit spreads on investment grade bonds can be either upward-sloping or humped-shaped. A hump-shape will arise when (i) there is little chance of immediate default, (ii) there is a non-trivial probability of default on □-year debt and (iii) those firms that do survive past □ years tend to have recovered from any earlier misfortune and have a reduced probability of default in the years subsequent to year □.

The logic underlying the heuristic approach in Johnson (1967) and the approximate result developed in (3) above was first formalized in Merton (1974).[58]

Part 2 A formal model of the term structure of debt margins

Merton (1974) used a variant of the Black-Scholes option pricing model to price risky zero-coupon debt. Merton's model impls that debt margins decline with maturity for below investment-grade bonds and increase or are mildly hump-shaped for investment grade bonds. Jones, Mason, and Rosenfeld (1984) extended this model to incorporate coupons and Kim, Ramaswamy and Sundaresan (1993) further extended the model to recognize bankruptcy costs.[59,60] Anderson and Sundaresan (1996) undertook a different extension that recognized the possibility of strategic behaviour by a firm that threatens to pay less than it is contractually obligated knowing that if the bondholders do not accept the reduced payment they will have to bear high costs of enforcing the terms of the debt contract.[61]

[58] Merton, R. C., 1974, "On the pricing of corporate debt: The risk structure of interest rates," *Journal of Finance* 29, 449-470.

[59] Jones, E. P., S. P. Mason, and E. Rosenfeld, 1984, "Contingent claims analysis of corporate capital structures: An empirical analysis," *Journal of Finance* 39, 611-625.

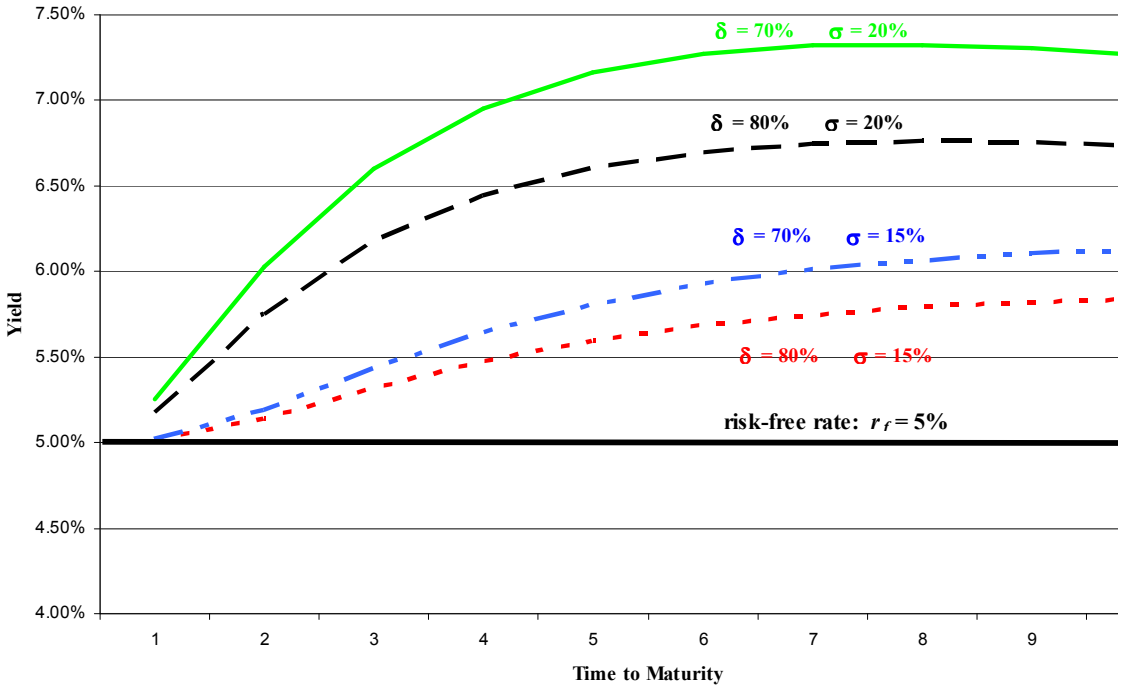
[60] Kim, I. J., K. Ramaswamy, and S. M. Sundaresan, 1993, "Valuation of corporate fixed-income securities," *Financial Management*, *Special Issue on Financial Distress*, Autumn, 117-131.

[61] Anderson, Ronald W. and Suresh Sundaresan, 1996, "Design and valuation of debt contracts," *Review of Financial Studies* 9(1), 37-68.

The theoretical evaluation of debt margins in this section does not consider strategic underpayment by firms. The evaluation does incorporate periodic coupons and bankruptcy costs. The value of the firm's underlying risky assets is assumed to follow a diffusion process with annual standard deviations of the continuously compounded percent change in firm value, □, of 15% and 20% per annum. With a 60% debt to value ratio, these values for firm volatility imply equity volatilities of 37.5% and 50% respectively. To recognize bankruptcy costs I consider recovery rates of 70% and 80% of the contractual amount due.[62] I assume a flat term structure of risk-free rates at 5% per annum.

For the four combinations of parameter values, I consider a bond maturing T years hence and solve for the yield the bond would have to promise such that the bond was worth its par value and that amount was equal to 60% of the market value of firm assets. I consider maturities of 1 through 10 years in increments of 1 year. Figure 1 depicts the yields on the risky bonds as a function of T. The debt margin is simply the excess of the yield above the 5% risk-free rate.

Figure 1: Term Structure of Yields



[62] The theoretical valuation exercise of Kim, Ramaswamy and Sundaresan (1993) assumes $\delta = 0.8$.

In each case the term structure of debt margins is upward sloping or very mildly hump-shaped. (In the only hump-shaped scenario, the curve is very steep when the time to maturity is less than three years.) In the hump-shaped example, the debt margin on 10-year bonds is a mere 0.69 of a basis point less than the debt margin on 6-year bonds. The conclusion drawn from this model-based analysis of debt margins is as follows:

> ***Conclusion on the term structure of debt margins based on an implementation of the extant theoretical finance literature:*** *While a downward sloping term structure of debt margins beyond 6 years cannot be ruled out in a setting with an alternate stochastic process for changes in firm value, an extended Merton (1974) model incorporating coupon payments and bankruptcy costs implies a flat or upward sloping term structure of debt margins when the model is evaluated at realistic values for the asset volatility and recovery rate parameters.*

The conclusion on the shape of the term structure of debt margins is an outcome of the risky bond pricing model that is standard in the theoretical academic literature today. But it is possible that an alternate model could produce a different conclusion. Hence it is useful to also consider the recent empirical literature on the shape of the term structure.

Part 3 The Recent empirical literature on the term structure of debt margins

Trűck, Laub and Rachev (2004) examined trade data reported on Reuters on February 11, 2004 for a large sample of Eurobonds and domestic currency bonds issued by EU countries. [63] Debt margins are calculated relative to government securities issued in the same currency. Plots of the average debt margin on investment grade bonds and of all observed debt margins on BBB-rated bonds as functions of the time to maturity are reproduced below. The figures show that the term structure of debt margins on BBB-rated European bonds was not downward sloping on February 11, 2004.

[63] Trűck, Stefan, Matthias Laub and Svetlozar T. Rachev, 2004, "The term structure of credit spreads and credit default swaps: An empirical investigation," Universität Karlsruhe Working Paper

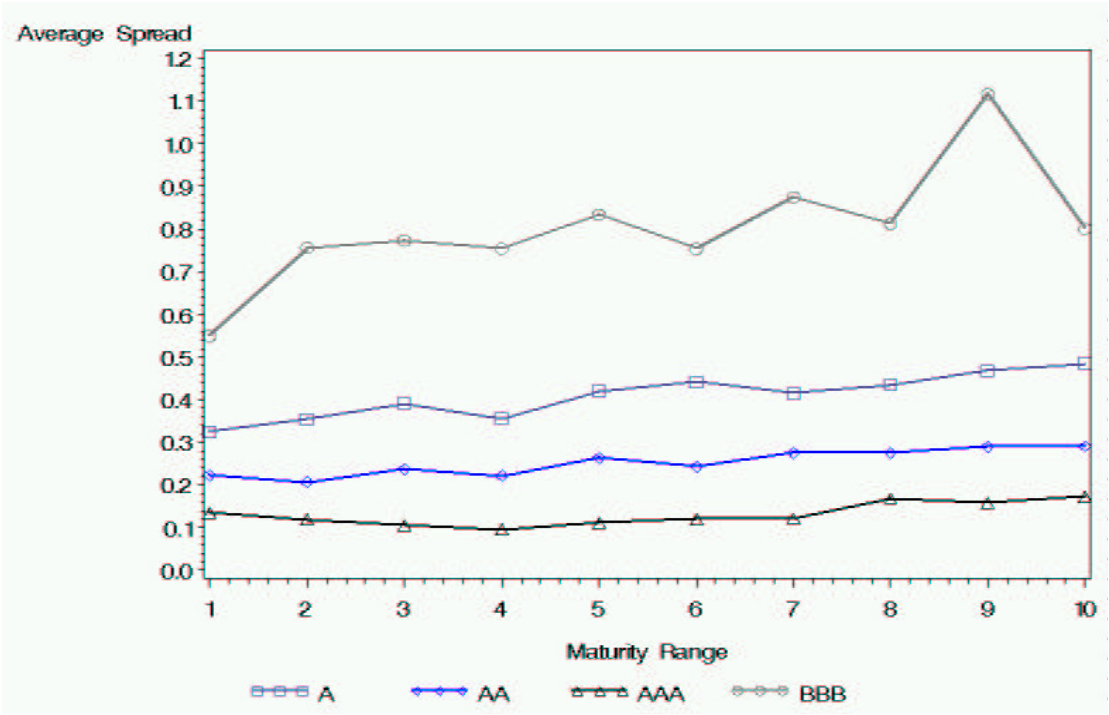


Figure 3 Average debt margins for European investment-grade bonds observed on February 11, 2004. Source: Trűck, Laub and Rachev (2004)

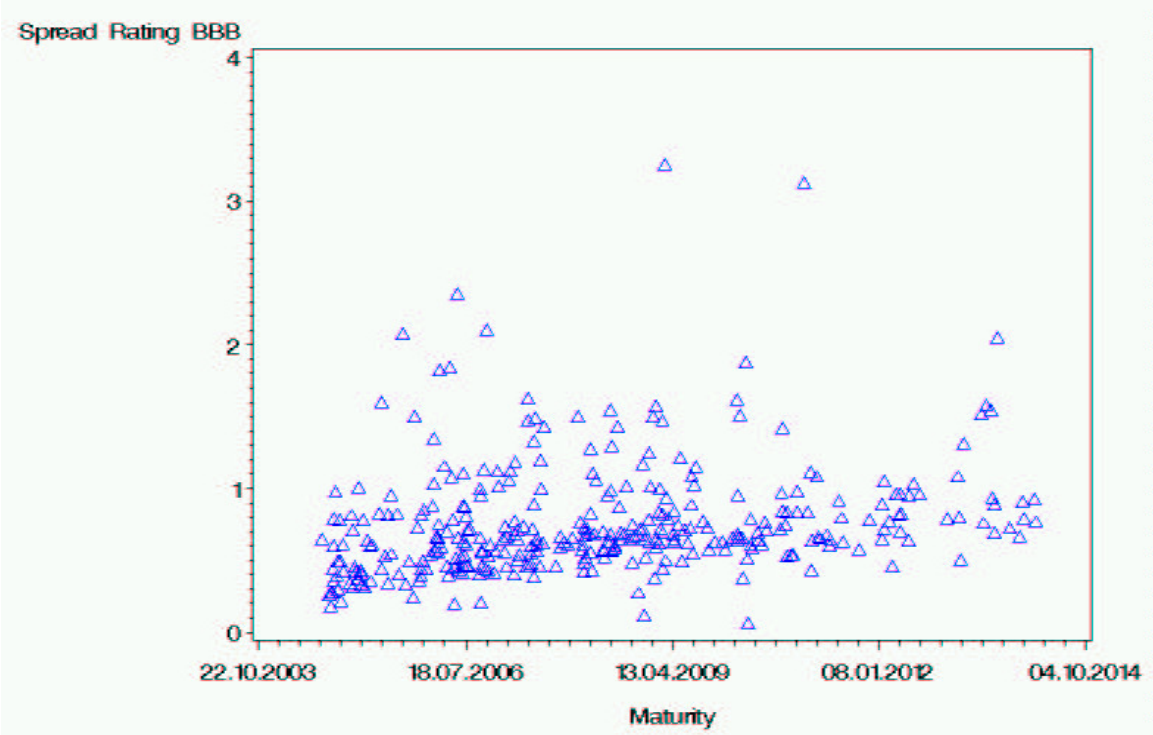


Figure 4 Debt margins for European BBB-rated bonds observed on February 11, 2004. Source: Trűck, Laub and Rachev (2004)

Bedendo, Cathcart and El-Jahel (2007) undertake the most recent study of the term structure of debt margins by investigating data from the National Association of Insurance Commissioners database of bond transactions by U.S. insurance companies between January 1995 and December 2001.64 The paper's goal is to examine the determinants of the slope and curvature of the term structure of debt margins. The measure of the slope examined by the authors is the difference between the margin on 3-year and 10-year bonds of a given bond rating.

The authors calculate separate slopes for industrial and financial bonds. There are no BBB-rated financial bonds in their sample. The average value of the slope for BBB industrial bonds was 37 basis points; i.e., on average for the set of bonds traded by insurance companies between 1995 and 2001 inclusive the debt margin on 10-year

[64] Bedendo, Mascia,Lara Cathcart and Lina El-Jahel, 2007, "The slope of the term structure of credit spreads: An empirical investigation," *The Journal of Financial Research* 30(2), 237–257.

BBB-industrials exceeded the debt margin on 3-year BBB-industrials by 37 basis points.

***Conclusion on the term structure of debt margins based on the extant empirical finance literature**: The empirically observed term structure of debt margins on BBB-rated bonds is largely flat with some evidence of a mild humped shape and some evidence of an upward slope. There is no evidence of a downward sloping term structure of debt margins on BBB-rated bonds.*

Appendix A. Bloomberg data and screen shots

170. Below are relevant 'screen shots' taken from Bloomberg and also a list of all BBB and A rated bonds used in the analysis of Bloomberg 6th May 2009 fair value curves.

Figure 14: Description of Bloomberg Generic Price

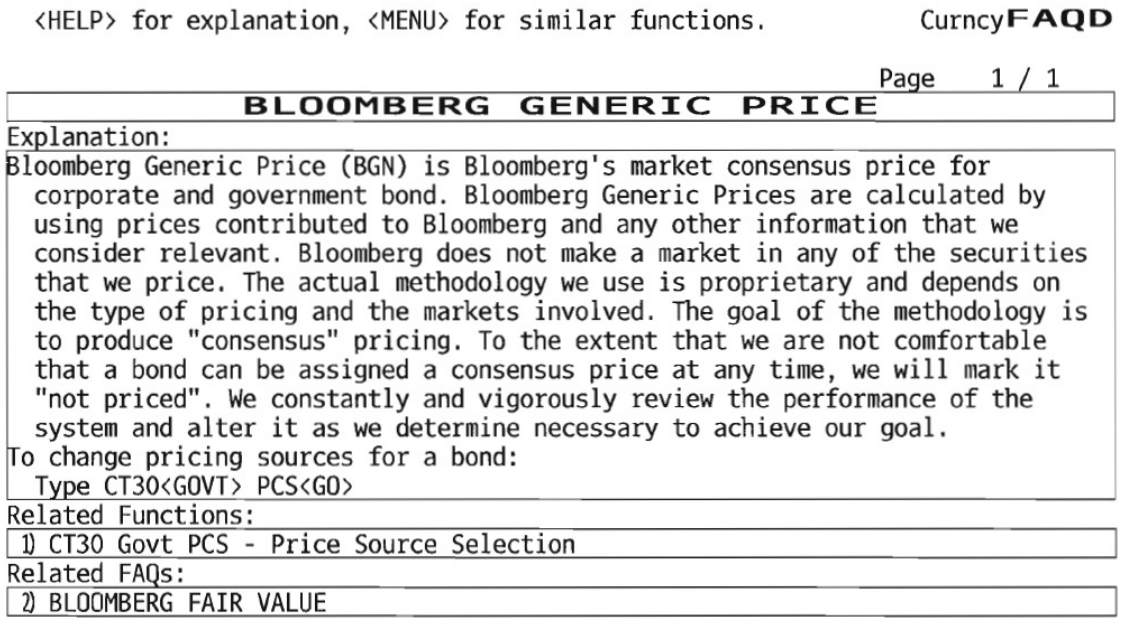
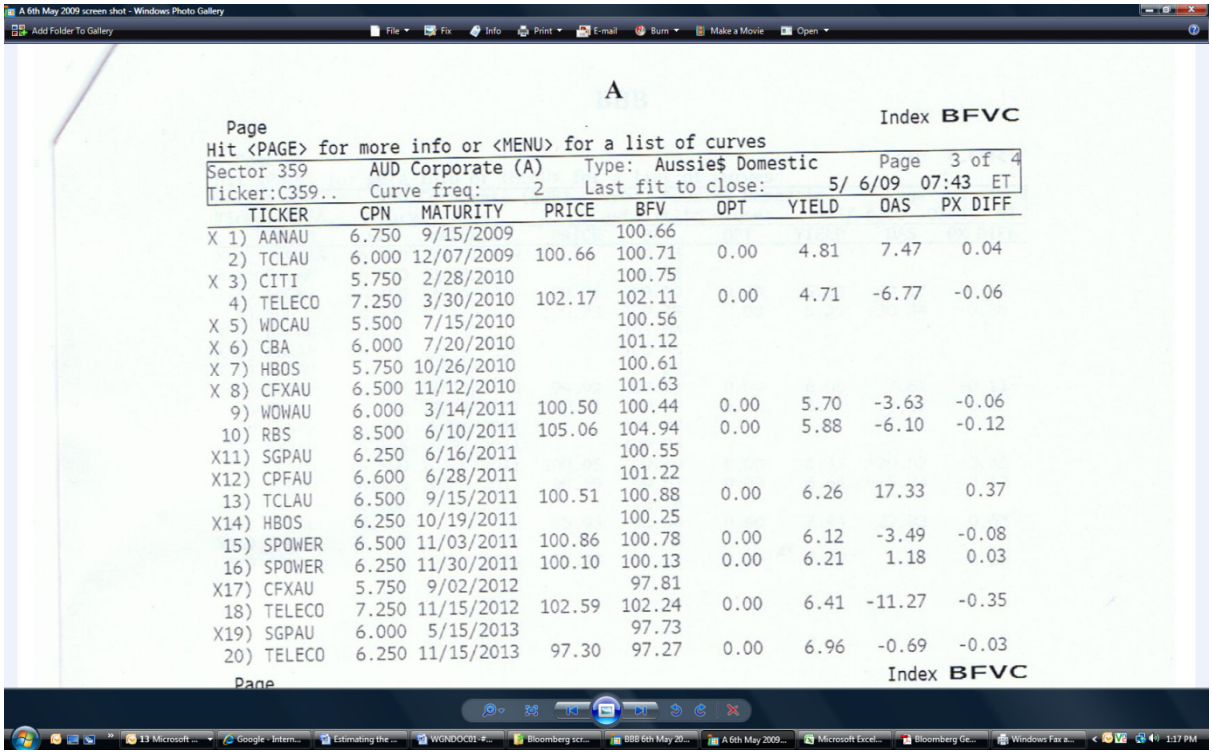


Figure 15: Description of bonds included in Bloomberg A and BBB fair value construction



A

Page Index BFVC

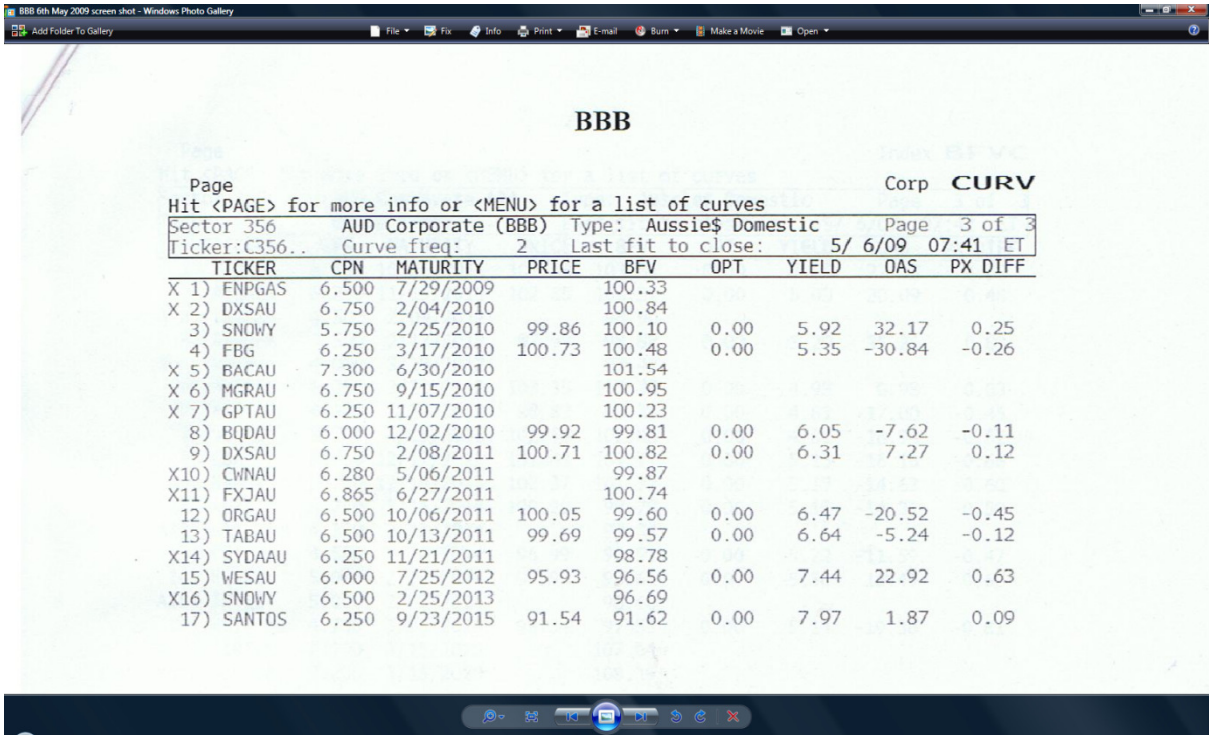
Hit <PAGE> for more info or <MENU> for a list of curves

Sector 359 AUD Corporate (A) Type: Aussie$ Domestic Page 3 of 4

Ticker:C359.. Curve freq: 2 Last fit to close: 5/ 6/09 07:43 ET

	TICKER	CPN	MATURITY	PRICE	BFV	OPT	YIELD	OAS	PX DIFF
X 1)	AANAU	6.750	9/15/2009		100.66				
2)	TCLAU	6.000	12/07/2009	100.66	100.71	0.00	4.81	7.47	0.04
X 3)	CITI	5.750	2/28/2010		100.75				
4)	TELECO	7.250	3/30/2010	102.17	102.11	0.00	4.71	-6.77	-0.06
X 5)	WDCAU	5.500	7/15/2010		100.56				
X 6)	CBA	6.000	7/20/2010		101.12				
X 7)	HBOS	5.750	10/26/2010		100.61				
X 8)	CFXAU	6.500	11/12/2010		101.63				
9)	WOWAU	6.000	3/14/2011	100.50	100.44	0.00	5.70	-3.63	-0.06
10)	RBS	8.500	6/10/2011	105.06	104.94	0.00	5.88	-6.10	-0.12
X11)	SGPAU	6.250	6/16/2011		100.55				
X12)	CPFAU	6.600	6/28/2011		101.22				
13)	TCLAU	6.500	9/15/2011	100.51	100.88	0.00	6.26	17.33	0.37
X14)	HBOS	6.250	10/19/2011		100.25				
15)	SPOWER	6.500	11/03/2011	100.86	100.78	0.00	6.12	-3.49	-0.08
16)	SPOWER	6.250	11/30/2011	100.10	100.13	0.00	6.21	1.18	0.03
X17)	CFXAU	5.750	9/02/2012		97.81				
18)	TELECO	7.250	11/15/2012	102.59	102.24	0.00	6.41	-11.27	-0.35
X19)	SGPAU	6.000	5/15/2013		97.73				
20)	TELECO	6.250	11/15/2013	97.30	97.27	0.00	6.96	-0.69	-0.03

Page Index BFVC



BBB

Page Corp CURV
Hit <PAGE> for more info or <MENU> for a list of curves
Sector 356 AUD Corporate (BBB) Type: Aussie$ Domestic Page 3 of 3
Ticker:C356.. Curve freq: 2 Last fit to close: 5/ 6/09 07:41 ET

	TICKER	CPN	MATURITY	PRICE	BFV	OPT	YIELD	OAS	PX DIFF
X 1)	ENPGAS	6.500	7/29/2009		100.33				
X 2)	DXSAU	6.750	2/04/2010		100.84				
3)	SNOWY	5.750	2/25/2010	99.86	100.10	0.00	5.92	32.17	0.25
4)	FBG	6.250	3/17/2010	100.73	100.48	0.00	5.35	-30.84	-0.26
X 5)	BACAU	7.300	6/30/2010		101.54				
X 6)	MGRAU	6.750	9/15/2010		100.95				
X 7)	GPTAU	6.250	11/07/2010		100.23				
8)	BQDAU	6.000	12/02/2010	99.92	99.81	0.00	6.05	-7.62	-0.11
9)	DXSAU	6.750	2/08/2011	100.71	100.82	0.00	6.31	7.27	0.12
X10)	CWNAU	6.280	5/06/2011		99.87				
X11)	FXJAU	6.865	6/27/2011		100.74				
12)	ORGAU	6.500	10/06/2011	100.05	99.60	0.00	6.47	-20.52	-0.45
13)	TABAU	6.500	10/13/2011	99.69	99.57	0.00	6.64	-5.24	-0.12
X14)	SYDAAU	6.250	11/21/2011		98.78				
15)	WESAU	6.000	7/25/2012	95.93	96.56	0.00	7.44	22.92	0.63
X16)	SNOWY	6.500	2/25/2013		96.69				
17)	SANTOS	6.250	9/23/2015	91.54	91.62	0.00	7.97	1.87	0.09

Note that a ‘cross’ next to a bond indicates that it was not used by Bloomberg to estimate its fair value curve.

Table 7: All A and BBB rated bonds with Bloomberg pricing on the 6th May 2005

Bond	Maturity	Term to Maturity	Yield	CGS FV
BBB				
ENPGAS 6.5Corp	29/07/2009	0.23	5.82	2.64
DXSAU 6.75Corp	4/02/2010	0.75	6.33	2.68
SNOWY 5.75 Corp	25/02/2010	0.81	5.92	2.68
FBG 6.25 Corp	17/03/2010	0.86	5.35	2.69
BACAU 7.3 Corp	30/06/2010	1.15	6.50	2.80
MGRAU 6.75 Corp	15/09/2010	1.36	6.69	2.93
GPTAU 6.25 Corp	7/11/2010	1.51	18.58	3.02
BQDAU 6 Corp	12/02/2010	0.77	6.05	2.68
DXSAU 6.75 Corp	8/02/2011	1.76	6.31	3.18
CWNAU 6.28 Corp	6/05/2011	2.00	7.58	3.33
FXJAU 6.865 Corp	27/06/2011	2.14	21.28	3.38
ORGAU 6.5 Corp	6/10/2011	2.42	6.47	3.49
TABAU 6.5 Corp	13/10/2011	2.44	6.64	3.50
SYDAAU 6.25 Corp	21/11/2011	2.54	7.49	3.54
WESAU 6 Corp	25/07/2012	3.22	7.45	3.78
SNOWY 6.5 Corp	25/02/2013	3.81	7.46	3.96
SANTOS 6.25 Corp	23/09/2015	6.38	7.97	4.50
A				
AANAU 6.75 Corp	15/09/2009	0.36	4.98	2.65
TCLAU 6 Corp	7/12/2009	0.59	4.81	2.66
CITI 5.75 Corp	28/02/2010	0.82	5.82	2.69
TELECO 7.25 Corp	30/03/2010	0.90	4.71	2.69
WDCAU 5.5 Corp	15/07/2010	1.19	8.34	2.83
CBA 6 Corp	20/07/2010	1.20	6.00	2.83
HBOS 5.75 Corp	26/10/2010	1.47	6.66	3.00
CFXAU 6.5 Corp	12/11/2010	1.52	7.33	3.03
WOWAU 6 Corp	14/03/2011	1.85	5.70	3.24
RBS 8.5 Corp	10/06/2011	2.09	5.88	3.37
SGPAU 6.25 Corp	16/06/2011	2.11	9.62	3.37
CPFAU 6.6 Corp	28/06/2011	2.14	6.71	3.38
TCLAU 6.5 Corp	15/09/2011	2.36	6.26	3.47
HBOS 6.25 Corp	19/10/2011	2.45	7.79	3.50
SPOWER 6.5 Corp	3/11/2011	2.49	6.12	3.52
SPOWER 6.25 Corp	30/11/2011	2.57	6.21	3.55
CFXAU 5.75 Corp	2/09/2012	3.33	9.00	3.81
TELECO 7.25 Corp	15/11/2012	3.53	6.41	3.88
SGPAU 6 Corp	15/05/2013	4.02	11.71	4.03
TELECO 6.25 Corp	15/11/2013	4.53	6.96	4.19
CIVIC 6.5 Corp	15/09/2014	5.36	7.27	4.38
TELECO 6.25 Corp	15/04/2015	5.94	7.41	4.45