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Electranet: Estimating the benchmark debt risk premium

Electranet Pty Ltd

Estimating the benchmark debt risk premium

May 2012

Contents

Executive summary

1.1 Introduction

ElectraNet engaged PricewaterhouseCoopers (PwC) to estimate the debt risk premium to assist ElectraNet in formulating its revenue proposal for submission to the Australian Energy Regulator (AER). In this report we address the following Terms of Reference:

- Whether the AER's approach, as adopted in its recent decisions, results in a value for the debt risk premium that results in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating and a maturity of 10 years; and allows for an overall rate of return commensurate with the regulatory and commercial risks involved in providing transmission services.

- Our advice on what is a reasonable basis for estimating the debt risk premium for a benchmark transmission business that would: result in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating a maturity of 10 years; and allows for an overall rate of return commensurate with the regulatory and commercial risks involved in providing transmission services.

1.2 The debt risk premium – recent developments

While the methodologies applied by the Australian Energy Regulator (AER) to estimate a debt risk premium for a 10 year BBB+ bond have varied over recent years, the Bloomberg fair value curve has remained a continuous benchmark, which the Australian Competition Tribunal (ACT or the Tribunal) has endorsed due to its:[1]

- Widespread use in the market for funds;

- Being representative of conditions in the market for funds; and

- Providing a 'good fit' to the available bond data.

The AER's methodologies for estimating the debt risk premium

Prior to the global financial crisis the estimation of the debt risk premium was based on a relatively straightforward application of the Bloomberg and/or the CBA Spectrum fair value curves, and the difference between these estimates lay in the range of 15 to 25 basis points. During the global financial crisis the differential between the estimates obtained from the Bloomberg and CBA Spectrum curves widened considerably, and the AER's methodology consisted of choosing between the curves based on observations for as few as 5 fixed coupon bonds with terms to maturity greater than 2 years.

When the CBA Spectrum curve was withrawn from the market in August 2010, the AER adopted the Australian Pipeline Trust (APA) bond as the counterweight to the

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1 See Application by Jemena Gas Networks (NSW) Ltd (No 5) [2011] ACompT 10 (9 June 2011), para. 86;.and Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 1 (6 January 2012), para. 440.

extrapolated Bloomberg curve, and calculated a weighted average debt risk premium based on arbitrarily chosen weights. This approach was rejected by the Tribunal, after which the AER adopted a new methodology, which was to calculate the simple average of the debt risk premiums for a sample of bonds with terms to maturity between 7 and 13 years. Using this methodology the AER estimated a debt risk premium of 319 basis points in its draft decision for Powerlink.

Our critique of the AER's Powerlink draft decision methodology

In a report for Powerlink after the AER's draft decision, we documented how the AER had misapplied its new methodology, and found that a correct application of its methodology would have derived a debt risk premium approximately 35 basis points higher. We also found that by applying an econometric analysis to a broad sample of bonds across a spectrum of terms to maturity for the AER and Powerlink averaging periods, an implied debt risk premium in the range of 378 to 380 basis points was obtained compared with the range of 391 to 408 basis points indicated by an extrapolated Bloomberg curve. We recommended that the AER adopt the upper end of the range of estimates, which is defined by the extrapolated Bloomberg curve, as the econometric evidence indicated a debt risk premium that was relatively closer to the extrapolated Bloomberg curve.[2]

The Tribunal's recent decisions

The relative convergence of our regression-based estimates and the extrapolated Bloomberg curve came as the Tribunal issued a number of decisions that once again focussed attention on the extrapolated Bloomberg curve. In its decision on Jemena Gas Networks (JGN) the Tribunal found that when the Bloomberg and CBA Spectrum curves were compared against the relevant data, the former was found to provide the best fit.[3]

Subsequently, in its decision on a joint appeal by five Victorian electricity distribution businesses the Tribunal continued to express strong support for reliance on the Bloomberg fair value curve to estimate the debt risk premium:[4]

> JEN submitted, and the Tribunal agrees, that it was unreasonable for the AER to reject its proposal to rely on the Bloomberg FV curve and instead to incorporate also the yield from a single bond which it had not demonstrated in any way to be a relevant benchmark or comparator bond. The AER appeared only to rely on the fact that the APT bond was appropriate because it was a 10-year bond issued by a company with infrastructure interests and that it had a lower yield than that predicted by the Bloomberg FV curve.

Importantly, the Tribunal found that:[5]

> In addition, there was evidence before the AER to show that the Bloomberg fair value curve provided an accurate representation of the yields on benchmark corporate bonds and that it was widely accepted by market practitioners.

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[2] We originally reported that the econometric evidence provided an estimated debt risk premium range of 360 to 367 basis points, however we later discovered that we had inadvertently included three SP AusNet bonds, which we had held not to be appropriate due to their Singapore Government ownership. Hence, in a follow-up letter to the AER we recommended with greater conviction the adoption of a debt risk premium close to the extrapolated Bloomberg curve.

[3] Application by Jemena Gas Networks NSW) Ltd (No 5) [2011] ACompT 10 (9 June 2011), paras. 88-90.

[4] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 434. This was a joint appeal including five parties: United Energy Distribution Pty Limited; SPI Electricity Pty Limited; Citipower Pty Limited and Powercor Australia Limited. Other similar Tribunal decisions at this time included: Application by Envestra Limited (No 2) [2012] ACompT 3 (11 January 2012); and Application by APT Allgas Energy Limited (no 2) [2012] A CompT 5 (11 January 2012)

[5] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 436.

As part of the appeals by five Victorian electricity distribution businesses the Tribunal provided a debt risk premium of 434 basis points to Jemena Electricity Networks (based on the extrapolated Bloomberg fair value curve), with the Tribunal concluding that:[6]

> The Tribunal emphasises that it is important for the AER to estimate the DRP and other WACC components with rigour and transparency, using comprehensive market-accepted data and offering some degree of certainty about the way in which it will apply the various estimating formulae (including the DRP formula) to a regulated company. Its estimating practices, data sources and reference periods must be well articulated, consistent and communicated to the parties and must, generally speaking, follow the precedents well-established in previous decisions made by the Tribunal in *Application by ActewAGL Distribution and Application by Jemena Gas Networks (NSW) Ltd (No5).*

Alongside the Tribunal's endorsement of the Bloomberg fair value curve, these statements suggest that if an alternative methodology to the extrapolated Bloomberg fair value curve is proposed, it should be based on a rigorous and transparent approach, and sound reasons would need to be provided to depart from reliance on the Bloomberg curve.

Most recently Envestra Limited and APT Allgas Energy Limited sought review of the AER's approach to estimating the DRP in the 2011 and 2016 gas access arrangement decisions. In those appeals the Tribunal found that the AER's methodology of averaging the Bloomberg fair value curve with the APT bond was in error and directed the use of the Bloomberg fair value curve for estimating the debt risk premium. The Tribunal found that there was no reason shown from the available material why the use of the extraploated Bloomberg fair value curve should not be adopted.[7]

The AER's reassessment of debt risk premium methodologies in the Powerlink final decision[8]

In its final decision on Powerlink's transmission determination, the AER accepted Powerlink's estimate of the debt risk premium, which was 393 basis points for the final Powerlink averaging period spanning the 40 business days from 6 February 2012 to 30 March 2012. Powerlink's methodology was to extrapolate the 7 year Bloomberg BBB debt risk premium to 10 years using the observed difference in the debt risk premium on pairs of bonds issued by the same entity (referred to below as the 'paired bonds' extrapolation method). The AER compared the debt risk premium estimate obtained using Powerlink's methodology, against the estimates that would have been obtained using two alternative extrapolations of the Bloomberg 7 year BBB fair value curve:[9]

- 401 basis points - if the last historical spread between the debt risk premiums obtained using the 7 and 10 year AAA rated fair value curves was applied; and
- 367 basis points – if a linear extrapolation were undertaken using the 5 and 7 year Bloomberg BBB fair value curve debt risk premiums.

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6 Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 462.

7 Application by Envestra Limited (No 2) [2012] ACompT 3 (11 January 2012), para. 123.

8 The AER's final decisions on Powerlink and Aurora were released after this assignment for Electranet had been mostly completed. We note that, as a consequence of the change in the AER's preferred method, some of the material may prove redundant; however, we have retained it nonetheless for completeness.

9 Australian Energy Regulator (April, 2012) Final decision – Powerlink Transmission determination 2012-13 to 2016-17, pp. 183-185.

The AER considered that there are weaknesses in all three approaches, but accepted the 'paired bonds' extrapolation methodology 'in the absence of a more robust alternative approach.'[10] The AER explained that it also adopted Powerlink's revised proposed approach due to the Tribunal's recent decisions, which supported methodologies incorporating reliance on the Bloomberg fair value curve. In conclusion, the AER noted that it was adopting Powerlink's revised proposed approach until it has 'undertaken a public consultation process to determine alternative methodologies'.[11]

In view of the conclusions reached in this report, our view is that the AER's method in the Powerlink final decision would:

- result in a value for the debt risk premium that results in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating and a maturity of 10 years; and
- allow for an overall rate of return commensurate with the regulatory and commercial risks involved in providing transmission services.

1.3 Estimating the debt risk premium

Extrapolated Bloomberg fair value curve

Noting the Tribunal's continuing endorsement of the extrapolated Bloomberg fair value curve, we have relied on this curve as the most comprehensive published embodiment of market opinion about the debt risk premium. In the current report we have estimated the debt risk premium for an averaging period that covers the 20 business days up to and including 18 November, 2011, which was the last date for which we had data from both AFMA and UBS, which could be cross-referenced to the Bloomberg data. For the defined averaging period the 7 year Bloomberg BBB fair value curve estimated a debt risk premium of 354 basis points.

The AER objected to our extrapolation of the Bloomberg curve in our earlier report for Powerlink, where we used the average annual increment in the debt risk premium observed among 9 (mostly 'A' credit rated) pairs of bonds, where a pair refers to two bonds that had been issued by the same entity . The basis for the AER's objection was that the terms to maturity of many of the longer bonds in these pairs were much shorter than 10 years. We have responded to the AER's objection by limiting the sample of paired bonds to those where:

- the paired bonds were part of the wider sample that we used in our econometric analysis,
- the longer dated bond had a term to maturity that is close to 10 years,
- the shorter dated bond had a term that is closest to the shorter term that is of concern (i.e. closest to 7 years), and
- the match was between a pair of fixed coupon bonds, or a pair of floating rate bonds.

Three pairs of bonds were chosen on the basis of these selection criteria: a pair of 'A-' rated Stockland fixed coupon bonds, a pair of 'A' rated Telstra fixed coupon bonds, and a pair of 'BBB' rated Sydney Airport floating rate bonds. For the test

[10] AER (April, 2012), p. 185.

[11] AER (April, 2012), p. 185.

averaging period ending 18 November, 2011, these paired bonds showed an average annual increment of 9.1 basis points.

By adding the observed 9.1 basis points annual increment to the 7 year Bloomberg BBB fair value curve estimate of 354 basis points, we derived an estimated 10 year BBB+ debt risk premium of **381 basis points**.

Structure of the underlying bond yield data

While the extrapolated Bloomberg curve has provided an estimated debt risk premium of 381 basis points for our averaging period, our approach was to cross-reference this finding against an econometric analysis that incorporates data drawn from two additional bond yield data sources that are widely used by participants in the Australian bond market:

- the corporate bond yield data base of the Australian Financial Management Association (AFMA); and
- the daily term sheets issued by the investment bank UBS.

The guidance provided by the Australian Competition Tribunal has emphasised the importance of understanding the underlying bond yield data that is used in estimating the debt risk premium. Therefore, prior to undertaking our econometric analysis, the key questions we addressed were whether the yield data is:

- reflective of market opinion, and
- up-to-date (i.e. not 'stale').

It is important to first understand that the bond yields that are reported by the service providers such as Bloomberg and the Australian Financial Management Association (AFMA) and UBS are in the vast majority of cases not the yields that have resulted from actual trades of bonds. Rather, they are the opinions of the likely trading yield that would apply if the bonds were to be traded. On most days these yields are set to a fixed margin above a reference curve such as the Swap Curve or Asset Swap Curve (ASW), but from time to time the financial institutions that provide yield quotes to service providers such as Bloomberg and AFMA will adjust the yield margin above the reference curve based on new information. The new information could include actual trades the bond in question or for comparable bonds, the pricing of a new issue of bonds, or specific information relating to the credit quality of the bond. Each day these financial institutions will report to the service provider a yield for each bond that they cover (we refer to these quotes as the 'bank feeds'), but for the vast majority of days for any single bond, this yield will be derived by adding the previous day's margin to that day's reference rate.[12]

Our sample was drawn from the population of 955 fixed coupon and floating rate corporate bonds in the Australian market and available between 4 April 2010 and 18 November 2011 within the data bases of Bloomberg, AFMA and UBS. We then filtered the sample to include only bonds that were:

- issued in Australia,
- rated BBB, BBB+ or A- by Standard & Poor's,

[12] Based on discussions with Michael Bush, Head of Fixed Interest Research, National Australia Bank, who confirmed that NAB references its bond yield margins to the Asset Swap Curve and undertakes pricing re-sets when new information such as a new bond issue is observed.

- issued by a corporate (i.e. not a financial entity),
- not affected through significant ownership by a sovereign entity,
- senior debt (i.e. not subordinated),
- standard corporate bonds without special features such as call options, and
- had a term to maturity greater than one year.

We found that over the study period from 4 April 2010 and 18 November 2011 the total number of bonds with more than 7 years remaining to maturity has increased from 5 to 7, while the proportion of longer dated fixed coupon bonds increased from 0 per cent to 43 per cent. We also observed that for the full sample over the entire study period:

- UBS accounted for 44 per cent of the fixed coupon bond yield day observations and 74 per cent of the trading margin day observations for floating rate bonds;[13]
- Bloomberg accounted for 34 per cent of the fixed coupon bond yield day observations, and did not provide trading margins for floating rate bonds; and
- AFMA had the lowest proportion of the fixed coupon bond yield day observations (22 per cent), and only 26 per cent of the trading margin day observations for floating rate bonds.

It should also be noted that the number of bonds in our final sample varied over the 19 month study period, ranging from 66 at the start (20 business days beginning 4 April, 2010), reaching a maximum of 68 bonds and a minimum of 55 bonds. For the 20 business day averaging period to 18 November, 2011, there were 63 bonds.

Assessing the quality of the data

Our first consideration was to assess whether Bloomberg yields (BGNs) and UBS yields were reflective of the market's opinion over the study period. We did this by calculating for the entire study period the average difference (expressed in basis points) between the median of the Bloomberg bank feeds, and the yields reported by Bloomberg (i.e. Bloomberg BGNs) and UBS. The results were as follows:

- **Bloomberg BGNs** – on average over the entire study period Bloomberg BGNs were 2 basis points lower than the median of the Bloomberg bank feeds.
- **UBS yields** – on average over the entire study period UBS yields were 4 basis points lower than the median of the Bloomberg bank feeds.

As a general rule, therefore, over the whole study period, the data sources that we have relied on could be said to be reflective of market opinion, as represented by the Bloomberg bank feeds.

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[13] That is, UBS accounted for 44 per cent of the total of bond yield day observations for all the bond yield days of observations from the three data sources. That is, for some bonds we found bond yield days of observations for all three data providers, for some bonds there were only two providers with observations for particular days, while for some bonds only one provider reported yields for particular days.

In order to test for potential staleness of the data, i.e. whether it can be considered to be reflective of current market conditions, we examined the daily UBS bond yield service. We could only apply this test to the bond yield opinions published by a single provider, and UBS presented by far the most comprehensive data set for this purpose. In 85 per cent of cases for the UBS data there was enough continuous daily yield data to apply the Quandt-Andrews breakpoint test, which tests for whether there is a structural change in the relationship of the data with respect to time. That is, it tests whether there has been a sufficient jump in the margin at some points in time to be reasonably confident that there had been a major and sustained revision, which is consistent with UBS having revised its opinion of the pricing of the bond based on new information. We found that all 79 of the UBS bonds that could be tested had a structural break in their margins over the 6 months prior to 18 November, 2011.

Having established a degree of confidence that the yield data provided by the three service providers was reflective of the market for funds, and that UBS data (which we have found to be highly correlated with broader market opinions represented by Bloomberg feeds) is not stale or outdated, we used a simple average of the yields provided by all three services where available.[14] In some cases, however, this meant that the average of two, or a single provider's bond yields would be taken as the yield value. This provided the maximum possible source of data using these three services.

Undertaking an econometric regression analysis

In order to undertake an econometric analysis to estimate the debt risk premium, we needed to specify the form of the relationship between debt risk premium and term to maturity, i.e. the functional form, or shape of the debt risk premium curve. At a theoretical level, Merton's 1974 theory of bond pricing proposed a humped relationship between the debt risk premium and term. However, this theory has been challenged in the literature due to a perceived inability to explain empirical findings. As noted by Covitz and Downing (2007):[15]

> ...direct tests of Merton-style models find that the models seriously under predict the level of long-term bond spreads.

In academic circles this tendency for Merton-style models to under-predict yield spreads has been called the 'credit puzzle'. In fixed interest markets, practitioners have observed that corporate bond spreads have almost always been upward sloping. In 1999 Helwege and Turner found that it is generally only the most credit worthy firms in a credit rating band issue long dated bonds, which can give the impression of a 'humped' relationship, but when paired bonds were tested (holding constant their credit worthiness) they found that the relationship is overwhelmingly upward sloping.[16] Litterman and Iben, of the Fixed Income Research Department of Goldman Sachs, noted this in their 1991 paper:[17]

> ...we find that the term structure of corporate spreads is generally upward-sloping, indicating a market perception of higher probabilities of default in the more distant future.

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14 UBS does not provide yield data to either of Bloomberg or AFMA (i.e. it is not one of the 'bank feeds' to these providers).

15 Dan Covitz and Chris Downing (October, 2007), 'Liquidity or Credit Risk? The Determinants of Very Short-Term Corporate Yield Spreads,' *Journal of Finance*, Vol. 62, No. 5, pp. 2303-2328.

16 Helwege, J. and C.M. Turner, (1999), 'The slope of the credit yield curve for speculative grade issuers, *Journal of Finance*, Vol. 54, pp.1869-1884.

17 Robert Litterman and Thomas Iben (Spring, 1991), 'Corporate bond valuation and the term structure of credit spreads,' *Corporate Journal of Portfolio Management*, p.54.

While it is generally accepted that the debt risk premium rises with term to maturity, a point of debate is whether the relationship is linear, or a concave function (i.e. where the premium increases with term but at a decreasing rate). Empirical research has provided evidence of both linear and non-linear relationship. To account for both linear and non-linear functional forms, we estimated regressions using various functional forms representing both shapes, and then tested for which functional form was superior. The following common non-linear functions were tested:

- quadratic
- exponential
- logarithmic, and
- power.

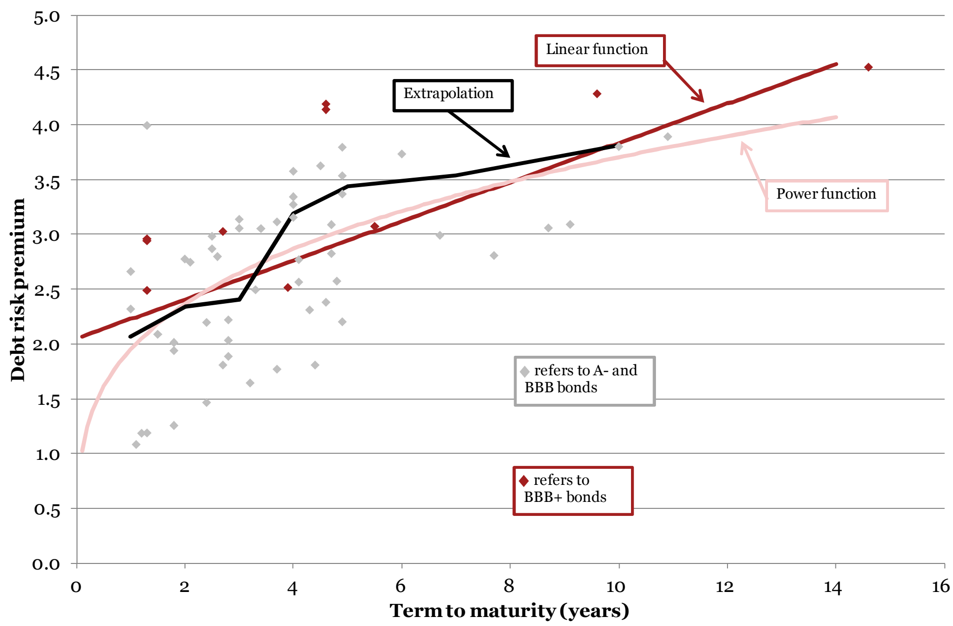
The results of our econometric regression analysis

To test for the best functional form we applied the Schwatz Information Criterion (SIC), otherwise known as the 'Bayesian Information Criterion.' This test takes account of the number of variables a functional form requires to achieve its goodness of fit. The optimal functional form is one that fits the data best, and uses a minimum number of variables.

For each of the functional forms listed above, we undertook 392 regressions, i.e. one per day, where each day's regression was based on the debt risk premiums calculated for the previous 20 day averaging period. We found that in 322 of these regressions (82.4 per cent), the linear form had the best (lowest) SIC, while in 69 cases (17.6 per cent) the power function had the best (lowest) SIC. For the 20 day averaging period ending 18 November, 2011, the extrapolated Bloomberg curve (381 basis points), was positioned in between the linear function estimate (384 basis points) and the power function estimate (371 basis points).

These estimates are shown in Figure ES 1 below. In observing this figure, it is noteworthy that of the 10 BBB+ rated bonds in the sample, only two lay below the extrapolated Bloomberg, linear and power curves. However, we have reservations about inferring the debt risk premium for a 10 year BBB+ bond with only 3 BBB+ bond yield observations with greater than 5 year terms to maturity. That is why we have placed greater emphasis on our broader 'pooled' analysis that includes bonds from the BBB, BBB+ and A- credit rating bands.

Figure ES1 – Debt risk premium estimates for 20 business days to 18 November 2011 (basis points)



Source: PwC's analysis, Bloomberg, UBS, AFMA

Conclusion on the debt risk premium

For the 20 day averaging period to 18 November, 2011, we found a close correspondence between the extrapolated Bloomberg estimate of the 10 year BBB+ debt risk premium and our own econometric estimates (whether based on a linear or power function), which rely on a different sample of bonds, and have applied a different estimation methodology. Based on these findings, we recommend that the extrapolated Bloomberg curve be applied to estimate the debt risk premium.

1.4 Applying the methodology to ElectraNet's averaging period

ElectraNet informed us that it had selected an averaging period for the 10 business days spanning 9 May, 2012 to 22 May, 2012. We therefore applied the methodology developed in this report to ElectraNet's chosen averaging period. Table ES1 below shows that application of the methodology developed in this report derived a debt risk premium estimate of **398 basis points** for Electra Net's averaging period. This estimate of the 10 year BBB+ debt risk premium was obtained through the summation of:

- The debt risk premium estimated on the basis of the Bloomberg 7 year BBB credit rating fair value curve (376 basis points); and

- An extrapolation component from 7 to 10 years, which was estimated by reference to the average annual increment in the debt risk premium for three groups of paired bonds (i.e. 7.4 basis points per annum, which for three years provided an extrapolation value of 22.2 basis points).

Table ES1 –Debt risk premium estimate applying the Bloomberg 'paired bonds' extrapolation for the 10 business days to 22 May, 2012 (basis points)

Bond Issuer	Short Maturity (years)	Long Maturity (years)	Debt Risk Premium – Bloomberg (basis points)	Debt risk premium - UBS (basis points)	Debt risk premium increment per year (basis points)
Telstra	4.2	8.2	10.4	10.2	10.3
Stockland	4.1	8.6	4.4	1.8	3.1
Sydney Airport	3.5	9.5	n/a	8.8	8.8
Average annual increment			**7.4**	**6.9**	**7.4**
3 years of average increment					22.2
Plus, Bloomberg 7 year debt risk premium					376
Extrapolated debt risk premium					**398**

Source: Bloomberg, PwC

2 Scope and report outline

2.1 Scope

ElectraNet has engaged PricewaterhouseCoopers (PwC) to estimate the debt risk premium to assist ElectraNet in formulating its revenue proposal for submission to the AER later this year.

As set out in our letter of engagement (dated 7 November, 2011), this report addresses the following Terms of Reference:

- Whether the AER's approach, as adopted in its recent decisions, results in a value for the debt risk premium that:
  - when combined with the appropriate risk-free rate, results in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating and a maturity of 10 years; and
  - when used in the WACC formula, results in a rate of return that is commensurate with the return required by investors in a commercial enterprise with a similar nature and degree of non-diversifiable risk as that faced by the transmission business of ElectraNet
- Provides our advice on what is a reasonable basis for estimating the debt risk premium for a benchmark transmission business that would:
  - result in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating a maturity of 10 years; and
  - allows for an overall rate of return commensurate with the regulatory and commercial risks involved in providing transmission services.

2.2 Outline of report

In undertaking our assessment of the above issues, we have structured the remainder of the report as follows:

- Chapter 3 provides an overview of recent regulatory decisions made by the AER in relation to the debt risk premium, how these decisions have been dealt with by the Australian Competition Tribunal in the course of appeals, with our views on the AER's most recent methodology.
- Chapter 4 presents our empirical analysis of alternative data sources for estimating the debt risk premium, establishing whether the data is reflective of the market for funds.
- Chapter 5 outlines a more sophisticated empirical analysis approach, which is used to estimate the debt risk premium for a 20 business day averaging period to 18 November, 2011. We then apply our preferred methodology to the averaging period nominated by ElectraNet.

3 Estimating the debt risk premium

3.1 Introduction

In this chapter we examine how the debate about estimation of the debt risk premium has developed since the onset of the global financial crisis, and how the AER's methodology to estimate the debt risk premium has evolved alongside the Australian Competition Tribunal's (ACT or Tribunal) decisions relating to this parameter. We then examine the recent methodologies applied by the AER in estimating the debt risk premium.

The debt risk premium methodologies applied or approved by the AER can be divided into the following three periods:

- Prior to August 2010 – Choosing which of the extrapolated Bloomberg and CBASpectrum curves provided the best performing fair value curve (i.e. best reflects the underlying bond yield data).
- Between September 2010 and November 2011 – Calculating the debt risk premium as the weighted average of the extrapolated Bloomberg BBB fair value curve and the yield on a single Australian Pipeline Trust (APA) bond.
- From December 2011 to March 2012 – Taking the simple average of a chosen sample of fixed and floating rate bonds with an average credit rating of BBB+, and an average term to maturity of approximately 10 years within a range of 5 to 15 years.
- From April 2012 – in its final report the AER accepted the methodology put forward in Powerlink's revised proposal, which was to apply an extrapolation of the Bloomberg 7 year BBB fair value curve to 10 years using a 'paired bonds' extrapolation method.

We consider the AER's approach in each of these periods in turn.

3.2 Choosing between the extrapolated Bloomberg and CBASpectrum curves

Throughout the global financial crisis, and up to September 2010, Bloomberg and CBASpectrum provided competing fair value curves. From the beginning of the global financial crisis late in 2008, CBASpectrum's fair value curve began to diverge from Bloomberg's, rising well above the latter, which stayed relatively flat in conditions of unprecedented financial markets risk. By the end of 2009 the Bloomberg curve and the CBASpectrum curve had converged. As Bloomberg had ceased providing yield estimates beyond 7 years from 18 August 2009, the Tribunal endorsed an extrapolation of the Bloomberg BBB curve by adding on the change in the Bloomberg AAA curve between 7 and 10 years.

ActewAGL proposed an averaging of the extrapolated Bloomberg and CBASpectrum curves. The AER rejected this and used a sample of bonds to test which of the curves was most accurate. The AER's sample of bonds included those with a term to maturity of more than 2 years, and excluded bonds with the following characteristics:

- not rated BBB+ by Standard & Poor's,
- do not have a yield estimate from all of CBASpectrum, Bloomberg and UBS, and
- excluded floating rate bonds, bonds not issued in Australia, and bonds issued in Australia by a foreign business.

After excluding a high yield DBCT bond from the sample, this left 5 bonds. The AER then compared to the predicted Bloomberg and CBASpectrum fair value curves to the yield on these bonds and selected the curve that had the lowest weighted sum of squared errors (WSSE). Applying its methodology, the AER found that the CBASpectrum curve lay closer to the 5 observed bond yields.

In its decision on ActewAGL in September 2010, the Tribunal upheld ActewAGL's proposal to average the Bloomberg and CBASpectrum curves and suggested that the AER undertake the following process:[18]

> a) assemble a representative population of observed yields of sufficient number and term to maturity. It is difficult for the Tribunal to provide any hard and fast rule for determining whether a population is 'representative'. A representative population would contain many bonds after the point at which the bonds diverge. It should contain bonds with a term to maturity close to 10 years. The AER should include floating rate bonds and/or bonds with observations available from one or two sources in the population unless there is good reason to exclude them. The inclusion of these bonds may raise questions which the AER will need to address in the future, such as the weighting that should be given to them;
>
> b) only exclude bonds where there are sufficient qualitative reasons to consider that they are not correctly classed as being part f the relevant population;
>
> c) once a representative set of bonds has been chosen and refined in this way, select the fair value curve that most closely corresponds to the relevant set;
>
> d) use any other information, such as observed yields on other rated bonds, to check that the selected fair value curve remains likely to provide the best estimate.

While not wishing to discourage the AER from investigating other ways to estimate the debt risk premium, the Tribunal concluded that it was 'appropriate to average the yields provided by each curve, so long as the published curves are widely used and market respected.'[19] The Tribunal ordered that the average of CBA Spectrum's BBB+ and Bloomberg's extrapolated BBB fair value curves be calculated, consistent with ActewAGL's proposal, which raised the debt margin by 53 basis points to 3.89 per cent.[20].

3.3 Averaging the Bloomberg curve and the APA bond

CBASpectrum discontinued publication of its fair value curve from mid-August, 2010. It cited CBASpectrum's poor performance, increasing disparity of the data, and changing historical relationships due to the global financial crisis as the reasons for discontinuance.[21] This caused the AER to change its approach to debt premium estimation. The Australian Pipeline Trust (APA) had recently issued a 10 year BBB rated bond. The AER concluded that the debt risk premium should be calculated as a weighted average of the yield on the APA bond and the extrapolated

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[18] Application by ActewAGL Distribution [2010] ACompT4, para.77.

[19] Application by ActewAGL Distribution [2010] ACompT4, para.78.

[20] Application by ActewAGL Distribution [2010] ACompT 4

[21] From CBASpectrum website, accessed 8 September, 2010.

Bloomberg curve, albeit with the weights being determined by judgement, and varying between decisions. This method was appealed against to the Tribunal.

In 2010 the Victorian electricity distributors applied the extrapolated Bloomberg BBB fair value curve. Rejecting this, the AER proposed the weighted average of the yield of the Australian Pipeline Trust bond (25 percent), and the extrapolated Bloomberg BBB fair value curve (75 percent), resulting in margins of 374 basis points for Citipower, Powercor and United Energy, 405 basis points for SP Ausnet and 370 basis points for Jemena Electricity networks. [22] A subsequent appeal by Jemena for technical errors in the AER's application of the methodology resulted in its debt margin being raised further.

The Tribunal has provided strong endorsement to the Bloomberg fair value curve in several of its decisions. In Jemena's appeal it was noted that:[23]

> The Tribunal has previously endorsed the Bloomberg fair value (FV) curve in Application by Jemena Gas Networks (NSW) Ltd (No 5) (2011) ATPR 42-360 as being the suitable benchmark for estimating the DRP in Australia. A major reason for this is that this curve appears to be accepted by the market as providing accurate estimates of the benchmark corporate bond rate.

The Tribunal expressed strong support for the businesses to propose reliance on the Bloomberg fair value curve to estimate the debt risk premium:[24]

> JEN submitted, and the Tribunal agrees, that it was unreasonable for the AER to reject its proposal to rely on the Bloomberg FV curve and instead to incorporate also the yield from a single bond which it had not demonstrated in any way to be a relevant benchmark or comparator bond. The AER appeared only to rely on the fact that the APT bond was appropriate because it was a 10-year bond issued by a company with infrastructure interests and that it had a lower yield than that predicted by the Bloomberg FV curve.

Furthermore, the Tribunal found that:[25]

> In addition, there was evidence before the AER to show that the Bloomberg fair value curve provided an accurate representation of the yields on benchmark corporate bonds and that it was widely accepted by market practitioners.

The Tribunal provided Jemena with a debt risk premium of 434 basis points (based on the extrapolated Bloomberg fair value curve), with the Tribunal concluding that:[26]

> The Tribunal emphasises that it is important for the AER to estimate the DRP and other WACC components with rigour and transparency, using comprehensive market-accepted data and offering some degree of certainty about the way in which it will apply the various estimating formulae (including the DRP formula) to a regulated company. Its estimating practices, data sources and reference periods must be well articulated, consistent and communicated to the parties and must, generally speaking, follow the precedents well-established in previous decisions made by the Tribunal in *Application by ActewAGL Distribution and Application by Jemena Gas Networks (NSW) Ltd (No5).*

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[22] AER (October, 2010*), Final Decision – Victorian electricity distribution network providers, Distribution determination, 2011-2015.*

[23] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 400.

[24] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 434.

[25] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 436.

[26] Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 461.

Envestra proposed a debt risk premium based on the extrapolated Bloomberg fair value curve. Rejecting this, the AER applied equal weightings to the APT bond, and an extrapolated Bloomberg BBB fair value curve, resulting in a debt margin of 393 basis points. This was appealed by Envestra and APT Allgas.[27] While the Tribunal acknowledged that it is for the AER to determine whether to rely on the Bloomberg curve, the Tribunal stated that sound reasons would need to be provided for the AER to depart from its previous practice of accepting the Bloomberg fair value curve:[28]

> The Tribunal, of course, accepts that in the first instance it is for the AER to determine whether to rely upon the Bloomberg curve, or to accept the extrapolation of that curve in the manner done in the past. It is not obliged to do so, although there were sound reasons to depart from that practice. For the future, that is a matter for the AER.

While the Tribunal also indicated that it is open for the AER to adopt a different methodology, this process would need to consider:[29]

> …the proper composition of the comparison sample of bonds, the methodology for deciding on the appropriate sample of bonds and the relevance of these bonds to its task should be undertaken by the AER on consultation with interested parties across the spectrum of entities in the industries it regulates, consumers of their services and other interested parties.

The AER had placed considerable reliance on the Bloomberg curve in the past. As noted by the Tribunal in its Envestra decision:[30]

> There had been identified to the AER a range of other bonds, some of which lay below the EBV and some above the EBV. Had the AER considered them, its caution about the limited use of the EBV may have been resolved. The hybrid position emerges from the fact that the AER nevertheless decided to rely on the EBV as one of the two significant inputs into its weighting process. It must have regarded the EBV as relevant and meaningful.

In its Envestra decision, the Tribunal concluded the following:[31]

> Envestra provided to the AER strong evidence in support of the EBV, in particular by its response to the May 23 letter. The view of Dr Hird of CEG was that that material did not demonstrate any basis for the substitution of an alternative estimate for the EBV. As noted, the AER itself accepted the relevance of the EBV. Whilst the Tribunal accepts that the AER properly considered the reliability of the EBV, it has reached the view on the available material that there is no reason shown from the available material why the use of the EBV should not be adopted in this particular matter. There is no viable alternative methodology at present, other than making a decision on all the material. The observations of the Tribunal in ActewAGL at [74]-[78] suggest that, on the existing material, it is appropriate to vary the decision in the manner indicated.

In light of these Tribunal decisions, it became untenable for the AER's to continue advocating its hybrid approach of using a weighted average of the APA bond and the Bloomberg curve.

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27 Application by Envestra Limited (No 2) [2012] ACompT 4 (11 January 2012), and Application by APT Allgas Energy Limited (No 2) [2012] ACompT 4 (11 January 2012).

28 Application by Envestra Limited (No 2) [2012] ACompT 4 (11 January 2012), para. 120.

29 Application by Envestra Limited (No 2) [2012] ACompT 4 (11 January 2012), para. 121.

30 Application by Envestra Limited (No 2) [2012] ACompT 4 (11 January 2012), para. 103.

31 Application by Envestra Limited (No 2) [2012] ACompT 3 (11 January 2012), para. 123.

3.4 A simple average of debt risk premiums

3.4.1 The AER's simple average of debt risk premiums methodology (Powerlink and Aurora draft decisions)

Even before the Tribunal published its findings on the Envestra and Jemena appeal decisions referenced above, the AER had revised its approach to estimating the debt risk premium. The AER's new approach was applied in its draft decisions relating to Powerlink's and Aurora Energy's 2012-13 to 2016-17 revenue determinations.[32] In these recent draft decisions, the AER's new methodology does not make use of the Bloomberg fair value curve as it had in the past. Instead, the AER's new methodology estimates the debt risk premium for a BBB+ rated 10 year bond by calculating a simple average of the debt risk premiums for bonds with a term to maturity between 7 and 13 years with the following characteristics:

- Australian issuance,
- rated BBB, BBB+ or A- by S&P,
- 7 to 13 year term,
- yield data observed by UBS or Bloomberg during the draft decision averaging period,
- fixed rate or floating rate converted reliably to a fixed rate equivalent,
- standard bonds (not callable or subordinated),
- no strong qualitative grounds that the bond is 'unrepresentative of a benchmark 10 year, BBB+ rated Australian corporate bond' (i.e. consistent with NER 6A.6.2e), and
- annualise yields and convert to spreads over CGS.

For the bonds in the sample, the AER's methodology is to take an average of the UBS yield and the Bloomberg value where both are available, or the yield provided by one supplier otherwise. For Bloomberg, the BGN value is used where available, with the BVAL used otherwise.[33]

In its draft decision for Powerlink, the AER concluded that a debt risk premium of 319 basis points was appropriate.

3.4.2 Comments on the AER's simple average of debt risk premiums methodology and its application to Powerlink

Powerlink engaged us to provide advice on the debt risk premium in the context of the AER's draft decision on Powerlink's revenue proposal 2012-13 to 2016-17. Our final report (our report) titled, 'Powerlink: Debt risk premium and equity raising

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[32] AER (November, 2011), *Draft decision, Powerlink Transmission determination, 2012-13 to 2016-17*; and AER (November, 2011), *Draft Distribution Determination, Aurora Energy Pty Ltd 2012-13 to 2016-17.*

[33] The Bloomberg BGN value is yield that is derived on the basis of the individual securities industry feeds to Bloomberg (i.e. a combination of the contributor opinions about the yield), while the BVAL value is Bloomberg's opinion of the yield.

costs', which was dated 16 January, 2012, identified a number of flaws in the AER's simple average of debt risk premiums methodology.[34]

First, by completely setting aside the Bloomberg fair value curve the AER was ignoring a respected source of market data. Secondly, we considered that the AER had misapplied its own approach in a number of ways. Thirdly, we also considered that if direct regard was going to be had to the market evidence, more sophisticated techniques should be applied. These concerns are outlined in more detail below.

The Bloomberg fair value curve should not be set aside

In its Powerlink draft decision, the AER decided to implement an approach of directly interpreting available market data. We are of the view that this approach should not have been applied without reference to the Bloomberg fair value curve, and a more sophisticated analysis of the underlying bond yield data (i.e. econometric analysis).

Bloomberg applies a series of tests in screening its data to ensure a robust and quality sample is available. Due to this approach, a number of bonds are set aside by Bloomberg. The exclusion of this data led the AER to form the opinion that Bloomberg had ignored information relevant to the AER's consideration. We were of the view that Bloomberg's rejection of many data points that were used by the AER should have raised questions in the AER's mind about whether it is appropriate to include these bonds in its sample.

While the Bloomberg fair value curve has occasionally departed from providing debt risk premium information that is reflective of the current market, setting it aside completely overstates this issue given the advantages associated with the continued use of the Bloomberg fair value curve, including:

- the controls in place to ensure that data is of an acceptable quality,
- it is an observable benchmark which is simple to apply in practice, and
- repeated statements by the Australian Competition Tribunal that the Bloomberg fair value curve is an appropriate benchmark for estimating the debt risk premium, as the AER has applied it in the past, and it appears to be widely used and respected in the market.

Application of the AER's simple average methodology to directly interpret market data

The AER's simple average of debt risk premiums methodology was highly dependent on the quality of bonds available in the market at the time it undertakes its analysis. While Bloomberg's methodology filters the data and the outcome is reasonably predictable, regulated businesses would have had no certainty over the final application of the AER's simple average approach and the nature of the bonds that would be included.

The AER's simple average methodology had the potential to introduce new information into the regulatory process without allowing the regulated business an opportunity to comment on its appropriateness due to the timing issues in the regulatory process. That is, the regulatory process allows businesses to have a final opportunity to comment on the WACC parameters 4 to 5 months prior to the AER handing down its determination, and while businesses can have reasonable confidence in a process under which, at the time of its final determination the AER

[34] PricewaterhouseCoopers (16 January, 2012), *Powerlink: Debt risk premium and equity raising costs.*

would apply a debt risk premium methodology based on the final averaging period, such confidence cannot be applied to the AER's methodology itself. With the AER's simple average methodology it was possible that new bonds will have been issued in the market after the draft review and a business's response, and that these bonds would have been included in the AER's sample and would have had a material impact on the result, without providing the business with any opportunity to respond.

In our Powerlink report we noted that the AER's adviser, Oakvale Capital had commented on the inappropriateness of the SPAusNet bonds as their yields are lower due to the fact that 'the risk is in fact the risk of the Government of Singapore.'[35]

> The key feature supporting the bond was the parental support of the issuer's owners and the link to the Government of Singapore.

After removing the foreign issue Coca Cola bond, which the AER had erroneously included, removing SPAusNet's bonds due to the credit enhancement affored by the Singapore Government's ownership,[36] and extending the range of terms to maturity considered from 7 to 13 years to 5 to 15 years, we concluded that the AER's simple average methodology estimated debt risk premiums in the range of 351 to 356 basis points for Powerlink's averaging period.

3.5 The AER's reassessment of debt risk premium methodologies in the Powerlink final decision

In its final decision on Powerlink's transmission determination, the AER accepted Powerlink's estimate of the debt risk premium, which was 393 basis points for the final Powerlink averaging period spanning the 40 business days from 6 February 2012 to 30 March 2012. Powerlink's methodology was to extrapolate the 7 year Bloomberg BBB debt risk premium to 10 years using the observed difference in the debt risk premium on pairs of bonds issued by the same entity (referred to below as the 'paired bonds' extrapolation method). The AER compared the debt risk premium estimate obtained using Powerlink's methodology, against the estimates that would have been obtained using two alternative extrapolations of the Bloomberg 7 year BBB fair value curve:[37]

- 401 basis points - if the last historical spread between the debt risk premiums obtained using the 7 and 10 year AAA rated fair value curves was applied; and
- 367 basis points – if a linear extrapolation were undertaken using the 5 and 7 year Bloomberg BBB fair value curve debt risk premiums.

The AER considered that there are weaknesses in all three approaches, but accepted the 'paired bonds' extrapolation methodology 'in the absence of a more robust alternative approach.'[38] The AER explained that it also adopted Powerlink's revised proposed approach due to the Tribunal's recent decisions, which supported

35 Oakvale Capital, Report on the cost of debt during the averaging period: *The impact of callable bonds,* February, 2011, p. 24

36 See Oakvale Capital (February, 2011), *Report on the cost of debt during the averaging period: The impact of callable bonds*, p.25.

37 Australian Energy Regulator (April, 2012) Final decision – Powerlink Transmission determination 2012-13 to 2016-17, pp. 183-185.

38 AER (April, 2012), p. 185.

methodologies incorporating reliance on the Bloomberg fair value curve. In conclusion, the AER noted that it was adopting Powerlink's revised proposed approach until it has 'undertaken a public consultation process to determine alternative methodologies'.[39]

In view of the conclusions reached in this report, our view is that the AER's method in the Powerlink final decision would:

- result in a value for the debt risk premium that results in a cost of debt that is in line with the Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating and a maturity of 10 years; and
- allow for an overall rate of return commensurate with the regulatory and commercial risks involved in providing transmission services.

3.6 Applying more sophisticated econometric techniques

The extrapolated Bloomberg fair value curve

In our report for Powerlink, we adopted the 7 year Bloomberg fair value curve as our key reference point, and extrapolated to 10 years using the average annual increment in the debt risk premium observed for two higher (A and A-) rated paired bonds where the longer dated bond had a term to maturity close to 10 years. This approach provided a debt risk premium estimate of 408 basis points (391 basis points) using the AER's draft decision (Powerlink's) averaging period.[40]

Our econometric approach

In our Powerlink report we also applied econometric techniques to estimate the BBB+ fair value curve. We identified a sample of 68 bonds across the three credit rating bands of BBB, BBB+ and A- (with an average rating close to BBB+), with terms to maturity greater than 1 year. Linear and quadratic (i.e. curvilinear) functional forms were applied, and the latter was found to provide a superior fit to the data.

Our quadratic regression equations predicted a 10 year BBB+ debt risk premium of 378 basis points (380 basis points) using the AER's draft decision (Powerlink's) averaging period. Our estimates using econometrics were higher than those we obtained by correctly applying the AER's methodology of taking a simple average of debt risk premiums. Indeed, our econometric estimates were found to be closer to the extrapolated Bloomberg debt risk premium (391 basis points) than to the 351 to 356 basis points estimated using the AER's methodology adjusted for the errors that we identified in it. We concluded that a debt risk premium at the top of the range was appropriate, as two of the three methodologies would have been indicating a debt risk premium in the range of 380 to 391 basis points.[41]

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39 AER (April, 2012), p. 185.

40 The AER's averaging period extended over the 40 business days ending 14 October, 2011, while Powerlink's averaging period was the 40 business days ending 9 December, 2011.

41 We originally reported that the econometric evidence provided an estimated debt risk premium range of 360 to 367 basis points, however we later discovered that we had inadvertently included three SP AusNet bonds, which we had held not to be appropriate due to their Singapore Government ownership. Hence, in a follow-up letter to the AER we recommended application of a debt risk premium close to the extrapolated Bloomberg curve estimate. We also found that by removing the three SPAusNet bonds, the goodness of fit of the estimate (adjusted R-squared) was improved

4 Establishing reliable data sources to estimate the debt risk premium

4.1 Introduction

The strength of any data analysis is contingent upon the quality of the underlying data. For the purposes of our analysis, 'quality' refers to the extent to which the data is reflective of the price or yield at which a bond would trade at any point in time, and therefore about the debt risk premium. We have obtained bond yield data from three providers: Bloomberg, the Australian Financial Markets Association (AFMA), and UBS. This section sets out the tests we have performed on this data to assess its quality.

To address this issue, in this chapter we:

- describe the process by which published bond yields are determined,
- assemble a representative sample of bond yields by applying a number of filters, and
- report the results of a number of tests of the quality of the data.

4.2 How published bond yields are determined in the market

In the vast majority of cases the yields supplied by market providers like Bloomberg and UBS do not represent trades of bonds. Instead, they may be characterised as the opinions of financial institutions engaged in bond market issue and trading. These opinions are not adjusted via executive decision making on a daily basis. Instead, daily bond yields are determined by pegging a bond's yield to a benchmark reference rate, which is most commonly the Bank Bill Swap Rate. For example, the yield of a particular bond may be set at a margin of 120 basis points to the benchmark reference rate.

At various times, which could be weeks or months apart, executives of the price making institution will consider whether specific information relating to the bond in question justifies a yield revision. This decision will be made on the basis of recent market activity, including:

- any actual trades in the bonds or comparable bonds,
- the pricing of newly issued bonds,
- comparative yields for the bond in question,
- other comparable bonds that are being priced by other institutions (for example, through benchmarking syndicates, AFMA, Bloomberg or the circulation of the institutions' daily 'rate sheets'), and

- any other specific information that has come to hand about the relative risk characteristics of the bond in question.

Since most bonds will have been issued some years previously, and many would have been infrequently or possibly never traded, it is possible that for some bonds the setting of the margin relative to the benchmark will not be updated for a long period. In this case the observed margin can be said to be 'stale', that is, not reflective of the current market for funds. Testing for the extent to which the bond yield data may be stale, and therefore not market reflective, is one of the key objectives of the data quality analysis undertaken in this chapter.

4.3 Assembling a representative sample

Our initial task was to assemble a sample of observed bond yields. In the first instance this required a decision about the source of the information.

As discussed above, we obtained bond yield data from three providers: Bloomberg, AFMA, and UBS. Before applying tests to the data, it is important to understand the specific characteristics of these three major bond data providers, and how they derive the daily bond yields that they supply.

Bloomberg

Bloomberg is the world's largest supplier of financial market information, with over 300,000 subscribers around the world receiving data from terminals on a daily basis. Bloomberg currently publishes a number of fair value curves, including a 7 year curve for the BBB credit rating band. Bloomberg receives daily 'feeds' of bond yields from a number of Australian banks and other financial institutions.[42] Bloomberg's 'Bloomberg Generic Price' (also known as the BGN) is its 'market consensus view' of the yields supplied to it. While Bloomberg does not reveal the process by which it derives the consensus number, it appears that the number is not a mechanical formula, and involves analyst judgement. Bloomberg also provides its own estimate of the yield from its Bloomberg Valuation Service, which is known as the BVAL yield. In this report we have focussed on the BGNs, which are represented as being reflective of the market's opinion of the bonds.

We collected each BGN yield observation and have accessed the individual bank 'feeds' that Bloomberg used in deciding on that BGN yield.

AFMA

AFMA is a highly regarded and representative body in the Australian financial market. In February, 2011, the AER's own adviser, Oakvale Capital, has noted that 'AFMA pricing sources are increasingly used by market practitioners'.[43] Unlike Bloomberg, AFMA's criteria for selection, and the method applied in deriving its yields, are available on its website.[44] In order to be included the bonds must be Australian denominated and:

- They are issed by a bank, corporate or other non-government entity, acceptable to the AFMA Debt Capital Markets Committee,

- The Issue has a minimum face value greater than AUD 100 million outstanding,

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42 Bloomberg obtains 'feeds' from between 2 and generally less than 5 or 6 bond yield suppliers on a daily basis.

43 Oakvale Capital (February, 2011), *Report on the cost of debt during the averaging period: The impact of callable bonds*, p.25.

44 http://www.afmadata.com.au/markets/bonds2.asp

- The Issue has more than twelve (12) months to run to maturity at time of issue, and

- At least three Contributing Price Makers are willing to provide regular Reference Rates.

The current contributing AFMA price makers are 11 significant Australian financial institutions.[45] AFMA publishes a daily yield for each bond that it covers, and the yield estimate is derived by a process that:

- calculates the standard deviation of the distribution of the mid yields provided by contribution financial institutions,

- removes 'outlier' yield observations that are more than ±1 standard deviations away from the mean, and

- calculates the average yield based on the sample of bond yields that remain after removing the outliers.[46]

While providing the daily average yield for each bond covered by its service, AFMA does not provide the individual bond yields of its contributing price making institutions. However, since we know the process applied by AFMA to estimate the average yields, we can have some confidence that it reflects the average opinion of its contributing institutions.

UBS

Bond yields supplied by UBS represent its own opinion about the end of day yield. These are yields are provided by UBS on a daily basis and disseminated electronically to its clients. Unlike the Bloomberg and AFMA data sources, which represent the average of the opinions of several institutions, the UBS service is the opinion of one institution. However, we would expect that fixed interest market analysts at UBS, like those at Bloomberg, take account of other comparable bond data sources when making their own decisions about yields.

Bond selection criteria

We have used the three data sources described above for our bond yields because we consider that yields based on multiple sources will result in a data base that is more reflective of the market for funds. The bond yields that we apply in our analysis are based on, where available, the average of the yields reported by the three data sources listed above[47].

Our initial sample was based on the population of fixed and floating corporate bonds available between 4th April 2010 and 18 November 2011. This 19 month period was defined by the longest period over which we had access to daily yield

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45 AFMA's current list of contributors is: Australian & New Zealand Banking Group Limited; Citigroup Global Markets, Commonwealth Bank of Australia, Deutsche Bank AG, Macquarie Bank Limited, National Australia Bank Limited, Royal Bank of Canada, Royal Bank of Scotland, Societe Generale, Australia, TD Securities, and Westpac Banking Corporation.

46 http://www.afmadata.com.au/markets/bonds2.asp, accessed 13/02/2011

47 It is worthwhile noting that we have expanded upon the traditionally used data sources, being Bloomberg and UBS, to also include AFMA data. We consider AFMA is a reputable provider of bond yields and the inclusion of its data is likely to increase the overall accuracy of bond yield estimates.

observations from all three services.[48] From the initial sample of bonds, we filtered the data to only include corporate bonds with the following characteristics:

- Australian issuance,
- credit rating of either BBB, BBB+ or A- by Standard and Poors,
- the issuing entity is not a financial entity,
- the corporate bond is senior (i.e. not subordinated),
- standard corporate bonds without special features such as call options attached, and
- a term to maturity greater than one year.

The above criteria were applied with an aim of estimating a debt risk premium curve for Australian issued BBB+ rated corporate bonds with a range of terms to maturity including 10 years. We have included bonds with credit ratings half a notch higher and half a notch lower than BBB+ (i.e. to cover the range BBB to A-) in order to increase the sample of bonds analysed.

Bonds that had less than one year to maturity were eliminated. The yields on bonds with less than a year to maturity remaining are influenced by monetary policy, and their inclusion would be likely to distort the shape of the debt risk premium curve. We understand from discussion with market price makers that bonds with less than a year to maturity are ignored when the yield relativities of bonds with longer terms to maturity are being considered.

Finally, we have eliminated the bonds that were issued by SP AusNet. These bond are distinguished from the others due to a majority holding by Temasek, which is the investment arm of the Singapore Government. When assessing this bond the AER's adviser, Oakvale Capital, noted that a key issue impacting the yield of these bonds is that 'the risk is in fact the risk of the Government of Singapore.'[49]

> The key feature supporting the bond was the parental support of the issuer's owners and the link to the Government of Singapore.

Description of the bond sample

Our initial sample comprised 955 bonds which was the population of bonds available from the three sources over our study period.[50] Filtering this raw sample based on the criteria outlined above resulted in a sample of 92 bonds, which included 48 fixed coupon bonds, and 44 floating coupon bonds[51]. This reduced sample was subjected to further analysis, for which the key findings are presented below.

[48] The study period was constrained by the first date from which we had UBS daily term sheets (4 April, 2010) and the last day for which we had AFMA daily yield data (18 November, 2011).

[49] Oakvale Capital, *Report on the cost of debt during the averaging period: The impact of callable bonds,* February, 2011, p. 24

[50] This was the total number of bonds that were included in the data base of one or more of the yield providers (i.e. Bloomberg, AFMA and UBS).

[51] The trading margins reported by floating coupon bonds were converted to yield to maturity estimates for equivalent fixed coupon bonds using an appropriate interest rate swap yield.

The relative number of bonds covered by the yield providers

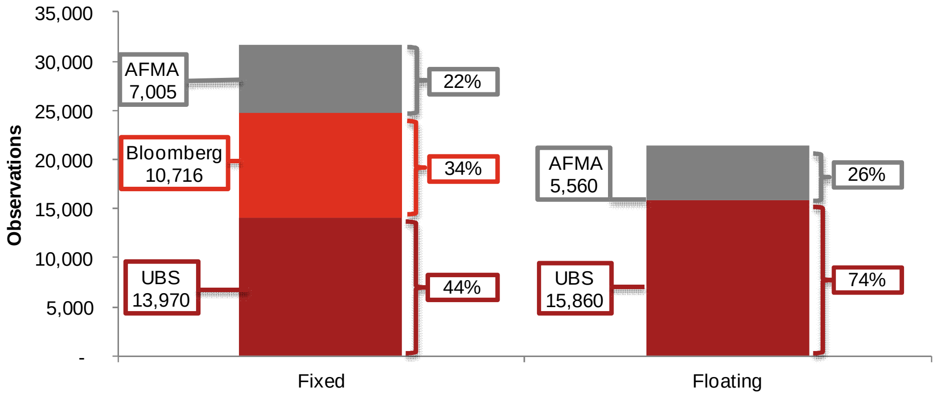
Figure 1 below shows that the number of daily yield observations varied significantly between the three data sources. The vertical axis denotes 'observations', which is the total number of bond yield days that were available in the data base. The main reasons for variations in the number of daily bond yield observations are:

- Gaps in coverage – the bond yield providers do not cover the same group of bonds; and
- Gaps in the available days of observations– even if two bond yield providers had the same sample of bonds, there could be differences in the number of days that yields are available for these bonds.

For the population of fixed coupon bonds approximately 44 per cent of the total daily bond yield observations came from UBS, compared with 34 per cent coming from Bloomberg, and 22 per cent coming from AFMA. For the population of floating coupon rate bonds (and associated trading margins), approximately 74 per cent of daily bond yield observations came from UBS, compared with only 26 per cent coming from AFMA. Bloomberg provides no trading margin data for floating rate bonds. The total data set for the sample of 92 bonds comprised close to 50,000 daily bond yield observations.

Since there is an unequal distribution of daily bond yield observations from the three data sources, our approach of taking the average of the three sources (if available), means that many of the yields often represented an average of the yields of two service providers, and sometimes only one service provider (often UBS) . For floating coupon bonds, in the vast majority of cases the yields was the UBS yield.

Figure 1 –Proportion of daily bond yield observations from each data source (Fixed and floating coupon bonds)

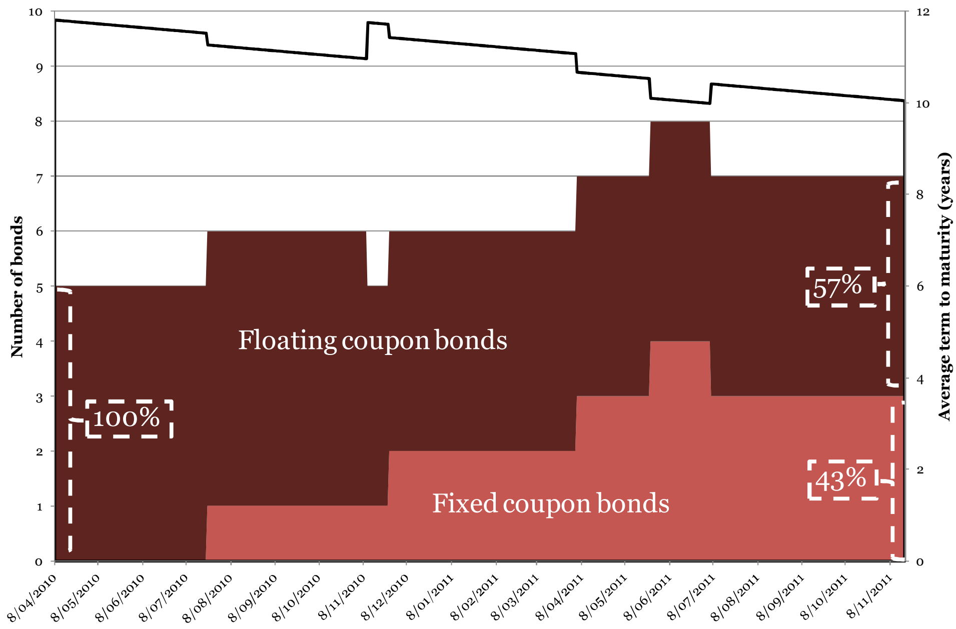


Source: Bloomberg, UBS, AFMA

Composition of bonds greater than seven years to maturity

We found that while the total number of long term bonds decreased over the 19 month study period, at the end of the period there were relatively more fixed coupon bonds than previously.

Figure 2 –Number of fixed and floating coupon bonds with greater than 7 years to maturity



Source: Bloomberg, UBS, PwC

The estimation of a 10 year term for the debt risk premium will be heavily influenced by the number of bonds that exceed a 7 year term to maturity. [52] The quality of data for bonds which fall into this category will also be relevant. We found that the number of bonds with term greater than 7 years increased from 5 to 7. Figure 2 shows how the number of bonds with a term greater than 7 years has changed over time. We note that during the study period the number of fixed coupon bonds with greater than 7 years to maturity increased from zero to 3, while the number of floating coupon bonds reduced from 5 to 4.

Coverage of bonds with greater than 5 years to maturity

For longer term bonds,[53] and particularly for new issuances, only UBS and Bloomberg produce yields. Table 1 and 2 below show which provider's yields are available for dates within the study period (with UBS, AFMA and Bloomberg data availability denoted as maroon, red and grey bars or dots respectively). From an inspection of these tables, it is apparent that AFMA has not produced bond yield observations for a majority of the long term bonds.

Of particular note is the fact that as at November 2011, AFMA did not provide bond yield observations for any bonds issued after mid 2011. It is possible that this is an outcome of AFMA's cautious approach to the inclusion of bonds in its coverage portfolio based on the inclusion criteria outlined above.

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[52] The starting date for the calculation of term to maturity was 8/4/2010 because this is the first date of our observation period.

[53] For the purposes of the analysis in this chapter, a long term bond is defined as a bond with a term to maturity greater than 5 years from 8 April 2010.

Table 1 – Bond yield observations for long term bonds (Fixed coupon bonds)

Name	Date of maturity	Issue date
Stockland	25/11/2020	25/11/2010
APT	22/07/2020	22/07/2010
Brisbane Airport	9/07/2019	4/04/2011
Caltex	23/11/2018	23/11/2011
Sydney Airport	6/07/2018	25/05/2011
DB RREEF	21/04/2017	21/04/2010
Wesfarmers	4/11/2016	4/11/2011
ETSA utilities	29/09/2016	29/03/2011
Adelaide Airport	20/09/2016	23/08/2006
Mirvac	16/09/2016	29/09/2010
Melbourne Airport	25/08/2016	25/08/2010
Stockland	1/07/2016	13/12/2010
DBCT	9/06/2016	9/06/2006
Transurban	8/06/2016	8/06/2011
Goodman Australian industrial fund	19/05/2016	19/05/2011
Woolworths	22/03/2016	22/03/2011
CBA office/ fund	11/03/2016	11/03/2011
Melbourne Airport	14/12/2015	14/12/2005
Santos	23/09/2015	23/09/2005
Volkswagen	14/07/2015	14/07/2011
Sydney Airport	6/07/2015	6/07/2010

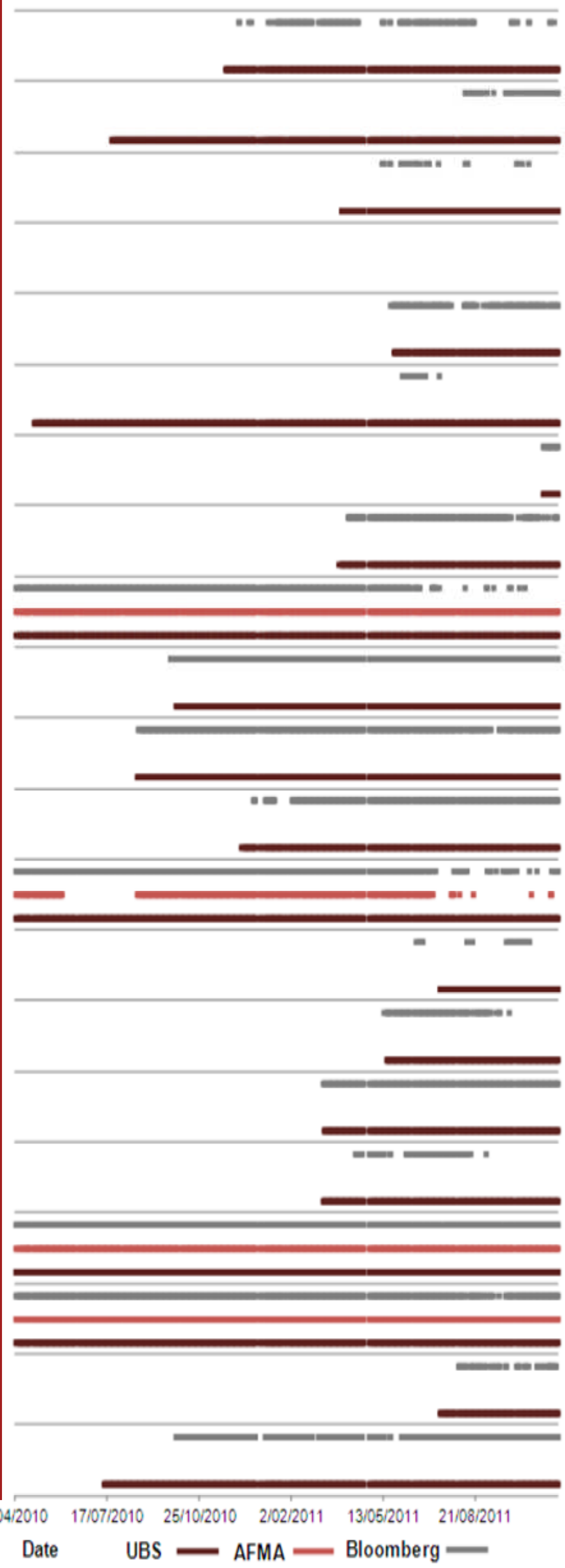
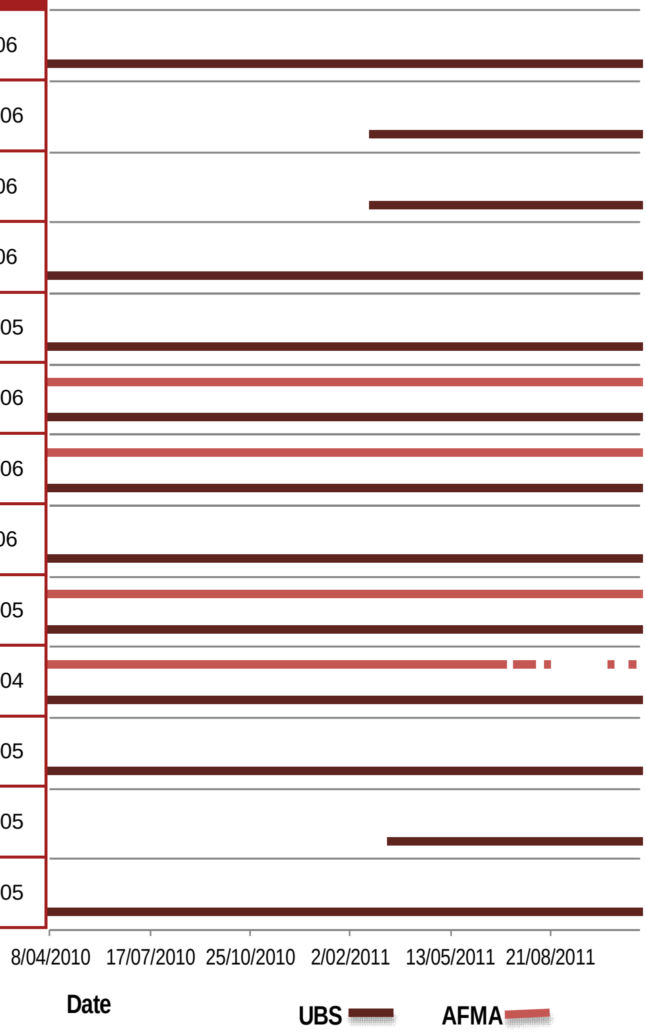


Table 2 – Bond yield observations for long term bonds (Floating coupon bonds)

Name	Date of maturity	Issue date
DBCT	9/06/2026	9/06/2006
Sydney Airport	11/10/2022	15/12/2006
Sydney Airport	20/11/2021	8/12/2006
DBCT	9/06/2021	9/06/2006
Transurban	10/11/2017	11/10/2005
Adelaide Airport	20/09/2016	23/08/2006
Brisbane Airport	1/07/2016	29/06/2006
DBCT	9/06/2016	9/06/2006
Melbourne Airport	14/12/2015	14/12/2005
Sydney Airport	20/11/2015	10/09/2004
China Light and Power	16/11/2015	16/11/2005
Powercor	15/11/2015	15/11/2005
Transurban	10/11/2015	10/11/2005



Source: UBS, AFMA, PwC

4.4 Assessing the quality of the data

Having selected the core sample of bonds, we considered whether the bond yields are reflective of the current market for funds. We also addressed the question of whether the yields (i.e. market opinions) derived from the data providers might be 'stale', in the sense that they represent outdated market information. Stale bond yields (i.e. out of date yields) are of concern because they are not representative of the most up to date market opinion and would bias the estimated debt risk premium in unknown ways.

4.4.1 Does the yield data reflect market opinion?

By definition, AFMA yields are representative of the market for funds. As discussed above, AFMA undertakes a process which produces approximately an average bank feed estimate based on 11 bank feed contributors.

As discussed above, Bloomberg receives bond yields from banks (bank feeds) on a daily basis, which they convert into yields that are presented as reflecting the market's consensus. UBS yields are the opinion of one bank, and since it provides the most comprehensive coverage of bond yields, these yields will be an important determinant of an average bond yield calculated by reference to three providers. Therefore, it is important to assess to what extent Bloomberg BGNs and UBS yields are reflective of the market's opinion. We did this by calculating for the entire study period the average difference (expressed in basis points) between the median of the Bloomberg bank feeds, and the yields reported by Bloomberg (i.e. Bloomberg BGNs) and UBS.[54] The results were as follows:

- **Bloomberg BGNs** – on average over the entire study period Bloomberg BGNs were 2 basis points lower than the median of the Bloomberg bank feeds.

- **UBS yields** – on average over the entire study period UBS yields were 4 basis points lower than the median of the Bloomberg bank feeds.

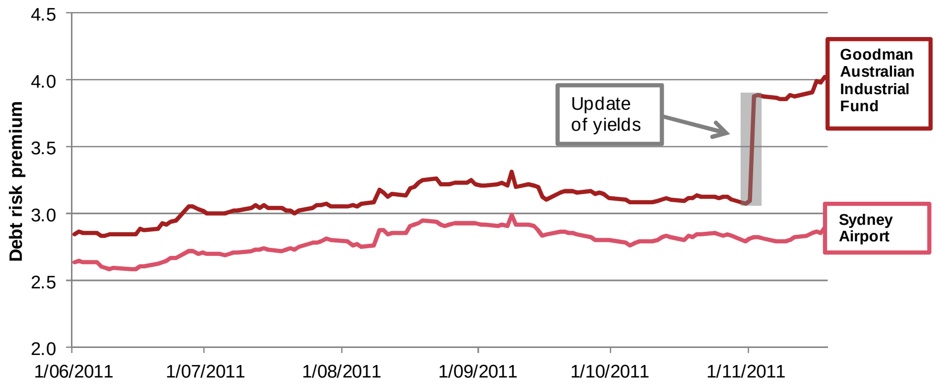
As a general rule, therefore, over the whole study period, the data sources that we have relied on, could be said to be reflective of market opinion, as represented by the Bloomberg bank feeds.

4.4.2 Testing for staleness of bond yields

Since reported bank feeds and UBS yields are typically set to follow a benchmark curve, it is possible that some of the yields are 'stale' (i.e. out of date) if they have not been updated for a considerable period of time.

If the bank's opinion of a bond yield has been updated for new information, we would expect to see an immediate and material shift in the yield. An example is provided in Figure 3 below, which shows how the debt risk premiums for two bonds, Goodman Australian Industrial Fund, and Sydney Airport, appeared to track the same reference curve over a period extending from the start of June 2011 to November 2011. On 2 November 2011, however, there was a significant uplift in the UBS debt risk premium for the Goodman Australian Industrial Fund, which persisted in the period following the shift. This re-pricing of the bond relative to the Sydney Airport bond is likely to have occurred as a result of a change in UBS's assessment of the bond. We define such a shift as a 'structural break', which we distinguish from a temporary shift, since the latter may merely reflect outlier observations that are less likely to be due to a re-pricing of the bond.

Figure 3 – Example of an update in debt risk premium (UBS data)



Source: PwC

54 This approach is similar to the analysis of Bloomberg BGN bond yields that we undertook in November, 2009. See PwC (November, 2009), *Victorian Distribution Businesses – Methodology to Estimate the Debt Risk Premium*. One of the tests that was applied in that study looked at the degree to which Bloomberg's BGN's reflected the bank feeds that were being provided to it. In the present study we have expressed this difference relative to the median of bank feeds (which is likely to be a good reflection of the market's opinion as it minimises the influence of outliers). We have also elected to express the differential in terms of basis points rather than percentage points, as this can be related more easily to the scale of the BGN, which can also be expressed in terms of basis points.

As we are interested in identifying structural breaks in the individual yields over time, we applied the Quandt-Andrews breakpoint test. The premise of the test is to analyse whether, in a particular set of historical time series data, there has been a structural change in the relationship of the data with respect to time.[55] That is, we wish to test whether UBS appears to update the prices and yields of the bonds it covers (and therefore their debt risk premiums) recently enough for the yields (and debt risk premiums) to be considered representative of the current market – that is, not stale.

We applied the Quandt-Andrews breakpoint test to the UBS data only. We did not consider it appropriate to apply the Quandt-Andrews breakpoint test to the AFMA data, as this service does not provide individual bank feeds, but rather the mean yield, which through its process of calculation (i.e. eliminating bank feed observations greater than two standard deviations from the average), will be close to the median of market opinion. Technically, we could have applied the Quandt-Andrews breakpoint test to all of the Bloomberg bank feed data, however, these bank feeds were not individually as comprehensive as the UBS data. In addition, there would remain the question of how Bloomberg incorporates these updates into its own BGN yields.

For the purpose of identifying stale yield data we have defined 'recent' to be a period of six months up to the latest bond yield date (18 November 2011). It was felt that a shorter period would set an unrealistic target for a reassessment of all the bonds in the UBS data base. It was felt that a longer period, such as a year, would be too long to consider those opinions to be reflective of the current market.

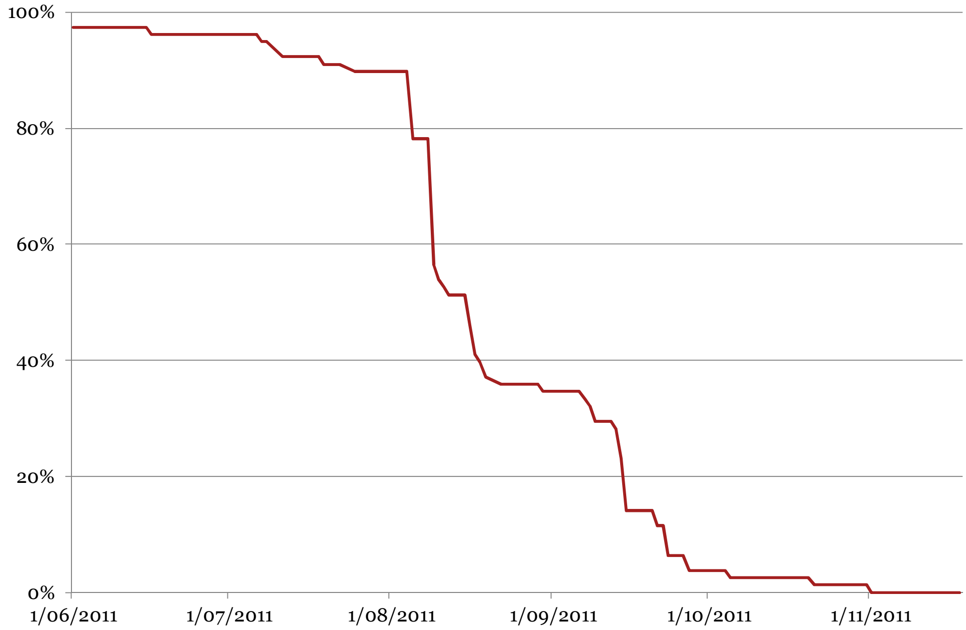
Results of applying the staleness test to UBS yield data

Applying our bond staleness test, we found no reason to exclude any UBS data.

From the 92 series of UBS bond data, we found that 78 (82 per cent) could be tested. The Quandt-Andrews breakpoint test could only be applied if there are a sufficient number of consecutive daily observations. From the total sample of 92 series of data, we found that 14 could not be tested because the bond either matured before the six month period, or was recently issued, and therefore did not have enough observations for testing. The yields of newly issued bonds could not be considered to be stale.

55 The Quandt-Andrews Breakpoint Test tests for one or more unknown structural breakpoints in a sample for a specified equation. The idea behind the Quandt-Andrews test is that a single Chow Breakpoint Test is performed at every observation between two dates, or observations. The test statistics from these Chow tests (Likelihood ratio and Wald F statistic) are then summarised into one test statistic for a test against the null hypothesis of no breakpoints between two dates. For further explanation see: Donald W. K. Andrews , '(July, 1993), Tests for Parameter Instability and Structural Change With Unknown Change Point', *Econometrica*, Vol. 61, No. 4 pp. 821-856.

Figure 4 – Relative staleness of bond yields - UBS data yet to pass Quandt Andrews breakpoint test (6 months of data to 18/11/2011)



Source UBS data and PwC analysis

As displayed in Figure 4, for the data we could test, we did not find evidence of stale bond data. For each one of the 78 bond series tested, we found evidence of a structural break within the last six months, which demonstrates the likelihood that the bond yields were recently updated. The chart shows the proportion of the bonds that had not experienced structural breaks by a certain date. We found that a disproportionate number of breaks occurred over the period of August to September 2011, indicating that the vast majority of the bonds (approximately 90 per cent) had been re-assessed by UBS in the four month period prior to 18 November, 2011, and 100 per cent had been re-assessed in the 6 month period prior to 16 December, 2011.

5 Methodology for estimating a debt risk premium

In this chapter we describe the methodology we have applied to estimate the 10 year BBB+ debt risk premium for a 20 day averaging period up to 18 November, 2011. We began by estimating the debt risk premium using an extrapolated Bloomberg fair value curve, as this curve is widely used in the market for funds, and supported by ACT decisions. As a cross-check to the extrapolated Bloomberg curve, we have directly examined the available market data using econometric techniques.

Hence, in this chapter we:

- derive a debt risk premium estimate using the extrapolated Bloomberg fair value curve methodology,
- estimate the debt risk premium based on a direct examination of market data applying econometric techniques,
- cross-check the results of the two methodologies, and
- apply our preferred methodology to estimate the debt risk premium for a 10 day averaging period nominated by ElectraNet.

5.1 Estimating the debt risk premium using Bloomberg

5.1.1 Extrapolated Bloomberg fair value curve

We first estimate the debt risk premium based on the extrapolated Bloomberg fair value curve. The Bloomberg fair value curve offers many advantages in estimating a benchmark debt risk premium:

- the Australian Competition Tribunal has endorsed the Bloomberg fair value curve as an appropriate benchmark for estimating the debt risk premium, including because it appears to be accepted by the market as providing accurate yield estimates,
- the Bloomberg fair value curve is an observable benchmark, and is simple to apply, and
- the Bloomberg methodology imposes a series of tests to ensure that the data that it applies is of sufficient quality.

In an electricity transmission determination, the final opportunity for a business to comment on a debt risk premium is likely to be before it is locked in. During this time, financial markets can change significantly, presenting a material risk to the business. Since Bloomberg is cautious in introducing new evidence and exhibits a degree of stability over time, it has in the past allowed regulators to commit to using the Bloomberg curve in advance.

Methodology used to extrapolate the Bloomberg fair value curve

Since 9 October, 2007, when Bloomberg ceased to report a 10 year BBB fair value curve, a key methodological issue has been how to extrapolate the curve to 10 years. For a period of time the annual increment in the Bloomberg A rating fair value curve out to 10 years was used, and when that was no longer published, the annual increment in the Bloomberg AAA rating fair value curve out to 10 years was applied. However, the Bloomberg AAA curve has not been published out to 10 years since 22 June, 2010, which raises questions about its continued relevance given the change in market conditions since that time. Currently the Bloomberg BBB fair value curve is only reported to 7 years.

In our April, 2011 report on the debt risk premium for Powerlink, we proposed extrapolation of the Bloomberg fair curve using the average annual increment observed across a sample where two bonds of differing maturity had been issued by the same company (paired bonds).[56] This approach was based on the logic that for two bonds issued by the same company, the difference in the debt risk premiums observed between the two bonds would be fully explained by term to maturity, rather than by other risk factors (unlike bonds of different issuers). Furthermore, provided the paired bonds are regularly priced by the market, the observed annual change in the debt risk premium between two bonds of the same issuer provides an estimate of the market's current opinion of how the debt risk premium varies with term.

The AER's draft decision on Powerlink's 2013-17 revenue proposal criticised our original paired bond methodology because the average difference in the terms to maturity of the 9 sets of paired bonds was considered too short.[57] In this report we have responded to the AER's objection by limiting the sample of paired bonds to those where:

- the paired bonds were part of the wider sample that we used in our econometric analysis,
- the longer dated bond had a term to maturity that is close to 10 years,
- the shorter dated bond had a term that is closest to the shorter term that is of concern (i.e. closest to 7 years), and
- the match was between a pair of fixed coupon bonds, or a pair of floating rate bonds.

5.1.2 Debt risk premium applying a Bloomberg extrapolation

For the 20 business day averaging period ending 18 November 2011, we estimated the extrapolated Bloomberg debt risk premium to be 381 basis points. The estimate of 381 basis points was obtained by adding a debt risk premium increment of 9.1 basis points per annum to the 7 year BBB debt risk of premium of 354 basis points based on the fair value curve reported by Bloomberg.

Three pairs of bonds were chosen on the basis of the selection criteria outlined above: a pair of 'A-' rated Stockland fixed coupon bonds, a pair of A rated Telstra fixed coupon bonds, and a pair of 'BBB' rated Sydney Airport floating rate bonds. For the test averaging period ending 18 November, 2011, these paired bonds

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56 PwC, *Methodology to estimate the debt risk premium*, April 2011

57 AER, *Draft decision: Powerlink transmission determination 2012-13 to 2016-17*, November 2011, p.235

showed an average annual increment of 9.1 basis points, as shown in Table 3 below.

By adding the observed 9.1 basis points annual increment to the 7 year Bloomberg BBB fair value curve estimate of 354 basis points, we derived an estimated 10 year BBB+ debt risk premium of **381 basis points**.

Table 3 –Average annual increment in the debt risk premium for the paired bonds - 20 business days to 18 November 2011

Bond Issuer	Short Maturity (years)	Long Maturity (years)	Debt Risk Premium – Bloomberg (basis points)	Debt risk premium - UBS (basis points)	Debt risk premium increment per year (basis points)
Telstra	4.7	8.7	8.6	10.3	9.4
Stockland	4.6	9.0	8.6	7.0	7.8
Sydney Airport	4.0	10.0	n/a	9.9	9.9
Average increment			**8.6**	**9.1**	**9.1**

Source: Bloomberg, PwC

5.2 Estimating the debt risk premium by direct examination of the bond data

5.2.1 Econometric approach

Our econometric regression approach consisted of creating a data set of debt risk premiums, considering the previous theoretical and empirical evidence on the functional form, testing alternative functional forms, and then assessing which functional form is most robust and reliable.

Shape of the debt risk premium curve

To apply econometric analysis, an assumption is required about the form of the relationship between debt risk premium and term to maturity, i.e. the functional form, or shape of the debt risk premium curve. At a theoretical level, Merton's 1974 theory of bond pricing proposed a humped relationship between the debt risk premium and term. That is, the debt risk premium was expected to rise with term at first, but then to peak, and subsequently fall with additional term. However, this theory has been challenged in the literature due to an inability to explain empirical findings. As noted by Covitz and Downing (2007):[58]

> ...direct tests of Merton-style models find that the models seriously under predict the level of long-term bond spreads.

In academic circles this tendency for Merton-style models to under-predict yield spreads has been called the 'credit puzzle'. Helwege and Turner (1999) found that it is generally only the most credit worthy firms in a credit rating band issue long dated bonds, which can give the impression of a 'humped' relationship, but when paired bonds were tested (holding constant the credit worthiness) they found that the relationship is overwhelmingly upward sloping.[59]

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[58] Dan Covitz and Chris Downing (October, 2007), 'Liquidity or Credit Risk? The Determinants of Very Short-Term Corporate Yield Spreads,' *Journal of Finance*, Vol. 62, No. 5, pp. 2303-2328.

[59] Helwege, J. and C.M. Turner, (1999), 'The slope of the credit yield curve for speculative grade issuers, *Journal of Finance*, Vol. 54, pp.1869-1884.

In fixed interest markets, practitioners have observed that corporate bond spreads have almost always been upward sloping. Litterman and Iben, of the Fixed Income Research Department of Goldman Sachs, noted this in their 1991 paper:[60]

> …we find that the term structure of corporate spreads is generally upward-sloping, indicating a market perception of higher probabilities of default in the more distant future.

While it is generally accepted that debt risk premium rises with term to maturity, a point of debate is whether the relationship is linear, or a more complex curvilinear function. Empirical research has provided evidence of both linear and non-linear relationships:

- Jia He, Wenwei Hu, and Larry H.P. Lang, (2000), found that for BBB rated bonds in the US over the period 1993 to 1997, the credit spread was upward sloping for terms up to 10 years, and was humped only for very long terms to maturity (i.e. after a term of 25.7 years).[61]

- Elton et al (2001) demonstrated that for the BBB rating band in the US, the debt risk premium attributed to systematic risk factors was linearly related to term.[62]

- Sorge and Gadanecz (2008), found that the 'term structure of bond spreads as estimated in regression (4a) can be fitted by an upwardly-sloping regression line with an R^2 exceeding 0.95 (i.e. it is essentially linear)'.[63]

To account for both linear and non-linear functional forms, we estimated regressions using various functional forms, and then tested for which functional form was superior. The following common non-linear functions were tested:

- quadratic,

- exponential,

- logarithmic, and

- power.

The equations for these functional forms are provided in Appendix A.

Assessment of the appropriate functional form

We employed the Schwarz Information Criterion (SIC), otherwise known as the 'Bayesian Information Criterion', to decide on the most appropriate functional form. The SIC value is used to rank and select a functional form based on the efficiency of the goodness of fit to the data. The best functional form is decided by the equation with the lowest SIC.

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60 Robert Litterman and Thomas Iben (Spring, 1991), 'Corporate bond valuation and the term structure of credit spreads,' *Corporate Journal of Portfolio Management*, p.54.

61 Jia He, Wenwei Hu, and Larry H.P. Lang, (11 August, 2000), 'Credit Spread Curves and Credit Ratings', Working Paper, Chinese University of Hong Kong.

62 Edwin Elton, Martin J. Gruber, Deepak Agrawal, and Christopher Mann (February, 2001), 'Explaining the Rate Spread on Corporate Bonds', *Journal of Finance*, Vol. LVI, No. 1, pp. 247 -278.

63 Marco Sorge and Blaise Gadanecz (2008), 'The term structure of credit spreads in project finance,' *International Journal of Finance and Economics*, Vol. 123, p.80.

The SIC is calculated as the negative of the goodness of fit that a given function has to the data through a likelihood value, taking account of the number of variables the function required to reach that goodness of fit.[64] The SIC therefore rewards a functional form (through a lower value) if it achieves a higher goodness of fit, and punishes (through a higher value) a functional form that uses more variables to achieve that higher goodness of fit. In other words, the SIC finds the optimal functional form: the one that fits the data best, while using a minimum number of variables. We applied the SIC test as:

- it is a robust, well established and widely used methodology for selecting the superior functional form, and
- it allows us to select functional forms based on their efficiency.

In econometric analysis 'efficient' functions are desirable because they minimise the problem of 'over-fitting', which arises when more variables are used than necessary to explain the underlying relationship. An over-fitted function has many undesirable qualities and is likely to be poor predictor. [65]

Bond yield estimates

As discussed in Chapter 4, we use the average debt risk premium for each bond in our sample across the three data sources, when available. Otherwise, debt risk premiums were calculated on an average of two sources, or were based on a single source. For each day during the study period after the first 20 business days, we calculated rolling 20 day average debt risk premiums.

'Pooled regressions' and the weighting of BBB+ bonds

As discussed in Chapter 4 above, the core sample of bonds consisted of bonds with BBB, BBB+ and A- credit rating. This was done in order to expand the sample of bonds that could be used in the analysis, and our core findings are based on this 'pooled sample'.

However, the credit rating of interest is the BBB+ credit rating band. While regressions that include only BBB+ bonds might bias the results due to small sample effects, including BBB and A- bonds could also bias the results in unknown ways.

5.2.2 Debt risk premium estimated by regression analysis

We undertook overlapping regressions, where the debt risk premium was estimated based on the average observed debt risk premium for the sample bonds over the 20 days prior to the running of each day's regression (i.e. the analysis was repeated for 392 successive overlapping periods, which was 19 less than the total number of days of data that was collected). We found that the linear functional form was the most appropriate function, since it had a superior SIC in the overwhelming majority of cases. However, the power function was superior during most of the overlapping 20 day periods close to 18 November, 2011.

Average credit rating of the bond yield data

Based on our filtering of the data, which we have described above, over the 19 month study period a total pool of 92 bonds was used in the regression analysis. Bonds entered and left this pool, due mainly to bonds falling below the 1 year term

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[64] See, G. Schwartz, (1978), 'Estimating the Dimension of a Model', *Annals of Statistics*, Vol. 6, No. 2, pp. 461 – 464.

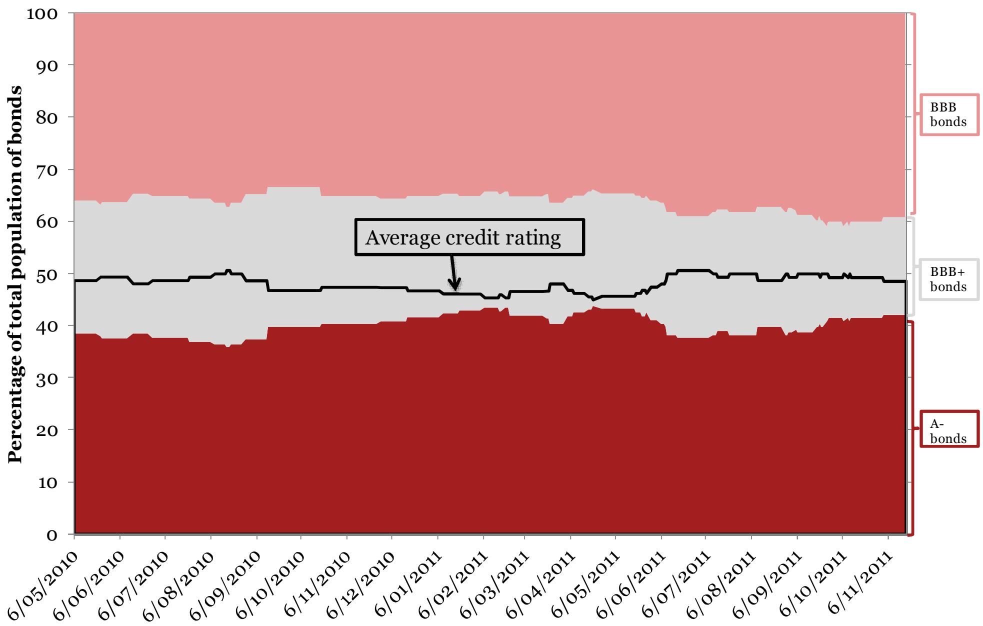
[65] D. Hawkins, (2004), 'The Problem of Overfitting', *J. Chem. Inf. Comput. Sci.*, 44, 1-12

to maturity cut-off, or due to new bond issues being covered by one of the service providers.

Our objective is to estimate the debt risk premium for a 10 year BBB+ corporate bond, but the pool of BBB+ bonds is relatively small. We have increased the size of the sample by broadening the data base to include bonds with BBB and A- credit ratings. This raises the question of whether the sample is more biased toward one or other of the neighbouring credit rating bands around the BBB+ band. To investigate this, we calculated the average credit rating by assigning values (1, 2 and 3), to the three rating bands.

The results of the analysis, and the percentage of the bonds used in the regressions during the study period are shown in Figure 5 below. We found that throughout the study period the average credit rating lay very close to BBB+ (based on the values assigned). Over the whole period the BBB+ ratings band was always less than one-third of the total sample, which justifies our pooling approach.

Figure 5 – Average credit rating of the bond sample over the study period



Testing for the best functional form

We tested each functional form by examining over our whole data set which functional form had the lowest SIC in each of the overlapping daily regressions. We determined that the linear functional form was the best by counting the number of times each functional form had the lowest SIC in the 392 regressions performed for each overlapping 20 day data set of the whole study period. For each 20 business day average over our whole data set, we regressed each functional form to estimate a group of SICs. These SICs were then ranked from lowest to highest (where lowest is the best), along with the matching functional forms. From the group of SIC values, we produced a list with the number of times each functional form had the lowest SIC.

As shown in Table 4 below, out of 391 regressions, the linear functional form had the lowest SIC in 320 (81.8 per cent) cases, followed by the power functional form (superior 69 times). The remaining functional forms did not have the lowest SIC for any 20 day averaging period.

Table 4 – SIC functional form test: 19 months to 18 November, 2011

	Linear	Quadratic	Exponential	Logarithmic	Power
Number of times with lowest SIC	322	0	0	0	69
Proportion	82.4%	0.0%	0.0%	0.0%	17.6%

Source: UBS, Bloomberg, AFMA, PwC

Regression results for the most recent averaging period

In Table 5 below, we show we have derived an estimated 10 year BBB+ debt risk premium of 384 basis points using linear regression, which implies an annual increment of 18 basis points per annum from the intercept of 205 basis points. This was 3 basis points higher than the 381 basis points debt risk premium we estimated by extrapolating the 7 year Bloomberg fair value curve to 10 years. While the linear functional form was found to be superior in most of our daily regressions, we have also reported the 371 basis points obtained using the power function, as this functional form was shown to be superior during the averaging period ending 18 November, 2011. This estimate of the debt risk premium was 10 basis points lower than the 381 basis point estimate derived with the extrapolated Bloomberg curve.

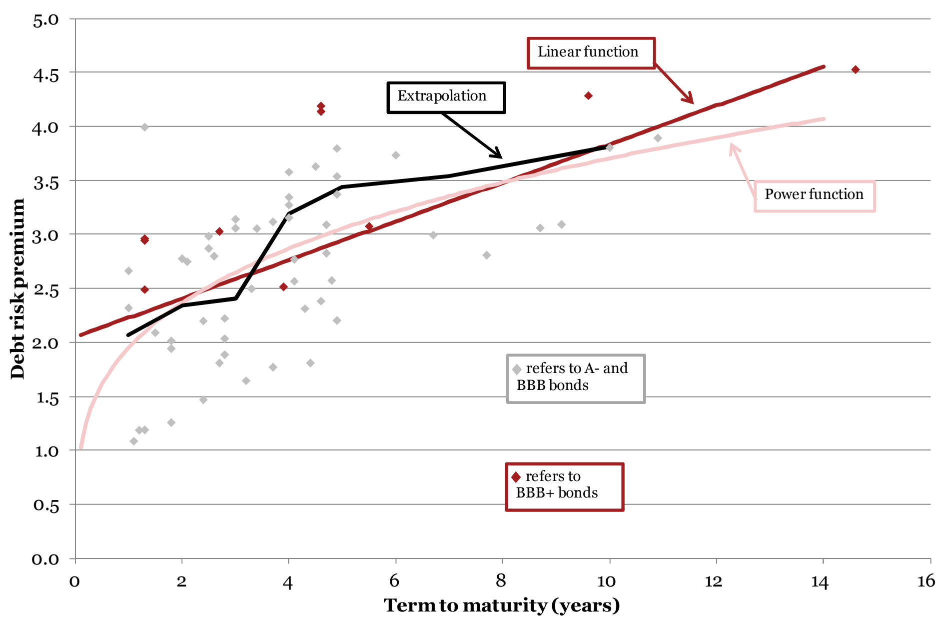
Table 5 – Debt risk premium linear regression estimates for 20 business days to 18 November 2011 (basis points)

Functional form	Regression constant	Debt risk premium increment per year	10 year debt risk premium
Linear	204.8	17.9	383.6
Power	n/a	n/a	370.5

Source: UBS, Bloomberg, AFMA, PwC

Our debt risk premium estimates using the alternative methodologies (and the sensitivity results) can be considered by reference to Figure 6 below.

Figure 6 – Debt risk premium estimates for 20 business days to 18 November 2011 (basis points)



Source: PwC's analysis, Bloomberg, UBS, AFMA

Figure 6 shows how our estimated straight line regression based on 'pooled' data for the three ratings bands lies below the Bloomberg curve over a range of terms to maturity between approximately 3.5 and 9.5 years. It is also noteworthy that of the 10 BBB+ rated bonds in the sample, only two lay below the extrapolated Bloomberg curve, and the linear and power curve functions. These relativities provide a degree of comfort that the estimated 10 year BBB+ debt risk premium of 384 (371) basis points using the 'pooled' regression under a linear (power) functional form is a reasonable estimate based on the current market for funds. Since these figures are not far from the estimate of 386 basis points obtained by extrapolating the Bloomberg curve, we consider the findings to be consistent and reinforcing of each other.

In summary, for the 20 day averaging period to 18 November, 2011, we found a close correspondence between the extrapolated Bloomberg estimate of the 10 year BBB+ debt risk premium and our own econometric estimates (whether based on a linear or power function), which rely on a different sample of bonds, and have applied a different estimation methodology. Based on these findings, we recommend that the extrapolated Bloomberg curve be applied to estimate the debt risk premium.

5.3 Applying the methodology to ElectraNet's averaging period

ElectraNet informed us that it had selected an averaging period for the 10 business days spanning 9 May, 2012 to 22 May, 2012. We therefore applied the methodology developed in this report to ElectraNet's chosen averaging period. Table 6 below shows that application of the methodology developed in this report derived a debt risk premium estimate of **398 basis points** for Electra Net's averaging period. This estimate of the 10 year BBB+ debt risk premium was obtained through the summation of:

- The debt risk premium estimated on the basis of the Bloomberg 7 year BBB credit rating fair value curve (376 basis points); and

- An extrapolation component from 7 to 10 years, which was estimated by reference to the average annual increment in the debt risk premium for three groups of paired bonds (i.e. 7.4 basis points per annum, which for three years provided an extrapolation value of 22.2 basis points).

Table 6 –Debt risk premium estimate applying the Bloomberg 'paired bonds' extrapolation for the 10 business days to 22 May, 2012 (basis points)

Bond Issuer	Short Maturity (years)	Long Maturity (years)	Debt Risk Premium – Bloomberg (basis points)	Debt risk premium - UBS (basis points)	Debt risk premium increment per year (basis points)
Telstra	4.2	8.2	10.4	10.2	10.3
Stockland	4.1	8.6	4.4	1.8	3.1
Sydney Airport	3.5	9.5	n/a	8.8	8.8
Average annual increment			**7.4**	**6.9**	**7.4**
3 years of average increment					22.2
Plus, Bloomberg 7 year debt risk premium					376
Extrapolated debt risk premium					**398**

Source: Bloomberg, PwC

Appendices

Appendix A Function equations

The following equations demonstrate the equations for the five functional types using data for the 20 business days ending 18 November 2011.

1 Linear function

$DRP = 2.049 + 0.179 * t$

where:

- DRP refers to the debt risk premium
- t is the term to maturity

2 Quadratic function

$DRP = 1.884 + 0.255 * t - 0.006 * t^2$

where:

- DRP refers to the debt risk premium
- t is the term to maturity

3 Exponential function

$DRP = 2.205 * \exp(0.054 * t)$

where:

- DRP refers to the debt risk premium
- t is the term to maturity

4 Logarithmic function

$DRP = 1.875 + 0.743 * Loge \ (t)$

where:

- DRP refers to the debt risk premium
- t is the term to maturity

5 Power function

$DRP = 1.949 * t^{0.279}$

where:

- DRP refers to the debt risk premium
- t is the term to maturity

Appendix B Regression outputs

1 Summary statistics – Linear functional form for the 20 business days to 18 November 2011

Dependent Variable: DRP

Method: Least Squares

Included observations: 62

DRP= C(1) +C(2)*T

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2.04852	0.153043	13.38525	0.0000
C(2)	0.178756	0.031854	5.611717	0.0000

R-squared	0.3442	Mean dependent var	2.766428
Adjusted R-squared	0.33327	S.D. dependent var	0.810031
S.E. of regression	0.661419	Akaike info criterion	2.042867
Sum squared resid	26.24849	Schwarz criterion	2.111484
Log likelihood	-61.32888	Hannan-Quinn criter.	2.069808
F-statistic	31.49137	Durbin-Watson stat	1.40012
Prob(F-statistic)	0.000001		

Source: Bloomberg, UBS, AFMA, PwC's analysis

2 Summary statistics – Quadratic functional form for the 20 business days to 18 November 2011

Dependent Variable: DRP

Method: Least Squares

Included observations: 62

DRP = C(1) + C(2)*T + C(3)*T^2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.883834	0.256388	7.3476	0.0000
C(2)	0.254719	0.099967	2.548033	0.0135
C(3)	-0.006082	0.007584	-0.801938	0.4258

R-squared	0.351272	Mean dependent var	2.766428
Adjusted R-squared	0.329281	S.D. dependent var	0.810031
S.E. of regression	0.663395	Akaike info criterion	2.064284
Sum squared resid	25.96546	Schwarz criterion	2.16721
Log likelihood	-60.99281	Hannan-Quinn criter.	2.104695
F-statistic	15.97358	Durbin-Watson stat	1.36445
Prob(F-statistic)	0.000003		

Source: Bloomberg, UBS, AFMA, PwC's analysis

3 Summary statistics – Exponential functional form for the 20 business days to 18 November 2011

Dependent Variable: DRP

Method: Least Squares

Included observations: 62

DRP = C(1)*EXP(C(2)*T)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2.204875	0.119439	18.46031	0.0000
C(2)	0.053933	0.009011	5.985334	0.0000

R-squared	0.328634	Mean dependent var	2.766428
Adjusted R-squared	0.317444	S.D. dependent var	0.810031
S.E. of regression	0.669223	Akaike info criterion	2.066327
Sum squared resid	26.87156	Schwarz criterion	2.134944
Log likelihood	-62.05614	Hannan-Quinn criter.	2.093268
		Durbin-Watson stat	1.419436

Source: Bloomberg, UBS, AFMA, PwC's analysis

4 Summary statistics – Logarithmic functional form for the 20 business days to 18 November 2011

Dependent Variable: DRP

Method: Least Squares

Included observations: 62

DRP = C(1) + C(2)*LOG(T)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.874734	0.184872	10.14073	0.0000
C(2)	0.742885	0.136803	5.430339	0.0000

R-squared	0.329523	Mean dependent var	2.766428
Adjusted R-squared	0.318349	S.D. dependent var	0.810031
S.E. of regression	0.668779	Akaike info criterion	2.065001
Sum squared resid	26.83594	Schwarz criterion	2.133618
Log likelihood	-62.01503	Hannan-Quinn criter.	2.091942
F-statistic	29.48858	Durbin-Watson stat	1.257612
Prob(F-statistic)	0.000001		

Source: Bloomberg, UBS, AFMA, PwC's analysis

5 *Summary statistics – Power functional form for the 20 business days to 18 November 2011*

Dependent Variable: DRP

Method: Least Squares

Included observations: 62

DRP = C(1)*T^C(2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.948963	0.146492	13.30422	0.0000
C(2)	0.27893	0.048798	5.716022	0.0000

R-squared	0.345357	Mean dependent var	2.766428
Adjusted R-squared	0.334446	S.D. dependent var	0.810031
S.E. of regression	0.660835	Akaike info criterion	2.041102
Sum squared resid	26.2022	Schwarz criterion	2.109719
Log likelihood	-61.27417	Hannan-Quinn criter.	2.068043
		Durbin-Watson stat	1.296049

Source: Bloomberg, UBS, AFMA, PwC's analysis

Appendix C Bond data from representative sample

Table 4 – Yields observations for fixed coupon bonds

Name	Date of maturity	Issue date
STOCKLAND	25/11/2020	25/11/2010
APT	22/07/2020	22/07/2010
BRISAIR	9/07/2019	4/04/2011
Caltex aus	23/11/2018	23/11/2011
SYDAIRPORT	6/07/2018	25/05/2011
DB RREEF	21/04/2017	21/04/2010
WESFARMERS	4/11/2016	4/11/2011
ETSA	29/09/2016	29/03/2011
ADLAIRPORT	20/09/2016	23/08/2006
MIRVAC FIN	16/09/2016	29/09/2010
MLBAIRPORT	25/08/2016	25/08/2010
STOCKLAND	1/07/2016	13/12/2010
BBIDBCTFIN	9/06/2016	9/06/2006
TRANSURBAN	8/06/2016	8/06/2011
GAIF	19/05/2016	19/05/2011
WOOLWORTHS	22/03/2016	22/03/2011
CPOF	11/03/2016	11/03/2011
MLBAIRPORT	14/12/2015	14/12/2005
SANTOS	23/09/2015	23/09/2005
VWGN	14/07/2015	14/07/2011
SYDAIRPORT	6/07/2015	6/07/2010
MIRVAC FD	15/03/2015	26/03/2010
STOCKLAND	18/02/2015	18/12/2009
VWGN	28/01/2015	28/01/2011
WESFARMERS	11/09/2014	11/09/2009
MLBAIRPORT	25/08/2014	25/08/2010
LEIGHTON	28/07/2014	28/07/2009
QICF	7/07/2014	28/04/2011
VWGN	31/03/2014	31/03/2010
TRANSURBAN	24/03/2014	24/03/2010
GPT	22/08/2013	22/08/2003
VWGN	17/08/2013	17/08/2010
STOCKLAND	15/05/2013	4/07/2003
SNOWYHYDRO	25/02/2013	25/02/2003
VODAFONE	10/01/2013	10/08/2006
VWGN	26/11/2012	26/11/2009
CLPAUST	16/11/2012	16/11/2005
Southern cross	11/10/2012	11/10/2002
HOLCIM	7/08/2012	7/08/2009
COLESMYER	25/07/2012	25/07/2005
SYDAIRPORT	21/11/2011	8/12/2006
TABCORP	13/10/2011	13/10/2004
ORIGINERGY	6/10/2011	6/10/2006
TRANSURBAN	15/09/2011	15/09/2006
CPOF	28/06/2011	28/06/2006
VWGN	24/06/2011	24/06/2009
STOCKLAND	16/06/2011	16/06/2005
PBL	6/05/2011	6/05/2005

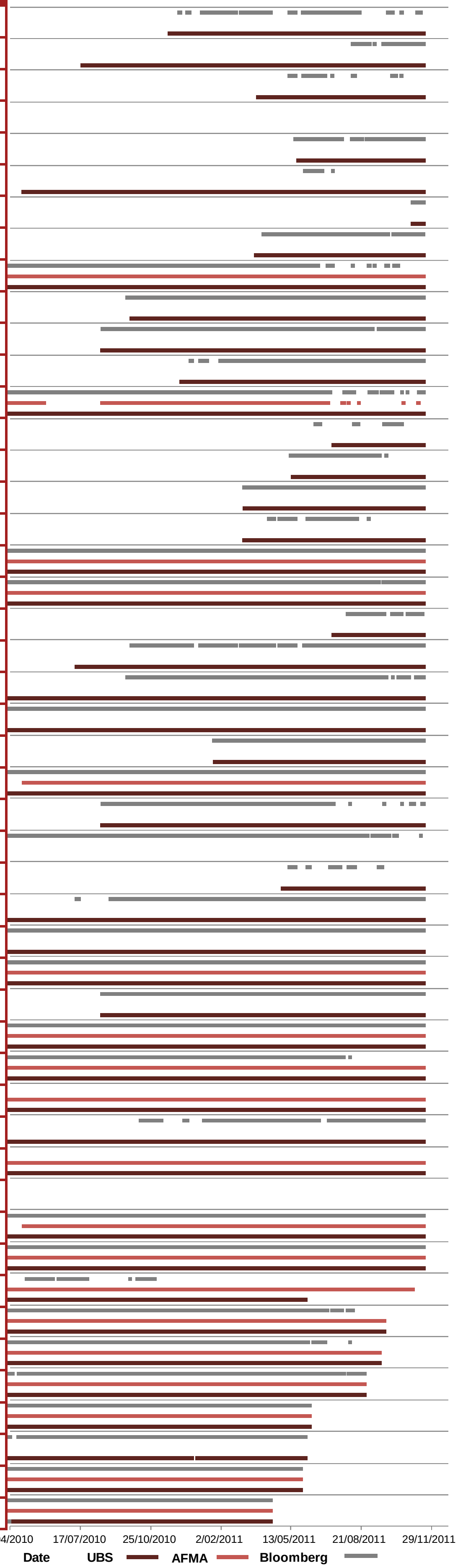
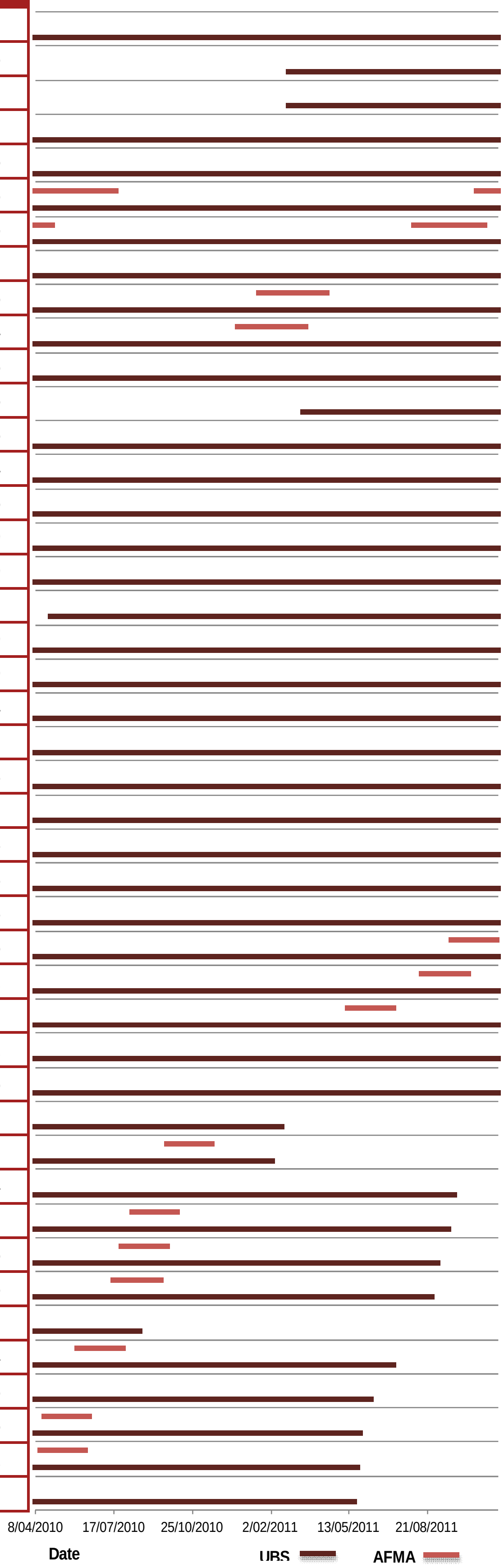


Table 5 –Trading margins observations for floating coupon bonds

Name	Date of maturity	Issue date
BBIDBCTFIN	9/06/2026	9/06/2006
*SYDAIRPORT**	11/10/2022	15/12/2006
*SYDAIRPORT**	20/11/2021	8/12/2006
BBIDBCTFIN	9/06/2021	9/06/2006
TRANSB (W)	10/11/2017	11/10/2005
ADLAIRPORT	20/09/2016	23/08/2006
BRISAIR	1/07/2016	29/06/2006
BBIDBCTFIN	9/06/2016	9/06/2006
MLBAIRPORT	14/12/2015	14/12/2005
SYDAIRPORT	20/11/2015	10/09/2004
CLPAUST	16/11/2015	16/11/2005
*POWERCOR**	15/11/2015	15/11/2005
TRANSB (W)	10/11/2015	10/11/2005
SYDAIRPORT	20/11/2014	10/09/2004
UNITE EN W	23/10/2014	31/10/2005
WESFARMERS	11/09/2014	11/09/2009
DB RREEF	28/07/2014	27/07/2009
ADLAIRPORT	15/06/2014	9/04/2010
TAHHA	1/05/2014	30/04/2009
TABCORP	1/05/2014	19/06/2009
BACL	11/12/2013	30/06/2004
SYDAIRPORT	20/11/2013	8/12/2006
GPT	22/08/2013	22/08/2003
COCACOLA	8/03/2013	8/03/2006
CPOWER (W)	28/02/2013	28/02/2003
SNOWYHYDRO	25/02/2013	25/02/2003
SNOWY (W)	25/02/2013	25/02/2003
CLPAUST	16/11/2012	16/11/2005
SYDAIRPORT	11/10/2012	11/10/2002
BROADCAST	9/07/2012	9/07/2002
MERIDIAN	9/02/2012	26/02/2002
BBIDBCTFIN	12/12/2011	12/12/2006
*STOCKLAND^*	15/05/2013	4/07/2003
*SYDAIRPORT^*	21/11/2011	8/12/2006
TABCORP	13/10/2011	13/10/2004
ORIGINERGY	6/10/2011	6/10/2006
SANTOS	23/09/2011	23/09/2005
TRANSURBAN	15/09/2011	15/09/2006
PACPRO	15/08/2011	
EPG (W)	29/07/2011	29/07/2004
CPOF	28/06/2011	28/06/2006
STOCKLAND	16/06/2011	16/06/2005
MLBAIRPORT	11/06/2011	30/05/2001
QICF	7/06/2011	3/11/2005



Source: Bloomberg, AFMA, UBS, PwC.

* trading margins began reporting after issue date

^ trading margins stopped being reported before maturity date pwc.com.au