Jemena Gas Networks (NSW) Ltd - Initial response to the draft decision

Appendix 5.5

PricewaterhouseCoopers: Cost of Debt Report

19 March 2010

Jemena Gas Networks (NSW)

The benchmark cost of debt for a gas distributor

March 2010

PRICEWATERHOUSECOOPERS

Contents

1 Questions and findings

1.1 Background to the report

The Australian Energy Regulator (AER) is reviewing the access arrangement proposal submitted by Jemena Gas Networks (NSW) Ltd (JGN) for the NSW gas networks for 2010 to 2015.

In its draft decision, the AER applied a methodology to derive an estimate of the benchmark debt margin (risk premium) for a BBB+ rated firm issuing 10 year bonds.

In determining the cost of debt, the AER applied the CBASpectrum estimated margin for the proxy averaging period (26 November, to 23 December, 2009), deriving a value of 418 basis points. It concluded that its methodology, which examined the performance of the Bloomberg and CBASpectrum's fair value curves (and an average) against observed bond yields, and concluded that CBASpectrum provided the best fit of the data. It concluded that this provides a 'reasonable basis to consider that using CBASpectrum's BBB+ fair value curve results in the best estimate possible in the circumstances … [and] … a debt risk premium commensurate with prevailing conditions in the market for funds and the risks of providing reference services'.[1]

1.2 Terms of Reference

PricewaterhouseCoopers (PwC) was engaged by JGN to assess the methodologies applied by Bloomberg and CBASpectrum, and the AER's reliance on these services to estimate a benchmark cost of debt under the National Gas Law (NGL) and National Gas Rules (NGR). More specifically, the Terms of Reference require PwC to:

1 *Review the AER's draft decision on the debt margin* — an assessment of the AER's analysis and conclusions on the data source and estimate of the debt margin in section 5.10 of the decision, including whether the AER's methodology for comparing Bloomberg and CBASpectrum fair value curves is robust and likely to lead to: (a) a rate of return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

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[1] AER (February, 2010), *JGN – Access arrangement proposal for the NSW gas networks*, Draft decision – Public, p. 139. We note that the AER formally required JGN to use a debt margin of 432 basis points, although this appeared to be (and we assume it was) an error. We also understand that the AER did not in fact conduct its tests during the specific averaging period, but rather relied upon the results of its test applied to a prior period.

2 *Propose a Bloomberg test* — propose a methodology to test whether the Bloomberg fair yield curves that the AER has relied on for estimates of the debt premium in previous determinations leads to:(a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

3 *Propose a CBASpectrum test* — propose a methodology to test whether the CBASpectrum fair yield curves that the AER has relied on for estimates of the debt premium in previous determinations leads to: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

4 *Propose a method* — propose a method for comparing Bloomberg and CBASpectrum fair value curves that will contribute to determining: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances. This method should have regard to Jemena's proposal, and the AER's draft determination, that the risk-free rate should be estimated using the yield on 10-year CGS.

5 *Apply the tests and method to estimate a debt premium for a BBB+ 10 year bond* — apply the proposed tests and method for comparing Bloomberg and CBASpectrum fair value curves to the 20 business days from 15 January to 12 February 2010 inclusive to estimate a debt premium for a BBB+ 10 year bond.

6 *Propose a debt premium estimate for a BBB 10 year bond* — propose a debt premium estimate for a BBB 10 year bond over the 20 business days from 15 January to 12 February 2010 that is (a) a return on debt capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

For convenience we approach these issues in a different order, addressing first tasks 2 to 4, thereby establishing first the methods for testing the appropriateness of Bloomberg and CBASpectrum and for testing the relative merits of each method. Next we assess the AER's draft decision (task 1), and then, we use the methodology derived in tasks 2 to 4 to estimate a debt margin for the averaging period covering the 20 business days from 15 January to 12

February 2010, inclusive (task 5). Lastly, we address the question of the margin on BBB debt during this latter period.

1.3 Authorship and declaration

This report has been prepared by Jeff Balchin and Matt Santoro. Our curricula vitae are attached to this report. We have been assisted in its preparation by Michael Lawriwsky, Steven Hong and Dean Glasscock.

As a professional services firm, PwC has an ongoing relationship with Jemena. This relationship includes advising on matters pertaining to the regulatory review that is the subject of this report. Further details of PwC's relationship with the businesses can be provided if necessary.

We confirm that, in preparing this report, we have made all the inquiries that we believe are desirable and appropriate and that no matters of significance that we regard as relevant have, to our knowledge, been withheld. We have been provided with a copy of the Federal Court's 'Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia' and this report has been prepared in accordance with those Guidelines.

1.4 Our approach

In performing this analysis, we have drawn heavily upon the analysis that we prepared for the Victorian electricity distribution businesses late last year,[2] which considered the question of whether the Bloomberg service was providing reliable estimates of the cost of debt financing at that time. This report was undertaken against the backdrop of the Bloomberg service being a tool that Australian regulators have used to derive benchmark costs of debt for regulated businesses (including in analysis undertaken by contributors to this report), but providing counterintuitive estimates after the onset of the worst of the global financial crisis in September 2008 and through much of 2009.

In that report, we presented tests for whether (and in what circumstances) the Bloomberg service was expected to provide reliable estimates of the prevailing cost of debt, the first test of which was in essence whether reliable information could be obtained on the prevailing yields on Australian corporate bonds. The assumption that we adopted in that report was that, so long as the reliable yields for actual Australian (fixed rate) corporate bonds on issue can be obtained, then sole reliance should be placed on information from those bonds when deriving a benchmark cost of debt. This assumption in our previous report reflected a number of factors, most notably that the previous report related to electricity distribution

[2] PricewaterhouseCoopers (November, 2009), *Victorian Distribution Businesses – Methodology to Estimate the Debt Risk Premium*.

(which has a more detailed framework around the determination of the cost of capital to apply in a regulatory period), because the AER had expressed a preference for concentrating on information from Australian (fixed rate) corporate bonds and because this data source had been advocated previously by both Australian regulators and regulated entities.

The current report proceeds on the basis of the same assumption outlined above. Again, that assumption is that, so long as reliable yields on the actual Australian (fixed rate) corporate bonds on issue are available, then sole reliance should be placed on information from those bonds when deriving a benchmark cost of debt. However, we note at the outset that the level of information that can be gleaned from Australian (fixed rate) corporate bonds for this task currently is poor.

The global financial crisis has seen the new issue of corporate bonds in the Australian market falling substantially, and there is a shortage of longer term bonds on issue in the lower credit ratings (with the longest dated bond in the BBB bands having a term to maturity of 6.5 years, and few longer dated bonds being on issue in the A bands). This means that deriving a fair value curve (and the benchmark debt margin) at 10 years is subject to considerable estimation error. We are aware that others have argued that, with this paucity of information regulators should supplement their analysis with information from other sources – such as the yields on Australian corporate floating rate bonds swapped back to create a synthetic fixed rate bond – which is a proposition with which we have sympathy. In any event, we note that determining a benchmark cost of debt at the current time requires the exercise of judgement, informed by both the available empirical evidence and relevant economic theory.

1.5 Methodology to assess the Bloomberg and CBASpectrum methods in isolation (Tasks 2 and 3)

In a recent report for the Victorian distribution businesses, we developed a method for testing whether the Bloomberg service was likely to be performing sufficiently reliably to be relied upon to estimate the (benchmark) cost of debt for a regulated entity. This report was prepared against the backdrop of the global financial crisis during which:

- both the issue of, and trade in, corporate bonds all but ceased;
- there was a substantial level of uncertainty about the current fair-market yield for the bonds on issue; and,
- the fair value yields that were produced by the Bloomberg service appeared to be out of line with the (limited) information that was available as well as being at odds with the general market observations which indicated that the cost of debt was at

historically high levels while Bloomberg was reporting a fairly constant or average cost of debt that did not vary significantly from the period prior to the onset of the global financial crisis.

We propose in this report to apply the same tests to both the Bloomberg and CBASpectrum service to ascertain whether the evidence suggests that the estimates that are produced by these services are likely to represent prevailing conditions in the market for funds. The three tests – and their function – are as follows:

- The level of dispersion across the opinions of the financial institutions that submit opinions on corporate bond yields to Bloomberg – which is a measure of the general degree of uncertainty about the values of corporate bonds (and implicitly is a measure of the degree of trade in those bonds).

  As noted above, one of the factors that was observed during the worst of the global financial crisis (and which we consider the Bloomberg algorithms were unable to cope with) was a substantial increase in the level of disagreement between the different financial institutions about the current fair market yield of the Australian corporate bonds on issue.

  If this test is failed, then we conclude that there can be no confidence that applying either service in isolation will produce estimates that represent the prevailing conditions in the market for funds and so recommend against applying either the Bloomberg or CBASpectrum service in isolation. In this circumstance, we recommend making use of a broader range of (albeit imperfect) information to address the uncertainty.

  To pre-empt the discussion below, we find that the level of disagreement across the different financial institutions that provide bond yield estimates to Bloomberg is currently very low – and back to pre global financial crisis levels – which means that the prevailing yield on actual corporate bonds on issue again can be observed with a reasonable reliability. Accordingly, this test is not mentioned further in this Chapter 1.

- The difference between the Bloomberg-determined and CBASpectrum-determined yields for bonds and the central tendency of the opinions provided by financial institutions – both Bloomberg and CBASpectrum use their own estimates of the fair market yield for the relevant Australian corporate bonds as the inputs into their estimation of the fair value curves for Australian corporate bonds. The purpose of this test is to assess whether the Bloomberg and CBASpectrum method for determining bond prices is different to the consensus of financial institutions and hence is likely to cause a (statistical) bias.[3]

[3] We use the 'feeds' from financial institutions into the Bloomberg service as the peer group for undertaking this test for both Bloomberg and CBASpectrum. We have access to (and so have used) feeds from 7 financial institutions (although the coverage is between 5 and 7 for any bond), namely ABN Armo (Royal bank of

If this test is failed for one or both of the services, then we conclude that the service in question is likely not to provide estimates that represent prevailing conditions in the market for funds and so recommend against using the service(s) in question.

- The average difference between the Bloomberg and CBASpectrum fair value yields for each of the bonds within their sample and the inputs that Bloomberg and CBASpectrum have applied – this essentially is a test of whether the relevant curves are fitted through the middle of the bond observations that were being considered. Implicitly it is a test of:
  - For Bloomberg, the aggregate effect of its practice of identifying and excluding outliers; and
  - For CBASpectrum, the aggregate effect of its practice of estimating all of its fair value curves as a 'system' (that is, where the BBB+ curve is affected by all bond yields, including AAA bonds).

If this test is not passed then it means that the curve is biased either upwards or downwards when compared to the inputs that the curve in question relied upon. If this test is failed for one or both of the services, then we conclude that the service in question is likely not to provide estimates that represent prevailing conditions in the market for funds and so recommend against using the service(s) in question.

We note, however, that the tests identified assess whether the two services provide appropriate estimates of the current fair market yield for corporate bond yields broadly across the terms for which there are bonds on issue. The tests are not focussed on the appropriateness of the different services for the problem at hand, which is to derive the fair market yield for a bond with a term of 10 years. It is inherent to the tests (and test 3 in particular) that the assessment is only relevant across the terms of debt for which there are corporate bonds on issue, which means that the tests currently can only test the accuracy out to 5.6 years in the case of BBB+ bonds. In addition, the tests place no particular weight on the accuracy of the curves at the 'longer end', even though that arguably is the priority. Our proposed approach for testing the relative merits of the two services for estimating the benchmark cost of 10 year, BBB+ debt is addressed next.

Scotland), Commonwealth Bank, Westpac, NAB, Royal Bank of Canada, ANZ and BNP Paribus.

1.6 Methodology to assess the relative merits of the Bloomberg and CBASpectrum methods (Task 4)

As noted above, there are two matters that need to be tested when asking whether the Bloomberg and CBASpectrum methods are likely to provide a cost of debt that represents 'prevailing conditions in the market for funds' and represents the 'best forecast or estimate possible in the circumstances', namely:

- which of the two services provides the better explanation of the yields on the bonds that are on issue; and
- given that the longest dated BBB+ bond currently is 5.6 years – and hence it is necessary to extrapolate from the current bond yields – what is the most appropriate means of undertaking that extrapolation and (for the CBASpectrum service, which does extrapolate fair value yields out to 10 years) is that method of extrapolation reasonable.

We note at the outset that the first of the tests is amenable to a mechanical test, which we propose. We note that the second is less amenable to a mechanical test, but we summarise the relevant factors for this assessment and our findings below.

1.6.1 Relative accuracy of Bloomberg and CBASpectrum – within sample

The main test that we have applied to judge the relative accuracy of the Bloomberg and CBASpectrum services within the bounds (terms) of the bonds on issue is to compare the (simple) average error associated with each of the services. This test is analogous to the third of the tests that we have recommended to judge the appropriateness of the two services on a stand alone basis, as discussed above.

A comparison of the simple average errors across the services is straightforward to interpret – a positive error means that the curve in question is providing an upward biased estimate of the cost of debt compared to the sample of bonds, and vice versa if the average error is negative. The magnitude of the average provides an estimate of the relative size of the bias associated with the different estimates produced by the services. We have also compared the errors that are found when different cut-offs for the term of bonds are considered, noting that as the objective is to provide an estimate of the margin associated with a 10 year bond, the accuracy associated with the longer dated bonds arguably is more important. We acknowledge at the outset, however, that by restricting the sample of bonds progressively to those with longer terms reduces the already small sample size, and that a trade off exists between the relevance of the bonds in the sample and the sample size. In applying this test:

- we have followed the AER's practice and restricted the sample to only BBB+ bonds, given that the objective is to derive a margin for bonds with this rating – although we note that this implies a sample of only 5 bonds; and
- the results that we rely upon are those that use the Bloomberg estimates of the yields for the actual bonds on issue (that is, the yields for the relevant bonds that are constructed by Bloomberg from the estimates that it obtains from different financial institutions). We report the results against the CBASpectrum yields for completeness, but caution against using these yields given our findings that the CBASpectrum yield estimates are often some distance from the central tendency of the group of financial institutions that provide yield estimates to Bloomberg.

We note that, in the period prior to the global financial crisis, it was common for regulators or advisers to rely on the (simple) average of the error to determine the relative accuracy of each of the services and the magnitude of any required adjustment.[4] However, at that time there were a number of bonds with 6 to 10 year terms, and the test was implicitly also a test of functional form out to a term of 10 years or close to it.

We also apply and report the results of two additional tests for judging the relative accuracy of the two services, which are the average of the *absolute error* and the average of the *squared error* across the sample of bonds. These tests are a measure of the general level of error – both positive and negative – associated with each of the curves.

1.6.2 Appropriate method for extrapolating beyond the data

As noted above, the most difficult issue with deriving a benchmark cost of debt from Australian (fixed rate) corporate bonds at present is the fact that the objective is to derive a cost of debt for bonds with a 10 year term, but the longest dated BBB+ bond has a term to maturity of about 5.6 years, and the longest dated bond in the BBB band generally has a term to maturity of only 6.5 years. As a consequence, Bloomberg only produces a 'fair value' yield curve out to 7 years. CBASpectrum, in contrast, provides a 'fair value' yield curve out to 10 years, but does this by:

- assuming a particular functional form for the relationship between the term of debt and the yield; and
- estimating the fair value curves across all credit ratings as a series, that is, by also estimating an empirical relationship between the different credit ratings.

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[4] For example, Essential Services Commission (October, 2005), Electricity Distribution Price Controls 2006-2010 – Final Decision Vol.1 (Statement of Purpose and Reasons), p.370.

In our previous report on this matter, we concluded that theory predicted that the relationship between the debt margin and term should be approximately linear, at least once short dated bonds are eliminated from the sample. We also concluded that the slope of this relationship should rise as the credit rating declines. We remain of these views, and present further support for these conclusions in this report.

Turning to the question of the relative merits of the Bloomberg and CBASpectrum services, we note that the Bloomberg service leaves open the choice of how to extrapolate beyond the data that underpins its fair value curve. Accordingly, if Bloomberg is used, we recommend that a linear extrapolation be applied. While noting that this requires an element of judgement, we remain of the view that extrapolating the Bloomberg debt margins at 5 and 7 years is likely to be the best. We also note that Bloomberg does produce a fair value curve for AAA bonds. This information can be used to infer the minimum value for the 10 year BBB+ debt margin – the difference in the margin between 10 year and 7 year BBB+ bonds should be greater than the difference between 10 year and 7 year AAA bonds.

Turning to the relative merits of the CBASpectrum method, we observe the following:

- by observation, the functional form that CBASpectrum assumes between the debt margin and the term of debt appears to be concave (that is, the slope declines with term);

- the CBASpectrum service estimates a system of equations that seek to explain all credit ratings simultaneously and, by observation, appears to rely upon the higher-rated bonds to derive the slope of the curve beyond the longest dated of the BBB (and A and AA) bonds.

For the reasons already provided, we consider that the first of these methodological assumptions would be inappropriate and would result in the fair value yield for bonds with a 10 year term being understated. Accordingly, if the CBASpectrum fair value curves were materially concave then we would conclude that the CBASpectrum service would be likely to provide debt margins that understate the cost of debt for long dated corporate bonds. To be clear, we do not know whether the CBASpectrum service always fits concave curves as we do not know its precise method. Our conclusion here is that this should be tested.

In addition, while we do not comment on the appropriateness of using of a system of equations to derive a debt margin,[5] we note that the fact that its fair value curve for any credit band relies upon information on yields for all credit bands, then it is necessary to analyse the appropriateness of the bond yields that it assumes for all

[5] To be clear, as the CBASpectrum method is proprietary (and hence there is no information in the public domain about the specification of the equations that are estimated), an a priori examination if its estimation method is not possible.

bonds on issue. Importantly, as noted above, the bond yield that it assumes for the longer dated bonds of higher credit ratings would be expected to have an impact on how the BBB+ curve is extrapolated beyond the range of the bonds in the BBB (and A and AA) bands.

While we note that the Commonwealth Bank – as an experienced market participant – is entitled to have its own view about the fair market yield for traded bonds, it is only one market participant and as a general comment we do not consider it appropriate to place undue weight upon one market participant's view if it is materially different to the central estimates of the yields assumed across the range of financial institutions.

1.7 Review of the AER's Draft decision on JGN's debt margin (Task 1)

We review the AER's draft decision for JGN, where the AER found that CBASpectrum's fair value curve was considered to provide the best alignment to the yield estimate data, irrespective of whether the Bloomberg or CBASpectrum yields are used as the best indicator of the actual yields of the bonds on issue.

We attempted to reproduce the AER's analysis from the discussion in the text, previous draft or final decisions of the AER, and from a model (with input data removed) that we obtained from the AER through JGN. We assumed that the AER tested the services against the five BBB+ bonds that have a term to maturity in excess of two years, and relied upon the average of the squared error as the test of the 'goodness of fit' of the relevant service. Our findings are reported in Table 1, which shows that CBASpectrum provided only a marginally better fit to the data provided that the Bloomberg bond yields were used as the indicator of the actual yield on the relevant bonds, as well as a better alignment with respect to CBASpectrum's own data.[6]

Table 1 – AER's weighted squared error tests – JGN Draft decision period (BBB+ bonds)

AER Test	Bond yield source	Fair value curve source:	
		Bloomberg	CBASpectrum
Sum of squared errors	Bloomberg	48	45
	CBASpectrum	165	153

Source: Bloomberg and CBASpectrum

6 For the avoidance of doubt, however, we prefer to use the Bloomberg yields as the best indicator of the actual prevailing yields of the corporate bonds on issue. This is not because we question the professionalism of the Commonwealth Bank's opinions on bond yields, but rather that the Commonwealth Bank is just one market participant and we consider it appropriate to place weight on as broad a field of participants as possible. The Bloomberg service presents the views of a number of market participants (including the Commonwealth Bank) and the Bloomberg service's synthesis of those opinions.

Our main concern with the AER's method is that, while it considers the accuracy of the different curves by looking at all bonds that have a term to maturity of greater than 2 years, in practice this results in comparing the two curves against a sample of only 5 bonds, the longest-dated of which has a term to maturity of 5.6 years. The AER's test, therefore, cannot provide any confidence about the appropriateness of the curve that is then extrapolated beyond the range of the data to predict the benchmark cost of 10 year debt.

We observe that during the period in question the CBASpectrum debt margin curves were markedly concave across bonds with medium to long terms, which we consider to be inconsistent with the predictions of economic theory. We also observe that the slopes of the debt margin curves generated by CBASpectrum are also similar across the different credit ratings, which is also contrary to predictions from economic theory. Thus, even if the CBASpectrum curve had a reasonable alignment to the BBB+ yield estimates up to 5.6 years, it would be likely to understate the debt margin curve at 10 years.

In addition, we note that CBASpectrum's assumed yields for the actual bonds on issue differ materially from the central tendency of other financial market participants for some credit bands (although not in the BBB+ band), as shown in Table 2 (with the performance of the Bloomberg yields over the period in question also provided for reference).

Table 2 – Bloomberg's and CBASpectrum's divergence from bank opinions (JGN Draft decision period)

Credit rating	Test 2a: Bloomberg	Test 2b: CBASpectrum
AAA	0.000	0.091
AA	0.000	0.091
A	0.011	0.264
BBB+	0.012	0.010
BBB	0.001	0.060

Source: Bloomberg and CBASpectrum.

Given the discrepancy, we consider there to be additional force to the proposition that it is preferable not to rely upon the extrapolation that is undertaken in the CBASpectrum service for bonds beyond the range of the observed yields on BBB bonds.

In addition, we note for completeness that the AER's finding that CBASpectrum had the best alignment to the data is sensitive to the cut-off term applied (the AER applied a 2 year cut-off). As Table 3 shows, with a cut-off of 4 years, for example, Bloomberg provided the best alignment, noting, however, that this would imply a test sample only 2 (albeit more relevant) bonds from which it is difficult to draw firm conclusions.

Table 3 – AER's 'sum of squared errors' Test of the BBB+ Fair Value Curve (26 November 2009 to 23 December 2009) using BBB+ bond yield estimates

		Error by cut-off period (basis points)			
FVC estimate	Yield data estimate	2 years	3 years	4 years	5 years
		n=5	n=4	n=2	n=1
CBA	Bloomberg	45	47	40	2
Bloomberg	Bloomberg	48	49	34	1
CBA	CBA	153	181	44	3
Bloomberg	CBA	165	192	38	3

Source: Bloomberg and CBASpectrum. Note: 'n' refers to the number of bonds

We conclude that the methodology applied by the AER during the JGN draft decision and applied to the proxy averaging period contained flaws. In particular, the AER applied the CBASpectrum extrapolation of yield (and implied margin) estimates to 10 years, which implied a relationship between the margin and term that was inconsistent with economic theory and that relied upon data inputs that was not representative of views across the range of financial institutions.

1.8 Applying the PwC methodology to the January-February 2010 period (Task 5)

JGN requested us to apply method for ascertaining whether the Bloomberg or CBASpectrum service is the more reliable for a reference period of 20 business days to 12 February, 2010.

Our first test assesses whether the yields that each of the services is close to the central estimate of their financial institution peers.[7] The critical value that we adopted for this test in our previous report was that the relevant service must adopt yield estimates that are within +/- 2.5 percent of the mean of the estimates that financial institutions provide into Bloomberg, averaged across the bonds.

As shown in Table 4 below, for the January-February 2010 reference period, Bloomberg passed this test in all rating categories, while CBASpectrum's data failed in all rating categories. This implies that some of CBASpectrum yield estimates have diverged significantly from the central tendency of the opinions provided to Bloomberg from other financial institutions.

[7] As noted above, our threshold test was whether reliable information existed on the current yield of the actual corporate bonds on issue, which we measured by the extent of disagreement on the yield for a relevant bond across the financial institutions that submit yield estimates to Bloomberg. This test was passed easily in this period.

While we note that the Commonwealth Bank – as an experienced market participant – is entitled to have its own view about the fair market yield for traded bonds, it is one market participant and as a general comment we do not consider it appropriate to place undue weight upon one market participant's view if it is materially different to the central estimates of the yields assumed across the range of financial institutions. Accordingly, we would recommend not using the CBASpectrum service to establish the prevailing benchmark cost of debt without further analysis. For completeness, however, we have shown CBASpectrum's performance in the remainder of the tests, which relate to both CBASpectrum and Bloomberg.

Table 4 –Divergence from bank opinions - 20 business days to 12 February 2010

Credit rating	Bloomberg	CBASpectrum
AAA	0.004	0.103
AA	0.018	0.070
A	0.018	0.069
BBB+	N/A	0.028
BBB	0.019	0.036

Source: Bloomberg and CBASpectrum

The next test asks whether the curve that each of the services fits appears to go through the middle of its data points. We measure this by asking whether the average difference between a service's yield estimate and the corresponding point on the service's fair value curve, expressed as a percentage of the yield estimate is material, which we defined in our previous report as exceeding +/- 4.00 percent. The results are shown in Table 5 below. We find that the alignment of Bloomberg's fair value curve to its own data is very close, but CBASpectrum's data fail the test in most rating categories, albeit passing the test in the BBB+ category.

Table 5 – Divergence of Bloomberg's and CBASpectrum's yield estimates from their fair value curves- 20 business days to 12 February 2010

Credit rating	Bloomberg	CBASpectrum
AAA	0.002	0.020
AA	-0.002	0.040
A	0.016	-0.075
BBB+	N/A	-0.015
BBB	0.007	-0.184

Source: Bloomberg and CBASpectrum

1.8.1 Bloomberg vs CBASpectrum – within sample

Table 6 summarises the results of the three tests described previously about the relative accuracy of the Bloomberg and CBASpectrum services. These results are presented for different cut-offs, that is, for a sample of bonds with a term of 2+ years, 3+ years, etc. As discussed already, we rely upon the comparison against the Bloomberg yields – the comparison against CBASpectrum yields is provided for information only.

Taken as a whole, we find that at longer terms the Bloomberg fair value curve has a better alignment with the data than CBASpectrum curves during the proxy measurement period used in the AER's draft decision:

- Using an average error test we find that Bloomberg's and CBASpectrum's alignment to the data depends on the cut-off against both Bloomberg and CBASpectrum data, with Bloomberg having a closer alignment at the 3 year cut-off against both Bloomberg and CBASpectrum data.

- Applying an absolute error test, against both sets of data we find that during the recent reference period Bloomberg uniformly shows less error than CBASpectrum. It is noticeable in this case that the size of the differential between Bloomberg and CBASpectrum increases as the cut-off is raised (i.e. increases with term).

- Applying the AER's weighted sum of squared errors test to the 20 business days to 12 February, 2010, we find that against Bloomberg's data, Bloomberg provides the best alignment for all cut-off periods above 2 years. However, the margin of Bloomberg's advantage is slender for 3 and 4 years.

Table 6 –Errors tests of the BBB+ Fair Value Curve using BBB+ bond yield estimates- 20 business days to 12 February 2010

		Error by cut-off period (basis points)			
FVC estimate	Yield data estimate	2 years n=5	3 years n=4	4 years n=2	5 years n=1
Average error test:					
CBA	Bloomberg	-8	-23	-3	-77
Bloomberg	Bloomberg	17	3	43	-20
CBA	CBA	-39	-61	7	-61
Bloomberg	CBA	-18	-39	46	-10
Absolute error test:					
CBA	Bloomberg	72	77	75	77
Bloomberg	Bloomberg	72	72	63	20
CBA	CBA	99	112	68	61
Bloomberg	CBA	99	107	56	10
AER's weighted sum of squared error test:					
CBA	Bloomberg	60	69	61	74
Bloomberg	Bloomberg	63	68	60	28
CBA	CBA	172	210	44	35
Bloomberg	CBA	177	210	50	2

Source: Bloomberg and CBASpectrum. Note: 'n' refers to the number of bonds

1.8.2 Bloomberg vs CBASpectrum – extrapolation beyond the data

As discussed above, when no data are available for 6 to 10 year terms, CBASpectrum extrapolates beyond the data. As we do not know whether the CBASpectrum service always fits concave curves, we reviewed the shape of its debt margin curve during the January-February 2010 reference period. We found a marked degree of concavity, even of the BBB+ and BBB debt margin curves. We also observe that the slopes of the debt margin curves generated by CBASpectrum are very similar across the different credit ratings. This concavity and absence of much slope differential between ratings are at odds with theoretical priors, causing us to question the results of CBASpectrum's extrapolation of the BBB+ curve to 10 years.

Since Bloomberg does not currently provide an estimate of a debt margin at 10 years, we applied linear extrapolation of Bloomberg's 5 and 7 year margins (using the BBB curve), and obtained an estimated debt margin of 448 basis points.

Bloomberg currently only provides a 10 year fair value yield estimate for the AAA curve. The slope of the Bloomberg AAA curve was not

concave during the reference period, and according to finance theory should have a significantly lower (flatter) slope than the BBB curve. Extrapolating the Bloomberg 7 year BBB debt margin using the slope of the Bloomberg AAA debt margin between 7 and 10 years provides an estimated margin of 434 basis points, which we consider to be an absolute lower bound estimate of the 10 year BBB+ debt margin.

1.8.3 Conclusion

PwC considers that the best point estimate of the debt margin for a 10 year BBB+ rated bond for the 20 business days up to and including 12 February, 2010 is 448 basis points. The calculation of this margin is set out in Appendix A.

In addition, we note that the AAA curve can be used to provide confidence that this extrapolation is reasonable. Our discussion above implies that the margin on BBB+ debt should increase faster with the term of debt than the margin on AAA debt. As Bloomberg produces an AAA curve out to 10 years, the change in the AAA debt margin between 7 and 10 years can be used to provide a lower bound to the amount that would need to be added to the 7 year BBB+ yield to derive a 10 year BBB+ yield. Applying this method results in a lower bound for the 10 year BBB+ debt margin of 434 basis points. To reiterate, however, this estimates is expected to understate the 10 year BBB+ yield; thus it should be interpreted as providing confidence that the debt margin of 448 basis points is reasonable. Our calculation of this margin is also provided in Appendix A.

1.9 BBB credit margin for the 20 period ending with 12 February 2010 (Task 6)

We have also been asked to advise on what the cost of debt for 10 year BBB rated debt may have been during the 20 day period ending with 12 February 2010.

First, we confirm that the analysis that we presented above has been directed at finding which of the two services of Bloomberg and CBASpectrum is likely to provide the best estimate of a 10 year bond with a BBB+ credit rating. In particular, while the Bloomberg service only presents a fair value yield curve for the broad BBB credit rating band (i.e., BBB+, BBB and BBB-), our testing of the relative performance of the two services followed the AER's practice of using only BBB+ bonds.

In principle, debt with a BBB credit rating would have a higher debt margin than debt that was in other respects equivalent except that it had a BBB+ credit rating. However, as we noted in our previous report, it is difficult at present to quantify the difference between BBB and BBB+ bonds if sole reliance is placed upon corporate bond yields, noting that Bloomberg's rationale for only providing a BBB curve in Australia is because there are too few bonds on issue to

make statistically meaningful distinctions between the ratings sub-bands, and we agree with this view (in contrast, a BBB+ curve is produced for the US). We note further that it is more difficult again to make such a meaningful distinction between the sub-bands for bonds with a 10 year term given that the longest dated bond in the BBB band has a term of only 6.5 years.

However, we note that the tests that we applied to assess the reliability of the Bloomberg and CBASpectrum curves can also be undertaken using BBB bonds rather than BBB+ (and also using the BBB curve that CBASpectrum produces), and provides the results of our preferred test (a simple average of the difference between the actual bond yields and the fair value curves) in Table 7 below.

Table 7 – Error tests of the BBB Fair Value Curve (15 January 2010 to 12 February 2010) using BBB bond yield estimates

Error = FVC - Yield		Error by cut-off period (basis points)					
FVC estimate	Yield data estimate	All	1 year	2 years	3 years	4 years	5 years
		n=7	n=5	n=3	n=2	n=2	n=1
CBA	Bloomberg	-98	-84	-69	-126	-126	-149
Bloomberg	Bloomberg	-50	-41	-30	-78-	-78	-80
CBA	CBA	-198	-312	-518	N/A	N/A	N/A
Bloomberg	CBA	-188	-303	-524	N/A	N/A	N/A

We would draw two conclusions from these results.

First, both of the services would appear to understate the yield on BBB rated debt and to do so materially, although we note that this is based upon very limited observations of bonds that have a greater term to maturity than 2 years. This conclusion is not surprising for the Bloomberg service given our earlier results that suggest that it provides a reasonably close fit for BBB+ bonds. The fact that the CBASpectrum BBB curve appears to under-predict the prevailing yields on the bond on issue is also consistent with our findings that are elaborated upon in Chapters 4 and 5 that the CBASpectrum curves currently appear to be squeezed towards the middle and hence overstating high-rated bonds and understating BBB bonds.

Secondly, we would also conclude that, of the two services, the Bloomberg BBB fair value curve provides a closer fit to the prevailing yields on the BBB bonds on issue than the CBASpectrum service. To be clear, we have tested the relative reliability of the CBASpectrum BBB curve, which is different to the analysis conducted in previous sections (which related to the CBASpectrum BBB+ curve).

1.10 Remainder of the report

We elaborate upon these findings in the remainder of the report.

2 Terms of Reference

2.1 Background

The AER is currently undertaking a review of JGN's access arrangement proposal for the NSW gas networks, covering the period 1 July, 2010 to 30 June 2015. In February, 2010 the AER published its draft decision. Based on its assessment that a benchmark gas distribution business would be rated BBB+, the AER has applied a methodology to derive an estimate of the benchmark debt premium for a BBB+ rated firm seeking to issue with a 10 year maturity.

There are two major professional services that provide estimates of fair value curves, which estimate the prevailing yields for fixed interest bonds at given maturity intervals:

- Bloomberg; and
- CBASpectrum.

The AER chose to apply the CBASpectrum service for the proxy reference period, which was the 20 days trading days from 26 November, to 23 December, 2009. It derived a benchmark debt risk premium of 4.18 percent for this period. The AER examined the performance of the Bloomberg and CBASpectrum's fair value curves (and an average) against observed bond yields, and concluded that CBASpectrum provided the best fit of the data. It concluded that this provides a 'reasonable basis to consider that using CBASpectrum's BBB+ fair value curve results in the best estimate possible in the circumstances … [and] … a debt risk premium commensurate with prevailing conditions in the market for funds and the risks of providing reference services'.[8]

The AER's methodology was described in more detail as follows:[9]

> The analysis is conducted by first defining a population of fixed interest corporate bonds to observe, then selecting a sample from this population. Yields are then observed for the sample of bonds from Bloomberg, CBASpectrum and UBS. Bloomberg's, CBASpectrum's and an average of the two fair value estimates are then compared to the observed yields to determine which fair value estimate more closely aligns with the observed yields.

We understand, however, that the AER did not in fact conduct its tests during the specific averaging period, but rather relied upon the results of an application of its test to a prior period.

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8 AER (February, 2010), *JGN – Access arrangement proposal for the NSW gas networks*, Draft decision – Public, p. 139. We note that the AER formally required JGN to use a debt margin of 432 basis points, although this appeared to be (and we assume it was) an error.

9 AER (February, 2010), p. 139.

In determinations relating to Actew AGL and Country Energy, the AER had applied its methodology and concluded that CBASpectrum's BBB+ fair value curve performed better than Bloomberg's BBB fair value curve, or an average of the two fair value curves at matching observed yields for the sample of bonds employed.

2.2 Terms of Reference

JGN has engaged PricewaterhouseCoopers (PwC) to provide a report that analyses the methodologies applied in the estimation of a benchmark cost of debt under the National Gas Law (NGL) and National Gas Rules (NGR). More specifically, the Terms of Reference require PwC to provide an opinion detailing:

1 *Review the AER's draft decision on the debt margin* — an assessment of the AER's analysis and conclusions on the data source and estimate of the debt margin in section 5.10 of the decision, including whether the AER's methodology for comparing Bloomberg and CBASpectrum fair value curves is robust and likely to lead to: (a) a rate of return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

2 *Propose a Bloomberg test* — propose a methodology to test whether the Bloomberg fair yield curves that the AER has relied on for estimates of the debt premium in previous determinations leads to:(a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

3 *Propose a CBASpectrum test* — propose a methodology to test whether the CBASpectrum fair yield curves that the AER has relied on for estimates of the debt premium in previous determinations leads to: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

4 *Propose a method* — propose a method for comparing Bloomberg and CBASpectrum fair value curves that will contribute to determining: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances. This method should have regard to Jemena's proposal, and the AER's draft

determination, that the risk-free rate should be estimated using the yield on 10-year CGS.

5 *Apply the tests and method to estimate a debt premium for a BBB+ 10 year bond* — apply the proposed tests and method for comparing Bloomberg and CBASpectrum fair value curves to the 20 business days from 15 January to 12 February 2010 inclusive to estimate a debt premium for a BBB+ 10 year bond.

6 *Propose a debt premium estimate for a BBB 10 year bond* — propose a debt premium estimate for a BBB 10 year bond over the 20 business days from 15 January to 12 February 2010 that is (a) a return on debt capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; and (b) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

2.3 Outline of the report

We have approached the Terms of Reference by first addressing tasks 2, 3 and 4. In Chapter 3 we outline a methodology for testing the general appropriateness of the Bloomberg and CBASpectrum methods for deriving a view of the current cost of debt, and then determine a method for assessing the relative merits of the two services for the task at hand, which is to estimate a 10 year BBB+ debt margin.

Once we have established a method for testing each service and the relative merits of each, Chapter 4 reviews the methodology applied by the AER in the JGN draft decision (Task1).

Finally, in Chapter 5 we apply our preferred approach for assessing the relative merits of the Bloomberg and CBASpectrum fair value curves for the 20 business days from 15 January to 12 February 2010 inclusive and provide our views on the best estimate of the debt margin for 10 year BBB+ rated debt during this period.

Task 6 is not addressed further beyond Chapter 1.

3 Methodology to assess the Bloomberg and CBASpectrum fair value curve services

3.1 Introduction

In this chapter we develop a methodology for assessing the Bloomberg and CBASpectrum fair value curve services. In doing so we have drawn heavily on the analysis that we prepared for the Victorian electricity distribution businesses.[10] That report was undertaken against the backdrop of the Bloomberg service being a tool that Australian regulators used to derive benchmark costs of debt for regulated businesses (including in analysis undertaken by contributors to this report), but providing counterintuitive estimates after the onset of the worst of the global financial crisis.

In our earlier report we presented a test of whether the financial institutions have sufficiently convergent opinions on the yields of corporate bonds for these yields to be able to inform an analysis of fair value curves that draw upon bond yield estimates. We describe this test first.

In our earlier report we also presented tests of whether there was significant divergence between a service's yield estimates and those of the market, and whether the yield curve drawn by the service reflected the data that it was based upon. These tests, which are tests of the service in isolation, will be considered next. Finally, we consider tests to assess the relative merits of the Bloomberg and CBASpectrum methodologies.

3.2 Methodology to assess the state of the market for funds

In our earlier report, we presented tests for whether (and when) the Bloomberg service was expected to provide reliable estimates of the prevailing cost of debt, the first test of which was in essence whether reliable information could be obtained on the prevailing yields on Australian corporate bonds. The assumption that we adopted in that report was that, so long as the reliable yields for actual Australian (fixed rate) corporate bonds on issue can be obtained, then sole reliance should be placed on information from those bonds when deriving a benchmark cost of debt. This assumption in our previous report reflected a number of factors, most notably that the previous report related to electricity distribution (which has a more detailed framework around the determination of the cost of capital to apply in a regulatory period), because the AER had expressed a preference

[10] PricewaterhouseCoopers (November, 2009), *Victorian Distribution Businesses – Methodology to Estimate the Debt Risk Premium*.

for concentrating on information from Australian (fixed rate) corporate bonds and because this data source had been advocated previously by both Australian regulators and regulated entities.

The current report proceeds on the basis of the same assumption. Again, that assumption is that, so long as the reliable yield estimates for actual Australian (fixed rate) corporate bonds on issue are available, then sole reliance should be placed on information from those bonds when deriving a benchmark cost of debt. However, we note at the outset that the level of information that can be gleaned from Australian (fixed rate) corporate bonds for this task currently is poor.

The global financial crisis has seen the new issue of corporate bonds in the Australian market falling substantially, and there is a shortage of longer term bonds on issue in the lower credit ratings (with the longest dated bond in the BBB bands having a term to maturity of 6.5 years, and few longer dated bonds being on issue in the A bands). This means that deriving the fair value curve (and the benchmark debt margin curve) at 10 years is subject to considerable estimation error. We are aware that others have argued that, with this paucity of information regulators should supplement their analysis with information from other sources – such as the yields on Australian corporate floating rate bonds swapped back to create a synthetic fixed rate bond – which is a proposition with which we have sympathy. In any event, we note that determining a benchmark cost of debt at the current time requires the exercise of judgement, informed by both the available empirical evidence and relevant economic theory.

We use the opinions from financial institutions that are aggregated by Bloomberg as the indicator of the range of opinions across such institutions of the price (yield) for the actual bonds on issue. Hence, the most fundamental issue is whether these bond yield opinions are sufficiently convergent that the yields on the actual bonds on issue can be observed with some reliability. Hence, our first test can be expressed as the level of dispersion across the opinions of the financial institutions that submit opinions on corporate bond yields to Bloomberg – which is a measure of the general degree of uncertainty about the values of corporate bonds (and implicitly is a measure of the degree of trade in those bonds). It is the same test that we applied in our earlier report. In that report we also posited a cut-off for when the level of dispersion was sufficiently low to judge that the bond yield estimates are sufficiently reliable, which was based on the level of dispersion that was observed prior to the global financial crisis (and at which time there was a consensus in favour of drawing information from this source, as discussed above).

Formally, the test is expressed as:

> ***Test 1: Divergence in bank opinions*** – Does the coefficient of variation of bank feeds into Bloomberg for the Australian corporate bonds of greater than three years duration that are considered for Bloomberg's fair value curve exceed 0.05?

As noted above, one of the factors that was observed during the worst of the global financial crisis (and which we consider the Bloomberg algorithms were unable to cope with) was a substantial increase in the level of disagreement between the different financial institutions about the current fair market yield of the Australian corporate bonds on issue.

If this test is failed, then we conclude that there can be no confidence that applying either service in isolation will produce estimates that represent the prevailing conditions in the market for funds and so recommend against applying either the Bloomberg or CBASpectrum service in isolation. In this circumstance, we recommend making use of a broader range of (albeit imperfect) information to address the uncertainty.

3.3 Methodology to assess the Bloomberg and CBASpectrum methods in isolation

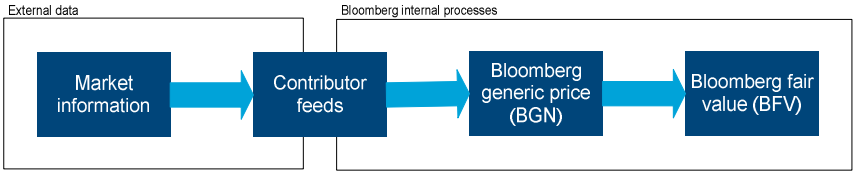
3.3.1 Bloomberg's methodology and tests of Bloomberg's yield opinions and fair value curve as a reflection of the market for funds

Bloomberg's methodology for estimating fair value yield curves for corporate bonds can be summarised in the following three stages:

- *Bank contributions* – Bloomberg's raw data are the current (market) yields for corporate bonds on issue. However, these yields are the *institutions' opinions* of the yield at which bonds would trade if there was a trade. While the yields may represent (or be informed by) actual trades, in general they are not actual trades.
- *Creation of Bloomberg yield estimate*– Bloomberg obtains the opinions of several financial institutions and constructs a single yield (Bloomberg Generic Price) for that bond. If the yield information is not considered to be sufficiently reliable, no price is constructed. The objective of this step is to construct a central-estimate for the yield from the information that institutions provide to Bloomberg.
- *Estimation of a fair value curve* – Using a proprietary method that involves analyst discretion, Bloomberg then uses its own yield estimates (referenced to the bank feeds) to construct its fair value curve for each major credit rating. The Bloomberg analyst fitting the curve to the data identifies and excludes observations that are considered to be outliers according to proprietary criteria. Bloomberg only provides fair value curves for the major credit ratings in Australia as it believes there are too few bonds to provide reliable estimates of sub-rating categories (such as BBB+ or BBB- in the case of the BBB rating band).

This methodology is illustrated in Figure 3.1 below:[11]

Figure 3.1 - Bloomberg's BFV process



During the worst of the global financial crisis, we identified two potential issues with the Bloomberg service, which were that:

- It appeared to be deriving its estimates of yields for the actual bonds on issue some distance from the central tendency of the estimates provided by financial institutions; and
- It appeared to be fitting its curves well below the middle of the observations that it was using as inputs, which we hypothesised was due to treating (and omitting) a large number of observations as outliers.

The tests that we derived were directed at testing whether these issues were still present. In particular, to test the suitability of Bloomberg methodology to potentially provide appropriate estimates of fair value yields in the market for corporate debt, in our November 2009 report we proposed the following two tests and critical values (again, these values were based upon observations prior to the global financial crisis):

> ***Test 2a: Bloomberg yields' divergence from the bank opinions*** – Does the average value of the difference between Bloomberg's yield estimate and the mean of bank feeds for the Australian corporate bonds used to construct Bloomberg's fair value curve, expressed as a percentage of Bloomberg's yield estimate, exceed +/- 2.50 percent?
>
> ***Test 3a: Bloomberg Fair Value Curve's divergence from Bloomberg's yield estimates*** – Does the average value of the difference between Bloomberg's fair value curve and Bloomberg's bond yield estimate, expressed as a percentage of Bloomberg's yield estimate, exceed +/- 4.00 percent?

3.3.2 CBASpectrum's methodology and tests of CBASpectrum's yield opinions and fair value curve as a reflection of the market for funds

It is our understanding that CBASpectrum's methodology does not rely on a number of feeds of bond yield opinions from banks, as Bloomberg's methodology does. Instead, CBASpectrum relies only

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[11] This is taken from our previous report, PricewaterhouseCoopers (November, 2009), *Victorian Distribution Businesses – Methodology to Estimate the Debt Risk Premium*, section 4.1.

on its own resources for its bond yield opinions.[12] According to the CBASpectrum website, it 'applies a proprietary model to calculate fair-value curves for Commonwealth Government Securities, semi-government, supranational and corporate markets.'[13] CBASpectrum informed us that its 'parametric model does not estimate fair value for each credit rating separately but instead estimates the entire spectrum of ratings in a system of equations model, subject to rules (such as credit curves do not cross). Thus, CBASpectrum fair-value indices are not a simple average or interpolated estimate from yields or spreads within a given credit rating category.'[14] Therefore, while CBASpectrum's methodology is proprietary, it is known that the methodology:

- Uses CBASpectrum's own bond yield estimates (rather than yields drawing on market consensus);
- Uses all the bond yields (of all rating categories) in its sample to estimate an optimised *structure* of fair value curves, which is achieved through a statistical procedure that simultaneously minimises the degree of error for all observations and all curves; and
- Provides estimates of a 10 year fair value yield irrespective of the existence of yield data near 10 years to maturity.

Analogues of tests 2 and 3 can be applied to CBASpectrum as follows:

> ***Test 2b: CBASpectrum yields' divergence from the bank opinions*** – Does the average value of the difference between CBASpectrum yield and the mean of bank feeds for the Australian corporate bonds, expressed as a percentage of the yield, exceed +/- 2.50 percent?
>
> ***Test 3b: CBASpectrum's Fair Value Curve's divergence from CBASpectrum's yield estimates*** – Does the average value of the difference between CBASpectrum's fair value curve and the CBASpectrum bond yield estimate, expressed as a percentage of the bond yield estimate exceed +/- 4.00 percent?

3.4 Methodology to assess the relative merits of the Bloomberg and CBASpectrum methods

As noted above, there are two matters that need to be tested when asking whether the Bloomberg and CBASpectrum methods are likely

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12 We note that CBASpectrum's bond yield estimates for some bonds are markedly different from those fed to Bloomberg by the Commonwealth Bank of Australia.

13 www.cbaspectrum.com

14 CBASpectrum email to PwC (22 February, 2010).

to provide a cost of debt that represents 'prevailing conditions in the market for funds' and represents the 'best forecast or estimate possible in the circumstances', namely:

- which of the two services provides the better explanation of the yields on the bonds that are on issue; and
- given that the longest dated BBB+ bond currently is 5.6 years – and hence it is necessary to extrapolate from the current bond yields – what is the most appropriate means of undertaking that extrapolation and (for the CBASpectrum service, which does extrapolate fair value yields out to 10 years) is that method of extrapolation reasonable.

We note at the outset that the first of the tests is amenable to a mechanical test, which we propose. We note that the second is less amenable to a mechanical test, but we summarise the relevant factors for this assessment below.

3.4.1 Relative accuracy of Bloomberg and CBASpectrum – within sample

The main test that we have applied to judge the relative accuracy of the Bloomberg and CBASpectrum services within the bounds (terms) of the bonds on issue is to compare the (simple) average error associated with each of the services. This test is analogous to the third of the tests that we have recommended to judge the appropriateness of the two services on a stand alone basis, as discussed above.

A comparison of the simple average errors across the services is straightforward to interpret – a positive error means that the curve in question is providing an upward biased estimate of the cost of debt compared to the sample of bonds, and vice versa if the average error is negative. The magnitude of the average provides an estimate of the relative size of the bias associated with the different service's estimates. We have also compared the errors that are found when different cut-offs for the term of bonds are considered, noting that as the objective is to provide an estimate of the margin associated with a 10 year bond, the accuracy associated with the longer dated bonds arguably is more important. We acknowledge, however, that by restricting the sample of bonds progressively to those with longer terms reduces the already small sample size, and that a trade off exists between the relevance of the bonds in the sample and the sample size. In applying this test:

- we follow the AER's practice and have restricted the sample to only BBB+ bonds, given that the objective is to derive a margin for bonds with this rating – although we note that this implies a sample of only 5 bonds; and
- the results that we rely upon are those that use the Bloomberg yields (that is, the yields for the relevant bonds that are constructed by Bloomberg). We report the results against the

CBASpectrum yields for completeness, but caution against using these yields given our findings that the CBASpectrum yields are often some distance from the central tendency of the group of financial institutions that provide yield estimates to Bloomberg.

We note that, in the period prior to the global financial crisis, it was common for regulators or advisers to rely upon the (simple) average of the error to determine the relative accuracy of each of the services and the magnitude of any required adjustment.[15] However, at that time there were a number of bonds with 6 to 10 year terms, and the test was implicitly also a test of functional form out to a term of 10 years or close to it.

Given its ease of interpretation and previous acceptance as discussed above, our preferred test for assessing the relative accuracy of the two services within the bounds of the data inputs is the average error test, which is expressed as follows:

Average error test

$$Average\ Error_r = \frac{1}{n}\sum (FVC_{rt} - Yield_{rt})$$

where the error for a given rating (in this case BBB+) is the difference between the fair value curve (FVC) for that rating (r) and term to maturity (t) and the estimated bond yield (Yield) for that rating and term to maturity, where n is the number of bonds.

We also apply and report the results of two additional tests for judging the relative accuracy of the two services, which are the average of the *absolute error* and the average of the *squared error* across the sample of bonds. These tests are a measure of the general level of error – both positive and negative – associated with each of the curves. We have included the latter method as this is the approach adopted by the AER.

Average absolute error test

$$Absolute\ Error_r = \frac{1}{n}\sum \left|FVC_{rt} - Yield_{rt}\right|$$

Squared average error test

$$Squared\ \ Average\ Error_r = \frac{1}{n}\sum (FVC_{rt} - Yield_{rt})^2$$

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15 For example, Essential Services Commission (October, 2005), Electricity Distribution Price Controls 2006-2010 – Final Decision Vol.1 (Statement of Purpose and Reasons), p.370.

3.4.2 Appropriate method for extrapolating beyond the data

Why functional form is important

None of the tests set out so far is a test of functional form, even though the error tests can give an indication (depending on the availability of yield data with higher terms to maturity) of which fair value curve performs better at longer terms. If there are few or no observations beyond 5 or 6 years, none of the tests is capable of projecting beyond the available data. What we need is a test that is better for our purpose, which is to estimate the debt margin for a BBB+ bond at a 10 year term to maturity.

Given the current absence of a Bloomberg fair value curve beyond seven years, and the existence of a CBASpectrum fair value curve to 10 years irrespective of the fact that no yield estimates are available for BBB+ bonds beyond 5.6 years to maturity, it is important to assess the likely shape of the fair value curve beyond 7 years.

Since CBASpectrum does provide an estimated 10 year fair value curve for all credit ratings irrespective of the existence of yield estimates close to 10 years, there is a need to test whether the functional form it assumes is likely to be reflective of the market for funds.

Theory and previous empirical studies

Practitioners in fixed income securities markets have often stated that the 'term structure of credit spreads is one that increases with maturity and is steeper the lower the credit rating.'[16] However, this contrasted with empirical observation in the US credit markets where the debt margin was found to rise with term for a period, but then decline, which is referred to below as being 'humped'. Merton's (1974) seminal work on the valuation of corporate bonds offered a theoretical explanation. He proposed that since highly rated bonds have a very low default risk, their exposure to term provides an opportunity for a significant rise in default risk.[17] Therefore the debt risk premium will rise with term. However, low rated bonds already have high default risk, and consequently time is more likely to improve this risk. As a result, he postulated that the term relationship for long dated low rated bonds would be humped.

However, more recent empirical work has cast significant doubt on the logic applied by Merton and others and specifically about the implications that can be drawn from the observed hump in the term

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16 Arthur D. Warga (1995), 'Review of Valuation of Fixed Income securities, by Frank Fabrozzi', *The Journal of Finance*, Vol. 50, No. 2, June, p762.

17 Robert C./ Merton (1974), 'On the pricing of corporate debt: The risk structure of interest rates', *Journal of Finance*, Vol. 29, pp.449-470.

structure of BBB bonds in the US. Helwege and Turner (1999) found that previous empirical studies had not controlled correctly for credit quality within the BBB credit rating band. They found evidence to support the hypothesis that:[18]

> When the more credit worthy firms in a given credit rating category are most likely to issue long-term bonds, the estimated credit yield curve for that rating category will be biased downwards.

That is, Helwege and Turner's hypothesis proposes that only the most highly regarded businesses in the low rating category will be able to issue bonds at the high end of the maturity range. This in turn raises the question of whether there is some inherent downward bias at the long end of Bloomberg's fair value curve (and CBASpectrum's as well). It is not apparent from Bloomberg's stated methodology that this potentially downward biasing effect is taken into account by analysts who fit its fair value curve to the data. This effect is likely to be very important in Australia, where the corporate bond market has been very thin, particularly at longer terms.

A subsequent academic study by Elton, Gruber, Agrawal and Mann (2001), which sought to explain the rate spread on corporate bonds, found a similar 'humped' term relationship for BBB bonds, but noted that this was likely to be a statistical artefact of the process described by Helwege and Turner.[19] Elton et al explained the rate spread on corporate bonds as a combination of expected default loss, tax premium (US state taxes not levied on government bonds), and a systematic risk premium.

As shown in Table 3.1 below, Elton et al found that for the BBB rating category, the mean spread that could be attributed to systematic risk was approximately linearly rising with term. This was the case in all three of the Fama-French factors.

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18 Jean Helwege and Christopher M. Turner (1999), 'The Slope of the Credit Yield Curve for speculative-Grade Issuers,' *The Journal of Finance*, Vol. 54, No. 5, October, p.1872.

19 Edwin Elton, Martin J. Gruber, Deepak Agrawal, and Christopher Mann (2001), *Journal of Finance*, Vol. LVI, No. 1, February, pp. 247-278.

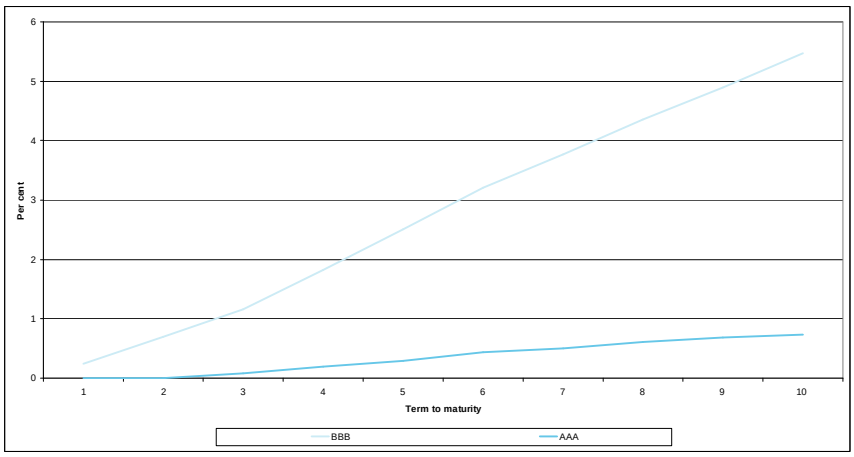
Table 3.1 – BBB corporate bonds – Fama-French risk sensitivities by term

Term Years	Market	Delta	Small - Big	Delta	High - Low	Delta
2	0.1112		0.3401		0.1259	
3	0.1691	0.0579	0.4656	0.1255	0.2922	0.1663
4	0.2379	0.0688	0.5836	0.1180	0.4605	0.1683
5	0.3131	0.0752	0.6987	0.1151	0.6263	0.1658
6	0.3919	0.0788	0.8127	0.114	0.7901	0.1638
7	0.472	0.0801	0.926	0.1133	0.9522	0.1621
8	0.5528	0.0808	1.0395	0.1135	1.1139	0.1617
9	0.6341	0.0813	1.1529	0.1134	1.2754	0.1615
10	0.7154	0.0813	1.2662	0.1133	1.437	0.1616

Source: Elton, Gruber, Agrawal and Mann (2001), p. 271, Table VIII, Panel C

Independently, based on a large number of observations over several decades, credit rating agencies such as Standard and Poor's find the risk of default rises approximately linearly with term, as shown in Figure 3.2 below, and has a significantly higher slope for BBB rated businesses compared with AAA rated businesses.[20]

Figure 3.2 – Standard & Poor's cumulative default risk[21]



Source: Standard and Poor's (2009)

This empirical regularity is noted by finance academics. In a recent book on the topic, Fabozzi and Mann stated that:[22]

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20 Standard & Poor's (2009) *2008 Annual Global Corporate Default Study and Rating Transitions.*

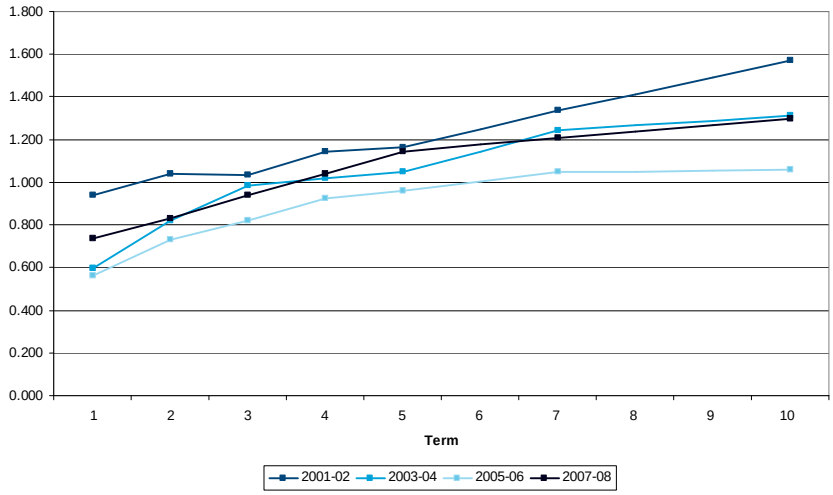
21 Standard & Poor's (2009)

22 Frank J. Fabozzi and Steven V. Mann (2000) *Floating-rate securities*, p.47.

The shape of the term structure is not the same for all for all credit ratings. The lower the credit rating, the steeper the term structure.

Figure 3.3 shows the slope typically observed during periods when Bloomberg reported a 10 year fair value yield. From a term of four to five years up to 10 years the relationship was approximately linear, with the exception of 2005/06, when the function appears to have been concave. It is also noticeable that when the BBB debt risk margin was high, the function was more strictly linear, and when the margin was low it was more likely to be concave.

Figure 3.3 – Slope of Bloomberg debt margins when a 10 year fair value curve was reported



Source: Bloomberg

In summary, while there can be a selection bias that masks the true relationship between risk and term for the BBB rating category, and gives the impression of a curve that reduces in slope (or in extreme cases may be 'humped'), when the underlying causal risk factors are assessed, there is both theoretical and empirical evidence to support:

- an approximately linear relationship between the credit margin and term to maturity of a bond; and
- an expectation that the slope of the function will rise with lower ratings.

Choice of extrapolation method

Based on the theoretical and empirical results reviewed above, we consider that it is appropriate to apply a straight line extrapolation to Bloomberg data.[23]

Table 3.2 shows the result of applying over 900 daily observations of Bloomberg fair value yield curves during the periods when the 10 year fair value yields were reported. The figures shown in the table are the deviations (deltas), measured in basis points (bp) between a straight line extrapolation from 4 or 5 years through 7 years to estimate a 10 year fair value yield. Thus, the median value of 10.6 bp applying an extrapolation from 4 years indicates that the straight line extrapolation was 10.6 bp higher than the debt risk margin estimated by the Bloomberg10 year value. Using 5 years as the base, the median delta was 16.2 bp.

Table 3.2– Bloomberg BBB category: slope differentials (in basis points) applying straight line extrapolation to debt risk margin[24]

	4 to 7 years		5 to 7 years	
	Delta bp	Delta %	Delta bp	Delta %
Median	10.6	1.51	16.2	2.34
Average	14.8	2.13	15.3	2.21
Max	50.6	7.51	53.0	7.15
Min	-6.1	-0.87	-20.9	2.97
Standard Deviation	13.2		15.4	

Taking into account that the median differentials (deltas) between the straight line extrapolations and the Bloomberg estimates were only 1.5 to 2.3 percent of the fair value yield, and the standard deviation ranged from 13.2 bp to 15.4 bp (indicating wide dispersion), we conclude that a simple extrapolation is likely to provide a reasonable estimate of the debt risk margin since:

- economically, a median differential of 10.6 to 16.2 bp in the debt risk margin at 10 years is small relative to fair value yields; and
- while this differential shows a small degree of (not statistically significant) bias based on Bloomberg's previously published fair value curves, there are theoretical reasons why at the long end of the term structure Bloomberg's estimated fair value yield may be biased downwards.

Given the ease and simplicity of application of an extrapolation of the 5 to 7 year Bloomberg debt risk margin, and the likely absence of

[23] We would recommend using the A curve to extrapolate if it exists. But currently there is no A or AA curve beyond 7 years.

[24] Bloomberg

any persistent and significant bias from the application of this rule, we recommended its adoption by the AER in our previous report.

Since the slope of the debt margin is expected to rise with each lower rating, the application of the Bloomberg debt margin slope for the next available higher credit rating should define a minimum estimate of the debt margin for a BBB+ rated bond at 10 years to maturity. Currently, a AAA curve is there, and so this represents an absolute lower bound to the extrapolation from 7 to 10 years.

Extrapolation implicit in the CBASpectrum fair value curve

CBASpectrum uses all of its yield estimates data to simultaneously calculate its extrapolation of all its fair value curves. Since the slope of CBASpectrum's debt margin curve is based on its own yield estimates (not Bloomberg's estimates, or the average of Bloomberg's bank feeds), the slopes of all its curves are tied to the representativeness of all the data that it uses. If its inputs are not representative of general market opinion on the yields of the bonds on issue, then the slope function that CBASpectrum applies to the BBB+ debt margin also must be questioned.

Regarding CBASpectrum's extrapolation of fair value curves outside the data sample (i.e. beyond 6.5 years), we observe the following:

- by observation, the functional form that CBASpectrum assumes between the debt margin and the term of debt appears to be concave (that is, the slope declines with term); and

- the CBASpectrum service estimates a system of equations that seek to explain all credit ratings simultaneously and, by observation, appears to rely upon the higher-rated bonds to derive the slope of the curve beyond the longest dated of the BBB (and A and AA) bonds.

We consider that the first of these methodological assumptions would be inappropriate and would result in the fair value yield for bonds with a 10 year term being understated. Accordingly, if the debt margin that CBASpectrum predicts is materially concave with term then we would conclude that the CBASpectrum service would be likely to provide debt margins that understate the cost of debt for long dated corporate bonds.[25] To be clear, we do not know whether the CBASpectrum service always fits concave curves as we do not know its precise method. Our conclusion here is that this should be tested.

[25] We understand that the CBASpectrum service predicts the fair value *yield* on debt rather than the *margin* over the risk free rate. It is possible for the yield on debt to be concave with term – or even to decline with term – but for the debt margin simultaneously to rise linearly with term, depending on how the yield on Commonwealth Government bonds is related to term at that particular time.

4 Assessment of the JGN draft decision

4.1 Introduction

In this chapter we review the AER's draft decision on the JGN proposed access arrangement, which included a determination, based on the CBASpectrum fair value curve, that the debt margin for a BBB+ bond was 4.18 percent over the 20 trading day period from 26 November 2009 to 23 December 2009 inclusive.

First we set out the AER's methodology and draft decision. We then review the AER's methodology and empirical findings. Finally, we report our assessment of CBASpectrum and Bloomberg for the JGN draft decision proxy averaging period applying the methodology set out in Chapter 3.

4.2 AER's Draft Decision on JGN

In late 2009, the AER undertook an analysis of the debt margins that were to be applied in JGN's New South Wales access arrangements. The methodology applied by the AER was described as follows:[26]

- Define a population of fixed interest corporate bonds to observe;
- Select a sample from this population;
- Observe yields for the sample of bonds from Bloomberg, CBASpectrum and UBS;
- Compare Bloomberg's, CBASpectrum's and an average of the two fair value estimates to the observed yields to determine which fair value estimate more closely aligns with the observed yields.

Based on a spreadsheet (with unpopulated data fields) provided to us by the AER through JGN, and formulae provided in previous AER decisions, we understand that the AER applied the following test for the relative error of Bloomberg and CBASpectrum fair value curves:[27]

AER's weighted sum of squared error test

$$WSSE = \frac{1}{n}\sum_{i=1}^{n}\left\{\left[\sum_{j=1}^{t_i}\left(Observed_{i,j} - Fair_{i,j}\right)^2\right]\frac{1}{t_i}\right\}$$

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26 AER (February, 2010), p.139.

27 AER (25 November 2009) South Australia: Draft distribution determination 2010-11 to 2014-15, p. 333.

Where n is the number of bonds, t_i is the number of observations for the ith bond, $Observed_{ij}$ is the jth observed yield for the ith bond from either Bloomberg, or CBASpectrum, and $Fair_{ij}$ is the jth fair yield for the ith bond, taken from Bloomberg or CBASpectrum. The weighting by t is the number of observations for days available out of the total number possible, which in this case is 20.

The AER's JGN draft decision concluded that the CBASpectrum BBB+ fair value curve provided a superior alignment to the yield data estimates compared with the BBB Bloomberg curve whether measured against Bloomberg, CBASpectrum or UBS yield data. [28] As a result, the AER applied the CBASpectrum curve for the period 26 November 2009 to 23 December 2009 and obtained a 10 year fair value debt margin of 418 basis points.

4.2.1 Application of the AER methodology

The AER's weighted sum of squared errors test was applied against Bloomberg yield estimates, CBA yield estimates and UBS yield estimates for the five bonds that had terms to maturity greater than 2 years, as shown in Table 4.1.

Table 4.1 – BBB+ bonds used by AER - JGN draft decision period

Bond	Maturity date	Years to maturity
Coles Group Finance	25/07/2012	2.4
Snowy Hydro Limited	25/02/2013	3.0
GPT Re Limited	11/09/2014	3.5
Wesfarmers Limited	23/09/2015	4.5
Santos Finance Limited	23/09/2015	5.6

Source: Bloomberg

The results obtained by applying the AER's sum of squared errors methodology for the JGN proxy reference period are shown in Table 4.2 below.

Table 4.2 – AER's error tests – JGN draft decision period (BBB+ bonds)

AER test	Bond yield source	Fair value curve source:	
		Bloomberg	CBASpectrum
Sum of squared errors	Bloomberg	48	45
	CBASpectrum	165	153

Source: Bloomberg and CBASpectrum

Using Bloomberg's yield data, the AER's test showed that the CBASpectrum fair value curve, by a narrow margin of 3 points (i.e. 45 points vs 48 points) had a lower degree of error measured

[28] We did not reconstruct the AER's test against UBS data as this is only a single data source (opinion), and UBS does not publish fair value curve estimates.

against the Bloomberg yield estimates, and 12 points when measured against CBASpectrum's yield estimates. This is the same as the AER's finding, which was that the CBASpectrum curve provided a better alignment irrespective of data source.

4.2.2 Initial observations on the AER's methodology

There are several initial observations that we make in relation to the AER's approach:

- First, the AER's choice of CBASpectrum over Bloomberg appears to have been made on the basis of a narrow margin;
- Secondly, there is no indication of whether this fine judgement had caused the AER to undertake further analysis, such as a sensitivity of its result to the cut-off term assumed; and
- Thirdly, while CBASpectrum's yield data were relied upon by the AER to extrapolate a 10 year BBB+ fair value yield when the longest dated bond (Santos Finance) has a term of only 5.6 years, the AER did not examine:
  - The extrapolation methodology applied by CBASpectrum, and
  - The representativeness of CBASpectrum's underlying yield estimates data.

4.3 Further empirical analysis of the AER's JGN Draft decision

In this section we undertake further analysis of the JGN draft decision, and apply the methodology that was outlined in Chapter 3.

4.3.1 Tests of the Bloomberg and CBASpectrum curves in isolation

We have applied the suitability tests detailed above to the reference period the AER used in the JGN draft decision.

Divergence in bank opinions

Table 4.3 displays the results of applying test 1 to the underlying bank feeds into Bloomberg against Bloomberg yields, estimated between 26 November 2009 and 23 December 2009. During the JGN proxy averaging period used by the AER, all of the coefficients of variation lie below 0.05, and therefore pass the test that we derived in our previous report. The degree of divergence in bank opinions on bond yields (for the Bloomberg sample) is now comparable to levels observed prior to the global financial crisis.

Passing this test implies that we conclude that meaningful information is available from Australian corporate bonds.

Table 4.3 – Divergence (coefficient of variation) in bank opinions (Bloomberg) - JGN draft decision period

Credit rating	Coefficient of variation
AAA	0.021
AA	0.010
A	0.033
BBB	0.039

Source: Bloomberg

Divergence from bank opinions

In Table 4.4, we apply test 2 to Bloomberg and CBASpectrum bond yield estimates for bonds issued over the JGN proxy averaging period. We find that Bloomberg passes the test for all rating categories. That is, the average value of the difference between the Bloomberg yield estimates and the mean of bank feeds for the Australian corporate bonds, expressed as a percentage of the yield, does not exceed the +/- 2.50 percent threshold that we derived in our previous report. In contrast to Bloomberg, we find that during the proxy averaging period CBASpectrum yield estimates were not representative of general financial market opinion in most of the credit rating categories, except for BBB+.

Table 4.4 – Bloomberg's and CBASpectrum's divergence from bank opinions - JGN draft decision period

Credit rating	Test 2a: Bloomberg	Test 2b: CBASpectrum
AAA	0.000	0.091
AA	0.000	0.091
A	0.011	0.264
BBB+	0.012	0.010
BBB	0.001	0.060

Source: Bloomberg

Fair value curve divergence from yield inputs

In test 3 we examine whether the two services appear to plot their yield curves through the middle of their inputs, which we assess by looking at the average value of the difference between Bloomberg's fair value curve and the corresponding Bloomberg bond yield estimate and, CBASpectrum's fair value curve and the corresponding CBASpectrum bond yield estimate, expressed as a percentage of the yield, exceeds the +/- 4.00 percent tolerance we adopted in our previous report.

Table 4.5 shows that this test was passed by all of Bloomberg's curves. This test was only passed by CBASpectrum's BBB+ and AAA curves.

Table 4.5 – Divergence of Bloomberg's and CBASpectrum's yield estimates from their fair value curves - JGN draft decision period

Credit rating	Test 3a: Bloomberg	Test 3b: CBASpectrum
AAA	0.001	-0.044
AA	-0.001	-0.049
A	0.037	0.112
BBB+	N/A	-0.007
BBB	0.004	0.199

Source: Bloomberg and CBASpectrum Note: N/A – not applicable

4.3.2 Testing the relative merits of Bloomberg and CBASpectrum

Bloomberg vs CBASpectrum – within sample

In the top panel of Table 4.6 we show the results for the estimation error calculated using the AER's weighted sum of the squared errors approach relative to Bloomberg bond yield estimates. In the bottom panel the errors are measured relative to CBASpectrum's bond yields. While we report the results against both Bloomberg and CBASpectrum yields for the bonds on issue, we rely upon the tests against the Bloomberg data given that we think it is more consistent with the central tendency of the views across financial institutions. Again, we note that the Commonwealth Bank – as an experienced market participant – is entitled to have its own view about the fair market yield for traded bonds, it is one market participant and we do not consider it appropriate to place undue weight upon one market participant's view if it is materially different to the central estimates of the yields assumed across the range of financial institutions.

The AER did not report whether it tested for the sensitivity of its results to the cut-off term to maturity, however, we provide such a test by successively removing the shorter term bonds at yearly intervals. For example, we remove the bond with a 2 to 3 year term to maturity leaving a sample of 4 bonds with more than 3 years to maturity, and so on.

In the first panel of Table 4.6, using a two and three year cut-off, we find the CBASpectrum BBB+ fair value curve provided a marginally closer fit to the Bloomberg data under the AER's average of the squared error test. With a 4 or 5 year cut-off Bloomberg's curve provided a marginally better fit with the Bloomberg data, although we note that the size of this sample does not permit firm conclusions to be drawn.

We do note, however, that applying the average error test and the absolute error test against Bloomberg's data shows that

CBASpectrum uniformly had a marginally better alignment with the data.

Table 4.6 – Sensitivity of error tests of the BBB+ Fair Value Curve using BBB+ bond yield estimates - JGN Draft decision period

		Error by cut-off period (basis points)			
FVC estimate	Yield data estimate	2 years n=5	3 years n=4	4 years n=2	5 years n=1
AER's weighted sum of squared error test:					
CBA	Bloomberg	45	47	40	2
Bloomberg	Bloomberg	48	49	34	1
CBA	CBA	153	181	44	3
Bloomberg	CBA	165	192	38	3
Average error test:					
CBA	Bloomberg	20	10	48	6
Bloomberg	Bloomberg	25	12	55	15
CBA	CBA	-14	-35	39	-17
Bloomberg	CBA	-19	-43	36	-16
Absolute error test:					
CBA	Bloomberg	60	59	49	6
Bloomberg	Bloomberg	65	62	55	15
CBA	CBA	96	103	56	17
Bloomberg	CBA	96	101	52	16

Source: Bloomberg and CBASpectrum. Note: 'n' refers to the number of bonds

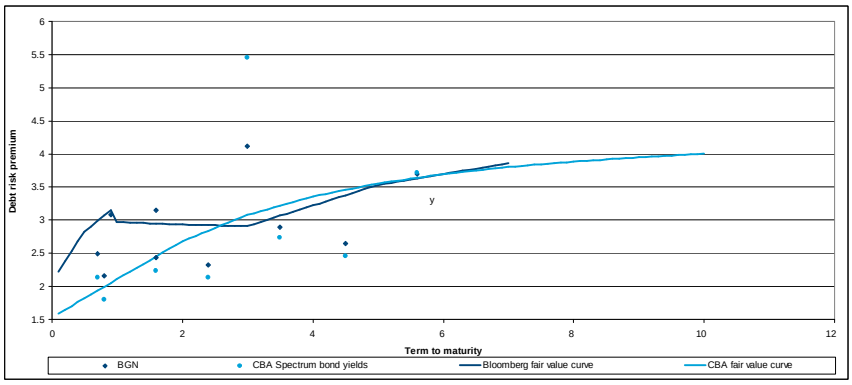
Bloomberg vs CBASpectrum – extrapolation beyond the data

Figure 4.1 below demonstrates the shape of the Bloomberg and CBASpectrum debt margin curves, relative to the common set of Bloomberg and CBASpectrum BBB+ bonds. With respect to this figure we make the following comments:

- by observation, the functional form that CBASpectrum assumes between the debt margin and the term of debt appears to be concave (that is, the slope declines with term); and
- the CBASpectrum service estimates a system of equations that seek to explain all credit ratings simultaneously and, by observation, appears to rely upon the higher-rated bonds to derive the slope of the curve beyond the longest dated of the BBB (and A and AA) bonds.

For the reasons already provided, we consider a concave function to be inappropriate and to result in the fair value yield for bonds with a 10 year term being understated.

Figure 4.1 – Bloomberg BBB and CBASpectrum BBB+ debt margin curves



Source: Bloomberg and CBASpectrum

Between one and three years the shape of the Bloomberg debt margin curve was horizontal, which is not supported by the predictions of economic theory. After three years, the Bloomberg and CBASpectrum curves were relatively close together, although the Bloomberg curve had a steeper slope than the CBASpectrum curve, and was almost linear.

While we do not comment on the appropriateness of using of a system of equations to derive a debt margin,[29] we note that the fact that CBASpectrum's fair value curve for any credit band relies upon information on yields for all credit bands, then it is necessary to analyse the appropriateness of the bond yields that it assumes for all bonds on issue. Importantly, as noted above, the bond yield that it assumes for the longer dated bonds of higher credit ratings would be expected to have an impact on how the BBB+ curve is extrapolated beyond the range of the bonds in the BBB (and A and AA) bands.

In Figures 4.2 and 4.3 below we consider the functional form of CBASpectrum's debt margin curves in greater detail, as this is the service that was considered by the AER to provide the better alignment to the Bloomberg data than the Bloomberg curve. In Figure 4.2 the CBASpectrum curves are presented against the Bloomberg yield estimates data.

We consider there to be a number of problems with the CBASpectrum system of curves over this period:

- First, the CBASpectrum curves are uniformly concave, which contravenes the predictions of economic theory, which indicate a linear functional form;

[29] To be clear, as the CBASpectrum method is proprietary (and hence there is no information in the public domain about the specification of the equations that are estimated), an a priori examination if its estimation method is not possible.

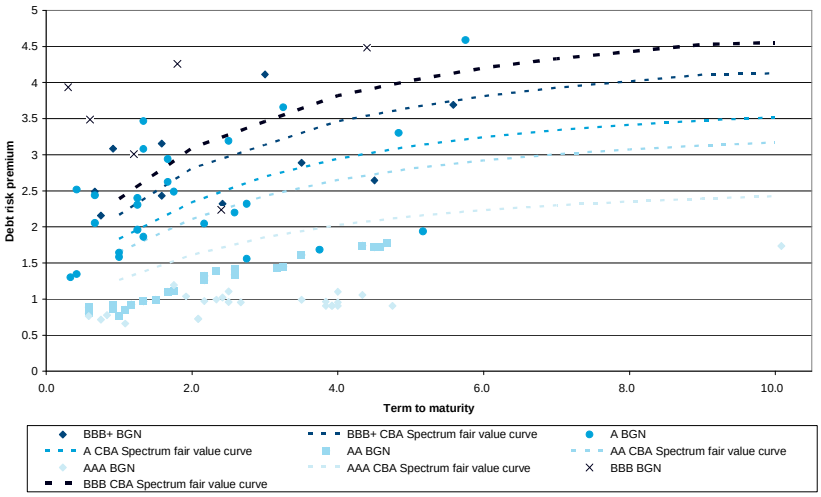
- Secondly, the CBASpectrum yield margin curves all have similar slopes, which is not consistent with the predictions of economic theory - the slope with term should be higher for lower rated bonds.

- Thirdly, the curves seem to be squeezed towards the centre, that is:

  – in the case of BBB rated bonds, all but one of the Bloomberg yield estimates lie above the CBASpectrum BBB curve (indicating an under-estimation of the BBB curve against Bloomberg data); whereas

  – in the case of AAA and AA rated bonds, all the Bloomberg yield estimates lie below the respective CBASpectrum AAA and AA curves (indicating a over-estimation of the AAA and AA curves against Bloomberg data).

Figure 4.2 – CBASpectrum fair value debt margin curve against Bloomberg yield estimates – JGN Draft decision period



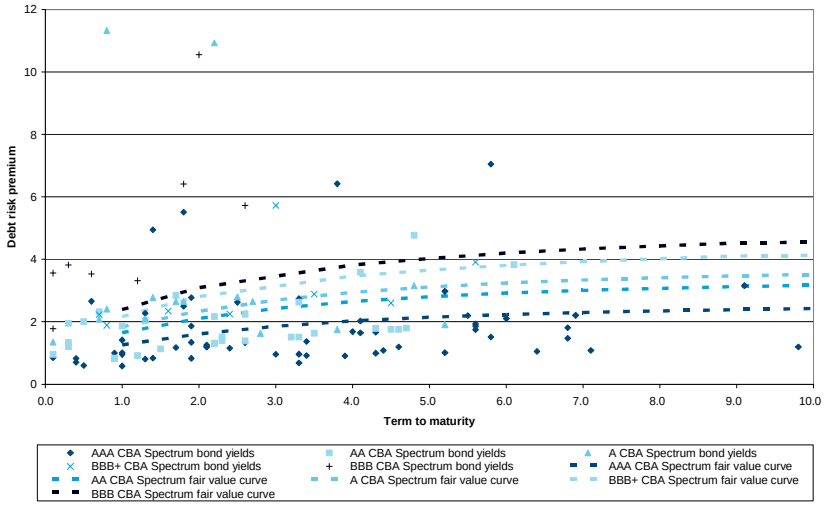
Source: Bloomberg and CBASpectrum

In Figure 4.3 the slopes of the CBASpectrum curves appear flatter because the vertical axis has been raised to accommodate the higher yield observations that are included in the CBA analysis. Our observations indicate that the CBASpectrum system of curves also has difficulties explaining the CBASpectrum data:

- in the case of BBB rated bonds, all but one of the CBASpectrum yield estimates lie above the CBASpectrum BBB curve (indicating under-estimation of the BBB curve against CBASpectrum data).

- in the case of AAA and AA rated bonds, all the Bloomberg yield estimates lie below the respective CBASpectrum AAA and AA curves (indicating over-estimation of the AAA and AA curves against CBASpectrum data).

Figure 4.3 – CBASpectrum fair value debt margin curve against CBASpectrum yield estimates – JGN Draft decision period



Source: CBASpectrum

4.4 Conclusion

We conclude that the methodology applied by the AER during the JGN draft decision and applied to the proxy averaging period contained many flaws. In particular, the AER applied the CBASpectrum extrapolation of yield (and implied margin) estimates to 10 years based on data that did not represent the best forecast or estimate possible in the circumstances. The AER did not:

- undertake a sensitivity analysis of the estimation errors produced by adopting the CBASpectrum or Bloomberg's fair value curve;
- test the representativeness of the data that was used by CBASpectrum to extrapolate its fair value (and debt margin) curves to 10 years; or
- assess whether the results of CBASpectrum's extrapolation methodology (i.e. the slope of the debt margin curves by credit rating) are consistent with economic theory.

Hence, we do not consider that the AER's estimated 10 year BBB+ debt margin of 4.18 percent was the best forecast possible during the proxy averaging period used in the JGN draft decision.

5 Applying the PwC methodology to the January – February 2010 period

5.1 Introduction

We have been asked to consider a proxy reference period spanning the 20 business day period from 15 January 2010 to 12 February 2010 inclusive.

5.2 Tests of the Bloomberg and CBASpectrum curves in isolation

We have applied the data suitability tests detailed above to the period 15 January 2010 to 12 February 2010 inclusive. Note that N/A refers to not applicable.

5.2.1 Divergence in bank opinions

Table 5.1 displays the results of our first test being applied to the underlying bank feeds into Bloomberg, estimated for the 20 business days from 15 January 2010 to 12 February 2010 inclusive. All the coefficients of variation lie below 0.05, and therefore pass the test, indicating that the degree of divergence in bank opinions on bond yields is now comparable to levels observed prior to the global financial crisis.

Table 5.1 – Divergence (coefficient of variation) in bank opinions (Bloomberg) - January-February, 2010 period

Credit rating	18/01/2010 – 12/02/2010
AAA	0.013
AA	0.023
A	0.025
BBB	0.025

Source: Bloomberg

5.2.2 Divergence from bank opinions

In Table 5.2, we apply test whether the yields that Bloomberg and CBASpectrum assume for the actual bonds on issue were representative of the market for funds during the 15 January 2010 and 12 February 2010 period.

We find that Bloomberg passes the test for all rating categories in the period 15 January 2010 to 12 February 2010. That is, the

average value of the difference between the Bloomberg yield estimates and the mean of bank feeds for the Australian corporate bonds, expressed as a percentage of the Bloomberg yield estimate, does not exceed +/- 2.50 percent. In contrast, we find that CBASpectrum inputs differ to the central estimates of financial institutions in all credit rating bands by more than the threshold we adopted in our last report.

While we note that the Commonwealth Bank – as an experienced market participant – is entitled to have its own view about the fair market yield for traded bonds, it is one market participant and we do not consider it appropriate to place undue weight upon one market participant's view if it is materially different to the central estimates of the yields assumed across the range of financial institutions.

Accordingly, we would recommend not using the CBASpectrum service to establish the prevailing benchmark cost of debt without further analysis. For completeness, however, we have shown CBASpectrum's performance in the remainder of the tests, which relate to both CBASpectrum and Bloomberg.

Table 5.2 – Bloomberg yields' divergence from bank opinions - January-February, 2010 period

Credit rating	Bloomberg	CBASpectrum
AAA	0.004	0.103
AA	0.018	0.070
A	0.018	0.069
BBB+	N/A	0.028
BBB	0.019	0.036

Source: Bloomberg and CBASpectrum

5.2.3 Fair value curve divergence from yield inputs

In the third test we examine whether the average value of the difference between, Bloomberg's bond yield estimates and the corresponding point on the Bloomberg fair value curve and, CBASpectrum's bond yield opinions and the corresponding point on the CBASpectrum fair value curve, expressed as a percentage of the yields, exceeds the threshold of +/- 4.00 percent that we applied in our previous report. This essentially is a test of whether the relevant curves are fitted through the middle of the bond observations that were being considered. Implicitly it is a test of:

- For Bloomberg, the aggregate effect of its practice of identifying and excluding outliers; and
- For CBASpectrum, the aggregate effect of its practice of estimating all of its fair value curves as a 'system' (that is, where

the BBB+ curve is affected by all bond yields, including AAA bonds).

If this test is not passed then it means that the curve is biased either upwards or downwards when compared to the inputs that the curve in question relied upon. If this test is failed for one or both of the services, then we conclude that the service in question is likely not to provide estimates that represent prevailing conditions in the market for funds and so recommend against using the service(s) in question.

Table 5.3 shows that, this test was passed by all of Bloomberg's curves, and by CAB Spectrum's BBB+ curve, albeit not by CBASpectrum's BBB, A or AA curves.

Table 5.3 – Divergence from Bloomberg's and CBASpectrum's yield estimates from their fair value curves - January-February, 2010 period

Credit rating	Bloomberg	CBASpectrum
AAA	0.002	0.020
AA	-0.002	0.040
A	0.016	-0.075
BBB+	N/A	-0.015
BBB	0.007	-0.184

Source: Bloomberg and CBASpectrum

5.3 Testing the relative merits of Bloomberg and CBASpectrum

5.3.1 Bloomberg vs CBASpectrum – within sample

Table 5.4 summarises the results of the three tests described previously about the relative accuracy of the Bloomberg and CBASpectrum services within the bounds of the sample of bonds that are on issue (the longest term of which is 5.6 years, as discussed earlier). These results are presented for different cut-offs, that is, for a sample of bonds with a term of 2+ years, 3+ years, etc, although the caveat described previously about the trade-off between the cut-off and size of the sample should be borne in mind when interpreting the results. Again, we rely upon the comparison against the Bloomberg yields – the comparison against CBASpectrum yields is provided for information only.

Taken as a whole, we find that at longer terms the Bloomberg fair value curve has a better alignment with the data than the CBASpectrum curve:

- Using an average error test we find that Bloomberg's and CBASpectrum's alignment to the data depends on the cut-off

applied, with Bloomberg having a closer alignment at the 3 year cut-off against Bloomberg data.

- Applying an absolute error test, we find that during the recent proxy reference period Bloomberg uniformly shows less error than CBASpectrum. It is noticeable in this case that the size of the differential between Bloomberg and CBASpectrum increases as the cut-off is raised (i.e. increases with term).

- Applying the AER's weighted sum of squared errors test to the 20 business days to 12 February, 2010, Bloomberg provides the best alignment for all cut-off periods above 2 years. However, the margin of Bloomberg's advantage is slender for 3 and 4 years.

Table 5.4 – Error tests of the BBB+ Fair Value Curve using BBB+ bond yield estimates - January-February, 2010 period

		Error by cut-off period (basis points)			
FVC estimate	Yield data estimate	2 years n=5	3 years n=4	4 years n=2	5 years n=1
Average error test:					
CBA	Bloomberg	-9	-24	-3	-77
Bloomberg	Bloomberg	17	4	43	-20
CBA	CBA	-39	-61	7	-61
Bloomberg	CBA	-18	-39	46	-10
Absolute error test:					
CBA	Bloomberg	72	77	75	78
Bloomberg	Bloomberg	72	72	63	20
CBA	CBA	99	112	68	61
Bloomberg	CBA	99	107	56	10
AER's weighted sum of squared error test:					
CBA	Bloomberg	60	69	61	74
Bloomberg	Bloomberg	63	68	60	27
CBA	CBA	177	210	44	35
Bloomberg	CBA	172	210	50	2

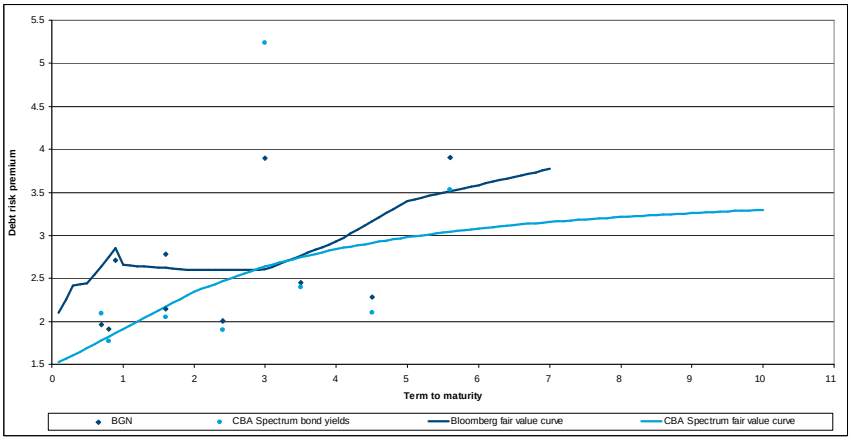
Source: Bloomberg and CBASpectrum. Note: 'n' refers to the number of bonds

5.3.2 Bloomberg vs CBASpectrum – extrapolation beyond the data

Due to the paucity of longer dated BBB+ rated bonds, it is necessary to consider the functional form of the debt margin curves, and the extrapolations that are undertaken to derive a 10 year estimate. Figure 5.1 below shows the relative positions of the CBASpectrum BBB+ fair value curve and the Bloomberg fair value curve.

Between one and three years the shape of the Bloomberg debt margin curve is horizontal, which is not supported by economic theory. After three years, the Bloomberg and CBASpectrum curves diverge, with the Bloomberg curve between five and seven years having a steeper slope than the CBASpectrum curve.

Figure 5.1 – CBASpectrum BBB+ vs Bloomberg BBB curve - January-February, 2010 period

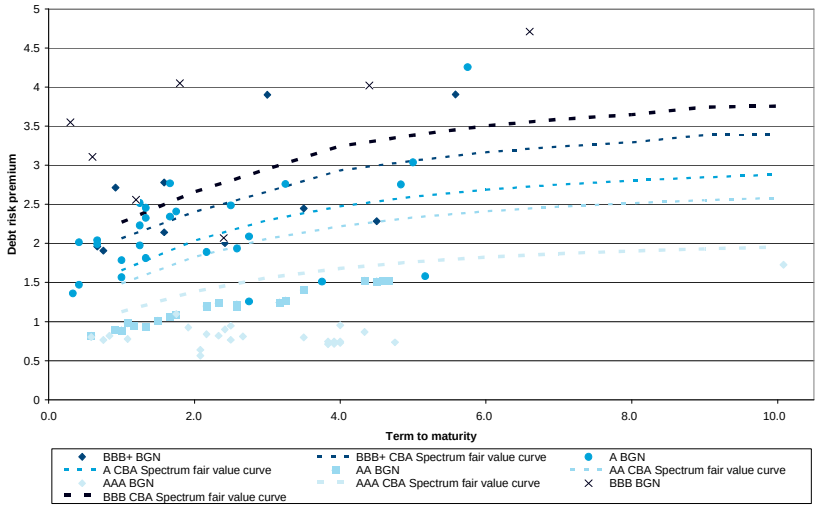


Source: Bloomberg and CBASpectrum

In Figure 5.2 the CBASpectrum curves are presented against the Bloomberg yield estimates data for each credit rating. Again, our observations indicate there are issues with the CBASpectrum system of curves:

- The CBASpectrum curves are uniformly concave rather than approximately linear after terms of 3 or 4 years;
- The CBASpectrum yield margin curves all have similar slopes, which does not reflect the higher default probability attached to lower rated bonds.
- Again, the curves seem to be squeezed towards the centre, that is:
  - in the case of BBB rated bonds, all but one of the Bloomberg yield estimates lie above the CBASpectrum BBB curve (indicating an under-estimation of the BBB curve against Bloomberg data); whereas
  - in the case of AAA and AA rated bonds, all the Bloomberg yield estimates lie below the respective CBASpectrum AAA and AA curves (indicating a over-estimation of the AAA and AA curves against Bloomberg data).

Figure 5.2 – CBASpectrum fair value debt margin curve against Bloomberg yield estimates – January-February 2010 period

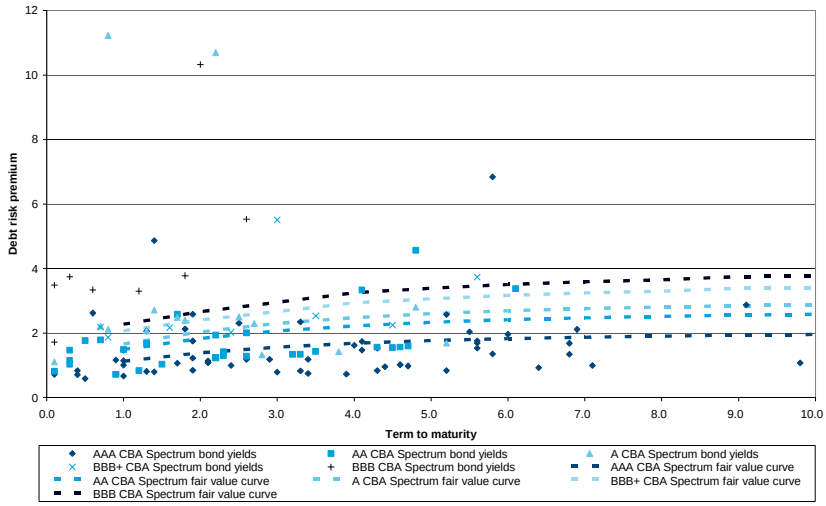


Source: Bloomberg and CBASpectrum

In Figure 5.3 our observations indicate that the CBASpectrum system of curves also have difficulties explaining the CBASpectrum data, including that they appear to be squeezed towards the centre as commented above.

In summary, we find that CBASpectrum's fair value curves produce debt margins that are materially concave (in contrast to the predictions of economic theory) and rely upon inputs that are not representative of the views across financial institutions. Accordingly, even if CBASpectrum predicted the current bond yields accurately, we consider that the extrapolation that it performs means that its estimate of the margin on 10 year BBB+ debt would not be the best estimate of that margin in the market for funds.

Figure 5.3 – CBASpectrum fair value debt margin curve against CBASpectrum yield estimates – January-February 2010



Source: Bloomberg and CBASpectrum

5.3.3 Applying our methodology to the 15 January to 12 February 2010 proxy averaging period

Bloomberg's curves and data passed all our tests of representativeness of the current market for funds. However, since Bloomberg does not currently provide an estimate of a debt margin at 10 years, we applied linear extrapolation of Bloomberg's 5 and 7 year margins (using the BBB curve), and obtained an estimated debt margin of 448 basis points. Our calculation of this margin is set out below.

In addition, we note that the AAA curve can be used to provide confidence that this extrapolation is reasonable. Our discussion in Chapter 3 implied that the margin on BBB+ debt should increase faster with the term of debt than the margin on AAA debt. As Bloomberg produces an AAA curve out to 10 years, the change in the AAA debt margin between 7 and 10 years can be used to provide a lower bound to the amount that would need to be added to the 7 year BBB+ yield to derive a 10 year BBB+ yield. Applying this method results in a lower bound for the 10 year BBB+ debt margin of 434 basis points. To reiterate, however, this estimates is expected to understate the 10 year BBB+ yield; thus it should be interpreted as providing confidence that the debt margin of 448 basis points is reasonable. Our calculation of this margin is also provided in Appendix A.

5.4 Conclusion

We consider that the best point estimate of the debt margin for a 10 year BBB+ rated bond for the 20 business days up to and including 12 February, 2010 is 448 basis points. That is, during the more recent proxy averaging period, utilising the Bloomberg service to estimate the debt margin will provide the best estimate of the cost of debt which, when incorporated in the WACC formula with other appropriate inputs, will provide a rate of return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services.

Appendices

Appendix A Calculation of debt margins

Table A.1 – 15 January 2010 to 12 February 2010: 10 year BBB+ debt risk margin based on a linear extrapolation of Bloomberg 5 and 7 year debt risk premiums

Date	Bloomberg BBB Yields		CGS		Debt margin		Extrapolated 10 year debt margin
2010	**5 Yr**	**7 Yr**	**5 Yr**	**7 Yr**	**5 Yr**	**7 Yr**	**Margin**
15/01	8.83%	9.31%	5.43%	5.57%	3.40%	3.74%	4.25%
18/01	8.78%	9.24%	5.39%	5.51%	3.40%	3.74%	4.24%
19/01	8.73%	9.24%	5.36%	5.48%	3.36%	3.75%	4.34%
20/01	8.70%	9.24%	5.38%	5.52%	3.32%	3.71%	4.30%
21/01	8.68%	9.21%	5.38%	5.52%	3.30%	3.69%	4.28%
22/01	8.60%	9.14%	5.28%	5.42%	3.33%	3.72%	4.30%
25/01	8.79%	9.36%	5.27%	5.45%	3.52%	3.91%	4.50%
27/01	8.84%	9.38%	5.24%	5.39%	3.60%	3.99%	4.58%
28/01	8.89%	9.44%	5.28%	5.45%	3.60%	3.99%	4.58%
29/01	8.82%	9.42%	5.15%	5.35%	3.67%	4.07%	4.66%
01/02	8.77%	9.38%	5.14%	5.35%	3.63%	4.03%	4.62%
02/02	8.73%	9.41%	5.10%	5.38%	3.64%	4.03%	4.62%
03/02	8.70%	9.34%	5.14%	5.39%	3.56%	3.95%	4.54%
04/02	8.69%	9.30%	5.18%	5.40%	3.51%	3.90%	4.49%
05/02	8.61%	9.23%	5.10%	5.34%	3.51%	3.90%	4.49%
08/02	8.70%	9.34%	5.09%	5.34%	3.60%	4.00%	4.59%
09/02	8.70%	9.32%	5.10%	5.32%	3.60%	3.99%	4.58%
10/02	8.73%	9.35%	5.17%	5.40%	3.55%	3.94%	4.53%
11/02	8.85%	9.44%	5.28%	5.47%	3.57%	3.97%	4.56%
12/02	8.92%	9.49%	5.29%	5.47%	3.63%	4.02%	4.61%
Ave.	**8.75%**	**9.33%**	**5.24%**	**5.43%**	**3.52%**	**3.90%**	**4.48%**

Source: Bloomberg

Table A.2 – 15 January 2010 to 12 February 2010: 10 year BBB+ debt risk margin based on a linear extrapolation of Bloomberg 7 and 10 year AAA debt risk premiums.

Date	Bloomberg AAA Yields		CGS		AAA Debt margin		Difference of 7 and 10 year debt margin	Extrapolated 10 year BBB+ debt margin
2010	**7 Yr**	**10 Yr**	**7 Yr**	**10 Yr**	**7 Yr**	**10 Yr**	**Margin**	**Margin**
15/01	6.91%	7.50%	5.57%	5.75%	1.34%	1.75%	0.41%	4.15%
18/01	6.85%	7.43%	5.51%	5.68%	1.34%	1.75%	0.41%	4.15%
19/01	6.82%	7.40%	5.48%	5.65%	1.34%	1.75%	0.41%	4.17%
20/01	6.84%	7.43%	5.52%	5.66%	1.32%	1.76%	0.45%	4.16%
21/01	6.83%	7.42%	5.52%	5.66%	1.31%	1.76%	0.45%	4.14%
22/01	6.76%	7.35%	5.42%	5.56%	1.34%	1.79%	0.44%	4.16%
25/01	6.78%	7.37%	5.45%	5.60%	1.32%	1.77%	0.45%	4.36%
27/01	6.71%	7.30%	5.39%	5.53%	1.33%	1.77%	0.44%	4.44%
28/01	6.79%	7.37%	5.45%	5.59%	1.34%	1.78%	0.44%	4.44%
29/01	6.73%	7.33%	5.35%	5.51%	1.38%	1.83%	0.45%	4.51%
01/02	6.73%	7.34%	5.35%	5.51%	1.38%	1.83%	0.45%	4.47%
02/02	6.73%	7.37%	5.38%	5.58%	1.35%	1.80%	0.45%	4.48%
03/02	6.69%	7.35%	5.39%	5.59%	1.31%	1.75%	0.45%	4.40%
04/02	6.71%	7.35%	5.40%	5.59%	1.31%	1.76%	0.45%	4.35%
05/02	6.65%	7.29%	5.34%	5.53%	1.31%	1.76%	0.45%	4.34%
08/02	6.66%	7.31%	5.34%	5.55%	1.31%	1.76%	0.45%	4.44%
09/02	6.62%	7.27%	5.32%	5.53%	1.29%	1.74%	0.45%	4.44%
10/02	6.68%	7.32%	5.40%	5.60%	1.28%	1.73%	0.45%	4.39%
11/02	6.73%	7.36%	5.47%	5.66%	1.26%	1.70%	0.45%	4.41%
12/02	6.77%	7.39%	5.47%	5.65%	1.30%	1.74%	0.45%	4.46%
Ave.	**6.75%**	**7.36%**	**5.43%**	**5.60%**	**1.32%**	**1.76%**	**0.44%**	**4.34%**

Source: Bloomberg

Appendix B Curricula vitae

Jeff Balchin

Executive Director

Qualifications and memberships:

- B.Ec. (Hons.) at the University of Adelaide (First Class Honours)
- CEDA National Prize for Economic Development

Recent project experience:

Prior to joining the Allen Consulting Group, Jeff held a number of policy positions in the Commonwealth Government.

- **Commonwealth representative on the secretariat of the Gas Reform Task Force (1995-1996)** - Played a lead role in the development of a National Code for third party access to gas transportation systems, with a particular focus on market regulation and pricing.
- **Infrastructure, Resources and Environment Division, Department of the Prime Minister and Cabinet (1994-1995)** - Played a key role in the creation of the Gas Reform Task Force (a body charged with implementing national gas reform that reports to the Heads of Government). During this time he also had responsibility for advising on primary industries, petroleum and mining industry issues, infrastructure issues, government business enterprise reform and privatisation issues.
- **Structural Policy Division, Department of the Treasury (1992-94)** – Worked on environment policy issues in the lead up to the UN Conference on Environment and Development at Rio de Janeiro, as well as electricity and gas reform issues.

Experience – Economic Regulation of Price and Service

A. Periodic Price Reviews – Major Roles for Regulators

- **South Australian default gas retail price review (Client: the Essential Services Commission, SA, 2007-2008)** - Directed a team that derived estimates of the benchmark operating costs for a gas retailer and the margin that should be allowed. This latter exercise included a bottom-up estimate of the financing costs incurred by a gas retail business.
- **South Australian default electricity retail price review (Client: the Essential Services Commission, SA, 2007)** -Directed a team that estimated the wholesale electricity purchase cost for the default electricity retail supplier in South Australia. The project involved the development of a model for deriving an optimal portfolio of hedging contracts for a prudent and efficient retailer, and the estimate of the expected cost incurred with that portfolio. Applying the principles of modern finance theory to resolve issues of how the compensation for certain risk should be quantified was also a central part of the project.
- **South Australian default gas retail price review (Client: the Essential Services Commission, SA, 2005)** - As part of a team, advised the regulator on the cost of purchasing gas transmission services for a prudent and efficient SA gas retailer, where the transmission options included the use of the Moomba-Adelaide Pipeline and SEAGas Pipeline, connecting a number of gas production sources.
- **Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2006-2008)** - Provided advice to the Essential Service Commission in relation to its review of gas distribution access arrangements on the treatment of outsourcing arrangements, finance issues, incentive design and other economic issues.

- **Envestra Gas Distribution Price Review (Client: the Essential Services Commission, SA, 2006)** - Provided advice on several finance related issues (including 'return on assets' issues and the financial effect of Envestra's invoicing policy), and the treatment of major outsourcing contracts when setting regulated charges.
- **Victorian Electricity Distribution Price Review (Client: the Essential Services Commission, Vic, 2003-2005)** - Provided advice to the Essential Service Commission on a range is economic issues related to current review of electricity distribution charges, including issues related to finance, forecasting of expenditure and the design of incentive arrangements for productive efficiency and service delivery. Was a member of the Steering Committee advising on strategic regulatory issues.
- **Victorian Water Price Review (Client: the Essential Services Commission, Vic, 2003-2005)** - Provided advice to the Essential Services Commission on the issues associated with extending economic regulation to the various elements of the Victorian water sector. Was a member of the Steering Committee advising on strategic regulatory issues, and also provided advice on specific issues, most notably the determination of the initial regulatory values for the water businesses and the role of developer charges.
- **ETSA Electricity Distribution Price Review (Client: the Essential Services Commission, SA, 2002-2005)** - Provided advice on the 'return on assets' issues associated with the review of ETSA's regulated distribution charges, including the preparation of consultation papers. The issues covered include the valuation of assets for regulatory purposes and cost of capital issues. Also engaged as a quality assurance adviser on other consultation papers produced as part of the price review.
- **Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2001-2002)** - Economic adviser to the Essential Services Commission during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Was responsible for all issues associated with capital financing (including analysis of the cost of capital and assessment of risk generally, and asset valuation), and supervised the financial modelling and derivation of regulated charges. Also advised on a number of other issues, including the design of incentive arrangements, the form of regulation for extensions to unreticulated townships, and the principles for determining charges for new customers connecting to the system. Represented the Commission at numerous public forums during the course of the review, and was the principal author of the finance-related and other relevant sections of the four consultation papers and the draft and final decisions.
- **ETSA Electricity Distribution Price Review (Client: the South Australian Independent Industry Regulator, 2000-2001)** - As part of a team, prepared a series of reports proposing a framework for the review. The particular focus was on the design of incentives to encourage cost reduction and service improvement, and how such incentives can assist the regulator to meet its statutory obligations. Currently retained to provide commentary on the consultation papers being produced by the regulator, including strategic or detailed advice as appropriate.
- **Dampier to Bunbury Natural Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000-2002)** - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft

decision.

- **Goldfield Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000-2004)** - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft decision.
- **Victorian Electricity Distribution Price Review (Client: the Office of the Regulator-General, Vic, 1999-2000)** - Economic adviser to the Office of the Regulator-General during its review of the price caps for the five Victorian electricity distributors. Had responsibility for all issues associated with capital financing, including analysis of the cost of capital (and assessment of risk generally) and asset valuation, and supervised the financial modelling and derivation of regulated charges. Also advised on a range of other issues, including the design of incentive regulation for cost reduction and service improvement, and the principles for determining charges for new customers connecting to the system. Represented the Office at numerous public forums during the course of the review, and was principal author of the finance-related sections of three consultation papers, and the finance-related sections of the draft and final decision documents.
- **Victorian Ports Corporation and Channels Authority Price Review (Client: the Office of the Regulator-General, Vic, 2000)** - Advised on the finance-related issues (cost of capital and the assessment of risk generally, and asset valuation), financial modelling (and the derivation of regulated charges), and on the form of control set over prices. Principal author of the sections of the draft and final decision documents addressing the finance-related and price control issues.
- **AlintaGas Gas Distribution Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999-2000)** - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline. This advice included providing a report assessing the cost of capital associated with the regulated activities, overall review of all parts of the draft and final decisions, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.
- **Parmelia Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999-2000)** - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft and final decisions, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.
- **Victorian Gas Distribution Price Review (Client: the Office of the Regulator-General, Vic, 1998)** - Economic adviser to the Office of the Regulator-General during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Major issues addressed included the valuation of assets for regulatory purposes, cost of capital financing and financial modelling. Principal author of the draft and final decision documents.

B. Periodic and Other Price Reviews – Other Activities

- **Equity Betas for Regulated Electricity Transmission Activities (Client: Grid Australia, APIA, ENA, 2008)** - Prepared a report presenting empirical evidence on the equity betas for regulated Australian electricity transmission and distribution businesses for the AER's five yearly review of WACC parameters for these industries. The report demonstrated the implications of a number of different estimation techniques and the reliability of the resulting estimates. Also prepared a joint paper with the law firm, Gilbert+Tobin, providing an economic and legal interpretation of the relevant (unique) statutory guidance for the review.
- **Economic Principles for the Setting of Airside Charges (Client: Christchurch International Airport Limited, 2008 ongoing)** - Provided advice on a range of economic issues relating to its resetting of charges for airside services, including the valuation of assets and treatment of revaluations, certain inputs to the cost of capital (beta and the debt margin) and the efficiency of prices over time and the implications for the depreciation of assets and measured accounting profit.
- **Treatment of Inflation and Depreciation when Setting Landing Charges (Client: Virgin Blue, 2007 2008)** - Provided advice on Adelaide Airport's proposed approach for setting landing charges for Adelaide Airport, where a key issue was how it proposed to deal with inflation and the implications for the path of prices over time. The advice also addressed the different formulae that are available for deriving an annual revenue requirement and the requirements for the different formulae to be applied consistently.
- **Application of the Grid Investment Test to the Auckland 400kV Upgrade (Client: Electricity Commission of New Zealand, 2006)** - As part of a team, undertook a review of the Commission's process for reviewing Transpower's proposed Auckland 400kV upgrade project and undertook a peer review of the Commission's application of the Grid Investment Test.
- **Appropriate Treatment of Taxation when Measuring Regulatory Profit (Client: Powerco New Zealand, 2005 2006)** - Prepared two statements for Powerco New Zealand related to how the Commerce Commission should treat taxation when measuring realised and projected regulatory profit for its gas distribution business (measured regulatory profit, in turn, was a key input into the Commission's advice to the Minister as to whether there would be net benefits from regulating Powerco New Zealand's gas distribution business). A key finding was that care must be taken to ensure that the inputs used when calculating taxation expenses are consistent with the other 'assumptions' that a regulator adopts if it applies incentive regulation (most notably, a need for consistency between assumed tax depreciation and the regulatory asset value).
- **Application of Directlink for Regulated Status (Client: Directlink, 2003 2004)** - Prepared advice on the economic issues associated with the Directlink Joint Venture's request to be converted from an unregulated (entrepreneurial) interconnector to a regulated interconnector. As with the Murraylink application, the key issues included the implications for economic efficiency flowing from its application and the appropriate application of a cost benefit test for transmission investment (and the implications of that test for the setting of the regulatory value for its asset).
- **Principles for the 'Stranding' of Assets by Regulators (Client: the Independent Pricing and Regulatory Tribunal, NSW, 2005)** - Prepared a report discussing the relevant economic principles for a regulator in deciding whether to 'strand' assets for regulatory purposes (that is, to deny any further return on assets that are partially or unutilised). An important conclusion of the advice is that the benefits of stranding need to be assessed with reference to how future decisions of the regulated entities are affected by the policy (i.e. future investment and pricing decisions), and that the

uncertainty created from ‘stranding’ creates real costs.

- **Principles for Determining Regulatory Depreciation Allowances (Client: the Independent Pricing and Regulatory Tribunal, NSW, 2003)** - Prepared a report discussing the relevant economic and other principles for determining depreciation for the purpose of price regulation, and its application to electricity distribution. An important issue addressed was the distinction between accounting and regulatory (economic) objectives for depreciation.
- **Methodology for Updating the Regulatory Value of Electricity Transmission Assets (Client: the Australian Competition and Consumer Commission, 2003)** - Prepared a report assessing the relative merits of two options for updating the regulatory value of electricity transmission assets at a price review - which are to reset the value at the estimated 'depreciated optimised replacement cost' value, or to take the previous regulatory value and deduct depreciation and add the capital expenditure undertaken during the intervening period (the 'rolling-forward' method). This paper was commissioned as part of the ACCC's review of its Draft Statement of Regulatory Principles for electricity transmission regulation.
- **Application of Murraylink for Regulated Status (Client: Murraylink Transmission Company, 2003)** - Prepared advice on the economic issues associated with Murraylink Transmission Company’s request to be converted from an unregulated (entrepreneurial) interconnector to a regulated interconnector. The key issues included the implications for economic efficiency flowing from its application and the appropriate application of a cost benefit test for transmission investment (and the implications of that test for the setting of the regulatory value for its asset).
- **Proxy Beta for Regulated Gas Transmission Activities (Client: the Australian Competition and Consumer Commission, 2002)** - Prepared a report presenting the available empirical evidence on the ‘beta’ (which is a measure of risk) of regulated gas transmission activities. This evidence included beta estimates for listed firms in Australia, as well as those from the United States, Canada and the United Kingdom. The report also included a discussion of empirical issues associated with estimating betas, and issues to be considered when using such estimates as an input into setting regulated charges.
- **Treatment of Working Capital when setting Regulated Charges (Client: the Australian Competition and Consumer Commission, 2002)** - Prepared a report assessing whether it would be appropriate to include an explicit (additional) allowance in the benchmark revenue requirement in respect of working capital when setting regulated charges.
- **Pricing Principles for the South West Pipeline (Client: Esso Australia, 2001)** - As part of a team, prepared a report (which was submitted to the Australian Competition and Consumer Commission) describing the pricing principles that should apply to the South West Pipeline (this pipeline was a new asset, linking the existing system to a new storage facility and additional gas producers).
- **Victorian Government Review of Water Prices (Client: the Department of Natural Resources and the Environment, Vic, 2000 2001)** - Prepared a report discussing the principles regulators use to determine the capital related cost (including reasonable profit) associated with providing utility services, and how those principles would apply to the water industry in particular. The report also provided an estimate of the cost of capital (and assessment of risk in general) associated with providing water services. The findings of the report were presented to a forum of representatives of the Victorian water industry.
- **Likely Regulatory Outcome for the Price for Using a Port (Client: MIM, 2000)** -

Provided advice on the outcome that could be expected were the dispute over the price for the use of a major port to be resolved by an economic regulator. The main issue of contention was the valuation of the port assets (for regulatory purposes) given that the installed infrastructure was excess to requirements, and the mine had a short remaining life.

- **Relevance of 'Asymmetric Events' in the Setting of Regulated Charges (Client: TransGrid, 1999)** - In conjunction with William M Mercer, prepared a report (which was submitted to the Australian Competition and Consumer Commission) discussing the relevance of downside (asymmetric) events when setting regulated charges, and quantifying the expected cost of those events.

C. Licencing / Franchise Bidding

- **Competitive Tender for Gas Distribution and Retail in Tasmania (Client: the Office of the Tasmanian Energy Regulator, 2001 2002)** - Economic adviser to the Office during its continuing oversight of the use of a competitive tender process to select a gas distributor/retailer for Tasmania, and simultaneously to set the regulated charges for an initial period. The main issues concern how the tender rules, process and future regulatory framework should be designed to maximise the scope for 'competition for the market' to discipline the price and service offerings. Principal author of a number of sections of a consultation paper, and the regulator's first decision document.
- **Issuing of a Licence for Powercor Australia to Distribute Electricity in the Docklands (Client: the Office of the Regulator General, Vic, 1999)** - Economic adviser to the Office during its assessment of whether a second distribution licence should be awarded for electricity distribution in the Docklands area (a distribution licence for the area was already held by CitiPower, and at that time, no area in the state had multiple licensees). The main issue concerned the scope for using 'competition for the market' to discipline the price and service offerings for an activity that would be a monopoly once the assets were installed. Contributed to a consultation paper, and was principal author of the draft and final decision documents.

D. Market Design

- **Options for the Development of the Australian Gas Wholesale Market (Client: the Ministerial Committee on Energy, 2005)** - As part of a team, assessed the relative merits of various options for enhancing the operation of the Australian gas wholesale markets, including by further dissemination of information (through the creation of bulletin boards) and the management of retailer imbalances and creation of price transparency (by creating short term trading markets for gas).
- **Review of the Victorian Gas Market (Client: the Australian Gas Users Group, 2000 2001)** - As part of a team, reviewed the merits (or otherwise) of the Victorian gas market. The main issues of contention included the costs associated with operating a centralised market compared to the potential benefits, and the potential long term cost associated with having a non commercial system operator.
- **Development of the Market and System Operation Rules for the Victorian Gas Market (Client: Gas and Fuel Corporation, 1996)** - Assisted with the design of the 'market rules' for the Victorian gas market. The objective of the market rules was to create a spot market for trading in gas during a particular day, and to use that market to facilitate the efficient operation of the system.

E. Development of Regulatory Frameworks

- **Implications of greenhouse policy for the electricity and gas regulatory frameworks (Client: the Australian Energy Market Commission, 2008 ongoing)** - Providing ongoing advice to the AEMC in its review of whether changes to the

electricity and gas regulatory frameworks is warranted in light of the proposed introduction of a carbon permit trading scheme and an expanded renewables obligation. Issues addressed include the framework for electricity connections, the efficiency of the management of congestion and locational signals for generators and the appropriate specification of a cost benefit test for transmission upgrades in light of the two policy initiatives.

- **Application of a 'total factor productivity' form of regulation (Client: the Victorian Department of Primary Industries, 2008)** - Assisted the Department to develop a proposed amendment to the regulatory regime for electricity regulation to permit (but not mandate) a total factor productivity approach to setting price caps – that is, to reset prices to cost at the start of the new regulatory period and to use total factor productivity as an input to set the rate of change in prices over the period.
- **Expert Panel on Energy Access Pricing (Client: Ministerial Council on Energy, 2005 2006)** - Assisted the Expert Panel in its review of the appropriate scope for commonality of access pricing regulation across the electricity and gas, transmission and distribution sectors. The report recommended best practice approaches to the appropriate forms of regulation, the principles to guide the development of detailed regulatory rules and regulatory assessments, the procedures for the conduct of regulatory reviews and information gathering powers.
- **Productivity Commission Review of Airport Pricing (Client: Virgin Blue, 2006)** - Prepared two reports for Virgin Blue for submission to the Commission's review, addressing the economic interpretation of the review principles, asset valuation, required rates of return for airports and the efficiency effects of airport charges and presented the findings to a public forum.
- **AEMC Review of the Rules for Setting Transmission Prices (Client: Transmission Network Owners, 2005 2006)** - Advised a coalition comprising all of the major electricity transmission network owners during the new Australian Energy Market Commission's review of the rules under which transmission prices are determined. Prepared advice on a number of issues and assisted the owners to draft their submissions to the AEMC's various papers.
- **Advice on Energy Policy Reform Issues (Client: Victorian Department of Infrastructure/Primary Industries, 2003 ongoing)** - Ongoing advice to the Department regarding on issues relating to national energy market reform. Key areas covered include: reform of cross ownership rules for the energy sector; the reform of the cost benefit test for electricity transmission investments; and the reform of the gas access arrangements (in particular, the scope for introducing more light handed forms of regulation); and the transition of the Victorian electricity transmission arrangements and gas market into the national regulatory regime.
- **Productivity Commission Review of the National Gas Code (Client: BHPBilliton, 2003 2004)** - Produced two submissions to the review, with the important issues including the appropriate form of regulation for the monopoly gas transmission assets (including the role of incentive regulation), the requirement for ring fencing arrangements, and the presentation of evidence on the impact of regulation on the industry since the introduction of the Code. The evidence presented included a detailed empirical study of the evidence provided by the market values of regulated entities for the question of whether regulators are setting prices that are too low.
- **Framework for the Regulation of Service Quality (Client: Western Power, 2002)** - Prepared two reports advising on the framework for the regulation of product and service quality for electricity distribution, with a particular focus on the use of economic incentives to optimise quality and the implications for the coordination of service

regulation coordinated with distribution tariff regulation.

- **Development of the National Third Party Access Code for Natural Gas Pipeline Systems Code (Client: commenced while a Commonwealth Public Servant, after 1996 the Commonwealth Government, 1994 1997**) - Was involved in the development of the Gas Code (which is the legal framework for the economic regulation of gas transmission and distribution systems) from the time of the agreement between governments to implement access regulation, through to the signing of the intergovernmental agreements and the passage of the relevant legislation by the State and Commonwealth parliaments. Major issues of contention included the overall form of regulation to apply to the infrastructure (including the principles and processes for establishing whether an asset should be regulated), pricing principles (including the valuation of assets for regulatory purposes and the use of incentive regulation), ring fencing arrangements between monopoly and potentially contestable activities, and the disclosure of information. Was the principal author of numerous issues papers for the various government and industry working groups, public discussion papers, and sections of the Gas Code.

F. Other Finance Work

- **Private Port Development (Client: Major Australian Bank, 2008)** - Prepared a report on the relative merits of different governance and financing arrangements for a proposed major port development that would serve multiple port users.
- **Review of Capital Structure (Client: major Victorian water entity, 2003)** - Prepared a report (for the Board) advising on the optimal capital structure for a particular Victorian water entity. The report advised on the practical implications of the theory on optimal capital structure, presented benchmarking results for comparable entities, and presented the results of detailed modelling of the risk implications of different capital structures. Important issues for the exercise were the implications of continued government ownership and the impending economic regulation by the Victorian Essential Services Commission for the choice of – and transition to – the optimal capital structure.
- **Expert Witness Roles**
- **Consultation on Major Airport Capital Expenditure** – Judicial Review (Client: Christchurch International Airport, 2008) - Prepared an affidavit for a judicial review on whether the airport consulted appropriately on its proposed terminal development. Addressed the rationale, from the point of view of economics, of separating the decision of 'what to build' from the question of 'how to price' in relation to new infrastructure.
- **New Zealand Commerce Commission Draft Decision on Gas Distribution Charges (Client: Powerco, 2007 08)** - Prepared an expert statement about the valuation of assets for regulatory purposes, with a focus on the treatment of revaluation gains, and a memorandum about the treatment of taxation for regulatory purposes and appeared before the Commerce Commission.
- **Sydney Airport Domestic Landing Change Arbitration (Client: Virgin Blue, 2007**) - Prepared two expert reports on the economic issues associated with the structure of landing charges (note: the evidence was filed, but the parties reached agreement before the case was heard).
- **New Zealand Commerce Commission Gas Price Control Decision** – Judicial Review to the High Court (Client: Powerco, 2006) - Provided four affidavits on the regulatory economic issues associated with the calculation of the allowance for taxation for a regulatory purpose, addressing in particular the need for consistency in assumptions across different regulatory calculations.

- **Victorian Electricity Distribution Price Review** – Appeal to the ESC Appeal Panel: Service Incentive Risk (Client: the Essential Services Commission, Vic, 2005 2006) - Prepared expert evidence on the workings of the ESC's service incentive scheme and the question of whether the scheme was likely to deliver a windfall gain or loss to the distributors (note: the evidence was filed, but the appellant withdrew this ground of appeal prior to the case being heard).
- **Victorian Electricity Distribution Price Review** – Appeal to the ESC Appeal Panel: Price Rebalancing (Client: the Essential Services Commission, Vic, 2005 2006) - Prepared expert evidence on the workings of the ESC's tariff basket form of price control, with a particular focus on the ability of the electricity distributors to rebalance prices and the financial effect of the introduction of 'time of use' prices in this context (note: the evidence was filed, but the appellant withdrew this ground of appeal prior to the case being heard).
- **New Zealand Commerce Commission Review of Information Provision and Asset Valuation (Client: Powerco New Zealand, 2005)** - Appeared before the Commerce Commission for Powerco New Zealand on several matters related to the appropriate measurement of profit for regulatory purposes related to its electricity distribution business, most notably the treatment of taxation in the context of an incentive regulation regime.
- **Duke Gas Pipeline (Qld) Access Arrangement Review** – Appeal to the Australian Competition Tribunal (Client: the Australia Competition and Consumer Commission, 2002) - Prepared expert evidence on the question of whether concerns of economic efficiency are relevant to the non price terms and conditions of access (note: the evidence was not filed as the appellant withdrew its evidence prior to the case being heard).
- **Victorian Electricity Distribution Price Review** – Appeal to the ORG Appeal Panel: Rural Risk (Client: the Office of the Regulator General, Vic, 2000) - Provided expert evidence (written and oral) to the ORG Appeal Panel on the question of whether the distribution of electricity in the predominantly rural areas carried greater risk than the distribution of electricity in the predominantly urban areas.
- **Victorian Electricity Distribution Price Review –** Appeal to the ORG Appeal Panel: Inflation Risk (Client: the Office of the Regulator General, Vic, 2000) - Provided expert evidence (written and oral) to the ORG Appeal Panel on the implications of inflation risk for the cost of capital associated with the distribution activities.
- **Major Coal Producers and Ports Corporation of Queensland Access Negotiation (Client: Pacific Coal, 1999)** - Provided advice to the coal producers on the outcome that could be expected were the dispute over the price for the use of a major port to be resolved by an economic regulator. The main issues of contention were the valuation of the assets for regulatory purposes, whether the original users of the port should be given credit for the share of the infrastructure they financed, and the cost of capital (and assessment of risk generally). Presented the findings to a negotiation session between the parties.

Matthew Santoro

Executive Director

Qualifications and memberships:

- Bachelor of Economics (Honours), University of Adelaide
- Affiliate, Institute of Chartered Accountants

Matthew has over 20 years of corporate and institutional banking experience, including 12 years at Deutsche Bank and eight years at Citibank. At Deutsche Bank he held various senior banking positions covering the origination, structuring and syndication of debt facilities. Following this and prior to joining PwC, Matthew jointly established and was Joint National Head of KPMG's debt advisory practice for a period of five years.

Project experience:

Matthew is experienced in a wide range of financing and fundraising transactions, in particular in the area of acquisition financing, leverage financing, re-financings, project and property financing and procurement of debt capital markets instruments across the Australian, European and USA markets. His experience includes dealings with credit rating agencies such as Standard & Poor's and Moody's.

Matthew has advised numerous companies on their debt and capital management needs, including the procurement of debt across a very broad industry sector. His clients have included the following:

- CSL
- David Jones
- Boom Logistics
- Pacific Brands
- Healthscope
- Hastings Funds Management
- Future Fund
- Australian Super
- Deutsche Asset Management
- South East Water
- Computershare
- ORIX Corporation
- Toll Holdings, and
- Tabcorp

Matthew's experience covers capital management and financing applications for a wide range of structures, asset types and industries. Matthew has over 20 years of debt markets experience with extensive dealings and established relationships with key participants in the capital markets such as banks, borrowers, fund and fixed interest managers, private equity investors, credit rating agencies, legal firms, etc.

Matthew's sector experience includes:

- debt structuring, arranging and procurement, onshore and offshore
- US Private Placement, Australian and European Bond markets
- capital management, and
- credit rating agencies.