Report prepared for the

Australian Energy Regulator

Comments of the CEG Report:

Estimating the 10 year BBB+ cost of debt

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1. INTRODUCTION

On the 28 June 2010 the Australian Energy Regulatory (AER) released its decision on the access arrangement to apply to the NSW gas distribution network owned by Jemena Gas Networks NSW Ltd (JGN) for the period 1 July 2010 to 30 June 2015. JGN has appealed to the Australian Competition Tribunal (Tribunal) for a merits review of this decision on a number of grounds including that the AER incorrectly determined the debt risk premium by using the CBA Spectrum fair value curve. JGN submitted that the debt risk premium should instead be based on the Bloomberg fair value curve. As a result of another Tribunal decision, the AER now considers that the debt risk premium relevant to the averaging period should be based on the average of the two fair value curves.

On 3 December 2010, JGN submitted a new report on the debt risk premium by Competition Economists Group (CEG).[1] CEG considers which bonds should be included in the sample of bonds for the purpose of choosing between the Bloomberg and CBA Spectrum fair value curves. Based on its proposed bond sample, CEG also presents an analysis from which it concludes that the Bloomberg fair value curve should alone be used in estimating the debt risk premium. The AER has decided to obtain its own expert advice in response to this report. In this regard, the AER has sought the following specific advice:[2]

1. Describe the relationship between the debt issued by the benchmark firm (as per the AER's final decision for the JGN network) and market observations of the cost of debt.
    a. Specifically address the argument that the benchmark film is defined by market practice.
    b. Specifically address the implications (if any) of the Miller-Modigliani theorem for the type of debt issued by the benchmark firm.

2. Comment on the relevance (in relative and absolute terms) of each of the following types of debt when attempting to set the cost of debt for use in the

[1] Competition Economists Group (2010).

[2] All questions are with reference to the CEG report. Relevant averaging period means the period from 8 April 2010 to 6 May 2010 inclusive.

AER's nominal vanilla weighted average cost of capital (as part of the post tax revenue model):

a. bonds with non-standard options: i. bonds with call options; ii. bonds with make whole call options; and iii. bonds with contracts that specify a coupon reset on credit rating downgrade.
b. bonds from other credit ratings: i. bonds with a credit rating of A– ; ii. bonds with a credit rating of BBB, and iii. bonds with other credit ratings.
c. bonds reported by: i. only one data source; and ii. multiple data sources

3. Consider the outlier testing undertaken in section 5.4 of the CEG report:
   a. comment on the use of spreads to average fair value in these tests
   b. comment on the maturity threshold (4 years).

4. Comment on the validity of comparing observed bond yields against fair value curves using an absolute error test or a squared error test with all bonds weighted equally.

5. Consider bonds issued after the relevant averaging period had concluded:
   a. comment on the relevance (if any) of these bonds to the cost of debt during the relevant averaging period
   b. describe what adjustments could be made to these bonds in order to inform the estimate of the cost of debt during the relevant averaging period.

6. Specifically consider the bond issued by APT in July 2010:
   a. what relevance (if any) should be given to this bond when estimating the cost of debt for the relevant averaging period
   b. estimate a value (or range) for a debt risk premium during the relevant averaging period that would be consistent with this bond.

7. Based on your answers to all the questions above, advise on whether the cost of debt should be set on the basis of:
   a. the Bloomberg fair value curve; or

b. an average of the Bloomberg and CBA Spectrum fair value curves.

The AER has also sought advice from Oakvale Capital Limited (Oakvale) on a number of matters concerning debt market practice. In preparing this report I have had access to the final report prepared by Oakvale.[3] A copy of my resume is set out in the Appendix.

2. CONTEXT

Before addressing the specific issues requested by the AER, I would like to highlight two key considerations which are involved in estimating the 10 year BBB+ rated cost of debt and which form the basis for much of the comments which follow in this report.

The first key consideration is the role of professional judgement.

Estimation is a process which by definition is subject to error. In the current case of estimating the 10 year BBB+ rated cost of debt, there is an unfortunate shortage of directly relevant data. In other words there are relatively few long maturity BBB+ rated fixed rate debt securities which trade in the Australian capital market and so the sample of bonds which are most relevant to the task at hand is relatively small. It is here that the role of professional judgement comes into play. Specifically, one possible way to address the data shortage is to introduce other bonds. This is precisely the motivation behind much of the analysis conducted by CEG who state:

> *"In my letter of 23 June 2010, I included in an appendix a number of charts exploring the information provided by UBS for bonds outside those used by the AER in its selected bond sample. These included floating rate bonds rated BBB+, and fixed and floating rate bonds with ratings of BBB and A-. I included information on these bonds because I believe their yields provide relevant information to the determination of the benchmark debt premium in the JGN averaging period."*[4] [emphasis added here]

[3] Oakvale Capital Limited (2011).
[4] Competition Economists Group (2010 para.4).

But the choice as to which classes of bonds should be included (along with the set of BBB+ fixed rate bonds) and the choice as to which bonds within each of those classes should be included, is a matter of professional judgement. There is no definitive answer here.

The second key consideration is the importance of comparability.

Whilst the exercise of professional judgement is required, important guidance comes from the principle of comparing "like-with-like". In other words, if other bonds are to be included then they should be included on a comparable basis otherwise the results from any subsequent analysis will not be meaningful.

The twin considerations of professional judgement and comparability have a number of important implications in the current case of estimating the 10 year BBB+ rated cost of debt including:

- there are three ways to take account of bonds with non-standard features (such as callable bonds, bonds with different credit ratings and bonds with coupon resets – whether fixed or floating). The first is to exclude them to avoid any inappropriate comparison of bonds with differing features (such as non-callable bonds with callable bonds). The second is to include them but with an appropriate adjustment to take account of the non-standard feature (such as the call option embedded in a callable bond) although in some cases it may be difficult to determine what that adjustment should be. The third is to include them but with no adjustment to take account of the non-standard feature. The need for a like-with-like comparison means that either of the first two approaches is valid and the choice between them is a matter of judgement;[5]

- even where an adjustment to take account of a non-standard feature is possible, doing so is likely to introduce a second layer of uncertainty into the estimate of the 10 year BBB+ rated cost of debt. This follows from the fact that there may be more than one way to make the said adjustment. For example, in the case of

[5] For clarity, practical considerations (such as a paucity of data) may require the third approach to be adopted notwithstanding this is a second best outcome.

callable bonds, there is more than one model that could be used to value the embedded interest rate option.[6] It is noted that for this purpose, Oakvale has used the "Hull White Factor 1 Model",[7] Bloomberg has used the "lognormal model", [8] whilst it is not clear what model is used by CBA Spectrum. In general, any adjustment to take account of a non-standard feature is conditional on the model that is used. It is for this reason that my preferred position is to exclude callable bonds rather than to adjust;

- the inclusion of bonds with different credit ratings reduces the efficacy of any quantitative test of "best fit" such as the absolute error test and the squared error test because such tests implicitly give equal weighting to each bond in the sample, irrespective of credit rating, notwithstanding the bonds are not strictly comparable;[9]

- the observed pattern of yields on A– rated bonds relative to BBB+ rated bonds makes it difficult to determine what adjustment would be required to take account of different credit ratings. For example, in both Figure 10 of the CEG report[10] and Graph 10 of the AER Submission[11], it is noted that whilst BBB bonds generally trade above nearby BBB+ bonds (which is in line with expectations) there are a number of A– bonds which trade above nearby BBB+ bonds (which is not in line with expectations). This may suggest factors other than simply credit risk (as reflected in the assigned credit rating) are taken into account by the market in pricing the bond; and

- the inclusion of bonds which are less than strictly comparable increases the importance of a qualitative approach to any outlier testing (compared to quantitative outlier tests).

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6 See Chapter 28 in Hull (2006).

7 Oakvale (2011 para. 19).

8 See slide 12 of Lee (2007) where it is stated that: *"Any interest rate options embedded in callable and puttable bonds are valued with the lognormal interest rate model"*.

9 An additional concern with the average squared error test is discussed later in section 6.

10 Competition Economists Group (2010 p.30).

11 Australian Energy Regulator (2010 p.29).

3. THE BENCHMARK FIRM

1. Describe the relationship between the debt issued by the benchmark firm (as per the AER's final decision for the JGN network) and market observations of the cost of debt.
   a. Specifically address the argument that the benchmark film is defined by market practice
   b. Specifically address the implications (if any) of the Miller-Modigliani theorem for the type of debt issued by the benchmark firm.

CEG argues that callable bonds should be included in the sample in the same proportion as they are actually observed in practice, consistent with prudent debt management strategies adopted by actual firms:

> *"If the financing practices of efficient firms is to issue some proportion of their debt as callable then it is necessary that the benchmark cost of debt reflect the cost of issuing callable debt (at least in proportion to that which it is actually issued)."*[12]

The cost of capital is defined to be equal a weighted average of the cost of equity and the cost of debt of the benchmark firm. In my opinion, the cost of debt for this purpose relates to straight debt rather than callable debt (and similarly does not relate to other non-standard types of debt such as convertible debt) i.e. the benchmark cost of debt is the cost of straight debt to the benchmark firm. However, as will be explained in the next section, this does not necessarily mean that callable bonds should be excluded from the sample used to compare the Bloomberg and CBA Spectrum fair value curves.

In my opinion, CEG's argument appears to be one concerning whether regulated firms should be allowed to recover the costs associated with prudent debt management/interest rate hedging strategies. For example, CEG also argues that excluding callable bonds from the sample would violate the Modigliani-Miller theorem of capital structure irrelevance and therefore:

> *"If the firms that the AER used to benchmark the cost of equity issued callable bonds then the benefits of this in terms of increasing the options open to equity holders (and thereby reducing their risk) will be captured in a lower equity beta.*

[12] Competition Economists Group (2010 para.44).

It is therefore appropriate that the cost of debt reflect the issuance of callable bonds because the cost of equity already does."[13]

It is well understood that the Modigliani-Miller theorem suggests that (in a perfect capital market) the mix of securities issued by a firm is irrelevant.[14] But since any reduction in the (systematic) risk exposure of equity holders from issuing callable bonds would be directly attributable to the embedded call option – which is a hedging tool – then in my opinion, this is a separate issue. In other words, this is an argument concerning the recovery of hedging costs rather than one concerning the determination of the appropriate cost of debt.

4. NON-STANDARD OPTIONS, OTHER CREDIT RATINGS AND DATA SOURCES

2. Comment on the relevance (in relative and absolute terms) of each of the following types of debt when attempting to set the cost of debt for use in the AER's nominal vanilla weighted average cost of capital (as part of post tax revenue model):
   a. bonds with non-standard options: i. bonds with call options; ii. bonds with make whole call options; and iii. bonds with contracts that specify a coupon reset on credit rating downgrade.
   b. bonds from other credit ratings: i. bonds with a credit rating of A– ; ii. bonds with a credit rating of BBB, and iii. bonds with other credit ratings.
   c. bond reported by: i. only one data source; and ii. multiple data sources

Before addressing these issues, I would like to make a number of brief comments concerning yields and yield curves.

There is more than one type of "yield" and it is important to distinguish between them. The yield-to-maturity on a bond is equal to that single discount rate which when applied to the promised cashflows on the bond gives a value equal to the market price of the bond. Mathematically, it is equal to the internal rate of return on the bond. The yield-

[13] Competition Economists Group (2010 para.120).

[14] As Brealey, Myers and Allen (2008 p.476) state*: "The law also applies to the mix of debt securities issued by the firm. The choices of long-term verses short-term, secured verses unsecured, senior verses subordinated, and convertible verses non-convertible debt should all have no effect on the overall value of the firm."*

to-maturity is the standard way by which the market quotes the yield on a bond.[15] If the bond happens to be a zero-coupon bond with only a single promised payment at maturity then the yield-to-maturity on the bond is also referred to as a spot-rate. For example, the yield-to-maturity on a one year zero coupon bond is the one year spot rate, the yield-to-maturity on a two year zero coupon bond is the two year spot rate, etc. If the bond happens to be trading at par then the yield-to-maturity on the bond is also referred to as a par-yield. More generally, the par-yield on a bond is equal to that single discount rate which when applied to the promised cashflows on the bond gives a value equal to the par value of the bond. For example, the yield-to-maturity on a two year coupon bond trading at par is the two year par-yield, the yield-to-maturity on a three year coupon bond trading at par is the three year par-yield, etc.

A yield curve describes the relationship between yield (shown on the vertical axis) and maturity (shown on the horizontal axis) for a set of comparable bonds. Since there is more than one type of yield then there is more than one type of yield curve. The yield curve which describes the relationship between spot rates and yield-to-maturity for a set of comparable bonds is called a spot curve (also called a zero curve). The yield curve which describes the relationship between par-yield and maturity for a set of comparable bonds is called a par curve (also called a par yield curve or a par coupon curve). Given the observed yields-to-maturity on a set of coupon bonds, it is possible to derive the spot curve and the par curve. Each point on the par curve corresponds to the par-yield on a hypothetical bond with that maturity.[16]

The defining characteristic of a yield curve (whether a spot curve or a par curve) is comparability meaning a requirement that all bonds within the set of bonds that are used to derive the spot curve or the par curve, differ only with respect to maturity. In other words, the yield curve purports to show the relationship between yield and maturity holding all other features of the bonds constant.

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15 Oakvale Capital Limited (2011 p.4).

16 The term "hypothetical" is used in the sense that it is not necessary for any of the bonds in the set of bonds to be trading at par.

CEG argues that, due to the paucity of BBB+ rated, long dated straight fixed rate bonds, the sample of bonds to be used in choosing between the CBA Spectrum fair value curve and the Bloomberg fair value curve should be extended to include callable bonds, bonds with different credit ratings, bonds with coupon resets (which protect investors against ratings downgrades) – whether fixed or floating – and further if callable bonds were to be excluded then so should bonds with coupon resets:

> *"I do not consider that callable bonds should be removed from the analysis. To the extent that callable bonds were to be removed a distinction between 'normal' callable bonds and 'make whole' callable bonds should be made. Make whole callable bonds should not be excluded because the nature of the call options is specifically designed to ensure that bond holders are not disadvantaged by the exercise of the call and, therefore, will not demand a material premium for the existence of such a call option.*
>
> *Also, to the extent that callable bonds were to be excluded then bonds that have interest rates (coupons) which increase in the event of credit rating downgrades should also be excluded."* [17]

Much of the argument focuses on callable bonds but the key issue concerns whether the sample should include bonds with non-standard features.

The suggestion that such bonds should be included is not controversial. There is an important proviso however – if a bond with a non-standard feature is to be included then the observed yield should be adjusted to "remove" the effect of that non-standard feature in order to identify the underlying cost of straight debt. Recall, the defining feature of a yield curve is the requirement that all bonds under consideration have the same features except for maturity. Including non-standard bonds certainly has the benefit of increasing the sample size of bonds that are available to be used in choosing between the Bloomberg and CBA Spectrum fair value curves but it also comes at a cost of reducing the comparability within the set of bonds. In other words, there is a trade-off between increasing the sample size and decreasing the relevance of the sample (if no adjustment was to be made).

[17] Competition Economists Group (2010 p.24).

Take callable bonds for example. It is well understood that a callable bond can be considered to be the same as an otherwise equivalent non-callable bond plus a short call option.[18] In addition, the value of the call option will be reflected in a higher yield on the callable bond compared to the yield on the otherwise equivalent non-callable bond. This relates to both standard callable bonds and make whole callable bonds. In this regard, CEG suggests that:

> *"the value of call options on most of these bonds can safely be assumed to be very low if not zero."*[19]

and accordingly CEG includes the callable bonds at their (unadjusted) observed yields.

However, in my opinion the CEG analysis is incomplete for two reasons. First it is noted that Oakvale has examined the yield impact of the embedded call options and shows that this is substantial in a number of cases.[20] Second, and more importantly, it is noted that the Bloomberg fair value curve is determined in a way which takes into account the yield impact of any embedded options. For example, in a previous report, CEG states:

> *"Rather, Bloomberg simply states in relation to the BBB fair value curve:*
>
> > *"The curve is populated with Australian dollar denominated fixed-rate bonds issued by Australian companies. The bonds have ratings of BBB+, BBB, BBB- from S&P, Moody's Fitch and/or DBRS. The yield curve is built daily with bonds that have either Bloomberg Generic (BGN) prices, supplemental proprietary contributor prices or both. The bonds are subject to option-adjusted spread (OAS) analysis and the curve is adjusted to generate a best fit." "* [21] [emphasis added here]

whilst according to Bloomberg:

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18 Oakvale Capital Limited (2011 p.6) and Fabozzi (2007 p.386).
19 Competition Economists Group (2010 para 50).
20 Oakvale Capital Limited (2011 p.16)
21 Competition Economists Group (2009 p.15).

"The Bloomberg Fair Value (BFV) model generates two sub-products:

- An option-free, par coupon yield curve, and

- An objective price for a bond that may or may not be priced by a market maker." [22] [emphasis added here]

Accordingly, a consistent like-with-like comparison requires the yields on any callable bonds in the sample to be adjusted in an appropriate manner.

Note that whilst it is clear that the Bloomberg fair value curve is expressed on an "option-free" basis, I have not been able to find any information which confirms that the CBA Spectrum fair value curve is similarly expressed on an "option-free" basis – although I would be surprised if this was not the case.

The general principle that observed yields on bonds with non-standard features should be appropriately adjusted to improve their comparability also extends to bonds with coupon resets and with different credit ratings.

In relation to the first, a resettable bond can be considered to be the same as an otherwise equivalent non-resettable bond plus the reset feature which means that the value of the reset feature will be reflected in a lower yield on the resettable bond compared to the yield on the otherwise equivalent non-resettable bond.[23] Accordingly, the yield on any bonds with coupon resets should be adjusted in an appropriate manner if they are to be included in the sample. I also note that CEG suggests that the AER has included five bonds with a coupon reset feature in its sample but (implicitly) without making any adjustment to their observed yields.[24]

In relation to the second, the observed yields on bonds with different credit ratings should also be adjusted to take account of the differential in credit rating. Unfortunately, this may prove problematic since the natural adjustment is to take account of the difference in yield on an A– bond and a BBB+ bond and similarly the

[22] See slide 5 of Lee (2007). Lee (2007) also provides additional information concerning the Bloomberg methodology.

[23] Oakvale Capital Limited (2011 p.8-9). In addition Oakvale suggests that the value of the reset feature will be lower the higher rated is the bond.

[24] Competition Economists Group (2010 p.18).

difference in yield on a BBB+ bond and a BBB bond but the yield on the BBB+ is what one is trying to estimate in the first place. If such bonds are to be included in the sample then in my opinion one would want to ensure that the yield on A– bonds are lower than "nearby" otherwise equivalent BBB+ bonds and the yield on BBB bonds are higher than "nearby" otherwise equivalent BBB+ bonds.

In regards to bonds reported by multiple sources, it is noted that CEG's empirical tests have been conducted using the median of the reported yields from UBS, Bloomberg and CBA Spectrum whereas the AER's analysis is based solely on yields from UBS. In this regard I make three comments. First, the use of UBS yields is supported by Oakvale who state:

> *"Whilst Bloomberg and CBA Spectrum provide useful price guidance, the use of a market makers price sheet such as that provided by UBS is the most commonly used guide for pricing of bond instruments ... Bloomberg often uses composite quotes (i.e. where they believe the market should be, whereas market practitioners use pricing models and actual data flow for pricing and this is deemed more reliable."* [25]

and further, it ensures consistency in the observed yields on the sample of bonds used in choosing between the Bloomberg and CBA Spectrum fair value curves, since all those yields have come from the same source. Second, CEG does not provide details of any robustness testing of its approach. In other words, one does not know how sensitive CEG's results are to using the median compared to say using the mean, maximum or minimum observed yields. Third, notwithstanding CEG suggests that:

> *"There is no way by which one can 'look behind' the values provided by either UBS, Bloomberg or CBA Spectrum to determine which data point is best supported or most robust"* [26]

[25] Oakvale Capital Limited (2011 p.25).
[26] Competition Economists Group (2010 p.21).

it is my opinion that closer examination of particular cases is warranted. For example, according to the CEG spreadsheet: "6033726_1_Debt risk premium analysis (JGN)", the average yield on the Promina bond is reported to be 14.943% by UBS and 9.883% by Bloomberg with no yield reported by CBA Spectrum.[27] Based on these two yields CEG has used a median (which is in this case is also an average) of 12.413%. In my view, an important issue for consideration is why the difference between the yields reported by UBS and Bloomberg is in excess of 5% compared to naively applying a simple median rule.

5. OUTLIER TESTING

3. Consider the outlier testing undertaken in section 5.4 of the CEG Report:
   a. comment on the use of spreads to average fair value in these tests
   b. comment on the maturity threshold (4 years).

CEG notes that the Tribunal has previously expressed scepticism about the use of statistical outlier tests when the sample is small. Notwithstanding, CEG presents a quantitative analysis of outliers on the basis that:

> *"quantitative assessment of the observations in the sample is still relevant to inform any qualitative assessments – especially where the magnitude of any affects identified in the qualitative assessment are not obvious".*[28]

Three tests are conducted based on each bond's yield spread to the average of the Bloomberg and CBA Spectrum BBB fair value curves: (i) Chauvenet's test; (ii) the "classic" outlier test (of excluding observations outside plus or minus two standard deviations of the mean); and (iii) a box-plot test.

[27] See line 67 of the "Results" sheet. I also note this Promina bond is a callable bond and has been excluded by the AER in its analysis.
[28] Competition Economists Group (2010 para. 67).

I note that the box-plot test has been described as simply *"a well known exploratory tool"*[29] whilst others have expressed doubts over Chauvenet's test. In particular, according to Barnett and Lewis (1994 p.4):

> *"Chavvenet's method ...was one of the earliest for dealing with outliers, dating from the middle of the nineteenth century. It turns out to be well meaning but misguided ! "*

It is noted that in testing for outliers, CEG uses the spread to the average of the Bloomberg and CBA Spectrum fair value curves on the basis that:

> *"I do not prejudge which of these two fair value curves will be determined to be the best aligned'. "*[30]

Barnett and Lewis (1994 p.7) define an outlier in a set of data to be:

> *"an observation (or subset of observations) which appears to be inconsistent with the remainder of that set of data".*

In other words, one first needs to determine what is meant by consistency. In the current case, one approach would be to simply compare the observed yields on each bond in the sample. Another would be to compare the observed yields to some benchmark – such as the Bloomberg fair value curve or the CBA Spectrum fair value curve or both or an average of the two. The choice is arbitrary but using the average of the fair value curves (as CEG has done) has the advantage of ensuring that any outlier would be treated as such in relation to both fair value curves and therefore a consistent sample of bonds would be used in choosing which fair value curve best fits the data.

In my opinion, however, the utility of such tests in relation to small samples is very limited since one needs a sufficiently large sample of observations to determine whether any particular observation "appears to be inconsistent with the remainder". There is no precise definition of small or sufficiently large in this context except to say that:

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29 Encyclopedia of Statistical Sciences (2005 p.651).

30 Competition Economists Group (2010 para 77).

> *"the phrase 'appears to be inconsistent' is crucial. It is a matter of subjective judgement on the part of the observer whether or not some observation (or set of observations) is picked out for scrutiny".*[31]

It is also noted that CEG has excluded bonds with a maturity of less than four years on the basis that the:

> *"Bloomberg and CBA Spectrum fair value curves are very similar for maturities less than 4 years and they only materially depart from each other after 4 years. The 4 year cut off date is also motivated as the purpose of this overall exercise is to identify the fair value curve that best reflects 10 year yields/spreads"*[32].

In my opinion a more complete analysis would include the entire sample of bonds with no restriction on their maturities. It is noted that CEG's choice has an important implication particularly in relation to its subsequent empirical testing – by restricting the sample to bonds with maturities of at least 4 years, CEG has increased the weighting given to each remaining bond in the sample which in turn increases the weighting given to each "error" for the purposes of calculating an average absolute error and an average squared error.

6. ABSOLUTE AND SQUARED ERROR TESTS

4. Comment on the validity of comparing observed bond yields against fair value curves using an absolute error test or a squared error test with all bonds weighted equally.

There are two aspects to be considered here: (i) comparing observed bond yields to fair value curves; and (ii) using an absolute error test and a squared error test.

Dealing first with the test metric.

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31 Barnett and Lewis (1994 p.7).

32 Competition Economists Group (2010 para 70).

The squared error test has as its foundation, the mean square error criterion, which is a well established statistical method used in assessing the quality of an estimator (in this case, the fair value curve). For a given sample, the mean square error measures the trade-off between the bias and precision of an estimator. Loosely, the smaller the mean square error the better the estimation such that a mean square error of zero corresponds to a perfect fit.[33]

A related measure is the mean absolute error criterion which similarly is the foundation for the absolute error test.

The choice between the mean squared error and the mean absolute error is largely one of mathematical convenience,[34] but it is noted that the mean squared error implicitly gives greater weight (by squaring each error) to more distant observations compared to the mean absolute error.

It is further noted that CEG does not provide any details of whether the differences in the average absolute errors and the average squared errors are statistically significant.

The second issue for consideration concerns the comparison of observed bond yields to the fair value curves.

CEG has conducted its test using the median of the reported yields from UBS, Bloomberg and CBA Spectrum. It is my understanding that these represent or correspond to a yield-to-maturity of each bond.[35]

As mentioned previously, the Bloomberg fair value curve is an (option free) par curve and it is my understanding that the CBA Spectrum fair value curve is also a par curve.

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[33] According to Judge et al (1988 p. 71), "*What we want of course is an estimator that usually yields estimates of the unknown parameter that are close to the true parameter value ... it is clear that both bias and variance must be taken into account when evaluating an estimator. One way to do this is to consider an estimator's mean squared error*".

[34] Encyclopedia of Statistical Sciences (2005 p.4680). In particular, from a mathematical point of view it is easier to deal with squared errors rather than the absolute value of errors.

[35] For example, see Appendix E in the CEG report. In contrast, the AER uses only the UBS yields.

This means that a comparison of observed bond yields to the fair value curves represents a comparison of a yield-to-maturity to a par-yield. In other words, the comparison is not strictly like-with-like. For example, the tests are based on a comparison of the yield-to-maturity on a 2 year bond with the par-yield on a hypothetical 2 year bond, and a comparison of the yield-to-maturity on a 3 year bond with the par-yield on a hypothetical 3 year bond, etc.

The key implication of comparing the yield-to-maturity to the par-yield (from the par curve) is that at least part of the "error" between the observed yield on the bond and the fair value curve could simply be due to the inconsistent comparison of a yield-to-maturity with a par-yield.

For example, assume based on the observed yields of a set of coupon bonds that the implied one year spot rate is 5%, the implied two year spot rate is 6%, the implied three year spot rate is 7%, the implied four year spot rate is 8% and the implied five year spot rate is 9%. Consider a five year 6% coupon $100 par value bond. Based on the spot curve, the yield-to-maturity on the bond should be 8.74% and the par-yield on a hypothetical five year bond is 8.65%. Assuming that the bond is trading in line with expectations, then a comparison of the yield-to-maturity (of 8.74%) with the par-yield (of 8.65%) would suggest that the par-curve underprices the bond by approximately 9 basis points when in fact no such "error" exists.

Now assume instead that the bond is a ten year 6% coupon $100 par value bond and that the implied six year, seven year, eight year, nine year and ten year spot rates are 9.5%, 10%, 10.5%, 11% and 11.5% respectively. Based on the spot curve, the yield-to-maturity on the bond should be 10.78% and the par-yield on a hypothetical ten year bond is 10.50%. Assuming that the bond is trading in line with expectations, then a comparison of the yield-to-maturity (of 10.78%) with the par-yield (of 10.50%) would suggest that the par-curve underprices the bond by approximately 28 basis points when again no such "error" exists.

Whilst the difference will be small in many cases it is noted that a comparison of a yield-to-maturity with a par curve is nonetheless not strictly comparable and in particular, part of the resultant "error" is not an error at all. Note that the closer a bond

is trading to its par value, the closer the bond's yield-to-maturity will be to the hypothetical par-yield.

7. BONDS ISSUED AFTER THE RELEVANT AVERAGING PERIOD

5. Consider bonds issued after the relevant averaging period had concluded:
   a. comment on the relevance (if any) of these bonds to the cost of debt during the relevant averaging period
   b. describe what adjustments could be made to these bonds in order to inform the estimate of the cost of debt during the relevant averaging period.

6. Specifically consider the bond issued by APT in July 2010:
   a. what relevance (if any) should be given to this bond when estimating the cost of debt for the relevant averaging period
   b. estimate a value (or range) for a debt risk premium during the relevant averaging period that would be consistent with this bond.

CEG documents a number of bonds which would otherwise fall within the sample but were issued after the end of the relevant averaging period. In particular, the APT bond is a 10 year BBB rated fixed rate bond and so is particularly relevant to estimating the 10 year BBB+ rated cost of debt. The obvious problem with all these newly issued bonds is that they did not exist during the relevant averaging period.

CEG suggests that only limited information is to be gained by considering these bonds since: (i) one would have to make an assumption regarding the spread to Commonwealth Government Securities (CGS) that the bond would have traded at had it been on issue during the relevant averaging period; and (ii) in a number of cases, the issuer of the newly issued bonds already had similarly dated bonds on issue over the relevant averaging period.[36]

The issue here is whether it is sensible to make an "inter-temporal" adjustment to the yield on a bond (in this case estimating the yield on the same bond at a different point in time). In my view this is no different in principle to making a "cross-sectional" adjustment to the yield on a bond (such as estimating the yield on a bond with a different maturity at the same point in time). Both are subject to error but that is the

[36] Competition Economists Group (2010 p.6-7).

nature of estimation. So whilst I agree with CEG's assessment that most of these bonds should be ignored, the particularly relevant features of the APT bond justify an attempt at estimating the yield it may have traded at during the relevant averaging period. In my opinion, a starting point for this purpose would be to examine the relationship between the spread to CGS on the APT bond and the average spread to CGS on a small sample of "comparator" bonds over some later period and then use this as the basis for an assumption concerning the spread to CGS on the APT bond relative to the average spread to CGS on the same small sample of "comparator" bonds during the relevant averaging period. Obviously the challenge here is to select the relevant "comparator" bonds.

8. WHICH FAIR VALUE CURVE SHOULD BE USED ?

7. Based on your answers to all the questions above, advise on whether the cost of debt should be set on the basis of:
   a. the Bloomberg fair value curve; or
   b. an average of the Bloomberg and CBA Spectrum fair value curves.

In my opinion, the relevant question here concerns the choice between the Bloomberg fair value curve and the CBA Spectrum fair value curve rather than the choice between the Bloomberg fair value curve and an average of the Bloomberg and CBA Spectrum fair value curves. This view follows from the fact that the Bloomberg and CBA Spectrum fair value curves represent two independent alternatives to estimating the cost of debt for the benchmark firm and is consistent with the diagrams in both the AER submission and the CEG report, which show the observed yields on various sets of bonds relative to each of the fair value curves (but does not show the observed yields relative to an average of the Bloomberg and CBA Spectrum fair value curves). Further, this is also consistent with the specific terms of reference considered by CEG report which includes:

"Based on the set of bonds resulting from your responses to questions (i)-(iv) above, compare the accuracy of the Bloomberg and CBA Spectrum fair value curves".[37]

Accordingly, in my opinion the choice between the Bloomberg and CBA Spectrum fair value curves should be based on the following considerations:

(i) ideally one should use a strictly comparable set of bonds which in the current context means BBB+ rated straight debt.

(ii) if bonds with non-standard features are to be included in the analysis (in order to increase the sample size) then it is first necessary to make appropriate adjustments to their observed yields-to-maturity to remove the effect of the non-standard features and thereby improve their comparability with BBB+ rated straight debt. If no adjustment is made then one is not comparing like-with-like and the bond with the non-standard feature should be excluded from the sample. This means that in the case of callable bonds, the yield impact of the embedded call option should be taken into account whilst in the case of bonds with coupon resets, the yield impact of the reset feature should also be taken into account[38] – otherwise both types should be excluded from the analysis. I note that there remains some disagreement concerning which bonds are in fact callable.[39] Further, as previously mentioned, there is more than one model that could be used to value any embedded interest rate options (and so any adjustment becomes conditional on the particular model used) whilst the observed pattern of yields on A– rated bonds relative to BBB+ rated bonds makes it difficult to determine what adjustment would be required to take account of any difference in credit ratings.

(iii) the choice between whether the Bloomberg fair value curve or the CBA Spectrum fair value curve provides a "better fit" to the sample of observed bond

[37] Competition Economists Group (2010 p.1).

[38] In this regard, I note the discussion in paragraphs 27-28 of the Oakvale report suggests that whilst the reset feature is not explicitly priced by the market in practice there may be an implicit price (around 25 basis points) in making the bond more attractive to investors at the time of issue.

[39] Competition Economists Group (2010 para 98).

yields should be based on a number of criteria subject to the exercise of professional judgement. In particular, if the choice is supplemented by (but not based solely on) an absolute error test or a squared error test then it should include a test of statistical significance but in either case, the efficacy of the test is reduced by: (i) the inclusion of bonds in the sample which are not strictly comparable with each other; and (ii) comparing observed yields-to-maturity with par-yield curves.

(iv) an absolute error test based on bonds of all maturities is preferred to a squared error test in order to give equal weight to each observed error.

Based on the above, in my opinion, the diagram in the AER submission which is most relevant for choosing between the Bloomberg and CBA Spectrum fair value curves is Graph 10, which is based on all "relevant" A–, BBB+ and BBB fixed and floating rate bonds plus the APT bond.[40] Similarly, in my opinion, the diagram in the CEG report which is most relevant for choosing between the Bloomberg and CBA Spectrum fair value curves is Figure 10, which is based on all bonds excluding all non-standard bonds.[41]

I note however that both diagrams have a number of limitations. It is my understanding that the AER diagram:

(i) includes a number of bonds with coupon resets but without adjusting the observed yields-to-maturities; and [42]
(ii) includes the APT bond, but based on yields observed during its first 20 trading days in July 2010 (which is several months after the end of the relevant averaging period),

whilst the CEG diagram:

(i) excludes bonds with less than 4 years to maturity;

40 Australian Energy Regulator (2011 p.29).
41 Competition Economists group (2010 p.30).
42 Competition Economists Group (2010 p.61-64).

(ii) excludes the APT bond; and

(iii) is based on the median reported observed yields from the three data sources – UBS, Bloomberg and CBA Spectrum.[43]

Further, two additional limitations common to both diagrams are that, the A– and BBB rated bonds are included without adjusting for the difference in credit rating and observed yields-to-maturity are being compared to par-yield curves.

It is my opinion that when examining Graph 10 from the AER Submission and Figure 10 from the CEG report, that the BBB+ rated bonds should receive more weight than the other bonds, since the task at hand is to estimate the cost of 10 year BBB+ rated debt.[44] For clarity this is not to say that the A– and BBB bonds should receive no weight but rather their lack of strict comparability means that they should be given less weight in the overall assessment.[45]

Precise quantification of what is meant by "more weight" verses "less weight" is not feasible due to the many considerations involved. But by way of example, refer to Graph 10 of the AER submission and consider the three bonds with a maturity of around 7 years and which plot between the Bloomberg and CBA Spectrum fair value curves. Two of these bonds are rated A– and the other is rated BBB+. Expectations would suggest that all else equal, A– bonds should trade below rather than above an appropriate BBB+ fair value curve and therefore the two A– bonds seem to provide support for the Bloomberg fair value curve over the CBA Spectrum fair value curve. An additional consideration however is the positioning of the BBB+ bond relative to these two A– bonds. In particular, it is noted that the leftmost A– bond (having a maturity of just under 7 years) trades above the BBB+ bond (having a maturity of 7 years) which, given their similar maturities, is not in line with expectations if credit risk was the only factor taken into account by the market in pricing the bond. Whether this means that the A– bond is relatively too high or the BBB+ bond is relatively too low is unclear and so in my opinion, the weight given to this A– bond should be discounted.

[43] It is also noted that the accompanying Table 10 in the CEG report does not indicate whether the results of the error tests are statistically significant or not.

[44] In addition, no weight should be placed on the APT bond in Graph 10 from the AER Submission since its yield relates to a period outside the relevant averaging period.

[45] Even if the A– and BBB bonds had been adjusted, I would still advocate that they receive relatively less weight due to residual uncertainty concerning the adjustment.

Similarly, the rightmost A– bond (having a maturity of 7+ years) also trades above the nearby BBB+ bond but in this case it is possible that the larger difference in maturities could explain the difference in yields[46] and so in my opinion, more weight should be given to this rightmost A– bond compared to the leftmost A– bond but in any case this should still be less than the weight given to the BBB+ bond.

Another example of nearby bonds which do not appear to trade in line with expectations concerns the BBB bond and A– bond both with a maturity of around 5½ years but which trade at a similar yield. Again, this may suggest that factors other than credit risk are taken into account by the market in pricing the bonds. Similar difficulties concerning how one should interpret the A– and BBB bonds (and therefore how much weight should be given to these bonds) also arise in relation to Figure 10 from the CEG report.

Having regard to the above factors, it is my view that neither diagram supports a clear choice for one fair value curve over the other.

9. DECLARATION

In preparing this report, I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld from the Tribunal.

[46] Assuming credit risk premiums increase with increasing maturity.

REFERENCES

Australian Energy Regulator, 2010, AER's Outline of Submission in the Australian Competition Tribunal re Jemena Gas Networks, 30 November.

Barnett, V. And T. Lewis, 1994, Outliers in Statistical Data, 3rd Edition, Wiley, Chichester.

Brealey, R.A., S.C. Myers and F. Allen, 2008, Principles of Corporate Finance, 9th edition, McGraw-Hill Irwin.

Competition Economists Group, 2009, Estimating the cost of 10 year BBB+ debt, A Report for Country Energy, June.

Competition Economists Group, 2010, Estimating the 10 year BBB+ cost of debt, A Report for JGN, December.

Competition Economists Group, "6033726_1_Debt risk premium analysis (JGN)".

Encyclopedia of Statistical Sciences, 2005, edited by Kotz, S et. al., 2nd Edition, Wiley, Hoboken NJ.

Fabozzi, F.J., 2007, Bond Markets, Analysis and Strategies, 6th edition, Pearson International, Upper Saddle River, NJ.

Hull, J.C., 2006, Options, Futures and Other Derivatives, 6th edition, Pearson International, Upper Saddle River, NJ.

Judge, G.C., R.C. Hill, W.E. Griffiths, H. Lutkepohl and T-C Lee, 1988, Introduction to the Theory and Practice of Econometrics, 2nd Edition, John Wiley and Sons.

Lee, M., 2007, Bloomberg Fair Value Market Curves, Presentation to the International Bond market Conference, Tapaei, Bloomberg L.P.

Oakvale Capital Limited, 2011, Report on the Cost of Debt During the Averaging Period: The Impact of Callable Bonds, Prepared for the Australian Energy Regulator, 4 February.

APPENDIX: COPY OF RESUME

Dr John C. Handley

February 2011

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1. QUALIFICATIONS

BCom, BMath *Newcastle*, MCom (Hons) *Melbourne*, PhD *Melbourne*

EMPLOYMENT HISTORY

Period	***Organisation***	***Position***
Jul 1993 to date	University of Melbourne Melbourne	Associate Professor of Finance (since July 2005)
Sep 2009 to Jan 2010	Stern School of Business NYU New York	Visiting Associate Professor of Finance (Fall Semester 2009)
May 2008 to Sep 2008	Stern School of Business NYU New York	Visiting Associate Professor of Finance (Summer Semester 2008)
Aug 1988 to Jul 1993	SBC Australia *(Now UBS)* Sydney and Melbourne	Corporate Finance Executive
Nov 1985 to Aug 1988	Coopers & Lybrand *(Now Pricewaterhousecoopers)* Newcastle	Audit Senior

2. RESEARCH

Research Focus: Corporate finance, derivative security pricing, corporate finance applications of derivative security pricing

Scholarly Publications (since 2000)

- Handley, J.C., 2008. "Dividend Policy: Reconciling DD with MM". Journal of Financial Economics, 87, 528-531.
- Handley, J.C. and K. Maheswaran, 2008. "A Measure of the Efficacy of the Australian Imputation Tax System". Economic Record, 84, 82-94.
- Brailsford, T.J., Handley, J.C. and K. Maheswaran, 2008. "Re-examination of the Historical Equity Risk Premium in Australia". Accounting and Finance, 48, 73-97.
- Handley, J.C., 2005. "On the Upper Bound of a Call Option". Review of Derivatives Research, 8, 85-95.
- Handley, J.C., 2003. "An Empirical Test of the Pricing of VPO Contracts". Australian Journal of Management, 28, 1, 1-22.
- Dyl, E.A., W.B. Elliott and J.C. Handley, 2002. "Do Share Prices Matter?" Accounting and Finance, 42, 225-237.
- Handley, J.C., 2002. "On the Valuation of Warrants". Journal of Futures Markets, 22, 765-782.
- Handley, J.C., 2000. "Variable Purchase Options". Review of Derivatives Research, 4, 219-230.

Case Studies

- Tufano, P. and J.C. Handley, 1999. "General Property Trust". Harvard Business School case study 299-098, HBS Publishing.

Work in Progress

- Brown, C.A., J.C. Handley and K. Palmer. "A Closer Look at Barrier Exchange Options".
- Brown, C.A., J.C. Handley and K. Palmer. "Partial Differential Equations for Asian Option Prices".
- Handley, J.C. and C. Sobfeldt-Hansen. "Floating Priced Convertibles – A Direct Test of the Faulty Contract Design and the Last Resort Financing Hypotheses"
- Brown, C.A., J.C. Handley and A. Lamba. "Share Buybacks and Information Asymmetry – Winners and Losers"

3. TEACHING

Teaching Focus: Financial Management, Corporate Finance, Derivatives, Investments

Awards

- 2009 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2008 Dean's Certificate for Excellence in Graduate Teaching.
- 2007 Dean's Certificate for Excellence in Undergraduate and Postgraduate Teaching.
- 2006 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2005 Dean's Certificate of Excellent Undergraduate and Postgraduate Teaching.
- 2004 Dean's Certificate of Excellent Undergraduate Teaching.
- 2003 Dean's Individual Award for Excellence in Teaching in the Faculty of Economics and Commerce.

4. ADMINISTRATION AND LEADERSHIP

- Deputy Head, Department of Finance, 2009—.
- Coordinator, PhD Program in Finance, 2009.
- Academic Director, Master of Applied Finance Program, 2006—2008.
- Coordinator, Honours Program in Finance, 2001—2003.
- Chair, 2003 Review Committee of the Honours Program in Finance at the University of Melbourne
- Chair, 2002 Review Committee of the Undergraduate Program in Finance at the University of Melbourne

5. ENGAGEMENT AND CONTRIBUTION TO THE PROFESSION

I have provided expert advice on various financial matters to the Australian Accounting Standards Board, Australian Competition and Consumer Commission, Australian Energy Regulator, KPMG Corporate Finance and the New Zealand Commerce Commission, including the following recent engagements:

- 2010, Consultant to the Australian Energy Regulator on matters dealing with the AER Electricity Distribution Determinations for Queensland and South Australia for 2010-2015, Victoria for 2011-2015 and Gas Distribution Decisions for New South Wales and the Australian Capital territory for 2010-2015, March–May, September-October

- 2009, Consultant to the Australian Energy Regulator on matters dealing with the AER Electricity Distribution Determinations for Queensland and South Australia for 2010-2015, October.

- 2009, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of Proposed Debt and Equity Raising Costs and the Weighted Average Cost of Capital for the 2009–14 Regulatory Control Period, April.

- 2009, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of the Weighted Average Cost of Capital for Electricity Distribution and Transmission, March/April.

- 2009, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the years ending 30 June 2005 and 2006, June.

- 2008, Consultant to the Australian Energy Regulator on matters dealing with The AER Review of the Weighted Average Cost of Capital for Electricity Distribution and Transmission, November.

- 2008, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the years ending 30 June 2004 and 2005, April.

- 2008, Presentation to the ACCC / AER on the Weighted Average Cost of Capital of Regulated Firms, February.

- 2007, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2004, March.

- 2006, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2004, May.

- 2005, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the year ending 30 June 2003, February.

- 2003, Consultant to the New Zealand Commerce Commission on matters dealing with the Telecommunications Service Obligations (TSO) Determination for the period ending 30 June 2002, June.

6. CONTACT DETAILS

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