

Jemena Gas Networks (NSW) Ltd

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Appendix 9.11

Incenta Bloomberg extrapolation

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Methodology for extrapolating the debt risk premium

June, 2014

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1. Executive Summary

1.1 Background and Terms of Reference and key recommendation

1.1.1 Background and Terms of Reference

Jemena Gas Networks and SA Power Networks have engaged Incenta Economic Consulting (Incenta) to undertake a review of alternative debt risk premium extrapolation methodologies, and to recommend a methodology that could be used to automatically estimate a trailing average cost of debt. Such an extrapolation is required if the debt risk premium is based upon the 7 year Bloomberg BBB fair value curve,¹ although our objective has been to derive the best estimate of the change in the debt risk premium between 7 and 10 years (subject to the other requirements for the method, described below).

The context for this work is the proposal by the Australian Energy Regulator (AER) (set out in the *Explanatory Statement* accompanying its *Final Decision on the Rate of Return Guidelines*) for the return of debt that is factored into prices to be derived as the ten year trailing average of the benchmark cost of debt, and for this trailing average to be updated annually (and with the updated values flowing through into prices) during the regulatory period.² The AER expressed a preference for applying an independent data source that uses a transparent methodology to estimate the yield of a 10 year BBB-rated fixed rate corporate bond, and has recently commenced a consultation on how this may be done in practice.

Given the need for the benchmark cost to be calculated during the regulatory period, we have been directed to consider extrapolation methodologies that can ‘apply automatically to update the return on debt, with limited or no discretion needed’. Our terms of reference also require us to consider ‘the stability, simplicity, implementation cost, objectivity, reliability, transparency and accuracy of each approach.’

1.1.2 Recommendation

We recommend that the Queensland Treasury Corporation’s (QTC) methodology be applied to extrapolate a 7 year debt risk premium to a 10 year value, because we consider that the QTC methodology is likely to provide the best estimate of the change in the debt risk premium between a term of 7 years and 10 years. This conclusion is based particularly on the relative accuracy of this methodology in predicting the change in the debt risk premiums between 7 and 10 years set by the AER in the last two years using the ‘paired bonds’ methodology. The next best extrapolation approach is the US Bloomberg BBB Composite index, which performed better (i.e. was more accurate) during the global financial crisis.

We also note that the empirical relationship that underpins the QTC methodology is independent of the recent change in Bloomberg’s approach to estimating its fair value curves. This is because the relationship derived by QTC was based upon the QTC survey information on corporate bond yields

¹ We note that Bloomberg has recently changed its method for calculating its fair value curve, and the previous notation for the curve of ‘BFV’ has changed to a notation of ‘BVAL’.

² AER (December, 2013), *Better Regulation: Explanatory Statement – Rate of Return Guidelines*.

and did not use Bloomberg corporate bond yield estimates as an input. However, we acknowledge that the application of the QTC method that we have tested requires a 7 year corporate bond yield as an input, and we have used the previous Bloomberg curve for this purpose.³ We did not undertake tests using the new BVAL fair value curve yields (which would have been relevant to one of our extrapolation methods, namely the straight line extrapolation of the Bloomberg fair value curve) because these new yields are only available for a relatively short period (since April 2010), have significant patches of missing data, and have demonstrated material volatility, although that appears to have subsided during the last year.

1.2 Alternative extrapolation methodologies

In this report we have assessed five alternative debt risk premium extrapolation methodologies:⁴

- *Straight Line extrapolation* - Under the straight line extrapolation the debt risk premium observed between the Bloomberg BBB 5 year and 7 year points on the Bloomberg fair value curve is multiplied by 1.5, and added to the 7 year Bloomberg debt risk premium to derive an estimate of the Bloomberg 10 year debt risk premium.
- *US Bloomberg BBB+ Utilities index* – This is the difference between the 7 and 10 year BBB+ debt risk premium for the US BBB+ Utilities index, with the relevant interest rates reflecting the rates that would be paid once swapped back from US dollars to Australian dollars (and including the transaction costs of doing so).⁵
- *US Bloomberg BBB Composite index* – Similarly, this is the difference between the 7 and 10 year BBB debt risk premium for the US BBB Composite index, again with the relevant interest rates reflecting the rates that would be paid once swapped back from US dollars to Australian dollars (and including the transaction costs of doing so). This index contains a much broader sample of bonds relative to the US Bloomberg BBB+ Utilities index.
- *RBA BBB index* – In December, 2013 the Reserve Bank of Australia (RBA) commenced publishing a BBB index on a monthly basis back to January 2005. The RBA applies a Gaussian kernel weighting methodology, which attaches more weight to the yields of bonds closest to the target term. We have applied the change in the debt risk premium using the RBA's BBB index between 7 and 10 years as the extrapolation method that we have tested.
- *QTC Methodology* – Since 2006 the Queensland Treasury Corporation (QTC) has undertaken a quarterly survey of debt market practitioners, who provide their opinions on the cost of debt by term and credit rating. From these data points, the QTC derived a relationship between the change

³ If the historical Bloomberg fair value curves were replaced with new curves that Bloomberg considered to be more accurate, and these were then used to re-calculate the extrapolations that are implied by the QTC method, it is difficult to predict how this would affect our testing of the QTC method. It is possible that the accuracy of the QTC method could be found to increase or to decrease. The same comment applies to the straight line extrapolation method.

⁴ We note that all of the cost of debt returns considered in this report are equivalent annual returns.

⁵ The foreign (USD) yield spreads were converted into equivalent AUD yield spreads applying the same methodology that was applied in: PwC (June, 2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*, Appendices C and D. The key steps involved in this process are set out in Appendix A below.

in the risk premium measured against the AFMA swap rate between a 7 and 10 year term, and the risk premium measured against the AFMA swap rate at a 7 year term (the QTC found that the change in the risk between 7 and 10 year terms was a linear function of the risk premium at 7 years, with all premia measured against the relevant AFMA swap rates). Once the change in the risk premium measured against AFMA swap rates is predicted, it is straightforward to convert this into a change in the debt risk premium measured against bonds (this is because the AFMA swap rates at different terms are easily observable).⁶

A criticism that could be mounted against the QTC method is based upon the information derived from the QTC debt risk premium survey, which is imperfect as it is based upon the views of a limited number of market participants and is quarterly (the QTC survey is discussed further below). We do not think these considerations mean that the QTC method is inappropriate. While the survey database may be imperfect, it is the best source of information available. Moreover, there are sufficient quarterly observations now available to apply normal econometric techniques to estimate the function that the QTC has done.

There were a number of potential extrapolation methods that we did not consider to be appropriate for the purpose and did not test:

- *Paired bonds method* – our terms of reference require us to ignore the “paired bonds” approach for extrapolating the debt risk premium.
- *Bloomberg A, AA or AAA fair value curve* – while these had been applied in the past by the AER, the longest dated of these curves (AA) is published only to a term of 8 years, and so cannot be used to extrapolate to 10 years. We also ignored the semi-sovereign yield curves of state governments as these entities are subject to materially less credit risk than a BBB rated business.
- *“Custom-made” yield curves* – we did not assess the capacity for new yield curves that are estimated and re-estimated specifically for this purpose (e.g., using econometric techniques to fit a simple function of the debt risk premium against term, or using the Nelson-Siegel approach to fit credit curves) to provide an estimate of the change in the debt risk premium between 7 and 10 years. Our reasoning was that if a yield curve were to be re-estimated over the regulatory period, then we would expect this method to be used to estimate the 10 year cost of debt. The full benefits of the approach would be realised by making use of the estimated results at a 10 year tenor.

1.3 Assessing the accuracy of alternative methodologies

1.3.1 Proxy for the “true” change in the debt risk premium between 7 and 10 years

The standard approach for testing the accuracy of different methods of prediction is to test those methods against observed (actual) values for what is being predicted (often referred to as “within sample” testing). However, one of the complications for assessing the different methods for extrapolating the debt risk premium from a 7 year to a 10 year term is that the actual change in the

⁶ We obtained the QTC survey information directly from the QTC. While the QTC’s survey is currently not publicly available, since the QTC has proposed its methodology to the AER we assume that it would make its underlying data source publicly available in the event that the AER adopted the QTC’s methodology.

debt risk premium between these terms cannot be observed directly. Therefore, we have adopted a range of different proxies or benchmarks for the ‘true’ change in the debt risk premium between terms of 7 and 10 years, and examine the performance of alternative extrapolation mechanisms against these benchmarks. We adopted three benchmarks for the ‘true’ change in the debt risk premium between 7 and 10 years (with associated time periods), which are as follows:

- *Bloomberg 10 year BBB fair value yield (2005 – 2007)* – during the period 2005 to 2007 Bloomberg published a 10 year BBB fair value curve.
- *Queensland Treasury Corporation (QTC) market survey (2006 – 2013)* – the QTC undertakes a quarterly survey of up to 6 debt market participants and averages their responses to obtain current market estimates of market yields for a range of credit ratings (including BBB/BBB+) and terms up to 10 years. Within the whole period that the QTC survey has been available, we identified four sub-periods, which can be described as:⁷
 - Period 1: ‘Pre-crises period’ (March 2006 – June 2007)
 - Period 2: ‘Global financial crisis’ (September 2007 – December 2009)⁸
 - Period 3: ‘Sovereign debt crisis’ (March 2010 – December 2012)
 - Period 4: ‘Post crises period’ (March 2012 – December 2013)
- *AER’s ‘paired bonds’ analysis decisions (2012 – 2013)* – since the AER’s Powerlink and Aurora Energy decisions early in 2012, it has applied this approach in a number of decisions. During this period, econometric analysis undertaken by PwC also found that the estimated 10 year BBB+ yield was generally close to the values estimated using the paired bonds analysis.⁹

We observe that one potential concern with using the QTC survey as one of our benchmarks against which we test the alternative extrapolation methods is whether a survey of half a dozen market participants is sufficient to provide an unbiased average of market opinion on the cost of debt. In this connection we note that the Bloomberg fair value curve (whether BFV or BVAL) is based on bond yield ‘observations’ that are actually the opinions of at most half a dozen financial institutions, and in many cases less than this number.¹⁰ We also observe that the QTC survey is produced and used for a

⁷ We acknowledge that the use of the QTC survey information as a proxy for the true change in the debt risk premium between 7 and 10 years should favour the QTC extrapolation method because the latter was derived on the basis of the former. However, we believe that the QTC survey information should be used to test the extrapolation methods because it is the only continuous source of information from market practitioners available over an extended period that can be used to deduce how those practitioners believed that the debt risk premium changed at that time with term. In relation to the testing of the QTC method, we note that we are also testing the methods against two other proxies for the true change in the debt risk premium with term, and that we are placing most weight on another source of information (namely paired bonds). We comment on this matter further below.

⁸ The GFC period is typically taken as commencing during July 2007. Thus, the first quarterly observation during this period is September 2007.

⁹ PwC (June, 2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*.

¹⁰ This is because actual trading in corporate bonds is rare, and relative pricing of bonds in the market is mainly assessed by market participants based on new issues of bonds, and relative movements of market rates.

real purpose that is unrelated to regulation (to guide the investment decisions and monitor the financial performance of a range of government owned businesses), which encourages the QTC to maximise the accuracy of the results. Moreover, there is no alternative and superior data source available that can claim to represent the views of market participants on the debt risk premium (and, more relevantly, how it changes with term) over time.¹¹

It would also be possible to directly test accuracy against fair value curves that had been fitted to historical data using the Nelson-Siegel curves or other econometric methodologies. However, we did not apply these techniques because of the heavy information requirements when applied over an extended time interval.

A further possible benchmark that we considered using in order to test the different extrapolation methods is the change in the debt risk premium between 7 and 10 years that is implied by the set of yield curves that the Reserve Bank of Australia (RBA) has recently produced, for which it has produced a historical series extending back to 2005. We did not use the RBA yield curves as a benchmark because other experts have reviewed the RBA BBB methodology and have concluded that, given the sample of bonds available to the RBA, its method is likely to understate the yield on 10 year bonds relative to 7 year bonds, and so produce a downwardly biased estimate of the change in the debt risk premium between 7 and 10 years.¹² The RBA has acknowledged this potential. However, we have included the use of the RBA yield curves as one of the potential extrapolation methods.

1.3.2 Measuring the accuracy of the extrapolation method

Our principal measure of the accuracy of the extrapolation method is the “root mean square error” (RMSE), which is the square root of the average of the squared distance between the predicted change in the debt risk premium and the actual value (or, rather, our proxy for the actual value). The use of the RMSE criterion is consistent with the AER’s previous approach to selecting between different fair value curves, and is a common criterion for selecting between different estimators. In addition, we have also disaggregated the RMSE into its two components,¹³ which are:

- *Bias* – which is the average difference (in basis points) between the estimate of the 7 to 10 year debt risk premium extrapolation, and the benchmark 7 to 10 year debt risk premium. The degree of bias signals the extent to which the relevant extrapolation method is likely to systematically over or under-predict the true value, on average, over time.
- *Standard deviation* – which is a measure of the volatility in the error in the extrapolation over time. Thus, a higher standard deviation would imply a wider range for the possible error in the extrapolation at any particular point in time.

¹¹ Another concern that may be raised is the fact that the QTC survey is undertaken on a quarterly basis rather than weekly or daily. Clearly, more frequent surveying would be preferable (at least if the more frequent survey is done to the same level of rigour as the quarterly survey), but again there is no alternative source of information that is superior to the QTC survey.

¹² ESQUANT Statistical Consulting (19 May, 2014), *A Review of Measures of Australian Corporate Credit Spreads published by the Reserve Bank of Australia*, A report prepared for United Energy and Multinet Gas.

¹³ These are related as follows: $RMSE = \sqrt{Bias^2 + Standard\ Deviation^2}$

Clearly, it is desirable for the extent of bias to be minimised (all else constant), and for the dispersion in the prediction error at any point in time to be minimised (all else constant), but with a trade-off between these “bads” being appropriate, which is consistent with the use of the RMSE criterion.

1.4 Ranking of alternative methodologies

Table 1 shows the performance of the different extrapolation methods against the three benchmarks for the “true” change in the debt risk premium between 7 and 10 years that we have applied, and Table 2 disaggregates the results against the QTC survey into the sub-periods that we identified earlier (with the QTC survey being the only benchmark for which it was possible to produce results for these different sub-periods).

Table 1: Accuracy of alternative DRP extrapolation methodologies – relative to benchmarks (basis points)

Period:	2005 - 2007			2006 - 2013			2012 - 2013		
Benchmark:	Bloomberg 10 year BBB			QTC survey			Paired Bonds (AER)		
	N = 480			N = 32			N = 10		
Methodology:	RMSE	Bias	SD	RMSE	Bias	SD	RMSE	Bias	SD
Straight line	18.9	13.8	13.0	37.5	9.3	36.3	28.9	-27.2	9.7
US BBB+ Utilities	16.1	12.7	9.9	19.3	-9.2	16.9	30.2	-28.5	10.1
US BBB Composite	13.5	12.7	4.4	15.7	-9.1	12.8	21.3	-18.3	10.9
RBA BBB	27.4	16.6	21.8	55.4	0.8	55.4	11.7	-1.3	11.7
QTC methodology	16.0	15.0	5.3	12.4	-0.5	12.4	7.7	-4.8	6.0

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis. SD = standard deviation.

Table 2: Alternative DRP extrapolation methodologies – relative to QTC survey benchmark by sub-period (basis points)

Period:	1: Jan 06 - June 07			2: Sept 07 - Dec 09			3: Mar 10 - Dec 11			4: Mar 12 - Dec 13		
Sample days	N = 6			N = 10			N = 8			N = 8		
Methodology:	RMSE	Bias	SD	RMSE	Bias	SD	RMSE	Bias	SD	RMSE	Bias	SD
Straight line	18.1	13.7	11.9	33.1	-8.5	32.0	61.6	49.2	37.0	14.4	-11.8	8.3
US BBB+ Util.	6.6	-1.2	6.5	26.5	-8.9	25.0	17.0	-11.2	12.8	16.8	-13.5	10.1
US BBB Comp	6.7	-2.9	6.0	21.7	-3.0	21.5	14.4	-10.5	9.8	12.7	-5.3	11.6
RBA BBB	13.5	-10.1	8.9	92.7	17.6	91.1	29.4	-28.5	7.3	22.5	17.2	14.5
QTC method.	5.8	1.2	5.7	17.1	-13.0	11.2	8.5	3.9	7.6	12.4	9.6	7.8

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis. SD = standard deviation.

We rank the QTC Methodology as the most accurate extrapolation method, with the US Bloomberg BBB Composite index being second. In relation to the QTC method, we observe that it:

- Provided the lowest RMSE against the ‘paired bonds’ benchmark, which is the benchmark in which we have the most confidence as to its accuracy. The QTC method also produced a low level of bias (-4.8 basis points) against this benchmark, and so is unlikely to lead to material windfall gains or losses, on average.

- Produced the lowest RMSE against the QTC survey in all sub-periods.¹⁴
- While less accurate than the US BBB Composite Index against the Australian Bloomberg 10 year BBB fair value curve (which applied to the 2005-2007 period), the difference in accuracy was only marginal (RMSE of 16.0 compared to 13.5). Moreover, we have the least faith in the Bloomberg 10 year BBB benchmark as a measure of the accuracy in the change in the ‘true’ debt risk premium between 7 and 10 years.¹⁵

We consider that the US BBB Composite index should be ranked second because:

- it is the second best performer against the QTC survey and Bloomberg BBB benchmark, and
- while it is ranked behind the RBA method against the ‘paired bonds’ benchmark, the RBA method is the least accurate against the QTC survey and the Bloomberg 10 year BBB benchmarks.

The relative ranking of the remaining methods is unimportant; however, we note for completeness that it would be reasonable to rank:

- the US Bloomberg BBB+ Utilities index third because of its greater consistency against the different benchmarks, and
- the RBA method as marginally ahead of the straight line method – while these are hard to split given that they both perform poorly against two benchmarks and well against the third, the RBA method does perform well against the ‘paired bonds’ benchmark, which as noted above is the benchmark in which we consider it reasonable to have the most confidence.

Applying the QTC method

Having recommended the mechanical application of the QTC methodology, we also recommend that it be applied based on an updated analysis at the beginning of a regulatory period with the coefficients (intercept and slope of the SRP term variable) being locked in for the duration of the regulatory period. Hence, at each annual update of the cost of debt the same coefficients would be applied to the then current SRP term premium value, which will determine the 7 to 10 year extrapolation value. We also recommend using Bloomberg as the source of the 7 year corporate bond yield (and associated

¹⁴ We note that testing the QTC methodology against the QTC survey may appear to be self-fulfilling; however, we believe that this provides useful information because (i) the tests include different sub-periods and so provides information on whether the relationship is robust to changes in the market, and (ii) the test provides information on how a fairly simple empirical relationship performs at predicting the change in the debt risk premium compared to methods that are based upon more direct observations or interpretations of market evidence. Moreover, as noted previously, we have tested the QTC methodology against two other benchmarks, and we have given most weight to performance against the ‘paired bonds’ analysis.

¹⁵ During the 2005 to 2007 period Bloomberg’s 10 year BBB debt risk premium was heavily influenced by a Snowy Hydro bond, and owing to government ownership this was likely to have a lower yield than a benchmark bond with the same term to maturity. See ACG (September, 2004), *Dalrymple Bay Coal Terminal: Debt Margin and Debt Issuance Costs*, Report to Queensland Competition Authority, p.10. While the ACG report did not discuss the potential bias introduced by the government ownership of Snowy Hydro, it did demonstrate the dominance of this bond at the longer end of the spectrum, which continued through the 2005-07 period.

swap risk premium) that is used in the extrapolation equation so that the same source is used for the extrapolation equation as is being used to derive the base 7 year debt risk premium.

The formula for predicting the change in the swap risk premium between 7 and 10 years using the current coefficients is:

$$\widehat{SRP_{10}} - SRP_7 = 14.6 + 0.079 \times SRP_7$$

Where:

$Yield_7$ is the 7 year BBB corporate bond yield from the Bloomberg fair value curve

$Swap_7$ is the 7 year swap rate that is published daily by AFMA

SRP_7 is the 7 year swap risk premium (i.e., $Yield_7 - Swap_7$), and

$SRP_{10} - SRP_7$ is the change in the SRP between terms of 7 and 10 years.

The implied extrapolation of the 7 year debt risk premium to a 10 year value can then be calculated as:

$$DRP_{10} - DRP_7 = SRP_{10} - SRP_7 + ((Swap_{10} - CGS_{10}) - (Swap_7 - CGS_7))$$

Where:

$DRP_{10} - DRP_7$ is the predicted change in the debt risk premium between 7 and 10 years

$Swap_{10}$ is the 10 year swap rate that is published daily by AFMA

CGS_{10} is the 10 year Commonwealth Government Securities (CGS) yield, and

CGS_7 is the 7 year Commonwealth Government Securities (CGS) yield.

2. Background and Terms of Reference

2.1 Background

As part of its recent Final Decision on the Rate of Return Guidelines, the AER published an *Explanatory Statement* that set out the reasoning behind its decisions on the guidelines. In Chapter 8 of the *Explanatory Statement*, the return on debt was considered in the context of a regulatory approach that employs a ten year trailing average of the return on debt.¹⁶ The AER expressed a preference for applying an independent data source that uses a transparent methodology to estimate the yield of a 10 year BBB fixed rate corporate bond. Several alternative approaches were considered in the AER's draft and final explanatory statements, including:¹⁷

- Straight line extrapolation of the Bloomberg 5 and 7 year BBB fair value curve yields (which has significant issues);¹⁸
- Adding the difference between the 10 year and 7 year yields from the US Bloomberg BBB fair value curve (swapped back into AUD) to the AUD 7 year Bloomberg BBB fair value curve;
- The Bloomberg 7 year BBB debt risk premium extrapolated to 10 years using the 'paired bonds' methodology, plus the rise in the Commonwealth Government Securities (CGS) yield between 7 and 10 years;
- The Queensland Treasury Corporation's (QTC) extrapolation methodology, which is based on the historical relationship between the 7 year swap risk premium (SRP) and the 10 year SRP for market participant survey data collected by it. Using the Bloomberg 7 year BBB SRP, QTC found that using its methodology estimates of the 10 year debt risk premium were very close to those estimated by PwC using the paired bonds extrapolation, and close to a number of AER decisions using paired bond extrapolation; and
- A proposal from AFMA, using the AFMA 10 year swap rate plus an additional adjustment for the 7 to 10 year yield differential.¹⁹

The AER concluded that where the 10 year/7 year BBB+ debt risk premium component of the yield can be 'robustly estimated in a mechanistic way' it should be applied. However:²⁰

- There are several alternative methods and 'no method addresses the issue of containing unexpected errors'; and hence

¹⁶ AER (December, 2013), *Better Regulation: Explanatory Statement – Rate of Return Guidelines*.

¹⁷ AER (August, 2013), *Better Regulation: Explanatory Statement – Draft rate of return guidelines*.

¹⁸ Extrapolation of the yield from 7 to 10 years is inappropriate and unnecessary owing to the fact that the underlying CGS yield is known, and it is only the debt risk premium component that needs to be estimated. Furthermore, concavity in the shape of the normal CGS yield curve means that a linear extrapolation of yield from 7 to 10 years will generally imply convexity in the debt risk premium over this range of terms, which is unsupported by theory.

¹⁹ AFMA (October, 2013), *Submission to the draft guideline – Benchmark term of debt*.

²⁰ AER (December, 2013), p. 152.

- It intends to ‘consider the method of extrapolation (if required) for annual updating of the return on debt at a service provider’s determination.’

The objective of the current report is to contribute to an understanding of the characteristics of alternative mechanical extrapolation measures, and to make a recommendation about the best methodology to apply.

2.2 Terms of Reference

Our Terms of Reference require us to propose a methodology for extrapolating the Bloomberg 7 year BBB fair value curve debt risk premium to 10 years, so that the cost of a 10 year BBB+ fixed yield corporate bond may be estimated and applied over the course of a regulatory period in the context of a regulatory approach that employs a ten year trailing average of the return on debt. This requires an analysis and assessment of the following issues, as quoted from the Terms of Reference.

Having regard to the AER’s position on estimating the cost of debt, as set out in the Rate of Return Guideline, the Expert will provide an opinion report that:

- First, identifies and describes alternative approaches to extrapolating the Bloomberg BBB fair value curve (or equivalent) from seven to 10 years, including use of data, judgement, and statistical analysis;
- Secondly, compares the merits of each approach, in terms of their ability to estimate the return on debt using the Bloomberg fair value curve (or equivalent) that:
 - Is commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to a regulated gas or electricity network in respect of the provision of reference services; and
 - Can apply automatically to update the return on debt, with limited or no discretion needed;
- Thirdly, recommends an approach, or combination of approaches, to extrapolate the Bloomberg BBB fair value curve (or equivalent) from seven to 10 years, having regard to the relative merits of the available approaches, and the requirements of the National Gas Law and Rules or National Electricity Law and Rules for the return on debt to be:
 - Commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to a regulated gas or electricity network in respect of the provision of reference services;
 - Applied automatically to update the return on debt, with limited or no discretion needed.

In preparing the report, we have also been requested to:

- Ignore paired bond analysis as one of the alternative approaches to extrapolating the Bloomberg BBB fair value curve (or equivalent) referred to in the first point above;
- Consider how approaches can apply both during a price review and automatically during a regulatory period;

- Consider the stability, simplicity, implementation cost, objectivity, reliability, transparency and accuracy of each approach;
- Consider the theoretical and empirical support for each of the approaches; and
- Consider any comments raised by the AER and other regulators on extrapolating the Bloomberg fair value curve.

The full terms of reference are attached to this report.

3. Conceptual framework

3.1 Introduction

Developing a debt risk premium extrapolation methodology that can be mechanically applied to a 7 year BBB fair value curve to estimate a 10 year trailing average cost of debt is made difficult due to the lack of an independent data source that can be relied upon as the historically ‘true’ change in the debt risk premium between these terms. In this chapter we develop criteria for the assessment of alternative mechanical cost of debt estimation methodologies in the face of this informational deficiency.

3.2 The Bloomberg Fair Value Curve

Our Terms of Reference require us to recommend a methodology for extrapolating the 7 year Bloomberg BBB fair value curve (or equivalent), or more accurately, the 7 year Bloomberg BBB debt risk premium, to 10 years to serve as a basis for the mechanical estimation of a 10 year trailing average cost of debt. Extrapolation of the yield from 7 to 10 years is inappropriate and unnecessary owing to the fact that the underlying CGS yield is known, and it is only the debt risk premium component that needs to be estimated. Furthermore, concavity in the shape of the normal CGS yield curve means that a linear extrapolation of yield from 7 to 10 years will generally imply convexity in the debt risk premium over this range of terms, which is unsupported by theory.²¹

The previously estimated 7 year Bloomberg BBB fair value curve (denoted ‘BFV’) was discontinued from 1 May, 2014, and in its place, Bloomberg is now providing a new BBB fair value curve (denoted ‘BVAL’). Bloomberg claims that its new (BVAL) fair value curve is based on a superior methodology that places more emphasis on the use of bonds that it considers to be more liquid and more representative of the market yield (i.e. yield observations that have a high ‘BVAL score’). However, there are several issues relating to Bloomberg’s new BVAL fair value curve series, as it:

- Is only available since April, 2010;
- Has had some significant periods of missing data; and
- Has exhibited some inexplicable volatility compared with the previous BFV series, including daily spikes of ± 100 basis points.

Given these characteristics we considered that it was not advisable to undertake analysis using the Australian BBB Bloomberg BVAL curve.

The method we tested that would be expected to be most directly affected by Bloomberg’s change in approach is the Straight line extrapolation approach, given that this is wholly a function on the relative yields predicted by the Bloomberg fair value curve at 5 and 7 years. Our testing of the QTC method will also be affected by Bloomberg’s changes. More specifically, the relationship between the debt risk premium at 7 years and the change in the debt risk premium between 7 and 10 years that

²¹ Some methods for fitting yield curves – such as the Nelson Siegel methodology – are applied to bond yields (rather than to debt risk premia). However, the fitted curves are almost always concave and such that the implied debt risk premium increases no more than linearly with term (i.e., is concave or linear with term, but not convex).

underpins the QTC method would be unaffected by Bloomberg's changes because QTC used its own survey of corporate bond yields of market practitioners (rather than Bloomberg information) to derive this relationship. However, a required input to the QTC method is the debt risk premium at 7 years, and in testing the QTC method we have used the previous Bloomberg fair value yield curves to derive the extrapolation that is implied by this method. In relation to our use of the US yield curves, we observe that change in Bloomberg's method for constructing yield curves would appear to have had a much lesser impact on yields.

Having said that, if the historical Bloomberg fair value curves were replaced with new curves that Bloomberg considered to be more accurate, and these were then used to re-calculate the extrapolations that are implied by the QTC method, it is difficult to predict how this would affect our testing of the QTC method. It is possible that the accuracy of the QTC method could be found to increase or to decrease. The same comment applies to the straight line extrapolation method.

3.3 Method for testing the accuracy of alternative extrapolation methodologies

3.3.1 Proxy for the 'true' change in the debt risk premium between 7 and 10 years

To test the accuracy of different methods of prediction, it is standard to test those methods against the observed (actual) values of the parameter that is being predicted (this is often referred to as 'within sample' testing). However, a complication of the assessment of different methods for extrapolating the debt risk premium from a 7 year to a 10 year term is that the actual change in the debt risk premium between these terms cannot be observed directly. We have adopted a range of different proxies or benchmarks for the 'true' change in the debt risk premium between 7 and 10 years (with associated time periods). We have then examined the performance of alternative extrapolation methodologies against the benchmarks using a range of measures that are fully described below. These benchmarks for three different (overlapping) time periods are:

- *Bloomberg 10 year BBB fair value yield (2005 – 2007)* – during the period 2005 to 2007 Bloomberg published a 10 year BBB fair value curve, so that an implied 7 to 10 year debt risk premium extrapolation is directly observable.
- *QTC market survey (2006 – 2013)* – the QTC undertakes a quarterly survey of up to 6 debt market participants and averages their responses to obtain current market estimates of market yields for a range of terms and credit ratings (including the 10 year BBB+), and therefore a 7 to 10 year debt risk premium extrapolation can be calculated. Within this period we identified four sub-periods, which can be described as:²²
 - Period 1: 'Pre-crisis period' (March 2006 – June 2007)

²² The QTC advised us that throughout most of the period the views of at least 5 banks were incorporated in its survey, and in the last two years 6 banks have responded each time. These are the major banking groups in Australia, accounting for the vast majority of domestic bank and capital markets debt.

- Period 2: ‘Global financial crisis’ (September 2007 – December 2009)²³
- Period 3: ‘Sovereign debt crisis’ (March 2010 – December 2011)
- Period 4: ‘Post crises period’ (March 2012 – December 2013)
- AER’s ‘paired bonds’ analysis decisions (2012 – 2013) – since the AER’s Powerlink and Aurora Energy decisions in April 2012, it has applied this approach in a number of decisions. During this period, econometric analysis undertaken by PwC also found that its yield estimates were generally close to the values estimated using the paired bonds analysis.²⁴ This provides a third benchmark proxy for the ‘true’ 7 to 10 year debt risk premium extrapolation.

We have given particular weight to the AER’s ‘paired bonds’ decisions because of the above mentioned empirical tests, and also because the methodology provides the best framework for a ‘controlled experiment’. As noted by PwC in its advice to the Queensland Competition Authority:²⁵

The logic behind using the paired bonds of a single issuer to estimate the change in the debt risk premium from 7 to 10 years is that this holds constant the quality of the issuer, so that the difference in the debt risk premium between the two bonds may be fully attributed to term

We observe that one potential concern with using the QTC survey as one of our benchmarks against which we test the alternative extrapolation methods is whether a survey of half a dozen market participants is sufficient to provide an unbiased average of market opinion on the cost of debt. In this connection we note that the Bloomberg fair value curve (whether BFV or BVAL) is based on bond yield ‘observations’ that are actually the opinions of at most half a dozen financial institutions, and in many cases less than this number.²⁶ We also observe that the QTC survey is produced and used for a real purpose that is unrelated to regulation (to guide the investment decisions and monitor the financial performance of a range of government owned businesses), which encourages the QTC to maximise the accuracy of the results.²⁷ Moreover, there is no alternative and superior data source available that can claim to represent the views of market participants on the debt risk premium (and, more relevantly, how it changes with term) over time. We discuss the relative merits of the QTC survey information further in section 4.2.3.

It would also be possible to directly test accuracy against fair value curves that had been fitted to historical data using the Nelson-Siegel curves or other econometric methodologies. However, the heavy information requirements of these methodologies ruled this out.

²³ The GFC period is typically taken as commencing during July 2007. Thus, the first quarterly observation during this period is September 2007.

²⁴ PwC (June, 2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*.

²⁵ PwC (June, 2013), p.29.

²⁶ This is because actual trading in corporate bonds may be infrequent.

²⁷ The Queensland Treasury’s policy on requiring a fair estimate of the commercial market cost of debt is set out in: Queensland Treasury (2010), *Commercialisation of Government Business Activities in Queensland – Policy Framework*, p. 23.

Should the RBA yield curves be used as a benchmark?

A further possible benchmark that could be used to test the different extrapolation methods is the change in the debt risk premium between 7 and 10 years that is implied by the set of yield curves that the Reserve Bank of Australia (RBA) has recently produced, for which it has produced a historical series extending back to 2005. We do not consider it appropriate to use the RBA yield curves for this purpose.

In December 2013, the RBA commenced publishing a new series of Australian corporate credit spreads for BBB and A rated corporate bonds.²⁸ The methodology that lies behind the RBA's credit spreads is set out in an article published in the December Quarter issue of the RBA's *Bulletin* magazine.²⁹ The RBA article documents an increase in the number of Australian corporate bonds on issue, and the increasing number of unique issuers. Considering only bonds issued by non-financial corporations, the RBA has maximised the number of bonds in its sample by including those with embedded options (by estimating the option adjusted spread), as well as foreign currency denominated bonds issued by Australian businesses, which have been converted to Australian dollar equivalent yields.

The RBA used a Gaussian kernel weighting methodology to fit its yield curve, which attaches more weight to the yields of bonds closest to the target term. Only yield estimates for the broad A and BBB credit rating bands have been provided, as these are the most heavily populated credit rating bands. These yield estimates are available on a monthly basis since January 2005.

A problem associated with the Gaussian kernel method is that it produces estimates of the cost of debt for a 10-year tenor that are downwardly biased by construction given the sample of bonds that is available. This outcome is an artefact of the local constant smoothing method that the RBA applies. This has been demonstrated in a report undertaken by ESQUANT Statistical Consulting.³⁰ The RBA has itself acknowledged one aspect of the biases, as evidenced by a comment in Arsov et al., (2013):³¹

Overall, the Gaussian kernel method produces weighted average tenors that are very close to each of the target tenors (Graph 11). . . . The exception is the 10-year tenor where the effective tenor is closer to 9 years. This reflects the dearth of issuance of bonds with tenors of 10 years or more. Notwithstanding the slightly shorter effective tenor for the 10-year point, the estimates of the 10-year spread from the Gaussian kernel are distinct from the estimates of the 9-year spread as the two are estimated by applying different weights to the bonds in the sample.

In light of these statistical properties, the change in the debt risk premium observed for the RBA's BBB rating band between a 7-year and a 10-year tenor should be viewed with caution. As such, we do

²⁸ On the RBA's website, the new interest rate statistics are provided in Statistical Table F3 – Aggregate Measures of Australian Corporate Bond Spreads and Yields.

²⁹ Ivailo Arsov, Matthew Brooks and Mitch Kosev (December Quarter, 2013), 'New Measures of Australian Corporate Credit Spreads', *Bulletin*, pp. 15-26.

³⁰ ESQUANT Statistical Consulting (19 May, 2014), *A Review of Measures of Australian Corporate Credit Spreads published by the Reserve Bank of Australia*, A report prepared for United Energy and Multinet Gas.

³¹ Ivailo Arsov, Matthew Brooks and Mitch Kosev (December Quarter, 2013), p.23.

not consider it appropriate to be used as a benchmark for the “true” change in the debt risk premium between these terms.

However, we have included the use of the RBA yield curves within the set of potential extrapolation methods that we have tested. Notwithstanding the concerns above, the extrapolation produced by the RBA curves need not necessarily be less accurate than the other methods, and so this is something that is appropriate to test.

3.3.2 Measuring the accuracy of the extrapolation method

The principal measure we used to test the accuracy of alternative extrapolation methodologies is the ‘root mean square error’ (RMSE), which is the square root of the average of the squared distance between the predicted change in the debt risk premium (i.e. 7 to 10 year debt risk premium) obtained using these methodologies and the extrapolation values implied by the benchmarks as proxies for the ‘true’ 7 to 10 year debt risk premium. Formally, we define RMSE as:

$$RMSE = \sqrt{\frac{\sum_{t=1}^n (\hat{y}_t - y_t)^2}{n}}$$

Where,

- \hat{y} is the debt risk premium (7 to 10 years) estimated by each alternative methodology;
- y is the benchmark debt risk premium (i.e. the proxy for the ‘true’ debt risk premium);
- t denotes the day for which an estimate of the debt risk premium (7 to 10 years) is made; and
- n denotes the total number of days for which estimates of the debt risk premium (7 to 10 years) are made.

The use of the RMSE criterion is a common criterion for selecting between different estimators. It is also consistent with the AER’s previous approach to selecting between different fair value curves. In 2010, when the AER was selecting between the CBASpectrum curve, the Bloomberg curve and an average of the curves, it wrote that:³²

The sample of bonds is used to conduct the comparison of observed yields to the fair value curves of CBASpectrum, Bloomberg and an average of the two curves. The comparison is conducted using the weighted sum of squared errors.³³ The weighted sum of squared errors is

³² AER (March, 2010), *Final decision – Public, Access arrangement proposal: ACT, Queanbeyan and Palerang gas distribution network, July 2010-30 June 2015*, pp. 42-43.

³³ The AER’s footnote 135 read as follows: The weighted sum of squared errors is defined as:

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

Where:

N is the number of bonds in the sample

t_i is the number of observations for the i^{th} bond

$Observed_{i,j}$ is the j^{th} observed yield for the i^{th} bond, taken from either Bloomberg, CBASpectrum or UBS

a mathematical formula which provides a measure of how closely each fair value curve fits to observed bond yields. A smaller value indicates a better fit.

A similar approach to that described above was reviewed by the Tribunal which found that there was no compelling case for departing from the AER’s methodology.³⁴

The RMSE may be disaggregated into its two components,³⁵ which are:

- *Bias* – which is the average difference (in basis points) between the estimate of the 7 to 10 year debt risk premium extrapolation, and the benchmark 7 to 10 year debt risk premium.³⁶

$$Bias = \frac{\sum_{t=1}^n (\hat{y}_t - y_t)}{n}$$

Where the symbols are as defined above. The degree of bias signals the extent to which the relevant extrapolation method is likely to systematically over or under-predict the true value, on average, over time. A positive bias would result in a higher than necessary trailing average cost of debt, and a negative bias would result in a lower trailing average cost of debt than is required to achieve efficient financing costs in the market.

- *Standard deviation* – which is a measure of the volatility in the error in the extrapolation over time. Thus, a higher standard deviation would imply a wider range for the possible error in the extrapolation at any particular point in time.

The relationship between RMSE, bias and the standard deviation is then given in the following formula:

$$RMSE = \sqrt{Bias^2 + Standard\ Deviation^2}$$

It is desirable for the extent of bias to be minimised (all else constant), and for the dispersion in the prediction error at any point in time to also be minimised (all else constant). Hence, a trade-off between these two “bads” is appropriate, which is consistent with the use of the RMSE criterion. That is, the RMSE combines the impact of bias (distance from the ‘actual’ 7 to 10 year debt risk premium extrapolation) and dispersion (the scatter of the estimated 7 to 10 year debt risk premium extrapolations).

3.3.3 Other assessment criteria

Our Terms of Reference also requires us to consider other assessment criteria, such as ‘implementation cost, objectivity, reliability and transparency’, which we do below:

- *Objectivity* – for a mechanistic process it is desirable that a minimum of judgement be required, and ideally that the required extrapolation methodology be dependent on data provided by a respected independent party, such as Bloomberg. As discussed below, this requirement will rule

³⁴ Fair_{i,j} is the jth fair yield for the ith bond, taken from either Bloomberg, CBASpectrum or UBS
 The AER’s footnote 136 provided the reference: Australian Competition Tribunal, *Application by Energy Australia and others [2009] ACompT8, November 2009*, p.39.

³⁵ Guy Lebanon, (4 September, 2010), *Bias, Variance and MSE of Estimators*.

³⁶ We also note that all cost of debt components are expressed as annual effective yields.

out some otherwise worthy candidates, such as econometric estimation of yields or debt risk premiums to derive an estimate of the extrapolation value.

- *Reliability* – for establishing a trailing average cost of debt it is desirable that the extrapolation methodology provide a reliable value rather than one that is highly variable, as this could potentially spuriously impact on the weighted average cost of capital. Our R.M.S.E. test above provides a test of relative stability of the estimation methodologies relative to the identified benchmarks.
- *Transparency and replicability* – it is desirable for the extrapolation methodology to be fully transparent, so that it may be replicated by parties, if they wish. For example, the fact that Bloomberg applies a proprietary methodology is not desirable, although this factor needs to be weighed against others.
- *Low cost of mechanisation* – other things being equal, it is preferred that the extrapolation methodology have a low cost to implement as a mechanised process. We consider that all of the five methodologies assessed in this report are relatively low cost.

Whilst we consider our tests of ‘accuracy’, RMSE, estimation bias, and standard deviation to be the primary criteria, we have also taken account of the additional criteria listed above.

4. Alternative extrapolation methodologies

4.1 Introduction

In this chapter we describe alternative methodologies that have previously been proposed or applied for extrapolating the Bloomberg 7 year BBB debt risk premium to 10 years, as well some other approaches that have not previously been applied. We did not consider the following potential extrapolation measures to be appropriate for the purpose:

- *Paired bonds method* – our terms of reference require us to ignore the “paired bonds” approach for extrapolating the debt risk premium.
- *Bloomberg A, AA or AAA fair value curve* – these curves have been applied in the past by the AER, however the longest dated of these curves (AA) is currently published only to a term of 8 years, and can therefore not be used to extrapolate to 10 years. We also ignored the semi-sovereign yield curves of Australian states as these entities are subject to materially less credit risk than a BBB rated business.
- *“Custom-made” yield curves* – we did not assess the capacity for new yield curves that are estimated and re-estimated specifically for this purpose. Such approaches could include econometric techniques that fit a simple function of the debt risk premium against term, or the Nelson-Siegel approach that is used to fit credit curves. Debt risk premium or yield estimates derived by such approaches could provide an estimate of the change in the debt risk premium between 7 and 10 years. However, if a yield curve were to be re-estimated over the regulatory period, then we expect that this would be used directly to estimate the 10 year cost of debt.

4.2 Description of alternative extrapolation methodologies

4.2.1 Straight line extrapolation

The straight line extrapolation of the Bloomberg 5 and 7 year BBB fair value curve debt risk premiums is perhaps the simplest extrapolation methodology that can be used to derive a 10 year BBB+ debt risk premium. Under the straight line extrapolation the debt risk premium observed between the Bloomberg 5 year and 7 year points on the Bloomberg fair value curve is multiplied by 1.5, and added to the 7 year Bloomberg debt risk premium to derive an estimate of the Bloomberg 10 year debt risk premium.

The linear extrapolation of the 5 and 7 year Bloomberg debt risk premiums was suggested by PwC in its November 2009 report for the Victorian distribution businesses.³⁷ It was proposed that often the Bloomberg debt risk premium between 5 years and 10 years approximated a straight line during the period that Bloomberg published a 10 year BBB fair value curve (7 December, 2005 to 9 October, 2007).

³⁷ PricewaterhouseCoopers (November, 2009), *Methodology to Estimate the Debt Risk Premium*, report to Victorian Distribution Businesses, pp.34-35.

In another report, PwC noted that the difference between a straight line extrapolation and extrapolation using the Bloomberg AAA fair value curve was in the order of 10 to 15 basis points.³⁸ Later PwC noted that straight line extrapolation was at times likely to result in unstable estimates of the 10 year debt risk premium, since small movements in the opposite direction for the 5 and 7 year points on the BBB fair value curve could create significant instability in the 10 year BBB estimate.³⁹

The straight line extrapolation methodology can be applied in the future even though the Bloomberg fair value curve has been discontinued, so long as Bloomberg continues to publish both 5 year and 7 year BVAL fair value yields.

4.2.2 US Bloomberg BBB and BBB+ fair value curves

The next two methodologies we examine rely on the US Bloomberg BBB+ and BBB fair value curves (BFV). Owing to the much larger bond market in the United States, Bloomberg provides its fair value curve estimates to 10 years and beyond. For example, Bloomberg provides both a Utilities BBB+ and a broader Composite BBB curve. The latter is a composite of all BBB credit rating bands (BBB+, BBB, and BBB-). Bloomberg is also phasing out its previous fair value curve methodology (BFV) in the US, and is now producing BVAL fair value curves (which are also available back to 2010). Since the Bloomberg BVAL curve is re-calculated on a daily basis, it is most amenable to application on a consistent basis to estimate a trailing average cost of debt. This methodology was recently suggested by CEG as one that could be applied mechanistically to derive a trailing average cost of debt.⁴⁰

Application of a US Bloomberg fair value curve (whether BFV or BVAL) to determine the 7 to 10 year extrapolation value can be justified on the grounds that international competition in bond markets will align the debt risk premiums in different markets to eliminate arbitrage opportunities. In other words, once the cost of debt in the US is swapped back from American to Australian dollars, and the transaction costs of doing so are included, there should be a close correspondence between the cost of debt that can be achieved in the US and in Australia. In a recent report undertaken for the Queensland Competition Authority (QCA), PwC (2013) found that if the yields of Australian businesses issuing bonds in the US are swapped back to AUD equivalents, the 10 year BBB+ bond yield estimate was relatively close to that obtained by reference only to Australian bond yield data using an econometric estimation methodology.⁴¹

4.2.3 Queensland Treasury Corporation extrapolation methodology

Background and QTC market practitioner survey

The Queensland Treasury Corporation's (QTC) extrapolation methodology, which relies on the observed historical relationship between the swap risk premium (SRP) and the SRP term premium between 7 and 10 years based on the market participant survey data collected by it. The SRP is the

³⁸ PwC (28 April, 2010), *Update of cost of debt methodology analysis in light of the AER's ActewAGL decision*, Letter to Sandra Gamble, Group Manager, Regulation, Jemena Gas Networks. .

³⁹ See, for example, PwC (2010), *Debt risk premium over the approved averaging period beginning 2 August, 2010*, Letter to Mark de Villiers of CitiPower and Powercor Australia and Jeremy Rothfield of United Energy and Mutlinet Gas.

⁴⁰ CEG (October, 2013), *Mechanistic cost of debt extrapolation from 7 to 10 years*.

⁴¹ See Appendices C and D of PwC (June, 2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*, pp.105-109.

margin between the annualised fixed corporate yield and the annualised fixed swap rate for the same term to maturity. The SRP term premium between 7 and 10 years is measured as $SRP_{10} - SRP_7$.⁴²

The obvious difficulty with estimating this relationship is that the SRP (like the debt risk premium measured against the Commonwealth Bond rate) cannot be observed.⁴³ The source of data that QTC has used to estimate this function is its own quarterly survey of the opinions of a number of debt capital market (DCM) specialists, which it undertakes in order to assess the competitive neutrality fee that is applied on behalf of Queensland Treasury and Trade. As stated by QTC:⁴⁴

Up to six DCM specialists are asked to provide indicative A\$ issue margins to swap for new debt issuance based on the following criteria:

A minimum total annual borrowing program of A\$1billion

Credit ratings from AAA to BBB-

Tenors ranging from 3 months to 10 years

Exclude margins for facility, underwriting or Commonwealth guarantees.

The QTC has collected quarterly estimates of 10 year BBB+ and BBB corporate bond yields dating back to March 2006. These estimates are collected by QTC so that it can apply appropriate cost of debt to commercialised Queensland Government owned commercialised business units (CBUs). As noted by QTC in a recent Policy Framework paper:⁴⁵

Short-term overdraft or long-term borrowing facilities will be made available to CBUs at commercial rates through QTC, subject to normal Treasurer approval processes... Loan funding will be subject to the terms and conditions applicable to QTC finance at that time. Such terms and conditions will generally accord with market practice.

Hence, for its own purposes QTC must determine what market practice is, which is why it undertakes a quarterly survey of financiers. It is in the interests of QTC to ensure that its quarterly survey of the terms available in the market is an accurate reflection of commercial rates. If QTC did not ensure accuracy in these rates it would result in distortions in the investment policies of its CBUs.

One potential criticism of the QTC's methodology is that it relies as its source of data on the opinions of half a dozen market participants, and that this could result in bias. However, it must be recalled that the Bloomberg 7 year BBB fair value curves (both BFV and BVAL) have been, and continue to be determined by inputs from only a small number of financial institutions, often approximately half a

⁴² Where the subscripts denote the year of the SRP (swap risk premium).

⁴³ We use the term "swap risk premium" to denote the risk premium over the AFMA swap rate and the term "debt risk premium" to denote the risk premium over the Commonwealth Government bond rate. The difference between these risk premia is equal to the difference between the AFMA swap rate and the bond rate at the relevant term (often referred to as the 'bond swap spread'). As swap rates are easily observable at all terms, the issues with observing the debt risk premium at different terms apply equally to the swap risk premium.

⁴⁴ QTC (11 October, 2011), *Queensland Treasury, Submission to the draft AER rate of return guideline, Attachment A: An alternative extrapolation method*, p. 2.

⁴⁵ Queensland Treasury (2010), *Commercialisation of Government Business Activities in Queensland – Policy Framework*, p. 23.

dozen. These institutions operate in a competitive market for funds and need to maintain a continuing in-depth knowledge of the debt markets in which they operate. Taking the average of such opinions is essentially the task that Bloomberg undertakes. Although Bloomberg now undertakes a weighting procedure under the BVAL fair value curve framework, which gives greater weight to more liquid bonds, this is what would be expected from the market participants who are surveyed by the QTC when forming their own views as to the prevailing cost of debt. Moreover, as discussed above, the purpose for which these yield estimates are applied places a strong requirement for the QTC to obtain yield estimates that are as accurate as possible.

QTC's proposed extrapolation methodology

As noted above, the QTC has used its quarterly survey estimates to derive a relationship that can be used to predict the change in the debt risk premium between 7 and 10 years. In particular, the QTC has found that there is a strong relationship between the change in the SRP between 7 and 10 years, and the SRP at 7 years. As swap rates at 7 and 10 years are easily observable, once this relationship has been estimated, it can be used to provide an estimate of the 10 year cost of debt for a BBB+ corporate bond based on currently published numbers (i.e. the BBB fair value curve at 7 years, the 7 and 10 year AFMA swap yields and the 7 and 10 year Commonwealth Bond rates).

Specifically, the QTC reported that applying regression analysis to the quarterly data from March 2006 to June 2013, it obtained the following relationship (measured in basis points):⁴⁶

$$SRP_{10} - SRP_7 = 15 + 0.0778 \times SRP_7 \quad (1)$$

Where:

SRP_{10}	is the swap risk premium for a BBB+ corporate bond at 10 years based on the QTC survey (i.e. $Yield_{10} - Swap_{10}$)
$Yield_{10}$	is the 10 year BBB+ yield reported by respondents to the QTC's survey of debt capital market specialists
$Yield_7$	is the 7 year BBB+ yield reported by respondents to the QTC's survey of debt capital market specialists
$Swap_{10}$	is the 10 year swap rate that is published daily by AFMA
$Swap_7$	is the 7 year swap rate that is published daily by AFMA
SRP_7	is the swap risk premium for a BBB+ corporate bond at 7 years based on QTC survey and AFMA data (i.e. $Yield_7 - Swap_7$), and
$SRP_{10} - SRP_7$	is the change in the SRP between terms of 7 and 10 years.

⁴⁶ This applies the coefficients that QTC provided to the AER up to June, 2013. See AER (December, 2013), p.149.

We have verified the QTC's regression estimates and note that the following regression coefficients are obtained when the additional observations since the date of the QTC's analysis are added to the sample:⁴⁷

$$SRP_{10} - SRP_7 = 14.6 + 0.079 \times SRP_7 \quad (2)$$

It follows that the change in the swap risk premium between 7 and 10 years can be predicted with reference to the observed swap risk premium at 7 years and the coefficients estimated from the regression set out above.

When applying the QTC relationship to predict the change in the debt risk premium between 7 and 10 years, we recommend replacing QTC with Bloomberg as the source of the 7 year corporate bond yield (and associated swap risk premium) that is used in the extrapolation equation. This is because it makes sense to use the same source for the extrapolation equation as is being used to derive the base 7 year debt risk premium. We have applied the QTC method using Bloomberg as the source of the 7 year debt risk premium in our testing. Making this substitution means that the predicted change in the risk premium (over the swap rate) between 7 and 10 years can be expressed as:

$$SRP_{10} - SRP_7 = 14.6 + 0.079 \times SRP_7 \quad (3)$$

Where:

*Yield*₇ is the 7 year BBB corporate bond yield from the Bloomberg fair value curve

*Swap*₇ is the 7 year swap rate that is published daily by AFMA

*SRP*₇ is the 7 year swap risk premium (i.e., *Yield*₇ - *Swap*₇), and

*SRP*₁₀ - *SRP*₇ is the change in the SRP between terms of 7 and 10 years.

The implied extrapolation of the 7 year debt risk premium to a 10 year value can then be expressed as:

$$DRP_{10} - DRP_7 = SRP_{10} - SRP_7 + ((Swap_{10} - CGS_{10}) - (Swap_7 - CGS_7)) \quad (2)$$

Where:

*DRP*₁₀ - *DRP*₇ is the predicted change in the debt risk premium between 7 and 10 years

*Swap*₁₀ is the 7 year swap rate that is published daily by AFMA

*CGS*₁₀ is the 10 year Commonwealth Government Securities (CGS) yield, and

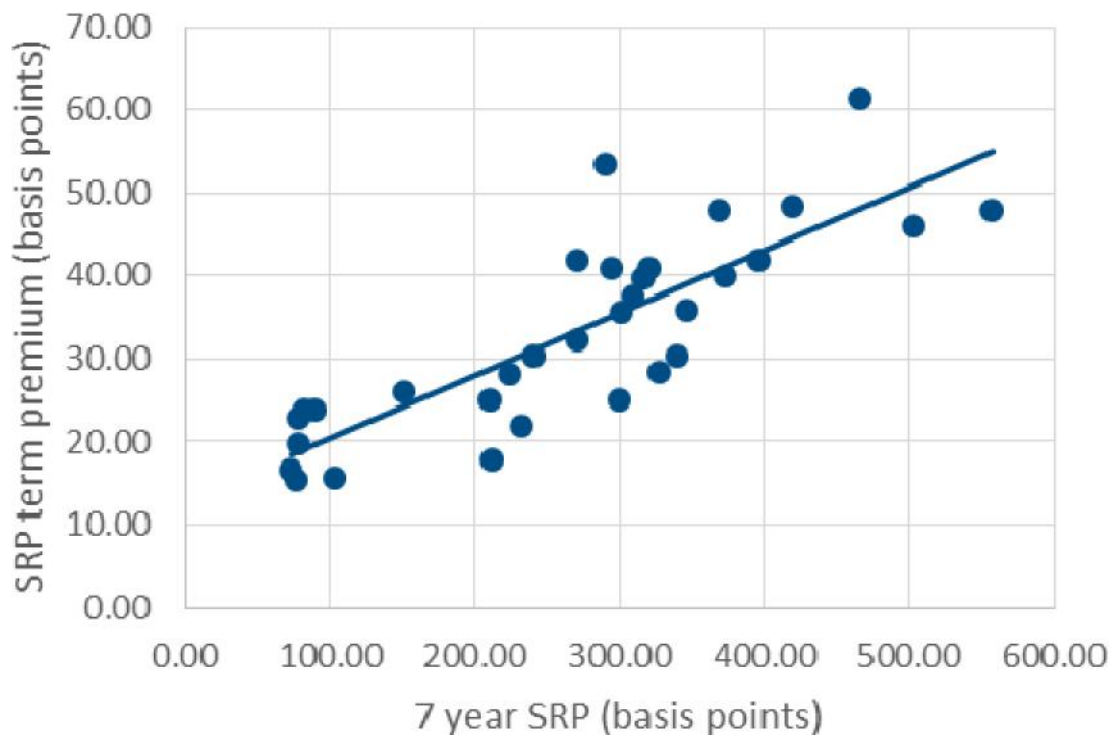
*CGS*₇ is the 7 year Commonwealth Government Securities (CGS) yield.

QTC found that, using its methodology, estimates of the 10 year debt risk premium were very close to the values estimated by PwC using the paired bonds extrapolation, close to a number of AER decisions using paired bond extrapolation, and also close to a number of AER decisions based on extrapolation of the Bloomberg 7 year BBB debt risk premium to 10 years based on the difference

⁴⁷ Refer to the bolded results in Table 4.1.

between the 10 and 7 year Bloomberg AAA debt risk premiums. Figure 4.1 shows the distribution of observations (combinations of the SRP term premium and 7 year SRP) around the regression line, which defines the SRP term premium relationship.⁴⁸

Figure 4.1: 7-year SRP vs. SRP term premium between 7 and 10 years



Source: QTC. Note: Coefficient and goodness of fit statistics are provided in Table 4.1 below.

Relative merits of the QTC's methodology

The fact that the QTC's methodology is based on its quarterly survey of business has advantages as well as disadvantages:

- One disadvantage is that QTC's survey is undertaken on a quarterly basis, and it could be argued that therefore the latest estimates may be out-of-date if the market has changed.
 - However, the key feature of the QTC methodology is the observed robust relationship between the SRP term premium and the 7 year SRP, and the latter can be observed up-to-the-day. If enough previous observations have been included, then an additional quarterly observation is unlikely to make a material change. Since the QTC methodology is based on econometric regression, we would expect to find that the QTC methodology's estimates are smoother than the market's movements. This is borne out in Figure 4.2 below, which shows relative movements in the swap term premium for the QTC survey and the QTC methodology.

⁴⁸ Note that the regression coefficients and goodness of fit statistics are provided in Table 4.1 below.

- As noted by QTC, deriving information from market based surveys is an approach that has received the support of the Australian Competition Tribunal, which in the case of Actew AGL stated that:⁴⁹

There are various ways to estimate the debt risk premium. Estimates based on historical averages are one of the most common proxies for the debt risk premium. Surveying market participants is another method and has the advantage of better reflecting prevailing market conditions.

- Another perceived disadvantage of the QTC's methodology is the perception that is based on a survey of half a dozen market specialists, and this could potentially result in a biased estimate of the cost of debt – as noted above, we do not consider that the approach taken by QTC will result in any material bias, and it is not in the interests of QTC to allow such bias to occur. While the Tribunal has expressed concern about surveys where a small number of participants is asked for opinions, those references are to surveys where there may be anonymity and there is nothing at stake. In the QTC's case the credibility of the market participants is at stake (just as it is for the half dozen financial institutions that provide bond yield term sheets to Bloomberg). Furthermore, the QTC has an incentive to ensure that the results of its market survey provide cost of debt estimates that reflect the market for funds.

- In response to the first of these disadvantages, the QTC noted that:⁵⁰

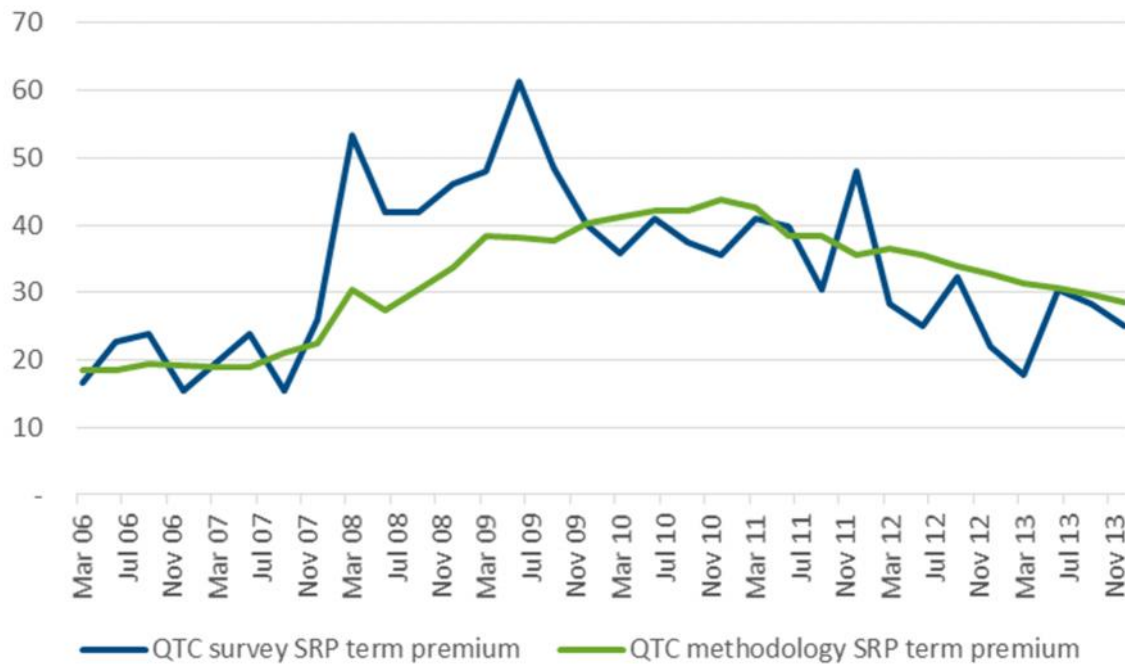
The survey data has only been used to establish a quantitative relationship between the SRP term premium and the 7 year SRP. This relationship is applied to the Bloomberg 7 year BBB SRP (i.e., data from an independent third party) to estimate the SRP term premium.

While significant, the SRP term premium is not large, averaging 20 basis points prior to the global financial crisis, and approximately 30 basis points in recent times (relative to the Bloomberg fair value curve). However, we would note that the market opinions expressed at any quarterly interval would not be likely to materially influence the historically estimated relationship between the SRP term premium and the 7 year SRP.

- As shown in Figure 4.2, historically the swap term premium has varied between 20 and 50 basis points at the height of the global financial crisis. The relationship established by econometric regression will regulate the response (in terms of the cost of debt applied) if there is a shock such as the global financial crisis. Owing to the nature of econometric regression smoothing out the effects of other variables, it is likely that the QTC's approach would provide a measured response to shocks, in contrast to the reactions of some other methodologies that could be influenced by a few extreme bond observations.

⁴⁹ Application by ActewAGL Distribution [2010] ACompT4 (17 December 2010), para. 10.
⁵⁰ QTC (11 October, 2011), p.8.

Figure 4.2: Swap term premium between 7 and 10 years – QTC survey vs QTC methodology



Source: QTC

- It could be argued that if there was a sudden permanent shift in the relationship between the SRP term premium and the 7 year SRP, owing to the dependence of the QTC methodology on a historical (econometrically estimated) relationship, a divergence would develop between the market rate and the estimate of the market rate that could take years to work through.
 - We consider the basic relationship between the SRP term premium and the 7 year SRP to be relatively stable, and spans experience of a wide range of 7 year SRP and SRP term premiums. As shown below, leaving out the global financial crisis period does not markedly change the coefficients.

Further methodological issues

The QTC assessed its own estimates relative to a number of decisions of the AER and found a reasonably close correspondence, on average. However, its estimate was based on knowledge across the whole period of the decisions, and is therefore not strictly predictive. That is why we consider it necessary to test the stability and relative accuracy of the QTC’s methodology based on previously available information. A key question in applying the QTC methodology to a new period is whether to:

- Include all previous periods of the QTC’s survey data in the econometric estimate, which assumes that a constant historical relationship between the SRP term premium and the 7 year SRP holds, and that more observations increase the confidence in the estimated relationship; or

- Include only a set number of previous periods of the QTC’s survey data in the econometric estimate, which assumes that the relationship may not be stable, and that the inclusion of distant historical periods will reduce the accuracy of the methodology.

We investigated the 7 year SRP to 10 year SRP term premium relationship across the four sub-periods that we defined above. The results, shown in Table 4.1 below, demonstrate that the intercept and slope coefficients are not stable when small sub-samples are tested, but are not particularly sensitive to whether the global financial crisis period is removed. While the parameters for the whole period have respectable goodness of fit (adjusted R-square of 0.624) and the intercept and slope coefficients are both highly statistically significant, the only sub-period that this is the case is the global financial crisis. However, when sample size increases above 14, statistical significance is achieved. Even if the two crisis periods are removed, there remains a statistically significant relationship with an intercept of 18.2 basis points and a slope coefficient of 0.034. Based on this evidence we believe that more observations are desirable for establishing the best estimate of the relationship between the 7 year SRP and the 7 to 10 year SRP differential that is critical for applying the QTC’s approach.

Table 4.1: QTC methodology regression equation parameters by period (basis points)

Period	Obs.	Intercept	Slope Coeff.	Adjusted R ²	T-value Intercept	T-value Slope Coeff.
1: March 2006 – June 2007	6	7.2	0.222	-0.197	0.228	0.418
2: Sept. 2007 – December 2009	10	20.6	0.070	0.479	2.672	3.045
3: March 2010 – December 2011	8	35.9	0.009	-0.164	1.455	0.109
4: March 2012 – December 2013	8	18.0	0.036	-0.049	1.798	0.820
Whole period – QTC term premium vs QTC survey 7 year SRP	32	14.6	0.079	0.624	5.084	7.239
Whole period - QTC term premium vs Bloomberg 7 year SRP	32	17.6	0.071	0.380	4.556	4.472
GFC period (2) removed	22	15.1	0.069	0.554	5.067	5.204
Both Crises removed (2 & 3)	14	18.2	0.034	0.338	8.132	2.762

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

We recommend that including a larger number of observations is preferred over the use of a smaller number of observations as this is likely to provide greater reliability. Hence, we recommend the highlighted coefficients obtained with the maximum number of 32 observations be applied. We note that even if the global financial crisis period were to be removed then the regression coefficients would not move materially.

We also note that in Table 4.1 we have shown the results of regressing the QTC survey’s SRP term premium against the Bloomberg BBB 7 year SRP. Although the adjusted r-square is lower, indicating greater variance, the intercept and slope coefficients are both highly statistically significant, and very similar to the results obtained by regressing the QTC survey BBB+ 7 year SRP against the QTC survey’s SRP term premium. This indicates that while there have at times been differences between the level of the 7 year Bloomberg BBB fair value curve yields and the 7 year QTC survey BBB+ yield, they both hold essentially the same relationship to the QTC survey term premium. Hence, it would not make very much difference to the QTC methodology’s estimate of the 7 to 10 year extrapolation whether the 7 year QTC survey data, or the Bloomberg data is applied.

4.2.4 Reserve Bank of Australia fair value yields

We described the RBA fair value yield curves in section 3.3.1. While we noted in that section that there are a priori reasons to believe that the RBA fair value curves may understate the change in the debt risk premium between 7 and 10 years, we have nonetheless included the use of these curves within the set of possible extrapolation methods to be tested.

We observe that two regulators, IPART and the AER, have recently considered the RBA's methodology. In February 2004 IPART released a *Fact Sheet* discussing its intention to adopt the RBA methodology, noting that it has the disadvantage of reporting an aggregate yield for the BBB rating band:⁵¹

The RBA aggregates BBB+, BBB and BBB (sic) ratings to a single category of BBB. Adopting the RBA methodology would mean that we may have to change our target credit rating in the WACC from BBB+/BBB to an aggregate of BBB+, BBB and BBB-.

That is, IPART's view is that since the RBA only provides yield estimates for a broad BBB credit rating it should change its view on the benchmark credit rating. Even more recently, the AER has made an interim determination in relation to TransGrid and Transend, where the RBA's methodology has been considered along with the paired bonds extrapolation methodology that the AER has applied for the last two years:⁵²

A return on debt between 6.7 and 7.5 per cent. The lower estimate in this range is based on the 7 year Bloomberg BBB rate FVC over the same recent 20 day averaging period extrapolated to 10 years with paired bonds. The upper estimate in the range is based on the RBA's 10 year return on debt yield. We are currently reviewing available data sources to estimate the return on debt. In particular we will assess their suitability for determining the return on debt for regulated service providers.

This indicates that the AER is undertaking further research into these estimates.

4.2.5 AFMA swap rates

In a submission to the AER the Australian Financial Markets Association (AFMA) made the following statement:⁵³

We suggest that there may be other mechanistic ways of determining a suitable 10 year benchmark, and this issue can and should be explored further. For example, you could use the AFMA 10 year swap rate as the initial starting point (which would account for a significant component of the debt risk premium as previously defined) and then add a margin for the BBB versus swap component at the 10 year mark. This margin can be estimated using the difference

⁵¹ IPART (February, 2004), *Fact Sheet, New Approach to Estimating the Cost of Debt: Use of the RBA's Corporate Credit Spreads*, p. 4.

⁵² AER (March, 2014), *TransGrid Transend Transitional transaction determinations 2014-15*, p.26.

⁵³ AFMA (17 October, 2013), *AER Draft Rate of Return Guideline – Choice of benchmark term of debt*, Letter to Mr Warwick Anderson, General Manager – Network Regulation Branch, Australian Energy Regulator, p.3.

between the 7 year BFV yield and the 7 year swap AFMA swap rate as a starting point with some additional adjustment for the 7 year to 10 year BBB curve.

We contacted AFMA, and were informed that it has not followed this general suggestion with explicit advice on how the Bloomberg fair value curve yield's relationship to the 7 year AFMA swap rate yield can be used to derive the appropriate margin to add to AFMA 10 year swap rate. As noted above, the QTC's methodology already applies the AFMA 7 and 10 year swap rates as part of the predictive relationship it has derived.

4.2.6 “Custom made” yield curves

Technically, econometric analysis could also be applied to estimate an extrapolation value between 7 and 10 years, and it could be mechanised if enough effort was applied to ensure that the full sample of appropriate bonds was included on each day. Different econometric approaches have been advocated by PwC (2012) and CEG (2013), although in the former case it was advocated as a cross-check in conjunction with the ‘paired bonds’ extrapolation.⁵⁴

PwC's approach was to apply alternative functional forms for regressions employing debt risk premium data for BBB+ bonds, and bonds on either side of that credit rating (i.e. BBB and A-), and to use the Schwartz Information Criterion Test to select the most appropriate functional form.⁵⁵ CEG's approach was to apply the Nelson-Siegel methodology, which applies the best functional form that fits the data based on minimising the squared deviations from the line. CEG concluded that:⁵⁶

Most BBB+ rated 10 year DRP estimates produced by applying this [Nelson-Siegel] methodology to larger samples of input bond yield data lie at or about the DRP level estimated by the extrapolated BBB fair value curve [using the paired bonds methodology].

This is a similar finding to the results reported by PwC using both the econometric (regression) approach and the paired bonds approach:⁵⁷

For the 20 day averaging period to 16 December, 2011, we found a close correspondence between the extrapolated Bloomberg estimate of the 10 year BBB+ debt risk premium and our own econometric estimates (whether based on a linear or a power function), which rely on a different sample of bonds, and have applied a different estimation methodology.

We have not included the option of a “custom made” yield curve in the set of the extrapolation methods that we have tested. Most importantly, if a custom made yield curve was to be derived – and expressed in a form that is mechanical – then we would expect it to be used to estimate 10 year cost of

⁵⁴ PwC (2012) *Electranet: estimating the benchmark debt risk premium*; and CEG (June, 2013), *Estimating the debt risk premium*.

⁵⁵ See G. Schwartz (1978), ‘Estimating the Dimension of a Model,’ *Annals of Statistics*, Vol. 6, NBo.2, pp.461-464. The Schwartz Information Criterion test is used to avoid ‘statistical over-fitting’ by reference to the efficiency of a regression equation (where fewer parameters and higher statistical significance indicate greater efficiency). ‘Statistical over-fitting’ could result in a close correspondence of the estimation curve to the data, but with less confidence in the fact that these coefficients are not due to chance.

⁵⁶ CEG (June, 2013), p.11.

⁵⁷ PwC (March 2012), *SP AusNet, Multinet Gas, Envestra and APA Group: Estimating the benchmark debt risk premium*, p. ix.

debt directly, rather than to just extrapolate the debt risk premium from one reflecting a term of 7 years to 10 years. We also note that estimating yield curves from bond observations would not rank highly against many of the criteria to which we were asked to have regard, most notably the simplicity and implementation cost criteria. We would also question how easy it would be to make the derivation of yield curves sufficiently mechanical for the purpose at hand.⁵⁸

4.3 Conclusion

In this chapter we reviewed several alternative potential practical mechanical extrapolation methodologies, and found that the methodologies that should be investigated further in the next chapter are:

- Straight Line extrapolation
- US Bloomberg BBB+ Utilities index
- US Bloomberg BBB Composite index
- RBA BBB index
- QTC Methodology

⁵⁸ We draw a distinction here between estimating new yield curves in order to predict the change in the debt risk premium over part of those curves, and using econometric techniques to estimate the relationship between the change in the debt risk premium between 7 and 10 years and an explanatory variable or variables (with this relationship then being able to be applied in a mechanical manner). The QTC method is an example of the latter.

5. Assessment of alternative extrapolation methodologies

5.1 Introduction

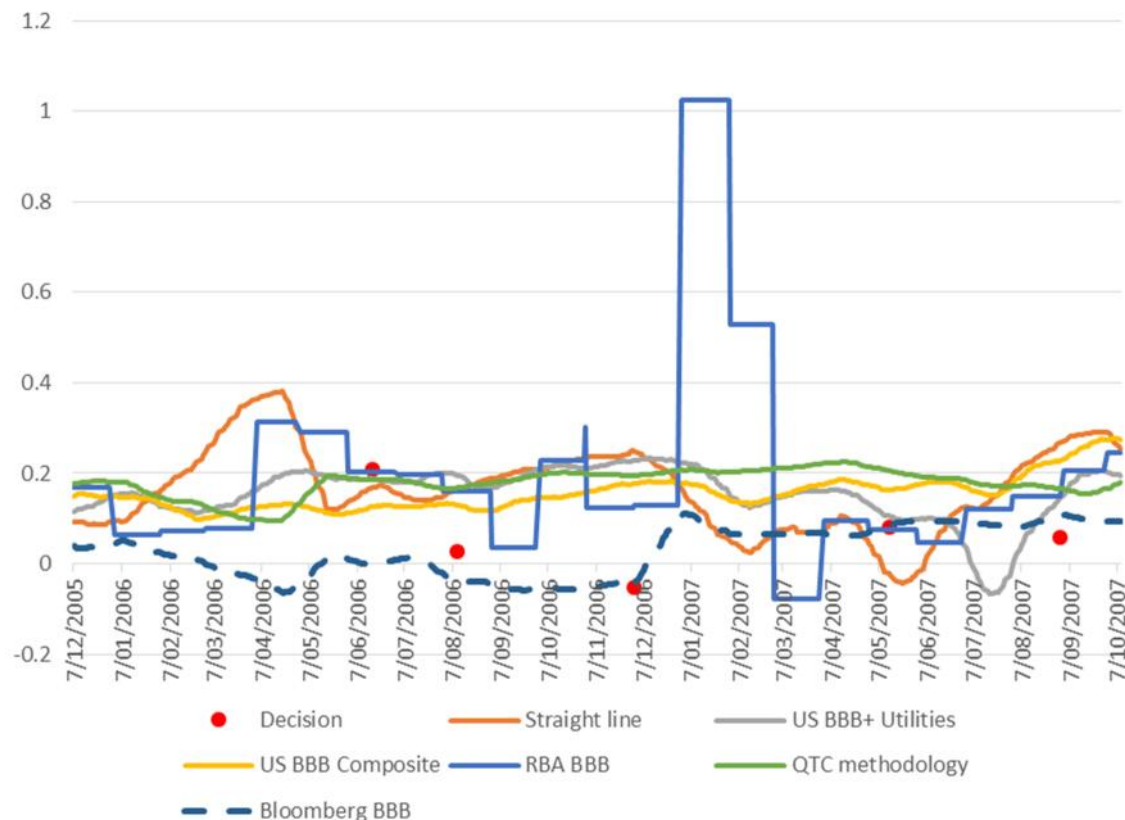
In this section we test the accuracy of five alternative extrapolation methodologies against the three benchmarks that were established in Chapter 3 above.

5.2 Performance of extrapolation methodologies

5.2.1 Accuracy against Bloomberg BBB BFV curve (2005-2007)

Figure 5.1 shows the variation in absolute debt risk premium extrapolations (7 to 10 years) over the relatively low market volatility period (2005 to 2007) that preceded the global financial crisis.

Figure 5.1: Debt risk premium extrapolation (7 to 10 years) for alternative methodologies, 2005 to 2007 (percentage points)



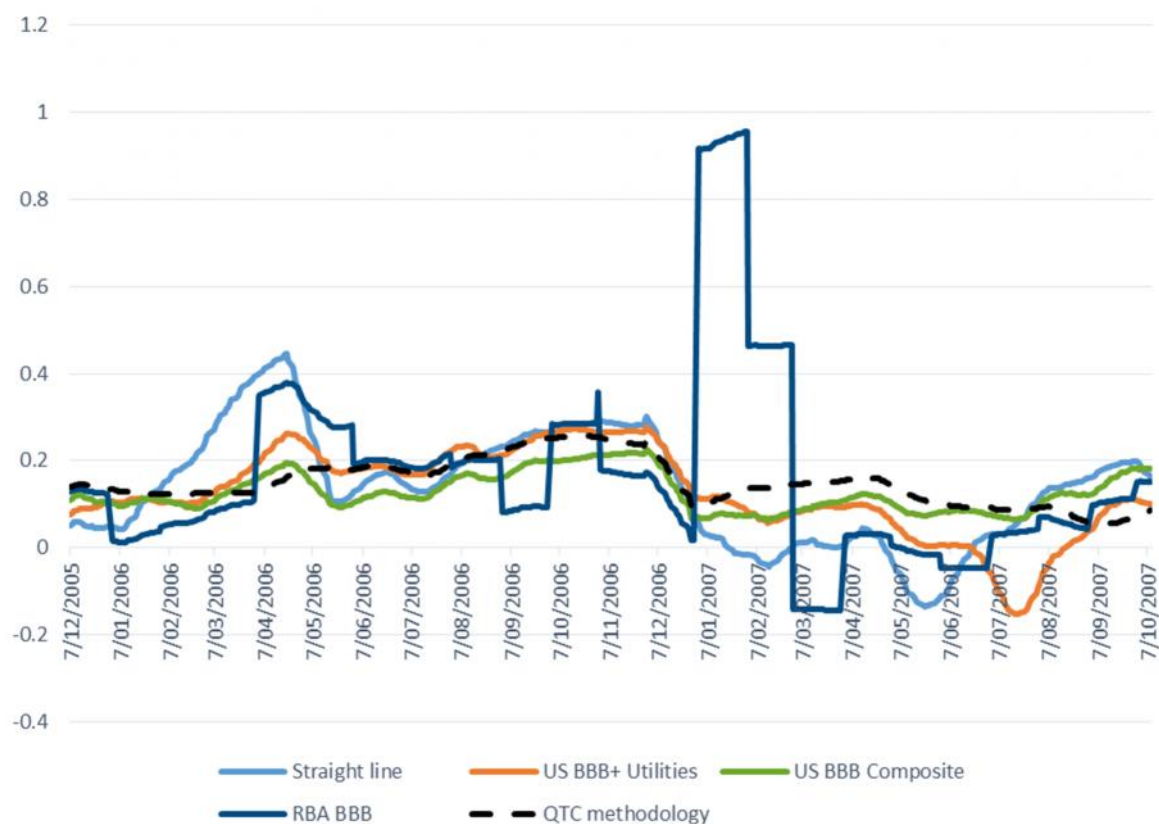
Source: Bloomberg, QTC, RBA and Incenta analysis

Some noteworthy aspects of this figure are the fact that the QTC methodology produced extrapolations that were uniformly high (at approximately 20 basis points) relative to other methodologies and that were relatively invariant over time. The RBA methodology's implied extrapolation between 7 and 10 years ranged from being negative for a short time and extremely high at one point (early in 2007). By contrast the extrapolation implied by the Bloomberg fair value curve was relatively low and indeed negative for a considerable period. Most of the regulatory decisions for

energy transmission and distribution businesses followed the Bloomberg 10 year BBB fair value curve’s implied 7 to 10 year debt risk premium extrapolation quite closely.

Figure 5.2 below shows that in almost all years, almost all of the alternative methodologies had a higher 7 to 10 year debt risk premium extrapolation value than the Bloomberg extrapolation, often by as much as 10 to 30 basis points. The highest differentials were for the Straight line and QTC methodologies. With respect to the latter, we have already noted our concern that the values have been derived based on a relationship between the 7 year SRP and the SRP term premium for a later period (in this case over the entire period 2006 to 2013).

Figure 5.2: Bias in 7-10 year extrapolation from Bloomberg BBB BFV curve extrapolation (percentage points)



Source: Bloomberg, QTC, RBA and Incenta analysis

Table 5.1 displays the measures of accuracy for the alternative methodologies relative to the 7 to 10 year BBB debt risk premium extrapolation implied by the benchmark Bloomberg. The RBA BBB methodology was the least accurate during this period, with a high RMSE driven for the most part by a relatively high positive bias. The US BBB Composite index performed the best against this benchmark during this period (RMSE of 13.5 basis points). The QTC methodology was positioned in the middle of the group in terms of overall accuracy (RSME of 16 basis points).

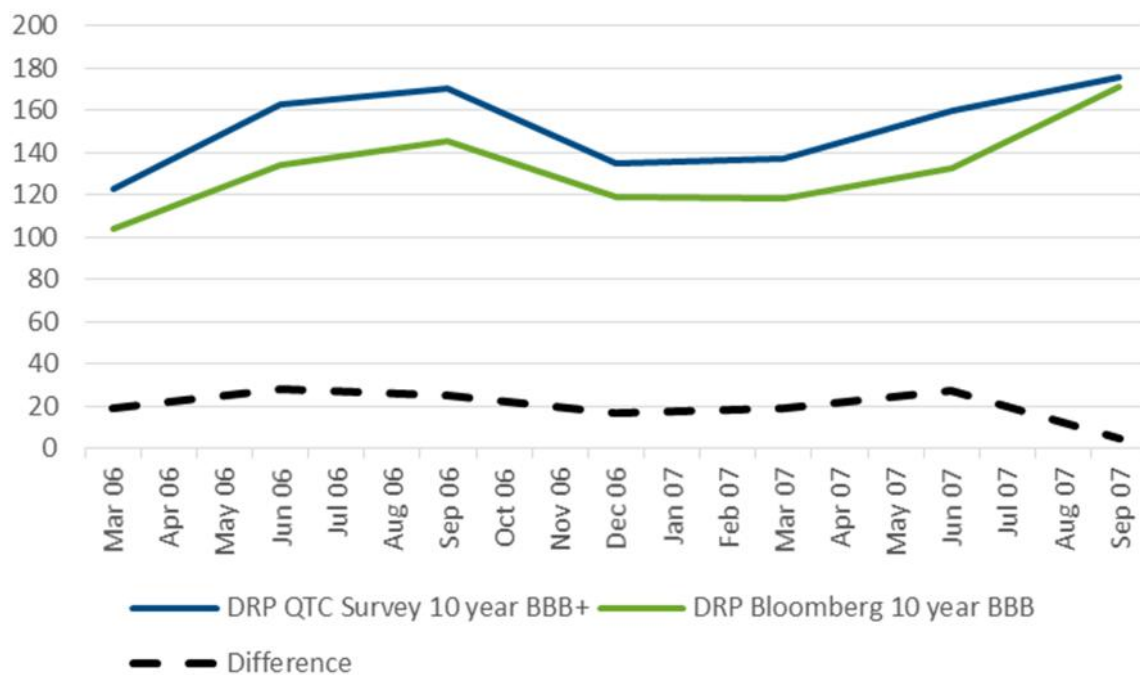
Table 5.1: Accuracy of alternative DRP extrapolation methodologies – relative to Bloomberg 10 year BBB, 2005 – 2007 (basis points)

Extrapolation methodology:	RMSE	Bias	Standard Deviation
Straight line	18.9	13.8	13.0
US BBB+ Utilities	16.1	12.7	9.9
US BBB Composite	13.5	12.7	4.4
RBA BBB	27.4	16.6	21.8
QTC methodology	16.0	15.0	5.3

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

As noted above, we have some concerns about the accuracy of the benchmark, the Bloomberg fair value curve, during this period of relatively low market volatility. As shown in Figure 5.3 below, between 2006 and 2007 the 10 year Bloomberg BBB debt risk premium was on average 20 basis points lower than the QTC survey’s 10 year BBB+ debt risk premium.

Figure 5.3: Debt risk premium at 10 years – QTC survey vs Bloomberg Fair value curve – 2006 to 2007 (basis points)



Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

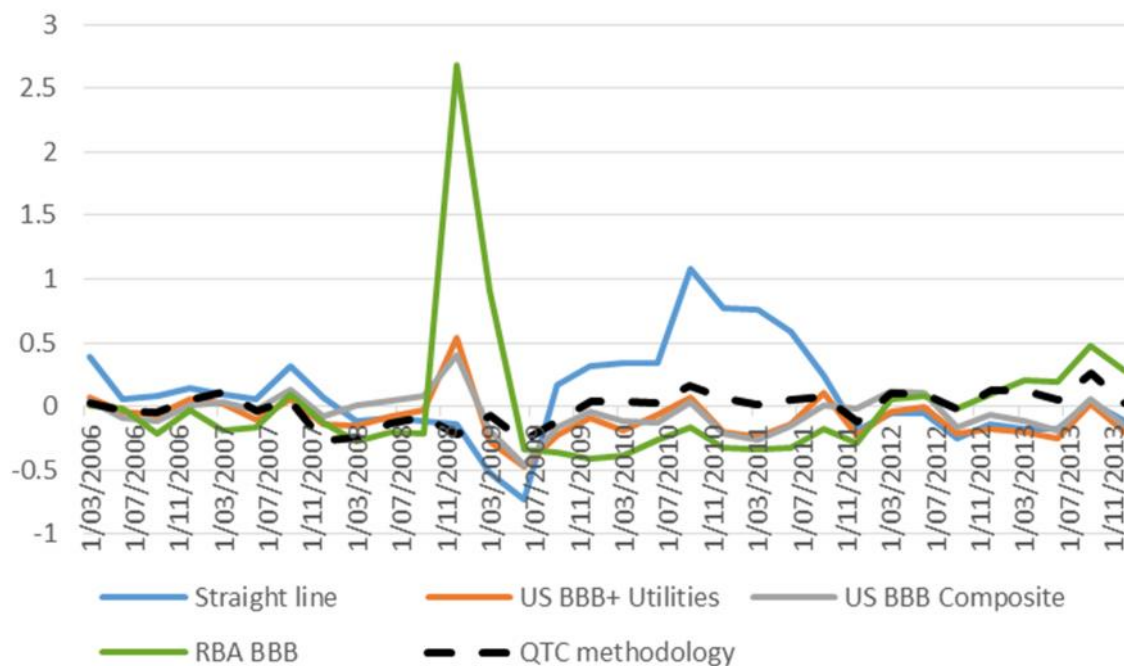
5.2.1 Accuracy against QTC survey

Figure 5.3 shows the absolute values of the debt risk premium extrapolations derived by our five alternative methodologies over the period from 2006 to 2013 compared with the QTC survey. While it might be objected that the QTC methodology is derived via a process that is linked to the QTC survey, and therefore would be expected to perform well against it, due to the smoothing element of the QTC methodology there is no reason to expect that it would perform best in all sub-periods. In

addition, the QTC methodology is the only method we have tested that uses an empirical relationship to predict the required extrapolation, and so testing the QTC methodology against the QTC survey also provides information on how a fairly simple empirical relationship performs compared to methods that are based upon more direct observations or interpretations of market evidence. We also note that the QTC survey is one of three benchmarks that we have measured performance against, and that our preferred benchmark (which we give most weight to) is the ‘paired bonds’ methodology. However, we also note that the strength of the QTC survey methodology is its direct relationship to market evidence, since it is based on the opinions of 6 of the leading Australian banking organisations.

We found the RBA methodology and the Straight line extrapolations were the most highly variable among these methodologies, with the QTC methodology again being the most stable. It is also noticeable that the extrapolations implied by the RBA methodology and the two US Bloomberg indexes increased significantly during the height of the global financial crisis, as would be expected. However, the Straight line extrapolation and the QTC methodology extrapolations both reduced at this time.

Figure 5.4: Bias in 7-10 year extrapolations based on QTC survey, 2006 to 2013 (percentage points)



Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

Figure 5.4 shows that for most of the period, most of the alternative methodologies had debt risk premium extrapolations that were below those implied by the QTC survey of practitioners. That is, for most of the time, and particularly during the global financial crisis, practitioners thought that the 7 to 10 year debt risk premium was higher than the other methodologies implied. In the last two years, however, the RBA methodology and the QTC methodology have implied a debt risk premium above the QTC survey, while all other methodologies have been below.

Table 5.2 shows that over the whole period the QTC methodology and the US BBB Composite index have been the most accurate relative to the QTC survey benchmark. Most methods predicted a lower extrapolation than the QTC survey benchmark on average as expected based on the figures above, with the Straight Line methodology being the only one with a high positive average difference. The RBA methodology exhibited a low degree of bias (0.8 basis points), but a very high degree of variability (Standard Deviation of 56.3 basis points). Not surprisingly, the RBA methodology's RMSE measure was also high (56.3 basis points).

Table 5.2: Alternative DRP extrapolation methodologies – relative to the QTC survey benchmark, 2006 to 2013 (basis points)

Extrapolation methodology:	RMSE	Bias	Standard Deviation
Straight line	37.5	9.3	36.3
US BBB+ Utilities	19.3	-9.2	16.9
US BBB Composite	15.7	-9.1	12.8
RBA BBB	55.4	0.8	55.4
QTC methodology	12.4	-0.5	12.4

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis. Note: This table is based on 32 quarterly observations for the QTC survey.

In Table 5.3 we show how the alternative methodologies performed against the QTC survey benchmark during the four sub-periods defined in Chapter 3.

Table 5.3: Alternative DRP extrapolation methodologies - differences from the QTC survey benchmark (basis points)

Period:	1: Jan 06 - June 07			2: Sept 07 - Dec 09			3: Mar 10 - Dec 11			4: Mar 12 - Dec 13		
Sample days	N=6			N=10			N=8			N=8		
Methodology:	RMSE	Bias	SD	RMSE	Bias	SD	RMSE	Bias	SD	RMSE	Bias	SD
Straight line	18.1	13.7	11.9	33.1	-8.5	32.0	61.6	49.2	37.0	14.4	-11.8	8.3
US BBB+ Util.	6.6	-1.2	6.5	26.5	-8.9	25.0	17.0	-11.2	12.8	16.8	-13.5	10.1
US BBB Comp	6.7	-2.9	6.0	21.7	-3.0	21.5	14.4	-10.5	9.8	12.7	-5.3	11.6
RBA BBB	13.5	-10.1	8.9	92.7	17.6	91.1	29.4	-28.5	7.3	22.5	17.2	14.5
QTC method.	5.8	1.2	5.7	17.1	-13.0	11.2	8.5	3.9	7.6	12.4	9.6	7.8

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

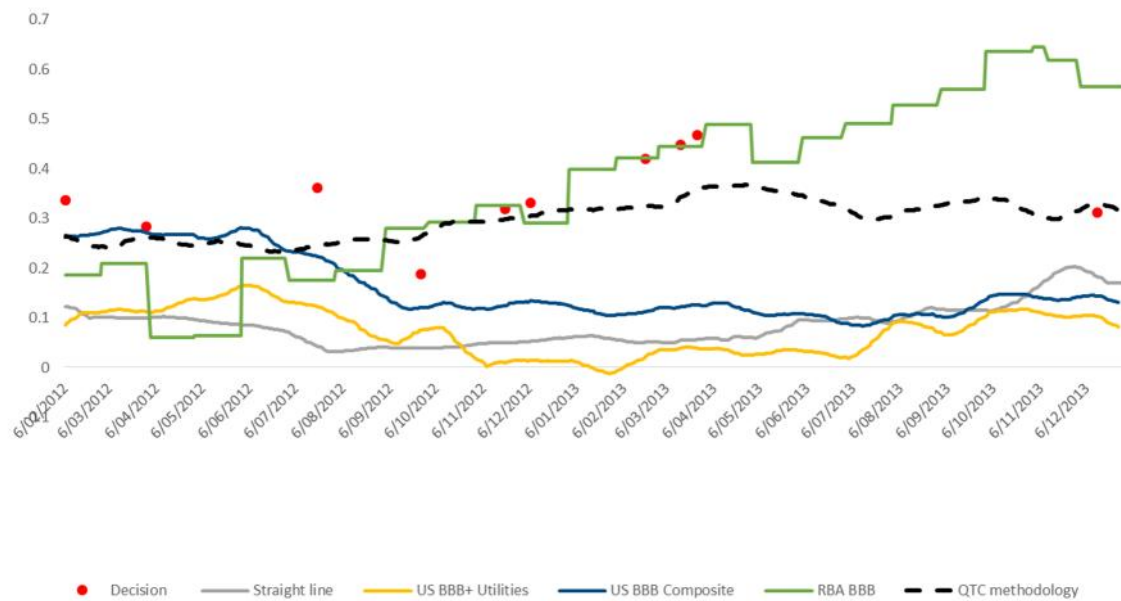
The same general pattern observed over the whole of the period is shown to apply in the sub-periods, with the exception of the first period (where the US Utilities BBB+ index moves from 3 to 2 and the US BBB Composite index method moves down a position) and the relative ranking of the least accurate methods (the RBA method and the straight line method) alternate.

5.2.2 Accuracy against AER's 'paired bonds' decisions

In Figure 5.5 the debt risk premiums implied by the AER's decisions based on a paired bonds analysis (for 2012 to 2013) are set against the alternative extrapolation methodologies. During 2012, the extrapolation implied by several of these methodologies, including the Straight line extrapolation and the two US Bloomberg indices fell, and have more recently increased to a level of 10 to 20 basis points. The 7 to 10 year debt risk premium implied by the RBA BBB index rose from approximately 20 basis points at the beginning of the period to much higher levels by the end of 2013 (50 to 60 basis points). For the QTC methodology the extrapolation rose from approximately 20 basis points to

approximately 30 basis points. The debt risk premium implied by the RBA BBB methodology was well below the AER’s decisions during the start of 2012. It then matched these decisions quite closely in early 2013, but by December 2013 had risen well above the AER’s decision based on a ‘paired bonds’ analysis.

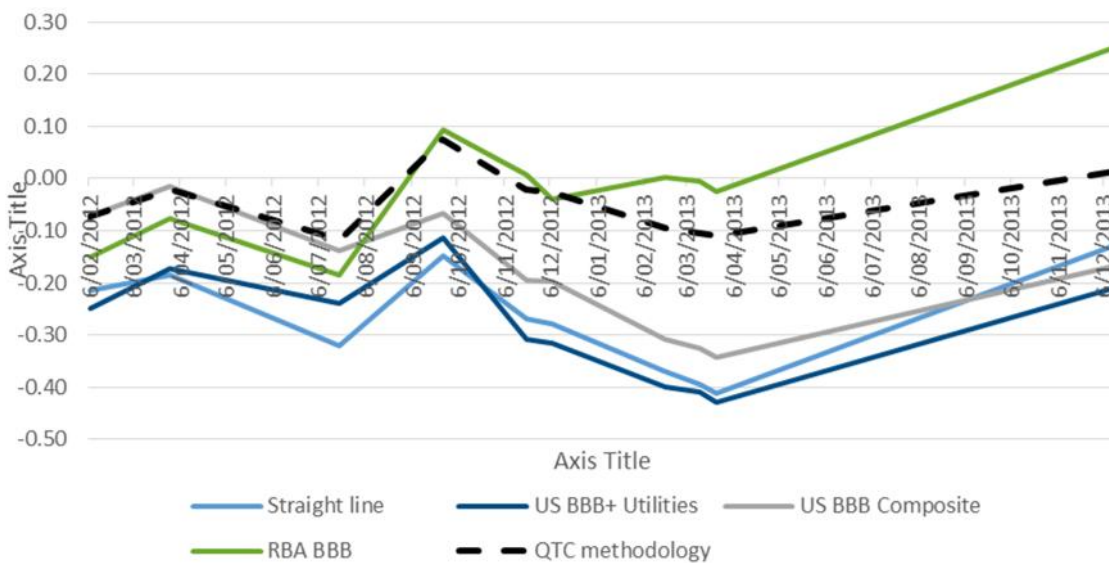
Figure 5.5: Debt risk premium extrapolation (7 to 10 years) for alternative methodologies, 2012 to 2013 (percentage points)



Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

The relativities to the AER’s paired bonds decisions are shown more clearly in Figure 5.6 below. This figure shows that the QTC methodology and the RBA methodology provided the best overall estimates of the AER’s paired bonds decisions, being sometimes above and at other times below these decisions. On the other hand, the other three methodologies (Straight line and the US Bloomberg indices) were uniformly below the AER’s 7 to 10 year term debt risk premium decisions based on the ‘paired bonds’ methodology.

Figure 5.6: Bias relative to 7-10 year extrapolation from AER’s ‘paired bonds’ decisions (basis points)



Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

Table 5.4 sets out the measures of accuracy of these alternative extrapolation methods compared to the ‘paired bonds’ benchmark. The most accurate method against this benchmark was the QTC method, which had a RMSE value of 7.7 basis points, followed by the RBA BBB and then the US BBB Composite index method, with the Straight line and US BBB+ Utilities index methods the least accurate. Consistent with the figure above, all methods under-predicted the extrapolation against the ‘paired bonds’ value, although the bias exhibited by the RBA BBB and QTC methods were reasonably modest (-1.3 basis points and -4.8 basis points).

Table 5.4: Alternative DRP extrapolation methodologies – relative to the AER’s ‘paired bonds’ decisions (basis points)

Extrapolation methodology:	RMSE	Bias	Standard Deviation
Straight line	28.9	-27.2	9.7
US BBB+ Utilities	30.2	-28.5	10.1
US BBB Composite	21.3	-18.3	10.9
RBA BBB	11.7	-1.3	11.7
QTC methodology	7.7	-4.8	6.0

Source: Bloomberg, RBA, QTC, AFMA and Incenta analysis

5.3 Relative rankings of the methodologies

As noted above, in determining the rankings of the methodologies we have placed considerable weight on the AER ‘paired bonds’ decisions benchmark, since this methodology is the only one that applies a ‘controlled experiment’ where the only reason for an observed yield differential is term (owing to the bonds of the same issuer being used). The period covered by the ‘paired bonds decisions’ (2012 – 2013) was also relatively stable compared with earlier periods that include the global financial crisis and the sovereign debt crisis.

On the basis of the information set out above, we rank the QTC methodology as the most accurate extrapolation method, with the US Bloomberg BBB Composite index being second. In relation to the QTC method, we observe that it:

- Provided the lowest RMSE against the ‘paired bonds’ benchmark, which is the benchmark in which we have the most confidence as to its accuracy. The QTC method also produced a low level of bias (-4.8 basis points) against this benchmark, and so is unlikely to lead to material windfall gains or losses, on average.
- Produced the lowest RMSE against the QTC survey in all sub-periods.
- While less accurate than the US BBB Composite Index against the Australian Bloomberg 10 year BBB fair value curve (which applied to the 2005-2007 period), the difference in accuracy was only marginal (RMSE of 16.0 compared to 13.5). Moreover, we have the least faith in the Bloomberg 10 year BBB benchmark as a measure of the accuracy in the change in the ‘true’ debt risk premium between 7 and 10 years.⁵⁹

We consider the US BBB Composite index should be ranked second because:

- it is the second best performer against the QTC survey and Bloomberg BBB benchmark, and
- while it is ranked behind the RBA method against the ‘paired bonds’ benchmark, the RBA method is the least accurate against the QTC survey and the Bloomberg 10 year BBB benchmarks.

The relative ranking of the remaining methods is unimportant; however, we note for completeness that it would be reasonable to rank:

- the US Bloomberg BBB+ Utilities index third because of its greater consistency against the different benchmarks, and
- the RBA method as marginally ahead of the straight line method – while these are hard to split given that they both perform against two benchmarks and well against the third, the RBA method does perform well against the ‘paired bonds’ benchmark, which as noted above is the benchmark in which we consider it reasonable to have the most confidence.

⁵⁹ During the 2005 to 2007 period Bloomberg’s 10 year BBB debt risk premium was heavily influenced by a Snowy Hydro bond, and owing to government ownership this was likely to have a lower yield than a benchmark bond with the same term to maturity. See ACG (September, 2004), *Dalrymple Bay Coal Terminal: Debt Margin and Debt Issuance Costs*, Report to Queensland Competition Authority, p.10.

6. Statement of authorship and qualifications

This report has been prepared by Mr. Jeff Balchin and Dr. Michael Lawriwsky. We have made all the enquiries that we believe are desirable and appropriate, and no matters of significance that we regard as relevant have, to our knowledge, been withheld. Copies of the curriculum vitae of each author are attached below.

Mr. Balchin and Dr. Lawriwsky have been provided with a copy of the Federal Court of Australia's 'Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia'. This report has been prepared in accordance with those Guidelines, which are attached below together with the Terms of Reference.

Appendix A: Conversion of USD yields to AUD yields

Six steps are required to derive the debt risk premium for a foreign fixed rate bond:⁶⁰

- First, using the foreign currency fixed/ floating swap rate for the remaining term to maturity of the bond, calculate the foreign currency spread by taking the difference of the yield for the foreign currency bond and the foreign currency floating rate index (e.g. Libor for US bonds).
- Convert the spread calculated in step 1 from foreign currency terms into Australian Dollar terms. This conversion recognises that the spread calculated in step 1 is a foreign spread, and cannot be used to represent an Australian spread. The ‘spread conversion’ for the remaining term to maturity of the bond is approximated by a relative duration method, which is to:
 - Determine the present value of the periodic foreign currency spread payments using the foreign currency fixed/ floating swap rate as the discount rate, and
 - Estimate the implied periodic Australian dollar spread payments using the present value of the foreign currency spread payments and using the Australian fixed/ floating swap rate (quarterly payment frequency) as the discount rate.
- Secondly, add the Australian fixed/ floating swap rate (quarterly frequency) for the remaining term to maturity of the bond to the spread determined in step 2.
- Thirdly, add the Australian BBSW/ Foreign Currency basis swap for the remaining term to maturity of the bond to the value calculated in step 3. The basis swap recognises that a foreign basis point is not equivalent to an Australian basis point. This calculation produces the Australian-equivalent fixed rate yield of the foreign currency bond yield.
- Fourthly, annualise the rate determined in step 4.
- Subtract the annualised Commonwealth Government Security yield for the remaining term to maturity of the bond from the yield in step 5 to determine the annualised Debt Risk Premium.

These 6 steps recognise that the translation of a non-AUD fixed rate bond to an AUD yield equivalent is best undertaken through the mechanism of the Cross Currency Swap. The Cross Currency Swap is a well-recognised market instrument used to convert or translate fixed or floating rate assets or liabilities from one currency to another. The translation may be for hedging or for analytical purposes.

⁶⁰ This is based on Appendix C of PwC (June, 2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*, which is the approach that has been applied in this report.

Appendix B: CVs of authors

Jeff Balchin

Managing Director

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Jeff is the Managing Director of Incenta Economic Consulting. Jeff has 20 years of experience in relation to economic regulation issues across the electricity, gas, ports, airports and water sectors in Australia and New Zealand. He has advised governments, regulators and major corporations on issues including the development of regulatory frameworks, regulatory price reviews and issues around the introduction and measurement of competition (including franchise bidding). Jeff has undertaken a number of expert witness assignments. In addition, Jeff has led a number of analytical assignments for firms to understand the responsiveness of consumers to changes to prices and related factors (like promotional activities) and to use this information to inform pricing strategy, and has assisted with the application of economic principles in transfer pricing matters. His particular specialities have been on the application of finance principles to economic regulation, the design of incentive compatible regulation and efficient tariff structures, the drafting and economic interpretation of regulatory instruments and the application of economic principles to pricing in unregulated markets.

Past positions

Jeff previously was a Principal at PwC in its economics and policy team for almost 4 years, prior to that a director and partner at the Allen Consulting Group for over 13 years, and prior that he held a number of policy positions in the Commonwealth Government. In this latter role, he was on the secretariat of the Gas Reform Task Force (1995-1996), where he played a lead role in the development of the National Gas Code.

Relevant experience

A. Economic regulation of network / monopoly activities

- Assistance to parties during price reviews/negotiations
- Design of incentives for operating expenditure efficiency (Client: ElectraNet, 2012-13) – provided expert advice on the detailed application of the incentive arrangements for operating expenditure, including the link between the incentive scheme and the forecasting method.
- Regulatory depreciation (Client: APA, 2012-13) – provided expert reports on the economic principles relevant to the depreciation method that is applied to set gas transmission charges.
- Regulatory cost of debt (Clients: Powerlink, ElectraNet and Victorian gas distributors 2011-2012) – provided a series of reports addressing how the benchmark cost of debt should be established pursuant to the National Electricity Rules and on the appropriate benchmark allowance for debt and equity raising costs.
- Strategic advice, Victorian electricity distribution review and NSW gas distribution review (Client: Jemena Electricity Networks, 2009-2011) – retained as strategic adviser during the review and also provided advice on a range of technical regulatory economic issues, including on regulatory finance matters, service incentives, party contracts, allocation of costs between regulated and unregulated activities and forecasting of expenditure.

- Regulatory cost of debt (Client: Powercor Australia Limited, 2009-2010) – provided a series of reports addressing how the benchmark cost of debt should be established pursuant to the National Electricity Rules.
- Service incentive scheme (Client: Powercor Australia Limited, 2010) – assisted Powercor to quantify the financial effect that would have flowed if the former service performance incentive scheme had continued. Also prepared an expert report pointing to a material inconsistency in how the AER intended to close out the old scheme and the parameters for the new service performance incentive scheme, which was accepted by the AER.
- Input methodologies for NZ regulated businesses (Clients: Powerco NZ and Christchurch International Airport, 2009-2012) – advised in relation to the Commerce Commission’s development of input methodologies, focussing asset valuation, the regulatory cost of capital, the use of productivity trends in regulation and the design of incentive-compatible regulation. Also assisted in briefing counsel in subsequent reviews.
- 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, 2008-2013) – 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 a series of statements on how taxation should be treated when measuring realised and projected regulatory profit.
- Application of Directlink for Regulated Status (Client: Directlink, 2003-2004) – Prepared advice on the economic efficiency of the conversion of an unregulated (entrepreneurial) interconnector to a regulated interconnector and how the asset should be valued for pricing purposes.
- 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).

- 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 efficiency of the conversion of an unregulated (entrepreneurial) interconnector to a regulated interconnector and how the asset should be valued for pricing purposes.
- 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 describing the pricing principles that should apply to the South West Pipeline (this gas transmission pipeline was a new asset, linking the existing system to a new storage facility and additional gas producers).
- 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.

Major roles for regulators

- 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.
- DBCT price review (Client: QCA, Qld, 2004-2006) – advice on a number of finance related issues, including the calculation of IDC for a DORC valuation, cost of debt and equity beta.
- 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.
- 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.
- 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.

Development/Review of Regulatory Frameworks

- Review of the Australian energy economic regulation (Client: Energy Networks Association, 2010-2012) – assisting the owners of energy infrastructure to engage in the current wide-ranging review of the regime for economic regulation of energy infrastructure. Advice has focussed in

particular on the setting of the regulatory WACC and on the regime of financial incentives for capital expenditure efficiency, and included strategic and analytical advice, preparation of expert reports and assistance with ENA submissions.

- Review of the Australian electricity transmission framework (Client: Grid Australia, 2010-2013) – assisting the owners of electricity transmission assets to participate in the wide-ranging review of the framework for electricity transmission in the national electricity market, covering such matters as planning arrangements, the form of regulation for non-core services and generator capacity rights and charging. Has included analytical advice on policy choices, facilitation of industry positions and articulation of positions in submissions.
- Implications of greenhouse policy for the electricity and gas regulatory frameworks (Client: the Australian Energy Market Commission, 2008-2009) – Provided 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 (including transmission pricing) for generators and the appropriate specification of a cost benefit test for transmission upgrades in light of the two policy initiatives.
- Economic incentives under the energy network regulatory regimes for demand side participation (Client: Australian Energy market Commission, 2006) – Provided advice to the AEMC on the incentives provided by the network regulatory regime for demand side participation, including the effect of the form of price control (price cap vs. revenue cap), the cost-efficiency arrangements, the treatment of losses and the regime for setting reliability standards.
- 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) - advice to the Department regarding on issues relating to the transition to national energy market arrangements, cross ownership rules for the energy sector, the reform of the cost benefit test for electricity transmission investments and the scope for lighted handed regulation in gas transmission.
- 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.
- 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 new legal framework for the economic regulation of gas transmission and distribution systems, with advice spanning the overall form of regulation to apply to the infrastructure and the appropriate 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 whether upstream infrastructure should be included within the regime.

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 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.
- 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.

Assessments of the need for regulation

- South East network (Client: Kimberley Clarke, 2011) – advised whether the gas pipeline from which it is supplied would pass the threshold for regulation.
- Need for regulation of gas transmission pipelines (Client: SA Government) – advised as to whether the Moomba to Adelaide pipeline was likely to pass the threshold required for regulation.

B. Pricing in non-infrastructure markets

Assessment of competition in energy retail markets

- Assessment of retail competition in Victoria and South Australia (Client: Australian Energy Market Commission) – assisted the Commission to quantify and interpret information on margins

for retailers and draw inferences for the level of competition. Also reviewed the Commission's assessment of the other indicators of the level of competition.

Default/transitional regulated prices for retail functions

- ACT transitional tariff review (Client: ICRC, ACT, 2010) – advised the regulator on an appropriate method to derive a benchmark wholesale electricity purchase cost for an electricity retailer, including the relationship between the wholesale cost and hedging strategy.
- South Australian default gas retail price review (Client: the Essential Services Commission, SA, (2007-2008) - 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) - 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.
- 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.

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, 1960) - 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.

Transfer pricing

- Application of a netback calculation for infrastructure under the Minerals Resource Rent Tax (Client: BHPB, 2011-13) – advised on how the arms-length price for the use of downstream infrastructure should be determined, including the valuation of assets, weighted average cost of capital and on the implications for the price of incentive compatible contracts.

Pricing strategy

- Pricing for telephone directory services (Sensis, 2012) – as part of a team, advised on how margins could be maximised for the telephone directory business in the context of falling print advertising and a very competitive digital market, informed by the application of econometric techniques.
- Effectiveness of promotional strategies (Target, 2011-12) – as part of a team, applied econometric techniques to assess the effectiveness of Target’s promotional strategies, with tools developed for management to improve profitability.
- Optimal pricing (Client: Coles, 2011-12) – applied econometric techniques to assist Coles to set relativities of prices within “like” products and developed a method to test the effectiveness of promotional strategies.

C. Regulatory due diligence and other finance work

- Sale of the Sydney Desalination Plant (Client: a consortium of investors, 2011-12) – Prepared a regulatory due diligence report for potential acquirer of the asset, including a review of the financial modelling of future pricing decisions.
- Sale of the Abbot Point Coal Terminal port (Client: a consortium of investors / debt providers, 2010-11) – Prepared a regulatory due diligence report for potential acquirer of the asset, including a review of the financial modelling of future pricing decisions.
- 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.
- Sale of Allgas gas distribution network (Client: confidential, 2006) – Prepared a regulatory due diligence report for potential acquirer of the asset.
- 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, taking account of the likely impact of cost based regulation.

D. Expert Witness Roles

- Abbot Point Coal Terminal Pricing Arbitration (Client: Adani, 2013) – Prepared a number of expert reports for the arbitration on economic issues arising from the application of the cost-based formula in the pricing agreement, including the economic meaning of key terms, the valuation of assets (and specifically the role and calculation of interest during construction), the quantification of transaction costs of raising finance and the calculation of the required rate of return (most notably, the benchmark cost of debt finance).
- New Zealand Input Methodologies (Clients: Powerco and Christchurch International Airport Limited, 2009-2012) – Prepared expert report for both clients on a range of economic issues, including the valuation of assets, weighted average cost of capital, cost allocation, the regulatory treatment of taxation and interpretation of the new purpose statement in the Commerce Act. Appeared as an expert before the Commerce Commission in the key conferences held during the review. Also assisted the clients in their subsequent merit reviews of the Commission’s decision.
- Victorian gas market dispute resolution panel (Client: VENCORP, 2008) – Prepared a report and was cross examined in relation to the operation of the Victorian gas market in the presence of supply outages.
- 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.

Qualifications and memberships

- Bachelor Economics (First Class Honours) University of Adelaide
- CEDA National Prize for Economic Development

Dr. Michael Lawriwsky

Executive Director

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Michael is an Executive Director at Incenta. Previously he was a director at PricewaterhouseCoopers (Australia), a director and partner in the Allen Consulting Group, and a director – corporate finance in ANZ Investment Bank. He has had a career spanning academia, investment banking and economic policy advice. He has had involvement in regulation and market reform in wide a range of businesses spanning energy, transport, water, gaming and wagering. He has advised on over \$15 billion of bids in the Australian energy and transport sectors.

Regulatory and Policy roles:

- International Air Services Commission - Between 1997 and 2007 Michael was a part-time Commissioner of the International Air Services Commission. The IASC was established in 1992 as an independent body regulating new entrant airlines and allocating capacity to Australian international airlines with an objective of strengthening competition.
- Review of Business Programs (Mortimer Report) - In November 1996 Dr. Lawriwsky was appointed to the Review of Business Programs under the leadership of Mr. David Mortimer (Mortimer Report). This was a major review of Government support programs for business with a 15 person secretarial staff. The process included public forums, stakeholder interviews with key government and business groups, and analysis of numerous submissions. The report led to the formation of Invest Australia.

Relevant experience by sector

Regulated gas networks:

- Energy Networks Association – assessment of the appropriate term for the risk free rate when estimating the cost of equity.
- Jemena Gas Networks – advice on the appropriate methodology to estimate the cost of debt in relation for gas transmission assets. This is part of the WACC proposal for a gas network revenue determination.
- Essential Services Commission (Victoria) – adviser to the ESC on cost of capital issues associated with the 2007-2008 Gas Price Review.
- QCA – adviser on cost of capital issues (including beta) in relation to Queensland gas distribution assets.
- QCA – adviser on the prepayment of network charges by Envestra.
- Allgas – Adviser on regulatory modelling and regulatory outlook for ANZ Infrastructure Services in its bid for Allgas.
- Envestra – adviser to ESCOSA and Queensland Competition Authority on cost of capital and working capital (prepayment) issues relating to Envestra’s 2006 access arrangements in SouthAustralia and Queensland respectively.

- ACCC – advised the ACCC on differentials between BBB and BBB+ for a gas utility in connection with an appeal lodged by the East Australia Pipeline Limited. ACCC – prepared a report on review of studies comparing international regulatory determinations, which was included as Appendix G of ACCC’s submission to Productivity Commission Review of the National Gas Code.
- BHP Billiton – advised BHP Billiton on its submission in response to the Draft Report of the Productivity Commission Review of the National Gas Code.
- Gas and Fuel (Gascor) – adviser to the company in relation to the potential purchase of the Wagga Wagga Gas Company from the City of Wagga Wagga.
- Gas and Fuel (Gascor) – mandated to critique Gascor’s weighted average cost of capital calculation used in regulatory tariff setting.
- The USA Gas Utility market – authored this ANZ Securities monograph examining the regulatory structure and market reforms introduced into the US gas industry and implications for Australia.
- Gas and Fuel Corporation – co-authored this ANZ Securities monograph

Regulated electricity networks:

- Energy Networks Association – assessment of the appropriate benchmark term of debt.
- Energy Networks Association – debt financing costs.
- Powerlink – adviser to Powerlink on regulatory cost of capital including beta, debt risk premium and on equity and debt raising transaction costs.
- Aurora Energy – advice to Aurora Energy by writing their debt risk premium submission to the Australian Energy Regulator
- CitiPower and Powercor - advice on the appropriate methodology to estimate the cost of debt in relation for electricity distribution assets, as part of the WACC proposal for an electricity network revenue determination.
- Independent Market Operator WA – advised the Western Australia’s wholesale electricity market operator, the Independent Market operator, by advising on the methodology to be used to calculate to estimate Allowance For Funds Used During Construction, and the WACC to be applied in the determination of the maximum reserve price for generation capacity.
- Energy Networks Association, APIA and Grid Australia – adviser on the AER review of WACC parameters for electricity transmission and distribution network service providers.
- Retail credit support arrangements – advised the Essential Services Commission of Victoria on new arrangements for credit support by electricity retailers.
- ETSA Utilities – adviser to the Essential services Commission of South Australia on cost of capital issues.
- Energex and Energon – advised the Queensland Competition Authority on cost of capital issues relating to the 2005 access arrangements of these companies.
- Electricity Commission of Papua New Guinea (PNG Power) – lead financial/strategic adviser to the PNG Government on the corporatisation/privatisation of PNG Power, managing a team of investment bankers, lawyers, accountants and regulatory consultants.

- Electricity Trust of South Australia (ETSA) – lead financial adviser to Edison Mission Energy in their bid for this \$3.5 billion electricity distribution and retailing company, particularly in relation to regulation, valuation, financial modelling and capital structure.
- Pacific Gas and Electric Company – lead financial adviser in bids for four electricity distribution/retailing companies totalling \$5.5 billion (United Energy, Powercor, Citipower, Eastern Energy).
- Electro Power Limited (NZ) – adviser to the company’s board in its merger negotiations with the contiguous Central Power Limited, including valuation and capital structure issues.

Energy:

- Snowy Hydro – Michael led a team undertaking a comprehensive valuation analysis of Snowy Hydro, including a cost of capital update.
- Snowy Hydro – Adviser to the Snowy Hydro on cost of capital (on-going annual review). • Southern Electric International (US) – advised on cost of capital with respect to Australian electricity generation assets.
- Energy Developments Limited – float valuation and pricing for this independent power project underwritten by ANZ Securities.
- Loy Yang A – coordinated a sell-down of \$30 million of equity in Horizon Energy Investments to institutional investors.
- Southern Hydro Limited – established a consortium of bidders for this privatisation (Pacific Hydro, Hyder Investments and Hastings Funds Management) and directed financial due diligence/valuation. Including capital structure determination.
- Electro Power Limited (NZ) – analysis of the rate of return on investment which would be required by investors in the Gateway Electronic Monitoring System (“GEMS”) – a “smart meter” technology.

Road and Rail:

- QCA – Adviser on equity beta and cost of debt for the Aurizon Network price review.
- Federal Government Department – Strategic and governance review of Australian Railtrack Corporation (ARTC).
- QCA – Adviser on the cost of capital issues relating to the Northern Missing Link railway.
- QCA – Adviser on cost of capital issues in relation to the Queensland Rail below rail network – coal price review.
- Victorian Department of Transport – adviser on new techniques for attracting private sector capital to the roads sector
- Victorian Auditor General’s Office – Adviser analysing the terms of the cost of capital for the financing of the Tulla-Calder freeway extension.
- Stagecoach plc – adviser to Stagecoach on cost of capital issues relating to bidding for rail infrastructure assets in Victoria.
- Adelaide-Darwin railway – adviser on regulatory issues to the ANZ Investment Bank project finance team in relation to this financing.

Ports:

- Infrastructure investor – advice on cost of capital issues in the course of an arbitration involving a significant unregulated transport infrastructure asset.
- Abbot Point Coal Terminal – regulatory adviser to the consortium comprising CKI and Deutsche Bank (RREEF), which bid for this asset (lead adviser, Macquarie Bank).
- Port of Brisbane – regulatory adviser to the Q Ports Holdings consortium partners, Industry Funds Management, Global Infrastructure Partners, QIC Global Infrastructure and Tawreed Investments, which won this bid and was awarded ‘Best Privatisation Deal’ and ‘Asian Infrastructure of the Year’ awards (lead advisor, Macquarie Bank). PwC received an award from Infrastructure Partnerships Australia for the role it played in this transaction.
- BHP Billiton – advise on Pilbara ports from a real options perspective
- Port of Melbourne Corporation – review of regulatory cost of capital for price monitoring by the Essential Services Commission.
- Wiggins Island Coal Terminal - adviser to the ANZ Bank and the User Group proposing a self-funded expansion of coal loading capacity at the Port of Gladstone.
- Port of Waratah – adviser to Newcastle Coal Infrastructure Group (NCIG) in relation to the Prime Minister’s Taskforce on Infrastructure.
- Dalrymple Bay Coal Terminal – Adviser to the Queensland Competition Authority on the WACC parameters (including beta) for DBCT.
- Port of Brisbane Corporation – strategic adviser to the port, including a review of strategic options and a valuation of the port’s operations.
- Ports of Portland and Geelong – advice on cost of capital to the ANZ Investment Bank team bidding for the assets on behalf of the Strang/Hastings consortium.
- Port of Napier (NZ) – reviewer of the valuation of the port by the ANZ Investment Bank Auckland office.

Aviation and tourism:

- Tourism Victoria – Adviser on commercial issues surrounding the proposed Werribee Theme Park.
- Travel Compensation Fund – Michael led a team which reviewed the TCF’s revenue model and proposed a new risk-based revenue model.
- Department of Transport and Regional Services – adviser to DoTRS in connection with financial issues associated with the proposed Air New Zealand/Ansett takeover in connection with the FIRB review.
- Qantas Airlines – float valuation and pricing when ANZ Securities was a joint Lead Manager of the initial float process.
- Australian Airlines – prepared a valuation and analysis for the purchase of the airline for a private consortium prior to the merger with Qantas.
- Indian Airlines – on an advisory panel of an ANZ team (based in London and Mumbai) mandated to sell a 26% stake in the Indian Government-owned domestic/international airline. • Compass Airlines – advised on the preparation of an Information Memorandum for an initial private equity raising to fund Compass Airlines (prior to the float by JB Were).

Airports:

- New Zealand Airports Association – analysis of airport betas for negotiations with airlines and the Commerce Commission.
- Virgin airlines – advice on cost of capital issues for negotiations with airports on landing charges.
- Federal Airports Corporation – directed a seven-month regulatory modelling, valuation and capital structure analysis of all 22 airports as part of the Capital Structure Review commissioned by the Department of Transport/Department of Treasury.
- Brisbane International Airport – lead financial adviser to the Port of Brisbane Corporation in the course of the successful Schiphol/CBA/POBC bid in 1997.
- Christchurch International Airport – adviser to the airport with respect to its negotiations with the NZ Commerce Commission on the cost of capital and implications for landing charges.

Water:

- Gladstone Area Water Board – adviser to the Queensland Competition Authority on the assessment of costs of capital parameters for the 2005 GAWB price review.
- Melbourne Water – adviser to Melbourne Water on its financial strategy, including capital structure, dividend policy and financial benchmarks.
- SA Water – adviser on its capital structure review and review of dividend policy.
- SA Water – adviser on commercialisation, and dividend policy in negotiations with the SA Treasury.
- Auckland City Council (NZ) – advice on the corporatisation of water and waste water assets.
- Gippsland Water – adviser on pricing policy with respect to future capital funding requirements. • South Gippsland Water – prepared a benchmarking analysis of corporate performance relative to peers.
- United Water – advised the company on the potential for listing on the stock exchange pursuant to requirements under the United Water Management Contract.

General regulatory assignments:

- QCA – Advice on a cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority.
- QCA – adviser on the level of regulated WACCs.
- Debt and equity transaction costs – Advised the ACCC on debt and equity transaction costs that could be applied in regulatory determinations.
- International evidence on regulatory rates of return – Adviser to the ACCC on rates of return provided internationally by regulators.
- Exceptional circumstances – advised the Queensland Competition Authority on appropriate regulatory responses to exceptional circumstances.
- Monte Carlo analysis – adviser to a regulatory agency assessing the efficacy of Monte Carlo analysis as a methodology to be employed in cost of capital studies for regulatory purposes.

Construction and industrial:

- Adroyal – prepared a takeover analysis of a potential target.
- Astec – prepared an independent valuation of the asphalt and quarrying operations to identify a carrying value in the books of the Standard Rods Group.
- GWA International – preparations for the refloating of 60% of the Anderson family’s interest.
- Expert’s Report on Futuris Corporation – prepared an Expert’s Report to the stakeholders of Air International Group Limited, an automotive air conditioner manufacturer, on the takeover offer by Keratin Holdings Pty Ltd (a wholly owned subsidiary of Futuris Corporation).
- Australian Tax Office – valuation of executive options over a listed company’s shares.

Media and Telecommunications:

- Telstra – analysis of the risk impacts of the NBN-Telstra deal, and its implications for the regulatory cost of capital for the fixed copper loop network.
- John Fairfax Group - undertook a valuation of the company that was used by the Banking Syndicate in its decision to take control under debt covenants.
- Austereo – reviewer of valuations of the Austereo radio licences for the Board of Directors.
- Australian Tax Office – valuation of shares in a UK media company for the ATO.

Resources:

- Review of hostile takeover – acted as adviser and expert witness to a party potentially seeking damages in a large hostile takeover bid of a major resources company, involving analysis of bid documents and valuation/modelling analysis.
- Ashton Mining – adviser to Ashton Mining Limited on the implementation of its 1999-2000 5% share buy-back and prepared a report on capital management options for the Board of Directors.
- MIM Holdings – participated in a comprehensive strategy report recommending divestment of non-core assets, debt reduction and restructure of shareholdings.
- Comindico – advised AGL with respect to the acquisition of a \$40 million equity interest in Comindico, overview of financial modelling and coordination of production of due diligence report.

Health:

- Victorian Auditor General’s Office – Performance audit of the \$1 billion Royal Melbourne Children’s Hospital.
- Department of Health (Victoria) – Analysis of the proposed user cost of capital approach to funding hospitals

Other:

- Infrastructure Partnerships Australia - Public Private Partnerships – Michael led a team that produced a report assessing the relative timing and construction cost efficiency of PPPs vs traditional procurement methods.
- Property Council of Australia – assessment of the scope and capacity of the Victorian Government to fund public infrastructure through increase public debt.
- Financial software developer – advised a financial software developer on merger and IPO options.

- Queensland Cane Growers' Association – advised the Association on the formula for the division of revenues between growers and millers and developed a new formula for negotiations with the millers.
- Godfrey Pembroke Financial Services – valuation of Godfrey Pembroke Financial Services Pty Ltd for FAI insurances Limited.
- Venture Stores – advised the ANZ Bank on a capital restructure including valuation, and the establishment of equity swaps in connection with negotiations between creditors and debt holders.
- Colonial Mutual Property Trust – advice on the fair terms for a merger of three listed and two unlisted property trusts.

Expert Opinions:

- Ferrier Hodgson – Expert opinion on the conduct of an investment bank advising on a multi-billion dollar merger transaction, which destroyed substantial shareholder value and resulted in a default of banking covenants.
- Essential Services Commission of Victoria – Relative bias in the yields of indexed Commonwealth Government Securities when used as a proxy for the CAPM risk free rate.
- Australian Taxation Office, Commerciality of AAPT's financial arrangements
- Australian Taxation Office, Statement on the financial arrangements of Futuris Corporation Limited

Qualifications and memberships

- Ph.D. B.Ec. (Hons) (University of Adelaide)
- Trustee and Chair of the Finance Committee, Shrine of Remembrance

Appendix C: Terms of reference

Terms of Reference – Extrapolation of the Bloomberg fair value curve

1 Background

Jemena Gas Networks (**JGN**) is the major gas distribution service provider in New South Wales (**NSW**). JGN owns more than 25,000 kilometres of natural gas distribution system, delivering approximately 100 petajoules of natural gas to over one million homes, businesses and large industrial consumers across NSW.

JGN is currently preparing its revised Access Arrangement proposal (**Project**) with supporting information for the consideration of the Australian Energy Regulator (**AER**). The revised access arrangement will cover the period 1 July 2015 to 30 June 2020 (July to June financial years).

As with all of its economic regulatory functions and powers, when assessing JGN's revised access arrangement (**AA**) under the National Gas Rules and the National Gas Law, the AER must do so in a manner that will or is likely to contribute to meeting the National Gas Objective, which is:

“to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.”

For electricity networks, the AER must assess regulatory proposals under the National Electricity Rules and the National Electricity Law in a manner that will or is likely to achieve the National Electricity Objective, as stated in section 7 of the National Electricity Law.

The AER must also take into account the revenue and pricing principles in section 24 of the National Gas Law and section 7A of the National Electricity Law, when exercising a discretion related to reference tariffs. The revenue and pricing principles include the following:

“(2) A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—

- a) providing reference services; and
- b) complying with a regulatory obligation or requirement or making a regulatory payment.

(3) A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes—

(a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services...

[...]

(5) A reference tariff should allow for a return commensurate with the regulatory and commercial risks involved in providing the reference service to which that tariff relates.

(6) Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.”

Some of the key rules that are relevant to an access arrangement and its assessment are set out below.

Rule 74 of the National Gas Rules, relating generally to forecasts and estimates, states:

- (1) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.
- (2) A forecast or estimate:
 - (a) must be arrived at on a reasonable basis; and
 - (b) must represent the best forecast or estimate possible in the circumstances.

Rule 87 of the National Gas Rules, relating to the allowed rate of return, states:

- (1) Subject to rule 82(3), the return on the projected capital base for each regulatory year of the access arrangement period is to be calculated by applying a rate of return that is determined in accordance with this rule 87 (the allowed rate of return).
- (2) The allowed rate of return is to be determined such that it achieves the allowed rate of return objective.
- (3) The allowed rate of return objective is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services (the allowed rate of return objective).
- (4) Subject to subrule (2), the allowed rate of return for a regulatory year is to be:
 - (a) a weighted average of the return on equity for the access arrangement period in which that regulatory year occurs (as estimated under subrule (6)) and the return on debt for that regulatory year (as estimated under subrule (8)); and
 - (b) determined on a nominal vanilla basis that is consistent with the estimate of the value of imputation credits referred to in rule 87A.
- (5) In determining the allowed rate of return, regard must be had to:
 - (a) relevant estimation methods, financial models, market data and other evidence;
 - (b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and
 - (c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.

[Subrules (6)–(7) omitted].

Return on debt

- (8) The return on debt for a regulatory year is to be estimated such that it contributes to the achievement of the allowed rate of return objective.
- (9) The return on debt may be estimated using a methodology which results in either:
 - (a) the return on debt for each regulatory year in the access arrangement period being the same; or
 - (b) the return on debt (and consequently the allowed rate of return) being, or potentially being, different for different regulatory years in the access arrangement period.

- (10) Subject to subrule (8), the methodology adopted to estimate the return on debt may, without limitation, be designed to result in the return on debt reflecting:
- (a) the return that would be required by debt investors in a benchmark efficient entity if it raised debt at the time or shortly before the time when the AER's decision on the access arrangement for that access arrangement period is made;
 - (b) the average return that would have been required by debt investors in a benchmark efficient entity if it raised debt over an historical period prior to the commencement of a regulatory year in the access arrangement period; or
 - (c) some combination of the returns referred to in subrules (a) and (b).
- (11) In estimating the return on debt under subrule (8), regard must be had to the following factors:
- (a) the desirability of minimising any difference between the return on debt and the return on debt of a benchmark efficient entity referred to in the allowed rate of return objective;
 - (b) the interrelationship between the return on equity and the return on debt;
 - (c) the incentives that the return on debt may provide in relation to capital expenditure over the access arrangement period, including as to the timing of any capital expenditure; and
 - (d) any impacts (including in relation to the costs of servicing debt across access arrangement periods) on a benchmark efficient entity referred to in the allowed rate of return objective that could arise as a result of changing the methodology that is used to estimate the return on debt from one access arrangement period to the next.
- (12) If the return on debt is to be estimated using a methodology of the type referred to in subrule (9)(b) then a resulting change to the service provider's total revenue must be effected through the automatic application of a formula that is specified in the decision on the access arrangement for that access arrangement period.

[Subrules (13)–(19) omitted].

The equivalent National Electricity Rules are in clauses 6A.6.2 (for electricity transmission) and 6.5.2 (for electricity distribution).

Accordingly, the independent opinion of Incenta, as a suitably qualified independent expert (**Expert**), is sought on extrapolating the Bloomberg BBB fair value curve from seven to 10 years as an input the return on debt component of the rate of return, in a way that that complies with the requirements of the National Gas Law and Rules, including as highlighted above. JGN seeks this opinion on behalf of itself and SA PowerNetworks.

2 Scope of Work

Having regard to the AER's position on estimating the cost of debt, as set out in the Rate of Return Guideline, the Expert will provide an opinion report that:

- (3) identifies and describes alternative approaches to extrapolating the Bloomberg BBB fair value curve (or equivalent) from seven to 10 years, including use of data, judgement, and statistical analysis;
- (4) compares the merits of each approach, in terms of their ability to estimate the return on debt using the Bloomberg fair value curve (or equivalent) that:
 - a. is commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to a regulated gas or electricity network in respect of the provision of reference services; and
 - b. can apply automatically to update the return on debt, with limited or no discretion needed;

- (5) recommends an approach, or combination of approaches, to extrapolate the Bloomberg BBB fair value curve (or equivalent) from seven to 10 years, having regard to the relative merits of the available approaches, and the requirements of the National Gas Law and Rules or National Electricity Law and Rules for the return on debt to be:
- a. commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to a regulated gas or electricity network in respect of the provision of reference services;
 - b. applied automatically to update the return on debt, with limited or no discretion needed.

In preparing the report, the Expert will:

- A. ignore paired bond analysis as one of the alternative approaches to extrapolating the Bloomberg BBB fair value curve (or equivalent) referred to in part 1 above;
- B. consider how approaches can apply both during a price review and automatically during a regulatory period;
- C. consider the stability, implementation cost, objectivity, reliability, transparency and accuracy of each approach;
- D. consider the theoretical and empirical support for each of the approaches; and
- E. consider any comments raised by the AER and other regulators on extrapolating the Bloomberg fair value curve.

3 Information to be Considered

The Expert is also expected to consider the following additional information:

- such information that, in Expert's opinion, should be taken into account to address the questions outlined above;
- relevant literature on the rate of return;
- the AER's rate of return guideline, including explanatory statements and supporting expert material;
- material submitted to the AER as part of its consultation on the rate of return guideline; and
- previous decisions of the AER, other relevant regulators and the Australian Competition Tribunal on the rate of return and any supporting expert material.

4 Deliverables

At the completion of its review the Expert will provide an independent expert report which:

- is of a professional standard capable of being submitted to the AER;
 - is prepared in accordance with the Federal Court Practice Note on Expert Witnesses in Proceedings in the Federal Court of Australia (CM 7) set out in Attachment 1, and includes an acknowledgement that the Expert has read the guidelines¹;
 - contains a section summarising the Expert's experience and qualifications, and attaches the Expert's curriculum vitae (preferably in a schedule or annexure);
 - identifies any person and their qualifications, who assists the Expert in preparing the report or in carrying out any research or test for the purposes of the report;
 - summarises JGN's instructions and attaches these term of reference;
 - includes an executive summary which highlights key aspects of the Expert's work and conclusions;
- and

¹ Available at: <http://www.federalcourt.gov.au/law-and-practice/practice-documents/practice-notes/cm7>.

- (without limiting the points above) carefully sets out the facts that the Expert has assumed in putting together his or her report, as well as identifying any other assumptions made, and the basis for those assumptions.

The Expert's report will include the findings for each of the items defined in the scope of works (Section 2).

5 Timetable

The Expert will deliver the final report to Jemena Regulation by **30 April 2014**.

6 Terms of Engagement

The terms on which the Expert will be engaged to provide the requested advice shall be:

- as provided in accordance with the Jemena Regulatory Consultancy Services Panel arrangements applicable to the Expert.

ATTACHMENT 1: FEDERAL COURT PRACTICE NOTE

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).
3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence², and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court³

- 1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.
- 1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.
- 1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report⁴

- 2.1 An expert's written report must comply with Rule 23.13 and therefore must
 - (a) be signed by the expert who prepared the report; and
 - (b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and
 - (c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and
 - (d) identify the questions that the expert was asked to address; and
 - (e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and
 - (f) set out separately from the factual findings or assumptions each of the expert's opinions; and

² As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

³ The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

⁴ Rule 23.13.

- (g) set out the reasons for each of the expert's opinions; and
 - (ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above⁵; and
 - (h) comply with the Practice Note.
- 2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the Court.*"
- 2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.
- 2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court⁶.
- 2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.
- 2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.
- 2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports⁷.

3. Experts' Conference

- 3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013

⁵ See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

⁶ The "*Ikarian Reefer*" [1993] 20 FSR 563 at 565

⁷ The "*Ikarian Reefer*" [1993] 20 FSR 563 at 565-566. See also Ormrod "*Scientific Evidence in Court*" [1968] Crim LR 240