

# *SP AusNet:*

## Debt risk premium for the 2013 Victorian Transmission Revenue Review

*SP AusNet Limited*

*Debt risk premium for  
the 2013 Transmission  
Revenue Review*

*March 2013*





**Mr. Thomas Hallam**  
Manager, Economic Regulation  
SP AusNet Limited  
L31, 2 Southbank Boulevard  
Southbank, Victoria 3006

18 March, 2013

Dear Thomas

***Debt risk premium estimate for the 2013 Victorian Transmission Revenue Review***

I am pleased to present PricewaterhouseCoopers' (PwC's) report outlining our advice on the most appropriate methodology to apply in estimating the debt risk premium for a 20 day averaging period from 12 November, 2012 to 7 December, 2012 within the context of the National Electricity Law and Rules, and precedent decisions made thereunder. This report has been prepared in accordance with the Terms of Reference contained in our Engagement Letter dated 30 November, 2012, which responded to your request for proposal. We understand that our report will be included as part of SP AusNet's submission to the Australian Energy Regulator (AER) in the 2013 Victorian Transmission Revenue Review (VTRR).

The report has been prepared in my capacity as adviser to SP AusNet, and as expert witness in this matter. I am an economist and principal in the PwC economics and policy team, and prior to this a director at the Allen Consulting Group, where I have built a consulting practice specialising in the economic regulation of price and service. I have extensive experience across the electricity, gas, airports, rail, ports, water, telecommunications, post and banking industries in Australia and New Zealand, and have advised governments, regulators and major corporations on various issues in the capacity as an adviser and an expert witness. My detailed curriculum vitae is found below in Appendix C.

This report was produced with the assistance with the following PwC staff members:

- Matthew Santoro (Principal – Debt and Capital Markets)
- Michael Lawriwsky (Director – Economics & Policy)
- Steven Hong (Manager – Economics & Policy)
- William Van (Consultant – Economics & Policy)

As a professional services firm, PwC has an ongoing relationship with SP AusNet. This relationship includes advising on matters pertaining to the upcoming Victorian Transmission Revenue Review, the subject of this report. Further details of PwC's relationship with SP AusNet can be provided if necessary.

I can confirm that, in preparing this report, I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance that we regard as relevant have, to our knowledge,

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been withheld. I have been provided with a copy of the Federal Court's "Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia" and this report has been prepared in accordance with those Guidelines.

Should you wish to discuss this report in any way, please do not hesitate to contact myself on (03)8603 4973.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Jeff Balchin', written in a cursive style.

Jeff Balchin  
Principal



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# *Executive summary*

## *Introduction*

SP AusNet engaged PricewaterhouseCoopers (PwC) to provide advice on the estimation of the debt risk premium (DRP) in connection with the 2013 Victorian Transmission Revenue Review. Your Scope of Work requires PwC to address the following matters:

- Advise whether the Bloomberg fair yield curve (extrapolated to 10 years) can be relied on to reasonably meet the legislative requirements;
- If not, propose an alternative methodology for calculating the DRP that best meets the legislative requirements; and
- Apply the Bloomberg and/or the alternative methodology during the 20 business days from 12 November to 7 December 2012.

In providing the advice, you stated that PwC should take into consideration the National Electricity Rules, outcomes of recent AER decisions, and relevant judgements handed down by the Australian Competition Tribunal (the Tribunal).

## *The debt risk premium – recent developments*

Estimation of the debt risk premium has been controversial since the onset of the global financial crisis. Methodologies proposed by the Australian Energy Regulator (AER) and regulated businesses to estimate a debt risk premium for a 10 year BBB+ bond have varied. However, in a series of cases the Bloomberg fair value curve has been endorsed by the Australian Competition Tribunal (ACT or the Tribunal).<sup>1</sup>

In recent final decisions relating to Powerlink and Aurora Energy, the AER has used the Bloomberg FVC to calculate a debt risk premium.<sup>2</sup> More specifically, it has commenced with the Bloomberg 7 year BBB debt risk premium, and extrapolated this to 10 years using the average annual change in the debt risk premium for a number of comparable ‘paired’ bonds to estimate the annual increase in the debt risk premium between years 7 and 10.<sup>3</sup> In its more recent draft decisions relating to ElectraNet and the Victorian gas distribution businesses the AER has again applied the extrapolated Bloomberg curve, but has also noted some reservations

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

<sup>2</sup> Australian Energy Regulator (April, 2012), *Final Decision – Powerlink Transmission determination 2012-13 to 2016-17*, p. 34; Australian Energy Regulator (April, 2012), *Final Distribution Determination – Aurora Energy Pty Ltd 2012-13 to 2016-17*.

<sup>3</sup> Australian Energy Regulator (April, 2012), *Final Decision – Powerlink Transmission determination 2012-13 to 2016-17*, p. 34. Also see, Australian Energy Regulator (April, 2012), *Final Distribution Determination – Aurora Energy Pty Ltd 2012-13 to 2016-17*.

regarding this approach, and noted that it is undertaking an internal review of its method for estimating the debt risk premium.<sup>4</sup>

Subsequent to our earlier reports for Powerlink, ElectraNet and the Victorian gas distribution businesses, on 8 June, 2012, the Tribunal published its decision in the ATCO appeal, which found ‘no error in the ERA’s decision to depart from the Bloomberg FVC as a basis for estimating the DRP.’<sup>5</sup> In its Final Decision on ATCO, the ERA had applied what it termed a ‘bond yield approach’ to estimate a debt risk premium. This approach uses bond yields observed for Australian bond issues with more than 2 years remaining to maturity and calculates the debt risk premium as the weighted average using weights that are a combination of issue size and term to maturity of the observed premia.<sup>6</sup>

Having reviewed the ERA’s methodology, we found that it suffers from numerous deficiencies, including that it:

- *Does not produce an estimate of the 10 year debt risk premium* – The ERA’s approach results in a debt risk premium estimate for an average term of approximately 5 years, depending on bond sample composition, rather than for 10 years. This is likely to be a significant under-estimate of the debt risk premium for a 10 year BBB+ rated bond. Whilst this is not necessarily inconsistent with the National Gas Rules, it is inconsistent with requirements under the National Electricity Rules. The ERA buttressed its case with the following:
  - *The trade-off between consistency and relevance* – The ERA maintained that the paucity of bond data caused it to choose relevance (i.e. reference to bonds whose yields can be observed, even if their terms to maturity are not close to 10 years) over consistency (attempting to estimate a 10 year debt risk premium that is consistent with the term applied to other CAPM parameters). We do not agree with this approach, since it derives a precise estimate of something we know to be wrong.
  - *An assertion that the ERA’s approach derives an estimate that is close to the 10 year debt risk premium* - This was based on a flawed test, where the ERA examined a period prior to the global financial crisis (2005 to 2007) and asserted that the resulting ‘error of estimate’ of 13 to 34 basis points (i.e. the ‘bond yield’ approach estimate relative to the 10 year yield estimated by the Bloomberg BBB FVC) was low. However, during that period the debt risk premium between terms of 5 and 10 years rose by only 15 basis points, and an error of 13 to 34 basis points would have been considered unacceptably large at that time. In current market conditions the underestimate would be higher owing to the more pronounced increase in the debt risk premium between 5 and 10 years.<sup>7</sup>

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<sup>4</sup> Australian Energy Regulator (September, 2012), *Access arrangement draft decision – SPI Networks (Gas) Pty Ltd 2013-17*, p.51; Australian Energy Regulator (November, 2012), *Draft Decision – ElectraNet transmission determination 2013-14 to 2017-18*.

<sup>5</sup> See Application by WA Gas Networks Pty Ltd (No 3) [2012] ACompT 12, Pp 176; Economic Regulation Authority (Western Australia) (28 February, 2011), *Final decision on WA Gas Networks Pty Ltd proposed revised access arrangement for the Mid-West and South-West Gas Distribution Systems*, pp. 75-92.

<sup>6</sup> Economic Regulation Authority (Western Australia) (1 December, 2010), *Measuring the Debt Risk Premium: A Bond-Yield Approach*.

<sup>7</sup> During the period that Bloomberg published a 10 year BBB FVC ( 17 August, 2004 to 5 February, 2007), the average rise in the debt risk premium between 5 and 10 years was 15 basis points. By contrast, during the 20 day

- *Relies only on bond yield data from Bloomberg* - By doing so the ERA has ignored a significant number of floating rate notes for which yield data is available from UBS. The Tribunal has endorsed the use of floating rate notes and UBS as a source of information on bond yields generally.

## ***Our approach to estimating the debt risk premium***

As the AER's public consultation process in relation to a debt risk premium methodology has not yet concluded, we have again applied the approach that we developed in our previous reports, and that the AER has applied in its draft decision on the Victorian gas distribution businesses.<sup>8</sup> That is, our methodology is to:

- Estimate the debt risk premium by extrapolating the 7 year debt risk premium obtained from the Bloomberg FVC to 10 years using the 'paired bonds' approach;
- Apply an econometric analysis to the bond yield data obtained from Bloomberg and UBS to test whether various alternative functional forms support the debt risk premium estimated by the extrapolated Bloomberg 10 year BBB+ curve; and
- In support of the above methods, we have undertaken a series of tests of the integrity of the underlying data, specifically:
  - Testing the integrity of Bloomberg's key inputs (BGN yield data) by testing whether these yields fairly represent market opinion, as represented by the median of the yield data supplied to Bloomberg by the banks (i.e. bank feeds);
  - Testing whether the UBS data fairly represent market opinion, as represented by the median of the yield data supplied to Bloomberg by the banks (i.e. bank feeds); and
  - Testing whether the market opinions have been updated recently (i.e. reflect a trade or just an update for the latest information), which reduces the risk that the data are stale. The second test re-inforces the first test. We can only test UBS data in this way.<sup>9</sup>

These tests revealed no reason for concern about the integrity of the data.

### **Extrapolated Bloomberg fair value curve**

We have been requested by SP AusNet to estimate the debt risk premium for an averaging period that covers the 20 business days from 12 November, 2012 to 7

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averaging period to 7 December, 2012, the average rise in the debt risk premium between 5 and 10 years was 33 basis points (based on the 5 year Bloomberg FVC and the 10 year extrapolated Bloomberg value).

<sup>8</sup> PricewaterhouseCoopers (March, 2012), *SP AusNet, MultiNet Gas, Envestra, and APA Group: Estimating the benchmark debt risk premium*.

<sup>9</sup> We did not test the staleness of Bloomberg data directly because the pricing/yield of a bond covered by Bloomberg could shift merely due to a change in the composition of its sample rather than a change in the opinions of one of more of its bank feeds, making it much more difficult to draw the link.



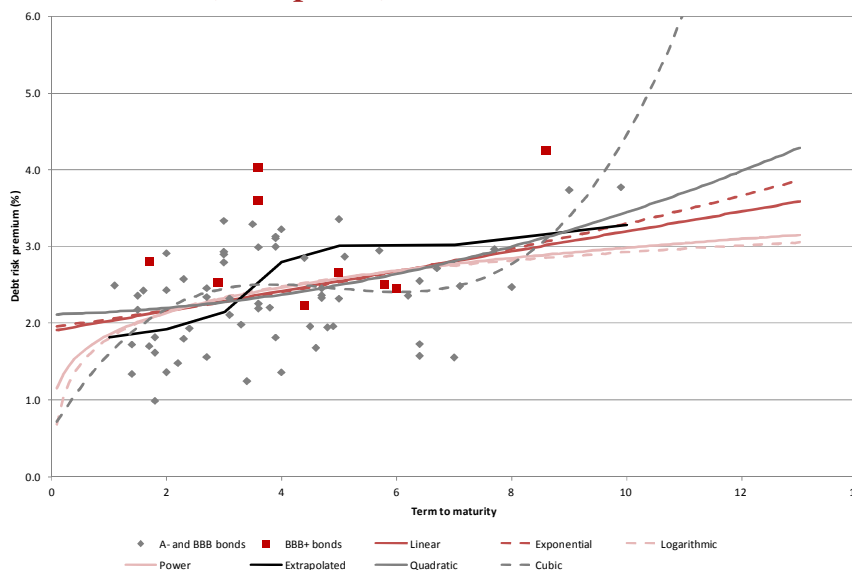
December, 2012. For this averaging period the 10 year extrapolated Bloomberg BBB FVC estimated a debt risk premium of **328 basis points**.<sup>10</sup>

**Results of our econometric regression analysis**

For our econometric analysis it was necessary to specify the form of the relationship between debt risk premium and term to maturity, i.e. the functional form, or shape of the debt risk premium curve. Empirical research has provided evidence of both linear and non-linear relationships, and in the present study we tested the following functional forms using the Schwartz Information Criterion (SIC), where a lower SIC indicates the superior functional form:<sup>11</sup>

- linear,
- quadratic,
- exponential,
- cubic,
- logarithmic, and
- power.

**Figure ES1 – Debt risk premium estimates for 20 business days to 7 December 2012 (basis points)**



Source: PwC’s analysis, Bloomberg, UBS.

Figure ES1 above shows the distribution of bond data points relative to the extrapolated Bloomberg curve and the alternative functional forms for the 20 day

<sup>10</sup> For the averaging period ending 7 December 2012 the Bloomberg 7 year BBB FVC estimate was 302 basis points. Applying paired bonds analysis we estimated an average debt risk premium increment of 8.5 basis points per annum, which implies a 25.5 basis points increase in the debt risk premium between 7 and 10 years.

<sup>11</sup> Otherwise known as the ‘Bayesian Information Criterion’, the Schwartz Information Criterion determines the optimal functional form by reference to the best fit the data using a minimum number of variables.

averaging period ending 7 December, 2012.<sup>12</sup> The extrapolated Bloomberg curve (328 basis points) was positioned between estimates using the exponential function (330 basis points) and the linear function (320 basis points). Higher estimates were obtained with cubic and quadratic functions (446 and 345 basis points respectively), and lower estimates were obtained using power and logarithmic functions (296 and 293 basis points respectively).

Table ES1 below arranges the alternative functional forms by debt risk premium estimate. Our view based on this analysis is that the linear function should be preferred.

- The exponential and linear forms scored best and second best (i.e. lowest and second lowest score) on the SIC test during the averaging period, and the linear function was ranked highest (best) on average throughout the 665 days up to 7 December, 2012.<sup>13</sup>
- We recommend placing less weight on the exponential function due to the fact that it lacks broader theoretical foundations and empirical support. On the other hand, the linear functional form does have theoretical and empirical backing.
- The remainder of the functions either performed poorly during the averaging period (power), or generally (quadratic, cubic and logarithmic).

**Table ES1 – Debt risk premium regression estimates for 20 business days to 7 December 2012 (basis points)**

Functional form	10 year BBB+ Debt Risk Premium (basis points)	Schwartz Information Criterion test for averaging period		Average rank by SIC for period 6 May 2010 to 7 Dec. 2012	
		Score	Rank		Rank
Extrapolated Bloomberg FVC	328	n/a	n/a	n/a	
Cubic	446	2.132	3	5.7	6
Quadratic	345	2.170	6	5.0	5
Exponential	330	2.118	1	2.9	3
Linear	320	2.123	2	2.2	1
Power	298	2.135	4	2.2	1
Logarithmic	293	2.139	5	3.1	4

Source: UBS, Bloomberg, PwC.

The debt risk premium estimate using the linear function of 320 basis points lends support to the 328 basis points estimated using the extrapolated Bloomberg methodology.

<sup>12</sup> Each observation is the simple average of the Bloomberg and UBS debt risk premium, where both services published an estimate, or the separate Bloomberg or UBS estimate where they did not. UBS is not a contributor to Bloomberg's bank feeds.

<sup>13</sup> More specifically, there were 665 overlapping regressions, with each day's regression being based on 20 days of observations up to and including that day. During these 665 overlapping periods of 20 days the linear functional form was ranked equal first with the power function (at an average ranking of 2.2), although the power function was marginally ahead at two decimal places.

### **Conclusion on the debt risk premium**

For the 20 day averaging period to 7 December, 2012, the extrapolated Bloomberg FVC methodology provided an estimated 10 year BBB+ debt risk premium of 328 basis points.

The regression analysis using our preferred linear functional form provided an estimated debt risk premium (320 basis points) that was not materially different to the extrapolated Bloomberg estimate. The linear functional form ranked second best on the basis of the empirical tests in the averaging period, and equal best during the broader Analysis Period (i.e. from April 2010 to 7 December, 2012), and has more theoretical and empirical support than the convex function that was ranked more highly during the averaging period. Our preference for the linear functional form is also consistent with findings in our previous reports for ElectraNet and the Victorian gas distribution businesses.

Our data integrity test of the Bloomberg bond data showed that the yields (i.e. BGNs) it used as a basis for estimating the Bloomberg FVC were a fair reflection of market opinion. We also found that the Bloomberg and UBS yields were relatively close to each other, and that the UBS data was not 'stale' and therefore more likely to be reflective of current market conditions. These tests confirmed our confidence in the integrity of the data underpinning the Bloomberg FVC, and our own regression analysis.

In conclusion, whilst noting that there is a degree of imprecision in this exercise due to the limited number of longer dated Australian corporate bonds on issue, we recommend that the extrapolated Bloomberg fair value curve estimate of 328 basis points should be adopted.



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# ***1 Scope and report outline***

## ***1.1 Scope***

PricewaterhouseCoopers (PwC) has been engaged to provide expert advice to SP AusNet in relation to the debt risk premium in relation to its upcoming transmission revenue review (TRR). The National Electricity Rules and the AER's 2009 determination under this set out the requirements for the WACC and the debt risk premium part of this.

The Terms of Reference you provided to us requires PwC to address the following matters:

- Advise whether the Bloomberg fair yield curve (extrapolated to 10 years) can be relied on to reasonably meet the legislative requirements;
- If not, propose an alternative methodology for calculating the DRP that best meets the legislative requirements; and
- Apply the Bloomberg and/or the alternative methodology during the 20 business days from 12 November to 7 December 2012.

In providing the advice, we were requested to take into consideration the National Electricity Rules, outcomes of recent AER decisions, and relevant judgements handed down by the Australian Competition Tribunal.

## ***1.2 Outline of report***

In undertaking the above tasks, we have structured the remainder of the report as follows:

- Chapter 2 provides an overview of recent regulatory decisions made by the AER (and ERA) in relation to the debt risk premium, and how these decisions have been assessed by the Australian Competition Tribunal in the course of appeals.
- Chapter 3 presents our empirical analysis of the quality of data sources for estimating the debt risk premium, and assesses whether the data is reflective of the market for funds.
- Chapter 4 outlines an empirical (regression) analysis, which is used to estimate the debt risk premium for a 20 business day averaging period to 7 December, 2012.

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## **2 Estimating the debt risk premium**

### **2.1 Introduction**

In our previous reports for Powerlink, ElectraNet and, most recently, the Victorian gas distribution networks, we examined in detail how the debate around the estimation of the debt risk premium has developed since the onset of the global financial crisis, and how the AER's methodology to estimate the debt risk premium has evolved alongside the Australian Competition Tribunal's (ACT or Tribunal) decisions relating to this parameter.

In this study we consider developments in debt risk premium estimation over the last two years. During this time the AER has adopted a practice of setting the benchmark based on an extrapolation of the Bloomberg fair value curve, with that extrapolation based on the change in the debt risk premium observed for pairs of bonds issued by the same company at different maturities (paired bonds approach). The other relevant development has come not from the AER, but from the ERA (Western Australian Economic Regulation Authority), which has developed a different method for deriving the debt risk premium (the 'bond yield' method described below). The Tribunal has found that the ERA was 'not in error' under the National Gas Rules to substitute its 'bond yield' approach for the Bloomberg extrapolation methodology.

In this chapter we review these new developments in the context of the methodological approach that we established in our earlier report for the Victorian gas distribution networks.

### **2.2 The extrapolated Bloomberg fair value curve**

Estimation of the debt risk premium has been controversial since the onset of the global financial crisis. Methodologies proposed by the Australian Energy Regulator (AER) and regulated businesses to estimate a debt risk premium for a 10 year BBB+ bond have varied. After much debate and several appeals to the Tribunal, the AER has settled on applying the extrapolated Bloomberg methodology, under which the debt risk premium observed for the 7 year Bloomberg FVC is extrapolated to 10 years based on the change in the debt risk premium observed for pairs of bonds issued by the same company at different maturities (i.e. the 'paired bonds' approach).

In a number of its decisions over recent years the Tribunal has endorsed the Bloomberg fair value curve. In Jemena's appeal it said:<sup>14</sup>

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

Furthermore, the Tribunal found that:<sup>15</sup>

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<sup>14</sup> Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 400.



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

The Tribunal concluded that:<sup>16</sup>

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

In the course of Envestra's appeal the Tribunal acknowledged that it is for the AER to determine whether to rely on the Bloomberg curve; however, it also observed that sound reasons would need to be provided for the AER to depart from its previous practice of accepting the Bloomberg fair value curve:<sup>17</sup>

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

Subsequently, in its Aurora Energy and Powerlink decisions the AER applied the extrapolated Bloomberg methodology, but concluded with a note of caution:<sup>18</sup>

The AER considers that there may be other preferable methodologies to estimate the DRP. Notwithstanding this, the AER acknowledges the Tribunal's views and agrees that it is desirable to consult widely on a new approach to estimate the DRP before it is used. The AER will begin an internal review of alternative methods to estimate the DRP and conduct a public consultation process.

Similarly, when it applied the extrapolated Bloomberg FVC methodology in the case of the Victorian gas distribution networks the AER noted that:<sup>19</sup>

Consistent with the AER's observations previously, the AER considers that the Bloomberg fair value curve continues to provide DRP estimates which are higher than other potential approaches (such as the ERA's approach). The Bloomberg fair value curve also provides estimates which are high in comparison to recent bond issuances from firms with similar characteristics to the benchmark firm. For these reasons, the AER has commenced an internal review into alternatives to the Bloomberg fair value curve. The AER will advise of a public consultation process on the development of an alternative in due course.

That consultation process has not concluded, and so this Report has applied the currently endorsed method.

## **2.3 The ERA's 'bond yield' approach**

The ERA's 'bond yield approach' was developed in a Discussion Paper, which was issued on 1 December 2010.<sup>20</sup> On 28 February, 2011, in its Final Decision on WA

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<sup>15</sup> Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 436.

<sup>16</sup> Application by United Energy Distribution Pty Limited (No 2) [2012] ACompT 4 (6 January 2012), para. 461.

<sup>17</sup> Application by Envestra Limited (No 2) [2012] ACompT 4 (11 January 2012), para. 120.

<sup>18</sup> Australian Energy Regulator (April, 2012), *Final Decision – Powerlink Transmission determination 2012-13 to 2016-17*, p. 34. Also see, Australian Energy Regulator (April, 2012), *Final Distribution Determination – Aurora Energy Pty Ltd 2012-13 to 2016-17*.

<sup>19</sup> AER (September, 2012) *Access arrangement draft decision – SPI Networks (Gas) Pty Ltd 2013-17*, p.36.

<sup>20</sup> Economic Regulation Authority (Western Australia) (1 December, 2010), *Measuring the Debt Risk Premium: A Bond-Yield Approach*.

Gas Networks Pty Ltd (ATCO), the ERA applied the approach to estimate a debt risk premium.<sup>21</sup> The ERA uses bond yields observed for Australian bond issues contained in the Bloomberg data base with more than 2 years remaining to maturity and calculates the debt risk premium as the weighted average of the observed premium.

ATCO appealed to the Tribunal, which on 8 June, 2012 concluded that there had been 'no error in the ERA's decision to depart from the Bloomberg FVC as a basis for estimating the DRP'. Tribunal disagreed with minor aspects of the ERA's method, and suggested that the ERA should consider applying a combined weighting system (namely, the form of weighting adopted), but otherwise found 'no error' in the ERA's approach.<sup>22</sup> The ERA then re-estimated a debt risk premium based on a 'combined weighting' methodology that increased the weighting given to a bond's yield if it had a longer term to maturity and larger size of issuance.<sup>23</sup>

### *2.3.1 Shortcomings in the ERA's methodology*

Having reviewed the ERA's methodology, we consider that it suffers from a number of shortcomings. First and foremost, the major deficiency in the ERA's methodology is its failure to estimate a debt risk premium for a corporate bond with a 10 year term to maturity. For the 20 business days to 20 December, 2010, the ERA's methodology derived a debt risk premium estimate of 289 basis points, which is close to the simple average of 286 basis points for the ERA's bond sample. The average term to maturity of bonds in this sample was only 5.2 years.

In its Discussion Paper, and in the ATCO decision, the ERA stated that there is a trade-off between market relevance and consistency with other WACC parameters, and that the market relevance of the estimates should carry more weight than the latter since attempting to maintain consistency would reduce the level of market relevance; and moving away from a 10 year term provides a larger sample, noting that 'any measure that relies on a small sample of data points will be less reliable than one based on a larger sample.'<sup>24</sup> We disagree, as the ERA's methodology derives a precise estimate of something that we know to be wrong.

The vast majority of finance academics and market practitioners expect that other things being equal, bonds with a longer term to maturity will command a higher debt risk premium, so that the ERA's estimation of a 5 year debt risk premium will necessarily underestimate the 10 year debt risk premium.<sup>25</sup> The only question is by how much.

The ERA asserted that its weighted average debt risk premium (as at 20 December 2010) was a close estimate of the likely value of the then current 10 year BBB+ debt risk premium. This was based on a flawed test, in which the ERA examined a period prior to the global financial crisis (2005 to 2007) and asserted that the resulting 'error of estimate' of 13 to 34 basis points (i.e. the 'bond yield'

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<sup>21</sup> Economic Regulation Authority (Western Australia) (28 February, 2011), *Final decision on WA Gas Networks Pty Ltd proposed revised access arrangement for the Mid-West and South-West Gas Distribution Systems*, pp. 75-92.

<sup>22</sup> Application by WA Gas Networks Pty Ltd (No 3) [2012] A CompT12, Para 176.

<sup>23</sup> The ERA's 'combined weighting system' multiplies the issue size weight (i.e. the percentage that the bond's issue size comprises of total issuance size of the sample) by the maturity weight (i.e. the percentage that the bond's years to maturity comprises of total years to maturity of the sample). The multiplied value for each bond then becomes the basis for a 'combined weighting', which is then multiplied by the bond's observed debt risk premium to calculate its 'contributed debt risk premium'. The sum of the 'contributed debt risk premiums' for all bonds in the sample derives the ERA's overall debt risk premium estimate.

<sup>24</sup> Economic Regulation Authority (Western Australia) (1 December, 2010), p.9.

<sup>25</sup> PricewaterhouseCoopers (March, 2012), pp.23-24.

approach estimate relative to the 10 year yield then estimated by the Bloomberg BBB FVC) was low. This test was deficient because the relationship between the debt risk premium and term in 2005-2007 was very different to the current period. On average during that period the debt risk premium rose by only 15 basis points between terms of 5 and 10 years, and was materially different to the current period. In the 2005-2007 period an error of 13 to 34 basis points would have been considered unacceptably large. Moreover, during the 20 day averaging period ending 7 December, 2012, the increase in the debt risk premium between 5 years (Bloomberg) and 10 years (extrapolated Bloomberg), was 33 basis points.

Secondly, the ERA's approach relies only on bond data from Bloomberg, thereby ignoring a significant number of floating rate notes for which yield data is reported by UBS. In previous decisions the Tribunal has held that information available from floating rate notes should be utilised.<sup>26</sup> The Tribunal also endorsed using information from UBS.

Finally, the ERA's approach does not benefit from the additional perspectives that can be obtained by applying more sophisticated econometric analysis, i.e. the ability to use the greater data set to produce a valid estimate of the 10 year debt risk premium. Given these observations about the ERA's 'bond yield' approach, we consider it is not appropriate for estimating the debt risk premium for a 10 year BBB+ rated bond.

## ***2.4 Application of more sophisticated econometric techniques***

### **The extrapolated Bloomberg fair value curve**

In our reports for Powerlink, ElectraNet and the Victorian gas distribution networks, we adopted the 7 year Bloomberg fair value curve as our key reference point, and extrapolated the 7 year debt risk premium to 10 years using the average annual increment in the debt risk premium observed for paired bonds where the longer dated bond had a term to maturity close to 10 years.

### **Our econometric approach**

In our reports for Powerlink, ElectraNet, and the Victorian gas networks reports we also applied econometric techniques to estimate the BBB+ fair value curve in order to provide a test of the Bloomberg values. We identified a sample of bonds spanning the three credit rating bands of BBB, BBB+ and A- (which had an average rating close to BBB+), and with terms to maturity greater than 1 year. A quadratic (i.e. curvilinear) functional form was applied in the Powerlink report, and in the ElectraNet and Victorian gas networks reports we tested several additional functional forms (i.e. linear, exponential, logarithmic and power).

### **Our results**

Our conclusions are summarised in Table 1 below.

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<sup>26</sup> For example: 'The Tribunal considers that, as a matter of principle, floating rate bonds ought to be taken into account and treated equivalently to fixed rate bonds.' See Australian Competition Tribunal, Application by ActewAGL Distribution [2010] ACompT 4, par. 58.

**Table 1 – BBB+ Debt Risk Premium - Extrapolated Bloomberg FVC vs direct observation (econometric regression) in basis points**

	<b>Powerlink 40 days to 14 October 2011</b>	<b>ElectraNet 20 days to 18 November 2011</b>	<b>Victorian gas networks 20 days to 16 December 2011</b>
Extrapolated Bloomberg FVC	391	381	392
Regression – quadratic function	379	383	392
Regression – linear function		384	399
Regression – exponential function		378	393
Regression – logarithmic function		359	376
Regression – power function		371	384

Source: PwC reports and analysis.

Our findings for the three studies spanned the final quarter of 2011, and demonstrated considerable stability over the three averaging periods that were spaced roughly a month apart. Over this period the extrapolated Bloomberg curve estimate of the 10 year BBB+ debt risk premium fell within a small range of between 381 basis points and 392 basis points. Our conclusions in these reports reflected these findings: we concluded that the estimate of the debt risk premium provided by the extrapolated Bloomberg fair value curve was well supported by econometric analysis based on a sample of 60 to 70 bonds. Hence, we recommended that the estimate of the debt risk premium that was based on the extrapolated Bloomberg FVC be adopted.

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## 3 *Our method and data sources*

### 3.1 *Our method*

The method that we have applied to estimate the debt risk premium for SP AusNet is as follows:

- Estimate the debt risk premium by extrapolating the 7 year debt risk premium obtained from the Bloomberg FVC to 10 years using the ‘paired bonds’ approach. As we have noted in our earlier reports, the Bloomberg fair value curve offers many advantages in estimating a benchmark debt risk premium:
  - The Tribunal has endorsed the Bloomberg fair value curve as an appropriate benchmark for estimating the debt risk premium, including because it appears to be accepted by the market as providing accurate yield estimates;
  - The Bloomberg fair value curve is an observable benchmark, and is simple to apply; and
  - The Bloomberg methodology imposes a series of tests to ensure that the data that it uses in its analysis is of sufficient quality.

In a review of regulated revenues, the final opportunity for a business to comment on a debt risk premium is likely to be before it is locked in. During this period, financial markets can change significantly. Hence, the caution that Bloomberg exercises in introducing new evidence imparts a degree of stability over time. In the past this has had the advantage of allowing regulators to commit to using the Bloomberg curve in advance.

- Next, we apply an econometric analysis to the bond yield data obtained from Bloomberg and UBS to test whether various alternative functional forms support the debt risk premium estimated by the extrapolated Bloomberg 10 year BBB+ curve. In our previous reports for ElectraNet and the Victorian gas distribution businesses we tested linear, quadratic, exponential, logarithmic and power functions. In the current report we have supplemented that list by including the cubic functional form.
- In support of the above methods, we have undertaken a series of tests of integrity of the underlying data, specifically:
  - Testing the integrity of Bloomberg’s key inputs (BGN yield data) by testing whether they fairly represent market opinion, as represented by the median of the yield data supplied to Bloomberg by the banks (i.e. bank feeds);
  - Testing whether the UBS data fairly represent market opinion, as represented by the median of the yield data supplied to Bloomberg by the banks (i.e. bank feeds); and
  - Testing whether the market opinions have been updated recently (i.e. reflect a trade or just an update for the latest information), which reduces the risk that the data are stale. The second test re-

inforces the first test. Whilst we can only test UBS data in this way, the UBS data and Bloomberg data move together.<sup>27</sup> Hence our two tests are designed to test whether the Bloomberg data reflects market opinion and that it is not 'stale'.<sup>28</sup>

This follows closely the method that we applied in our previous reports for ElectraNet and the Victorian gas distribution businesses. In addition, the use of the Bloomberg FVC and the method of extrapolation is in accordance with the method that has been applied by the AER in its draft decisions relating to these businesses. In its draft decision on the Victorian gas distribution businesses the AER noted that we had misapplied our 'paired bonds' analysis by including one pair of bonds (for Telstra) that should not have been included on the selection criteria we had determined.<sup>29</sup> We have ensured that all of the bond pairs included in the current analysis are drawn from the correct credit rating bands (i.e. A-, BBB+, or BBB).

### ***3.2 Assembling a representative sample for econometric analysis***

Bond yield data was obtained from two providers: Bloomberg, and UBS. We did not use data from an alternative source (the Australian Financial Markets Association), because our findings in the ElectraNet and Victorian gas distribution networks reports indicated that the yields provided by that source are highly correlated with the other two sources (Bloomberg and UBS).

#### **Bloomberg**

Bloomberg is the world's largest supplier of financial market information, with over 300,000 subscribers, and currently publishes a number of Australian corporate bond fair value curves, including a 7 year fair value yield for the BBB credit rating band. Having received daily 'feeds' of bond yields from a number of Australian banks and other financial institutions, it publishes a daily 'Bloomberg Generic Price' (also known as the BGN), which is its 'market consensus view' of the yields that have been supplied to it.<sup>30</sup> It is the BGN prices and respective yields that Bloomberg uses to construct its fair value curves.

Bloomberg does not make public the methodology that it uses to derive its consensus number. However, it is known that the number is not determined by a mechanical formula, but rather that it involves a degree of analyst judgement. In addition, Bloomberg provides its own estimate of bond yields in its Bloomberg Valuation Service (known as the BVAL yield). Our focus in this report is on Bloomberg's BGNs, which are presented as being reflective of the market's opinion of bond yields, and are used by Bloomberg in the estimation of its fair value curves. Each BGN yield observation was sourced from Bloomberg, including the individual bank 'feeds' that Bloomberg used in determining the BGN yield.

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<sup>27</sup> We did not test the staleness of Bloomberg data directly as a shift in the pricing/yield of a bond covered by Bloomberg could be due to a shift in the opinions of one or more of its bank feeds, making it much more difficult to draw the link. However, as we note in the text, the Bloomberg and UBS yield data were found to move together. Furthermore, we found that the linear regression we performed estimated a 10 year BBB+ debt risk premium of 320 basis points irrespective of whether a combined (i.e. averaged) Bloomberg and UBS data base was applied, or just the UBS data base was used.

<sup>28</sup> We first tested for 'staleness' in the UBS data in our reports estimating the debt risk premium for ElectraNet and the Victorian gas distribution businesses.

<sup>29</sup> See AER (September, 2012), p.85, footnote 205. A pair of Telstra bonds was incorrectly included, since Telstra was rated A, and the selection criteria for inclusion required that only A-, BBB+ and BBB bonds be included.

<sup>30</sup> Bloomberg describes the BGN as a 'market consensus view'. The service obtains 'feeds' (i.e. the provision of an opinion on the yield on a given bond) from between 2 and generally less than 5 or 6 suppliers on a daily basis.

## UBS

UBS bond yields represent its own opinions of the yield at which a bond would trade, and are disseminated electronically on a daily basis to its clients. Unlike the Bloomberg service, which provides a figure based on combining the opinions of several institutions, the UBS service is the opinion of one institution. However, we expect that fixed interest market analysts at UBS, like those at Bloomberg, do take account of other comparable bond data sources when making their own decisions (i.e. setting their own opinions) about bond yields.

### **3.3 Bond selection criteria for the econometric analysis**

The bond yields applied in our analysis are based on, where available, the average of the yields reported by Bloomberg and UBS, otherwise the information from the relevant single source. The initial sample was based on the population of fixed and floating corporate bonds available from these sources for the period between 8 April 2010 and 7 December 2012 (which we denote as the Analysis Period to distinguish it from the averaging period comprising the 20 business days to 7 December, 2012). We then filtered the data to only include corporate bonds with the following characteristics:

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

While the objective is a credit rating of BBB+, we selected bonds with credit ratings half a notch higher and half a notch lower than BBB+ (i.e. to cover the range BBB to A-) in order to expand the sample of bonds so that more rigorous econometric analysis could be applied.

We eliminated bonds with less than one year to maturity because these yields are influenced by monetary policy, and their inclusion would be likely to distort the shape of the debt risk premium curve. Bond market traders have informed us that bonds with less than a year to maturity are ignored when the yield relativities of bonds with longer terms to maturity are assessed.

As in our previous reports, we have eliminated bonds issued by SP AusNet due to the majority holding by Temasek, which is the investment arm of the Singapore Government. In assessing these bonds the AER's adviser, Oakvale Capital, has noted that a key issue impacting their yields is that 'the risk is in fact the risk of the Government of Singapore.'<sup>31</sup>

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<sup>31</sup> Oakvale Capital, (2011), Report on the cost of debt during the averaging period: *The impact of callable bonds*, February, p. 24

## ***Description of the bond sample***

The initial sample comprised 1601 bonds which was the population of bonds available from the two information sources over our study period.<sup>32</sup> Filtering this raw sample based on the criteria outlined above resulted in a sample of 123 bonds, which included 71 fixed coupon bonds, and 52 floating coupon bonds<sup>33</sup>. The refined sample was subjected to further analysis.

Given that our objective is to estimate the debt risk premium for 10 year debt, the number of long term observations greater than, for example, 7 years, is of importance. In our earlier reports we found that between 2010 and the last quarter of 2011 the number of bonds with a term greater than 7 years increased from 5 to 7, with the number of fixed coupon bonds in this group rising from zero to 3. As at the date of the current averaging period (i.e. the 20 days to 7 December, 2012), the number of bonds with a term greater than 7 years remained constant at 7, with the number of fixed coupon bonds in this group increasing from 3 to 4.

## ***3.4 Assessing the quality of the data***

In assessing the quality of the bond sample, we are most concerned about the Bloomberg data because it is used in estimating the Bloomberg fair value curve. We are also worried about the currency of the data more generally, as it affects the quality of the Bloomberg data, and our tests.

### ***3.4.1 Tests of Bloomberg data inputs***

Bloomberg receives bond yields from financial institutions ('bank feeds') on a daily basis, and converts these into yields that are represented as the market's consensus. UBS yields are the opinions of one bank, but those opinions would be expected to take account of that bank's views of the market. Therefore, it is important to assess to what extent Bloomberg BGNs and UBS yields are reflective of the market's opinion. We did this by calculating for the entire Analysis Period the average difference (expressed in basis points) between the median of the Bloomberg bank feeds, and the yields reported by Bloomberg (i.e. Bloomberg BGNs).<sup>34</sup>

We found that on average, over the entire Analysis Period, Bloomberg BGNs were 3 basis points higher than the median of the Bloomberg bank feeds.<sup>35</sup> We also found that on average over the entire Analysis Period the UBS yields were only 4 basis points higher than the median of the Bloomberg bank feeds. These differentials are not too dissimilar to those obtained in our previous reports for ElectraNet and the Victorian gas distribution networks, and indicate that the yields in both the Bloomberg and UBS data sources are close together. Hence we conclude that

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<sup>32</sup> This was the total number of bonds that were included in the data base of one or more of the yield providers (i.e. Bloomberg and UBS).

<sup>33</sup> The trading margins reported for floating coupon bonds were converted to yield to maturity estimates for equivalent fixed coupon bonds using an appropriate interest rate swap yield.

<sup>34</sup> This approach is similar to the analysis of Bloomberg BGN bond yields that we undertook in November, 2009. See PwC (November, 2009), *Victorian Distribution Businesses – Methodology to Estimate the Debt Risk Premium*. One of the tests that were applied in that study looked at the degree to which Bloomberg's BGN's reflected the bank feeds that were being provided to it. In the present study we have expressed this difference relative to the median of bank feeds (which is likely to be a good reflection of the market's opinion as it minimises the influence of outliers). We have also elected to express the differential in terms of basis points rather than percentage points, as this can be related more easily to the scale of the BGN, which can also be expressed in terms of basis points.

<sup>35</sup> Furthermore, as shown below, we found that the linear regression we performed estimated a 10 year BBB+ debt risk premium of 320 basis points irrespective of whether a combined (i.e. averaged) Bloomberg and UBS data base was applied, or just the UBS data base was used.



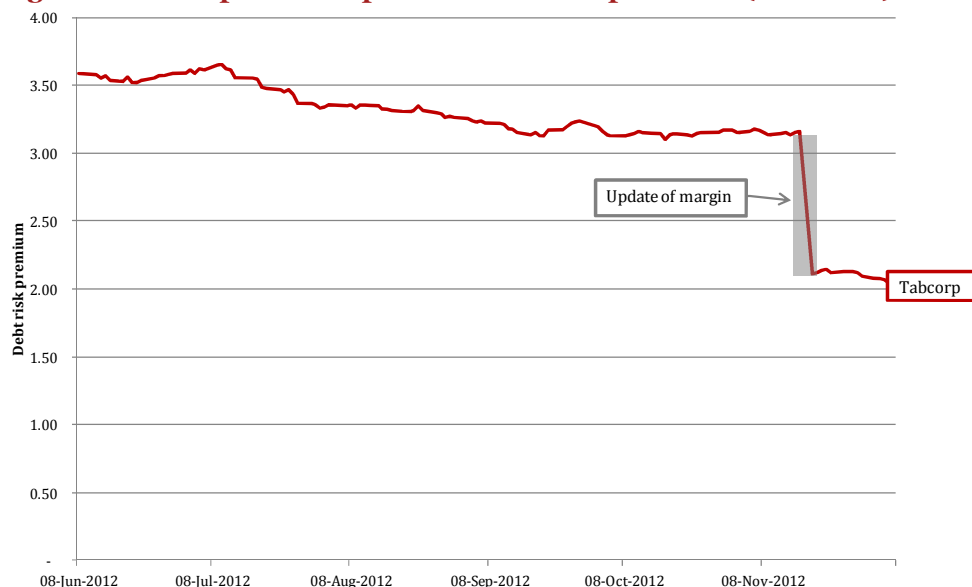
during the Analysis Period, the data sources that we have relied on were reflective of market opinion, as represented by the Bloomberg bank feeds.

### 3.4.2 Are the bond yield estimates ‘stale’?

Reported bank feeds and UBS yields are typically set to follow a benchmark curve; however, it is possible that some of the yields are ‘stale’ (i.e. out of date because they had not been updated for a considerable period of time).<sup>36</sup>

When a bank’s opinion of a bond yield has been updated for new information, we would expect to see an immediate and material shift in the debt risk premium. For example, Figure 1 below shows the debt risk premiums for a Tabcorp bond over the period between June 2012 and December 2012. During November 2012, the UBS debt risk premium for the Tabcorp bond experienced a material downward shift, and never returned to its original levels. We define such a shift as a ‘structural break’. Our hypothesis is that where such structural breaks are present in the data sources, it suggests that the yields have been updated, which then provides a test of whether the yield is reflective of current market conditions.

**Figure 1 – Example of an update in debt risk premium (UBS data)**



Source: PwC.

As in our previous reports for ElectraNet and the Victorian gas distribution networks, we applied the Quandt-Andrews breakpoint test to the UBS data in order to identify structural breaks in the individual yields over time.<sup>37</sup> Whilst we could have applied the Quandt-Andrews breakpoint test to all of the Bloomberg bank feed data, these bank feeds were not individually as comprehensive as the UBS data. We have defined ‘recent’ to be a period of six months up to the latest bond yield date (7 December 2012). We considered that a shorter period would set an unrealistic target for a reassessment of all the bonds in the UBS data base, and that

<sup>36</sup> This was confirmed by discussions with bond market participants.

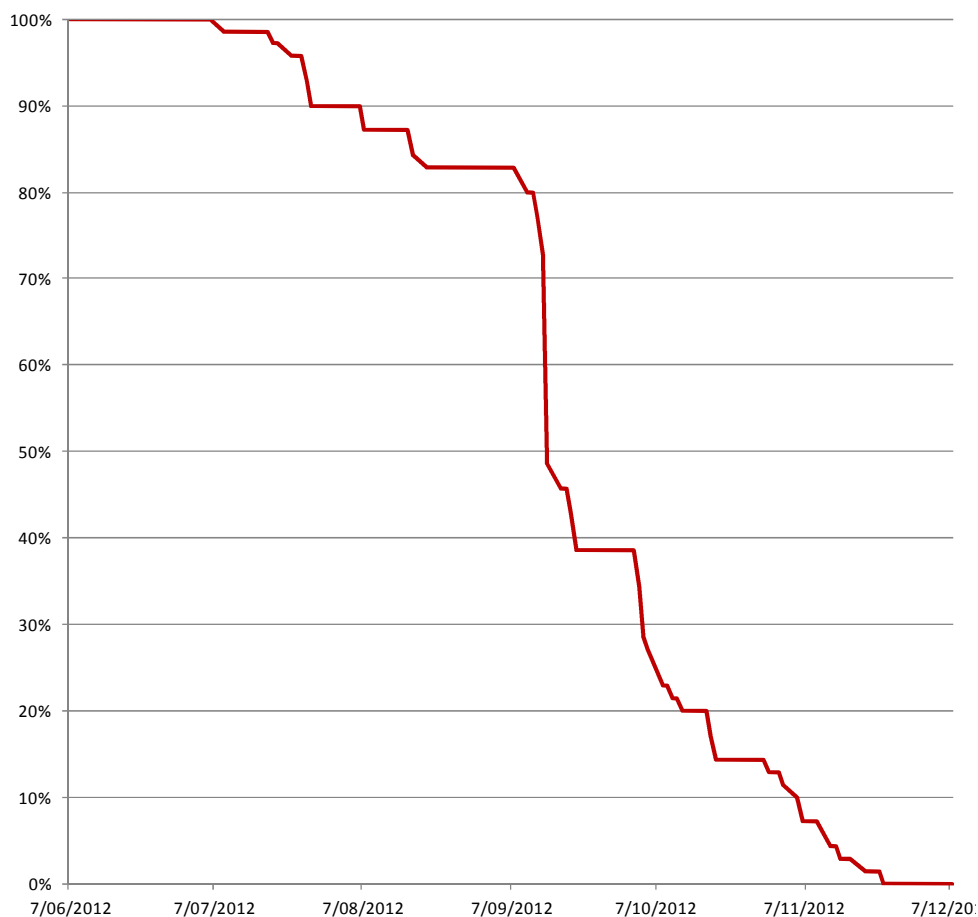
<sup>37</sup> The Quandt-Andrews Breakpoint Test tests for one or more unknown structural breakpoints in a sample for a specified equation. The idea behind the Quandt-Andrews test is that a single Chow Breakpoint Test is performed at every observation between two dates, or observations. The test statistics from these Chow tests (Likelihood ratio and Wald F statistic) are then summarised into one test statistic for a test against the null hypothesis of no breakpoints between two dates. For further explanation see: Donald W. K. Andrews, '(July, 1993), Tests for Parameter Instability and Structural Change With Unknown Change Point', *Econometrica*, Vol. 61, No. 4 pp. 821-856.

a longer period would be too long for those opinions to still be reflective of the current market.

### **Results of applying the staleness test to UBS yield data**

We have concluded that there is no reason to believe that the UBS data would not provide a reasonable reflection of current market conditions. For the 123 UBS bonds, 70 (57 per cent) had sufficient consecutive observations to apply the Quandt-Andrews breakpoint test. The 53 bonds that could not be tested were cases where the bond either matured before the six month period (36 cases), had a term to maturity lower than 1 year for the current averaging period (14 cases), or had been issued too recently (3 cases). Yields for newly issued bonds could not be considered to be stale.

**Figure 2 – Relative staleness of bond yields - UBS data yet to pass Quandt Andrews breakpoint test (6 months of data to 7/12/2012)**



Source UBS data and PwC analysis.

As shown in Figure 2 above, for the bonds that could be tested, a structural break occurred for all during the six month period. The chart shows a high proportion of breaks occurred over the period of September to October 2012, indicating that an overwhelming majority of the bonds (approximately 61 per cent) had been re-assessed by UBS in the 3 months prior to 7 December, 2012, and 100 per cent had been re-assessed in the 6 month period prior to 7 December, 2012.

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# 4 *Estimation of the debt risk premium*

This chapter applies the methodology we have applied to estimate the 10 year BBB+ debt risk premium for a 20 day averaging period up to 7 December, 2012. As described at the start of chapter 3, we estimated the debt risk premium based on the extrapolated Bloomberg fair value curve. Then as a cross-check, we have directly examined the available market data using econometric techniques.

## 4.1 *Estimating the debt risk premium using Bloomberg*

### 4.1.1 *Extrapolated Bloomberg fair value curve*

#### **Methodology used to extrapolate the Bloomberg fair value curve**

Bloomberg discontinued reporting a 10 year BBB fair value curve after 9 October, 2007, which has raised a key methodological issue of how to extrapolate the curve to the required 10 years. For a time, the change in the Bloomberg A rating fair value curve out to 10 years was used, and when that curve was no longer published to 10 years, the change in the Bloomberg AAA rating fair value curve out to 10 years was then used as the basis for extrapolation. However, since 22 June, 2010, the Bloomberg AAA curve has not been published out to 10 years. The Bloomberg BBB fair value curve remains reported to 7 years.

In our earlier reports for Powerlink, ElectraNet and the Victorian gas distribution networks, we proposed extrapolating the Bloomberg fair curve using the average annual increment observed across a sample where two bonds of differing maturity had been issued by the same company (paired bonds).<sup>38</sup> This approach was based on the logic that for two bonds issued by the same company, the difference in the debt risk premiums observed between the two bonds would be fully explained by term to maturity, rather than by other risk factors (unlike bonds from different issuers).

Following the AER's criticism of aspects of our approach in its draft decision on Powerlink's 2013-17 revenue proposal (where it considered the average difference in the terms to maturity of the 9 sets of paired bonds were too short),<sup>39</sup> and a further comment in the AER's draft decisions for the Victorian gas distribution businesses, we established a set of criteria to limit the sample of paired bonds to those where:

- The paired bonds are part of the wider sample that we use in our econometric analysis;
- The longer dated bond has a term to maturity that is close to 10 years;
- The shorter dated bond has a term that is closest to the shorter term that is of concern (i.e. closest to 7 years); and

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<sup>38</sup> PwC, *Methodology to estimate the debt risk premium*, April 2011

<sup>39</sup> AER, *Draft decision: Powerlink transmission determination 2012-13 to 2016-17*, November 2011, p.235

- The match is between a pair of fixed coupon bonds, or a pair of floating rate bonds.

We consider that applying the paired bonds approach for extrapolating the Bloomberg fair value curve according to these criteria will address the concerns the AER has raised.

#### 4.1.2 Debt risk premium applying a Bloomberg extrapolation

For the 20 business day average ending 7 December 2011, we estimated the extrapolated Bloomberg debt risk premium to be 328 basis points. The estimate of 328 basis points was obtained by adding a debt risk premium increment of 8.5 basis points per annum to the 7 year BBB debt risk of premium of 302 basis points derived from the fair value curve reported by Bloomberg.

Three pairs of bonds were chosen for the extrapolation on the basis of the selection criteria outlined above: a pair of A- rated Stockland fixed coupon bonds, a pair of A- rated GPT fixed coupon bonds, and a pair of 'BBB' rated Sydney Airport floating rate bonds. For the test averaging period ending 7 December, 2012, these paired bonds showed an average annual increment of 8.5 basis points, as shown in Table 2 below.

By adding the observed 8.5 basis points annual increment to the 7 year Bloomberg BBB fair value curve estimate of 302 basis points, we derived an estimated 10 year BBB+ debt risk premium of **328 basis points**.

**Table 2 – Average annual increment in the debt risk premium for the paired bonds - 20 business days to 7 December 2012**

Bond Issuer	Short Maturity (years)	Long Maturity (years)	Debt Risk Premium – Bloomberg (basis points)	Debt risk premium - UBS (basis points)	Debt risk premium increment per year (basis points)
Stockland (A-)	3.6	8.0	6.2	6.3	6.3
Sydney Airport (BBB)	3.0	9.0	n/a	15.8	15.8
GPT (A-)	4.96	9.47	3.5	n/a	3.5
<b>Average</b>					<b>8.5</b>
3 times average					26
Bloomberg 7 yr DRP					302
<b>Extrapolated DRP</b>					<b>328</b>

Source: Bloomberg, PwC.

## 4.2 Estimating the debt risk premium by direct examination of the bond data

### 4.2.1 Econometric approach

For our econometric regression analysis we commenced with a data set of debt risk premiums, considered the previous theoretical and empirical evidence on the functional form, tested alternative functional forms, and then assessed which functional form was most robust and reliable.

### Shape of the debt risk premium curve

To apply econometric analysis, an assumption is required about the form of the relationship between debt risk premium and term to maturity, i.e. the functional form, or shape of the debt risk premium curve. In 1974 Merton published a theory of bond pricing that proposed a humped relationship between the debt risk premium and term. Under this theory, the debt risk premium was expected to rise with term at first, but then to peak, and subsequently fall with additional term. However, Merton's theory has been challenged in the literature due to its inability to explain empirical findings. As noted by Covitz and Downing (2007):<sup>40</sup>

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

In academic circles, the tendency for Merton-style models to under-predict yield spreads has been called the 'credit puzzle'. Helwege and Turner (1999) found that it is generally only the most credit worthy firms in a credit rating band that issue long dated bonds, which can give the impression of a 'humped' relationship, but when paired bonds were tested (holding constant the credit worthiness) they found that the relationship is overwhelmingly upward sloping.<sup>41</sup> In another study Jia He, Wenwei Hu, and Larry H.P. Lang, (2000), showed that for BBB rated bonds in the US over the period 1993 to 1997, the credit spread was upward sloping for terms up to 25.7 years. In other words, it was humped only for very long terms to maturity, and was upward sloping and concave for terms up to and well beyond 10 years.<sup>42</sup>

In fixed interest markets, practitioners have observed that corporate bond spreads have almost always been upward sloping. Litterman and Iben, of the Fixed Income Research Department of Goldman Sachs, noted this in their 1991 paper:<sup>43</sup>

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

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

- Elton et al (2001) demonstrated that for the BBB rating band in the US, the debt risk premium attributed to systematic risk factors was linearly related to term.<sup>44</sup>
- Sorge and Gadanecz (2008), showed that the 'term structure of bond spreads as estimated in regression (4a) can be fitted by an upwardly-

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<sup>40</sup> Dan Covitz and Chris Downing (October, 2007), 'Liquidity or Credit Risk? The Determinants of Very Short-Term Corporate Yield Spreads', *Journal of Finance*, Vol. 62, No. 5, pp. 2303-2328.

<sup>41</sup> Helwege, J. and C.M. Turner, (1999), 'The slope of the credit yield curve for speculative grade issuers', *Journal of Finance*, Vol. 54, pp.1869-1884.

<sup>42</sup> Jia He, Wenwei Hu, and Larry H.P. Lang, (11 August, 2000), 'Credit Spread Curves and Credit Ratings', Working Paper, Chinese University of Hong Kong.

<sup>43</sup> Robert Litterman and Thomas Iben (Spring, 1991), 'Corporate bond valuation and the term structure of credit spreads,' *Corporate Journal of Portfolio Management*, p.54.

<sup>44</sup> Edwin Elton, Martin J. Gruber, Deepak Agrawal, and Christopher Mann (February, 2001), 'Explaining the Rate Spread on Corporate Bonds', *Journal of Finance*, Vol. LVI, No. 1, pp. 247 -278.

sloping regression line with an  $R^2$  exceeding 0.95 (i.e. it is essentially linear)<sup>45</sup>.

To account for both linear and non-linear functional forms, we estimated regressions using various functional forms, and then tested for which functional form was superior.<sup>46</sup> The following functional forms were tested:

- linear,
- quadratic,
- exponential,
- cubic,
- logarithmic, and
- power.

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

### **Assessment of the appropriate functional form**

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

The SIC is calculated as the negative of the goodness of fit that a given function has to the data through a likelihood value, taking account of the number of variables the function required to reach that goodness of fit.<sup>47</sup> The SIC therefore rewards a functional form (through a lower value) if it achieves a higher goodness of fit, and punishes (through a higher value) a functional form that uses more variables to achieve that higher goodness of fit. In other words, the SIC finds the optimal functional form: the one that fits the data best, while using a minimum number of variables. We applied the SIC test as:

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

In econometric analysis, 'efficient' functions are desirable because they minimise the problem of 'over-fitting', which arises when more variables are used than necessary to explain the underlying relationship. An over-fitted function has many undesirable qualities and is likely to be a poor predictor.<sup>48</sup>

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<sup>45</sup> Marco Sorge and Blaise Gadanecz (2008), 'The term structure of credit spreads in project finance,' *International Journal of Finance and Economics*, Vol. 123, p.80.

<sup>46</sup> The non-linear functions could give rise to either concave or convex relationships depending on parameter estimates obtained. As it happens, two were estimated to be convex functions and two concave, with one function concave at lower maturities and convex at higher maturities. We set out our views on convex functions below.

<sup>47</sup> See, G. Schwartz, (1978), 'Estimating the Dimension of a Model', *Annals of Statistics*, Vol. 6, No. 2, pp. 461 – 464.

<sup>48</sup> D. Hawkins, (2004), 'The Problem of Overfitting', *J. Chem. Inf. Comput. Sci.*, 44, 1-12

#### 4.2.2 Debt risk premium estimated by regression analysis

Since our sample included bonds in the neighbouring credit rating bands to BBB+ (i.e. A- and BBB), a question that arises is whether the sample is more biased toward one or other of the neighbouring credit rating bands around the BBB+ band. We therefore calculated the average credit rating by assigning values (1, 2 and 3) to the three rating bands. As in our previous reports, we found that throughout the study period the average credit rating lay very close to BBB+ (based on the values assigned).<sup>49</sup> The number of bonds in the BBB+ rating band was always less than one-third of the total sample, which justifies our pooling of observations with the neighbouring bands.

We estimated separate sets of regression equations for each of the 665 days in the Analysis Period (implying 3,990 equations in total, i.e., 665 days x 6 functional forms), where the input data for each comprised the average for each of the relevant bonds over the previous 20 day period.

##### Testing for the best functional form

We report two sets of results for the test of the functional form:

- First, for each of the sets of regression equations referred to above we calculated the SIC statistics, and from this established a rank for each of the different functions in each of the 665 sets of regression equations. We then calculated the averaging ranking for each of the functional forms, and from this established an overall ranking.
- Secondly, we also report the SIC results for the test averaging period.

We focussed on the two sets of results is because this allowed us to assess the relative merits of each functional form during the test averaging period, and also to assess the robustness of the ranking of each function over time. If a functional form were found to be highly ranked during the averaging period and also highly ranked over time, then this would give additional confidence that that functional form provides a reasonable depiction of the relationship between the debt risk premium and term (and is not unduly affected by any idiosyncratic factors during a particular 20 day averaging period). Choosing a functional form that is robust over time is also important in the context of the current matter where the test averaging period will not be the averaging period that is actually used to determine the debt risk premium for SP AusNet.

##### Regression results for the averaging period

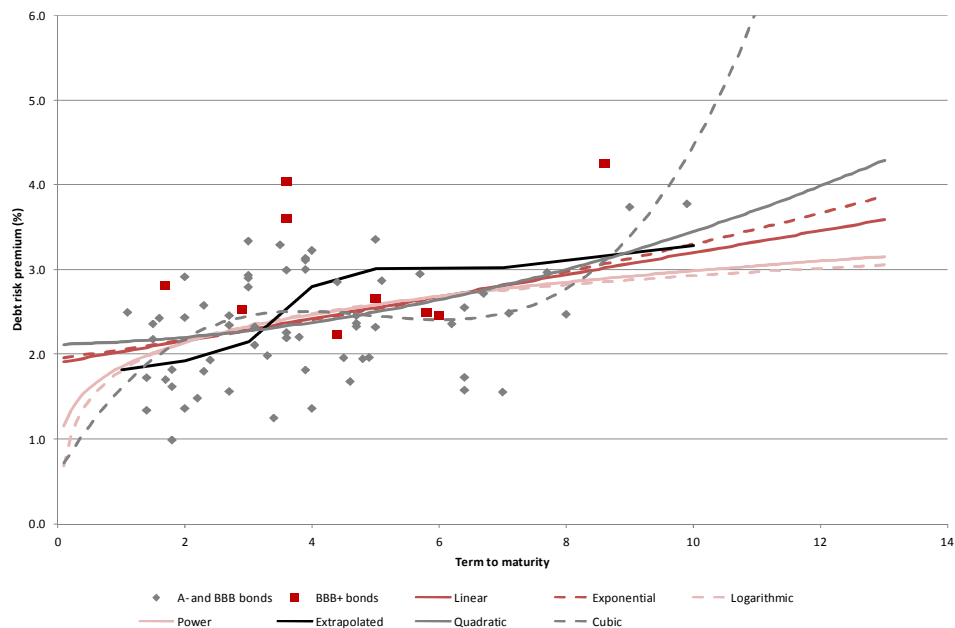
Figure 3 below shows how the bond data points were distributed relative to the extrapolated Bloomberg curve and the alternative functional forms for the 20 day averaging period ending 7 December, 2012.<sup>50</sup> The extrapolated Bloomberg curve (328 basis points) was positioned between estimates using the exponential function (330 basis points) and the linear function (320 basis points). There were also significantly higher estimates based on the cubic and quadratic functions (446 and 345 basis points respectively), and significantly lower estimates were derived

<sup>49</sup> The average score obtained for the sample was 2.1, which was close to the theoretical average of 2 required for a BBB+ credit rating given the notional scores applied to each credit rating between BBB and A- (i.e. a score of 1 for a credit rating of BBB, a score of 2 for a credit rating of BBB+, and a score of 3 for a credit rating of A-).

<sup>50</sup> Each observation is the simple average of the Bloomberg and UBS debt risk premium, where both services published an estimate, or the separate Bloomberg or UBS estimate where they did not. UBS is not a contributor to Bloomberg's bank feeds.

from the power and logarithmic functional forms (296 and 293 basis points respectively).

**Figure 3 – Debt risk premium estimates for 20 business days to 7 December 2012 (basis points)**



Source: PwC’s analysis, Bloomberg, UBS.

Table 3 below arranges the alternative functional forms by debt risk premium estimate. Our view based on this analysis is that the linear function should be preferred.

- The exponential and linear forms scored best and second best (i.e. lowest and second lowest score) on the SIC test during the averaging period, and the linear function was ranked highest (best) on average throughout the 665 days up to 7 December, 2012.<sup>51</sup>
  - We recommend placing less weight on the exponential function due to the fact that it lacks broader theoretical foundations and empirical support. On the other hand, the linear functional form does have theoretical and empirical precedents.
- The remainder of the functions either performed poorly during the averaging period (power), or generally (quadratic, cubic and logarithmic).

The debt risk premium estimate using the linear function of 320 basis points lends support to the 328 basis points estimated using the extrapolated Bloomberg methodology.

<sup>51</sup> More specifically, there were 665 overlapping regressions, with each day’s regression being based on 20 days of observations up to and including that day. During these 665 overlapping periods of 20 days the linear functional form was ranked equal first with the power function (at an average ranking of 2.2), although the power function was marginally ahead at two decimal places.



**Table 3 – Debt risk premium regression estimates for 20 business days to 7 December 2012 (basis points)**

Functional form	10 year BBB+ Debt Risk Premium (basis points)	Schwartz Information Criterion test for averaging period		Average rank by SIC for period 6 May 2010 to 7 Dec. 2012	
		Score	Rank		Rank
<b>Extrapolated Bloomberg FVC</b>	328	n/a	n/a	n/a	
Cubic	446	2.132	3	5.7	6
Quadratic	345	2.170	6	5.0	5
Exponential	330	2.118	1	2.9	3
Linear	320	2.123	2	2.2	1
Power	298	2.135	4	2.2	1
Logarithmic	293	2.139	5	3.1	4

Source: UBS, Bloomberg, PwC. Note: The exponential function was convex at higher terms to maturity in all 665 regressions (i.e. during the broader Analysis Period).

### Conclusion on the debt risk premium

For the 20 day averaging period to 7 December, 2012, the extrapolated Bloomberg FVC methodology estimated a 10 year BBB+ debt risk premium of 328 basis points. This was close to the estimate obtained by applying the linear functional form (320 basis points), which, while not ranked the best on the basis of the empirical tests in the averaging period, has more theoretical and empirical support than the higher ranked convex function. Furthermore, for the 665 overlapping periods of 20 days up to 7 December, 2012, the linear functional form was ranked equal best on average. Our resulting reliance on the linear functional form is consistent with the findings of our previous reports for ElectraNet and the Victorian gas distribution businesses.

In conclusion, whilst noting that there is a degree of imprecision in this exercise due to a relative paucity of data for longer dated bonds, we recommend that the extrapolated Bloomberg fair value curve estimate of 328 basis points should be adopted.



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# Appendix A Regression outputs and functions

## 1 Summary statistics – Linear functional form for the 20 business days to 7 December 2012

The equation for the linear function is

$$DRP = 1.90 + 0.13 * t$$

where:

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

### Regression summary statistics

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.899045	0.172041	11.03832	0.0000
C(2)	0.129793	0.038313	3.387682	0.0012
R-squared	0.142606	Mean dependent var		2.421872
Adjusted R-squared	0.13018	S.D. dependent var		0.686868
S.E. of regression	0.640602	Akaike info criterion		1.974947
Sum squared resid	28.31557	Schwarz criterion		2.038684
Log likelihood	-68.11062	Hannan-Quinn criter.		2.000293
F-statistic	11.47639	Durbin-Watson stat		1.231885
Prob(F-statistic)	0.001168			

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

## 2 Summary statistics – Quadratic functional form for the 20 business days to 7 December 2012

The equation for the quadratic function is

$$DRP = 2.11 + 0.02 * t + 0.01 * t^2$$

where:

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

### Regression summary statistics

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2.112267	0.33872	6.236025	0.0000
C(2)	0.020183	0.154668	0.130494	0.8966
C(3)	0.011322	0.015476	0.731638	0.4669
R-squared	0.149302	Mean dependent var		2.421872
Adjusted R-squared	0.124282	S.D. dependent var		0.686868
S.E. of regression	0.64277	Akaike info criterion		1.995275
Sum squared resid	28.09441	Schwarz criterion		2.090881
Log likelihood	-67.83225	Hannan-Quinn criter.		2.033294
F-statistic	5.967196	Durbin-Watson stat		1.245415
Prob(F-statistic)	0.004096			

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

## 3 Summary statistics – Exponential functional form for the 20 business days to 7 December 2012

The regression for the exponential function is

$$DRP = 1.95 * \exp(0.05 * t)$$

where:

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

### Regression summary statistics

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.947241	0.140167	13.89226	0.0000
C(2)	0.052714	0.014489	3.638087	0.0005
R-squared	0.1467	Mean dependent var		2.421872
Adjusted R-squared	0.134333	S.D. dependent var		0.686868
S.E. of regression	0.63907	Akaike info criterion		1.97016
Sum squared resid	28.18035	Schwarz criterion		2.033898
Log likelihood	-67.94069	Hannan-Quinn criter.		1.995507
Durbin-Watson stat	1.234792			

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

## 4 Summary statistics – Logarithmic functional form for the 20 business days to 7 December 2012

The equation for the logarithmic function is

$$DRP = 1.80 + 0.49 * \text{Log}_e(t)$$

where:

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

### Regression summary statistics

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.803612	0.205133	8.792416	0.0000
C(2)	0.487107	0.149969	3.248056	0.0018
R-squared	0.13262	Mean dependent var		2.421872
Adjusted R-squared	0.120049	S.D. dependent var		0.686868
S.E. of regression	0.644321	Akaike info criterion		1.986527
Sum squared resid	28.64536	Schwarz criterion		2.050264
Log likelihood	-68.5217	Hannan-Quinn criter.		2.011873
F-statistic	10.54987	Durbin-Watson stat		1.23533
Prob(F-statistic)	0.001796			

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

## 5 Summary statistics – Power functional form for the 20 business days to 7 December 2012

The equation for the power function is

$$DRP = 1.82 * t^{0.21}$$

where:

- DRP refers to the debt risk premium

### Regression summary statistics

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.851477	0.171106	10.82063	0.0000

C(2)	0.207147	0.063261	3.274475	0.0017
R-squared	0.135324	Mean dependent var		2.421872
Adjusted R-squared	0.122792	S.D. dependent var		0.686868
S.E. of regression	0.643316	Akaike info criterion		1.983404
Sum squared resid	28.55605	Schwarz criterion		2.047141
Log likelihood	-68.41084	Hannan-Quinn criter.		2.00875
Durbin-Watson stat	1.2317			

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

## **6 Summary statistics – Cubic functional form for the 20 business days to 7 December 2012**

The equation for the cubic function is

$$DRP = 0.59 + 1.26 * t - 0.27 * t^2 + 0.02 * t^3$$

where:

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

### **Regression summary statistics**

Dependent Variable: DRP

Method: Least Squares

Included observations: 71

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.589023	0.623917	0.944073	0.3485
C(2)	1.264199	0.460464	2.745491	0.0077
C(3)	-0.268905	0.099382	-2.705767	0.0086
C(4)	0.018121	0.006356	2.851157	0.0058
R-squared	0.241349	Mean dependent var		2.421872
Adjusted R-squared	0.20738	S.D. dependent var		0.686868
S.E. of regression	0.611513	Akaike info criterion		1.908928
Sum squared resid	25.05454	Schwarz criterion		2.036403
Log likelihood	-63.76696	Hannan-Quinn criter.		1.959621
F-statistic	7.104896	Durbin-Watson stat		1.386698
Prob(F-statistic)	0.000324			

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

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# Appendix B Terms of Reference

## PURPOSE

The purpose of this brief is to set out the nature, scope and purpose of work that SP AusNet, is seeking PricewaterhouseCoopers Australia (PwC) to undertake in relation to the debt risk premium (DRP) for its upcoming Transmission Revenue Reset (TRR).

## BACKGROUND

The transmission business's current regulatory control period is due to expire on 31 March 2014 and the next regulatory control period will commence on 1 April 2014 and run until 31 March 2017.

The revenue proposal for the upcoming regulatory control period, must be submitted to the Australian Energy Regulator (AER) by 28 February 2013. One of the considerations in preparing the revenue proposal will be the proposed methodology to calculate the DRP.

The legislative requirements for calculation of the DRP are contained in the National Electricity Law and the National Electricity Rules (Version 52).

Specifically, Clause 6A.6.2 (e) of the National Electricity Rules (Version 52) requires that, for the purpose of a revenue determination, the meaning of debt risk premium is as follows:

*“The debt risk premium for a regulatory control period is the premium determined for that regulatory control period by the AER as the margin between the annualised nominal risk free rate and the observed annualised Australian benchmark corporate bond rate for corporate bonds which have a BBB+ credit rating from Standard and Poors and a maturity equal to that used to derive the nominal risk free rate.”*

This has been interpreted in previous regulatory decisions as meaning:

- it must be determined using the 'observed annualised Australian benchmark corporate bond rate for corporate bonds' or some proxy thereof;
- the bonds must have a BBB+ credit rating; and
- the bonds must have a maturity period of 10 years.

## PURPOSE

The business is seeking PwC to:

- Advise whether the Bloomberg fair yield curve (extrapolated to 10 years) can be relied on to reasonably meet the legislative requirements;
- If not, propose an alternative methodology for calculating the DRP that best meets the legislative requirements; and
- Apply the Bloomberg and/or the alternative methodology during the 20 business days from 12 November to 7 December 2012.

In providing the advice, PwC should take into consideration the outcomes of recent AER decisions and relevant judgements handed down by the Australian Competition Tribunal.

The report must contain the following:

1. The terms of reference;



2. The qualifications of the person(s) preparing the report;
3. Identify any pre-existing relationship the person(s) and/or PwC has with the businesses;
4. Clearly and fully set out all the relevant facts;
5. Explain the person(s) process of reasoning;
6. Reference any documents relied on by the person(s);
7. Include specified wording at the end of the report stating that “[the person(s)] has made all the inquiries that [the person(s)] believes are desirable and appropriate and that no matters of significance that [the person(s)] regards as relevant have, to [the person(s)] knowledge, been withheld”; and
8. State that the person(s) have been provided with a copy of the Federal Court’s “Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia” (Attachment 1) and that the Report has been prepared in accordance with those Guidelines.

The business emphasises that the report prepared by PwC will be provided to the AER in support of the businesses’ revised access arrangements. Accordingly the report may become a public report.

As noted, the business intends to provide a copy of PwC’s report to the AER in support of its regulatory proposal. The person(s) may be required to act as an expert witness in relation to the advice provided in the report.

The business has attached a copy of the Federal Court’s “Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia”. These Guidelines contain useful direction regarding the steps that should be taken by potential witnesses to ensure the appropriate level of objectivity.

#### **CONTACT**

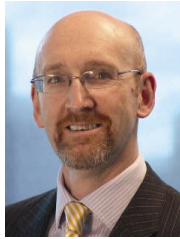
Tom Hallam will be the day to day contact for PwC in preparing its report. PwC should direct all of its queries to:

(03) 9695 6617 or tom.hallam@sp-ausnet.com.au.

#### **TIMING**

A draft report should be provided by 18 January 2012, and finalised by 8 February 2012.

# Appendix C Curriculum vitae



## **Jeff Balchin**

*Principal, Economics and Policy*

*Phone: 03 8603 4973*

*Fax: 03 8613 5576*

*jeff.balchin@au.pwc.com*

Jeff is an economist in the PwC Economics and Policy team. Jeff has almost 20 years of experience in relation to economic regulation issues across the electricity, gas and airports sectors in Australia and New Zealand and experience in relation to water, post and telecommunications. He has advised governments, regulators and major corporations on issues including the development of regulatory frameworks, regulatory price reviews, licensing and franchise bidding and market design. Jeff has also undertaken a number of expert witness assignments. His particular specialities have been on the application of finance principles to economic regulation, the design of tariff structures, the design of incentive compatible regulation and the drafting and economic interpretation of regulatory instruments.

In addition, Jeff has led a number of analytical assignments for firms to understand the responsiveness of consumers to changes to prices or other factors (like promotional activities) and to use this information to inform pricing strategy.

### **Relevant experience**

*Prior to joining the PwC, Jeff held a number of policy positions in the Commonwealth Government.*

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

### **Relevant experience - Economic Regulation of Price and Service**

- A. Periodic Price Reviews – Major Roles for**

### **Regulators**

- **South Australian default gas retail price review (Client: the Essential Services Commission, SA, (2007-2008)** - Directed a team that derived estimates of the benchmark operating costs for a gas retailer and the margin that should be allowed. This latter exercise included a bottom-up estimate of the financing costs incurred by a gas retail business.
- **South Australian default electricity retail price review (Client: the Essential Services Commission, SA, 2007)** - Directed a team that estimated the wholesale electricity purchase cost for the default electricity retail supplier in South Australia. The project involved the development of a model for deriving an optimal portfolio of hedging contracts for a prudent and efficient retailer, and the estimate of the expected cost incurred with that portfolio. Applying the principles of modern finance theory to resolve issues of how the compensation for certain risk should be quantified was also a central part of the project.
- **South Australian default gas retail price review (Client: the Essential Services Commission, SA, 2005)** - As part of a team, advised the regulator on the cost of purchasing gas transmission services for a prudent and efficient SA gas retailer, where the transmission options included the use of the Moomba Adelaide Pipeline and SEAGas Pipeline, connecting a number of gas production sources.
- **Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2006 2008)** - Provided advice to the Essential Service Commission in relation to its review of gas distribution access arrangements on the treatment of outsourcing arrangements, finance issues, incentive design and other economic issues.
- **Envestra Gas Distribution Price Review (Client: the Essential Services Commission, SA, 2006)** - Provided advice on several finance related issues (including 'return on assets' issues and the financial effect of Envestra's invoicing policy), and the treatment of major outsourcing contracts when setting regulated charges.
- **Victorian Electricity Distribution Price Review (Client: the Essential Services Commission, Vic, 2003 2005)** - Provided advice to the Essential Service Commission on a range of economic issues related to current review of electricity distribution charges, including issues related to finance, forecasting of expenditure and the design of incentive arrangements for productive efficiency and service delivery. Was a member of the Steering Committee advising on strategic regulatory issues.
- **Victorian Water Price Review (Client: the Essential Services Commission, Vic, 2003 2005)** - Provided advice to the Essential Services Commission on the issues associated with extending economic regulation to the various elements of the Victorian water sector. Was a member of the Steering Committee advising on strategic regulatory issues, and also provided advice on specific issues, most notably the determination of the initial regulatory values for the water businesses and the role of developer charges.
- **ETSA Electricity Distribution Price Review (Client: the Essential Services Commission, SA, 2002 2005)** - Provided advice on the 'return on assets' issues associated with the review of ETSA's regulated distribution charges, including

the preparation of consultation papers. The issues covered include the valuation of assets for regulatory purposes and cost of capital issues. Also engaged as a quality assurance adviser on other consultation papers produced as part of the price review.

- **Victorian Gas Distribution Price Review (Client: the Essential Services Commission, Vic, 2001 2002)** - Economic adviser to the Essential Services Commission during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Was responsible for all issues associated with capital financing (including analysis of the cost of capital and assessment of risk generally, and asset valuation), and supervised the financial modelling and derivation of regulated charges. Also advised on a number of other issues, including the design of incentive arrangements, the form of regulation for extensions to unreticulated townships, and the principles for determining charges for new customers connecting to the system. Represented the Commission at numerous public forums during the course of the review, and was the principal author of the finance related and other relevant sections of the four consultation papers and the draft and final decisions.
- **ETSA Electricity Distribution Price Review (Client: the South Australian Independent Industry Regulator, 2000 2001)** - As part of a team, prepared a series of reports proposing a framework for the review. The particular focus was on the design of incentives to encourage cost reduction and service improvement, and how such incentives can assist the regulator to meet its statutory obligations. Currently retained to provide commentary on the consultation papers being produced by the regulator, including strategic or detailed advice as appropriate.
- **Dampier to Bunbury Natural Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000 2002)** - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft decision.
- **Goldfield Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 2000 2004)** - Provided economic advice to the Office of the Independent Regulator during its continuing assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft decision, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Represented the Office on these matters at a public forum, and provided strategic advice to the Independent Regulator on the draft decision.
- **Victorian Electricity Distribution Price Review (Client: the Office of the Regulator General, Vic, 1999 2000)** - Economic adviser to the Office of the Regulator General during its review of the price caps for the five Victorian electricity

distributors. Had responsibility for all issues associated with capital financing, including analysis of the cost of capital (and assessment of risk generally) and asset valuation, and supervised the financial modelling and derivation of regulated charges. Also advised on a range of other issues, including the design of incentive regulation for cost reduction and service improvement, and the principles for determining charges for new customers connecting to the system. Represented the Office at numerous public forums during the course of the review, and was principal author of the finance related sections of three consultation papers, and the finance related sections of the draft and final decision documents.

- **Victorian Ports Corporation and Channels Authority Price Review (Client: the Office of the Regulator General, Vic, 2000)** - Advised on the finance related issues (cost of capital and the assessment of risk generally, and asset valuation), financial modelling (and the derivation of regulated charges), and on the form of control set over prices. Principal author of the sections of the draft and final decision documents addressing the finance related and price control issues.
- **AlintaGas Gas Distribution Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999 2000)** - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline. This advice included providing a report assessing the cost of capital associated with the regulated activities, overall review of all parts of the draft and final decisions, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.
- **Parmelia Gas Pipeline Access Arrangement Review (Client: the Independent Gas Pipelines Access Regulator, WA, 1999 2000)** - Provided economic advice to the Office of the Independent Regulator during its assessment of the regulated charges and other terms and conditions of access for the gas pipeline, including a review of all parts of the draft and final decisions, with particular focus on the sections addressing the cost of capital (and assessment of risk generally), asset valuation and financial modelling. Also provided strategic advice to the Independent Regulator on the draft and final decisions.
- **Victorian Gas Distribution Price Review (Client: the Office of the Regulator General, Vic, 1998)** - Economic adviser to the Office of the Regulator General during its assessment of the price caps and other terms and conditions of access for the three Victorian gas distributors. Major issues addressed included the valuation of assets for regulatory purposes, cost of capital financing and financial modelling. Principal author of the draft and final decision documents.

**B. Periodic and Other Price Reviews – Other Activities**

- **Equity Betas for Regulated Electricity Transmission Activities (Client: Grid Australia, APIA, ENA, 2008)** - Prepared a report presenting empirical evidence on the equity betas for regulated Australian electricity transmission and distribution businesses for the AER's five yearly review of WACC parameters for these industries. The report

demonstrated the implications of a number of different estimation techniques and the reliability of the resulting estimates. Also prepared a joint paper with the law firm, Gilbert+Tobin, providing an economic and legal interpretation of the relevant (unique) statutory guidance for the review.

- **Economic Principles for the Setting of Airside Charges (Client: Christchurch International Airport Limited, 2008 ongoing)** - Provided advice on a range of economic issues relating to its resetting of charges for airside services, including the valuation of assets and treatment of revaluations, certain inputs to the cost of capital (beta and the debt margin) and the efficiency of prices over time and the implications for the depreciation of assets and measured accounting profit.
- **Treatment of Inflation and Depreciation when Setting Landing Charges (Client: Virgin Blue, 2007 2008)** - Provided advice on Adelaide Airport's proposed approach for setting landing charges for Adelaide Airport, where a key issue was how it proposed to deal with inflation and the implications for the path of prices over time. The advice also addressed the different formulae that are available for deriving an annual revenue requirement and the requirements for the different formulae to be applied consistently.
- **Application of the Grid Investment Test to the Auckland 400kV Upgrade (Client: Electricity Commission of New Zealand, 2006)** - As part of a team, undertook a review of the Commission's process for reviewing Transpower's proposed Auckland 400kV upgrade project and undertook a peer review of the Commission's application of the Grid Investment Test.
- **Appropriate Treatment of Taxation when Measuring Regulatory Profit (Client: Powerco New Zealand, 2005 2006)** - Prepared two statements for Powerco New Zealand related to how the Commerce Commission should treat taxation when measuring realised and projected regulatory profit for its gas distribution business (measured regulatory profit, in turn, was a key input into the Commission's advice to the Minister as to whether there would be net benefits from regulating Powerco New Zealand's gas distribution business). A key finding was that care must be taken to ensure that the inputs used when calculating taxation expenses are consistent with the other 'assumptions' that a regulator adopts if it applies incentive regulation (most notably, a need for consistency between assumed tax depreciation and the regulatory asset value).
- **Application of Directlink for Regulated Status (Client: Directlink, 2003 2004)** - Prepared advice on the economic issues associated with the Directlink Joint Venture's request to be converted from an unregulated (entrepreneurial) interconnector to a regulated interconnector. As with the Murraylink application, the key issues included the implications for economic efficiency flowing from its application and the appropriate application of a cost benefit test for transmission investment (and the implications of that test for the setting of the regulatory value for its asset).
- **Principles for the 'Stranding' of Assets by Regulators (Client: the Independent Pricing and Regulatory Tribunal, NSW, 2005)** - Prepared a report discussing the relevant economic principles for a regulator in deciding whether to 'strand'

assets for regulatory purposes (that is, to deny any further return on assets that are partially or unutilised). An important conclusion of the advice is that the benefits of stranding need to be assessed with reference to how future decisions of the regulated entities are affected by the policy (i.e. future investment and pricing decisions), and that the uncertainty created from 'stranding' creates real costs.

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

additional gas producers).

- **Relevance of 'September 11' for the Risk Free Rate (Client: the Australian Competition and Consumer Commission, 2001)** - Prepared a report assessing the relevance (if any) of the events of September 11 for the proxy 'risk free rate' that is included in the Capital Asset Pricing Model (this is a model, drawn from finance theory, for estimating the required return for a particular asset).
- **Victorian Government Review of Water Prices (Client: the Department of Natural Resources and the Environment, Vic, 2000 2001)** - Prepared a report discussing the principles regulators use to determine the capital related cost (including reasonable profit) associated with providing utility services, and how those principles would apply to the water industry in particular. The report also provided an estimate of the cost of capital (and assessment of risk in general) associated with providing water services. The findings of the report were presented to a forum of representatives of the Victorian water industry.
- **Likely Regulatory Outcome for the Price for Using a Port (Client: MIM, 2000)** - Provided advice on the outcome that could be expected were the dispute over the price for the use of a major port to be resolved by an economic regulator. The main issue of contention was the valuation of the port assets (for regulatory purposes) given that the installed infrastructure was excess to requirements, and the mine had a short remaining life.
- **Relevance of 'Asymmetric Events' in the Setting of Regulated Charges (Client: TransGrid, 1999)** - In conjunction with William M Mercer, prepared a report (which was submitted to the Australian Competition and Consumer Commission) discussing the relevance of downside (asymmetric) events when setting regulated charges, and quantifying the expected cost of those events.

#### **C. Licencing / Franchise Bidding**

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



final decision documents.

#### **D. Market Design**

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

#### **E. Development of Regulatory Frameworks**

- **Implications of greenhouse policy for the electricity and gas regulatory frameworks (Client: the Australian Energy Market Commission, 2008 ongoing)** - Providing ongoing advice to the AEMC in its review of whether changes to the electricity and gas regulatory frameworks is warranted in light of the proposed introduction of a carbon permit trading scheme and an expanded renewables obligation. Issues addressed include the framework for electricity connections, the efficiency of the management of congestion and locational signals for generators and the appropriate specification of a cost benefit test for transmission upgrades in light of the two policy initiatives.
- **Application of a 'total factor productivity' form of regulation (Client: the Victorian Department of Primary Industries, 2008)** - Assisted the Department to develop a proposed amendment to the regulatory regime for electricity regulation to permit (but not mandate) a total factor productivity approach to setting price caps – that is, to reset prices to cost at the start of the new regulatory period and to use total factor productivity as an input to set the rate of change in prices over the period.
- **Expert Panel on Energy Access Pricing (Client: Ministerial Council on Energy, 2005 2006)** - Assisted the Expert Panel in its review of the appropriate scope for commonality of access pricing regulation across the electricity and gas, transmission and distribution sectors. The report recommended best practice approaches to the appropriate forms of regulation, the principles to guide the development of detailed regulatory rules and regulatory assessments, the procedures for the conduct of regulatory reviews and information gathering powers.
- **Productivity Commission Review of Airport Pricing (Client:**

**Virgin Blue, 2006)** - Prepared two reports for Virgin Blue for submission to the Commission's review, addressing the economic interpretation of the review principles, asset valuation, required rates of return for airports and the efficiency effects of airport charges and presented the findings to a public forum.

- **AEMC Review of the Rules for Setting Transmission Prices (Client: Transmission Network Owners, 2005 2006)** - Advised a coalition comprising all of the major electricity transmission network owners during the new Australian Energy Market Commission's review of the rules under which transmission prices are determined. Prepared advice on a number of issues and assisted the owners to draft their submissions to the AEMC's various papers.
- **Advice on Energy Policy Reform Issues (Client: Victorian Department of Infrastructure/Primary Industries, 2003 ongoing)** - Ongoing advice to the Department regarding on issues relating to national energy market reform. Key areas covered include: reform of cross ownership rules for the energy sector; the reform of the cost benefit test for electricity transmission investments; and the reform of the gas access arrangements (in particular, the scope for introducing more light handed forms of regulation); and the transition of the Victorian electricity transmission arrangements and gas market into the national regulatory regime.
- **Productivity Commission Review of the National Gas Code (Client: BHPBilliton, 2003 2004)** - Produced two submissions to the review, with the important issues including the appropriate form of regulation for the monopoly gas transmission assets (including the role of incentive regulation), the requirement for ring fencing arrangements, and the presentation of evidence on the impact of regulation on the industry since the introduction of the Code. The evidence presented included a detailed empirical study of the evidence provided by the market values of regulated entities for the question of whether regulators are setting prices that are too low.
- **Framework for the Regulation of Service Quality (Client: Western Power, 2002)** - Prepared two reports advising on the framework for the regulation of product and service quality for electricity distribution, with a particular focus on the use of economic incentives to optimise quality and the implications for the coordination of service regulation coordinated with distribution tariff regulation.
- **Development of the National Third Party Access Code for Natural Gas Pipeline Systems Code (Client: commenced while a Commonwealth Public Servant, after 1996 the Commonwealth Government, 1994 1997)** - Was involved in the development of the Gas Code (which is the legal framework for the economic regulation of gas transmission and distribution systems) from the time of the agreement between governments to implement access regulation, through to the signing of the intergovernmental agreements and the passage of the relevant legislation by the State and Commonwealth parliaments. Major issues of contention included the overall form of regulation to apply to the infrastructure (including the principles and processes for establishing whether an asset should be regulated), pricing principles (including the valuation of assets for regulatory

purposes and the use of incentive regulation), ring fencing arrangements between monopoly and potentially contestable activities, and the disclosure of information. Was the principal author of numerous issues papers for the various government and industry working groups, public discussion papers, and sections of the Gas Code.

#### **F. Other Finance Work**

- **Private Port Development (Client: Major Australian Bank, 2008)** - Prepared a report on the relative merits of different governance and financing arrangements for a proposed major port development that would serve multiple port users.
- **Review of Capital Structure (Client: major Victorian water entity, 2003)** - Prepared a report (for the Board) advising on the optimal capital structure for a particular Victorian water entity. The report advised on the practical implications of the theory on optimal capital structure, presented benchmarking results for comparable entities, and presented the results of detailed modelling of the risk implications of different capital structures. Important issues for the exercise were the implications of continued government ownership and the impending economic regulation by the Victorian Essential Services Commission for the choice of – and transition to – the optimal capital structure.

#### **G. Expert Witness Roles**

- **Consultation on Major Airport Capital Expenditure – Judicial Review (Client: Christchurch International Airport, 2008)** - Prepared an affidavit for a judicial review on whether the airport consulted appropriately on its proposed terminal development. Addressed the rationale, from the point of view of economics, of separating the decision of ‘what to build’ from the question of ‘how to price’ in relation to new infrastructure.
- **New Zealand Commerce Commission Draft Decision on Gas Distribution Charges (Client: Powerco, 2007 08)** - Prepared an expert statement about the valuation of assets for regulatory purposes, with a focus on the treatment of revaluation gains, and a memorandum about the treatment of taxation for regulatory purposes and appeared before the Commerce Commission.
- **Sydney Airport Domestic Landing Change Arbitration (Client: Virgin Blue, 2007)** - Prepared two expert reports on the economic issues associated with the structure of landing charges (note: the evidence was filed, but the parties reached agreement before the case was heard).
- **New Zealand Commerce Commission Gas Price Control Decision – Judicial Review to the High Court (Client: Powerco, 2006)** - Provided four affidavits on the regulatory economic issues associated with the calculation of the allowance for taxation for a regulatory purpose, addressing in particular the need for consistency in assumptions across different regulatory calculations.
- **Victorian Electricity Distribution Price Review – Appeal to the ESC Appeal Panel: Service Incentive Risk (Client: the Essential Services Commission, Vic, 2005 2006)** - Prepared expert evidence on the workings of the ESC’s service incentive scheme and the question of whether the scheme was likely to deliver a windfall gain or loss to the distributors

(note: the evidence was filed, but the appellant withdrew this ground of appeal prior to the case being heard).

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

#### ***Qualifications and memberships***

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



