DBCT – debt risk premium to 31 May 2016

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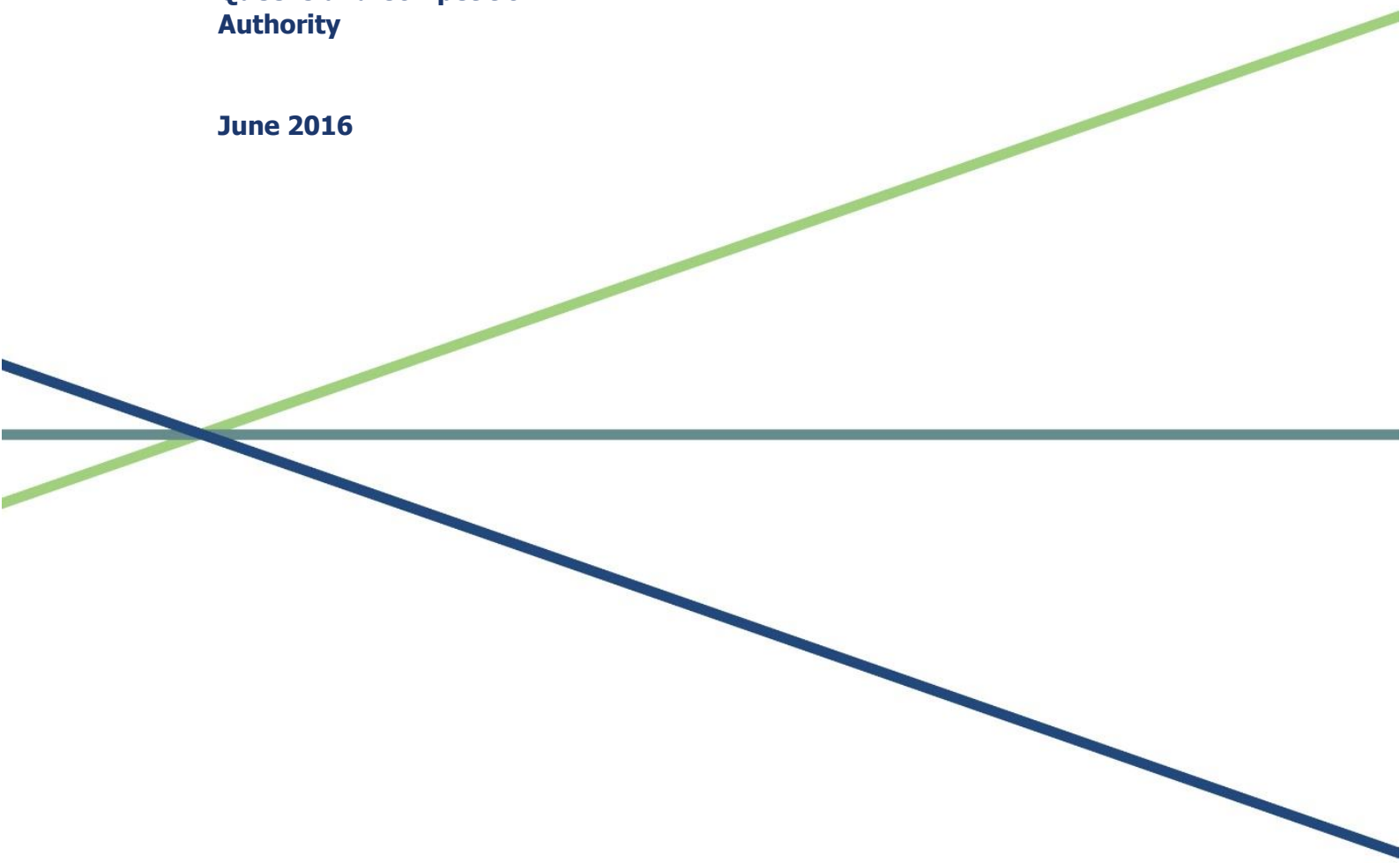
Queensland Competition Authority

June 2016



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1. Executive Summary

In June 2015, the Queensland Competition Authority (QCA) issued an initial undertaking notice under section 133 of the QCA Act requiring DBCT Management (DBCTM) to submit a DAU to it. Subsequently, in March 2016, the QCA agreed an averaging period of 20 business days ending 31 May 2016 with DBCTM for the purpose of setting the final cost of debt. The QCA engaged Incenta to provide an update of the cost of debt calculation, and of the risk free rate at five years in a stand-alone report.

Recommended BBB debt risk premium

Having reviewed the evidence, we conclude that the best estimate of the debt risk premium for 10-year BBB debt that is obtained from an econometric approach (in line with the QCA's policy) is **2.65 per cent** for the 20 business days up to and including 31 May, 2016. This estimate is based on direct regression using the sample of 25 BBB rated bonds. This is approximately 11 to 12 basis points lower than the Bloomberg and RBA interpolated estimates (2.76 per cent and 2.77 per cent respectively).

We make the following observations in relation to the alternative estimates:

- *Pooled regression estimates* – we previously estimated the BBB debt risk premium by pooling BBB, BBB+ and A- bonds (a BBB+ centred pooled regression, which was interpreted as a BBB+ estimate) and then adding a premium to convert this to a BBB debt risk premium. This method would provide a debt risk premium of 2.50 per cent using current evidence. However, while consistent with previous reports for the QCA, a strict application of the method recommended in the PwC (2013) report would involve applying a BBB centred pooled regression if the target credit rating is BBB (i.e., rather than applying a BBB+ centred pooled regression and adjusting to a BBB). This latter method generates a debt risk premium for the current evidence of 3.01 per cent. However, we believe that this latter value is unreliable and should not be applied because there is material asymmetry in the change in the debt risk premium either side of the target credit rating, which violates a key assumption of this method (this asymmetry is materially different to the result that has been found previously for a BBB+ centred pooled regression). Therefore, the pre-conditions for using the pooled regression are not met.

- *Dummy variable regressions* – an alternative to simply pooling observations (and assuming symmetry in debt risk premia around the target credit rating) is to include dummy variables to allow for the observed asymmetry. This method generates estimates for the BBB debt risk premium of between 2.49 per cent and 2.57 per cent depending on the sample of bonds employed (if the curves are constrained to shift parallel). These estimates corroborate the 2.65 per cent debt risk premium that is obtained using a regression of only BBB bonds.

The estimates discussed above are explained in more detail below.

Estimates of the 10 year BBB debt risk premium

As displayed in Table ES.1 below, using the range of methods outlined below, the estimated 10 year BBB debt risk premium ranges from 2.49 per cent to 3.01 per cent.

Pooled regression centred on BBB

Our analysis begins with the application of a pooled regression centred on the BBB credit rating band, as recommended by the PwC(2013) report (Column 1 in Table ES.1). This method involves simple pooling of the BBB bonds with those one credit rating either side and using the predicted value from the regression as the predicted debt risk premium for a bond with an average credit rating of the sample (we find that the average credit rating is very close to BBB). This method derives an estimate of 3.01 per cent.

However, we consider this estimate of the debt risk premium to be unreliable because a key assumption underpinning the pooled regression method is not met. This key assumption is that there is approximate symmetry in the change in the debt risk premium when moving either side of the central credit rating. We have found previously that this symmetry holds (approximately) for a BBB+ centred regression; however, we have found that the change in the debt risk premium when moving from BBB to BBB- is materially greater than the change in the premium between BBB+ and BBB. This is based upon the following evidence:

- Relative to the pooled regression line, the BBB- observations are approximately 84 basis points above the regression line whereas BBB+ observations lie approximately 23 basis points below the line (i.e. there is a marked asymmetry);[1] and

- The same outcome is generated when dummy variables are included in the regression to estimate the change in debt risk premium empirically (the BBB line is 84.4 basis points to 85.8 basis points below BBB- and 23 basis points to 23.1 basis points above BBB+).

We further note that the actual BBB bond yields are, on average, 13 basis points below the pooled regression line, which corroborates the results above. We have therefore recommended that in the current circumstances the pooled regression line centred on BBB should not be used when estimating a 10-year BBB debt risk premium.[2]

Pooled regression centred on BBB+ bonds with a BBB 'premium' added

One alternative to apply is a pooled regression that is centred on the BBB+ credit rating and to apply again the method in our previous report (and in previous reports for the QCA). This approach is to estimate the 10-year BBB debt risk premium by undertaking a pooled regression centred on BBB+ bonds, and then adding a 'BBB premium'. This latter premium is estimated by calculating the average difference between each BBB bond and the estimated pooled regression line (Column 3). Using this approach we estimated a 10 year BBB debt risk premium using current evidence of 2.50 per cent.

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1 We have previously noted that symmetry is the assumption underlying the PwC(2013) pooled regression method. See Incenta (September, 2015), *Aurizon Network 2014 DAU – response to submissions on WACC*, p. 28.

2 Based on current evidence, we consider that using the pooled regression approach centred on BBB+ (i.e. using a sample of BBB, BBB+ and A- bonds) is the best method to estimate a BBB+ debt risk premium.

Table ES.1: Estimates of the BBB debt risk premium for 20 business days to 31 May, 2016

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	Pooled BBB regression	Bloomberg / RBA	Pooled BBB+ regression + BBB premium	BBB own regression	Dummy variables All BBB only	Dummy variables A-,BBB+,BBB	Dummy variables All BBB and A-
No Obs	51	22 / 91	72	25	51	72	84
Credit ratings included	BBB-,BBB,BBB+	BBB-,BBB,BBB+	BBB,BBB+,A-	BBB	BBB-,BBB,BBB+	BBB,BBB+,A-	BBB-,BBB,BBB+,A-
Intercept	**1.531**		**1.418**	**1.554**	**1.600**	**1.618**	**1.655**
T-stat	7.675		14.635	9.882	10.395	17.026	15.912
Term	**0.147**		**0.086**	**0.109**	**0.097**	**0.093**	**0.083**
T-stat	3.295		3.898	2.973	2.911	4.827	4.101
A- dummy						**-0.395**	**-0.393**
T-stat						-5.027	-4.341
BBB+ dummy					**-0.230**	**-0.231**	**-0.231**
T-stat					-1.655	-2.334	-2.033
BBB- dummy					**0.844**		**0.858**
T-stat					5.641		7.085
A- x Term interaction							
T-stat							
BBB+ x Term interaction							
T-stat							
BBB- x Term interaction							
T-stat							
BBB premium to BBB+			**0.225**				
Adj. R-square	0.165		0.167	0.246	0.559	0.375	0.639
BBB DRP at 10 years	**3.01**	**2.76 / 2.77**	**2.50**	**2.65**	**2.57**	**2.54**	**2.49**

Source: Bloomberg, RBA and Incenta analysis

Using dummy variables

An alternative to simply pooling observations and assuming symmetry in the premium around the target value is to allow empirically for this asymmetry. This can be done by including dummy variables within the estimation, so that a set of parallel curves for each credit rating is estimated.[3] (Columns 5 to 7):

- Using the 51 BBB bonds (i.e. from BBB+ to BBB-) we obtain a 10 year BBB estimate of 2.57 per cent;
- Using 72 bonds spanning A- to BBB results in an estimate of 2.54 per cent; and
- Including all 84 bonds spanning A- to BBB- obtains an estimate of 2.49 per cent.[4]

[3] This analysis assumes, implicitly, that the change in the debt risk premium with term is approximately the same across credit ratings. It is plausible that the debt risk premium may increase more quickly with term for the lower credit ratings, although the effect on this on the dummy variable estimate is indeterminate.

[4] Each of these approaches derives a similar picture, in that the 'distance' between the expected BBB bond function and the BBB- bonds is found to be asymmetric relative to the distance between the pooled regression line / expected BBB function, and the BBB+ bonds (being respectively in the order of 84 to 86 basis points on the one hand, and 23 basis points on the other).

Regression using only BBB bonds

A final alternative is to apply evidence from only BBB bonds. The pooled regression approach was designed to overcome the problem of there not being enough bond observations in a given credit rating band to allow a reliable estimate to be made, which (at least at the time the method was developed) was a particular issue for BBB+ bonds. However, there are currently 25 BBB bonds, which is a larger sample than the 22 bonds that Bloomberg currently employs to estimate the 10-year broad BBB debt risk premium. As displayed in Table ES.1, using only the 25 BBB-rated bond observations, a 10-year BBB debt risk premium of 2.65 per cent is estimated (Column 4).[5]

Bloomberg and RBA estimates

The QCA's cost of debt policy recommends that in addition to applying the PwC (2013) method, the broad BBB band fair value corporate bond yield data published by Bloomberg and the Reserve Bank of Australia (RBA) should be used to generate debt risk premium estimates. Using these data sources we obtained 10-year BBB debt risk premium estimates of 2.76 per cent and 2.77 per cent respectively (Column 2). Since Bloomberg began to publish 10-year broad BBB fair value yields on 14 April, 2015, its estimates have on average been approximately 11 basis points below those of the RBA, but at present they are very close.

Estimate of risk free rate

Relying on the Reserve Bank of Australia's (RBA) data for Commonwealth bond yields, we estimate a five-year risk free rate of **1.82 per cent** for the 20 business days up to and including 31 May, 2016.

[5] We have applied the functional form recommended in the PwC (2013) report, which is that there is a linear relationship between the debt risk premium and term. Informal testing suggests this functional form remains appropriate, although we note that we have not formally tested alternative functions.

2. Background and scope of work

In June 2015, the QCA issued an initial undertaking notice under section 133 of the QCA Act requiring DBCT Management to submit a DAU to it. On 12 October 2015 DBCT Management submitted its proposal, including an indicative post-tax nominal vanilla WACC range, and proposed values for key parameters, including the asset and equity beta, benchmark credit rating and capital structure, and an indicative debt risk premium. In March 2016, the QCA agreed an averaging period of 20 business days ending 31 May 2016 with DBCTM for the purpose of setting the final cost of debt following its draft decision.

The QCA appointed Incenta to advise on this matter, applying the QCA's preferred methodology. The key tasks are to:

- *Update the debt risk premium calculation* — calculate the value of the benchmark debt risk premium for DBCT for the regulatory period, for the approved averaging period of 20 business days ending 31 May 2016; and

- *Update the risk-free rate calculation* — calculate the value of the five-year risk-free rate for the approved averaging period of 20 business days ending 31 May 2016, using Commonwealth Government bonds.

The QCA requested that the report presenting the updated cost of debt, including debt risk premium and risk-free rate clearly describe the data used in the calculation and the methodology employed, in addition to stating the results.

3. Estimation method and data

3.1 Estimation method

The pooled regression approach

Our scope of work requires us to apply the methodology that is consistent with the QCA's policy document on the cost of debt.[6] The QCA policy is based on the PwC (2013) report, which reasoned that in circumstances where there is a small number of bonds in the target credit rating category a more accurate estimate can be obtained through using the pooled regression approach:[7]

> ***Pooled regression approach*** *– i.e. pool neighbouring bands (i.e., if the target is BBB+, pool BBB, BBB+ and A-), assume that the predicted value is approximately a debt risk premium of the average (i.e., the target rating, and test whether this is likely to be the case). Thus, for the BBB+ credit rating band (11 observations), the inclusion of BBB and A- bonds increases the sample size to 70 pooled bonds, and for the A credit rating band the sample is increased from 16 to 58 pooled bonds, which allows for a more robust estimate of the debt risk premium.*

Two years previously the Australian Competition Tribunal had endorsed pooling as a valid approach,[8] and while at the time of the PwC (2013) report most of the regulatory debt risk premium estimates were expected to be for the BBB+ credit rating band, the application of the pooled regression method to the BBB credit rating band was envisaged:[9]

> *For example, a regression estimating the BBB curve would use the available BBB-, BBB and BBB+ observations.*

However, as explained by PwC(2013), implicit in the use of the pooled regression approach is the assumption that there is no material bias toward one or the other neighbouring bands around the target band as it stated the need to:[10]

> *Test whether the weighting of observations with different credit rating (and their term to maturity distribution) is likely to create bias away from the credit rating function being estimated.*

We have previously observed that in addition, underpinning the pooled regression approach is an assumption that there is an approximate symmetry in the difference in the debt risk premium between the target credit rating and the two credit rating bands on either side of the target band. In our response to stakeholders in relation to Aurizon's 2014 DAU we noted:[11]

> *This* [finding of approximate symmetry around the pooled regression line for a target BBB+ rating] *is further evidence that the assumption underlying PwC's econometric method – that*

6 QCA (2015), *Final decision: Cost of debt estimation methodology.*
7 PwC (2013), *A cost of debt estimation methodology for businesses regulated by the Queensland Competition Authority*, p.45.
8 See Application by Jemena Gas Networks (NSW) Ltd (No.5) [2011] ACompT10, para.55.
9 PwC (2013), p.66.
10 PwC (2013), p.95.
11 Incenta (September, 2015), *Aurizon Network 2014 DAU – response to submissions on WACC*, p. 28.

> *the differential between BBB+ bonds and A- bonds, and the differential between BBB+ and BBB bonds is approximately equal – is appropriate.*

The PwC(2013) report found that its estimates of debt risk premiums for the BBB, BBB+ and A- credit rating categories for October-November 2012 (i.e. about the BBB+ centred regression line) were relatively evenly spaced, but noted the potential (which was present in its results) for the steepness of the debt risk premium function (up to the BBB credit rating) to rise as the credit rating fell:[12]

> *We note that the steepness of each curve increases from A to BBB, which accords with the expectation that an increasing premium for term should be required by investors in successively less worthy credit rating bands.*

We observe that whether the curves for the different credit ratings have a different slope – or are parallel – as well as the magnitude of any differential is ultimately an empirical issue, and it is plausible for any such differentials to vary over time.

Finding that on average the pooled regression line for a BBB+ centred pooled regression passes approximately through the centre of the BBB+ bond observations is a desirable outcome of implementing the PwC (2013) pooled regression method. In other words, the estimation error calculated as the average difference between the actual BBB+ observation at a given term and the predicted BBB+ debt risk premium at that term using the pooled regression coefficients should be close to zero.

Summary of pooled regression assumptions / outcomes

In summary, the pooled regression approach was recommended by PwC in order to overcome the problem of small bond samples arise in certain credit rating bands (particularly the BBB+ credit rating band). However, for the debt risk premium estimated through a pooled regression to be reliable, two assumptions need to be satisfied:

- *No material sample bias* - The weighted average of the bond observations for the three credit rating bands used for the pooled regression should be close to the target band (i.e. close to 2, if the three bands are given values of 1,2 and 3); and

- *Approximate symmetry of debt risk premium differentials* - Relative to the pooled regression line the target (central) credit rating band, the average differential in the debt risk premiums of the lower and higher credit rating bands should not be materially different.

3.2 Data

We began with a sample of 254 bonds in the BBB- to A- credit rating bands, which are Australian issued, denominated in Australian dollars, and have been rated by one of Standard & Poor's, Moody's or Fitch.[13] Eliminating bonds issued by finance businesses, not having more than a year to maturity,

[12] PwC (June, 2013), p.67.

[13] The sample was drawn from Bloomberg on 1 June, 2016.

and being senior securities, resulted in a final sample of 84 bonds. A full listing of the bonds included in the analysis is provided in Appendix A. Each bond was allocated to a credit rating by:

- adopting the predominant credit rating if there were three credit ratings,
- adopting the lower credit rating if there were two divergent ratings one notch apart, and
- averaging the credit ratings if the divergence in credit ratings was more than one notch.

This resulted in the distribution of credit ratings shown in Table 1 below. The average term to maturity for the entire sample of 84 bonds was 4.1 years, with the 25 BBB rated bonds being close to the average (3.9 years), and the 12 BBB- rated bonds having above average terms (averaging at 4.8 years). Of the 84 bonds, 71 are fixed rate, and 13 are floating rate bonds whose equivalent fixed rate yields are calculated by Bloomberg on a daily basis.

Table 1: Distribution of credit ratings for the bond sample

Credit rating band	Number of bonds	Fixed rate bonds	Floating rate bonds	Average term to maturity (years)
A-	33	30	3	4.2
BBB+	14	10	4	3.8
BBB	25	23	2	3.9
BBB-	12	8	4	4.8
Total	**84**	**71**	**13**	**4.1**

Source: Bloomberg and Incenta analysis

In Table 2 we examine the weighting of bonds that we use to derive pooled regression estimates centred on BBB+ and BBB rated bonds:

- *BBB+ centred estimate* - Applying values of 1, 2 and 3 to bonds with credit ratings of A-, BBB+ and BBB respectively resulted in a weighted average credit rating of 1.89 which is 94 per cent of a BBB+ credit rating (value of 2). This suggests that there may be a slight bias toward the A- credit rating.
- *BBB centred estimate* - Applying values of 1, 2 and 3 to bonds with credit ratings of BBB+, BBB and BBB- respectively resulted in a weighted average credit rating of 1.96, which is 98 per cent of a BBB credit rating (value of 2). This suggests that no material sample bias is present.

Table 2: Weighted average credit ratings for the pooled samples

Credit rating band	Centred on BBB+			Centred on BBB		
	Value	No. of bonds	Product	Value	No. of bonds	Product
A-	1	33	33			
BBB+	2	14	28	1	14	14
BBB	3	25	75	2	25	50
BBB-				3	12	36
Total		72	136		51	100
Weighted average			**1.89**			**1.96**

Source: Bloomberg and Incenta analysis

The PwC (2013) report recommended the use of UBS bond yield data in addition to Bloomberg data (and averaging these when both were available),[14] and also used UBS estimates of the current fixed coupon equivalent yield for the floating rate bonds in the sample. However, UBS has recently changed its policy on the distribution of its rate sheets, making this data source inaccessible to all but certain UBS clients. This reduces the transparency of using UBS yields. As a result, we have relied exclusively on Bloomberg data, which is also relied on by the Reserve Bank of Australia (RBA) when it estimates fair value yields for corporate bonds.

We estimated the risk free rate applicable to each term to maturity for the sample bonds by linear interpolation between Commonwealth Government bonds maturing on either side of the maturity date in question, which we obtained from the RBA website's interest rate statistics tables. The resulting yields were annualised and averaged.

[14] PwC (2013), p.66.

4. Debt risk premium and risk free rate estimates for 20 business days to 31 May 2016

In this section we estimate the two cost of debt parameters that the QCA has requested for the 20 business day period from 4 May to 31 May, 2016, inclusive.

4.1 Estimate of 10 year BBB debt risk premium

Our previous analysis indicated that a BBB credit rating is appropriate for the benchmark 60 per cent geared DBCT business.[15] We have undertaken the estimates using several different approaches, and as required following the QCA's cost of debt policy, have compared our findings with the Bloomberg and RBA 10 year fair value curve estimates. We have applied four econometric regression-based methods to estimate the 10 year BBB debt risk premium, since we consider that a key assumption underpinning the PwC(2013) pooled regression method is violated when that method is applied to estimate the BBB debt risk premium. After consideration of the alternatives, we conclude that in the current circumstances the best estimate of the 10 year BBB debt risk premium is 2.65 per cent, which is obtained by a regression using only the BBB bond observations.

4.1.1 Pooled regression centred on the BBB credit rating band

Pooled regression estimate

In the first row of Table 3 we show the results of applying the PwC (2013) method. They indicate a 10 year BBB debt risk premium estimate of 3.01 per cent. As shown in Table 2 above, the composition of the broad BBB bonds sample (i.e. BBB+, BBB and BBB-) is not biased.

Table 3: Pooled regression analysis estimating the BBB debt risk premium for 20 business days to 31 May, 2016

Bond sample	No. of bonds	Intercept	T-statistic	Term coefficient	T-statistic	Adj.R-squared	Predicted DRP at 10 years	Ave. Error from Predicted BBB
All BBB bonds	51	1.531	7.675	0.147	3.295	0.165	3.01	-0.13

Source: Bloomberg and Incenta analysis

Symmetry of debt risk premium differentials

Using the full sample, relative to the pooled regression line centred on BBB, on average:

- The 12 BBB- bonds were 67 basis points above the pooled regression line;
- The 25 BBB bonds were 13 basis points below the pooled regression line; and
- The 14 BBB+ bonds were 35 basis points below the pooled regression line.

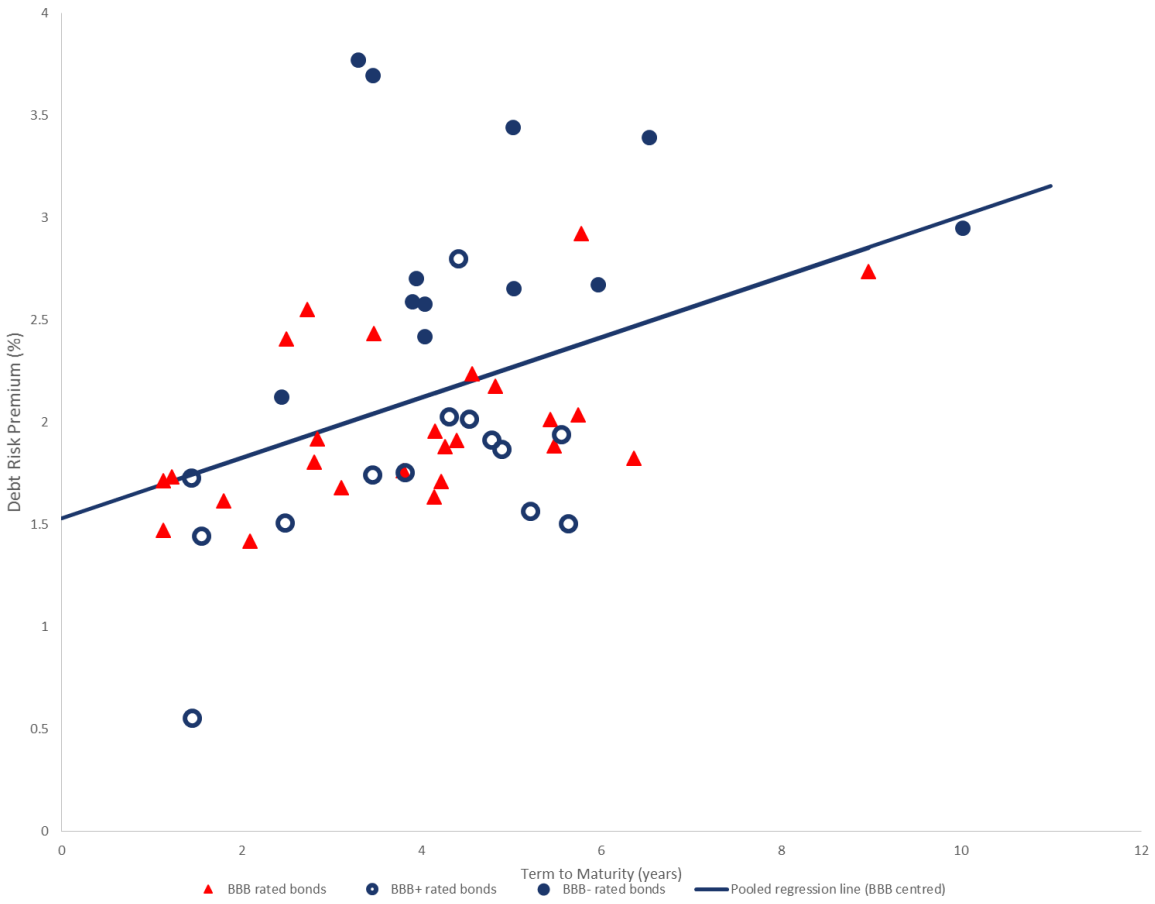
Hence, the 80 basis points differential between the BBB and BBB- bonds was materially larger than the 22 basis point differential between the BBB and BBB+ bonds, which violates a key assumption underpinning the use of the pooled regression approach. As a consequence, we would expect the

[15] Incenta (March, 2016), *DBCT 2015 DAU: Review of WACC parameters*, p.8-9.

pooled method to result in an upward biased estimate of the BBB debt risk premium (which is corroborated by the fact that the BBB observations, on average, sit below the pooled regression line).

A visual representation of the spread of bond (debt risk premium) observations in the pooled sample is provided in Figure 1 below. By successively removing one bond from the sample and running the regression with the remaining 50 observations, we tested to see whether there were any individual bonds whose removal would have a disproportionate influence on the 10-year debt risk premium. We found three bonds that increased the debt risk premium estimate by 6 to 9 basis points,[16] and two bonds that each reduce the estimate by approximately 7 basis points.[17]

Figure 1: Debt risk premium - pooled regression centred on BBB



Source: Bloomberg and Incenta analysis

16 These are two DBCT Finance Pty Ltd bonds (BBB- maturing 9/06/21 and 12/12/22 with term/debt risk premiums of 5.02/3.44 and 6.53/3.39 respectively), and a Transurban Finance Co Pty Ltd bond (BBB+ maturing 10/11/17, 1.66/0.56).

17 The two bonds were Victoria Power Network (BBB+ maturing 17/1/22, with term/debt risk premiums of 5.63/1.51) and Sydney Airport Finance Co Pty Ltd (BBB maturing 11/10/22, 6.36/1.82).

Conclusion on pooled regression centred on the BBB credit rating band

Our conclusion with respect to the pooled regression approach is that the estimated debt risk premium of 3.01 per cent using this approach is not reliable, owing to the violation of a key assumption of the approach, namely that the average difference in the debt risk premiums of the lower and higher credit rating bands relative to the pooled regression line are materially different (80 basis points vs 22 basis points). This would be expected to create upward bias, which is corroborated by the fact that the BBB observations, on average, sit below the pooled regression line.

4.1.2 BBB estimated through a pooled regression centred on BBB+

Previously both PwC and Incenta have estimated the BBB debt risk premium based on a two stage approach that:[18]

- First, estimates the 10 year BBB+ debt risk premium by undertaking a pooled regression centred on BBB+ (i.e. using A-, BBB+ and BBB bonds); and
- Then, estimates the average debt risk premium differential between the BBB bond observations and the pooled regression line and adds this value to the predicted BBB+ debt risk premium at 10 years to estimate the BBB debt risk premium.

Using this approach, Incenta previously estimated a benchmark BBB debt risk premium of 2.68 per cent for DBCT for the 20 business days to 30 October, 2015.[19]

Table 4: Debt risk premium for 20 business days to 31 May, 2016 based on adding a BBB premium to the pooled regression estimate of a BBB+ bond

Bond sample	No. of bonds	Intercept	T-statistic	Term coefficient	T-statistic	Adj.R-squared	Predicted BBB DRP at 10 years	DRP Premium BBB+ to BBB	Predicted BBB DRP at 10 years
BBB, BBB+ and A- bonds	72	1.418	14.635	0.086	3.898	0.167	2.28	0.23	2.50

Source: Bloomberg and Incenta analysis

Table 4 shows that applying the same approach for the 20 business days to 31 May, 2016, results in a BBB debt risk premium estimate of 2.50 per cent, which is made up of a BBB+ debt risk premium of 2.28 per cent, plus a BBB+ to BBB risk premium of 23 basis points. Using this approach the average prediction error for the 25 BBB bonds is close to zero. In addition, relative to the pooled regression line centred on BBB+, on average:

- The 25 BBB bonds were 23 basis points above the pooled regression line; and
- The 33 A- bonds were 17 basis points below the pooled regression line.

[18] Occasions on which this approach has been applied include: PwC (4 February, 2013) *Cost of Debt for SEQ distribution – retail water and wastewater entities*, Incenta (May, 2015) *WACC parameters for GAWB Price Monitoring Investigation 2015-20 – Final report*, Incenta (March, 2016), *DBCT 2015 DAU: Review of WACC parameters*.

[19] Incenta (May, 2016), p.11.

That is, the differential between the pooled regression line estimate for BBB+ bonds and BBB bonds (23 basis points) was larger but not materially so than the 17 basis point differential between the regression line and A- bonds.

However, it may be objected that by constraining the slope of the BBB debt risk premium function to be equal to that of the BBB+ function (based on the pooled regression) this approach does not allow for the fact that the BBB function may be steeper with term, as was commented on by PwC(2103).[20] Ultimately, this is an empirical matter.

4.1.3 BBB debt risk premium estimated via BBB bond observations only

The original logic behind the adoption of the pooled regression approach, was to deal with a situation (like that of BBB+ bonds) where the number of bond observations is too small to be confident of deriving a reasonable estimate of the 10 year debt risk premium. In the case of BBB+ bonds this has generally been the case, because there have been approximately 15 BBB+ rated bonds that fit the selection criteria. However, in the case of BBB bonds there are currently 25 bonds in the category, which is a larger sample than the one used by Bloomberg in its pooled regression estimate of the broad BBB band (i.e. it has 22 bonds in its sample).[21] It could therefore be argued that it is appropriate to directly estimate the BBB debt risk premium function based on the 25 BBB credit rated bonds in the sample. The results, shown in Table 5 below, indicate a 10-year BBB debt risk premium estimate of 2.65 per cent, and (by definition) an average error of zero.

Table 5: Regression analysis directly estimating the BBB debt risk premium for 20 business days to 31 May, 2016

Bond sample	No. of bonds	Intercept	T-statistic	Term coefficient	T-statistic	Adj.R-squared	Predicted DRP at 10 years
BBB credit rated bonds	25	1.554	9.882	0.109	2.973	0.246	2.65

Source: Bloomberg and Incenta analysis

The scatter of BBB bond observations is displayed in Figure 2 below indicates a reasonably even spread around the regression line. However, we tested which bonds individually would have the greatest influence on the 10-year BBB estimate, finding that there are:

- Two bonds whose absence would reduce the estimate by 15 basis points.[22]
- One bond whose absence would reduce the estimate by 4 basis points;[23]
- A small number of bonds whose removal would raise the estimate by 4 to 5 basis points;[24] and

[20] PwC (2013), p. 67.

[21] The Bloomberg sample as at 18 May, 2016, included 7 BBB- bonds, 10 BBB bonds and 5 BBB+ bonds.

[22] Asciano Finance Ltd (BBB maturing 19/5/25 with term/debt risk premium of 8.97/2.74), and Downer Group Finance Pty Ltd (BBB maturing 11/3/22, 5.78/2.92).

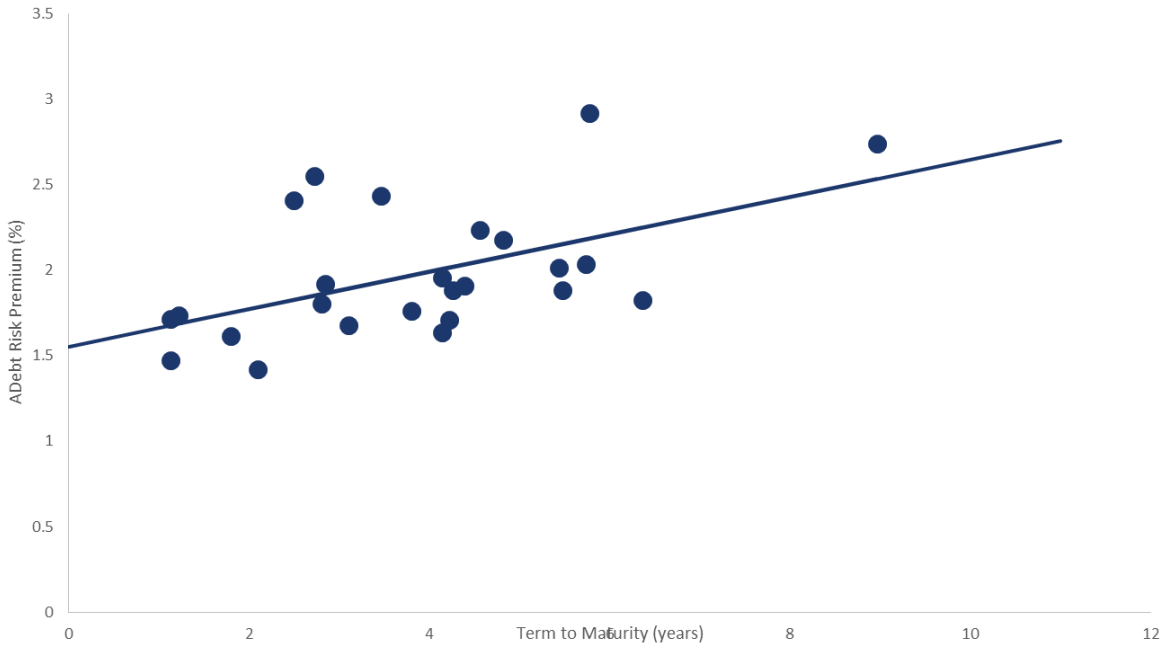
[23] Crown Group Finance (BBB maturing 18/7/17, 1.13/1.47).

[24] These bonds were AGL Energy Ltd (BBB maturing 5/11/21 5.43/2.01), Downer Group Finance Ltd (BBB maturing 29/11/18 2.5/2.41), Incitec Pivot Ltd (BBB maturing 21/2/19 2.73/2.55), ConnectEast

- One bond whose absence would raise the estimate by 10 basis points.[25]

These findings highlight the fact that these regression estimates are subject to estimation error.

Figure 2: Debt risk premium – regression using BBB bonds



Source: Bloomberg and Incenta analysis

4.1.4 Using dummy variables to estimate the BBB debt risk premium

The dummy variables approach

In this section we apply dummy variables to estimate the BBB debt risk premium. This approach assumes that the same term premium per annum applies to each of the credit rating bands, with the credit rating shifting the intercept. If the BBB credit rating band is used as the 'base' this can be expressed as:[26]

$$DRP = \gamma_1 + \gamma_2.Term + \gamma_3.(BBB+) + \gamma_4.(BBB-) + \varepsilon$$

Where, γ_1 is the intercept and γ_2 to γ_4 are parameter estimates;

Term is the term to maturity of the bond (in years);

Finance (BBB maturing 25/2/22 5.74/2.04), and Sydney Airport Finance Co Ltd (BBB maturing 20/11/21 5.47/1.88).

25 Sydney Airport Finance (BBB maturing 11/10/22, 6.36/1.82).

26 Since BBB rated bonds have been used as the base, the coefficient values (γ_3 and γ_4) on the BBB+ and BBB- parameters are the increments in the intercept associated with the respective credit ratings relative to the BBB credit rating (whose intercept is γ_1).

BBB+ is the dummy variable with a value of 1 if the bond is BBB+ rated, and zero otherwise;

BBB- is the dummy variable with a value of 1 if the bond is BBB- rated and zero otherwise; and

ε is the stochastic error term.

Using this approach the average term premium coefficient (γ_2) will be influenced by all bond observations.

Estimates of BBB debt risk premium using dummy variables

The resulting estimates of the 10-year BBB debt risk premium using dummy variables are shown in Table 6 below. Using dummy variables our general finding, irrespective of approach, was that the average actual debt risk premium value is very close to the debt risk premium based on the estimated coefficients for the sample of 25 BBB bonds. The individual results of the three equations estimated can be summarised as follows:

- Intercept dummies centred on BBB using only the broad BBB bond sample - The first column uses only bonds in the broad BBB band, centres on the BBB band, and applies intercept dummies to reflect expected values for BBB+ and BBB- rated bonds. We find that relative to BBB rated bonds, BBB+ rated bonds have an expected value that is 23 basis points lower (but only weakly statistically significant), while the BBB- rated bonds have an expected value that is 84.4 basis points higher (this coefficient being highly statistically significant). Under this approach the expected value of a BBB rated bond is 2.57 per cent, i.e. only 3 basis points higher than when the intercept dummies are based on the BBB+ rating category.

- Intercept dummies centred on BBB using the BBB, BBB+ and A- bond sample - In the second column the intercept and term coefficients (both highly statistically significant) reflect the expected value of a BBB rated bond, with the BBB+ coefficient (-0.231, which is also statistically significant) indicating that relative to the expected value of a BBB bond, the expected value of a BBB+ bond is 23.1 basis points lower. The expectation is that at a term of 10 years a BBB rated bond would have a debt risk premium of 2.54 per cent. An A- bond on the other hand has an expected value that is 39.5 basis points below the expected value for a BBB rated bond.

- Intercept dummies centred on BBB using the all BBB bonds and A- bonds sample - The third column of results relies on all 84 bonds in our sample (A- to BBB-). Relative to the base (BBB), the intercept dummies for BBB+ and BBB- bonds are roughly the same as when only BBB bonds were used (i.e. -23.1 basis points and 85.2 basis points respectively), but are now both highly statistically significant. However, the resulting expected value of a BBB rated bond is lower at 2.49 per cent.

Table 6: Estimating the BBB debt risk premium for 20 business days to 31 May, 2016 using dummy variables

	Column (1) Dummy variables All BBB only	Column (2) Dummy variables A-,BBB+,BBB	Column (3) Dummy variables All BBB and A-
No Obs	51	72	84
Credit ratings included	BBB-,BBB,BBB+	BBB,BBB+,A-	BBB-,BBB,BBB+,A-
Intercept	**1.600**	**1.618**	**1.655**
T-stat	10.395	17.026	15.912
Term	**0.097**	**0.093**	**0.083**
T-stat	2.911	4.827	4.101
A- dummy		**-0.395**	**-0.393**
T-stat		-5.027	-4.341
BBB+ dummy	**-0.230**	**-0.231**	**-0.231**
T-stat	-1.655	-2.334	-2.033
BBB- dummy	**0.844**		**0.858**
T-stat	5.641		7.085
Adj. R-square	**0.559**	**0.375**	**0.639**
BBB DRP at 10 years	**2.57**	**2.54**	**2.49**

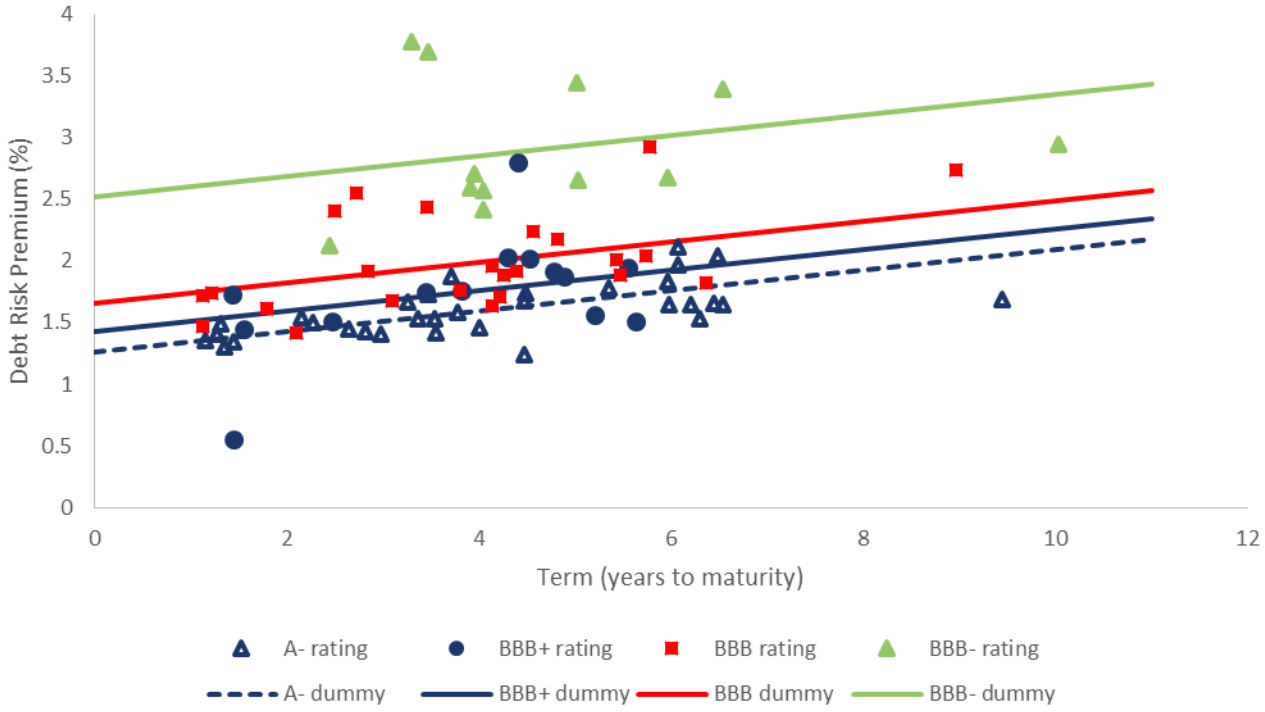
Source: Bloomberg and Incenta analysis

Examining the spread of bond observations

For the averaging period to 31 May, 2016, it is instructive to observe the spread of debt risk premiums by credit rating relative to the underlying bond observations. Figure 1 shows the observations and the expected values for each credit rating category based on intercept dummies centred on the BBB rating (using all BBB bonds and A- bonds). As only intercept dummies are used, the expected debt risk premium functions for each credit rating category are constrained to run parallel based on the prevailing slope coefficient determined by all observations.

What is most striking about Figure 3 is the fact that the BBB+ line runs approximately half way between the BBB and A- lines, which reflects the spread of the bond data. This corroborates our earlier conclusions that the pooled regression method can readily be applied to estimate the BBB+ debt risk premium. It also provides a visual representation of how the BBB- function and the BBB- observations around it are a material distance away from the other three regression lines and their associated bonds. As discussed above, this material differential between the BBB- line and the BBB/BBB+ lines means that a key assumption relied on by the PwC(2013) report is not met, and therefore, that the pooled regression approach cannot be applied in this case with any degree of reliability.

Figure 3: Debt risk premium by term to maturity for A- to BBB- credit ratings for the 20 business days to 31 May, 2016



Source: Bloomberg and Incenta analysis

At the time of the averaging period used by the PwC(2013) report (October-November 2012), there was relative symmetry around the BBB debt risk premium function,[27] and it was therefore appropriate to recommend the pooled regression approach be applied. However, this condition is clearly not satisfied during the current averaging period.

4.1.5 Bloomberg and RBA estimates of the BBB debt risk premium

The QCA's debt policy document also requires a comparison of the estimate obtained using the PwC (2013) econometric approach with estimates published by Bloomberg and the RBA.

Bloomberg BVAL estimate

Bloomberg has published daily estimates of the yield on 10 year broad BBB bonds (i.e. bonds rated BBB- to BBB+) since 14 April, 2015. We downloaded the yield data for the 20 days to 31 May, 2016, annualised the yields and calculated the average for that period. We then subtracted the 10 year risk free rate of 2.32 per cent, and obtained an estimated 10 year BBB debt risk premium of 2.76 per cent.

[27] It is well known that spreads between the yields of the strongest and weakest credit rating bands are time varying. We analysed the spreads between Industrial BBB-, BBB and BBB+ bond yields in the US since 2012 and found that the current margin between BBB- bonds and BBB bonds relative to the margin between BBB bonds and BBB+ bonds is materially higher than it was in 2012.

We also tested to see if the average credit rating of Bloomberg's broad BBB band is reflective of a BBB credit rating, and concluded that it is.[28]

RBA estimate

The RBA's fair value broad BBB yields are available on a monthly basis since January 2005, however the approach derives an estimate for an effective term of approximately 9 years, which needs to be extrapolated to 10 years. The Australian Energy Regulator uses a linear extrapolation method suggested by Dr Martin Lally, which we have also applied.[29] We used this approach to obtain extrapolated, annualised RBA 10-year debt risk premiums for the last business days in April and May, 2016, and then interpolated for each day in between to obtain an average debt risk premium of 2.77 per cent for the 20 business days to 31 May, 2016. As for the Bloomberg sample, we tested whether the average credit rating of Bloomberg's broad BBB band is reflective of a BBB credit rating, and concluded that it is.[30]

For the current averaging period the RBA and Bloomberg 10 year BBB estimates are closely aligned, but on average since April 2015 the RBA estimate has been approximately 11 basis points higher.

4.1.6 Conclusion on the debt risk premium

Having reviewed the evidence, we conclude that the best estimate of the debt risk premium for 10-year BBB debt that is obtained from an econometric approach (in line with the QCA's policy) is **2.65 per cent** for the 20 business days up to and including 31 May, 2016. This estimate is based on direct regression using the sample of 25 BBB rated bonds. This is approximately 11 to 12 basis points lower than the Bloomberg and RBA interpolated estimates (2.76 per cent and 2.77 per cent respectively).

We highlight that, while the method we applied when estimating the debt risk premium for the QCA's draft decision was consistent with previous reports for the QCA, a strict application of the method recommended in the PwC (2013) report would involve applying a BBB centred pooled regression if the target credit rating is BBB (i.e., rather than applying a BBB+ centred pooled regression and adjusting to a BBB). Applying the BBB centred regression has therefore been our starting point, which results in a predicted debt risk premium for 10-year BBB debt of 3.01 per cent for the relevant period.

However, in our view, this estimate is unreliable because there is evidence that, at the current time, the change in the debt risk premium between BBB and BBB- credit ratings is materially different to the change in the premium between BBB and BBB+ (this asymmetry around the BBB rating was not present at the time of the PwC 2013 report). Consequently, if the observations are simply pooled, then upward biased estimate of the debt risk premium would be expected (and this is corroborated by the fact that the BBB observations sit, on average, below the pooled regression line).

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28 Applying values of 1,2 and 3 to BBB+, BBB and BBB- rated bonds, we obtained a weighted average of 2.09 (i.e. slightly below a BBB rating).

29 Martin Lally (20 November, 2014), *Implementation issues for the cost of debt*, Capital Financial Consultants.

30 For the 87 bonds in the RBA's sample that we could obtain credit ratings for, we found the weighted average to be 2.05 (where BBB is given a value of 2, and BBB+, BBB- and BB+ are given values of 1, 3 and 4 respectively).

Accordingly, we have also applied the following econometric methods to estimate the 10-year, BBB debt risk premium:

- A pooled regression centred on the BBB+ band and adjusted to convert this to a BBB premium, as we did for the QCA's draft decision. This generates a 2.50 per cent debt risk premium using current evidence. However, we note that there is imprecision in this indirect technique, and note that there is a potential for the resulting debt risk premium to be understated (this may result if the relationship between premium and term is stronger for the lower credit ratings).

- Regressions that allow empirically for asymmetry in the debt risk premium between credit ratings, which is done by including dummy variables in the regressions. This provided a range for the debt risk premium of between 2.49 per cent and 2.57 per cent (the range depends on which other credit ratings are included in the regression sample).

- Applying a regression to the BBB sample alone, which generates a predicted debt risk premium of 2.65 per cent

Of these estimates, we recommend using the last of these – the 2.65 per cent that is obtained by direct regression on BBB bonds – as the best estimate from an econometric approach in the spirit of the PwC (2013) report (albeit modified to respond to asymmetry in debt risk premia around the BBB credit rating at present). We observe that, while the PwC (2013) report recommended against applying regression techniques to bonds from a single credit rating, this was in large part a response to the unusual characteristics of BBB+ bonds at the time (with BBB+ being the main focus of that report). In contrast, the BBB bond observations are reasonable closely clustered around the regression line. In addition, the results of the dummy variable regressions produce a predicted debt risk premium that is very close to the premium generated by BBB observations alone, which provides further confidence in the BBB regression results.

4.2 Risk free rate at a term of five years

The QCA has also requested that we calculate the five-year risk free rate for the 20 business days to 31 May, 2016. We did this by interpolating the yields of two Commonwealth Government bonds maturing on either side of the five-year target dates for the 20 business days in the averaging period. The resulting interpolated yields for each day were annualised and averaged. This resulted in a five-year risk free rate estimate of **1.82 per cent**.[31]

[31] In the current averaging period, up to 13 May, 2021 we interpolated the two closest bonds on either side of the maturity dates (21 November, 2020 and 15 May, 2021), and for maturity dates between 16 May, 2021 and 31 May 2021 we used bonds maturing on 15 May, 2021 and 1 July, 2022.

A. The bond sample

Issuer Name	Ticker	Bloomberg ID	Incenta Credit Rating	Bond type
AMP Capital Wholesale Office Fund	AMPAU	EK5135125	A-	Fixed
AusNet Services Holdings Pty Ltd	ANVAU	EI1939400	A-	Fixed
AusNet Services Holdings Pty Ltd	ANVAU	EI6263145	A-	Fixed
AusNet Services Holdings Pty Ltd	ANVAU	EJ2512352	A-	Fixed
AusNet Services Holdings Pty Ltd	ANVAU	EJ2514606	A-	Fixed
AusNet Services Holdings Pty Ltd	ANVAU	EJ5424159	A-	Fixed
Australia Pacific Airports Melbourne Pty Ltd	MELAIR	EJ6958775	A-	Fixed
Australia Pacific Airports Melbourne Pty Ltd	MELAIR	UV8008012	A-	Fixed
Australia Pacific Airports Melbourne Pty Ltd	MELAIR	QJ5397360	A-	Fixed
BWP Trust	BWPAU	EK2774488	A-	Fixed
DEXUS CPA Trust	CPAAU	EJ4653378	A-	Fixed
DEXUS CPA Trust	CPAAU	EJ4653428	A-	Fixed
DEXUS Finance Pty Ltd	DXSAU	EJ3477605	A-	Fixed
DEXUS Finance Pty Ltd	DXSAU	QJ5397659	A-	Fixed
ETSA Utilities Finance Pty Ltd	ETSA	EJ0489371	A-	Fixed
ETSA Utilities Finance Pty Ltd	ETSA	EI6011817	A-	Floating
ETSA Utilities Finance Pty Ltd	ETSA	EJ4505263	A-	Floating
General Property Trust	GPTAU	EI9634433	A-	Fixed
General Property Trust	GPTAU	EJ3202615	A-	Fixed
GPT Wholesale Office Fund No 1	GPTAU	EK9073694	A-	Fixed
GPT Wholesale Shopping Centre Fund No 1	GPTWSC	EJ4315051	A-	Fixed
New Zealand Milk Australasia Pty Ltd	FCGNZ	EJ2023566	A-	Fixed
QIC Finance Shopping Center Fund Pty Ltd	QIC	EJ3717919	A-	Fixed
QIC Finance Shopping Center Fund Pty Ltd	QIC	EJ5223155	A-	Fixed
QIC Finance Shopping Center Fund Pty Ltd	QIC	EJ9349006	A-	Fixed
Stockland Trust	SGPAU	EI4751000	A-	Fixed
Stockland Trust	SGPAU	EJ8128716	A-	Fixed
Stockland Trust	SGPAU	QJ7681795	A-	Fixed
Vicinity Holdings Ltd	VCXAU	EJ4730853	A-	Fixed
Wesfarmers Ltd	WESAU	EJ1021298	A-	Fixed
Wesfarmers Ltd	WESAU	EJ5679471	A-	Fixed
Wesfarmers Ltd	WESAU	EK8989288	A-	Fixed
Wesfarmers Ltd	WESAU	EK9024770	A-	Fixed
AGL Energy Ltd	AGLAU	EK5737813	BBB	Fixed
Ale Direct Property Trust	LEPAU	EK3042133	BBB	Fixed
Ale Direct Property Trust	LEPAU	EK3042315	BBB	Fixed
APT Pipelines Ltd	APAAU	EI3253362	BBB	Fixed
Asciano Finance Ltd	AIOAU	EK9072910	BBB	Fixed
Brisbane Airport Corp Pty Ltd	BACAU	EI6204404	BBB	Fixed
Brisbane Airport Corp Pty Ltd	BACAU	EJ8798880	BBB	Fixed
ConnectEast Finance Pty Ltd	CEUAU	EJ8026167	BBB	Fixed
ConnectEast Finance Pty Ltd	CEUAU	EK7582084	BBB	Fixed
Crown Group Finance Ltd	CWNAU	EJ2797904	BBB	Fixed
Crown Group Finance Ltd	CWNAU	EK5876389	BBB	Fixed
Downer Group Finance Pty Ltd	DOWAU	EJ6876910	BBB	Fixed
Downer Group Finance Pty Ltd	DOWAU	EK7841308	BBB	Fixed
Global Switch Property Australia Pty Ltd	GSWITC	EJ9875117	BBB	Fixed
Goodman Australia Industrial Fund Bond Issuer Pty Ltd	GAIF	EJ5983410	BBB	Fixed
Holcim Finance Australia Pty Ltd	LHNVX	EJ2780645	BBB	Fixed
Holcim Finance Australia Pty Ltd	LHNVX	EJ3793092	BBB	Fixed
Holcim Finance Australia Pty Ltd	LHNVX	EK7996698	BBB	Fixed

Issuer Name	Ticker	Bloomberg ID	Incenta Credit Rating	Bond type
Incitec Pivot Ltd	IPLAU	EJ7922069	BBB	Fixed
Perth Airport Pty Ltd	WESAIR	EJ7588209	BBB	Fixed
Perth Airport Pty Ltd	WESAIR	EK1306886	BBB	Fixed
Sydney Airport Finance Co Pty Ltd	SYDAU	EI6849026	BBB	Fixed
Sydney Airport Finance Co Pty Ltd	SYDAU	EG0640763	BBB	Floating
Sydney Airport Finance Co Pty Ltd	SYDAU	EG0219857	BBB	Floating
Woolworths Ltd	WOWAU	EJ0949291	BBB	Fixed
AquaSure Finance Pty Ltd	AQUA	EJ9637749	BBB+	Fixed
Aurizon Network Pty Ltd	AZJAU	EJ8893137	BBB+	Fixed
Australian Gas Networks Vic 3 Pty Ltd	ENVAU	EK6519434	BBB+	Fixed
Caltex Australia Ltd	CTXAU	EI8834174	BBB+	Fixed
Coca-Cola Amatil Ltd	CCLAU	EJ4333419	BBB+	Fixed
Investa Office Fund	IOFAU	EJ4225003	BBB+	Fixed
Mirvac Group Finance Ltd	MGRAU	EJ4596338	BBB+	Fixed
Mirvac Group Finance Ltd	MGRAU	EJ8671962	BBB+	Fixed
SGSP Australia Assets Pty Ltd	SPIAUA	EK1048710	BBB+	Fixed
SGSP Australia Assets Pty Ltd	SPIAUA	EJ5984160	BBB+	Floating
Shopping Centres Australasia Property Retail Trust	SCAPRT	EK8553381	BBB+	Fixed
Transurban Finance Co Pty Ltd	TCLAU	EF0695496	BBB+	Floating
Victoria Power Networks Finance Pty Ltd	VPNF	EI6011379	BBB+	Floating
Victoria Power Networks Finance Pty Ltd	VPNF	EI6010694	BBB+	Floating
Alumina Ltd	AWCAU	EK5989620	BBB-	Fixed
DBCT Finance Pty Ltd	BIP	EF4624229	BBB-	Floating
DBCT Finance Pty Ltd	BIP	EF4624468	BBB-	Floating
DBCT Finance Pty Ltd	BIP	EG0222109	BBB-	Floating
Energy Partnership Gas Pty Ltd	DUEAU	EK9545295	BBB-	Fixed
Energy Partnership Gas Pty Ltd	DUEAU	EK9580078	BBB-	Floating
Glencore Australia Holdings Pty Ltd	GLENLN	EK4881927	BBB-	Fixed
Lend Lease Finance Ltd	LLCAU	EJ6640936	BBB-	Fixed
Lend Lease Finance Ltd	LLCAU	EJ6614428	BBB-	Fixed
Qantas Airways Ltd	QANAU	EJ6468916	BBB-	Fixed
Qantas Airways Ltd	QANAU	EK2690916	BBB-	Fixed
Qantas Airways Ltd	QANAU	EK3117976	BBB-	Fixed

Source: Bloomberg and Incenta analysis