Milliman

GROUP OF 100 DISCOUNT RATE

September 2016

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1 BACKGROUND

Objectives and scope

The Group of 100 has commissioned Milliman to generate a standardised set of discount rates to be made publicly available for the purpose of discounting employee benefit liabilities under Australian Accounting Standard 119 (AASB 119). The scope of the work is limited to Australian employee benefit schemes, and excludes any schemes of foreign subsidiaries of domestic entities which are denominated in foreign currency.

This report provides the Australian corporate bond discount rate curve as at the end of September 2016 produced under the methodology and assumptions described in the 'Discount Rates for Australian Employee Benefit Liability Valuation' report.

Reliance and limitations

In producing this report, we have relied upon the following information:

- Capital market data as sourced from Bloomberg. Should this data be incorrect, it could materially affect the analysis and conclusions drawn from it.

Users of this report should also be aware that it is subject to the following limitations:

- Current debt market conditions. Issuance of corporate bonds is subject to change over time, which may impact upon whether the accounting standard requirements of a deep market are met.
- Current capital market conditions, in particular the liquidity and credit ratings of corporate bond markets, which can change rapidly. The asset calibration set could change very rapidly under stressed market conditions.
- Reassessments of the suitability of the asset calibration set would be needed if the AAA and/or AA corporate bond market thins, which would require a prospective change to the assets selected for AASB 119 calibration purposes.

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2 METHODOLOGY AND ASSUMPTIONS

Summary of the asset calibration set

The set of assets to be used to calibrate the discount rate curve is defined by those securities that meet the following conditions:

1. Individual bonds must have the following characteristics:
    a. Physical bonds, with no embedded derivatives (e.g., callable, putable, convertible, extendible, variable/floating coupon, index-linked)
    b. High-quality corporate bonds issued by both domestic and foreign entities
    c. Payments denominated in Australian dollars (AUD)
    d. Pay fixed (or zero) coupons, non-inflation-linked
    e. Maturity terms of greater than one month and less than 10 years
    f. Minimum amount outstanding on an individual security of $100 million
    g. Securitised bonds are included

2. A deep market for these bonds must exist, as characterised by the ready availability of observable prices and current trades.

What is meant by high quality?

Figure 1 defines the credit ratings by each agency that map to each of these broad categories. This forms the basis for the asset calibration set used in this report.

Figure 1: Definition of AAA and AA Credit Ratings by Agency

Category	AAA	AA
S&P	AAA	AA+, AA, AA-
Fitch	AAA	AA+, AA, AA-
Moody's	Aaa	Aa1, Aa2, Aa3

Where there is disagreement between credit rating agencies on particular securities, we use the following conditions:

- If a security has at least two AAA ratings, then it is classified as a AAA security
- If a security has at least two AA ratings, then it is classified as a AA security
- If a security has only been rated by two agencies with different ratings, then the lower rating is used
- If a security has only been rated by one agency, then that rating becomes the sole reference

Hereafter, all references to credit ratings refer to those that meet the above conditions. For the purposes of this paper, we refer to this as the combined credit rating.

Corporate bond universe

The table in Figure 2 shows the decomposition of the market by the combined credit rating satisfying all but the 'high quality' characteristic.

Figure 2: Australian Corporate Bond Market Outstanding Debt by Combined Credit Rating ($ millions)

Combined Rating	Number of Securities	Outstanding ($ Millions)	% of Total
AAA	11	9,000	8.8%
AA	137	37,599	36.7%
A	146	40,283	39.3%
BBB	60	14,870	14.5%
BB	1	373	0.4%
Other	2	280	0.3%
Total	**357**	**102,405**	**100.0%**

Source: *Milliman analysis based upon Bloomberg data as at 30 September 2016.*

The table in Figure 3 shows the universe of AAA and AA bonds used in the asset calibration set broken down into the composition of their respective S&P, Moody's and Fitch ratings.

Figure 3: Australian AAA/AA Corporate Bond Market Outstanding Debt ($ millions)

Credit Rating Composition	Number of Securities	Outstanding ($ Millions)	% of Total
Combined Credit Rating of AAA			
3 AAA ratings	0	0	0.0%
2 AAA ratings	8	8,225	91.4%
1 AAA rating	3	775	8.6%
Total Combined AAA	**11**	**9,000**	100.0%
Combined Credit Rating of AA			
3 AA ratings	42	14,545	38.7%
2 AA ratings	82	19,924	53.0%
1 AA rating	13	3,130	8.3%
Total Combined AA	**137**	**37,599**	100.0%

Source: *Milliman analysis based upon Bloomberg data as at 30 September 2016.*

Interpolation methodology

For fitting the discount curve to the asset calibration set, the Merrill Lynch Exponential Spline (MLES) method with nine exponential basis functions was used calibrated to yield data as at 30 September 2016, weighting each issue by the inverse duration of the issue. The results of the calibrated MLES parameters are shown in Figure 4.

Figure 4: MLES-Calibrated Parameters as at 30 September 2016

MLES Parameters		
Long-Run	**b0**	5.7%
Param1	**λ1**	157.3%
Param2	**λ2**	0.0%
Param3	**λ3**	-117.1%
Param4	**λ4**	24.0%
Param5	**λ5**	49.8%
Param6	**λ6**	30.9%
Param7	**λ7**	-50.0%
Param8	**λ8**	-2.9%
Param9	**λ9**	8.0%

For the calibration of the MLES basis functions, an adjusted R-squared statistical goodness-of-fit measure was applied to the difference between modelled and actual bond prices.

An adjusted R-squared statistic value close to 100% indicates a very good fit, whilst lower values (closer to 0%) indicate poor fits. Figure 5 shows the results of the interpolation analysis used.

Figure 5: Adjusted R-Squared Statistic as at 30 September 2016

Regression Statistic	
Adjusted R-Squared	**97.0%**

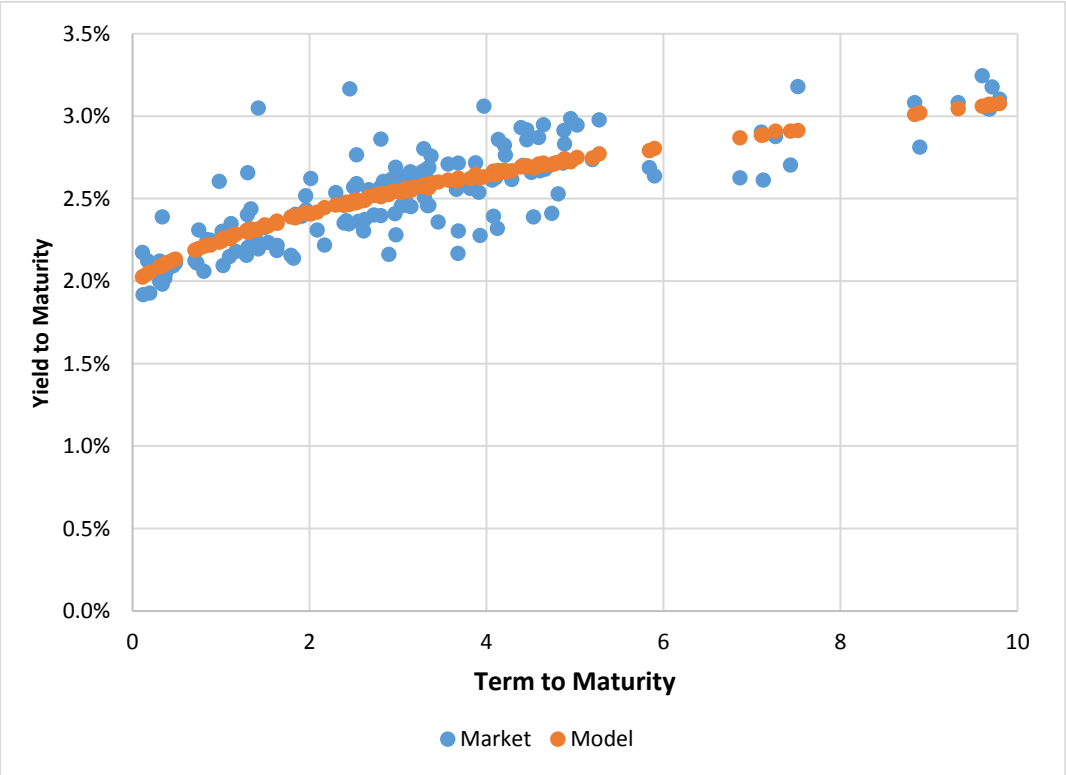
Extrapolation methodology

For rates beyond 10-year maturities, the fitted yield curve has been extrapolated by assuming that 1-year forward rates remain constant for all subsequent maturities. This is based on the 1-year forward rate between 9- and 10-year maturities, based on the fitted MLES model.

3 FITTED YIELD CURVE

Figure 6 shows the modelled yield-to-maturity for each bond in the asset calibration set, compared with the actual yield-to-maturity, using the MLES method with inverse duration weightings. Note that these are the same bonds as those discussed and analysed in Section 2 above.

Figure 6: Modelled vs. Market Yields to Maturity for Asset Calibration Set Using the MLES Method with Inverse Duration Weightings



Figures 7 and 8 show the resulting spot and forward yield curves of one to 50 years for the calibration set using the MLES method and extrapolated with the constant forward rate extrapolation method. Spot rates shown are quoted as annually compounded rates on zero coupon bonds with maturities of the specified term, forward rates shown are 1-year forward rates ending at the specified term.

Figure 7: Spot and Forward Rate Curves for Asset Calibration Set Using an MLES Interpolation and Constant Forward Rate Extrapolation Method

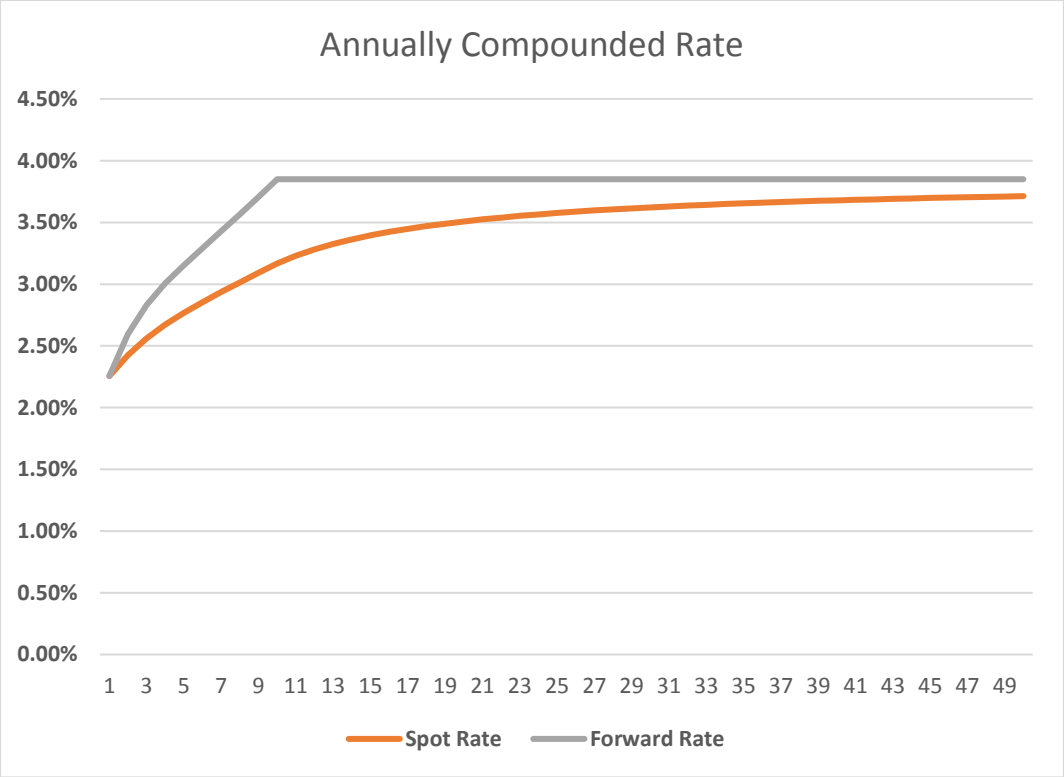


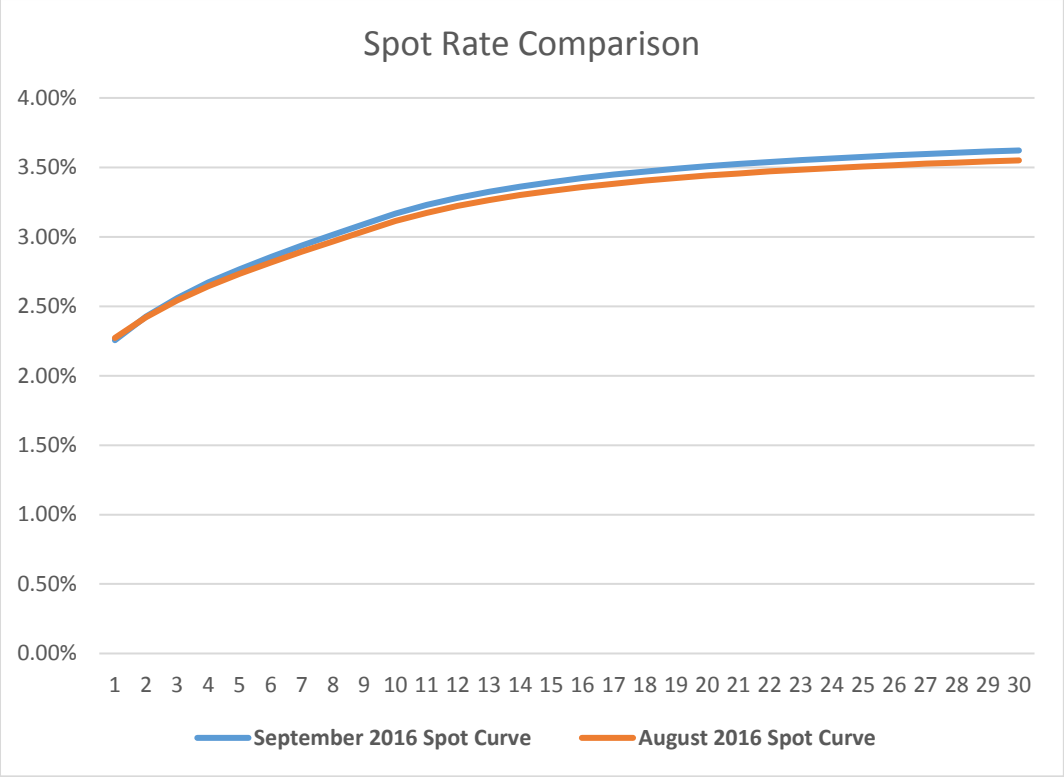
Figure 8: Spot and Forward Rate Curves for Asset Calibration Set Using an MLES Interpolation and Constant Forward Rate Extrapolation Method

Term (Years)	Spot Rate	Discount Factor
1	2.26%	0.977944
2	2.43%	0.953195
3	2.56%	0.926968
4	2.67%	0.899922
5	2.77%	0.872409
6	2.85%	0.844605
7	2.94%	0.816609
8	3.02%	0.788485
9	3.09%	0.760297
10	3.17%	0.732113
11	3.23%	0.704974
12	3.28%	0.678841
13	3.32%	0.653677
14	3.36%	0.629445
15	3.39%	0.606112
16	3.42%	0.583644
17	3.45%	0.562009
18	3.47%	0.541175
19	3.49%	0.521114
20	3.51%	0.501797
21	3.52%	0.483195
22	3.54%	0.465284
23	3.55%	0.448036
24	3.56%	0.431427
25	3.58%	0.415435

Term (Years)	Spot Rate	Discount Factor
26	3.59%	0.400035
27	3.60%	0.385206
28	3.61%	0.370926
29	3.61%	0.357176
30	3.62%	0.343936
31	3.63%	0.331186
32	3.64%	0.318910
33	3.64%	0.307088
34	3.65%	0.295704
35	3.65%	0.284743
36	3.66%	0.274187
37	3.66%	0.264023
38	3.67%	0.254236
39	3.67%	0.244812
40	3.68%	0.235737
41	3.68%	0.226998
42	3.69%	0.218583
43	3.69%	0.210481
44	3.69%	0.202678
45	3.70%	0.195165
46	3.70%	0.187930
47	3.70%	0.180964
48	3.71%	0.174256
49	3.71%	0.167796
50	3.71%	0.161576

Figure 9 shows the resulting spot rate curve of one to 30 years relative to the prior period fitted curve.

Figure 9: Spot Rate Curves Relative to Prior Period Fitted Curve



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