

Tab D 2 – CBO Memorandum to Board re Selecting Discount Rates

Memorandum

To: FASAB
From: Donald Marron and David Torregrosa
Subject: Selecting Discount Rates for Actuarial Estimates
Date: April 26, 2007
CC: Bob Dennis, Wendy Kiska, Damien Moore, and Marvin Phaup

At the last Board meeting, the Board staff asked the Congressional Budget Office (CBO) to provide some additional information about our views on the discount rate issues now facing the Board. This memo summarizes our views and then provides additional information about the calculation of discount rates.

CBO's Views

- **CBO would prefer to separate the issue of the display standard, which we strongly support, from guidance on selecting discount rates.** We believe that guidance can be provided to the Department of Veterans Affairs through a staff interpretation/letter or an Accounting and Auditing Policy Committee technical release rather than through a standard. Doing so would address Bob Reid's concerns, which motivated the Board to take up this issue.
- If the Board does decide to address the proper discount rate for actuarial estimates, CBO recommends that:
 - **The standard should emphasize a yield-curve approach.** By definition, a yield-curve approach is the only method of discounting that always provides a correct valuation.¹
 - **The standard should allow alternatives to a yield-curve approach in certain instances if (a) implementing the yield-curve approach would be costly and (b) another method of discounting is likely to provide a reasonably close approximation.** The accuracy of alternative approaches depends on several factors, including the timing of cash flows and the shape of the yield curve.
 - **The standard should require the use of current interest rates.** Interest rates can move significantly from year to year. Using interest rates from a prior year (or smoothing this year's rates with those from prior years) can therefore result in significant misstatements about the current value of future cash flows. Changing interest rate assumptions annually would result in more accurate but also more volatile estimates of liabilities and changes in net cost than the current actuarial

¹ The yield-curve approach is already highlighted in the draft at paragraph 26: "The discount rates should be matched with the expected timing of the associated expected cash outflow (i.e., the expected yield curve)."

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practice of revisiting interest rate assumptions every 3 to 5 years. The proposed display standard is the best way to deal with volatility by reporting on a separate line changes in net cost due to changes in actuarial assumptions.

Approaches to Discounting

The Yield Curve Approach

Financial markets establish the yield curve – the differing interest rates on bonds of differing maturities – based on expectations about future short-term interest rates plus a term premium (the additional return that investors require to hold securities of longer maturity). Interest rates typically vary across maturities, so the interest rate(s) that one should use to calculate the net present value of future cash flows depends on when those cash flows will occur.²

The yield curve typically slopes upward, with interest rates on longer-term bonds tending to be higher than interest rates on short term bonds.³ As a result, cash flows in the more distant future should be discounted using a higher discount rate than cash flows in the near future. If the present value of a stream of cash flows were, instead, calculated using a single long-term rate, the resulting figure would understate, perhaps significantly, the present value of those cash flows (see the fourth example in the spreadsheet). This is why the yield curve was frequently mentioned in the debate over private pension funding a couple of years – using a fixed, long-term interest rate often led firms to understate the present value of their pension obligations. (Using a single short-term rate for discounting would similarly lead to an overestimate of present values.)

A yield-curve approach to discounting has the benefit that it always gives the correct present value of the cash flows. That accuracy is the reason that the yield-curve approach should be favored, whenever possible. In practice, however, there may be circumstances in which other methods provide valuations that are almost as accurate. For example, some filers analyze cash flows that stretch over multiple decades and assume that long-term interest rates converge to some stable value within 10-15 years. If a sufficient bulk of the cash flows occur in later decades, then using the long-term interest rate to calculate the discounted present value may provide a result that is quite close to what a yield-curve approach would give. Put another way, the slope of the yield curve doesn't matter that much – in relative terms – if most of the cash flows occur in later years when the interest rate is assumed to have settled to a long-term value. The difference could still be large, however, if a large fraction of the cash flows occur in the near future. This raises a question for the Board of determining how to determine when a yield-curve approach would be required.

The Weighted-Average Approach

² For simplicity, the discussion assumes that interest rates – in particular, interest rates on Treasury obligations – are the relevant discount rates. A separate issue, beyond the scope of the current memo, is whether and when discount rates should also include premiums for systematic or market risk.

³ The yield curve is actually somewhat inverted at the moment, with long-term yields somewhat lower than short-term yields; this suggests that the market expects short-term rates to decline at some point in the future. (Current rates are: 3-month Treasury bills yield 5.05 percent; 1-year 4.94 percent; 5-year 4.58 percent; 10-year 4.68 percent; and 20-year 4.94 percent.)

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Another alternative would be to calculate net present values using a single weighted-average discount rate, *in which the weights are based on the particular cash flows whose discounted value is to be calculated*. The weighted-average approach is generally better than using a single (unweighted) discount rate – since the methodology weights most heavily the discount rates that apply to the largest cash flows – but is not as accurate as the yield-curve.

At least in some circumstances, the weighted average approach results in only small errors relative to the yield-curve approach (see examples 1, 2, and 3 below). The degree of inaccuracy depends in part on the steepness of the yield curve and how fast the cash flows are expected to change. Thus there is a question of materiality and cost-benefit on whether to require a yield curve approach.

However, there can be significant differences if there is an imperfect link between the cash flows being discounted and the cash flows used to calculate the average discount rate. Suppose, for example, that an agency has two programs, one with spending next year and another with spending ten years from now. If the agency wants to use a single discount rate in all its calculations, it could (in principle) calculate one using the combined cash flows of the two programs. The combined net present value of the future spending could be close to the correct value. But the net present value liability attributed to each program could be off significantly. With an upward sloping yield curve, an understatement of the net present value cost of the near-term spending would be roughly offset by an overstatement of the net present value cost of the distant spending. That would reduce the ability to make cross-program comparisons.

(Note: Calculating a weighted-average discount rate involves almost the same mathematical calculations as implementing a yield-curve approach. Thus, it is not clear under what conditions a filer would find a weighted-average approach more convenient.)

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Calculating Discounted Cash Flows

Yield Curve vs. Weighted-Average Discount Rates

* The yield curve provides the exact interest rates that ought to be used in calculating the net present value of a series of cash flows.

* A weighted-average discount rate can be used to calculate a net present value that is an approximation of the true value.

* The quality of that approximation depends on the steepness of the yield curve and the growth rate of the cash flow stream

Example 1: Flat cash flows, moderate yield curve

Cash flows grow 0% per year

Interest rates increase 0.10% per year

Year	Cash Flow	Yield	NPV Using Yield Curve		NPV Using Wtd. Avg.		Difference
			NPV Factor	NPV	NPV Factor	NPV	
1	100	4.0%	0.96	96.2	0.957	95.7	-0.4%
2	100	4.1%	0.92	92.3	0.917	91.7	-0.7%
3	100	4.2%	0.88	88.4	0.878	87.8	-0.7%
4	100	4.3%	0.85	84.5	0.840	84.0	-0.6%
5	100	4.4%	0.81	80.6	0.804	80.4	-0.2%
6	100	4.5%	0.77	76.8	0.770	77.0	0.3%
7	100	4.6%	0.73	73.0	0.737	73.7	1.0%
8	100	4.7%	0.69	69.3	0.706	70.6	1.9%
9	100	4.8%	0.66	65.6	0.676	67.6	3.1%
10	100	4.9%	0.62	62.0	0.647	64.7	4.4%
Weighted Average Discount Rate		4.45%		788.5		793.2	0.6%

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Example 2: Rising cash flows, moderate yield curve

Cash flows grow 15% per year
Interest rates increase 0.10% per year

			<u>NPV Using Yield Curve</u>		<u>NPV Using Wtd. Avg.</u>		Difference
Year	Cash Flow	Yield	NPV Factor	NPV	NPV Factor	NPV	
1	100	4.0%	0.96	96.2	0.956	95.6	-0.5%
2	115	4.1%	0.92	106.1	0.915	105.2	-0.9%
3	132	4.2%	0.88	116.9	0.875	115.7	-1.0%
4	152	4.3%	0.85	128.5	0.837	127.2	-1.0%
5	175	4.4%	0.81	141.0	0.800	139.9	-0.8%
6	201	4.5%	0.77	154.5	0.765	153.9	-0.4%
7	231	4.6%	0.73	168.8	0.732	169.3	0.3%
8	266	4.7%	0.69	184.2	0.700	186.2	1.1%
9	306	4.8%	0.66	200.6	0.669	204.8	2.1%
10	352	4.9%	0.62	218.0	0.640	225.2	3.3%
Weighted Average Discount Rate		4.56%		1514.8		1523.0	0.5%

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Example 3: Rising cash flows, steep yield curve

Cash flows grow 15% per year
Interest rates increase 0.33% per year

			<u>NPV Using Yield Curve</u>		<u>NPV Using Wtd. Avg.</u>		Difference
Year	Cash Flow	Yield	NPV Factor	NPV	NPV Factor	NPV	
1	100	1.5%	0.99	98.5	0.968	96.8	-1.8%
2	115	1.8%	0.96	110.9	0.936	107.7	-2.9%
3	132	2.2%	0.94	124.0	0.906	119.8	-3.4%
4	152	2.5%	0.91	137.8	0.876	133.3	-3.3%
5	175	2.8%	0.87	152.2	0.848	148.3	-2.6%
6	201	3.2%	0.83	167.0	0.820	165.0	-1.2%
7	231	3.5%	0.79	182.1	0.794	183.6	0.9%
8	266	3.8%	0.74	197.2	0.768	204.3	3.6%
9	306	4.1%	0.69	212.3	0.743	227.3	7.1%
10	352	4.5%	0.65	227.2	0.719	252.9	11.3%
Weighted Average Discount Rate		3.35%		1609.3		1639.0	1.8%

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An Example Comparing Yield Curve to Using Long-Term Rate; rising cash flows, steep yield curve

Cash flows grow 15% per year
Interest rates increase 0.33% per year

Year	Cash Flow	Yield	NPV Using Yield Curve		NPV Using LT Rate		Difference
			NPV Factor	NPV	NPV Factor	NPV	
1	100	1.5%	0.99	98.5	0.957	95.7	-2.8%
2	115	1.8%	0.96	110.9	0.916	105.4	-5.0%
3	132	2.2%	0.94	124.0	0.877	116.0	-6.5%
4	152	2.5%	0.91	137.8	0.840	127.7	-7.4%
5	175	2.8%	0.87	152.2	0.804	140.6	-7.7%
6	201	3.2%	0.83	167.0	0.769	154.7	-7.3%
7	231	3.5%	0.79	182.1	0.736	170.3	-6.4%
8	266	3.8%	0.74	197.2	0.705	187.5	-4.9%
9	306	4.1%	0.69	212.3	0.675	206.4	-2.8%
10	352	4.5%	0.65	227.2	0.646	227.2	0.0%
Long-term Rate		4.47%		1609.3		1531.4	-4.8%