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The Basket-of-Zeros Approach to Discounting

The revised Credit Subsidy Calculator implements an improved method of discounting, called the "basket of zeros." Previously, credit subsidies are calculated using the “similar maturity” method that was adopted when credit reform was first enacted. Under the similar maturity method, all cash flows are discounted using the interest rate (more technically called the “yield-to-maturity” rate) on a Treasury security of similar maturity to the term of the loan. For example, the cash flows for a 10-year loan are discounted using the rate on a 10-year Treasury security, and the cash flows for a 30-year loan are discounted using the rate on a 30-year Treasury security.[1]

The distinguishing feature of the basket-of-zeros method is that each cash flow is discounted using the interest rate on a zero coupon Treasury (explained below) with the same maturity as that cash flow, regardless of the term of the loan. Cash flows that would occur exactly at the end of one year are discounted using the interest rate on a Treasury zero that would mature in exactly one year. Cash flows that would occur exactly at the end of the fifth year are discounted using the interest rate on a Treasury zero that would mature in exactly five years. Cash flows that would occur exactly at the end of five years and one month would be discounted using the interest rate on a Treasury zero that would mature in exactly five years one month.[2] And so on. The basket-of-zeros method, therefore, defines the present value of any collection of future cash flows as the market price of a collection (or “basket”) of Treasury zeros that, at maturity, exactly matches the cash flows.

The basket-of-zeros method provides a more precise measure of present value because it permits matching discount rates with the timing of cash flows. A zero coupon bond pays all interest and principal at maturity. The term “zero” distinguishes these securities from other Treasury notes and bonds that make semi-annual coupon payments of interest and a payment of principal at maturity. The interest rate on a zero is a rate for a single payment at a particular point in time. In contrast, the interest rate on a 10-year Treasury note is a rate applicable to 20 semi-annual coupon payments of interest. The yield-to-maturity rate, therefore, is a blending of rates for 20 points in time. Unless the cash flows for a direct loan or loan guarantee match the cash flows on a Treasury security that makes coupon payments, using the yield-to-maturity rate as the discount rate provides an imperfect measure of present value.

Example 1 compares the two methods for a hypothetical loan guarantee program. The loans are

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[1] To simplify the calculations, similar maturity is defined by broad categories: loans maturing in 1 year or less, more the 1 year and less than 5 years, 5 years or more and less than 10 years, 10 years or more and less than 20 years, and 20 years or more. The discount rate for each category is the average interest rate on Treasury securities with remaining maturities within each of these categories.

[2] The revised Credit Subsidy Calculator will be able to use discount rates that are stated in twice-monthly intervals.

for 10 years. The Government is assumed to pay claims of $10,000 per year (line 1). The interest rates for Treasury zeros are shown on line 2a. Line 2b shows the yield-to-maturity rate for a 10-year Treasury note. The rates are based on the Treasury yield curve for 1997.

Example 1

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Assumptions										
1	Guarantee claim payments	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
2	Interest rates:										
	a. Treasury zeros	5.71%	6.12%	6.25%	6.34%	6.42%	6.48%	6.54%	6.58%	6.60%	6.61%
	b. 10-year "yield-to-maturity"	6.56%									

Subsidy Calculation

	Using similar maturity (10-year rate):		Using basket of zeros:	
3	PV of Year 1 claims (@10 year rate)	9,384	PV of Year 1 claims (@ 1 year rate)	9,460
4	PV of Year 2 claims (@10 year rate)	8,806	PV of Year 2 claims (@ 2 year rate)	8,880
5	PV of Year 3 claims (@10 year rate)	8,264	PV of Year 3 claims (@ 3 year rate)	8,337
6	PV of Year 4 claims (@10 year rate)	7,755	PV of Year 4 claims (@ 4 year rate)	7,820
7	PV of Year 5 claims (@10 year rate)	7,277	PV of Year 5 claims (@ 5 year rate)	7,326
8	PV of Year 6 claims (@10 year rate)	7,326	PV of Year 6 claims (@ 6 year rate)	7,326
9	PV of Year 7 claims (@10 year rate)	6,408	PV of Year 7 claims (@ 7 year rate)	6,418
10	PV of Year 8 claims (@10 year rate)	6,013	PV of Year 8 claims (@ 8 year rate)	6,006
11	PV of Year 9 claims (@10 year rate)	5,643	PV of Year 9 claims (@ 9 year rate)	5,626
12	PV of Year 10 claims (@10 year rate)	5,295	PV of Year 10 claims (@10 year rate)	5,273
13	Total subsidy	71,673	Total subsidy	72,007

Difference =333

The present value of each of the cash flows is shown on lines 3-12, with the total on line 13. The left bank shows the present values using the yield-to-maturity rate, which is the 10-year rate (6.56%) in this example. The right bank shows the present values using the rates on Treasury zeros. Using these rates, the present value of the $10,000 payment in year 1 is discounted at 5.71%, the payment in year 5 is discounted using 6.42%, and the payment in year 10 is discounted using 6.61%. Because the yield curve is not flat – usually it is upward sloping – the Treasury zero rate differs from the yield-to-maturity rate in every year. The present values are therefore different in every year. For example, the present value of the 4th year payment is $7,820, using the rate on a 4-year Treasury zero, and it is $7,755, using the yield-to-maturity rate. As a result, the total subsidy cost estimates differ by $333.

The basket-of-zeros is an improvement over similar maturity because it is more accurate. Each 7cash flow is discounted by the discount rate that is defined for the term of that cash flow, not the term of the final contractual cash flow of the loan. For example, the basket of zeros produces the same subsidy cost estimate for loans and loan guarantees that have identical cash flows,

regardless of the contractual term of the loan, whereas the similar maturity approach produces different cost estimates. Example 2 illustrates this for the following two Government-guaranteed loans: one loan has a one year term and the other has a 10 year term, both default at the end of the first year, and the Government pays a $10,000 guarantee claim for each. Since the cash flows are identical, the subsidy cost should be the same. The similar maturity approach (left bank) would yield different subsidy estimates for the two guarantees, because the 1-year rate would be used for the loan with a term of one year, and the 10-year rate would be used for the loan with a term of ten years. The basket of zeros approach (right bank) would yield the same estimate of subsidy cost for both guarantees, because both default payments would be discounted using the 1-year rate.

Example 2

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Assumptions										
1	Guarantee claim payments:										
	1 year loan	10,000									
	10 year loan	10,000									
2	Interest rates:										
	a. Treasury zeros	5.71%	6.12%	6.25%	6.34%	6.42%	6.48%	6.54%	6.58%	6.60%	6.61%
	b. 10-year "yield-to-maturity"	6.56%									

Subsidy Calculation

	Using similar maturity (10-year rate):		Using basket of zeros:	
3	1 year loan (discount rate = 10 year rate)	9,460	1 year loan (discount rate = 1 year rate)	9,460
4	10 year loan (discount rate = 10 year rate)	9,384	10 year loan (discount rate = 1 year rate)	9,460
5	Difference	76	Difference	0