

THE BOND BUYER

Commentary Hedging munis — Easier said than done

By Andrew Kalotay, Joel Buursma
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The standard measure of interest rate risk is effective duration; it is the critical input to portfolio-based hedging. Effective duration is defined as the percent change in value per 1% shift of the benchmark yield curve. The calculation entails bumping the curve up and down by the same amount, and then averaging and normalizing the resulting price changes. Modified duration, obtained by shifting yields rather than yield curves, is recognized to be a poor substitute, since it ignores optionality.

Because effective duration is an average, it masks possible asymmetry in upside and downside risk. A well-understood example is a callable bond — the upside is limited by the call option. In the case of munis, an additional source of asymmetry arises from the fact that discount bonds are tax-affected, while premium bonds are not.

Consider a 10-year muni currently selling at par. If interest rates decline 100 basis points, its price will increase by roughly 9 points to 109. However, a 100 basis point rate increase would depress the price by 13 points to 87, due to the de minimis tax effect, which is familiar to muni practitioners. Because of such asymmetry, it can be illuminating to separately consider the “up” and “down” components of effective duration.

Note that standard option adjusted spread (OAS) analytics do not account for the de minimis tax effect, and therefore underestimate the true effective duration of discount munis, possibly by as much as 50%.

The overall interest rate risk of a portfolio can be hedged by shorting the right mix of futures contracts, so the change in the value of the portfolio and that of the hedge offset each other when rates move. The practical problem is that effective duration is based on parallel shifts of the yield curve, but in reality interest rates do not move uniformly across maturities. Therefore, hedges relying solely on effective duration may not fully protect against non-parallel curve movements.

The solution is to decompose effective duration into so-called key rate durations. KRDs isolate the sensitivities to specified “key” rates on the curve (e.g. 7-year, 10-year, 20-year), and thus facilitate more precise hedging. A reassuring characteristic of KRDs is that, in the absence of tax effects, their sum equals the effective duration. For the 20-year taxable agency bond below, callable in 5 years and selling near par, the KRDs add up to the effective duration of 9.8 years, but the 10-year KRD of 4.5 is the most significant. The modified duration of 14 years misses the mark by a mile as it does not capture the reduced upside caused by the call option.

20-Year 3.75% Agency Bond Callable in 5 Years – Price 99.60

Key rate durations (yrs)

2-year	3-year	5-year	7-year	10-year	30-year	Sum
0	0.1	1.3	0.7	4.5	3.2	9.8

Effective duration
9.8

Modified duration
14

But when it comes to hedging munis, there is a further complexity: effective duration can differ from the sum of KRDs by a wide margin. The reason is that for discount bonds the tax due at maturity is baked into their prices. The tax rate depends on the size of the discount. When it is small (de minimis), the capital gains rate applies; otherwise it is treated as ordinary income.

For a bond selling near par, raising the entire yield curve could reduce its price below the de minimis threshold — tax rate around 40%. In contrast, raising individual key rates could result in de minimis discounts — tax rate at about 20%. The table below shows results for a 2% 8- year bond selling at 100.61. We calculate its effective duration and KRDs by shifting the interest rates 50 basis points. The tax-aware 8.9-year effective duration is the average of the up-duration (10.2 years) and the down-duration (7.5 years). The reason for the substantially larger up-duration is that a shift up of 50 basis points results in a 95.46 price, well below the de minimis threshold of 98 (100 less 0.25 times number of years to maturity). The price decline is exacerbated by the punitive tax treatment of the discount. However, the 7-year and 10-year upward rate shifts each separately result in prices above the threshold, and are subject to a less severe tax effect (long-term capital gains).

8-Year 2% Muni Priced at 100.61 De Minimis Threshold 98

Key rate durations (yrs)

	7-year	10-year	Sum	Effective Duration
Up-Duration (yrs)	3.3	5.1	8.4	10.2
Down-Duration	3	4.5	7.5	7.5
Average	3.1	4.8	7.9	8.9
	7-Yr + 50bps	10-Yr + 50bps	Sum	Yield Curve + 50 bps
Price (Change)	98.96 (1.65+)	98.07 (2.54+)	(4.19+)	95.46 (5.15+)

In summary, hedging a muni portfolio which contains bonds priced close to or below par is surprisingly complicated. First, the tax-aware effective duration of such bonds is considerably longer than indicated by conventional OAS models, reflecting the market impact of taxes on price changes not captured by such models. Additionally, tax-aware KRDs may not sum up to the effective duration, and therefore may need to be adjusted to determine the appropriate hedge ratios.

Andrew Kalotay is president of Kalotay Analytics

Joel Buursma is vice-president and senior software architect at Investortools