



## CBOT® Treasury Futures

# A SIMPLE TREASURY DURATION ADJUSTMENT

The specter of rising interest rates can give managers of fixed-income portfolios nightmares. The soothing balm in this case is not a glass of warm milk but a lower duration target. You might be targeting a Treasury benchmark that has a 5.5-year duration. Facing the prospect of rising yields, you might prefer a 4.5-year duration. Once you have achieved the shorter duration, rising yields will pose less of a threat to your sleep. Your portfolio will suffer a loss but not as large a loss. You can still outperform your benchmark.

## Alternative Approaches

You can re-target your portfolio duration in a number of ways. You can shorten portfolio duration by replacing longer-dated securities with shorter-dated securities. Alternatively, you can use futures to sell duration. The advantages of futures include lower transaction costs and greater flexibility. In particular, you can unwind a futures position quickly should the need arise. The same cannot always be said for positions in Treasury securities.

Even having decided to use CBOT Treasury futures, you have choices in how to proceed. The simplest way to shorten duration is to sell all you need to sell at one maturity—for

example, by using CBOT 10-year Treasury futures. A better way to sell a year's worth of duration might be to parcel the futures position across all four futures maturities. This will allow you to hit your duration target no matter how the yield curve shifts.

## What Yield Curve Shifts Can Do to a Portfolio

Suppose you have a \$100 million par portfolio of Treasury securities. For simplicity, this miniature portfolio holds the four securities that were on-the-run when the data was recorded. Exhibit 1 shows the relevant initial market conditions.

Exhibit 2 shows one configuration of these four securities that achieves the 5.5-year duration target.

Given these durations, you can purchase \$18 million par of the 2-year note, \$52 million par of the 5-year, \$24 million par of the 10-year, and \$6 million par of the 30-year to arrive at a 5.49-year weighted average duration for the portfolio. The values in the weights column are the products of the durations and the full prices. The weighted average, then, is the result of dividing the sum of the weights by the sum of the values ( $556,372,928.92 \div 101,391,939.50 = 5.49$ ).

**Exhibit 1: Initial Market Conditions**

Treasury Security	Yield	Duration (years)	Full Price (\$1 million par)	DV01
1 5/8% of Jan 05	1.68	1.96	998,906.25	195.79
3% of Nov 07	2.93	4.40	1,009,662.47	444.25
4% of Nov 12	3.96	7.97	1,011,945.79	806.52
5 3/8% of Feb 31	4.86	14.58	1,103,746.60	1,609.26

## Exhibit 2: A Portfolio to Target a 5.50-Year Duration

Yield Curve Sector	Duration	Million Par	Full Price Position	Position DV01	Weight
2-year	1.96	18	17,980,312.50	3,527.14	35,241,412.50
5-year	4.40	52	52,502,448.44	23,101.08	231,010,773.14
10-year	7.97	24	24,286,698.96	19,356.50	193,564,990.71
Long bond	14.58	6	6,622,479.60	9,655.58	96,555,752.57
Portfolio	5.49	100	101,391,939.50	55,664.17	556,372,928.92

The tables of Exhibit 3 illustrate what would happen to this portfolio in the event of:

- 20 basis point (bp) parallel shift of the Treasury yield curve
- a more realistic yield curve flattening

## Exhibit 3: How Two Yield Curve Shifts Affect the Portfolio

### Scenario a: A 20 bp Upward Parallel Shift

Yield Curve Sector	Position DV01	Yield Change	Result (to nearest \$)
2-year	3,527.14	20	-70,483
5-year	23,101.08	20	-462,022
10-year	19,356.50	20	-387,130
Long bond	9,655.58	20	-193,112
Portfolio	55,664.17		-1,112,746

### Scenario b: A Yield Curve Flattening

Yield Curve Sector	Position DV01	Yield Change	Result (to nearest \$)
2-year	3,527.14	30	-105,724
5-year	23,101.08	25	-577,527
10-year	19,356.50	10	-193,565
Long bond	9,655.58	5	-48,278
Portfolio	55,664.17		-925,094

Note that while the 20 bp yield increase will cause the portfolio to lose \$1,112,746, the more realistic yield curve flattening of Exhibit 3b will cause a \$925,094 loss.

## Testing Alternative Futures Strategies

Now suppose you had elected to sell a year of duration by establishing a short position in CBOT 10-year Treasury note futures. The first step is to determine how many contracts you will need to use. A full hedge takes the duration to zero. This would make your portfolio perform the same way a cash holding would. It would be completely unresponsive to yield shifts. Lowering your duration to 4.5 years amounts to an 18% reduction, so you can use 18% of a full hedge. To determine the number of contracts for a full hedge, divide the portfolio DV01 (55,664.17) by the 10-year futures DV01 (66.50).

$$55,664.18 / 66.50 = 837$$

Then calculate 18% of 837 which is 151 contracts.

$$837 * 0.18 = 151$$

Exhibit 4 shows how a single maturity adjustment might perform under three scenarios.

Exhibit 4a shows that, given a 20 bp parallel shift, 151 contracts of 10-year Treasury note futures will generate a \$200,830 gain. This reduces the effective loss to \$911,915, which is 18% less than the \$1,112,746 loss of the Treasury portfolio.

While the simple 10-year futures position performed well in the case of the 20 bp parallel shift, Exhibit 4b shows that it misses the mark when the yield curve changes shape. In this case, it produces the effect of an 11% duration target reduction. Obviously, a big part of the mismatch occurs because the 10-year yield moved only 10 bps. This might lead you to think that using the 5-year futures contract would improve your results. It won't, as Exhibit 4c shows. This

#### Exhibit 4: Selling Duration with One Futures Maturity

##### *Scenario a: A 10-Year Futures Position and a 20 bp Upward Parallel Shift*

<b>Futures Maturity</b>	<b>Futures DV01</b>	<b>Yield Change (in bps)</b>	<b>Position</b>	<b>Result (to nearest \$)</b>
10-year	66.50	20	-151 contracts	200,830

##### *Scenario b: A 10-Year Futures Position and a Yield Curve Flattening*

<b>Futures Maturity</b>	<b>Futures DV01</b>	<b>Yield Change (in bps)</b>	<b>Position</b>	<b>Result (to nearest \$)</b>
10-year	66.50	10	-151 contracts	100,415

##### *Scenario c: A 5-Year Futures Position and a Yield Curve Flattening*

<b>Futures Maturity</b>	<b>Futures DV01</b>	<b>Yield Change (in bps)</b>	<b>Position</b>	<b>Result (to nearest \$)</b>
5-year	47.50	25	-211 contracts	250,563

\$250,562 futures gain has the effect of a 27% duration target reduction. That is farther off target than the 10-year result.

Alternatively, you can use CBOT 2-year, 5-year, and 10-year Treasury note futures and Treasury bond futures to sell duration at each maturity. Again, since you are targeting a duration that is 18% less than the current portfolio duration,

In the case of the 20 bp parallel shift, the complex position produces a \$198,616 gain. This reduces the \$1,112,745 loss to a \$914,129 loss. Thus, this futures position creates the effect of an 18% duration reduction. In the case of the more realistic yield curve flattening, the \$165,754 futures gain reduces the loss from \$925,094 to \$759,340, again close to the effect of an 18% duration target reduction.

#### Exhibit 5: Structuring a Synthetic Portfolio with CBOT Futures

<b>Yield Curve Sector</b>	<b>Position DV01</b>	<b>Futures DV01</b>	<b>Full Hedge (contracts)</b>	<b>18% Hedge (contracts)</b>
2-year	3,527.14	40.40	87	16
5-year	23,101.08	47.50	486	87
10-year	19,356.50	66.50	291	52
Long bond	9,655.58	130.30	74	13

you can calculate a full hedge at each maturity and use 18% of those numbers of contracts. Exhibit 5 shows the details of these calculations.

The next step is to compare the results of this complex futures position with the results you can get using only one futures maturity. Exhibit 6 shows how the complex futures position will perform given the two yield curve shifts.

#### Conclusion

Clearly, the most effective duration targeting will result from the use of CBOT Treasury futures at all the maturities to which your portfolio has exposure.

If your outlook indicates that this is a temporary situation, then this synthetic portfolio, constructed with CBOT futures, will help you target your preferred duration. When the

## Exhibit 6: Targeting a 4.50-Year Duration with CBOT Futures

### *Scenario a: A 20 bp Upward Parallel Shift*

<b>Yield Curve Sector</b>	<b>Futures DV01</b>	<b>Yield Change (in bps)</b>	<b>Position</b>	<b>Result (to nearest \$)</b>
2-year	40.40	20	-16	12,928
5-year	47.50	20	-87	82,650
10-year	66.50	20	-52	69,160
Long bond	130.30	20	-13	33,878
Portfolio				198,616

### *Scenario b: A Yield Curve Flattening*

<b>Yield Curve Sector</b>	<b>Futures DV01</b>	<b>Yield Change (in bps)</b>	<b>Position</b>	<b>Result (to nearest \$)</b>
2-year	40.40	30	-16	19,392
5-year	47.50	25	-87	103,313
10-year	66.50	10	-52	34,580
Long bond	130.30	5	-13	8,470
Portfolio				165,755

situation normalizes, a futures position can be unwound as easily as it can be initiated. On the other hand, if you conclude that this will be a longer-term situation, you can begin to adjust your underlying portfolio as the market creates opportunities to do so in a cost-effective way. With the futures position in place, you need be in no hurry. You can afford to wait for advantageous prices in the cash market. As you eliminate unwanted securities and replace them with securities that fit in with your new goals, you can easily lift your futures position piecemeal until the portfolio make-over is complete.

