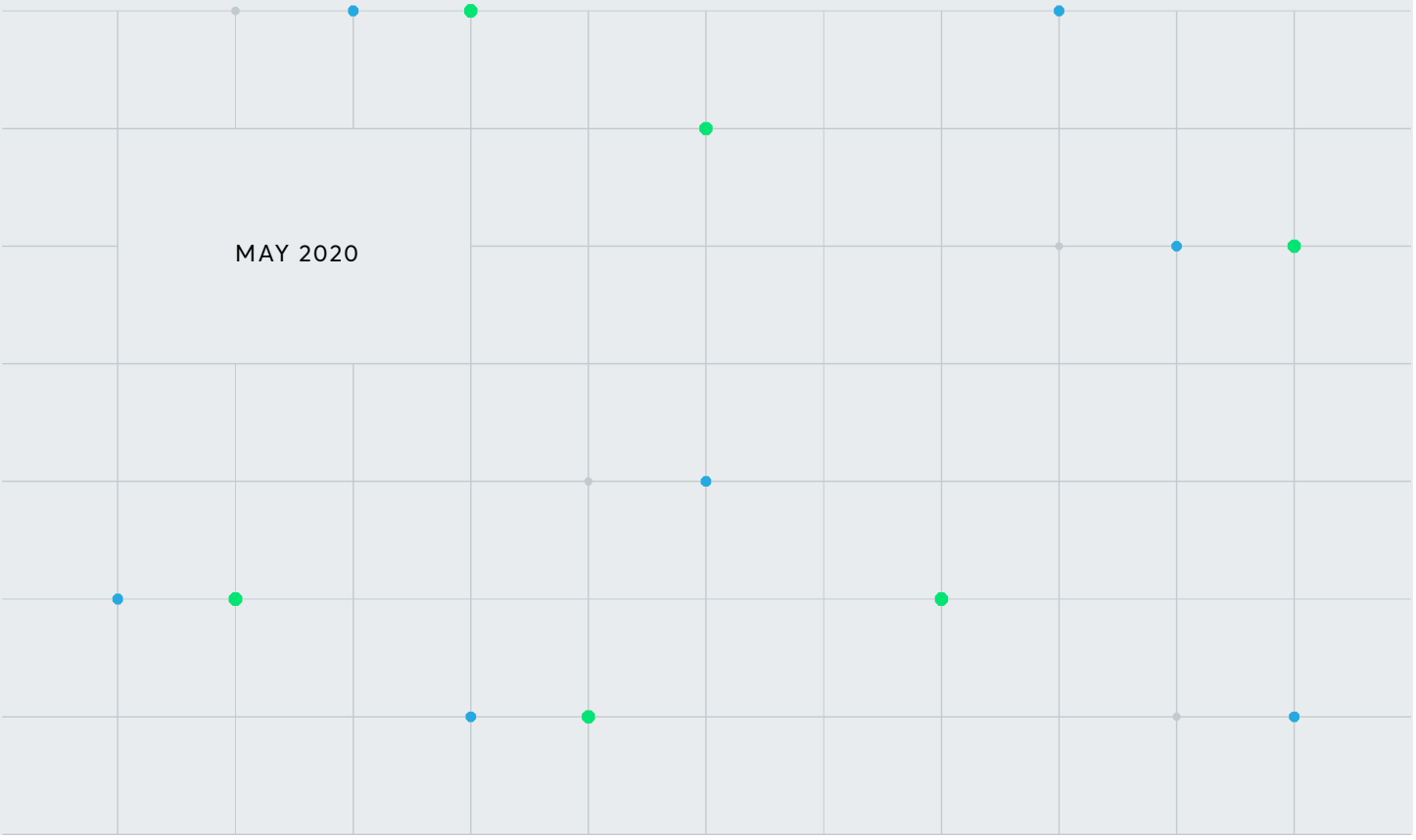
CME Group

A Simple Treasury Futures Duration Adjustment

INTEREST RATES

MAY 2020



CME Group

When volatile interest rates challenge even the most skilled fixed-income portfolio managers, CME Group U.S. Treasury futures provide easy, efficient, and flexible means to adjust portfolio interest rate sensitivity.

Fluctuating interest rates can cause unexpected losses, high transaction costs, and lost opportunities for the fixed income portfolio manager who wants to maintain an appropriate portfolio duration target. When volatile interest rates challenge even the most skilled fixed-income portfolio managers, CME Group U.S. Treasury futures provide easy, efficient, and flexible means to adjust portfolio interest rate sensitivity.

This paper discusses how to manage portfolio duration with Treasury futures while anticipating changes in yields. This is illustrated by two scenarios: Scenario A examines yield-curve flattening during a period of falling interest rates, and Scenario B examines yield-curve steepening during a period of rising interest rates.

Alternative Approaches

In theory, the simplest way to adjust portfolio duration is to shift the portfolio's allocation between long-dated and short-dated assets by buying and selling securities in the cash market. In practice, however, this may involve hard trade-offs between generic duration management and specific portfolio allocation decisions.

A portfolio manager frequently expends much effort in determining whether a particular bond is likely to outperform comparable assets, before deciding whether to add it to the portfolio. By changing positions in such bonds simply to adjust generic portfolio duration, the portfolio manager risks sacrificing the hard-won upside potential that is unique to these holdings. Moreover, futures concentrate liquidity at each tenor point, offering narrower bid/offer spreads than even the most liquid individual bonds, giving the portfolio manager a relatively inexpensive way to tweak a portfolio's target duration.

By contrast, Treasury futures are ideal for this purpose. The CME Group Treasury suite comprises all key maturity points: the 2-year, 5-year, 7-year (via the Classic 10-year), 10-year (via the Ultra 10-year), as well as the 15-20 and 25+ year ranges (via the Classic and Ultra Bonds). Among their many advantages are low transaction costs and tremendous flexibility. In particular, the portfolio manager can establish and unwind a futures position quickly, should the need arise.

The simplest way to shorten or lengthen duration with Treasury futures is to buy or sell the required number of contracts in one contract – for example, by buying or selling 10-Year T-Note futures. However, a more effective approach may be to apportion the futures position across several maturity sectors. This enables the portfolio manager to maintain the duration target even if the yield curve changes shape. The following scenarios examine both alternatives.

The Impact of Yield Curve Shifts on Portfolio Valuation

Suppose you hold a $100 million par portfolio of Treasury securities. For simplicity, assume it is composed of the four Treasury securities shown in Exhibit 1.

Exhibit 1: Initial Portfolio Composition and Market Conditions June 2020

TREASURY	SECURITY	YIELD	MODIFIED DURATION (YRS)	PRICE W/ ACCRUED INTEREST	DV01 (PER $1MM)
2-year	0 3/8% Mar 2022	0.31%	1.991	$1,001,328	$199
5-year	1 1/8% Feb 2025	0.52%	4.795	$1,030,092	$494
10-year	1 1/2% Feb 2030	0.87%	9.198	$1,061,492	$976
30-year	2 1/2% Feb 2045	1.37%	19.236	$1,240,247	$2,386

In face value terms, the portfolio contains $26 million 2-year notes, $43 million 5-year notes, $22 million 10-year notes, and $9 million 30-year bonds. Its weighted average duration is approximately 6.6 years. Exhibit 2 lays out the details of the portfolio's interest rate sensitivity.

Exhibit 2: Portfolio Weighted Average Duration = 6.6 Years

TREASURY	SECURITY	MODIFIED DURATION (YRS)	POSITION (UNITS OF $1MM FV)	MARKET VALUE (PRICE X POSITION)	AGGREGATE DV01	WEIGHT (DURATION X MKT VAL)
2-year	0 3/8% Mar 2022	1.991	26	$26,034,531	$5,174	$51,834,752
5-year	1 1/8% Feb 2025	4.795	43	$44,293,944	$21,242	$212,389,461
10-year	1 1/2% Feb 2030	9.198	22	$23,352,826	$21,472	$214,799,295
30-year	2 1/2% Feb 2045	19.236	9	$11,162,225	$21,474	$214,716,565
	Portfolio	6.617	100	$104,843,527	$69,362	$693,740,074

For each portfolio component, the values in the 'Weight' column equal duration times the full price. The weighted average duration at the bottom of the 'Modified Duration' column is the sum of the weights divided by the sum of market values ($694M / $105M = 6.617).

CME Group

Testing Futures Strategies

Scenario A: Falling Interest Rates and Flattening Yield Curve

Suppose you anticipate a decline in the general level of yields along with a flattening of the yield curve. Exhibit 3 illustrates the impact of a drop in yields combined with flattening of the yield curve on the unhedged portfolio.

Exhibit 3: Portfolio Impact of Falling Yields and Flattening Yield Curve

TREASURY	SECURITY	AGGREGATE DV01	YIELD CHANGE (BPS)	RESULT
2-year	0 3/8% Mar 2022	$5,174	-5	+25,870
5-year	1 1/8% Feb 2025	$21,242	-10	+212,420
10-year	1 1/2% Feb 2030	$21,472	-20	+429,440
30-year	2 1/2% Feb 2045	$21,474	-30	+644,220
	Portfolio	$69,362		+1,311,950

To enable the portfolio to benefit from this course of events, you might wish to extend your portfolio duration target from around six and a half years to, for example, nine years. Suppose you elect to do so by augmenting the portfolio with a futures overlay consisting of a long position in either 10-Year T-Note futures or T-Bond futures.

To construct the overlay for 10-Year T-Note futures, first calculate the number of contracts that would be required to replicate the DV01 for the entire portfolio. That is, divide the portfolio DV01 – $69,362 per basis point – by the 10-Year T-Note futures DV01 – $85.07 per basis point.

Treasury Analytics

Jun 2020 Contract

TREASURY			CHEAPEST TO DELIVER*					
NAME	SYMBOL	PRICE	COUPON	MATURITY DATE	DELIVERY DATE	ISSUE DATE	FUTURES YIELD	FUTURES DV01
2 Yr (TU)	TUM0	110.03625	2 3/8	3/15/2022	7/6/2020	3/15/2019	0.26%	$36.74
5 Yr (FV)	FVM0	124.2200	1 1/4	8/31/2024	7/6/2020	9/3/2019	0.49%	$50.52
10 Yr (TY)	TYM0	137.0950	2 1/4	2/15/2027	6/30/2020	2/15/2017	0.71%	$85.07
Ultra 10 Yr (TN)	TNM0	153.2450	1 3/4	11/15/2029	6/30/2020	11/15/2019	0.87%	$133.49
30 Yr (US)	USM0	177.130	4 1/2	2/15/2036	6/30/2020	2/15/2006	0.98%	$216.78
Ultra 30 Yr (UL)	ULM0	218.180	3	11/15/2045	6/30/2020	11/16/2015	1.41%	$414.25

$69,362 / $85.07 = 815.3 10-Year T-Note futures
Given that your objective is to increase the portfolio DV01 by about one-third (i.e., to boost portfolio duration from under seven to nine years), you would then simply scale the futures overlay so that it equals one-third of 815.3 contracts:

0.333 x 815.3 10-Year T-Note futures = 271 10-Year T-Note futures
In the same way, to obtain appropriate scale for a Treasury Bond futures overlay, first find the number of Treasury Bond futures that would replicate the portfolio DV01. With the T-Bond futures DV01 at $216.78 per basis point, the result is:

$69,362 / $216.78 = 320 T-Bond futures
Accordingly, to increase portfolio DV01 by one third, the T-Bond futures overlay should be:

0.333 x 320 T-Bond futures = 107 T-Bond futures

Single-Maturity Futures Overlay

If Treasury yields were to decline uniformly by, say, 20 bps along the entire yield curve, then the choice of futures contract for the overlay structure would be moot. The 10-Year T-Note version and the Treasury Bond version would perform almost identically, with each producing an incremental portfolio gain around $460,000. Note that this would boost the total portfolio return to nearly $1,774,000 or 35 percent more than the $1,311,950 portfolio return without the futures overlay.

Parallel Shifts vs. Slope Changes

If the yield curve changes shape, however, then your choice of futures overlay makes a potentially big difference. Exhibit 4 summarizes the performance of each futures overlay – 10-Year T-Note futures versus Treasury Bond futures – for Scenario A in which a flattening of the curve accompanies the drop in yields.

Exhibit 4: Duration Extension with 10-year Note or Classic Bond Futures

FUTURES MATURITY	FUTURES DV01	YIELD CHANGE (BPS)	FUTURES POSITION	RESULT
10yr Note	85.07	-20	+271	+461,079
		OR		
30yr Bond	216.78	-30	+107	+695,864

As before, given a 20 bp decrease in yields at the 10-year point on the curve, the overlay that holds a long position of 271 10-Year T-Note futures would boost portfolio returns by 35 percent. With a 30 bp drop in yields at the 30-year point on the curve, however, the overlay employing a long position of 107 T-Bond futures would generate incremental revenue of $695,864 raising total portfolio returns by 53 percent.

The important lesson in this is that by constructing the futures overlay with one futures contract, referencing only one segment of the Treasury curve, you may introduce an unwelcome source of incremental risk into your portfolio management program. Insofar as the single-maturity overlay fails to respond to appropriately to shifts in yield curve slope or shape, it is unlikely to be the right tool for achieving duration extension.

CME Group

A Multiple-Maturity Futures Overlay

Using a combination of Treasury futures to extend duration at each of the portfolio's key maturity points should enable you to extend duration while maintaining a tighter control over portfolio risk exposure.

Assuming that your aim is still to boost portfolio duration by 33 percent, you would construct the futures overlay as follows. First, for each key maturity bracket within the portfolio, calculate the number of futures contracts at the corresponding term to maturity that would be required to replicate that maturity bracket's DV01.

Then, in each case, use one-third of that number of contracts, as illustrated in Exhibit 5. Note that the 10-year and 30-year brackets have been split between Classic and Ultra contracts, so their overlay is halved. Exhibit 6 indicates how this multi-contract overlay would perform against Scenario A's combined drop in yields and flattening of the yield curve.

Exhibit 5: Duration Extension with Treasury Futures: Construction

TREASURY	SECURITY	TOTAL DV01	TREASURY FUTURES	FUTURES DV01	FUTURES EQUIV	FUTURES OVERLAY
2-year	0 3/8% Mar 2022	$5,174	2-year (TU)	$36.74	$5,174	47
5-year	1 1/8% Feb 2025	$21,242	5-year (FV)	$50.52	$21,242	140
10-year	1 1/2% Feb 2030	$21,472	10-year (TY)	$85.07	252	42*
			Ultra 10-year (TN)	$133.49	161	27*
30-year	2 1/2% Feb 2045	$21,474	Classic Bond (US)	$216.78	99	17*
			Ultra Bond (UL)	$414.25	52	9*

** Indicates halved futures overlays for shared tenor points*

Exhibit 6: Duration Extension with Treasury Futures: Results

FUTURES MATURITY	FUTURES DV01	YIELD CHANGE (BPS)	FUTURES OVERLAY	RESULT
2-yr (TU)	$36.74	-5	47	$8,623
5-yr (FV)	$50.52	-10	140	$70,807
10-yr (TY)	$85.07	-15	42	$53,594
Ultra 10-yr (TN)	$133.49	-20	27	$72,085
Classic Bond (US)	$216.78	-25	17	$92,132
Ultra Bond (UL)	$414.25	-30	9	$111,848
Portfolio				$409,088

For the fiduciary portfolio manager concerned with management of market risk exposures, the notable feature of the results in Exhibit 6 is their precision. The futures overlay generates an incremental portfolio gain of $409,088, signifying a 31 percent increase beyond the $1,311,950 portfolio return without the futures overlay. Given that the objective in extending duration is to boost portfolio returns by one third, the outcome is reassuringly close to target.

Testing Futures Strategies

Scenario B: Rising Interest Rates and Yield-Curve Steepening

Rising interest rates vex even the most skilled fixed-income managers. Fortunately, the Treasury futures toolkit is as equally effective for adjusting a bond portfolio to cope with bear market conditions as it is for modifying the portfolio to accommodate a bull market.

To see this, suppose once again that your portfolio is as shown in Exhibits 1 and 2. Suppose, moreover, that you anticipate a general rise in yields combined with a steepening of the curve. Exhibit 7 illustrates the impact of an increase in yields and a steepening of the yield curve on the unhedged portfolio.

Exhibit 7: Portfolio Impact of Rising Yields and Steepening Yield Curve

TREASURY	SECURITY	POSITION DV01	YIELD CHANGE (BPS)	RESULT
2-year	0 3/8% Mar 2022	$5,174	+20	-$103,480
5-year	1 1/8% Feb 2025	$21,242	+35	-$743,470
10-year	1 1/2% Feb 2030	$21,472	+50	-$1,073,600
30-year	2 1/2% Feb 2045	$21,474	+75	-$1,610,550
	Portfolio	$69,362		-$3,531,100

Single-Maturity Futures Overlays

Faced with this prospect, you decide to shrink portfolio duration by one-third, i.e., to four years from its current six years. Exhibit 8 presents calculations similar to those in Exhibit 4 to illustrate the performance of duration adjust- ment overlays that use single futures contracts – either 10-Year T-Note futures or 30-Year T-Bond futures.

Exhibit 8: Duration Shrinkage with Either 10-Year T-Note or 30-Year T-Bond Futures

FUTURES MATURITY	FUTURES DV01	YIELD CHANGE (BPS)	FUTURES POSITION	RESULT
10yr Note	85.07	+50	-271	+1,152,699
		OR		
30yr Bond	216.78	+75	-107	+2,341,224

Given a 50 bps yield increase at the 10-year point of the curve, a futures overlay consisting of a short position of 271 10-Year T-Note futures would produce incremental revenue of $1,152,699. This would suffice to scale back the portfolio's overall loss to $2,378,401, 33 percent smaller than the $3,531,100 loss on the cash Treasury portfolio without the futures overlay. In the same way, for a 75 bp increase in yield at the 30-year point of the curve, a futures overlay consisting of 107 short T-Bond futures would produce incremental gains of $2,341,224, enough to trim the overall portfolio loss by nearly two thirds.

CME Group

A Multiple-Maturity Futures Overlay

Gratifying though these results might be, they stray disturbingly far from your basic objective of achieving a 33 percent reduction in portfolio interest rate sensitivity. As in the bull market environment featured in Scenario A, the prudent investment manager is likely to achieve a finer degree of control over the portfolio's risk exposure under Scenario B's bear market move by using a combination of Treasury futures that reference several points along the yield curve.

Procedures for structuring a multi-contract duration reduction overlay are exactly as for the duration extension overlay. For each of the portfolio's key maturity brackets, calculate the number of futures contracts *at the corresponding term to maturity* needed to replicate the maturity bracket's DV01.

Then, in each case, find 33 percent of that number of contracts. Exhibit 9 sketches the computational details, and Exhibit 10 shows how the multiple- maturity futures overlay performs when it confronts Scenario B's combination of a general interest rate rise and a steepening of the yield curve.

TREASURY	SECURITY	TOTAL DV01	TREASURY FUTURES	FUTURES DV01	FUTURES EQUIV	FUTURES OVERLAY
2-year	0 3/8% Mar 2022	$5,174	2-year (TU)	$36.74	-141	-47
5-year	1 1/8% Feb 2025	$21,242	5-year (FV)	$50.52	-420	-140
10-year	1 1/2% Feb 2030	$21,472	10-year (TY)	$85.07	-252	-42*
			Ultra 10-year (TN)	$133.49	-161	-27*
30-year	2 1/2% Feb 2045	$21,474	Classic Bond (US)	$216.78	-99	-17*
			Ultra Bond (UL)	$414.25	-52	-9*

** Indicates halved futures overlays for shared tenor points*

Exhibit 10: Duration Shrinkage with the Treasury Futures Curve: Results

FUTURES MATURITY	FUTURES DV01	YIELD CHANGE (BPS)	FUTURES OVERLAY	RESULT
2-yr (TU)	$36.74	+15	-47	$34,493
5-yr (FV)	$50.52	+25	-140	$247,823
10-yr (TY)	$85.07	+30	-42	$160,782
Ultra 10-yr (TN)	$133.49	+35	-27	$180,212
Classic Bond (US)	$216.78	+45	-17	$202,689
Ultra Bond (UL)	$414.25	+60	-9	$242,336
Portfolio				$1,068,336

The multi-contract futures overlay produces an incremental gain of $1,068,336, enough to trim the overall loss on the portfolio by 30 percent. Given that your basic objective in deploying the futures overlay is to reduce portfolio exposure to rising interest rates by one-third, this outcome is pleasingly close to target.

Conclusion

Regardless of the general direction of market interest rates, if you anticipate any material change in the slope of the yield curve, then the most effective approach to duration targeting with futures overlays will be to construct the futures position with a mix of U.S. Treasury futures contracts that reference all key maturities to which your portfolio is exposed.

By contrast, if you expect any changes in market interest rates to take the form of a parallel or near-parallel shift in the yield curve, then you are likely to find that constructing the futures overlay with a single contract, referencing a single maturity sector, is simpler and more direct, and therefore potentially more desirable. Regardless of the approach you choose, CME Group U.S. Treasury futures permit quick and cost-effective adjustment to your portfolio duration target.

With the futures overlay in place, you can afford to move gradually, waiting for propitious conditions in the cash market to adjust your portfolio's securities holdings. As you do so, you can easily disassemble your futures overlay at a comparably gradual pace, until your portfolio make-over is complete. If instead you anticipate that the move in interest rates that motivated you to add the futures overlay in the first place will be temporary, prone to near-term reversal, then the ease and flexibility of market entry and exit that are characteristic of Treasury futures will prove all the more important. In either case, your futures overlay position can be unwound as easily as it was initiated.

For more information, visit cmegroup.com/interestrates

1 *The Treasury Analytics tool provides a convenient way to view information for CME U.S. Treasury futures and the deliverable cash Treasuries which make up their deliverable basket and drive their price movements. This includes the yield, duration, and DV01 values referenced here. To learn more, go to www.cmegroup.com/tools-information/quikstrike/treasury-analytics.html*

2 *The CME Group 2-Year Treasury Note futures contract has a notional value of $200,000, twice the amount of the other Treasury futures contracts. Therefore, its DV01 is double*

cmegroup.com

PM2806/0420