

The Dow Jones CBOT Treasury Index Index Methodology

INTRODUCTION

Despite considerable progress over the years, bond indices still lack the transparency, consistency, and reliability that are normally associated with the major stock indices. Consequently, it is difficult to accurately assess the quality and consistency of returns generated by various bond market trading strategies and investment management styles.

Measurement uncertainty poses difficult challenges for bond investors. For instance, portfolio transitions are difficult to measure and manage without a reliable benchmark of intra-day market activity. Periodic adjustments to conventional benchmark indices can lead to temporary market distortions (and significant portfolio transaction costs) as investment managers seek to adjust portfolios the same way at the same time. The Dow Jones CBOT Treasury Index was created to address these concerns.

Index Description

The Dow Jones CBOT Treasury Index measures default-free returns available to investors in U.S. capital markets. It is composed of duration-weighted prices of U.S. Treasury bond, 10-year Treasury note and 5-year Treasury note futures contracts. Using Treasury futures contracts as building blocks imports the immediacy, transparency, and efficiency of real-time markets into index valuations.

Duration weighting makes the Dow Jones CBOT Treasury Index yield-curve neutral; each element makes an equal contribution to index performance, so available returns along the curve are efficiently aggregated into a single measure. Moreover, index performance is transparent, reliable, and real-time, based on actual transactions rather than end-of-day quotes. More than \$100 billion face value in T-bond, 10-year T-note, and 5-year T-note futures is typically traded daily, with transactions that are executed openly and continuously. As such, the Dow Jones CBOT Treasury Index is a reliable and dynamic measure of default-free bond market returns.

For bond market professionals measuring the return of a single bond is relatively

simple. However, measuring returns available in the bond market as a whole can be extraordinarily complex. First, data collection is difficult and costly. Second, the universe of outstanding bonds constantly changes as new bonds are issued and old bonds mature. Finally, changes in the characteristics (and prices) of individual bonds occur with the passage of time with no change in the term structure of rates. As a result, apples-to-apples returns comparisons over time are difficult.

The Dow Jones CBOT Treasury Index uses a real-time market-based methodology to address these problems; bond market professionals now have an index that accurately and consistently measures U.S. default-free returns over time.

Moreover, supporting data are transparent and easily accessible. Measurement error attributable to wide bid-ask spreads or imprecise marks-to-market is eliminated because pricing is based on real-time transactions, not market quotes.

Index Methodology

The Dow Jones CBOT Treasury Index consists of the weighted average price of T-bond, 10-year T-note, and 5-year T-note futures contracts. Weighting is by Macaulay modified duration.

The significance of duration lies in its utility as a measure of bond price volatility; longer durations imply greater price volatility. Weighting prices by Macaulay modified duration produces an unbiased valuation measure. No single sector dominates pricing; each sector's contribution to index valuation is consistent with its position along the risk-reward continuum. For the purpose of calculating durations (and therefore weights), the Dow Jones CBOT Treasury Index treats the component futures contracts as if:

- The 5-year T-note futures contract is a 6.00% semiannual coupon note maturing in 5 years
- The 10-year T-note futures contract is a 6.00% semiannual coupon note maturing in 10 years
- The T-bond futures contract is a 6.00% semi-annual coupon bond maturing in 20 years

Consider the numerical example in Table 1. It illustrates index construction using hypothetical price data for the March 2004 Treasury futures contracts as of the (hypothetical) close of business February 27, 2004.

In Table 1, yields are calculated from the prices and maturities displayed in their respective columns. Modified durations are calculated using these yields.

Weights are then calculated, as shown here, using the T-bond's modified duration in the numerator.

Index Weights:

$$\text{5-year T-note} = 12.0492 / 4.3675 = 2.7588$$

$$\text{10-year T-note} = 12.0492 / 7.6736 = 1.5702$$

$$\text{T-bond} = 12.0492 / 12.0492 = 1.000$$

$$\text{The sum of the weights} = 2.7588 + 1.5702 + 1.000 = 5.3291$$

The weighted average price (WAP) is 113.1516. It is the sum of the price of each futures contract component times its weight (602.9909), divided by the sum of the weights (5.3291). The WAP is the index value for the March expiry.

Index Rebalancing

Since the component Treasury futures contracts expire quarterly, the Dow Jones CBOT Treasury Index is also rebalanced quarterly and new durations are calculated and new weights are assigned. Calibration of the index takes place at the close of business on the last business day preceding the components' current contract month. For example, the March index is composed of March Treasury futures contracts, therefore, the calibration of the June index would take place on the last business day in February.

To maintain continuity at the time of recalibration, index values are equalized across the expiration of the component contracts. In this example, the index value based on new June Treasury futures contracts is equalized with the index value based on the expiring March contracts. After those index values are calculated, a divisor is used to set the new June index to equal to the March index. Table 2, on the following page, shows calculations used to determine the WAP using June contracts, before a divisor is determined.

The June index value (before rebalancing) is equal to the WAP of the June contracts, in this case 112.5243. In this example, at the close of business February 27, 2004, index values calculated using March and June futures contracts would be equal to 113.1516 and 112.5243, respectively. A divisor is then used to equalize them.

Table 1 – March Index

Date	Component	Price	Yield	Modified Duration	Weights	Weights x Price	WAP (March)
2/27/2004	5-year	113-4/32	3.143%	4.3675	2.7588	312.0933	
2/27/2004	10-year	114-8/32	4.237%	7.6736	1.5702	179.3976	
2/27/2004	T-bond	111-16/32	5.078%	12.0492	1.0000	111.5000	
					SUM	SUM	
					5.3291	602.9909	113.1516

Table 2 – June Index

Date	Component	Price	Yield	Modified Duration	Weights	Weights x Price	WAP (June)
2/27/2004	5-year	112-24/32	3.219%	4.3648	2.7503	310.0912	
2/27/2004	10-year	113-16/32	4.323%	7.6623	1.5667	177.8172	
2/27/2004	T-bond	110-12/32	5.162%	12.0042	1.0000	110.3750	
					SUM	SUM	
					5.3169	598.2834	112.5243

The divisor is equal to the quotient of the new and expiring calculated Weighted Average Prices, with the new WAP in the numerator and the expiring WAP in the denominator:

$$\text{Divisor} = \text{WAP}_{\text{new}} / \text{WAP}_{\text{expiring}}$$

In this case the divisor would be equal to the June WAP divided by the March WAP or 112.5243 divided by 113.1516 = 0.9945. See Table 3 below.

The June divisor remains 0.9945 until the index is rebalanced following the market close on the last business day of May 2004. On that day, the process is repeated using the expiring June T-bond, 10-year T-note, and 5-year T-note contracts and the new front-month September T-bond, 10-year T-note, and 5-year T-note contracts.

Index Methodology & Returns Continuity

The Dow Jones CBOT U.S. Treasury Index methodology addresses the measurement consistency problem that has been the bane of bond market indexing. It treats futures contracts as measuring instruments, organizes the data into cohorts and uses market prices (and therefore market expectations) to equalize index values across component contract expirations. This way the index captures changes in the universe of available returns while still maintaining both construct and measurement consistency. Returns are easily compared over time.

This simple methodology addresses the structural discontinuity issue that has made bond index construction problematic.

Bond indexes have traditionally grappled with two sources of discontinuity. The first concerns time and the term structure of interest rates. Because bonds are priced according to their position on the yield curve, the values of individual bonds will change over time absent a change in the general level of rates. For example, in a year's time, a conventional index of 5-year notes will become an index of 4-year notes, possessing a different set of risk-return characteristics. Since the baseline is a moving target, returns comparisons are suspect.

Table 3 – Divisor Calculation

WAP March	WAP June (Without Divisor)	June Divisor	WAP June (With Divisor)
113.1516	112.5243	0.9945	113.1516

A second source of discontinuity is the ever-changing universe of returns. New bonds are issued and old bonds mature (or are called). These events change the universe of available returns. To deal with this situation, most bond indexes adopt rules for when and how to add or subtract bonds from existing indexes. But this makes returns comparisons over time problematic because (1) the index has changed, (2) the universe being tracked has changed, and (3) the change in the index may not fully capture changes in the universe. Further, index changes are a source of transaction cost and tracking error for portfolio managers who need to adjust for alterations in benchmarks.

By contrast, the Dow Jones CBOT Treasury Index methodology creates index continuity over time, strengthening the validity of inter-temporal returns comparisons. Index components—front-month futures contracts—remain constant, but their prices change to reflect changes in market conditions. Futures prices build in market expectations about already outstanding bonds as well as yet-to-be-issued bonds that may become eligible for delivery in the future.

Quarterly rebalancing is dynamic. It is based on changing market conditions and adjusts for changes both within and across index cohorts. Quarterly adjustments in index weights reflect relative changes, if any, in the durations of the 5-year T-note, 10-year T-note and T-bond contracts. The divisor used for adjustments across quarters is derived from market prices for rolling positions forward. As a result, it aggregates market expectations for the future, including the likelihood of changes in delivery eligibility. So the index maintains continuity while capturing the dynamics of a changing universe of investable securities.

A Capital Markets Benchmark

The Dow Jones CBOT Treasury Index benchmarks default-free capital market returns. But default-free returns are not risk-free returns; there is price volatility to consider. The Dow Jones CBOT Treasury Index methodology does this by isolating the capital market portion of returns. It does so by replicating the price action of longer-dated securities while subtracting their carry value.

Underlying index components reflect the price behavior of Treasury securities with maturities of five years and longer. Prices of the underlying Treasury futures also discount carry. The market discount rate is (generally) a close approximation of the overnight federal funds rate, plus an embedded delivery option. As a result, discounting effectively strips out the money market component of the returns. The residual is the Dow Jones CBOT Treasury Index, which represents investor willingness to extend out the yield curve from the money markets to the capital markets to seek marginal gains. The Dow Jones CBOT Treasury Index thus offers a transparent and unique real-time benchmark of default-free U.S. capital market returns.

If you have questions about the Dow Jones CBOT Treasury Index, please contact the Interest Rate Products Team at interestrates@cmegroup.com.

Additional information can be found under “Major Indexes” on the Dow Jones Indexes website at www.djindexes.com.

Futures trading is not suitable for all investors, and involves the risk of loss. Futures are a leveraged investment, and because only a percentage of a contract's value is required to trade, it is possible to lose more than the amount deposited for a futures position. Therefore, traders should only use funds that they can afford to lose without affecting their lifestyles. And only a portion of those funds should be devoted to any one trade because they cannot expect to profit on every trade.

“Dow Jones” is a service mark of Dow Jones & Company, Inc. “Dow Jones CBOT Treasury Index” is a service mark of Dow Jones and the Board of Trade of the City of Chicago, Inc. and the Dow Jones CBOT Treasury Index is owned by CBOT and calculated by Dow Jones. CBOT's futures and futures options contracts based on the Dow Jones CBOT Treasury Index™ are not sponsored, endorsed, sold or promoted by Dow Jones, and Dow Jones makes no representation regarding the advisability of trading in such product(s).

CME Group is a trademark of CME Group Inc. The Globe logo, CME, and Chicago Mercantile Exchange and Globex are trademarks of Chicago Mercantile Exchange Inc. CBOT and the Chicago Board of Trade are trademarks of the Board of Trade of the City of Chicago, Inc. New York Mercantile Exchange and NYMEX are registered trademarks of the New York Mercantile Exchange, Inc.

The information in this brochure has been compiled by CME Group for general purposes only. CME Group assumes no responsibility for any errors or omissions. Although every attempt has been made to ensure the accuracy of the information within this brochure, CME Group assumes no responsibility for any errors or omissions. Additionally, all examples in this brochure are hypothetical situations, used for explanation purposes only, and should not be considered investment advice or the results of actual market experience.

All matters pertaining to rules and specifications herein are made subject to and are superseded by official CME, CBOT, and NYMEX rules. Current rules should be consulted in all cases concerning contract specifications.