

The background of the entire page is a dark, semi-transparent overlay of various financial data visualizations. It includes bar charts, line graphs, and floating numerical values in a light, monospace-style font. Some of the visible numbers include 5512.03, 7524.16, 6625.14, 8956.21, 6725.89, 55.02, 11.02, 0.00, 0.02%, and 1.0. The overall aesthetic is technical and data-driven.

MBIS

MUNICIPAL BOND INFORMATION SERVICES

MBIS National Municipal Index and Benchmark Curve methodology

Constituent Rules, Pricing Model and
Benchmark Curve Calculations.

Jan 2018

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Overview

The Municipal Bond Information Service (MBIS) U.S. Tax-Exempt Municipal Index covers the long-term tax-exempt municipal bond market. The index is valued directly against pre-and-post trade market data provided by MBIS and the MSRB. Unlike existing indices that utilize third party valuations, this index is dynamically rebalanced to include a large sample of bonds in the municipal bond market with recent market observations. It is designed to track the offered side of the market and include smaller transaction sizes to reflect opportunities available to the individual investor.

Features

- Tax-Exempt municipal bond index that can inform both the sophisticated market professional and the individual investor.
- Valuation directly based upon observable data from both the quoted and traded markets.
- Based upon the sectors and instruments with the most current market activity.
- Published daily with the potential for intra-day updates.
- Approximately 4,000 bonds in the index with multiple market observations on a daily basis.

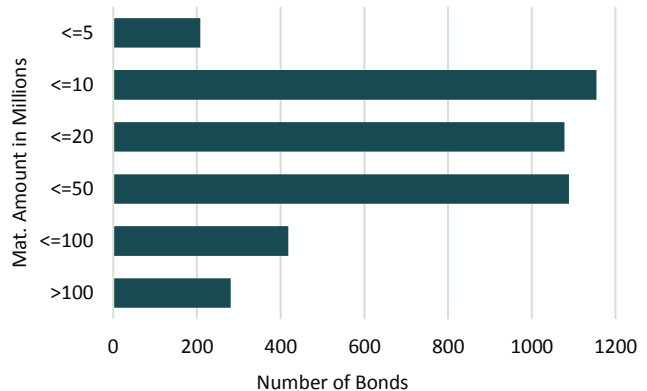
Constituents

The constituents of the index are chosen based upon a combination of a traditional set of inclusion rules defined on the characteristics of the bonds and a test for a minimum threshold of market activity. This test insures that most of the bonds in the index can be valued directly from the available market data without the use of a more complex and subjective pricing model.

Inclusion Rules

The potential constituents of the index must conform to a set of inclusion rules that define the most commonly traded municipal bonds.

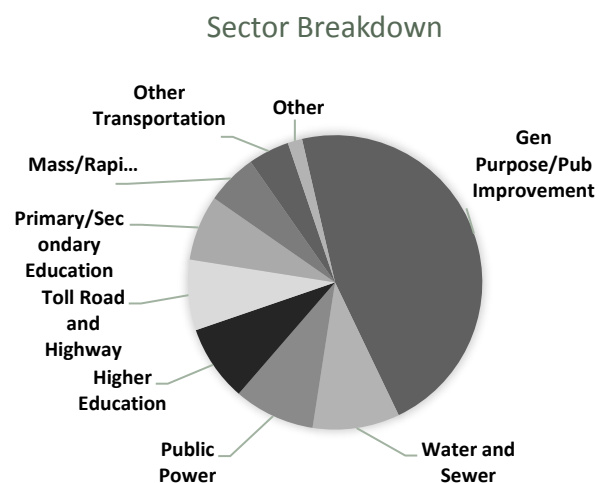
Amount Outstanding – The bonds must have an amount outstanding of at least \$50MM for the issue and at least \$5MM for the maturity.



Tax Status – The bonds will be Tax-Exempt, with taxable bonds and bonds subject to the AMT excluded.

Sectors – The bond in the index will be general obligation bonds and essential purpose revenue bonds. The revenue sources are:

- Water and Sewer
- Public Power
- Mass Transit
- Primary/Secondary Education
- Higher Education
- Toll Road and Highway
- Government/Public Buildings
- Other Transportation
- Public Utilities

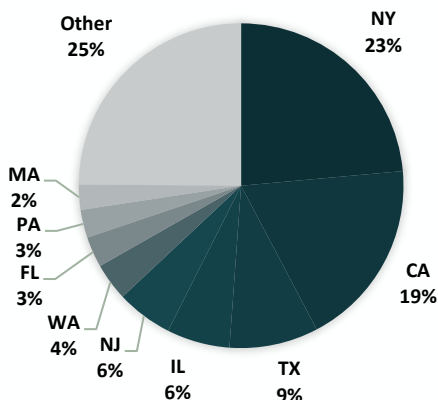


Redemption – No pre-refunded or escrowed to maturity bonds are included in the index. No bonds with active sinking funds will be included.

Distressed – No defaulted or distressed debt will be included.

State – Bonds from Puerto Rico and U.S. territories will be excluded.

State Breakdown

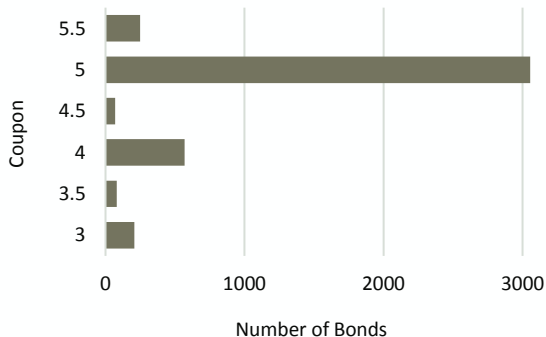


Debt Type – The debt type must be one of: Bonds, Certificates of Obligation, or Warrants.

Security Type – Unlimited G.O., Limited G.O., Revenue Double Barreled, or Loan Agreement.

Bank Qualification – No bank qualified bonds are included in the index.

Coupon – the bonds must have a coupon between 3% and 5.5%. No zero coupon bonds are included.



Maturity – The maturity date must be between one year and 30 years of the date of the index rebalancing.

Call Date – The next date on the bond must be at least 1 year from the date of the index constituent selection.

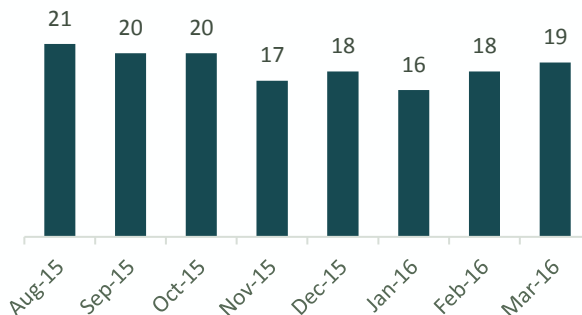
The composition of the index constituents will be adjusted on a monthly basis to account for changing market activity as well as changes in the bonds characteristics with regard to the inclusion criteria specified above.

The above rules will result in a pool of approximately 45,000 potential index constituents. The constituents of the index will be chosen from this group based upon market activity as described below.

Market Activity

Bonds will be required to have multiple (at least two) market observations on a minimum number of business days in the previous month. Bids, offerings and trades will be considered. The threshold for the number of required days will be chosen so that there are at least 4,000 bonds that qualify for inclusion in the index. Over recent market history this will generally be between 16 and 22 business days.

Minium Days of Data



The bonds are chosen so that they represent rates for the full term structure of the curve. The minimums for each region are

- 1-10 years: 3000 bonds
- 10-20 years: 800 bonds
- 20-30 years: 200 bonds

The combination of the rules based upon the bond characteristics and the market activity results in the constituent for the index. Here are some average statistics on the constituents:

Total Number of Bonds:	4000 – 4500
Total Number of Issuers:	~900
Issues per Issuer:	~2.5
Bonds per Issuer:	~5
Par Amount per Issuer:	~145,000,000

Pricing Model

The bonds will be priced at the offered side of the market. Market data from the current business day will be used based upon the following hierarchy:

1. Inter-Dealer Offerings
2. Sale-To-Customer Trades
3. Inter-Dealer Trades
4. Purchase-From-Customer Trades
5. Inter-Dealer Bids

In order to price all of the bonds on the offered side of the market, inter-Dealer Bids and Purchase-From-Customer trades will be adjusted based upon an average bid-ask spread calculated for the index.

Where no market data is available from the current day for a bond, the price from the previous day will be used and adjusted for the average movement of similar bonds in the index with day-over-day market indications. This will prevent bonds with no current data from holding the curve back without having an impact on curve movement. The market data threshold used for choosing the index constituents will guarantee that there are not too many bonds with no current market data under most circumstances.

Lot Size

All market indications with a 10 bond or lower lot size will be excluded from pricing.

Price and Yield Range

Since all of the bonds in the index will be investment grade bonds in a narrow coupon range, all of the prices and yields should be within a reasonable range. The ranges are:

$$70.0 \leq \text{Price} \leq 150.0$$

$$0.0 \leq \text{Yield} \leq 15.0$$

Any market indication that is outside of these ranges will be excluded from pricing.

Outliers

For bonds with more than three market indications for the same day, any market indication with a price that is more than 3 points away from the average will be excluded from pricing.

Customer Sell Orders

Offerings that are marked as customer sell orders will not be included for the purposes of pricing the index constituents. Since not all customer sell orders are marked as such, any offerings with a price or yield and amount that matches a customer sell order will also be excluded.

Bid-Ask Spreads

The bid-ask spread for the index is computed separately for each tenor, from 1 to 30. The bid-ask spread is an un-weighted average of the bid-ask spread from each bond with both a bid and an offer on the same business day from the previous 5 business days. Cases where the data shows an inverted market or where the bid-ask spread is over 100 bps are excluded.

Settlement Assumption

All of the bonds will be assumed to settle on a T+1 basis. Bonds that are traded when-issued will be excluded based upon the monthly market activity requirement.

Benchmark Curve

The benchmark curve is calculated based upon the Curvilinear software library provided by Kalotay Analytics.

Outlier Removal

Outlier points are moved from the curve construction by establishing tolerance bands centered on an initial pass of the curve building algorithm. The tolerance band limits are then scaled

based upon the standard deviation of the data, with a minimum tolerance width of ± 150 bps from the initial curve. Any data points outside of these bands are excluded from the inputs to the curve.

Curve Calculation

The Curvilinear software library is a versatile tool for building a muni yield curve using a nonlinear least square fit to a set of bond yields. The bonds used for building the curve can be both non-callable and callable bonds. This is essential, especially for the long end of the curve, since almost any muni whose maturity is longer than 10 years is callable.

The yield curve is obtained by searching through a universe of possible yield curves for the one that leads to the smallest pricing errors. Each possible yield curve is converted into a discount factor curve, which is used to obtain model prices for the bonds. If a bond is callable, then the bond price is adjusted downward using an OAS valuation model calibrated to the discount factor curve.

The distribution of the market data across the term structure of the curve is not uniform. There is much more data for the short end of the curve than the longer end. In order to effectively represent the market movement for the various regions of the curve, it is built in three sections: 1-10 year, 10-20 years and 20-30 years. This allows the curve to follow the movement of the long end of the curve in

the 25-30 years range with the available market data, without getting impacted by the market movement of the bonds in the 10-15 year range where there is considerably more data.

Stability

There is always a tension between minimizing the pricing error and maintaining the proper shape of the yield curve. If the bonds used for building the curve are concentrated within a narrow range of maturities, then standard methods for building a yield curve can be unstable, leading to unrealistic yield curves.

The unique approach implemented by the Curvilinear library remains stable and produces properly shaped curves under these circumstances. It does this by controlling how many degrees of freedom there are for the family of eligible curves. If prices are noisy and/or available for only a narrow maturity spectrum, then fewer degrees of freedom ensure a properly shaped yield curve that best fits the prices. If there is less noise in the prices and a broad maturity spectrum, then more degrees of freedom allows a much tighter fit to the prices.