S&P Global
Market Intelligence

CONTACT US

**The Americas**
+1 877 863 1306

**Europe,**
**Middle East & Africa**
+44-207-176-1234

**Asia-Pacific**
+852-2533-3565

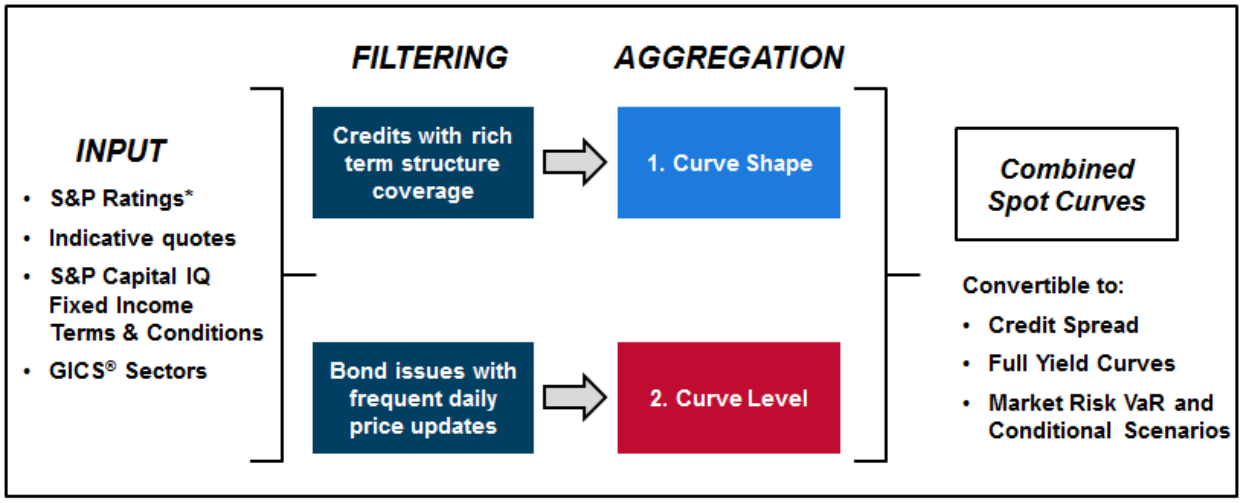
# Corporate Yield Curve Methodology.

## October 2019.

S&P Global Market Intelligence Corporate Yield Curves provide credit spread term structures by currency, sector, and rating using corporate bond quotes. This offering covers histories starting from July 2011 and produces curves daily on an ongoing t+1 basis for USD, EUR, and GBP. The S&P Global Market Intelligence Corporate Yield Curve solution is unique, because it provides the following results in an easily accessible and transparent method:

- Broad and consistent coverage of the credit term structures daily across currency, sector, and rating
- Market relevant and reliable time series that can be used for both price verification and risk management
- Smooth term structure shapes that capture the typical credit market evolution across different credit spread levels
- Turn-key transparency measures published daily with each term structure that provide insight into the underlying quotes that went into calibrating the curve:
    - The actual bonds that were used to build the curve on that day
    - The yield standard deviation of the published curve.

S&P Global Market Intelligence uses the following process flow to achieve a set of technical objectives required to produce rating and sector corporate credit yield curves:




* S&P Global Ratings credit ratings.

The technical objectives are:

- **Level Relevance:** For a particular risk group, the curve provides a relevant estimate of the yield at which the market currently prices the debt of those issuers.
- **No-Arbitrage Condition:** The system of curves should assign a higher yield to a debt with higher probability of default. This means that curves with a higher rating should imply a lower spread than curves with a lower rating.
- **Shape Relevance:** For an individual risk group, the term structure shape will provide an estimate of relative credit spreads for the same issuer across various maturities, covering the range of zero through 30 years. In addition, the credit term structures should exhibit smooth and monotonic z-spread (aka "credit spread") curve shapes.
- **Market Relevant Time Series of Day-to-Day Returns:** For a given risk group, the curve's day-to-day credit spread returns reflect on the current volatility of the credit spread changes observed in the market.

## Shape Process

The process uses a repository of issuer quotes in order to calibrate an analytical scheme that exhibits the observed credit market shape evolution at different levels. Issuer quotes are then selected based on how well they represent credit shapes at different price levels. For shape aggregation a term structure can only be implied by looking at the issuer quotes (i.e. all quotes for a particular issuer).

The shape process relies on the following steps:

- **Issuer Quotes Selection:** Where a repository of recently observed issuer market quotes with representative credit shapes is built. The repository stores all possible issuer term structures that could be used in shape aggregation. Those that are actually selected from the repository need to satisfy additional criteria in order to be admitted:
    - The difference between the maximum and minimum maturity needs to be equal to or greater than one year
    - The greatest number of bonds observed for that issuer concurrently (i.e., all quotes came from the same snapshot day)
- **Shape Aggregation:** An analytical scheme is fitted to the selected set of issuer quotes.

This process will result in two analytical shape schemes; one scheme for Non-Financials and the other for Financials.

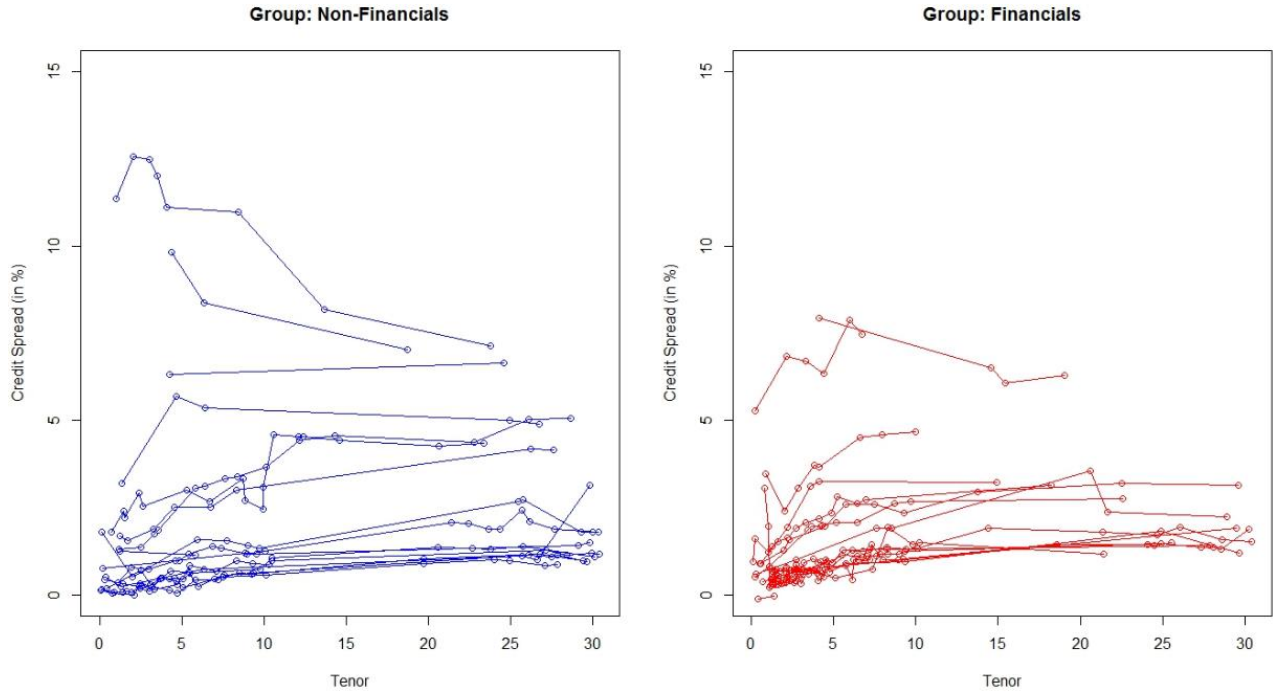
## Issuer Quotes Selection

During this step a process monitors the observed stream of quotes and finds any issuers that are quoted on the same day with a rich sample across the term structure. A rich sample is relative to what is being observed when the shape scheme is being calibrated. It is not an absolute number. If there are multiple candidates, the issuer with the most number of bonds first in order is used. These issuers are then stored in a repository that constitutes a learning sample used to calibrate the analytical shape scheme. The objectives that must be satisfied for a set of issuer quotes to be admitted into this learning sample are:

- The issuers included in the sample should cover all relevant price levels
- Pricing should be recently observed within the last six months, relative to what is being observed within that six month period
- Market quotes for a specific issuer are all observed quotes for that issuer that satisfy the selection criteria in the following order:

- Bond prices cover the widest range of maturities, given by a distance between the shortest and longest maturity quoted
- Further coverage between the minimum and maximum maturities should be densely populated.

An example of this repository for USD Non-Financials and Financials is shown below:

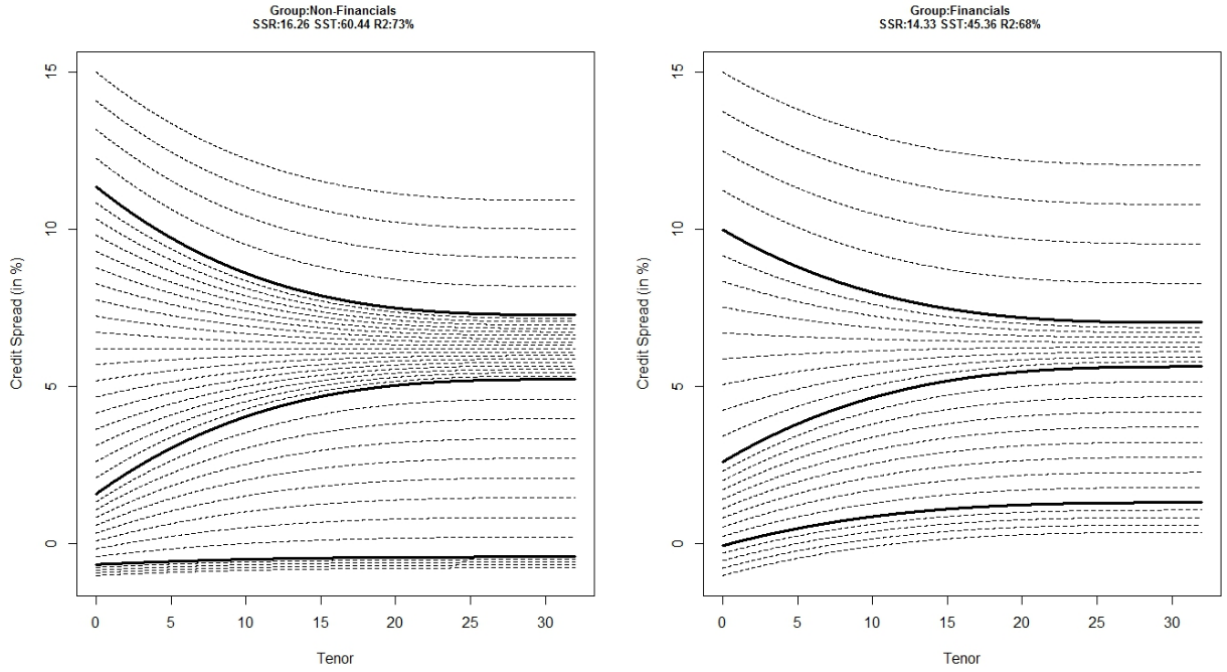



Source: S&P Capital IQ platform, June-December 2013 repository (Non-Financials: Number of Bonds 172, Number of Credits 17; Financials: Number of Bonds 192, Number of Credits 160). For illustrative purposes only.

## Shape Aggregation

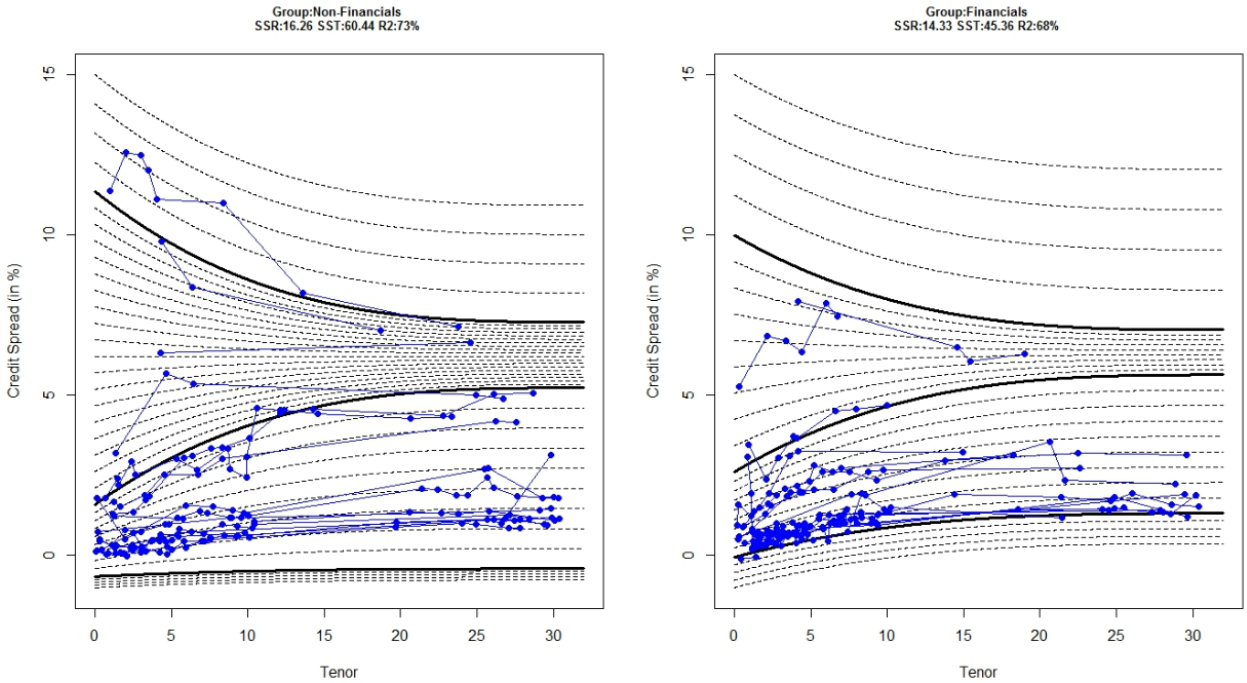
An analytical shape scheme defined by three cubic polynomials is then fitted to each set of selected issuer quotes. This is done using a gradient based root searching algorithm that minimizes the sum of the squared differences between observed yields and the fitted yields and searches simultaneously for 12 degrees of freedom (four per polynomial) that best fits the data. The results are two shapes schemes, one for Non-Financials and another for Financials.

An example of these shape schemes for USD Non-Financials and Financials is shown below:




Source: S&P Capital IQ platform, June-December 2013 repository (Non-Financials: Number of Bonds 172, Number of Credits 17; Financials: Number of Bonds 192, Number of Credits 160). For illustrative purposes only.

The shape scheme below is shown with the underlying bonds from the repository:




Source: S&P Capital IQ platform, June-December 2013 repository (Non-Financials: Number of Bonds 172, Number of Credits 17; Financials: Number of Bonds 192, Number of Credits 160). For illustrative purposes only.

## Level Process

The process fits a curve for each risk group in the sample. For each currency, a risk group is defined as the combination of sector [(10 GICS® Sectors, all Corporates and Non-Financials) and S&P Global Ratings credit ratings (AAA to CCC)]. Bonds are admitted to a risk group based on their issuer's GICS sectors and their issuer's S&P Global Ratings credit rating.

The level process relies on the following steps:

1. Market Activity based selection: Where a bond is admitted into a sample based on its calculated market activity grade
2. Level Aggregation: Where a level that fits the selected risk group sample is found using the corresponding analytical shape scheme

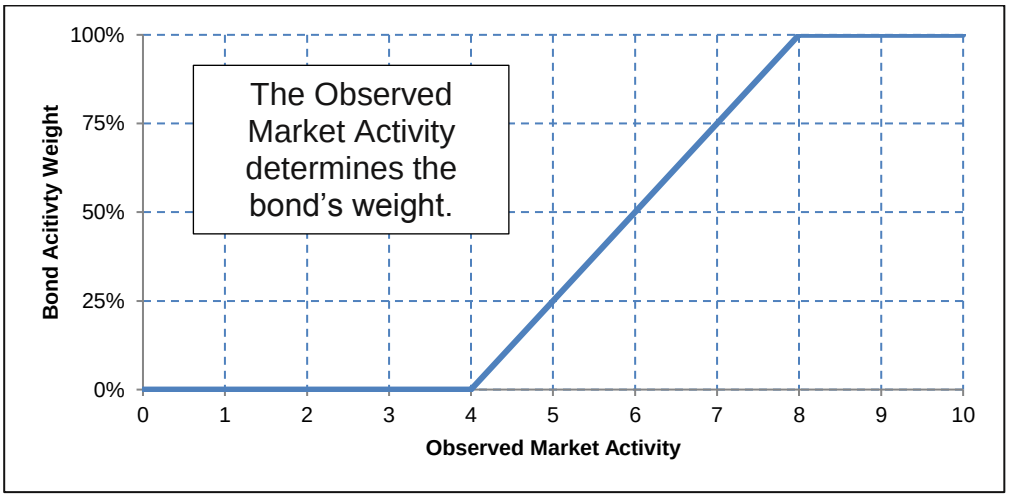
## Market Activity-Based Selection

The motivation for market activity based selection and weighting is that over a series of consecutive days, the bonds may drift in and out of the sample due to changes in quoted patterns. As a result of bonds drifting in an out of the sample, the impact of market activity fluctuations on the aggregate level should be minimized. This is done by admitting a certain set of bonds with a certain market activity threshold and controlling the level aggregation by using liquidity weights where less liquid bond have a lower weighting than more liquid bonds.

A market activity grade is calculated for each bond in the sample as the number of days the bond was observed over the most recent 10 day period. Only bonds that have been observed more than 4 times out of 10 days are admitted into the sample for level calibration.

The market activity grade is converted to an observed liquidity weight via a piecewise linear transformation as:

- Bonds with a grade of 4 and below are given a 0% weight
- Bonds with a grade between 4 and 8 exclusively are given linearly increasing weights with a step size of 25%
- Bonds with a grade of 8 and above are given 100% weight.




Source: S&P Capital IQ platform.

## Level Aggregation

The level aggregation for generating a risk group curve has the following steps:

1. For each bond in that risk group the corresponding analytical shape scheme is used to search for the level that fits that bond yield. For example, for Financials bonds the Financials shape scheme is used and a search is performed for each bond the corresponding level that fits the observed yield. Similarly, for Consumer Staples the Non-Financials shape scheme is used to do the equivalent level search. This is a one dimensional search where the search is for the first factor (level) given the shape of the curve.
2. For that risk group, a set of bond levels results with their corresponding liquidity weights
3. The liquidity weighted trimmed average is used for those bond levels for that risk group to calculate that risk group's overall level
4. That level, along with the corresponding Financials or Non-Financials shape scheme, are used to calculate the full curve for that risk group

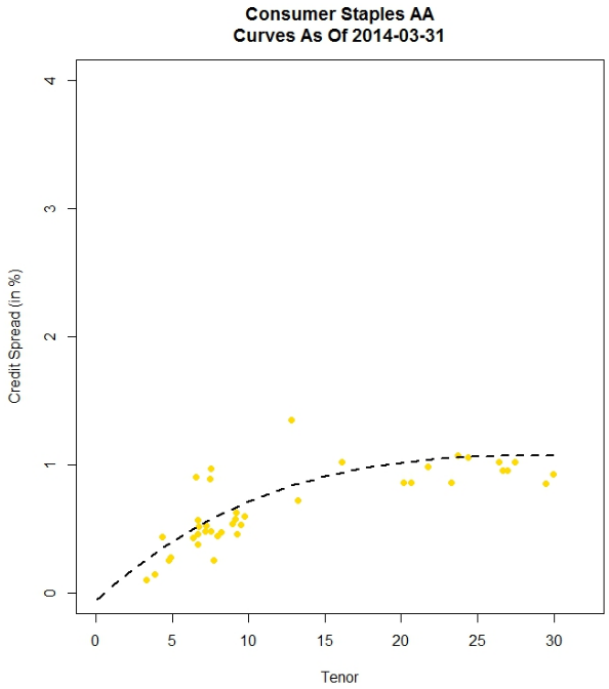
To illustrate this process, two sectors were selected:

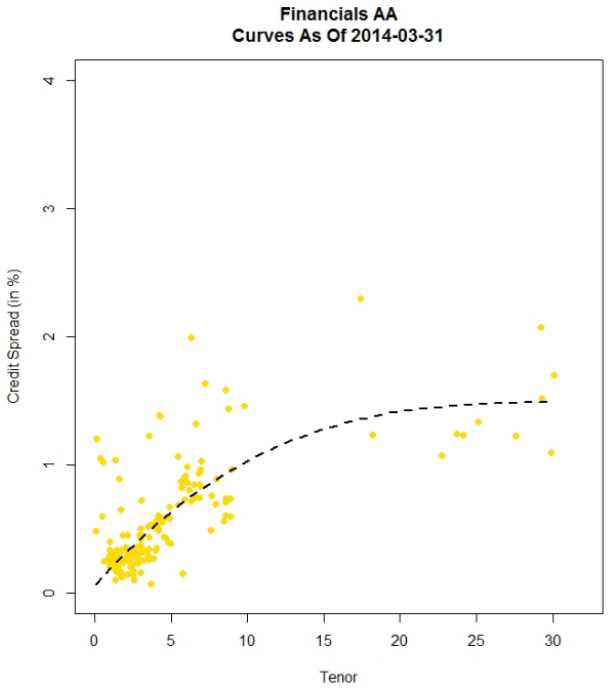
- Financials
- Consumer Staples

The underlying observations for AA, A, and BBB are shown against the calibrated curve using the following sample data:

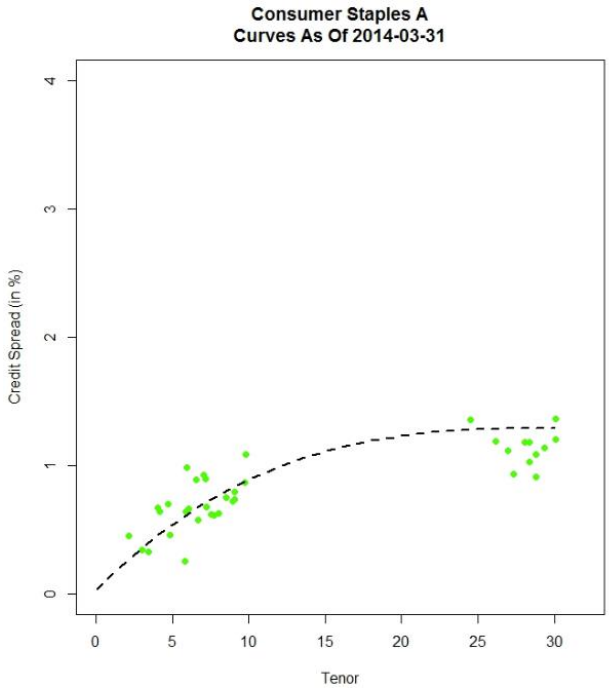
| Sector | Issuers' Rating | Number of Bonds | Number of Issuers |
|---|---|---|---|
| Consumer Staples | AA | 40 | 7 |
| Consumer Staples | A | 37 | 9 |
| Consumer Staples | BBB | 113 | 29 |
| Financials | AA | 158 | 27 |
| Financials | A | 584 | 104 |
| Financials | BBB | 395 | 105 |

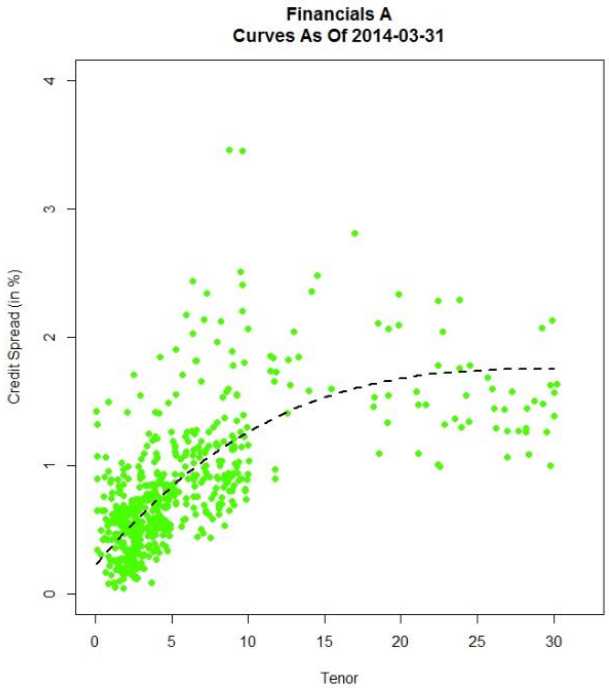
For Illustrative purposes only.



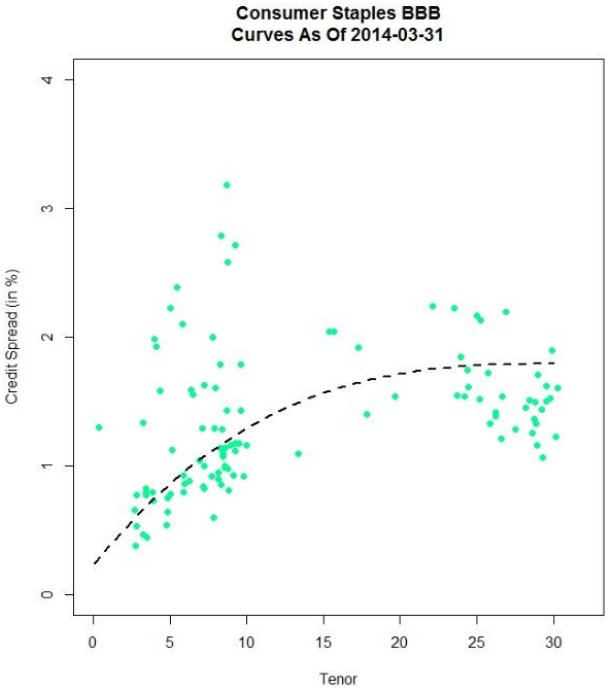



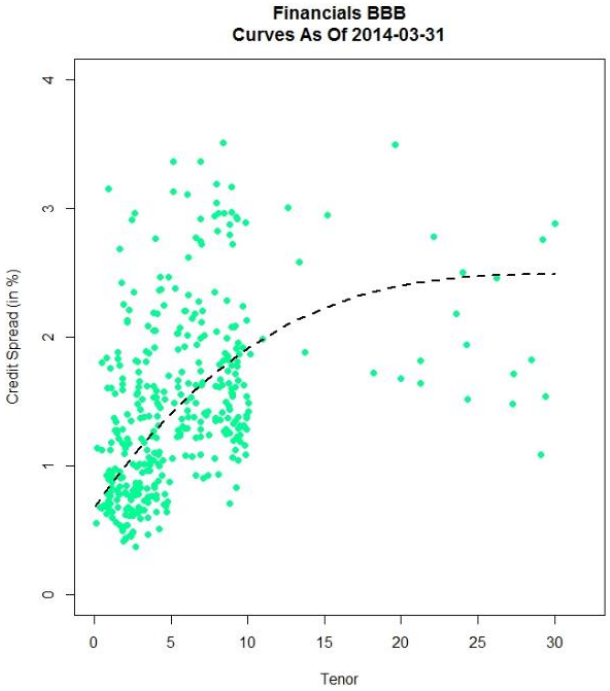

Source: S&P Capital IQ platform, March 31, 2014 bond quotes (Consumer Staples AA: Number of Bonds 40, Number of Credits 7; Financials AA: Number of Bonds 158, Number of Credits 27). For Illustrative purposes only.



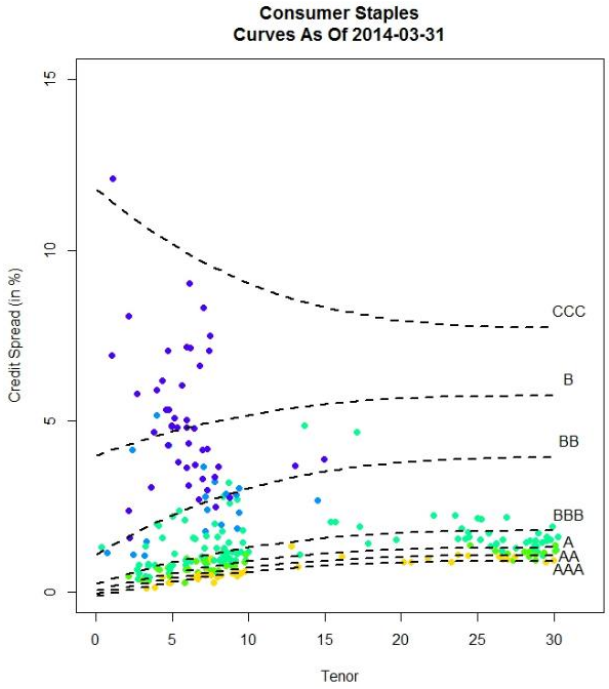

Source: S&P Capital IQ platform, March 31, 2014 bond quotes (Consumer Staples A: Number of Bonds 37, Number of Credits 9; Financials A: Number of Bonds 584, Number of Credits 104). For Illustrative purposes only.

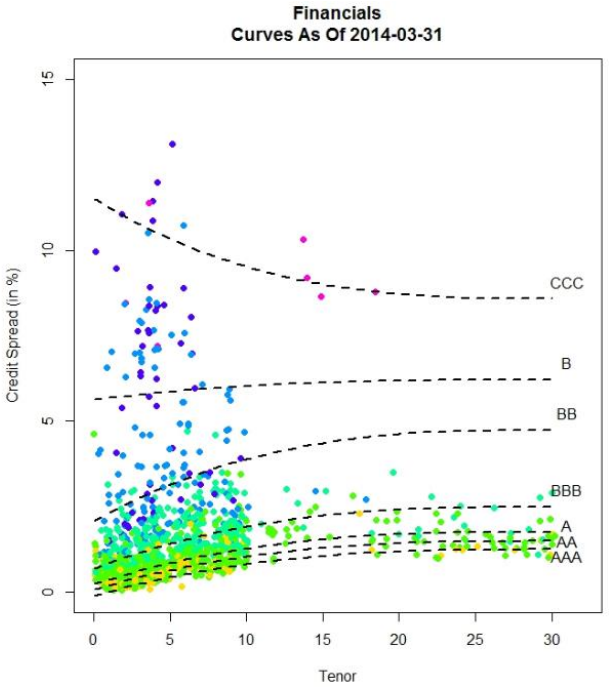



Source: S&P Capital IQ platform, March 31, 2014 bond quotes (Consumer Staples BBB: Number of Bonds 113, Number of Credits 29; Financials BBB: Number of Bonds 395, Number of Credits 105). For Illustrative purposes only.

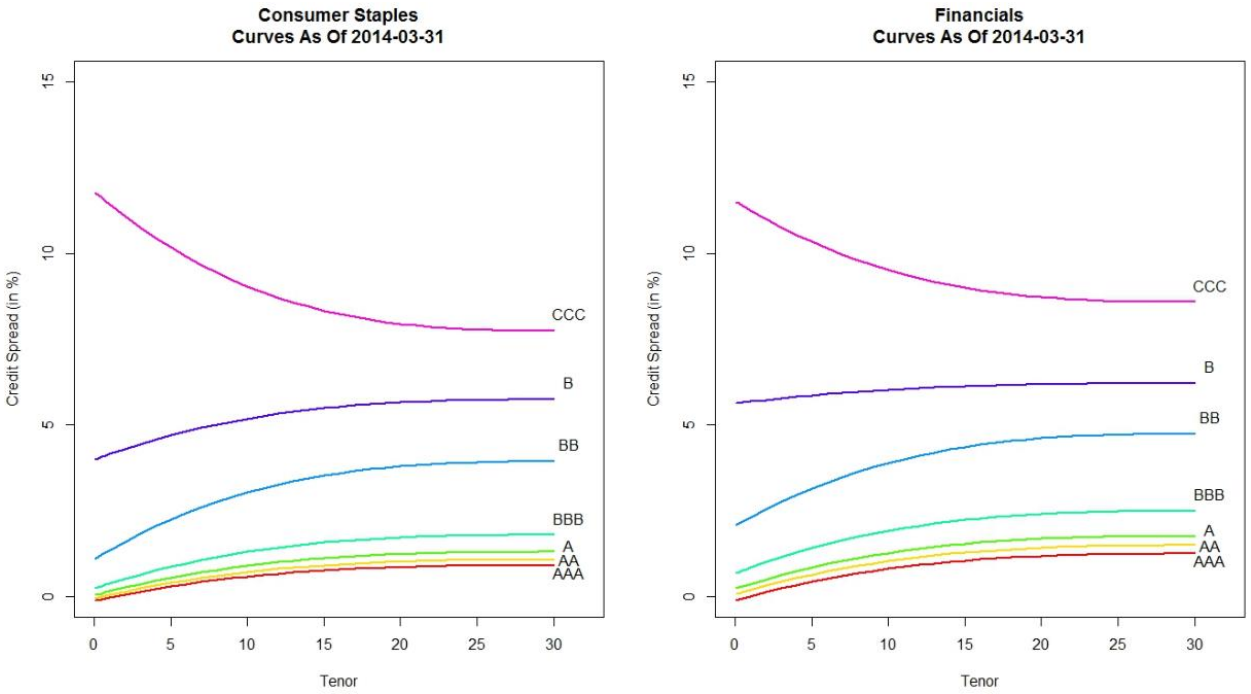
And for all ratings in these sectors:




Source: S&P Capital IQ platform, March 31, 2014 bond quotes (Consumer Staples: Number of Bonds 254, Number of Credits 85; Financials: Number of Bonds 1333, Number of Credits 312). For Illustrative purposes only.

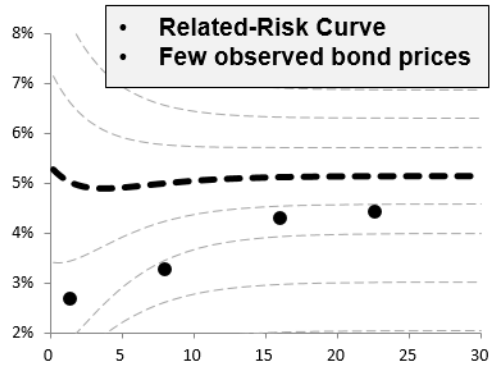
The resulting curves for those two sectors across ratings are shown below:




Source: S&P Capital IQ platform, March 31, 2014 bond quotes (Consumer Staples: Number of Bonds 254, Number of Credits 85; Financials: Number of Bonds 1333, Number of Credits 312). For Illustrative purposes only.

## Illiquid Groups: Curve Derivation Process

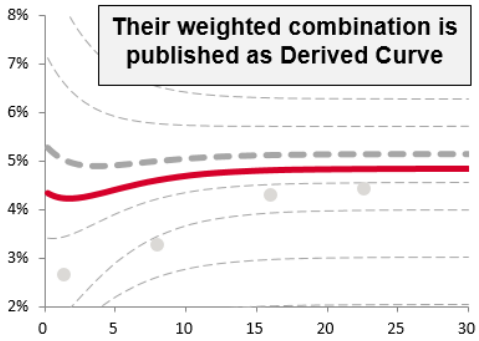
For sparsely populated groups, the curve derivation process will derive the group curve relative to that currency's All Corporates credit curve for that corresponding rating group, by applying a sector basis to the corresponding All Corporates credit curve.




For each illiquid risk group we use a partial derivation to produce a curve

We combine the few if any available observations, with the level calibrated for a related risk groups, e.g., all-corporate AAA group with healthcare sector basis are used to derive healthcare AAA curve, if illiquid.

Source: S&P Global Market Intelligence, September 02, 2019,
For illustrative purposes only.




A group is marked as derived Derived (D), if it has less than 6 bonds available. The derivation starts combining with All Corporates + Sector basis starting from 12 observed bonds or less. When the reliance becomes more than 50% on the sector basis i.e. 6 or less bonds the group curve is marked as Derived (D).

Source: S&P Global Market Intelligence, September 02, 2019,
For illustrative purposes only.

The threshold of 6 bonds is given by the liquidity level at which outliers' identification becomes inconvenient. The remaining data are then blended with a more robust estimator from a higher risk group in order to mitigate the risk of excessive bias. A Derived curve is by more than 50% derived from the higher-risk group rather than from directly observed bond prices.

## Illiquid Groups: Worked Example of Derivation

**Assumptions:**

1. Max Number Bonds to be "fully" observed are 12
2. All instantaneous rates shown are assumed to be continuously compounded
3. Instantaneous rates refer to an infinitesimally small time period
4. All samples here are shown for illustrative purposes only

**Step 1:**

- Determine if there are sufficient observations to proceed with an observed curve.
- In a particular group (currency, sector rating) how many bonds do we have? If >12 bond then proceed as observed with fitting.
- If not then proceed with the derived curve.
- Let's suppose we are trying to build a curve for USD, Healthcare, A where there are 2 bonds.

**Step 2:**

- Calculate the Sector Basis on a particular day.

| Individual Bond Instantaneous Credit Spread | Bond Currency, Sector, Rating | Group Instantaneous Credit Spread | Group Currency, Sector, Rating | Basis |
|---|---|---|---|---|
| 0.95% | USD, Healthcare, A, Bond 1 | 0.50% | USD, All Corporates, A | 0.45% |
| 0.98% | USD, Healthcare, A, Bond 2 | 0.50% | USD, All Corporates, A | 0.48% |
| 1.00% | USD, Healthcare, BBB, Bond 3 | 1.00% | USD, All Corporates, BBB | 0.00% |
| 2.00% | USD, Healthcare, BBB, Bond 4 | 1.00% | USD, All Corporates, BBB | 1.00% |
| 3.00% | USD, Healthcare, BB, Bond 5 | 2.00% | USD, All Corporates, BB | 1.00% |

| | | | | |
|---|---|---|---|---|
| 3.10% | USD, Healthcare, BB, Bond 6 | 2.00% | USD, All Corporates, BB | 1.10% |
| | | | **Sector Basis** | **0.67%** |

- Sector basis is a trimmed average of Basis.
- If there are insufficient observations on that day, use the last observed sector basis across time.

**Step 3:**

- Calculate the "derived" level for the concerned group.

| | |
|---|---|
| Group Instantaneous Credit Spread for Group Currency, Sector, Rating : USD, All Corporates, A | 0.50% |
| Sector Basis (Healthcare) | 0.67% |
| **Group Level implied from All Corporates (addition of above)** | **1.17%** |

**Step 4:**

- Calculate the "observed" level within the concerned group, if available.

| Bond Currency, Sector, Rating | Individual Bond Instantaneous Credit Spread |
|---|---|
| USD, Healthcare, A, Bond 1 | 0.95% |
| USD, Healthcare, A, Bond 2 | 0.98% |
| **Group level implied from observed bonds (trimmed average of above)** | **0.97%** |

**Step 5:**

- Calculate the final derived level for concerned group.

| | Spread | Number of Bonds | Weight |
|---|---|---|---|
| Group Level implied from All Corporates | 1.17% | 10 | 10/12 |
| Group level implied from observed bonds | 0.97% | 2 | 2/12 |
| **Published Instantaneous Derived Credit Spread for USD, Healthcare, A (sum-product of spread and weight)** | **1.137%** | | |

**Step 6:**

- Use the Instantaneous Credit Spread from Step 5, and calculate the full term structure via the shape scheme like any other curve.
- Please note, if there are no bonds in the group (in this case USD, Healthcare A) then step 3 will be Not Available and of course the Weight for "Group level implied from observed bonds" will be 0.
- **So the final curve for USD, Healthcare, A will be: 1.17%**
    - i.e. Only Group Level implied from All Corporates

**FAQ**

1. What is the bond selection criteria?
    - The bond selection criteria are:
        - The bond must have a price that has been observed more than four times in the last 10 days.
        - The bond's currency must be in the selected group currency.
        - The bond must have a fixed rate coupon
        - The issuer must have an Long Term rating from S&P Global Ratings
        - The issuer must have a GICS sector classification

2. What bond prices are used for Corporate Yield Curves?
    - We use Mid Bond Prices in percent of PAR terms.

3. Are the published group curves based on geography?
    - No the constructed group curves are strictly by currency, not geography.
    - Clients can create their own custom curves that can be done by geography (or any other segmentation) using the "Corporate Yield Curves" excel template in the "Custom Curves" tab.