MORNINGSTAR®

Morningstar Fixed-Income Style Box™
Methodology

Morningstar
Feb. 22, 2022

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Introduction

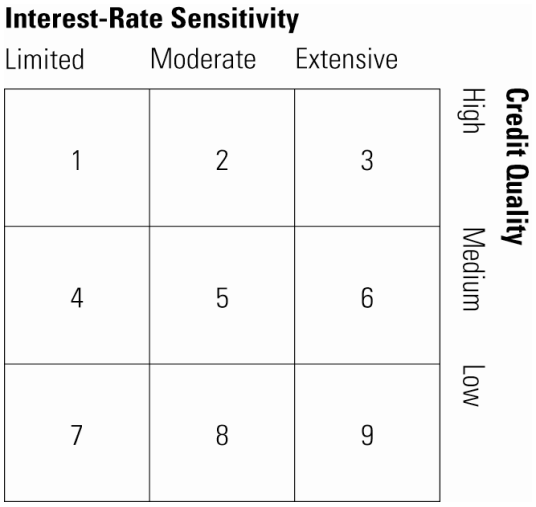
The Morningstar Style Box was introduced in 1992 to help investors and advisors determine the investment style of a fund. Different investment styles often have different levels of risk and lead to differences in returns. Therefore, it is crucial that investors understand style and have a tool to measure their style exposure. The updated Morningstar Fixed-Income Style Box provides an intuitive visual representation of style that helps investors build better portfolios and monitor them more accurately.

Morningstar classifies bond funds in its style box according to interest-rate sensitivity and credit quality. The classifications for interest-rate sensitivity are *Limited, Moderate,* and *Extensive*, while the credit classifications are *High, Medium,* and *Low*. The two sets of classifications produce nine possible combinations, each of which corresponds to one of the nine coordinate squares of the Morningstar Fixed-Income Style Box, in which interest-rate sensitivity is represented by the horizontal axis and credit quality the vertical. The specific placement of a fund provides a description of the qualitative style and is an effective method for determining a peer group of comparable investment alternatives.

The methodology used to calculate the average credit quality of a fund is changing with this update. Also changing is the methodology for determining the average rating symbols represented by each of the three credit classes. Finally, a new element is introduced that will determine if a fund has sufficient credit information to qualify for the calculation of an average and the dependent assignment of a style-box classification.

Fixed-Income Style Box Overview

The model for the fixed-income style box is based on two fundamental pillars of fixed-income investment performance: interest-rate sensitivity and credit quality. As depicted in the visualization, the three interest-sensitivity classifications are Limited, Moderate, and Extensive, while the three credit-quality classifications are High, Medium, and Low. The average value of a portfolio's duration and credit rating are used to provide a combined representation of the two exposures, resulting in assignment to one of the nine coordinate square locations.



Note: For a style box to be assigned to a fund, both the average interest-rate sensitivity and credit quality must be available.

Horizontal Axis: Interest-Rate Sensitivity

Classification is determined by a combination of the average interest-rate sensitivity of the fund, measured by duration, the fund's country of domicile, and the category to which it is assigned.

All U.S. taxable-bond category funds also domiciled in the United States use a dynamic index benchmark methodology, while all others use static duration value ranges.

U.S. taxable-bond funds domiciled in the U.S. are benchmarked to the Morningstar Core Bond Index, or MCBI. Classification is dependent on the fund's duration relative to the index's duration.

- Limited: 25% to 75% of MCBI
- Moderate: 75% to 125% of MCBI
- Extensive:125% of MCBI (no upper limit on long-term durations)

By using the MCBI as the duration benchmark, the classification boundary values fluctuate in step with the market, which minimizes market-driven classification changes.

Non-U.S. taxable-bond funds domiciled in the US use static duration breakpoints. These include U.S.-domiciled funds in the world bond Morningstar Category and emerging-markets bond Morningstar Category. These thresholds are:

- Limited: <= 3.5 years
- Moderate: > 3.5 and <= 6.0 years
- Extensive: > 6.0 years

Municipal-bond funds domiciled in the U.S. also use static duration breakpoints. These thresholds are:

- Limited: <= 4.5 years
- Moderate: > 4.5 and <= 7.0 years
- Extensive: > 7.0 years

All non-U.S.-domiciled funds also use static duration breakpoints. These thresholds are:

- Limited: <= 3.5 years
- Moderate: > 3.5 and <= 6.0 years
- Extensive: > 6.0 years

Vertical Axis: Credit Quality

Classification of a fund is determined by the average credit quality and the specific rating values allowable for each of the three classes. The average credit quality of a fund is calculated by Morningstar from information provided by asset managers through the Credit Quality Breakdown described below. The methodology used to calculate the average, which is changing with this update, is described herein. Also changing is the methodology for determining the average rating symbols represented by each of the three credit classes. A new element will determine if a fund has sufficient credit information to qualify for the calculation of an average and the dependent assignment of a style-box classification.

Average Credit Methodology

The new methodology being introduced has significant differences from the previous version. The key elements of revision are:

- The method of transformation of alphabetic rating symbols to numeric values for the purpose of quantifying an average value
- The method for treating the portion of a portfolio for which there is no credit-rating information available, represented as Not Rated in the Credit Quality Breakdown
- Introduction of a minimum threshold of completeness (credit rating coverage) for an average to be calculated

Linear Numeric Transformation

To calculate an average from the portfolio weights reported in the Credit Quality Breakdown, the rating symbols (AAA, AA, and so on) must first be converted to numeric equivalents. Taken together, the entirety of a set of credit rating symbols is known as a *rating scale*. Morningstar uses a rating scale with 27 distinct values as the basis of numeric transformation. The numeric transformation is structured as a linear function with all rating symbols having a possible integer value of 1 to 27. Because the Credit Quality Breakdown uses a subset of only seven of the 27 available rating symbols in the complete scale, they are mapped and assigned numeric values as follows:

Exhibit 1 Numeric Transformation

Credit-Quality Breakdown Symbol	Full Rating Scale Symbol	Numeric Value
AAA	AAA	1
	AA+	2
AA	AA	3
	AA-	4
	A+	5
A	A	6
	A-	7
	BBB+	8
BBB	BBB	9
	BBB-	10
	BB+	11
BB	BB	12
	BB-	13
	B+	14
B	B	15
	B-	16
	CCC+	17
	CCC	18
	CCC-	19
	CC+	20
Below B	CC	21
	CC-	22
	C+	23
	C	24
	C-	25
	SD	26
	D	27

Source: Morningstar. Note: For Credit Quality Breakdown ratings AA to B, the mapping is to the middle value of the full rating scale's applicable level values. For Below B, the mapping is to the midpoint of the combined CCC/CC/C rating values.

Treatment of Not Rated and Determination of Minimum Coverage Threshold

In addition to the seven credit rating values described above, a portfolio may include holdings for which there is no credit rating information available. These holdings and their weights are assigned to the Not Rated category of the Credit Quality Breakdown.

A key difference between this new methodology and the previous one is how Not Rated is treated. Previously, a low-quality rating level (either B or BB, depending on fund category) was assigned to the portion of the portfolio that was submitted as Not Rated. The assigned rating was then used as an input for the calculation of the average rating. One result of this approach is that every portfolio for which data was submitted received a style box assignment, even if the entire portfolio consisted of Not Rated.

A different approach is taken in the new methodology. Rather than making a rating assignment for the Not Rated portion, it is treated as an unknown and lacking information to be used for the calculation of the average. To manage the potential impact of the Not Rated weight, a minimum threshold of coverage is employed to ensure that the calculated average is meaningful and has an appropriate level of completeness:

Minimum Threshold of Coverage: Not Rated <= 10%

If the weight of Not Rated exceeds the maximum allowable value (10%), then no average credit value will be calculated and the fund cannot qualify for calculation of a style box placement. Stated differently, unless 90% of the portfolio has credit rating information available, the calculated average is deemed to be insufficient and will be suppressed, resulting in a failure to calculate a placement.

Numeric Average Calculation

For portfolios where Not Rated meets the required minimum coverage level, a numeric average is calculated by dividing the sum of the product of each rating category weight by the numeric rating value and then dividing by the sum of rated weights.

*Average Numeric Rating = SUM(Product of numeric rating values * weights)/ SUM(rated weights)*

Including each numeric rating value:

*Average Numeric Rating = SUM[(AAA weight * 1)+ (AA weight * 3)+ (A weight * 6) + (BBB weight * 9)+ (BB weight * 12)+ (B weight * 15)+ (Below B weight * 21)] / SUM(AAA weight+ AA weight+ A weight+ BBB weight+ BB weight+ B weight+ Below B weight)*

The resulting average numeric value reflects only the portion of the portfolio that has rating information and thus is rescaled to exclude the portion that is Not Rated. Rescaling impacts are minimized by the application of the 90% minimum coverage threshold.

Reconversion of Numeric Value to Rating Symbol

Assignment of a fund to a style box credit class is based on rating symbols rather than numeric value. This requires a remapping of the numeric average value back to a rating symbol. Although the input numeric rating values from the Credit Quality Breakdown are integers, the average numeric value is likely to be decimal. Given the granularity afforded by the numeric average calculation, remapping is made using the full 27-level rating scale. Because each rating symbol is represented by an integer value, a rounding methodology is required for averages with decimal values. The mapping methodology incorporates a conservative "rule of two thirds" when determining the breakpoint boundary value for rounding up or down between each of the 27 rating symbols.

Numeric Rounding Methodology

If the decimal value is greater than two thirds of the difference between the lesser and greater integer values representing the rating symbols, the higher-quality rating symbol is assigned; if equal to or less than two thirds, the lower-quality symbol is assigned.

Exhibit 2 Mapping Numeric Average to Rating Symbol

Rating Symbol	Maximum Numeric Value
AAA	<1 1/3
AA+	<2 1/3
AA	<3 1/3
AA-	<4 1/3
A+	<5 1/3
A	<6 1/3
A-	<7 1/3
BBB+	<8 1/3
BBB	<9 1/3
BBB-	<10 1/3
BB+	<11 1/3
BB	<12 1/3
BB-	<13 1/3
B+	<14 1/3
B	<15 1/3
B-	<16 1/3
CCC+	<17 1/3
CCC	<18 1/3
CCC-	<19 1/3
CC+	<20 1/3
CC	<21 1/3
CC-	<22 1/3
C+	<23 1/3
C	<24 1/3
C-	<25 1/3
SD	<26 1/3
D	27

Source: Morningstar.

The result of the new average credit methodology will be the assignment of one of 27 potential rating symbols so long as the minimum coverage threshold is met.

Assignment of Average Rating Symbol to Credit Classification

The mapping of the 27 possible rating symbols to the three credit classifications is based on two primary objectives. First is to maintain coherence with the widely adopted practice of splitting the credit rating scale into two distinct credit grades—investment grade and high yield. Because this perspective is so pervasive, the adoption of the style box promotes interoperability with existing information available to investors. For this reason, the Low credit classification will align with the common definition of high yield, which is also consistent with the previous methodology. The second goal is to make a qualitative differentiation between High and Medium meaningful from the perspective of the respective number of

funds assigned to each. To do so, Morningstar considers that it should be more difficult for a fund to qualify for the High than the Medium classification.

Determination of Low Classification

The common definition of high-yield ratings are those lower in quality than the BBB (or equivalent) rating level. Mapping to the full rating scale, the following will be assigned to the Low class:

Exhibit 3 Low Classifications

Rating Symbol	Credit Classification
BB+	Low
BB	Low
BB-	Low
B+	Low
B	Low
B-	Low
CCC+	Low
CCC	Low
CCC-	Low
CC+	Low
CC	Low
CC-	Low
C+	Low
C	Low
C-	Low
SD	Low
D	Low

Source: Morningstar.

Determination of Boundary Between High and Low Classifications

While the definition of ratings included in the Low class is straightforward and based on widely accepted market convention, there is not an equivalent template for determining whether a fund should be assigned to either the High or Medium class. Using a guiding principle of reserving the high-quality classification as a more exclusive assignment, an analysis of the distribution of fund assignments using different ratings was undertaken. A meaningful breakpoint was determined to be between the AA and AA- ratings, resulting in the distribution of a greater number of funds to Medium than to High, as intended.

Exhibit 4 Boundary Between High and Low Classifications

Enumeration	Style Box Category
AAA	High
AA+	High
AA	High
AA-	Medium
A+	Medium
A	Medium
A-	Medium
BBB+	Medium
BBB	Medium
BBB-	Medium

Source: Morningstar.

Source of Input Data

The fixed-income style box is calculated from information provided to Morningstar by asset managers via a standardized survey, which is generally submitted on a monthly or quarterly schedule. It is intended to apply to portfolios in the fixed-income and allocation categories.

In some cases where a fund consists of underlying funds-—rather than individual securities—as holdings and the underlying funds have the requisite duration and credit information provided by the asset manager, Morningstar will calculate a "rolled-up" style box based on the weight of the underlying funds and their respective input values.

Finally, for funds domiciled in Canada, asset managers do not provide duration or credit information to Morningstar. To produce the style box for Canadian funds, Morningstar instead uses the duration and credit rating values of the portfolio holdings to produce the aggregate measures of average duration and credit breakdown. These values are then used, applying the same methodology described herein.

Credit Quality Breakdown

Credit quality is represented as a distribution of holding weights for each of eight common credit rating categories as applicable. The weight totals are intended to sum to 100% and are to be rescaled as necessary to reflect only the portion of a portfolio that is fixed income.

Example credit-quality breakdown:

Exhibit 5 Credit-Quality Breakdown

AAA	AA	A	BBB	BB	B	Below B	Not Rated	Total
71.72	3.91	7.08	9.49	1.44	0.98	0.00	5.38	100.00

Source: Morningstar.

The credit information submitted is required to be based on credit ratings produced by established, regulatory designated credit rating agencies such as those in the United States that are recognized as NRSROs by the Securities and Exchange Commission. Proprietary or internally assigned ratings are not allowed.

The chosen ratings represent broad rating levels rather than the more granular "notched" levels widely produced by credit rating agencies. The rating symbols used are intended as generic values that can be directly mapped to any specific symbology used by different credit rating agencies, although they most closely approximate those used by Standard & Poor's. Below is an illustration of rating symbols from Moody's and S&P mapped to each other.

Exhibit 6 S&P's and Moody's Symbols

S&P	Moody's
AAA	Aaa
AA	Aa2
A	A2
BBB	Baa2
BB	Ba2
B	B2

Source: Morningstar.

In assigning ratings to portfolio holdings, Morningstar guidance is that, when ratings are available from multiple rating agencies, a conservative methodology commonly used by index providers is to be adopted: For cases where there are three distinct ratings available, use the middle-quality rating (dropping the highest and lowest ratings); if two different ratings are available, use the lower rating; if only one agency rates a holding, then use that rating. For cases where there is not a rating available from any agency, the holding is classified as Not Rated.

Average Effective Duration

Morningstar asks fund companies to calculate and send average effective duration (also known as *option-adjusted duration*) for each of their fixed-income or allocation funds. Morningstar asks for effective duration because that measure typically gives the best estimation of how the prices of bonds with embedded options, which are common in many mutual funds, will change as a result of changes in interest rates.

Effective duration models optionality features such as expected mortgage prepayments or the likelihood that embedded call options will be exercised. If a fund holds futures, other derivative securities, or other funds as assets, the aggregate effective duration should include the weighted impact of those exposures. Standard practice for calculating this data point requires determination of a security's option-adjusted spread, including the use of option models or Monte Carlo simulations, as well as testing of interest-rate scenarios. Morningstar requests that funds only report data in this field that has been specifically labeled as effective or option-adjusted duration or that the fund is certain has been calculated in the fashion described.

Morningstar categorizes any fixed instrument with less than 92 days to maturity as cash for the purposes of calculating a fund's asset-allocation breakdown. These short-term fixed securities and other cash instruments are to be included in the calculation of effective duration.

Morningstar accepts surveys returned with modified duration (if no effective duration is provided) for U.S.-domiciled funds in the municipal and high-yield categories and for all non-U.S.-domiciled fixed-income funds except those in convertible-bond categories. Surveys for all other U.S. bond categories that lack a submission for effective duration will not be accepted as an input for style box calculation.

Modified duration is generally defined as the approximate percentage change in a bond price for a 100-basis-point change in yield, assuming that the bond's expected cash flows do not change when the yield changes. Modified duration works well as an estimator for modest interest-rate shifts that occur over a short period of time for bonds without embedded options.

Bonds with embedded options are quite common, particularly in the U.S., making even the simplest callable bond a potential roadblock to the use of modified duration. However, in Europe, such concerns are much less of an issue. Morningstar will accept modified duration when effective duration is not provided.

Morningstar will not accept modified duration for funds in convertible-bond categories, as the interest-rate sensitivity of a convertible bond depends on the value of its embedded option. If convertibles trade at distressed prices (its option is said to be *deep out of the money)*, the price of the convertible bond will be driven mainly by the probability of default of the company and therefore will be minimally sensitive to change in interest rates. If the option is slightly *out of the money* or *at the money*, the convertible bond will trade like a corporate bond and may be highly sensitive to changes in interest rates. If the option is *in the money* or *deep in the money*, the bond will trade more like an issuer's underlying equity, such that its value will be almost equal to the underlying equity plus the time value of the embedded option. In this case, the bond becomes nearly insensitive to interest-rate changes. Modified durations assume that an instrument's sensitivity to interest rates depends exclusively on the schedule of coupon payments. Because the sensitivity to interest rates for a convertible bond depends on whether its option is in the money or out of the money, as well as the price of the underlying stock, Morningstar cannot rely on modified duration as a reasonable measure of convertible-bond interest-rate risk.

Exhibit 7 Credit Rating Scale Comparison

Morningstar Credit Quality Breakdown	Full Morningstar Rating Scale	DBRS Morningstar	Moody's	S&P	Fitch	Numeric Value
AAA	AAA	AAA	Aaa	AAA	AAA	1
	AA+	AA (high)	Aa1	AA+	AA+	2
AA	AA	AA	Aa2	AA	AA	3
	AA-	AA (low)	Aa3	AA-	AA-	4
	A+	A (high)	A1	A+	A+	5
A	A	A	A2	A	A	6
	A-	A (low)	A3	A-	A-	7
	BBB+	BBB (high)	Baa1	BBB+	BBB+	8
BBB	BBB	BBB	Baa2	BBB	BBB	9
	BBB-	BBB (low)	Baa3	BBB-	BBB-	10
	BB+	BB (high)	Ba1	BB+	BB+	11
BB	BB	BB	Ba2	BB	BB	12
	BB-	BB (low)	Ba3	BB-	BB-	13
	B+	B (high)	B1	B+	B+	14
B	B	B	B2	B	B	15
	B-	B (low)	B3	B-	B-	16
	CCC+	CCC (high)	Caa1	CCC+		17
	CCC	CCC	Caa2	CCC	CCC	18
	CCC-	CCC (low)	Caa3	CCC-		19
	CC+	CC (high)				20
Below B	CC	CC	Ca	CC	CC	21
	CC-	CC (low)				22
	C+	C (high)				23
	C	C	C	C	C	24
	C-	C (low)				25
	Sd				RD	26
	D	D	D	D	D	27

Source: Morningstar.

For More Information

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