

Morningstar Fixed Income Exposure Analysis Methodology

Morningstar Research and Data Methodology

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Important Disclosure

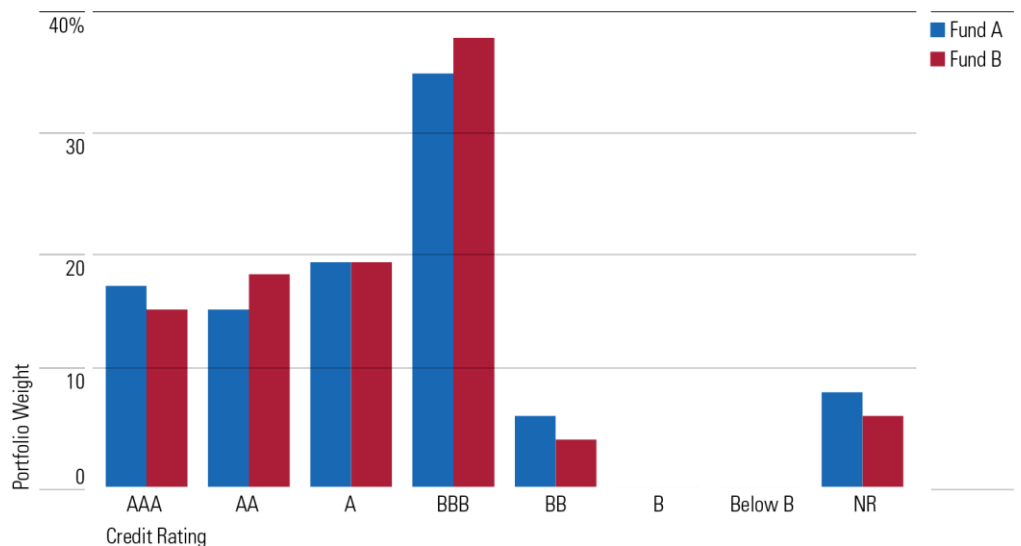
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Introduction

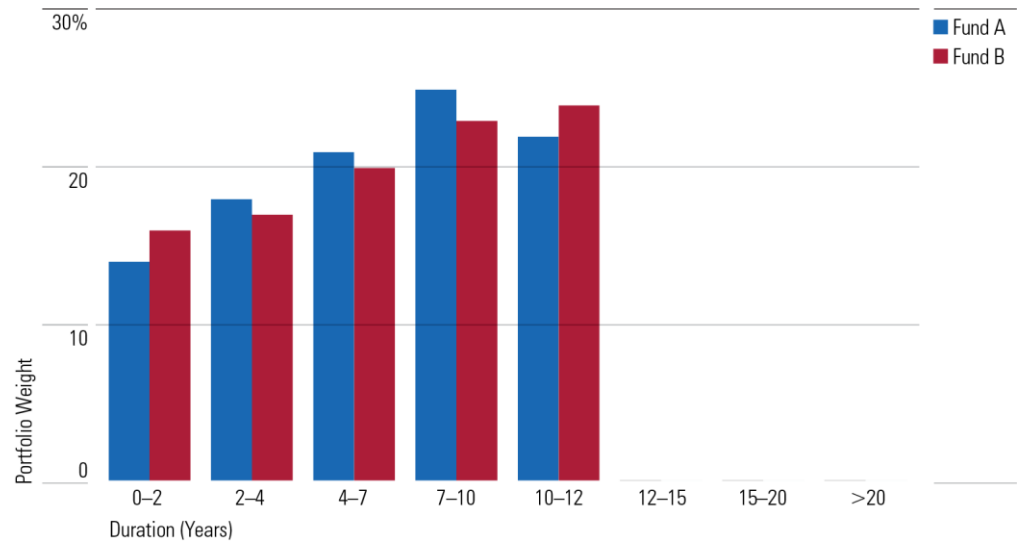
Fixed income risk has a way of embedding itself in unexpected places. Nonetheless, it’s important for investors to have a clear and complete picture of risk to understand their investments and achieve their desired outcomes.

One common tool for assessing risk is a “portfolio breakdown” analysis, where different sources of risk are broken out into smaller pieces and displayed based on their weightings in a portfolio. While such breakdowns can provide valuable insights into various portfolio risks, they don’t always tell the whole story. Take, for example, the comparison below of two hypothetical funds. Their basic breakdowns of credit rating and duration (a common measure of interest-rate sensitivity) seem to suggest similar risk profiles.

Exhibit 1 Credit Rating Breakdown



Source: Hypothetical example.

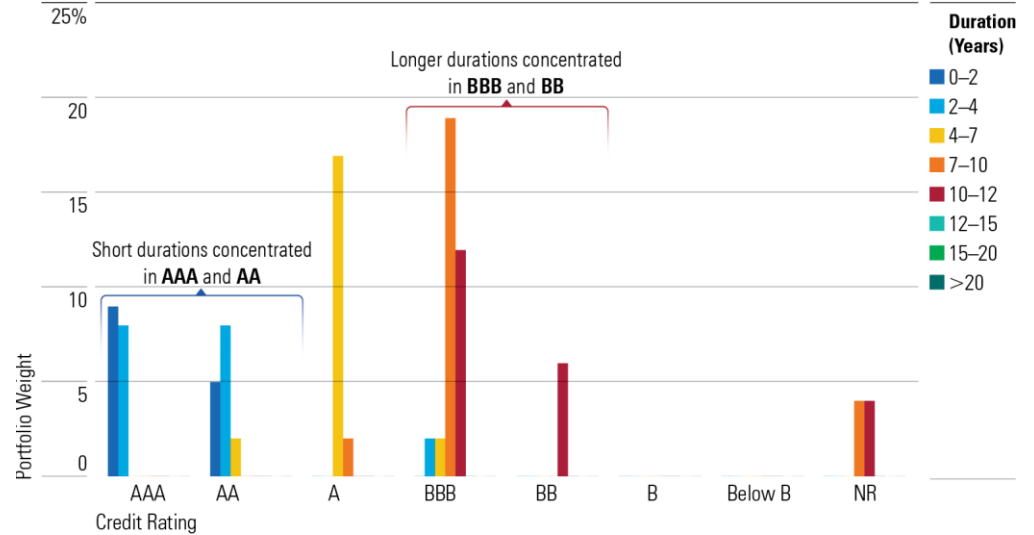
Exhibit 2 Duration Breakdown

Source: Hypothetical example.

These two breakdowns show both funds having very similar weighted distributions for both of these key fixed income risk attributes, which might lead one to the reasonable conclusion that each has similar levels of credit and interest-rate risk. However, this would overlook an important consideration that investors need to understand. What's missing is how the two risks are related. Single-attribute breakdowns like these, while valuable summary tools, cannot illuminate how different types of risks intersect.

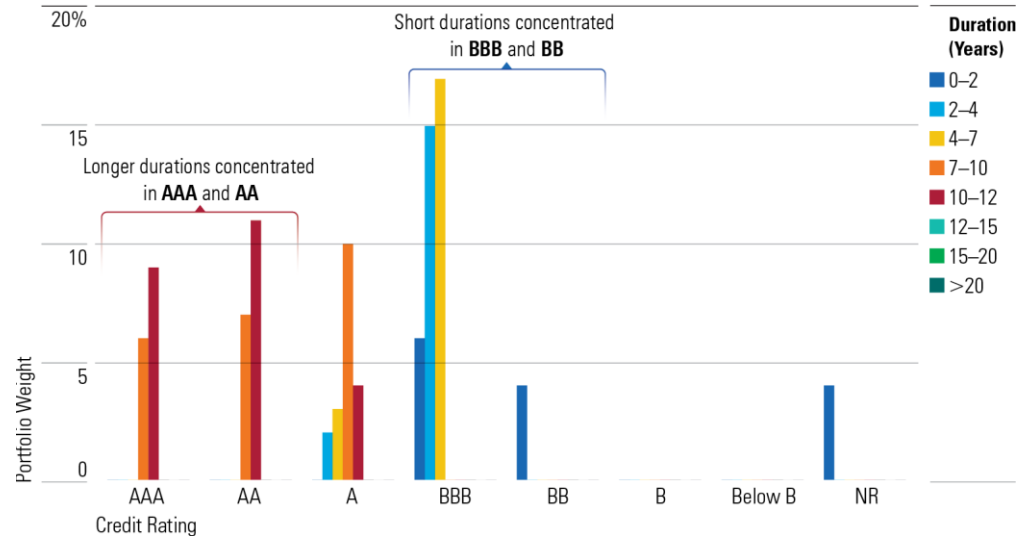
When we combine the credit rating and duration values for these two funds, a different picture emerges.

Exhibit 3 Fund A Credit by Duration



Source: Hypothetical example.

Exhibit 4 Fund B Credit by Duration



Source: Hypothetical example.

Seeing how the credit rating and duration values intersect for each fund provides a new level of understanding of their risk profiles. Lower credit ratings and longer duration values generally indicate greater risk exposure, so holdings possessing both are inherently riskier. Holdings with better credit

quality and longer duration or lower credit quality and shorter duration are relatively less risky, assuming the probability of default is lower over the short term.

In this example, Fund A's lower-quality holdings are also those more sensitive to interest-rate risk, boosting the portfolio's overall risk. Fund B balances these risks somewhat through the combination of less credit risk when duration risk is higher, and vice versa. Hence, despite the similarities in these funds' basic single-level breakdowns, it becomes clear when the attributes are combined that the two funds have different types of risk exposures and would likely perform quite differently in varying market conditions.

Investors need this ability to analyze multiple attributes in combination, in addition to single-attribute breakdowns, to be able to accurately assess whether an investment will meet their requirements and expectations. Meeting this need is the genesis for developing Morningstar's new *Fixed Income Exposure Analysis* tool.

Morningstar Fixed Income Exposure Analysis—Empowering Risk and Return Analysis

Fixed Income Exposure Analysis, or FIEA, represents a new capability enabling users to more effectively analyze fixed income portfolios. It's built upon a framework in which users can select portfolio characteristics, labeled "attributes," and their underlying values to create breakdowns. The breakdowns can then be combined to identify where they have commonalities, described as their "intersections." Intersections can then be measured in five different ways, each providing a different analytic perspective, labeled "exposures."

By allowing the combination of attribute breakdowns and multiple exposure perspectives, FIEA gives users more detailed information to understand how risks are related and how they may be concentrated or balanced in a portfolio. This powerful tool can reveal more precise insights into contributors of risk and return, allowing for more meaningful differentiation between fixed income investment alternatives and assessment of fit for an investor's portfolio.

Holdings-Based Analytics

Understanding how risks intersect at a portfolio level depends upon understanding how each individual holding contributes to any given risk. This requires identifying the attributes each holding possesses and the significance of each holding relative to the overall portfolio. Attribute values can be assigned to, or calculated for, each holding. These assignments can then be quantified at a portfolio level by aggregating them according to the relative weight of each holding. Aggregation and quantification of holding risks to portfolio level is known as "holdings-based analytics," or HBA. By enabling precise risk assignment and quantification through holding-weighted aggregation, a robust analysis of portfolios is possible.

For more details on Morningstar's holdings-based calculation methodology, click [here](#).

Attributes

FIEA includes multiple attributes that can be combined and analyzed. The initial release of the tool includes the following attributes, with the expectation that additional attributes will be added in the future:

- ▶ Effective Duration
- ▶ Modified Duration
- ▶ Effective Maturity
- ▶ Yield to Maturity
- ▶ Credit Rating
- ▶ Super Sector
- ▶ Primary Sector
- ▶ Secondary Sector
- ▶ Economic Development
- ▶ Region
- ▶ Country

Combining Attributes–Portfolio Intersections

FIEA allows users to generate multilevel breakdowns for up to six attributes at once (three at the column level and three at the row level), providing a deep view into how attributes are interrelated within a portfolio. Each intersection represents the portion of a portfolio in which the various attribute value conditions, as defined by their underlying breakdowns, are met. In the example below, the highlighted intersection represents holdings with an attribute value of A for credit rating and an attribute value of 1%-2% for yield.

Exhibit 5 Portfolio Intersections

	⌵ Total	Negative	0 to 0.5%	0.5 to 1%	1 to 2%	2 to 3%	3 to 4%	4 to 5%	5 to 6%
⌵ Total	100.00	11.81	10.01	3.19	17.16	7.27	6.92	6.72	6.85
1 AAA	51.36	9.78	9.69	2.41	14.36	4.49	2.90	1.14	3.68
2 AA	3.51	0.54	–	0.00	0.09	0.01	0.44	0.09	0.14
3 A	5.27	–	–	0.15	0.27	0.96	0.27	0.24	0.68
4 BBB	23.24	–	0.07	0.64	0.90	1.14	2.07	4.07	2.09
5 BB	7.24	–	0.04	–	0.81	0.35	1.00	0.82	0.23
6 B	0.00	–	–	–	–	–	0.00	–	–
7 Not Rated	9.37	1.49	0.21	–	0.74	0.32	0.23	0.36	0.02

Source: Morningstar Direct.

Measuring Intersections—Exposure Types

Portfolio attributes can be grouped into three primary types:

- ▶ Numeric values, such as duration
- ▶ Coded symbology, such as credit ratings
- ▶ Classifications, such as sectors

Depending on the type of attribute, intersections can be measured in different ways, called exposure types. FIEA allows five distinct exposure types. Some of them are available for all attribute types; others are available only for numeric attributes, when calculations are possible.

Exposure Type Definitions

The following table describes these different exposure types:

Exhibit 6 Exposure Types

Applicability	Exposure Type	Definition	Formula
All	Portfolio Weight	The portion of portfolio assets represented by the intersection, expressed as a percentage.	SUM of holding weights meeting attribute conditions
	Count	The number of holdings represented by the intersection, expressed as a number.	COUNT of holdings meeting attribute conditions
Numeric Only	Weighted Exposure	A modification of Portfolio Weight adjusted based on an attribute, calculated by multiplying holding weight by the attribute's numeric value and expressed as a percentage.	SUM of weighted calculation value of holdings meeting attribute conditions divided by
		For example, this may show that x% of a portfolio's total duration comes from a certain geographic region.	SUM of all weighted calculation values regardless of attribute
	Contribution	The portion of a numeric attribute's total value represented by the intersection, expressed as a number with units determined by the attribute type. For example, this may show that x years of a portfolio's average duration come from a certain sector.	SUM of weighted calculation value of holdings meeting attribute conditions
Average	The average value represented by the intersection, expressed as a number with units determined by attribute type.	SUM of weighted calculation value of holdings meeting attribute criteria divided by SUM of holding weights meeting attribute conditions	

Prioritization of Attributes—Choosing the Basis

Calculating these intersections and exposures in FIEA requires designating one of the multiple attributes on which to base the calculations. This is necessary for two reasons: to define which exposure types are applicable to any chosen combinations and to determine the weight of each holding. In FIEA, this determination is called the “attribute basis,” or “basis” for short. The attribute basis must be defined in order to successfully generate analytics.

As previously noted, not all exposure types are applicable to all attributes. FIEA requires that a numeric attribute be used as the basis for generating any of the numeric exposure types. In cases where users are combining more than one numeric attribute, the choice of attribute basis defines which of them will be reflected in the exposure values.

Determining Holding Weight—Attribute Basis Weighting

To fully understand how attribute basis affects the exposure calculations, a note about calculating holding weight is required. Conceptually, portfolio holding weight is the percentage of value a holding represents relative to the entire portfolio. It is the result of dividing the holding value by the portfolio value:

$$\blacktriangleright \text{Portfolio Holding Weight} = \text{Holding Value} / \text{Portfolio Value}$$

This calculation requires a way to measure the total portfolio value (in other words, to determine which portfolio holdings will be part of the denominator). For the purpose of FIEA, because the focus is on sources of fixed income risk, any holdings not falling into the fixed income asset class are excluded, a methodology referred to as “Asset Class Rescaling.”

$$\blacktriangleright \text{Fixed Income Holding Weight} = \text{Fixed Income Holding Value} / \text{Fixed Income Portfolio Value}$$

Even within the fixed income portion of a portfolio, however, not all attributes apply to all holding types. Certain holding types may contain credit risk but not duration risk or vice versa—for example, credit default swaps do not have interest-rate durations associated with them. Carrying the concept of asset class rescaling to its logical conclusion, for any attribute calculated through holdings-based analysis, the holding weight should be determined by only those holdings capable of contributing to a particular risk. Thus, holding weights can differ by attribute, a methodology called “Attribute Basis Weighting.”

$$\blacktriangleright \text{Attribute Basis Holding Weight} = \text{Attribute-Eligible Holding Value} / \text{Attribute-Eligible Portfolio Value}$$

Attribute basis becomes important with FIEA because the possibility exists of a combination including holdings that possess one risk without the other. FIEA calculates holding weights based upon the assignment of a primary attribute, which is used to define the “Attribute-Eligible Portfolio Value” denominator.

Summary

Fixed income investors can find their portfolios exposed to many different types of risk. These risks can affect whether their investment objectives are achieved. Portfolio breakdowns are a traditional means of analyzing risk. They have a critical shortcoming, however, in that they hide the way individual risks are interrelated.

FIEA solves for this shortcoming by combining attribute breakdowns and calculating related risks. The relationships between different risk types are revealed, allowing investors to understand with greater precision and detail the contributors of risk and return that have an impact on portfolio performance.

FIEA allows users to choose the combinations they want to analyze and calculates the intersections between the risks. Intersections can be presented through a variety of exposures types, providing further lenses through which to analyze risk and return contribution.

In these ways, FIEA provides investors with a rich palette of information with which to make informed investment decisions. For the first time, the interplay of fixed income risks within a portfolio are clearly accessible and can be used to differentiate between investment alternatives. ■■■

Fixed Income Exposure Analysis Key Concepts

Holdings-Based Analytics

- ▶ Each holding in a portfolio contains inherent attributes that can be identified and assigned.
- ▶ Portfolio risks can be calculated by aggregating the holding-weighted attribute values.

Attributes

- ▶ Attributes are types of portfolio characteristics affecting fixed income investors.
- ▶ Attributes are specific to the risk being measured and can be classifications, coded symbols, or calculated numeric values.
- ▶ Attribute values often represent a numeric range of risks that are presented ordinally from lesser to greater.
- ▶ Attribute analytics are commonly presented as portfolio breakdowns—the distribution of portfolio weight across categorical values of an attribute.

Combining Attributes—Portfolio Intersections

- ▶ Because holdings possess multiple attribute values, it is possible to quantify combinations of attributes through holdings-based aggregation.
- ▶ When multiple holdings have the same specific value categories for multiple attributes, they share a commonality, which is called an intersection of the attributes.
- ▶ Intersections combine different breakdowns to identify how risks are related within a portfolio.
- ▶ Intersections provide critical information on how attributes can jointly affect portfolio performance so overall relative risk may be different than it appears when analyzed by a single attribute.

Exposure Types

- ▶ FIEA provides five distinct measures of portfolio intersections called exposure types.
- ▶ Each exposure type presents a specific analytic perspective about an intersection.
- ▶ These different lenses help investors better understand how the intersecting risks are related.
- ▶ Some exposure types are dependent on an attribute value being numeric.

Fixed Income Attribute Basis Weighting

- ▶ Only the portfolio holdings that are considered fixed income are included for determination of holding weight.
- ▶ Not all fixed income holdings possess all fixed income attributes.
- ▶ Because a user may choose a combination of attributes that don't apply to all holdings, a decision must be made on how to determine the holding weight by defining the denominator logic.

About Morningstar® Fixed Income Data and Analytics

The Morningstar Fixed Income Data and Analytics team produces information that fixed income investors use to make informed decisions. Our solutions cover individual securities, managed investment products, portfolios, and markets.

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