The credit spread barbell: Managing credit spread risk in pension investment strategies

When constructing a liability-hedging portfolio for their pension plan, sponsors should consider the funding status risk posed by credit spread volatility in both plan assets and plan liabilities.

Credit spread risk between pension assets and liabilities can’t be eliminated entirely, thanks to the non-investable nature of the pension liability and the scarcity of, and issuer concentration in, Aa-rated corporate bonds. It can, however, be mitigated.

The best way to do this is by carefully balancing the plan’s fixed-income exposure between securities of lower credit quality (rated A and Baa) and those of higher quality (rated Aaa); we describe this approach as a “credit spread barbell.”

The appropriate balance for any given portfolio will depend on several factors, including the extent to which the portfolio also invests in return-seeking assets.

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Introduction

Many corporate pension plan sponsors have become familiar with liability-hedging assets—investments selected to track the movement of a pension liability value as tightly as possible. Generally, the greater a plan’s allocation to liability-hedging assets, the lower its funding status risk.

When constructing a liability-hedging portfolio, most plan sponsors think first of how to optimize the portfolio’s interest rate exposure (i.e., its duration) relative to the pension liability.1 They’re less likely to consider how best to optimize the portfolio’s credit spread exposure relative to the pension liability—but a successful liability-hedging strategy takes both factors into consideration.

A recent Vanguard research note (Bosse and Paradise, 2017) discusses one interesting aspect of credit spread risk for a corporate pension plan, which is that the same downgrade or default that can push down a bond portfolio’s value can at the same time push up the pension liability’s value.

But there’s more: Even in a market environment with few or no downgrades or defaults, unexpected changes in the level of credit spreads—caused by changes in the market’s perception of future default or liquidity risk—can materially affect a pension plan’s funding status.

In this paper, we briefly explore the nature of credit spread risk (including, among other types, default and downgrade risk). We then discuss how a portfolio can be constructed using a credit spread barbell approach to mitigate a plan’s spread risk exposure.

How do credit spreads affect pension liabilities?

Credit spread is the additional yield required by investors, compared to that offered by an otherwise identical U.S. Treasury security, for a bond perceived to be at risk of default. Figure 1 lists the range of credit ratings assigned by Moody’s Investors Service to high-quality (investment-grade) bonds, together with some relevant market statistics.

Pension plans subject to U.S. corporate pension accounting standards determine their liability values using discount rates derived from market yields on Aa-rated corporate bonds. Both the publicly available Citigroup Pension Discount Curve and the proprietary Vanguard Pension Discount Curve use this bond universe as their starting point.2 Because of this association, pension liabilities used for financial reporting are seen as being “Aa-like”—that is, tightly correlated with the Aa-rated corporate bond market.

### Figure 1. Not all investment-grade bonds are created equal

<table>
<thead>
<tr>
<th>Credit rating</th>
<th>Annual global default rate, weighted by issuer, 1983–2016 (%)</th>
<th>Corporate bond market weight as of June 30, 2017 (%)</th>
<th>Corporate bond average spread as of June 30, 2017 (in basis points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>0.000</td>
<td>2</td>
<td>65</td>
</tr>
<tr>
<td>Aa</td>
<td>0.023</td>
<td>10</td>
<td>66</td>
</tr>
<tr>
<td>A</td>
<td>0.059</td>
<td>39</td>
<td>88</td>
</tr>
<tr>
<td>Baa</td>
<td>0.189</td>
<td>49</td>
<td>137</td>
</tr>
</tbody>
</table>

**Notes:** The annual global default rate calculation accounts for defaults of all magnitudes (i.e., regardless of recovery rate). The corporate bond market weight calculation uses the Bloomberg Barclays U.S. Corporate Bond Index. The corporate bond average spread calculation uses the Bloomberg Barclays U.S. Corporate Bond Index option-adjusted spread. An option-adjusted spread may include compensation for additional risks beyond default risk—liquidity risk, for example. For the sake of simplicity, however, we use the terms credit spread and option-adjusted spread interchangeably in this paper. A basis point is 1/100 of a percentage point.

**Sources:** Moody’s Investors Service and Bloomberg.

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1 See Bosse (2018) for further discussion.

2 See Dutton and Gazzolo (2017) for further information.
So why not invest exclusively in Aa-rated bonds?

For Aa-like pension liabilities, wouldn’t the ideal liability-hedging portfolio consist entirely of Aa-rated corporate bonds? On the contrary: Despite its appeal in theory, this approach is basically unheard of in practice, because it is seen as both impractical and undesirable:

- **Impractical**: As indicated in Figure 1, Aa-rated bonds make up only 10% of the total U.S. corporate bond market. This low percentage precludes widespread adoption of Aa-only liability-hedging portfolios. As of December 31, 2016, the total market value of Aa bonds with more than 10 years to maturity was $137 billion, while the total market value of total investable U.S. corporate pension assets was $3.3 trillion.3 Moreover, insurance companies and pension funds tend to be buy-and-hold investors of high-quality, long-duration bonds.

- **Undesirable**: Even if a sponsor could build a liability-hedging portfolio using only Aa-rated corporate bonds, holding such a portfolio would likely not be an optimal approach. This is because of the inherent issuer concentration risk, which stems from the small number of corporate bond issues currently rated Aa. Using the Bloomberg Barclays bond rating rules as of June 30, 2017, we find that only 104 corporate issues have Aa ratings. Moreover, the top four issuers of Aa-rated bonds (General Electric, Apple, Wal-Mart, and Shell) account for an eye-popping 64% of the market value of the entire Aa-rated universe. Thus, the holder of an all-Aa-rated bond portfolio is likely to be exposed to significant idiosyncratic risk to single issuers—and that idiosyncratic risk is unlikely to precisely match the issuer-specific risk inherent in the pension liability value.

The barbell strategy uses a broader bond universe

If an all-Aa liability-hedging portfolio is typically neither feasible nor desirable, how can a pension sponsor best manage credit spread risk? Our analysis indicates that a barbell approach to managing credit spread risk—that is, maintaining a balanced exposure between investment-grade bonds with credit quality *above* (e.g., Aaa) and *below* (e.g., A or Baa) the liability’s implied Aa rating—may be a practical approach that suitably dampens credit spread risk relative to the liability.

The market views investment-grade bonds with credit ratings of A or Baa as having greater default risk than Aa-rated bonds, although, as indicated in Figure 1, historical default rates for these bonds have been relatively modest on average. Because of this perception, these bonds have a higher credit spread (which can be viewed as desirable, since it translates to higher expected yield, even net of expected defaults) than Aa bonds. Conversely, bonds rated higher than Aa, including Aaa-rated corporates as well as U.S. Treasury bonds, have lower credit spreads, or none at all.

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Of course, there’s a trade-off for higher expected yield. As one might infer from Figure 2, bonds with higher spread levels also have higher spread volatility. In describing these relationships, we sometimes say that the movement of credit spreads is “accordion-like,” as when credit spreads rise (often during equity market downturns), they tend to fan out, with Baa spreads moving further than Aa spreads.

Because of this “accordion-like” relationship between various credit spreads, using a combination of higher- and lower-quality bonds—the aforementioned barbell strategy—results in a portfolio that may track well with a pension liability measured using Aa rates.

Consider three otherwise identical bonds: one Baa corporate, one Aa corporate, and one Treasury, each with a duration of 12 years. Now consider an event where Baa credit spreads suddenly widen by 75 basis points (i.e., 0.75%) while Aa spreads widen 50 basis points. The value of the Baa bond will decline by approximately 9%, that of the Aa bond will decline by about 6%, and the Treasury bond will not decline in value. This is, of course, a simplified scenario that ignores such considerations as the difference in starting yield between the three bonds. Even so, it illustrates the math behind the barbell approach to managing credit spread risk in pension plans.

Putting the barbell strategy into practice

The following scenarios show how this barbell approach might work in practice, and how the optimal mix between corporate and Treasury bonds depends on the overall asset allocation.

One important note: In practice, Vanguard attends to both interest rate risk and credit spread risk when constructing liability-hedging portfolios for our pension clients. For the analysis below, however, we chose to sidestep the duration decision so that we could stay focused on the sector and quality composition of the liability-hedging portfolio. To allow for this, we built a customized liability returns history whereby all of the bond portfolios roughly match the pension liability’s duration. In other words, we took steps to minimize (but not completely eliminate) mismatch between asset and liability returns stemming from duration differences.

We also assumed that the pension liability is 100% funded (as measured under U.S. corporate pension accounting standards).

Figure 2. Between 2007 and 2017, corporate credit spreads showed ‘accordion-like’ movement several times

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Notes: Data are for the period January 1, 2007, through June 30, 2017. A basis point is 1/100 of a percentage point. Source: Bloomberg.

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4 For the period January 1, 2007, through June 30, 2017, the annualized standard deviation for the Bloomberg Barclays U.S. Corporate Bond Index (segregated by credit quality) was as follows: Aaa, 72 basis points (bps); Aa, 82 bps; A, 100 bps; Baa, 123 bps. Source: Bloomberg.
Scenario 1: Corporate and Treasury bonds; no equity
First, we consider a portfolio consisting solely of investments benchmarked to the Bloomberg Barclays U.S. Long (10+ Years) Corporate Index and the Bloomberg Barclays U.S. Long (10+ Years) Treasury Index. As illustrated in Figure 3, our analysis indicates that a mix of approximately 70% corporate bonds and 30% Treasury bonds maximizes historical correlation to monthly returns on our pension liability. The inherent spread risk of the Long Corporate Index—as of June 30, 2017, 49% of the index was in Baa-rated securities—is balanced by a 30% allocation to Treasury bonds, which have no credit spread risk. The specific weighting of 30% to Treasury bonds does not appear to have any unique magic to it, as Treasury weightings between 20% and 40% generate similar historical return correlations.

Figure 3 also shows how the historical correlations change if Baa-rated securities are removed from the liability-hedging portfolio. For a number of reasons, it is common for sponsors to reduce or eliminate a pension plan’s exposure to Baa-rated bonds in a liability-hedging portfolio. Excluding the Baa-rated bonds—the most volatile from a credit spread perspective—reduces the overall credit spread volatility of the corporate bond portfolio; thus, a lower concentration of Treasury bonds is needed to maximize the historical correlation to monthly liability returns. This analysis identifies the optimal mix between A or better rated corporate bonds and Treasury bonds as approximately 80%/20%, but we believe that a Treasury weighting anywhere between 10% and 30% would provide substantially similar results.

Figure 4 shows the portfolio weights (by sector and credit quality) of the two portfolios identified as optimal in Figure 3, along with the all-Aa bond portfolio that, as we noted earlier, is impractical and undesirable for most pension investors. Figure 4 illustrates a barbell approach that incorporates both bonds that are rated above Aa and bonds that are rated below Aa. This is the approach that our analysis suggests is suitable for a corporate pension sponsor.

Notes: We used the Bloomberg Barclays U.S. Long (10+ Years) Corporate Index to model corporate bonds and the Bloomberg Barclays U.S. Long (10+ Years) Treasury Index to model Treasuries. We measured all historical correlations in these scenarios using monthly returns from December 31, 2000, through June 30, 2017, a period that both includes the two major market downturns of the 2000s and corresponds to the longest period for which returns data are available for all indexes used in this analysis. We also measured historical correlations using different lengths of returns history, obtaining substantially similar results for all time horizons of at least three years that ended June 30, 2017. The dots indicate, roughly, the maximum y-value (maximum correlation) for each line.
Source: Vanguard calculations, based on data from Bloomberg.

Figure 3. Using Treasury bonds to balance credit spread risk

![Figure 3](image)

Notes: We used the Bloomberg Barclays U.S. Long (10+ Years) Corporate Index to model corporate bonds and the Bloomberg Barclays U.S. Long (10+ Years) Treasury Index to model Treasuries. We measured all historical correlations in these scenarios using monthly returns from December 31, 2000, through June 30, 2017, a period that both includes the two major market downturns of the 2000s and corresponds to the longest period for which returns data are available for all indexes used in this analysis. We also measured historical correlations using different lengths of returns history, obtaining substantially similar results for all time horizons of at least three years that ended June 30, 2017. The dots indicate, roughly, the maximum y-value (maximum correlation) for each line.
Source: Vanguard calculations, based on data from Bloomberg.

Figure 4. The credit spread barbell approach

![Figure 4](image)

Notes: We used the Bloomberg Barclays U.S. Long (10+ Years) Corporate Index to model corporate bonds and the Bloomberg Barclays U.S. Long (10+ Years) Treasury Index to model Treasuries.
Source: Vanguard calculations, based on data from Bloomberg.
**Scenario 2: Corporate and Treasury bonds, including equity exposure**

Scenario 1 assumes that the pension plan’s entire portfolio is invested in liability-hedging assets. Currently, that is rarely the case for U.S. corporate plans—most plans maintain an equity allocation in hopes of generating additional returns and reducing funding deficits for the plan over the long term. (This is why equities in pension plans are often called “return-seeking assets.”)

For this reason, we next add an equity allocation to the previous analysis in increments of 10% (6% domestic and 4% international) to see how historical correlations are affected for different mixtures of corporate and Treasury bonds.

Interestingly, we find that each incremental increase in equity allocation significantly reduces the optimal weighting of corporate bonds in the liability-hedging portfolio, as illustrated in Figure 5. This movement is a logical result of the relationship between equity returns and changes in credit spreads. When the market’s outlook on the future of the U.S. economy dims, credit spreads typically increase (reducing the value of corporate bonds, all else being equal) and equity markets typically fall. Thus, to maintain an optimal historical correlation to pension liability returns, any added equity risk exposure should be balanced by a commensurate trimming of exposure to corporate bonds.

In fact, if the sole objective is to maximize correlation with historical returns on our sample pension liability, and if the allocation to equity is at least 40% (which, again, is common in today’s environment), then the optimal allocation to corporate bonds is … zero! Indeed, our analysis suggests that under such conditions, a liability-hedging portfolio made up entirely of Treasury bonds maximizes historical correlation with the pension liability.

Before rushing to sell completely out of corporate bonds, though, pension plan sponsors should keep in mind two things:

- First, when at least 40% of a pension portfolio is allocated to equities or other return-seeking assets, it is extremely unlikely that the plan sponsor’s primary objective is to optimize correlations with pension liability returns. A pension sponsor with a significant equity allocation instead signals that maximizing long-term portfolio return is likely a key consideration in their investment strategy—in which case it may not make sense to replace all corporate bonds with Treasury bonds.

**Figure 5. Treasury bonds can be used to balance credit spread and equity risk**

![Figure 5](image-url)

Notes: We used the Dow Jones U.S. Total Stock Market Float Adjusted Index to model domestic equity and the MSCI All Country World Index ex-US to model international equity. All equity allocations are assumed to be 60% domestic and 40% international. We used the Bloomberg Barclays U.S. Long (10+ Years) Corporate Index to model corporate bonds and the Bloomberg Barclays U.S. Long (10+ Years) Treasury Index to model Treasuries. The dots indicate, roughly, the maximum y-value for each line. We measured all historical correlations in these scenarios using monthly returns from December 31, 2000, through June 30, 2017, a period that both includes the two major market downturns of the 2000s and corresponds to the longest period for which returns data are available for all indexes used in this analysis. We also measured historical correlations using different lengths of returns history, obtaining substantially similar results for all time horizons of at least three years that ended June 30, 2017.

Source: Vanguard calculations, based on data from Bloomberg, Dow Jones, and MSCI.
Second, note that, as Figure 5 shows, as equity allocations increase from 0% to 40%, the correlation curve drops and flattens. As we mentioned earlier, the drop in the curve means that correlations with liability returns weaken as equity allocation increases. The flattening of the curve means that the corporate/Treasury weighting decision becomes less meaningful overall as equity allocation increases. In other words, when there is significant equity exposure, choosing between corporate and Treasury bonds may not move the needle much in terms of overall tracking of pension liability returns.

Practically speaking, Vanguard does often recommend that its pension clients increase exposure to Treasury bonds when there is a significant equity allocation—though, for reasons noted above, we suggest a less drastic increase than is indicated by the model. Often, when liability-hedging assets make up no more than half of the total pension portfolio, we will recommend that 40% to 50% of those liability-hedging assets be allocated to Treasury bonds.

Summary
For pension plan sponsors managing a liability-hedging portfolio, several insights from our analysis may prove useful:

- Liability-hedging portfolios can be constructed using a mix of corporate and Treasury bonds to mitigate a pension plan’s exposure to credit spread risk.
- The optimal mix between corporate and Treasury bonds likely depends on the credit rating composition of the corporate bond portfolio—for instance, the extent to which Baa-rated bonds are included in the corporate bond portfolio—as well as the concentration of other asset classes such as domestic and international equity.
- While a pension plan sponsor should take the liability’s implied credit spread risk exposure under consideration when constructing a liability-hedging portfolio, a perfect match is likely impossible to achieve in practice. This is because correlations—including both the relationship between various levels of credit spreads and the relationship with returns in other markets—are dynamic and will change over time.

References

Notes on risk
All investing is subject to risk, including possible loss of principal. Past performance does not guarantee future results. When interest rates rise, the price of a bond or bond fund will decline. Bonds are subject to credit risk and inflation risk. Credit risk is the risk that a bond issuer will fail to make timely payments of interest and principal. Inflation risk is the possibility that increases in the cost of living will decrease or eliminate the returns of an investment. Because high-yield bonds are considered speculative, investors should be prepared to assume a substantially greater level of credit risk than with other types of bonds. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

U.S. government backing of Treasury or agency securities applies only to the underlying securities and does not prevent share-price fluctuations. Unlike stocks and bonds, U.S. Treasury bills are guaranteed as to the timely payment of principal and interest.

Although the income from the U.S. Treasury obligations held in a fund is subject to federal income tax, some or all of that income may be exempt from state and local taxes.

In a diversified portfolio, gains from some investments may help offset losses from others. However, diversification does not ensure a profit or protect against a loss in a declining market.