Junk or jewel? Assessing the role of high-yield bonds in a diversified portfolio

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- High-yield bonds, which represent the debt financing of companies rated below investment grade by the primary rating agencies (Ba1 or lower for Moody's Investors Service, BB+ or lower for Standard & Poor's), carry greater issuer risk than traditional fixed income products.[1] Higher liquidity and default risks in the high-yield market are critical considerations for investors.

- On average, high-yield bonds have outperformed higher-quality fixed income securities. Likewise, forward-looking median returns and volatility levels for high-yield bonds, as estimated by the Vanguard Capital Markets Model (VCMM), exceed those for higher-quality fixed income.

- High-yield bonds behave like a "hybrid" instrument, reflecting characteristics of both the equity and fixed income markets. With this in mind, we look at the portfolio impact of two types of high-yield positions: one funded by an investor's existing fixed income allocation, and one sourced from an equity allocation. We conclude that high-yield bonds are expected to improve the risk and return characteristics of a traditional balanced portfolio *if funded by the portfolio's existing equity allocation*.

Acknowledgments: This is an update and expansion of a 2012 Vanguard research paper, *Worth the Risk? The Appeal and Challenges of High-Yield Bonds*, by Christopher B. Philips. The authors thank Michael Chang for his valuable contributions to this paper. They also thank Andrew Hon and Vivien Chen for their assistance with data updates.

1 This analysis focuses on taxable high-yield bonds, not high-yield municipal bonds (revenue and general obligation bonds issued by local and state municipalities that carry below-investment-grade ratings). Because investors generally have different motivations for investing in tax-exempt bonds, we consider such bonds beyond the scope of this paper.

Introduction

The high-yield bond market consists of bonds considered by major rating agencies to have a greater risk than others of not paying interest and/or principal on a timely basis. In the 1970s, the high-yield universe consisted primarily of issues by "fallen angels"—companies whose bonds had been downgraded from investment-grade status because of increased risk to interest and/or principal payments, often as a result of underperforming businesses. The market for such below-investment grade bonds was not popularized until the 1980s, when investment banks began selling original-issue high-yield bonds in order to finance leveraged buyouts. Issues today mainly include those from capital-intensive companies at risk of not meeting obligations, newer companies looking to refinance potentially higher-cost bank or private loans, and growing companies entering the debt markets for the first time.

The high-yield market has grown rapidly since the 1980s, to a $1.1 trillion market as of December 31, 2018. Some of the main appeals of high-yield bonds for investors include:

- Their higher levels of current income, compared to higher-quality bonds.
- Their potential for significant capital appreciation (a rise in price) if the issuer's financial health improves and the bond is upgraded to a higher rating.[2]
- The diversification benefit they offer, thanks to their imperfect correlation with other fixed income sectors.[3]

To this last point, the fact that high-yield bonds are excluded from investment-grade indexes such as the Bloomberg Barclays U.S. Aggregate Bond Index may be reason enough for investors who desire full market exposure to include them as part of their bond portfolio. However, as shown in **Figure 1**, these bonds account for only a small portion of the total U.S. taxable fixed income market—5% as of December 31, 2018 (19% of the total U.S. corporate bond market).

As their name implies, high-yield bonds offer a higher yield than investment-grade bonds, largely as compensation for their higher risk of default (where the issuer cannot pay back its obligations to the bondholders) or downgrade (where the issuer's financial footing weakens to the point where its bonds are downgraded to a more speculative level) associated with lesser-quality issues or issuers. This premium can be seen in **Figure 2**. Although these bonds offer a yield premium, they have not always compensated investors for the higher embedded risks in the form of higher *total returns*.[4]

Given the uncertain nature of compensation for bearing higher default risk, do high-yield bonds offer characteristics that are unique and attractive enough to warrant some exposure in a diversified portfolio? If the answer is yes, how should investors think about constructing an allocation to high-yield bonds?

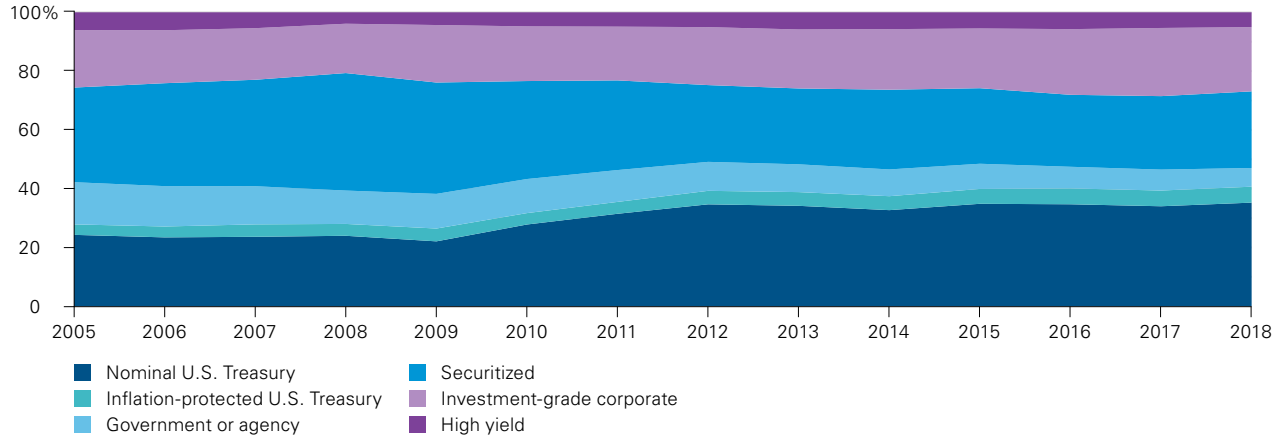
IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from VCMM are derived from 10,000 simulations for each modeled asset class. Simulations as of December 31, 2018. Results from the model may vary with each use and over time. For more information, please see Appendix II.

2 Note that this appreciation could be temporary if it leaves the bond's price at a premium.

3 Using data from Morningstar, we examined three-year rolling correlations, for the period from July 1983 through December 2018, between high-yield bonds and investment-grade corporate bonds, nominal Treasuries, inflation-linked Treasuries, agency bonds, mortgage-backed securities, and investment-grade municipal bonds. High-yield bond returns had average three-year rolling correlations of 0.51, 0.11, 0.21, 0.19, 0.26, and 0.22, respectively, with these fixed income sectors.

4 Note also that this relationship may not hold for individual bonds. In general, the greater the yield, the greater the default risk.

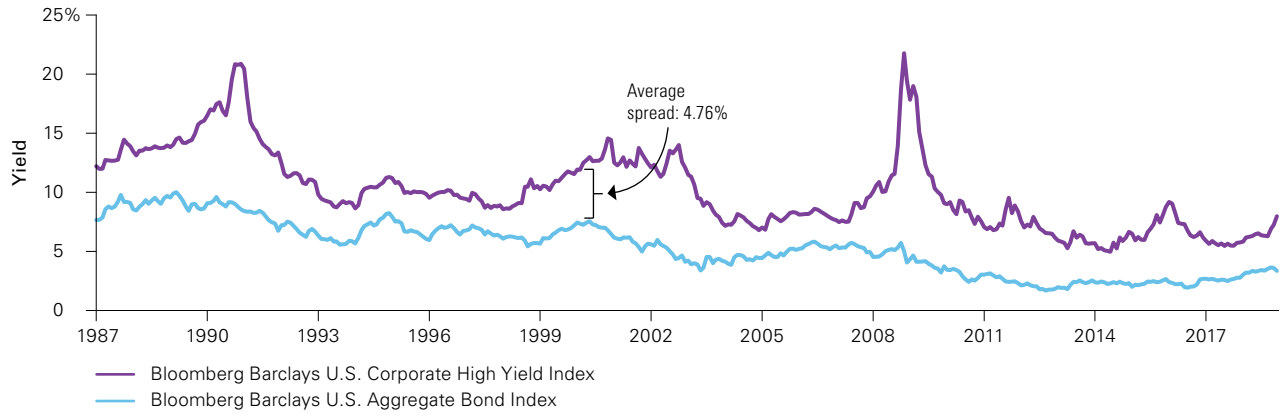
Figure 1. High-yield bonds are a small portion of the total U.S. bond market



Notes: Categories represent fixed income categories as provided by Bloomberg Barclays. Securitized includes mortgage-backed, asset-backed, and commercial mortgage-backed securities. Values represent market values of relevant indexes as of December 31, 2018.

Source: Bloomberg Barclays.

Figure 2. High-yield bonds offer a premium to investment-grade bonds



Notes: Yield data are as of December 31, 2018, beginning January 30, 1987. The relationship holds if evaluated versus the 10-year Treasury bond. The average spread of high yield versus the 10-year U.S. Treasury bond for this period was 5.09%.

Sources: Vanguard calculations, using data from Morningstar and FRED (Federal Reserve Economic Data).

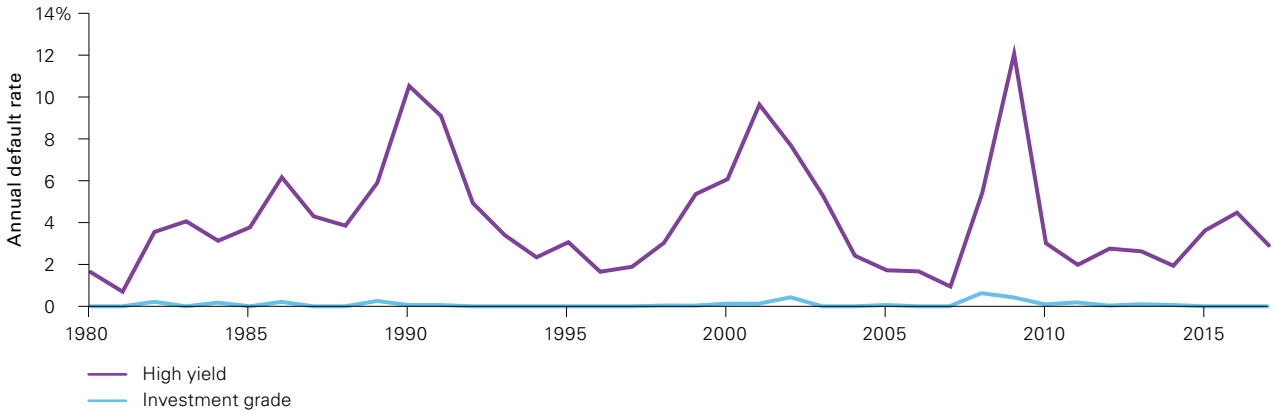
Unique risks and considerations

High-yield bonds' below-investment-grade rating implies increased credit risk and an expectation of higher average returns or yields. One credit risk is that a bond will be downgraded because of worsening prospects for its issuer's ability to adequately manage its outstanding liabilities. From 1999 through 2018, downgrades have outpaced upgrades, often significantly. Although this period was characterized by two equity bear markets, even during the 2003–2007 bull market, downgrades still outnumbered upgrades in most months.

Of course, downgrades can be symptomatic of an enduring problem at a given firm. For example, Moody's Investors Service has shown that since 1983, the median defaulted bond has had a B1 rating 60 months before default and ultimately ended up with a rating of Caa2 (four rungs lower on the scale) just before default. An investor can never be certain that they will capitalize on the higher yield offered to compensate for the lower credit rating, because the downgrade is often just the result of problems that the market has already recognized and priced in.

Although changes to a bond's rating can be damaging, the ultimate risk is that of default and its associated loss rate (the value of a given bond that is not recovered during bankruptcy proceedings).[5] **Figure 3** shows that since 1980, the default rate within the high-yield market has both exceeded that of the investment-grade corporate bond market by a large margin and experienced significant volatility over time. While the data on losses are not as extensive as those on defaults, losses on high-yield bonds have been considerable. According to Moody's, between 1983 and 2017, bonds rated Caa-C had an average cumulative credit loss of 21% over the five years following a default event. In contrast, bonds rated B lost 13%, and bonds rated Ba lost 5%. These statistics suggest, not surprisingly, that the higher the quality of a defaulting issue, the greater the recovery rate of lenders' principal.

Figure 3. Default rates for high-yield bonds and investment-grade corporate bonds



Notes: Default rates are issuer-rated. Data are as of December 31, 2017. The average default rates for investment-grade and high-yield bonds were 0.15% and 2.81%, respectively.

Source: Moody's Investors Service.

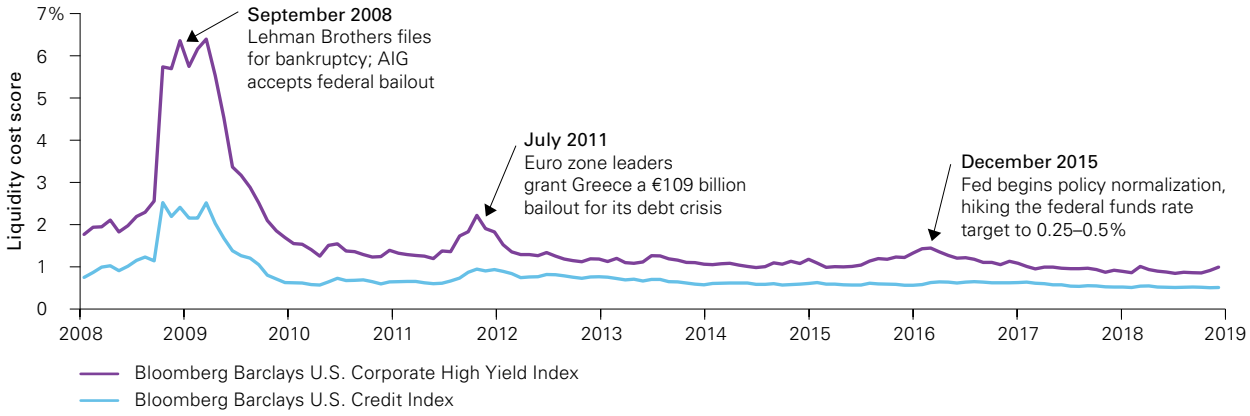
5 Not all defaults involve bankruptcy. Moody's divides defaults into three types: bankruptcy filing, payment default (a missed or delayed disbursement of interest or principal), and distressed exchange. In a distressed exchange, an issuer offers creditors a package of new or restructured debt representing a lesser financial obligation than the original principal amount. According to Moody's, bankruptcy filings and distressed exchanges each made up 40% of the Moody's-rated corporate issuers that defaulted globally in 2017, with payment defaults accounting for the remainder.

Investors should also account for the lower liquidity associated with much of the high-yield market. This can be estimated using the liquidity cost score that Bloomberg Barclays provides for every bond in a specific index. It measures the cost, as a percentage of the bond price, of immediately executing a roundtrip transaction for a standard institutional trade, such as would be made in a typical mutual fund.[6] **Figure 4** compares the weighted average liquidity cost score for the Bloomberg Barclays U.S. Corporate High Yield Index with that for the Bloomberg Barclays U.S. Credit Index. One illustrative comparison is the score on October 31, 2008 (the height of the liquidity crunch in the bond markets) and on November 30, 2018 (a more normal time). Clearly, the cost of lower liquidity can be significant for high-yield portfolios, particularly during periods of stress.

The alternative is to hold bonds in the more liquid segments of the market. According to Bloomberg Barclays, the segment identified as "very liquid" contained 807 issues, with a market value of $694 billion as of December 31, 2018, compared with 1,938 issues and a market value of $1 trillion for the broader Bloomberg Barclays U.S. Corporate High Yield Index.[7] A comparison of monthly returns for the Bloomberg Barclays U.S. Corporate High Yield Index and the Bloomberg Barclays Very Liquid High Yield Index, however, shows a very high correlation (0.97) and R-squared (0.95) for the period from July 1983 through December 2018. This implies negligible differences between the two types of bonds over long periods.[8]

The implication of this higher level of risk is that collectively, investors in high yield have not realized the reported yield in full over time. From 1987 through 2018, the average total return lagged the average yield, likely because of the loss rate associated with high-yield bond defaults. If losses were not an issue, it might be reasonable to expect average total returns to be on par with or even exceed average yield, as was the case with the aggregate index representing investment-grade bonds.

Figure 4. Lower liquidity can be costly in the high-yield market



Notes: Data are for the period from January 31, 2008, through November 30, 2018.
Sources: Vanguard calculations, using data from Bloomberg Barclays.

6 Other measures of liquidity include bid-ask spread, average daily trading volumes, turnover, issue size, price impact, time since issuance, and frequency of zero trading days. For a deeper discussion of the implications of low liquidity, see Richardson and Palhares (2019).

7 To be included in the Bloomberg Barclays U.S. High Yield Very Liquid Index, each bond must have been issued within the past five years, have a $500 million minimum amount outstanding, and be its issuer's largest bond.

8 Likewise, the difference in the average monthly return of the Bloomberg Barclays U.S. Corporate High Yield Index and the Bloomberg Barclays U.S. High Yield Very Liquid Index over the same period was negligible.

Another feature that can help to explain why returns have on average trailed yields is callability. Many high-yield bonds are issued with a call feature so that if market rates fall enough, the issuer can replace the bond with one that has more favorable terms. The call feature effectively puts a cap on the price of a given bond (prices move in the opposite direction of yields). According to Bloomberg Barclays, as of December 31, 2018, 98% of bonds in the Bloomberg Barclays U.S. Corporate High Yield Index had a call feature.[9]

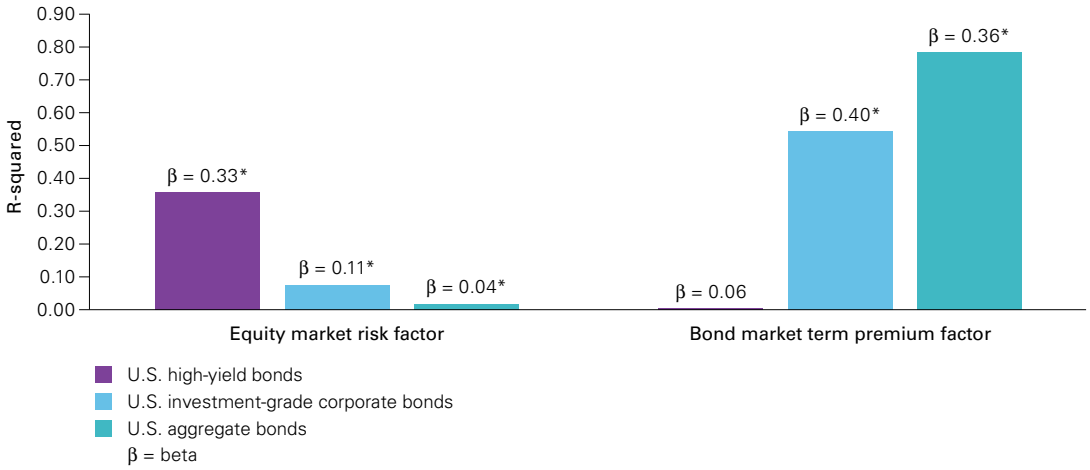
Finally, there are important risk considerations for investors in high yield that stem from its unique return distribution. As is true for many asset classes, high yield's returns exhibit negative skew, or an asymmetric tail extending toward more negative values. This implies a tendency for more instances of large losses than a normal return distribution would indicate. High yield has more negative skew than U.S equity, non-U.S. equity, U.S. fixed income, and non-U.S. fixed income. From 1990 through 2018, average monthly returns for high yield had a skewness of –0.88 compared with –0.60 for U.S. equity and –0.19 for U.S. bonds.

A comparison with the equity market is illustrative of high yield's higher negative skew. Investors who hold a bond to maturity can earn no more than the coupon—and they risk losing everything in the event of a full default. By contrast, equity investors also risk losing 100% of their investment, but the upside potential is unlimited.

Unique characteristics

Although high-yield bonds are debt instruments, their return characteristics could classify them as a hybrid asset class in the eyes of many investors. Because of the default risk associated with the firms and securities that constitute their market, these bonds exhibit risk and return characteristics more typical of equities. We compared the monthly returns of high yield, investment-grade corporate, and broad market bonds to the bond market term premium factor (a proxy for interest rate risk), and to the equity market risk factor. We chart those results in **Figure 5**. As expected, given its historically small credit allocation, the Bloomberg Barclays U.S. Aggregate Bond Index—a broad market-cap-weighted bond index—had a higher R-squared with the term factor than did either investment-grade corporate or high-yield bonds.

Figure 5. The higher credit risk embedded in high-yield bonds results in stronger similarities to equity risk characteristics



Notes: Coefficient (beta) values are displayed above each bar. Betas shown are from a multivariate regression analysis of monthly bond returns on the Fama-French equity market risk factor and bond market term premium factor, a proxy for interest rate sensitivity. * denotes significance at the 5% level.

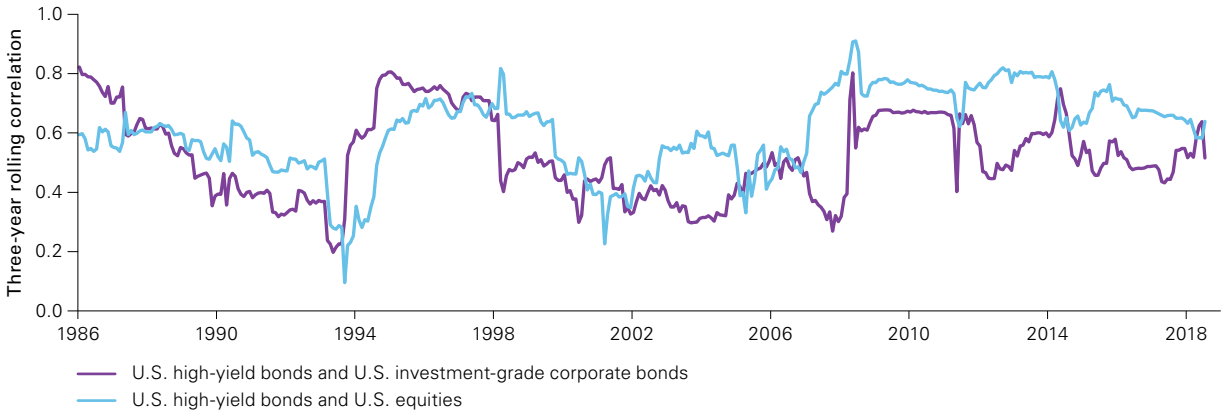
Sources: Vanguard calculations, using data from Vanguard, Morningstar, and the Kenneth R. French Data Library. High-yield bonds are represented by the Bloomberg Barclays U.S. Corporate High Yield Index; U.S. investment-grade corporate bonds, by the Bloomberg Barclays U.S. Credit Index to December 31, 1988, and the Bloomberg Barclays U.S. Corporate Index thereafter; U.S. aggregate bonds, by the Bloomberg Barclays U.S. Aggregate Bond Index. Data are for the period from July 31, 1983, through December 31, 2018.

9 Eighty-two percent of the bonds are callable/nonrefundable, meaning the issuer cannot use the proceeds from a refinance to repay the called issues (repayment must be made from a cash account or general account); 0.1% (two bonds) are callable/refundable, meaning the issuer can repay the called bond with the proceeds from a refinance; 0.7% are European callable bonds, meaning the issuer has a one-time option to call the bond; and 15% are make-whole bonds, meaning the issuer can prepay the remaining debt according to a net present value calculation.

However, betas of *both* aggregate and investment-grade corporate bond returns with respect to the term factor were considerably higher, with statistical significance, while high-yield bonds had a low positive but insignificant beta with respect to the term factor. And high yield exhibited a much higher R-squared and beta with the equity market factor than did either broad market bonds or investment-grade corporates. These results illustrate the large impact that credit quality has on the risk characteristics of a bond.

It is important to note that the relationships shown in Figure 5 are time-varying. **Figure 6** illustrates the rolling three-year correlations of the returns of high-yield bonds with those of investment-grade corporate bonds and equities over the past 35 years. As the figure shows, high-yield bonds have experienced periods when they showed higher correlation to investment-grade corporate bonds, as well as times when they correlated more strongly to equities. Overall, high-yield bonds were more highly correlated to equities than to investment-grade corporates, with average correlations of 0.61 and 0.52, respectively.

Figure 6. High-yield bonds have experienced periods of both bond-like and equity-like returns



Notes: U.S. high-yield bonds are represented by the Bloomberg Barclays U.S. Corporate High Yield Index. U.S. equities are represented by the MSCI USA Index. U.S. investment-grade corporate bonds are represented by the Bloomberg Barclays U.S. Credit Index to December 31, 1988, and the Bloomberg Barclays U.S. Corporate Index thereafter. Data are for the period from July 1, 1983, through December 31, 2018.

Sources: Vanguard calculations, using data from Morningstar.

Statistical comparison tests

A statistical comparison of high-yield bonds versus other asset categories offers some clarity on just how unique high-yield bonds' risk characteristics really are. We ran an F-test of variance ratios to see if high-yield bond volatility is statistically different from that of other asset classes. The test results are reported in **Figure 7**.

Although historical high-yield bond returns over 35 years look similar to most other fixed income asset class returns, the statistically significant p-values of the variance comparisons tell a different story about volatility.[10] Almost every pair of variance comparisons to high-yield bonds is significantly different at the 5% level. The results offer some insight into the asset allocation impact of a high-yield bond exposure—namely, that high yield's impact on a balanced portfolio may come more from its effect on portfolio volatility than on returns, depending on which asset class it displaces. For example, the ratio of high yield's variance to that of U.S. investment grade is 4.0, meaning high yield is four times more variable. In contrast, high yield is 30% less volatile than equities, a difference that is statistically significant.

Figure 7. The benefits of a high-yield bond allocation may derive more from their impact on portfolio volatility than on returns

	Ratios of return variances		
	Broad (1983–2018)	Tech bear market (2000–2002)	Global financial crisis (2007–2009)
U.S. high yield versus cash	43.0*	88.1*	1371.1*
U.S. high yield versus U.S. investment-grade fixed income	4.0*	5.9*	40.1*
U.S. high yield versus non-U.S. hedged fixed income	7.6*	12.9*	39.2*
U.S. high yield versus U.S. equity	0.3*	0.2*	1.2
U.S. high yield versus non-U.S. equity	0.3*	0.3*	0.6

Notes: For the variance comparisons, we used an F-test of the equality of variances, which is a test for the null hypothesis that two normal populations have the same variance. (High-yield returns are close to normal with a negative skew < |1|.) Although the F-test calculation requires that the larger variance be placed in the ratio's numerator, for clarity of comparison, we have expressed all the figures with high-yield bond variance in the numerator. * denotes significance at the 5% level. The tests use quarterly return data from July 1983 through December 2018, except for the non-U.S. debt index, which begins February 1990. The tech bear market represents March 2000 through October 2002 and the global financial crisis represents September 2007 through March 2009. Asset class returns are represented by the following indexes: Bloomberg Barclays U.S. Corporate High Yield Index, FTSE 3 Month US T-Bill Index, Bloomberg Barclays U.S. Aggregate Bond Index, Bloomberg Barclays Global Aggregate ex-USD Index (USD hedged), MSCI USA Index, and MSCI World Index ex US. The tests were also conducted using monthly and annual return data, which produced almost identical results.

Sources: Vanguard calculations, using data from Morningstar.

Portfolio construction implications

Given the distinct characteristics of high-yield bonds as an individual asset class, what are the implications for an exposure to high yield at the portfolio level? To begin to answer this question, we first conducted a mean-variance optimization (MVO) analysis to compare the risk-return trade-off of a portfolio with high-yield exposure to a portfolio without. Specifically, we wanted to see which scenario offered a higher return for a given level of risk, and vice versa.

As previously noted, the relationship between high-yield bond returns and those of other asset classes is time-varying. To address this, we reviewed efficient frontiers on a forward-looking basis using the VCMM. The results are driven by VCMM expectations for high-yield bond returns, which are that they will:

- Be higher (lower) than broad market global fixed income (equity).
- Be more (less) volatile than broad market global fixed income (equity).
- Be imperfectly correlated with broad market bonds and equity.
- Have wider (narrower) distributions than broad market global fixed income (equity).

Figure 8a shows the two efficient frontiers: one for a portfolio with global equities and global bonds (blue line), and one for a portfolio with global equities, global bonds, and high-yield bonds (purple line). The figure shows that portfolios that include high-yield bonds are expected to have higher risk-adjusted returns than those without. Based on the MVO results, a 60% global equity/40% global bond portfolio will have a median expected return of 7.5% and a median standard deviation of 9.7%. At the same level of risk, portfolios that include high-yield bonds are expected to provide an additional 20 bps of return. High-yield-inclusive portfolios are also expected to reach the 60/40 portfolio's level of return with 70 bps lower risk.

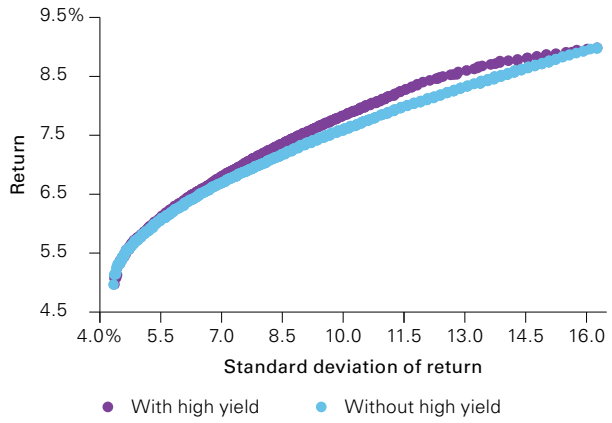
Put another way: Investors who include high yield in a 60/40 portfolio should get a higher level of return for the same level of risk, and a lower level of risk for the same level of return, as they would with a 60/40 portfolio that does not include high yield.

10 From 1983 to 2018, results for univariate regressions of the quarterly excess returns of high yield (relative to the same assets in the variance comparison) on a constant variable were insignificant for all but cash (p-value of 0.0014 and T-statistic of 3.26).

The two efficient frontiers show the set of portfolios that offer the highest expected return for a given level of risk—but what *mix* of underlying assets is expected to provide such results? **Figure 8b** illustrates a breakdown of asset allocation weights along the high-yield-inclusive efficient frontier. As we increase risk, measured by standard deviation of return, the proportion of global bonds in the portfolio shrinks relative to global equity and high-yield bonds. Intuitively, it makes sense that increased risk would be associated with greater exposure to risky assets (global equity and high-yield bonds). However, as we move to increasingly higher levels of risk, eventually we would have to increase equity and decrease high yield in order to access the higher risk and return.

Figure 8a. Including high-yield bonds should improve risk/return trade-off

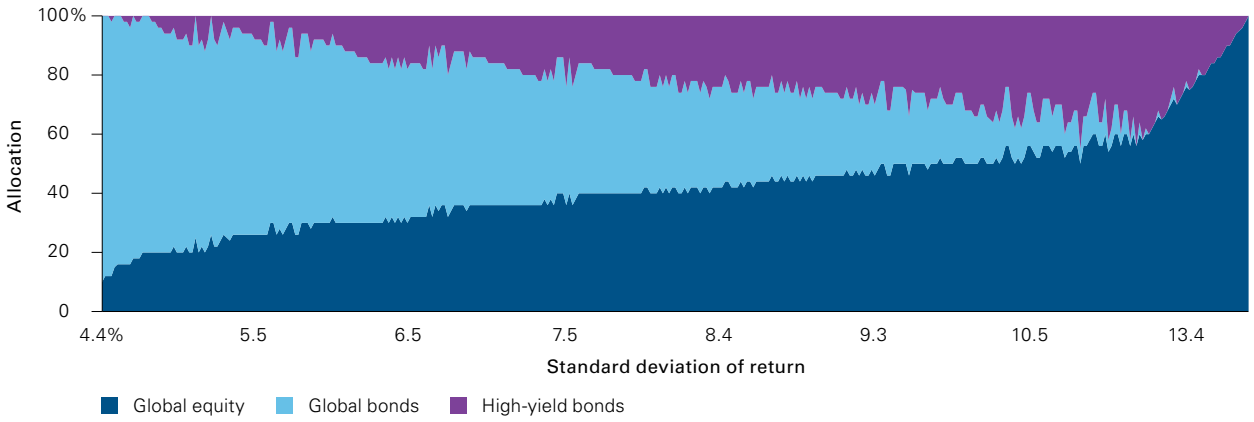
Forward-looking efficient frontiers



Notes: Expected standard deviation and return are based on the medians of 10,000 simulations from the VCMM and reflect the long-term-average risk-free rate plus risk premium from the VCMM steady state as of December 31, 2018. The optimization is constrained to no more than 40% of equity allocation to non-U.S. equity and no more than 30% of bond allocation to non-U.S. bonds (hedged).

Source: Vanguard.

Figure 8b. Asset allocation along the efficient frontier with high yield



	60/40	60/40 equivalent return	Difference with high yield	60/40 equivalent risk	Difference with high yield	Maximum high-yield weight
Equity allocation	60.0%	46.0%	–14.0%	50.0%	–10.0%	50.0%
Fixed income allocation	40.0	28.0	–12.0	22.0	–18.0	5.0
High-yield bond allocation	0.0	26.0	26.0	28.0	28.0	45.0
Median return	7.5	7.5	0.0	7.7	0.2	8.1
Median risk	9.7	9.0	–0.7	9.7	0.0	10.9

Notes: Expected standard deviation is based on the median of 10,000 simulations from the VCMM and reflects the long-term-average risk-free rate plus risk premium from the VCMM steady state as of December 31, 2018. The optimization is constrained to no more than 40% of equity allocation to non-U.S. equity and no more than 30% of bond allocation to non-U.S. bonds (hedged).

Source: Vanguard.

Substitution analysis

While a mean-variance analysis sheds light on the portfolio impact of including high yield, it does not clearly illustrate the relative impact of substituting high yield for fixed income versus substituting it for equity. Our analysis shows that results can be quite different depending on the asset class replaced. To more clearly identify this difference, we conducted a forward-looking analysis, again using the VCMM, evaluating the impact of substituting high yield in a 60% global equity/40% global bond portfolio (hereafter referred to as the base case).

Fixed income substitution

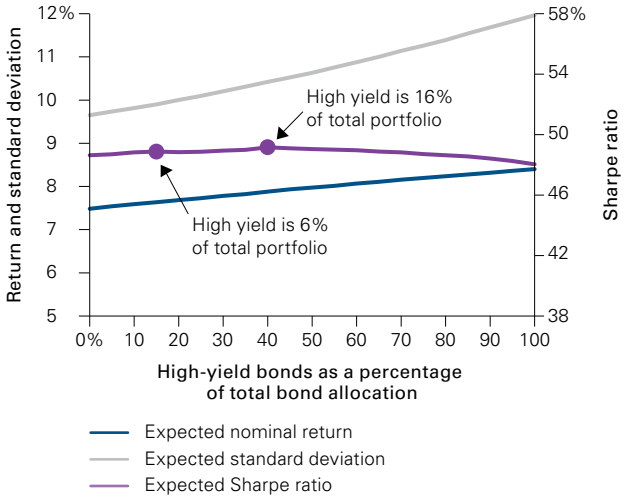
We first substituted the fixed income allocation of the base case for high-yield bonds. The high-yield bond exposure was increased in increments of 5% of the fixed income allocation until the fixed income allocation consisted entirely of high-yield bonds. Although imperfect correlation is expected to provide a diversification benefit, the higher volatility of high-yield bonds will likely offset that effect at the portfolio level, resulting in higher portfolio volatility. As shown in **Figure 9a**, both volatility and return are expected to increase as the high-yield bond allocation increases. Initially, the median Sharpe ratio is expected to increase slightly from the small return improvement, peaking at a 16% high-yield allocation (40% of total bond allocation). Moreover, a weighting of 6% high yield (15% of total bond allocation, 60% equities/34% fixed income) improves the median Sharpe ratio by only 24 bps. At allocations greater than 16%, however, volatility is expected to increase more than return, which would push down Sharpe ratios.

Equity substitution

Next, we incrementally replaced the base case's equity allocation with high-yield exposure, leaving the 40% allocation to global fixed income constant. The portfolio impact is illustrated in **Figure 9b**. Equity substitution is expected to improve the Sharpe ratio more than bond substitution. For example, a weighting of 6% high yield (54% equities/40% fixed income) improves the median Sharpe ratio by 2.9%—while a 12% allocation to high yield (48% equity/40% fixed income) improves the median Sharpe ratio by 6.5%, with a peak improvement of 10.6% at a 27% high yield allocation. Driving the equity substitution outcome are a small decrease in return and a steeper decline in volatility expectations as high yield is substituted for equity, up to a 27% high-yield allocation. As the variance ratio tests suggested, the bond and equity substitution results show that the largest impact on overall portfolio performance stems from differences in high-yield bond volatility, not differences in return.

Figure 9a. Substituting high-yield bonds for the bond allocation of a 60/40 portfolio should increase both returns and volatility

Expected return, standard deviation, and Sharpe ratio



Notes: Expected return, standard deviation, and Sharpe ratio are based on the median of 10,000 simulations from the VCMM and reflect the long-term-average risk-free rate plus risk premium from the VCMM steady state as of December 31, 2018. Starting portfolio weights for the equity allocation are 36% U.S. equities and 24% non-U.S. equities. Starting portfolio weights for the bond allocation are 28% U.S. bonds and 12% non-U.S. bonds.

Source: Vanguard.

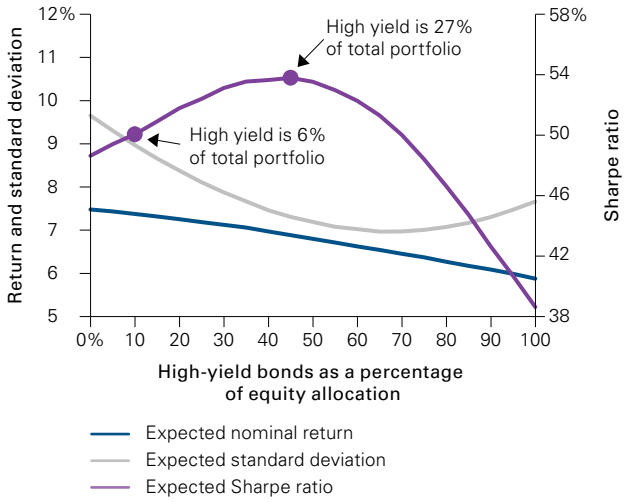
Finally, we incrementally replaced the base case's U.S. equity allocation with high-yield exposure, leaving the 40% allocation to global fixed income and the 24% allocation to non-U.S. equity constant. The goal of this simulation was to apply a risk factor lens to the portfolio and maintain exposure to U.S. equity risk with high-yield bonds, an asset with a higher risk-adjusted return expectations than U.S. equity. As shown in **Figure 9c**, the median Sharpe ratios showed the largest expected improvement with this substitution method, peaking at 12.0% improvement from the base case at a 27% allocation to high yield (9% U.S. equity/24% non-U.S. equity/40% global fixed income). In addition, a weighting of 5.4% high-yield (30.6% U.S. equity/24% international equity/40% global fixed income) improved the median Sharpe ratio by 3.1%.

The implications for investors looking for a high-yield tilt in their portfolios are meaningful. Our observations demonstrate that a high-yield bond position can have very different effects on an investor's portfolio depending on which allocation or risk factor the substitution is funded by—fixed income or equity. This discrepancy is reflective of high-yield bonds' unique risk and return characteristics, which, as noted earlier, are reminiscent of the behavior of equities. Thus, the decision to increase one's high-yield bond exposure is a complex one that should be considered in the context of the whole portfolio.[11]

Similar conclusions can be drawn from a historical analysis in all of these markets in **Figures A-1** and **A-2** on page 14 in Appendix I.

Figure 9b. Substituting high-yield bonds for equity in a 60/40 portfolio should increase risk-adjusted returns

Expected return, standard deviation, and Sharpe ratio

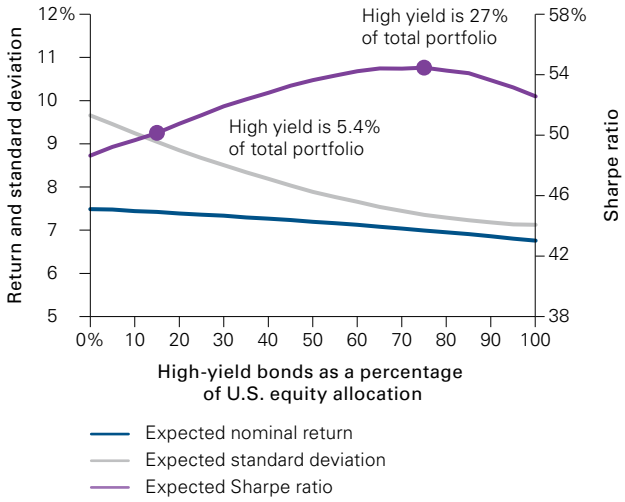


Notes: Expected return, standard deviation, and Sharpe ratio are based on the median of 10,000 simulations from the VCMM and reflect the long-term-average risk-free rate plus risk premium from the VCMM steady state as of December 31, 2018. Starting portfolio weights for the equity allocation are 36% U.S. equities and 24% non-U.S. equities. Starting portfolio weights for the bond allocation are 28% U.S. bonds and 12% non-U.S. bonds.

Source: Vanguard.

Figure 9c. Substituting high-yield bonds for U.S. equity in a 60/40 portfolio should dramatically increase risk-adjusted returns

Expected return, standard deviation, and Sharpe ratio



Notes: Expected return, standard deviation, and Sharpe ratio are based on the median of 10,000 simulations from the VCMM and reflect the long-term-average risk-free rate plus risk premium from the VCMM steady state as of December 31, 2018. Starting portfolio weights for the equity allocation are 36% U.S. equities and 24% non-U.S. equities. Starting portfolio weights for the bond allocation are 28% U.S. bonds and 12% non-U.S. bonds.

Source: Vanguard.

11 As they should for any taxable bond, investors interested in high-yield bonds should consider their income tax rate and whether they will hold the bonds in tax-advantaged or taxable accounts. These considerations can prove significant in determining the relative success of a given allocation.

Other considerations for investors

Investability

Investors interested in high-yield bonds may also be interested in whether the investment vehicle they select provides the exposure and experience they expect. Many investors construct a portfolio based on output from some form of portfolio optimizer (such as the efficient frontier analysis shown in Figure 8a). Often, the return history used in the optimizer is that of the broadest high-yield benchmark, rather than something that is investable.

Figure 10 shows all mutual funds, active (purple) and index or ETF (green), that have had at least 60 months of continuous returns at any time since 1987, and how they fared relative to the two versions of the Bloomberg Barclays U.S. high-yield bond index over their return history. In neither instance did a majority of actively managed funds outperform. The index that gave active managers the best opportunity for relative outperformance was the Bloomberg Barclays U.S. High Yield Very Liquid Index—yet even then, only 11% of managers outperformed and only 10% did so with less volatility. While one potential reason for this would be the challenges of investing in high-yield bonds, another is likely the costs of the portfolios over time. For example, according to Morningstar, as of December 31, 2018, the asset-weighted net expense ratio for high-yield funds was 92 bps. This represents a significant hurdle just to break even with a benchmark index, which incurs no costs.

It is worth noting that the vast majority of funds that underperformed their target benchmark did so with less volatility. When returns are risk-adjusted, 88% of funds outperformed the Bloomberg Barclays U.S. Corporate High Yield Index and 91% surpassed the Bloomberg Barclays U.S. High Yield Very Liquid Index.

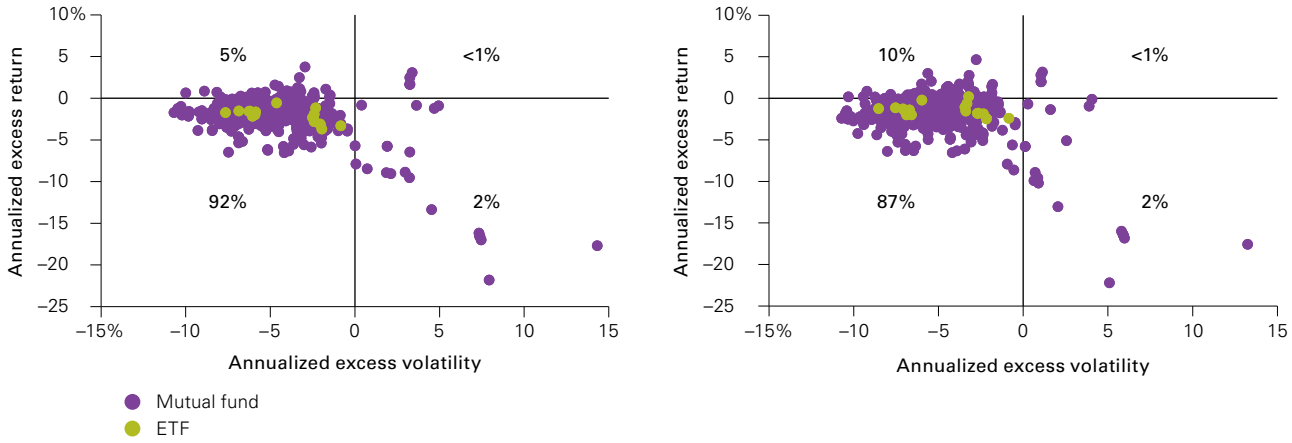
Systematic risk mismatch to the benchmark could have driven this risk-adjusted outperformance, however. Managers could have held high-yield issues that fell outside of the liquid segment and therefore received appraisal-based and/or smoothed pricing over time. If these less-liquid issues are infrequently mark-to-market, unlike higher-quality fixed income, they would appear less volatile than they really are. This could account for the lower relative volatility of the funds. It would not, however, explain their underperformance, if one assumes that investing in illiquid securities should on average engender a "liquidity premium."

Another reason for the benchmark mismatch could be quality; for example, active managers could have overweights to higher quality and underweights to lower quality relative to the benchmark. Finally, these funds may have had a duration mismatch to the benchmark. Shorter durations would have resulted in lower returns and risk than the benchmark, all else being equal.

Figure 10. How have investors in high-yield funds performed?

a. Funds versus Bloomberg Barclays U.S. Corporate High Yield Index

b. Funds versus Bloomberg Barclays U.S. High Yield Very Liquid Index



Notes: Data are as of December 31, 2018, and include all funds and share classes of funds in Morningstar's high-yield bond category (aside from high-yield municipal bonds), ETFs, and funds that have been liquidated or merged over time. All funds with at least 60 months of continuous data were compared to the identified benchmark over the period the fund has been or was alive. Excess returns were computed monthly and annualized. Risk-adjusted return performance is calculated by each fund's annualized returns divided by annualized volatility over the period the fund has been or was alive, compared to that of the benchmark over the same period.

Source: Vanguard calculations, based on data from Morningstar.

Conclusion

Because high-yield bonds are excluded from investment-grade indexes such as the Bloomberg Barclays U.S. Aggregate Bond Index, it is reasonable to evaluate their impact on a traditional portfolio. It is important for investors to recognize the increased credit and liquidity risks these bonds present. Investors who are comfortable with these risks may also want to closely examine the potential benefits. The funding source is an important consideration in the decision to create an exposure to high-yield bonds. Our analysis shows that a high-yield position may improve the risk-adjusted returns of a traditional balanced portfolio if funded by the existing equity allocation. This improvement is driven entirely by lower expected volatility and does entail a return sacrifice, as equity returns are replaced with lower expected high-yield returns. On the other hand, both volatility and return are expected to increase when high-yield bonds replace a portfolio's existing fixed income allocation. Initially, risk-adjusted return may increase very slightly, but this reverses for high-yield allocations greater than 32% of the total portfolio.

These results are explained by the fact that high-yield bonds historically have shown characteristics resembling those of equities, even though they are a fixed income security. Although below-investment-grade bonds represent a small slice of the taxable U.S. fixed income universe, their impact is amplified as a tilt toward high-yield bonds exceeds market weight. Our findings underscore the importance of keeping the entire portfolio in mind when incorporating high-yield bonds into a balanced portfolio.

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Appendix I

A historical analysis shows that substituting high yield for equity improved risk-adjusted returns

In addition to the forward-looking analysis, we reviewed the historical impact on a portfolio of replacing fixed income and equity with high yield. Similar conclusions can be drawn.

As shown in **Figure A-1a**, both annualized risk and return ticked upwards as the high-yield bond allocation increased. The net result was a decline in portfolio risk-adjusted return, compared to the base case. This supports the observation that high-yield bonds have historically experienced more volatility than some other segments of the fixed income space.

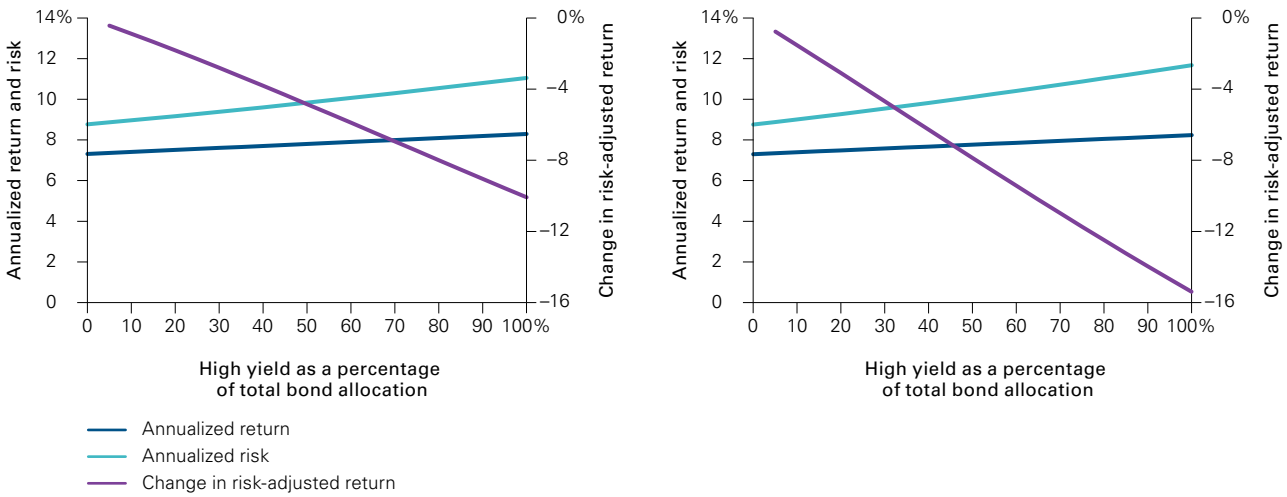
Given the liquidity considerations of this asset class mentioned previously, we also conducted an analysis replacing fixed income with "very liquid" high-yield bonds. **Figure A1-b** displays the results, which were very similar to the broad high-yield substitution analysis. In both the broad and very liquid cases, the steeper slope of risk, compared to return, highlights an important observation. The decline in risk-adjusted return was driven largely by the increase in portfolio volatility as high-yield was added, and less by the change in return.

Next, we replaced the base case's equity allocation with the incremental high-yield exposure. The portfolio impact is illustrated in **Figures A-2a and A-2b**. As with the forward-looking VCMM results, risk-adjusted return improved considerably in both the broad and very liquid high-yield scenarios. When taking the risk contribution into account, as quantified by the change in risk-adjusted return, the high-yield allocation provided improved portfolio outcomes relative to the base case.

Figure A-1. Historically, substituting high-yield bonds for the total bond allocation of a 60/40 portfolio resulted in a decrease in risk-adjusted returns

a. The impact of adding high-yield bonds using bond substitution

b. The impact of adding "very liquid" high-yield bonds using bond substitution



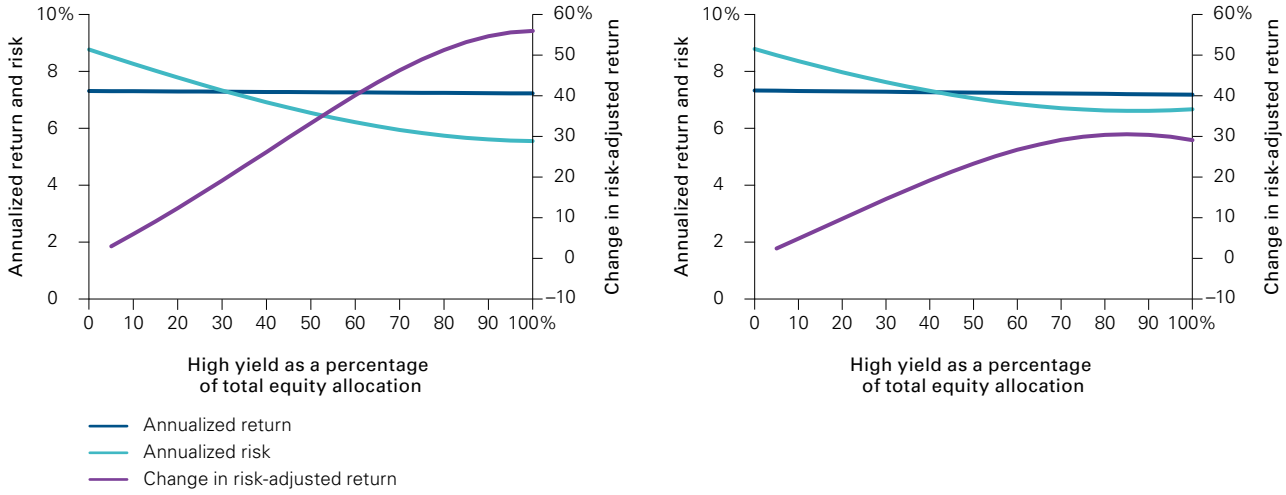
Notes: Data are from January 31, 1990, through December 31, 2018. Starting portfolio weights for the equity allocation are 36% U.S. equities and 24% international equities, represented by the MSCI USA Index and the MSCI World Index, respectively. Starting portfolio weights for the bond allocation are 28% U.S. bonds and 12% international bonds, represented by the Bloomberg Barclays U.S. Aggregate Bond Index and the Bloomberg Barclays Global Aggregate Bond ex-USD Index (USD hedged). High-yield bonds are represented by the Bloomberg Barclays U.S. Corporate High Yield Index and the Bloomberg Barclays U.S. High Yield Very Liquid Index.

Sources: Vanguard calculations, using data from Morningstar.

Figure A-2. Historically, substituting high-yield bonds for the total equity allocation of a 60/40 portfolio resulted in an increase in risk-adjusted returns

a. The impact of adding broad high-yield bonds to a portfolio using equity substitution

b. The impact of adding "very liquid" high-yield bonds to a portfolio using equity substitution



Notes: Figures represent the same indices and data range from the bond substitution scenario in Figure A-1. We also conducted the analysis using the Bloomberg Barclays U.S. Corporate High-Yield Ba/B Index (another representation of the more investable segments of the market), which produced almost identical results. As high yield was incrementally added, the change in risk-adjusted return using the high yield Ba/B index versus using the Bloomberg Barclays U.S. High Yield Index was highly correlated at 0.99.

Sources: Vanguard calculations, based on data from Morningstar.

Appendix II

About the Vanguard Capital Markets Model

IMPORTANT: The projections and other information generated by the Vanguard Capital Markets Model regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM results will vary with each use and over time.

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More important, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based.

The Vanguard Capital Markets Model® is a proprietary financial simulation tool developed and maintained by Vanguard's primary investment research and advice teams. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include U.S. and international equity markets, several maturities of the U.S. Treasury and corporate fixed income markets, international fixed income markets, U.S. money markets, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the Vanguard Capital Markets Model is that the returns of various asset classes reflect the compensation investors require for bearing different types of systematic risk (beta). At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data from as early as 1960. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several time horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results produced by the tool will vary with each use and over time.

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All investing is subject to risk, including the possible loss of principal. Diversification does not ensure a profit or protect against a loss.

Be aware that fluctuations in the financial markets and other factors may cause declines in the value of your account. 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.

Bond funds are subject to interest rate risk, which is the chance bond prices overall will decline because of rising interest rates, and credit risk, which is the chance a bond issuer will fail to pay interest and principal in a timely manner or that negative perceptions of the issuer's ability to make such payments will cause the price of that bond to decline.

High-yield bonds generally have medium- and lower-range credit quality ratings and are therefore subject to a higher level of credit risk than bonds with higher credit quality ratings.

Past performance is not a guarantee of future results. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. Current and future portfolio holdings are subject to risk.

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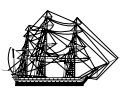

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