

The role of bonds in a low-yield environment

- Yields for most fixed income investments globally are historically low, and low interest rates are likely to result in muted bond returns over the next decade. Because of the low return expectations, investors may be concerned about allocating to fixed income in multi-asset portfolios.
- However, we believe the primary role of bonds in a portfolio is not to produce high returns, but to act as a shock absorber in times of equity market stress. History suggests that high-quality bonds act as ballast for the portfolio in both high and low interest rate environments because of their low correlation with equity.
- Amid the low interest rate environment and fears of rising U.S. rates, investors may benefit from non-U.S. fixed income. This can offer diversification because of imperfect correlations of interest rate movements in other countries. Also, when we use Vanguard's portfolio construction models to build an optimized portfolio, we find that certain high-yielding assets, such as U.S. high-yield corporates and emerging-market bonds, enhance the portfolio's risk-adjusted return. However, these portfolios should be created based on a solid asset allocation methodology, in particular to manage drawdown risk and at the same time increase expected returns.

Authors



Giulio
Renzi-Ricci



Oliver
Harvey



Harshdeep
Ahluwalia

Bond yields have been historically low for quite some time. For some countries that have adopted a negative interest rate policy, such as Japan and a few countries in Europe, 10-year government bond yields are still negative. The role of fixed income in portfolios, then, has come under increasing scrutiny, because the return that investors can expect from government and corporate bonds has fallen significantly over the last 10 years.

Despite the increase of more than 90 basis points in the 10-year U.S. Treasury note's yield from August 2020 through September 2021, rates are still low by historical standards. At the end of September 2021, the 10-year U.S. Treasury yield was 1.49%, compared with a historical average of 3.20% since January 2000. Yields of 10-year government bonds in the U.K., Germany, Australia, Canada, and Japan have experienced a similar trend: September 2021 yields were 1.02%, -0.20%, 1.49%, 1.51%, and 0.07%, compared with historical averages since January 2000 of 3.06%, 2.38%, 4.18%, 3.11%, and 0.88%, respectively.

With low bond yields and increasing uncertainty about rising rates that can hurt bond returns, it is understandable that some investors question the role of fixed income in a portfolio. Their main concern is the low expected return of bonds over the next decade.

In this paper, we address the main role that fixed income plays in a portfolio, which is to act as ballast in times of equity market stress.

First, we look at the correlation between bonds and equities, which provides a glimpse into the diversification benefit of bonds. We then focus on how, from a historical perspective, different types of fixed income investments have performed when equities nosedived. Then we discuss the elevated risk of equity market downturn over the next three years.

Next, we tackle the risk and impact of rising rates. While predicting interest rate movements is notoriously difficult, we illustrate that a negative price impact for bonds dictated by rising interest rates can be offset by reinvesting at higher yields over the longer term, even in a low-rate environment.

Finally, we use data from the Vanguard portfolio analytics service used by our financial advisor clients¹ to look at how these U.S. financial advisors are currently positioning their asset allocation. We compare this typical portfolio with an optimized portfolio that relies on our asset return forecasts using Vanguard Capital Markets Model® (VCMM) (Davis et al., 2014). This case study surfaces the potential benefits of allocating to certain investments and some common allocation pitfalls we observe.

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 are as of March 31, 2021. Results from the model may vary with each use and over time. For more information, please see the Appendix.

¹ This refers to all advisors' model portfolios that are part of Vanguard's Portfolio Analytics & Consulting (PA&C) service in the United States as well as Vanguard's Online Portfolio Analytics Tool. Advisors' portfolios are aggregated by equally weighting each advisor's portfolio across every asset class. Vanguard's PA&C was servicing around 14,000 different portfolios as of January 2019.

Bonds act as ballast during equity market downturns

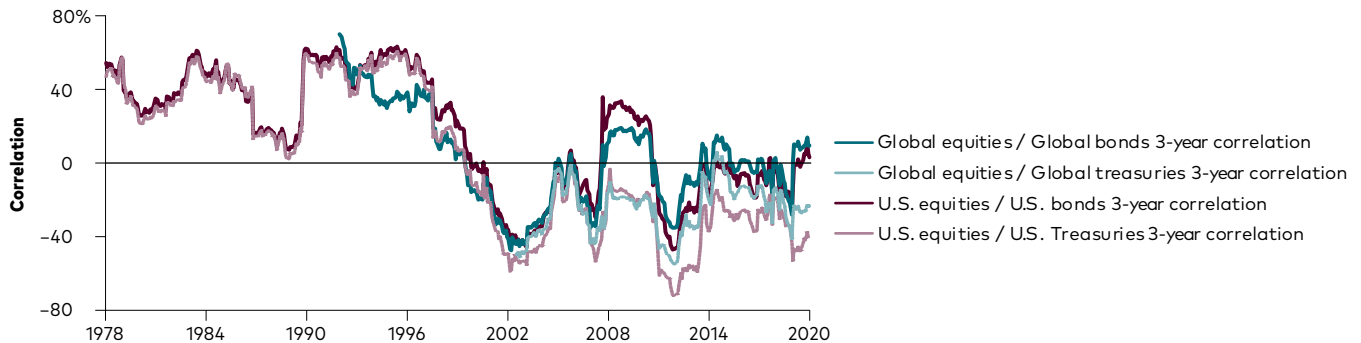
While the expected return of equities is higher than that of fixed income over the long term, so is the volatility or risk. This is evident by the 21 corrections—defined as annual returns that represent declines of more than 20%—that the U.S. equity market has experienced since January 2000, using the MSCI USA Total Return Index as a proxy. The worst U.S. equities decline during this period was a return of -50.6%, from October 2007 to March 2009. It's important to diversify against this drawdown risk in a portfolio, using stable assets such as fixed income.

Correlation is probably the first metric that investors look at to understand the diversification potential between two assets in a portfolio.

The level of correlation can be as low as -100% and as high as 100%. An asset that has low correlation, typically less than 30%, with another asset is said to be a good diversifier.

The correlation between equities and bonds has changed over time and has bounced between negative and positive on multiple occasions, but it has been predominantly negative since the late 1990s (Ilmanen, 2003). **Figure 1** shows the three-year rolling correlation from December 1975 to the end of March 2021 for different equity and bond index return pairs. As expected, the correlation between equities and high-quality fixed income tends to fluctuate and has been especially low since the 2000s. This provides a first insight that fixed income diversifies the equity risk in a portfolio.

FIGURE 1.
Three-year rolling correlation between equity and bond returns



Notes: Data are monthly returns in USD from December 31, 1975, to March 31, 2021. For global aggregate and government bonds, available data started on January 31, 1990, and September 29, 2000, respectively. U.S. equities are represented by the MSCI USA Total Return Index and global equities by the MSCI ACWI Total Return Index. U.S. aggregate bonds are represented by the Bloomberg U.S. Aggregate Index and Treasuries by the Bloomberg U.S. Treasury Index. Global aggregate bonds are represented by the Bloomberg Global Aggregate Index Value (USD Hedged) and global treasuries by the Bloomberg Global Aggregate Treasuries Index (USD Hedged).

Source: Bloomberg.

Will the correlation between equities and bonds change direction?

We must note that if the correlation between equity and fixed income were subject to a structural change and reverted to being positive, as it was in the 1980s, the diversification benefits of fixed income would be muted. The dynamics affecting the relationship between equity and bond returns are complex and beyond the scope of this paper; however, one of the key drivers of the equity-bond correlation is the correlation between economic growth and interest rates (Shen and Weisberger, 2021). If economic growth and rates tend to move in the same direction, the correlation between equities and bonds will tend to be negative.

The relationship between economic growth and interest rates is predominantly a function of fiscal and monetary policy. The introduction of more transparent monetary policies, forward guidance, and inflation targeting have helped central banks react to economic shocks in a more systematic and predictable way.

More specifically, central banks tend to cut interest rates during recessions and raise them during periods of strong economic growth to prevent inflation. This mechanism naturally leads to a positive relationship between economic activity and rates and, consequently, a negative correlation between equities and bonds. Governments are focusing more on sustainable levels of debt to GDP. They are thus preventing the potentially vicious cycle of higher rates, because of increasing credit risk, and low growth that could lead to a positive correlation between equity and bond returns. We do not anticipate that monetary and fiscal policies will substantially change in the future, which supports our base case that the correlation between equities and bonds will stay negative for the foreseeable future.

However, correlation tells only part of the story. Correlation provides an estimate of how two variables are linearly related. That means, for example, that if we assume the correlation between equities and government bonds to be negative, we expect that when equity returns are below their historical mean, government bond returns will be above their historical mean, and vice versa.

Correlation has two main limitations: It provides only an estimate of the average relationship, whereas investors are generally more interested in how bonds respond when equities plummet. And it does not indicate the magnitude of the relationship between equities and bonds. In fact, correlation does not tell us anything about how much bond returns might increase during an equity market downturn. For these reasons, it is important to assess the actual performance of different assets, including bonds, when U.S. equities have performed poorly.

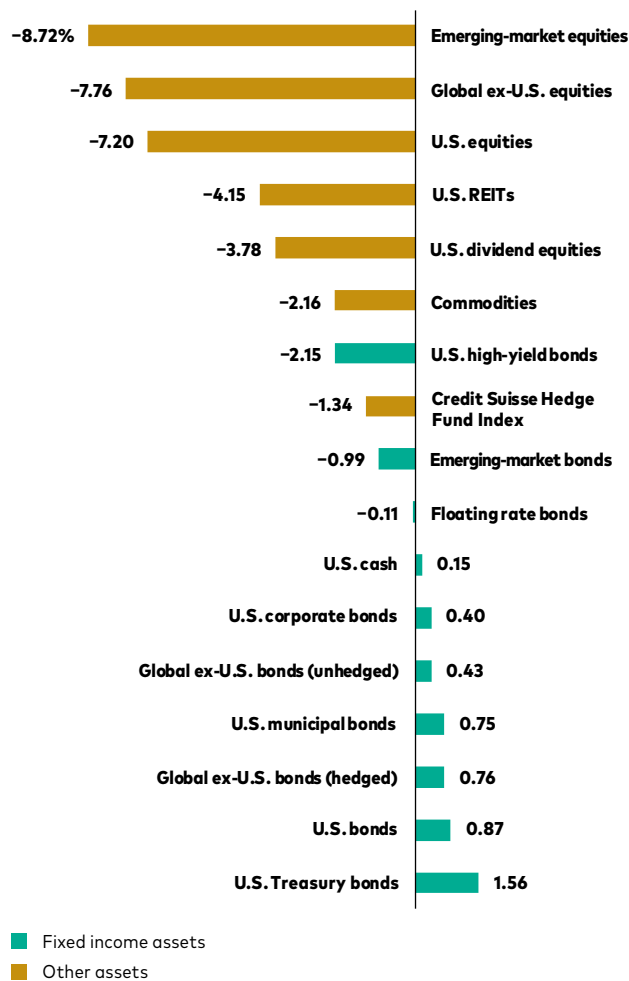
Figure 2 quantifies the performance of fixed income assets during periods of poor equity performance. Looking at the months when U.S. equity returns were in the lowest decile, since January 1988, we plot the median return for other assets in the same

months. Consistent with previous studies (e.g., Westaway and Thomas, 2013, Philips et al., 2013, and Renzi-Ricci and Baynes, 2021), the figure shows how the negative correlation we observed in Figure 1 works to the investor's benefit, with high-quality bonds exhibiting positive returns in contrast to the negative returns of equities and other riskier assets such as real estate investment trusts (REITs) and commodities.

Figure 2 also illustrates that even during the worst decile of U.S. equity returns, emerging-market equities (-8.7%) and global ex-U.S. equities (-7.8%) actually performed worse than their U.S. counterparts (-7.2%). This shows that globally diversifying an equity portfolio may not be enough to offer protection against U.S. equity underperformance because of the correlation across global equity markets. If an investor is seeking greater downside protection against U.S. equity market risk, then a well-diversified portfolio containing stocks and bonds seems to be the answer. In fact, during periods of equity market stress, high-quality fixed income acted as ballast, cushioning the losses in the equity portion of the portfolio.

FIGURE 2.

Median return of various assets during the worst decile of monthly U.S. equity returns from January 1988 to March 2021



Notes: Emerging-market equities are represented by the MSCI Emerging Markets Index; global ex-U.S. equities by the MSCI AC World ex-USA Index; U.S. equities by the Dow Jones U.S. Total Stock Market Index; U.S. REITs by the FTSE/NAREIT Real Estate Index; U.S. dividend equities by the Dow Jones U.S. Select Dividend Index; commodities by the Bloomberg Commodity Index; U.S. high-yield bonds by the Bloomberg U.S. Corporate High Yield Bond Index; emerging-market bonds by the Bloomberg EM USD Sovereign Index; floating rate bonds by the Credit Suisse Leveraged Loan Index; U.S. cash by U.S. Government 3-Month T-Bill Yield; U.S. corporate bonds by the Bloomberg U.S. Corporate Index; global ex-U.S. bonds by the Bloomberg Global Aggregate ex-USD Bond Index; U.S. bonds by the Bloomberg U.S. Aggregate Bond Index; U.S. municipal bonds by the Bloomberg Municipal Bond Index; and U.S. Treasury bonds by the Bloomberg U.S. Treasury Bond Index. All data begin in January 1988, other than the Dow Jones U.S. Select Dividend Index, which begins in January 1992; the Bloomberg Commodity Index, in February 1991; the Bloomberg U.S. Corporate High Yield Bond Index, in February 1988; the Credit Suisse Hedge Fund Index, in January 1994; the Bloomberg EM USD Sovereign Index, in January 1993; and the Bloomberg Global Aggregate ex-USD Bond Index, in January 1990 (unhedged) and in February 1990 (hedged).

Sources: Bloomberg and FactSet.

Of course, bonds are not all created equal. Some of the riskier, lower-quality bonds can more closely resemble equities during periods of equity market stress. Notably, high-yield credit and emerging-market bonds did have median negative returns over the sample period. However, their returns were still less negative than the equity returns. On the other hand, U.S. Treasury bonds, U.S. aggregate bonds, and global ex-U.S. bonds did provide more significant protection, delivering positive returns ranging from 0.76% to 1.65%.

The key point is that bonds are part of a multi-asset portfolio not to provide high returns, but rather to hedge against the risk of severe equity shocks, with government bonds in particular playing a critical role in diversifying risk during equity market corrections.

If this is the case, the next logical question is: What are the odds of an equity market correction?

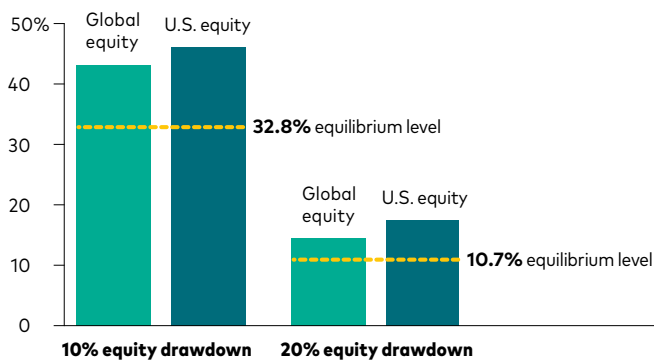
The likelihood of an equity market correction

As we discussed in our *Vanguard Economic and Market Outlook for 2021*,² even though global equity markets lost almost a third of their value in March 2020, markets have rebounded sharply. Global equities, as measured by the FTSE All-World Index, returned 55.1% for the year ended March 2021.

² For further details, see Davis et al. (2020).

Given the current high U.S. equity market valuations, the risk of a sharp downturn (defined as a drop of greater than 20% peak to trough) over the next three years, as shown in **Figure 3**, remains elevated at 18%. We estimate a 15% probability of a 20% downturn for global equities. We also estimate that U.S. equities have a 46% and global equities a 43% probability of decreasing by more than 10% over the next three years. These figures are higher than our long-term equilibrium estimates.

FIGURE 3.
Probability of equity market correction over the next three years



Notes: Probabilities correspond to the percentage of U.S. equity and global equity in 10,000 VCMM simulations that experience declines over the next three years, in USD. Returns do not take into account management fees and expenses, nor do they reflect the effect of taxes. Returns do reflect reinvestment of dividends and capital gains. The dashed yellow lines represent the probabilities for global equity in the market's long-term equilibrium state.

Source: Vanguard, as of March 31, 2021.

Overall, these metrics suggest a higher-than-normal probability of equity market correction over the short to medium term. This creates a stronger case for building well-diversified multi-asset portfolios with strong hedging characteristics. The role of bonds as a diversifying asset class is therefore more important than ever.

Bonds in a low and rising rate environment

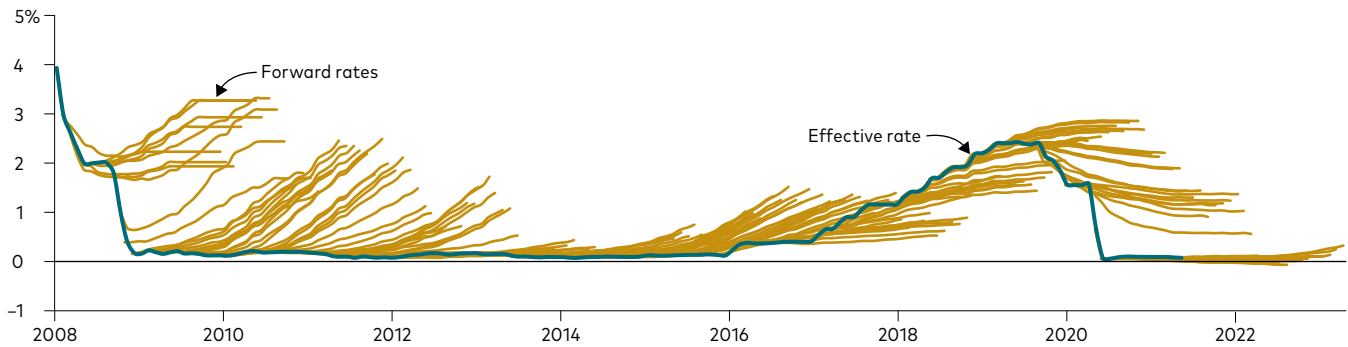
The enhanced probabilities of an equity market downturn create a compelling argument for holding bonds in a portfolio. Nevertheless, this relies on the assumption that the diversification benefits of bonds in the current yield environment are the same as those that investors have experienced since the late 1990s. For instance, do bonds also act as ballast in a rising rate environment? Investors often question this assumption. In this section, we expand our analysis and focus on the diversification properties of fixed income securities in a low and rising rate environment.

Predicting interest rate changes is notoriously difficult

It is worth acknowledging how difficult it is to accurately predict how and when interest rates will change. Predictions of rising rates over the last decade have been proven wrong time and time again. For example, investors often look at the implied forward rate as a proxy for future expected rates.³ As also illustrated in Davis et al. (2010), **Figure 4** shows the evolution of the U.S. federal funds effective rate from January 2008 to March 2021 and the market implied forward rates up to two years, at any point in time.

3 We do acknowledge that market implied forward rates are not necessarily unbiased proxies for market expectations of future short-term rates (see Ilmanen, 1996). The difference between implied forward rates and expected future short-term rates is called "term premium" and it has historically been positive. That is also one of the reasons why yield curves are, most of the time, upward sloping, unless markets expect an economic downturn in the near future.

FIGURE 4.
U.S. federal funds effective rate and forward rates



Notes: Monthly data are from January 31, 2008, to March 31, 2021. The federal funds effective rate is annualized. Forward rates are based on futures contracts with tenor of up to 2 years.

Source: Bloomberg.

The chart shows that although in most periods the market implied forward U.S. federal funds rate was expected to rise, the realized federal funds rates kept falling and ended significantly lower than the market predictions. This is just another example of how hard it can be, even for professional investors and the market as a whole, to accurately predict interest rate changes.

The different components of bond returns and rising rates

Although interest rate movements are hard to predict, investors still care a great deal about them because they directly affect the return of fixed income investments. This is understandable: Unlike other investments, such as equities, bonds have a well-defined stream of coupon payments.

Because of this income stream, bonds are uniquely affected by interest rate movements. If interest rates rise, bond prices will fall, reducing the total return on the investment. The opposite is true if interest rates fall. When analyzing expected bond returns, investors rely heavily on duration. Duration is the sensitivity of a bond’s price to changes in interest rates. Although duration is useful for rough estimates, it presents two key limitations:

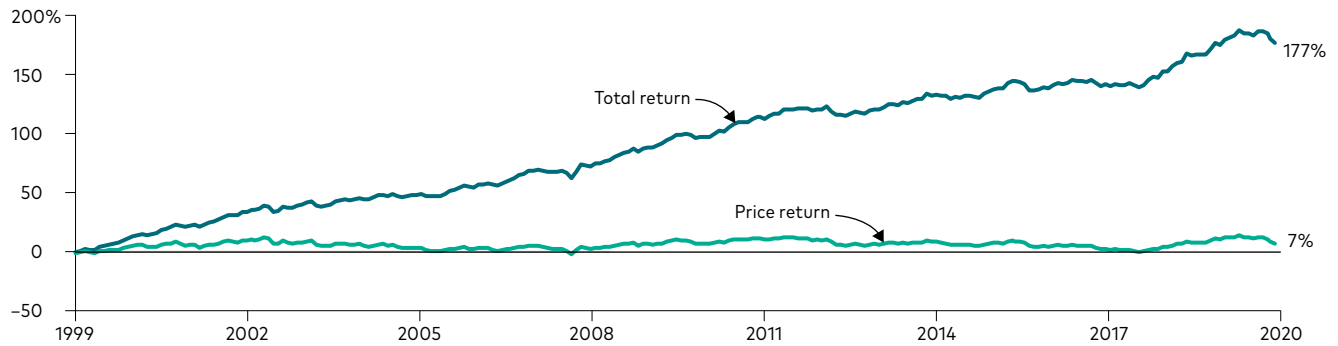
- It assumes a parallel shift of the yield curve, where yields of all maturities shift equally. This is a simplistic view of how interest rates will change over time.
- It can estimate instantaneous price return or capital gain/loss, but investors are best served by considering total returns over time. That is, the interest payments should not be ignored.

While rising interest rates can mute the performance of bonds over short time horizons, the impact of rising rates is often misunderstood.

Bond total returns have two main components: price return and return from income. Changes to interest rates cause these two components to move in opposite directions. Medium- to long-term investors should care about bond total returns instead of the negative short-term impact on bond prices. In fact, as we show in **Figure 5**, the long-term performance of bond investments has come mostly from income return, not price return.

While many investors may be concerned about the risk of a capital loss, it is important to consider any investment from the perspective of total return. This is better illustrated by looking at the evolution of the return components of a constant-maturity 5-year U.S. Treasury investment.

FIGURE 5.
Price return and total return for U.S. aggregate bonds



Notes: Monthly data are from December 31, 1999, to March 31, 2021. U.S. aggregate bonds are represented by the Bloomberg U.S. Aggregate Index in USD. All bond income is assumed to be reinvested.

Source: Bloomberg.

Figure 6 illustrates future returns that would be realized based on the changes in interest rates implied by the forward curve as of the end of March 2021.⁴ As do Westaway, Schlanger, and Kesidis (2015), Figure 6a shows that even though the stream of price returns is negative over the next five years, the investor's total return is actually positive in every single year. This is because the negative price impact dictated by the upward slope of the U.S. Treasury yield curve is more than offset by reinvesting in Treasury bonds that have higher yields.

In Figure 6b, we go one step further and assume that immediately after an investor purchases the 5-year Treasury note at the beginning of the first year, the yield curve shifts upward by 50 basis

points across all maturities in addition to the rise in rates implied by the forward curve. (A basis point is one-hundredth of a percentage point.) In this case, the one-year impact on the price return is noticeably more severe (–2.8% versus –0.9%) and, after two years, the cumulative total return of the investment is still negative at –1.1%. However, by the end of the fifth year, an investor would have reinvested at higher yields and, even in this extreme case, realized a cumulative total return of 5%.

Clearly, just focusing on capital losses ignores the bigger picture. In an environment where rates are expected to rise, the higher yields of longer-term bonds reflect the trade-offs of short-term capital loss versus higher income. In other words, investors suffer a short-term pain for a long-term gain.

FIGURE 6.

The return components of a 5-year U.S. Treasury investment

a. 5-year U.S. Treasury spot curve

	Year 1	Year 2	Year 3	Year 4	Year 5
Yield change (basis points)	47	46	35	22	12
Income return	1.0%	1.4%	1.9%	2.3%	2.5%
Price return	–0.9%	–1.2%	–1.0%	–0.6%	–0.4%
Annual total return	0.1%	0.3%	0.9%	1.6%	2.1%
Cumulative total return	0.1%	0.3%	1.2%	2.9%	5.0%

b. 5-year U.S. Treasury spot curve with a +50-basis-point parallel shift at the beginning of Year 1

	Year 1	Year 2	Year 3	Year 4	Year 5
Yield change (basis points)	96	46	35	22	12
Income return	1.0%	1.9%	2.4%	2.7%	3.0%
Price return	–2.8%	–1.2%	–1.0%	–0.6%	–0.4%
Annual total return	–1.9%	0.8%	1.4%	2.1%	2.6%
Cumulative total return	–1.9%	–1.1%	0.3%	2.4%	5.0%

Notes: The U.S. Treasury spot curve is derived from active U.S. Treasury bonds as of March 31, 2021. Figure 6a shows the returns of a 5-year U.S. Treasury investment, assuming rates change following the forward curve derived from the spot curve as of March 31, 2021. Figure 6b assumes that the U.S. Treasury spot curve has a positive 50-basis-point parallel shift at the very beginning of Year 1, just after the investor has purchased the 5-year Treasury note.

Source: Bloomberg.

⁴ We assume that an investor purchases a 5-year U.S. Treasury note, holds it for one year, and then sells it, reinvesting the proceeds in a new 5-year U.S. Treasury note. This approximates the performance characteristics of a portfolio, where maturity stays constant.

Now that we have investigated the possible effect of rising rates on the total return of bonds for medium- to long-term investors, we look at what our VCMM asset return projections tell us for the years to come. That gives us insight into what investors should expect from investing in fixed income assets and the effect of the current yield curve on future returns.

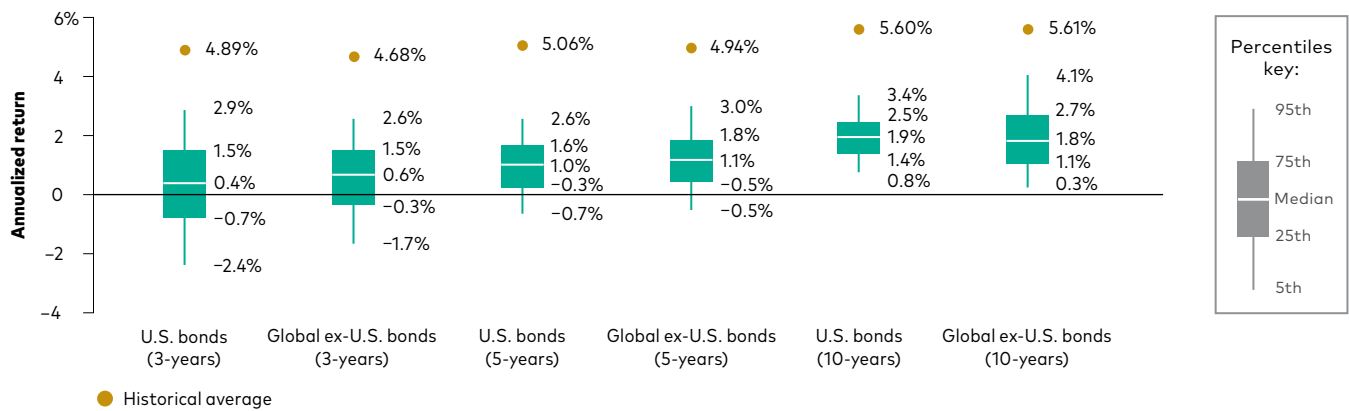
Our projections already have a modest rate increase built in. **Figure 7** shows that, over the next 10 years, the return on bonds is projected to increase from around 0.4% for U.S. bonds (0.6% for global ex-U.S. bonds) on an annualized basis over the next three years—up to 1.9% for U.S. bonds (1.8% for global ex-U.S. bonds) over the full 10-year period. This is consistent with an upward sloping yield curve.

Against a backdrop of lower yields across the curve, as we would have expected, these return forecasts are lower than the historical average. As explained by Philips et al. (2014), global ex-U.S. bonds are able to offset some risk specific to rising U.S. rates because of diversification that arises from imperfect correlations of interest rate movements in other countries.

Despite current conditions and the lower-than-normal expected bond returns, we still believe that bonds are likely to remain one of the best diversifiers of equity market risk and that they will likely provide downside protection to investors in balanced portfolios over the long term. We expand on this point in the next section.

FIGURE 7.

Distribution of annualized returns for U.S. and global ex-U.S. bonds over different time horizons



Notes: The figure uses VCMM simulations as of March 31, 2021, and forecasts are in USD. The historical average is the mean over the last 20 years from March 31, 2001, to March 31, 2021. U.S. bonds are represented by the Bloomberg U.S. Aggregate Index and global ex-U.S. bonds by the Bloomberg Aggregate ex-USD Total Return Index (Hedged USD).
Source: Bloomberg.

Bond returns when equities fall in the low-yield environment

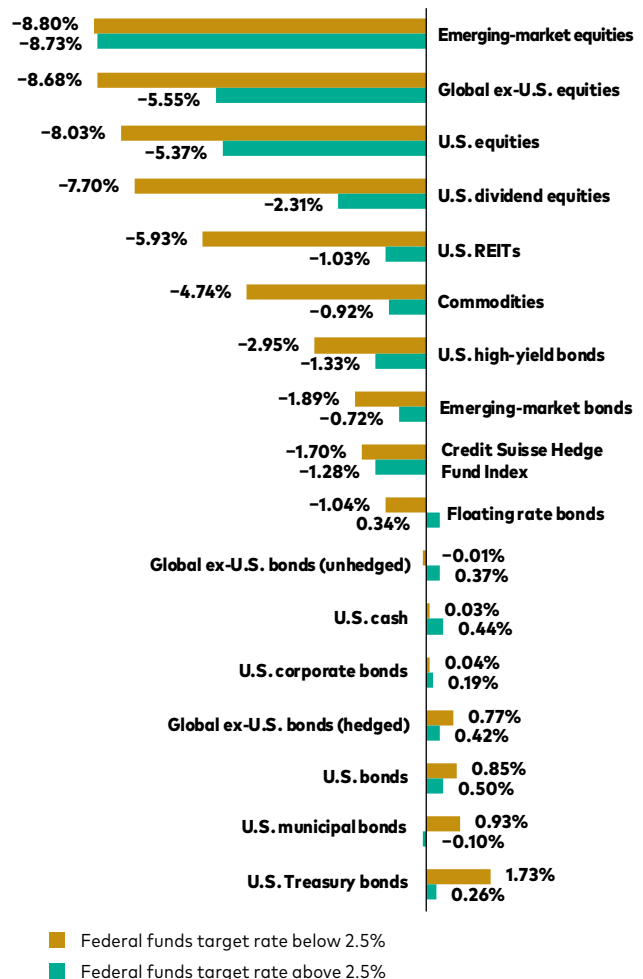
Figure 2 showed that during periods of equity market stress, measured as the worst decile of monthly U.S. equity returns, high-quality fixed income historically has acted as ballast, providing positive returns. However, in that analysis, we included all periods, independent of their yield environment.

Given the current low-yield environment, it would be sensible to question whether our earlier conclusions extend to low-yield environments as well. The simple answer is yes: In low-yield environments, high-quality bonds have actually offered more downside protection.

Figure 8 takes the worst decile of equity monthly returns and puts them into two groups, based on the level of the U.S. federal funds target rate.⁵ The first thing to note is that, regardless of the federal funds rate, the overall trend prevails: When equities are underperforming, bonds can offer better returns. However, this pattern is accentuated when the federal funds rate is lower, with equity returns more negative and bond returns more positive.⁶

FIGURE 8.

Median return of various asset classes during the worst decile of monthly U.S. equity returns split by yield environment from January 1988 to March 2021



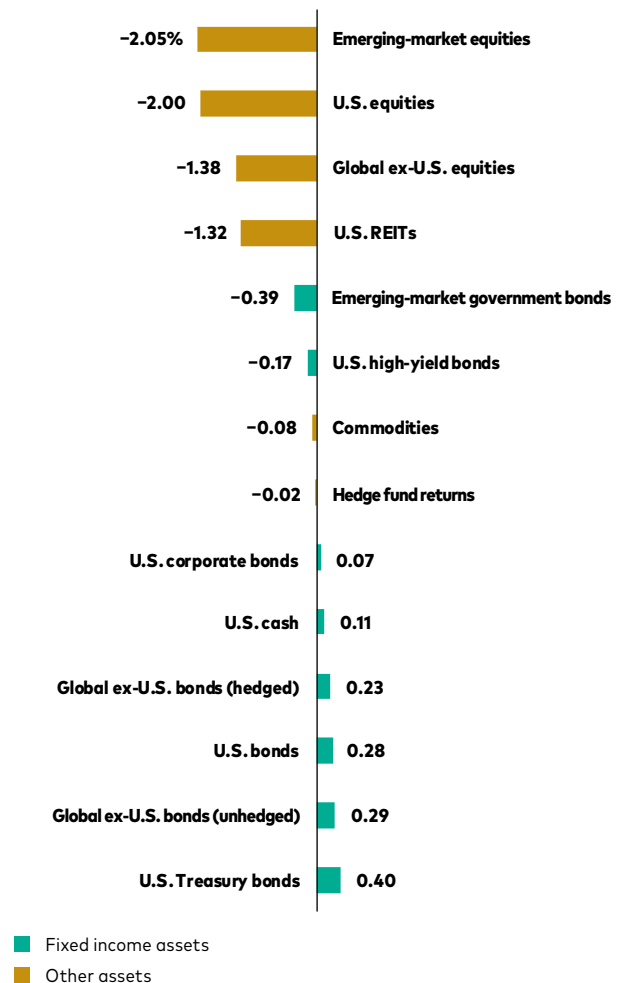
Notes: Emerging-market equities are represented by the MSCI Emerging Markets Index; global ex-U.S. equities by the MSCI AC World ex-USA Index; U.S. equities by the Dow Jones U.S. Total Stock Market Index; U.S. REITs by the FTSE/NAREIT Real Estate Index; U.S. dividend equities by the Dow Jones U.S. Select Dividend Index; commodities by the Bloomberg Commodity Index; U.S. high-yield bonds by the Bloomberg U.S. Corporate High Yield Bond Index; emerging-market bonds by the Bloomberg EM USD Sovereign Index; floating rate bonds by the Credit Suisse Leveraged Loan Index; U.S. cash by the U.S. Government 3-Month T-Bill Yield; U.S. corporate bonds by the Bloomberg U.S. Corporate Index; global ex-U.S. bonds by the Bloomberg Global Aggregate ex-USD Bond Index; U.S. bonds by the Bloomberg U.S. Aggregate Bond Index; U.S. municipal bonds by the Bloomberg Municipal Bond Index; and U.S. Treasury bonds by the Bloomberg U.S. Treasury Bond Index. The federal funds target rate is the upper boundary of the target range where applicable. All data begin in January 1988, other than the Dow Jones U.S. Select Dividend Index, which begins in January 1992; the Bloomberg Commodity Index, which begins in February 1991; the Bloomberg U.S. Corporate High Yield Bond Index, which begins in February 1988; the Credit Suisse Hedge Fund Index, which begins in January 1994; the Bloomberg EM USD Sovereign Index, which begins in January 1993; and the Bloomberg Global Aggregate ex-USD Bond Index, which begins in January 1990 (unhedged) and February 1990 (hedged).
Sources: Bloomberg and FactSet.

- The 2.5% threshold is used because it is approximately the median of the federal funds rate in the worst decile of months. After grouping the data with this threshold, we have 20 months of data in which the federal funds rate is below 2.5% and 21 months in which it is above 2.5%.
- These findings are consistent with the results in Renzi-Ricci and Baynes (2021), where the authors focused on the diversification benefits of bonds in the low-yield environment in the U.K. and Germany.

Now that we have explored the historical performance of bonds when equities nosedive, we turn to our VCMM projections to assess how this relationship might persist for certain asset classes in the future, since we do forecast that the low-yield environment will persist. In **Figure 9**, based on annualized return projections and examining the worst decile of years for U.S. equity returns over the next 10 years, we compute the median return for numerous other asset classes.⁷ These returns are then converted from yearly to monthly returns to maintain consistency.⁸

The trend that we noticed using historical data in Figures 2 and 8 also emerges when we use VCMM projections: Equity underperforms and the safer bonds (U.S. bonds, global ex-U.S. bonds, and U.S. Treasury bonds) offer the best return. Riskier bonds (emerging-market government bonds and U.S. high-yield bonds) are somewhere in the middle in terms of performance.

FIGURE 9.
Median monthly returns of various asset classes during the worst decile of annualized U.S. equity returns across VCMM simulations over the next 10 years



Notes: We use VCMM simulations as of March 31, 2021, and forecasts are in USD. For the indexes underlying asset classes, see the Appendix.
Source: Vanguard.

⁷ We currently do not provide VCMM projections for all the asset classes reported in Figure 8. That is why Figure 9 shows a smaller set of asset classes.
⁸ It is worth noting that since the forecasted data were yearly (not monthly, as was the case for the historical data for Figures 2 and 8), these returns are less extreme because the data are less granular and the worst returns are averaged out over the course of a year.

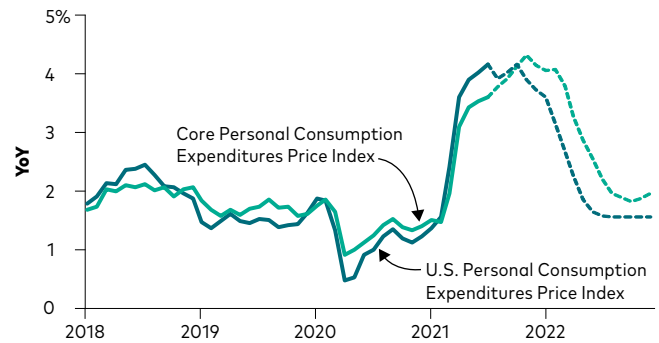
The elephant in the room: Inflation

In 2020, global economies suffered a major setback because of COVID-19. As a result, U.S. inflation fell to about 0.5% in the second quarter of 2020 before rapidly increasing in the first quarter of 2021. We expect both headline and core U.S. inflation to decline in the months ahead and moderate as the temporary drivers run their course. Specifically, we expect two key factors to drive inflation in the coming months:

- **Base effects**—the comparison of prices this year with their low levels a year earlier: The U.S. Personal Consumption Expenditures (PCE) Price Index began to rise in the second half of 2020, after its decline earlier in the year. The low base of inflation in the first half of 2020 is one transitory reason to have expected the high levels of inflation in the first half of 2021. Because PCE recovered in the second half of 2020, we expect inflation to decline from its peak in the second half of 2021 into 2022.
- **A mismatch in supply and demand:** As the pandemic shuttered economic activity, demand and supply for goods and services dried up. Demand began to increase as the economy reopened and consumers had cash from government stimulus programs to spend. However, supply took longer to get back to pre-pandemic levels. This mismatch in supply and demand could have helped push prices higher. We expect this mismatch to lessen, allowing prices to return to more normal levels.

For these reasons, as shown in **Figure 10**, we expect that headline inflation, as measured by PCE, will have peaked just below 4.2% as of July 2021 before peaking at the same level in October 2021. We expect core PCE, which excludes more volatile food and energy prices, to peak at just above 4.3% in November. These figures reflect comparisons with index levels from the same month a year earlier.

FIGURE 10.
U.S. PCE and core PCE forecasts



Notes: Data are as of July 31, 2021. The dotted lines represent our forecast for the inflation index. The forecast is obtained from Vanguard proprietary inflation forecasting models. Core PCE removes the more volatile food and energy components of inflation.

Sources: Moody's Data Buffet and Refinitiv.

Longer term, Vanguard expects inflation to moderate after peaking in the fourth quarter of 2021, with headline PCE declining to between 1.5% and 1.8% in the second half of 2022. We expect core PCE to fall below 2% in the second half of 2022 but stay above the headline PCE level, between 1.8% and 2%.

What does this imply for investors' portfolios? Higher inflation brings with it the prospect of near-term pain for investment portfolios, with prices on existing bonds pressured as investors seek new bonds with higher yields and with stocks appearing less attractive on a relative basis. A sustained rise in inflation would eventually mean that the Federal Reserve raises interest rates from near zero. Because interest rates have been so low for so long, adjusting to this new reality will take time. However, we would expect the impact on asset returns to last only as long as the inflation shock persists. Portfolios can be in position to recover over the medium term as inflation levels return to near the Fed's 2% target.

We do not anticipate a return to an extreme scenario of ever-accelerating inflation, in which markets can't keep up despite their pricing attempts. The Fed and central banks around the developed world appreciate the dangers of runaway inflation and would work to counter it.

Debunking a few misconceptions about bonds

In a low-rate environment, investors may worry about the low level of income from investing in bonds. For this reason, it is often tempting to move toward high-income securities and use them as replacements for bonds. We debunk some common myths about income and fixed income securities.

Myth 1. High-dividend stocks substitute for bonds in today's environment.

High-dividend stocks are indeed expected to generate higher income than some other types of stocks, which can invite comparison with bonds. However, the risk profiles of high-dividend stocks and those of bonds are completely different. In fact, bonds are held in a multi-asset portfolio to diversify equity risk. As we can see from Figure 8, for instance, U.S. dividend equities have had negative returns similar to those of other equities during periods of worst performance for U.S. equities. This is to be expected, since their risk profile is that of an equity, and therefore they do not serve as a substitute for bonds. This does not mean that high-dividend stocks do not belong in a portfolio, just that they cannot be used as a substitute for fixed income.

Myth 2. If I am not greatly worried about stock volatility because my dividend income is more than adequate for my needs, there is no reason to own bonds.

An investor's asset allocation should be aligned with the individual's goals and risk tolerance and should be based on the total return of the investment rather than just the dividend component (Bupp et al., 2021). Holding a 100% equity portfolio may cause a risk-averse investor to sell equities during times of market distress, when the prices are lowest. Thus, aligning the portfolio with risk tolerance and one's goals helps maintain discipline and helps the investor avoid rash decisions. An investor with very high risk tolerance might indeed find optimal a portfolio with very limited or even no fixed income exposure. However, sufficient dividend income itself does not imply that one should not hold bonds.

Myth 3. If the equity downside protection feature of bonds disappeared, there would be no role for bonds in a portfolio.

Even if bonds played a lesser role in diversifying equity risk and acting as a buffer when equities struggle, not every investor would invest only in equities and risky assets. Investors with higher risk aversion, who can tolerate only reasonably low levels of volatility—as well as investors who are primarily interested in capital preservation or who have liability-driven goals—would still hold a significant portion of their portfolio in fixed income assets. This is simply because bonds reduce the dispersion of possible future outcomes, thus making the portfolio more suitable for those who cannot handle high levels of uncertainty.

Practical portfolio applications for financial advisors

We have shown how the diversification properties of bonds hold even when yields are low and that longer-term investors should not worry about rising rates and higher inflation expectations. In this section, we discuss some practical implications and what they mean for investors' portfolios. We compare two portfolios: one a "typical" U.S. advisor portfolio and one an optimized portfolio constructed using the Vanguard Asset Allocation Model (VAAM), our model for building portfolios based on full-scale optimization (see Aliaga-Díaz et al., 2020).

In the first quarter of 2021, we saw a continuation of trends from the last quarter of 2020. Risk assets continued to rally, which resulted in a continued expansion in valuations and a compression of credit spreads across most markets. Specifically, in the first quarter of 2021 we saw larger valuation expansions in equity markets outside the U.S., causing global ex-U.S. equity return expectations to decline faster than their U.S. counterparts. Also, our

outlook for lower-trend GDP growth and its impact on corporate revenue growth leads to a guarded outlook for global equities. We expect global equities to return 3.9%–5.9% over the next decade, based on VCMM projections. Further, we still do not expect the trends that have defined the last decade to persist. Namely, we expect equity markets outside the U.S. to outperform, largely because of lower valuations and a higher dividend yield.

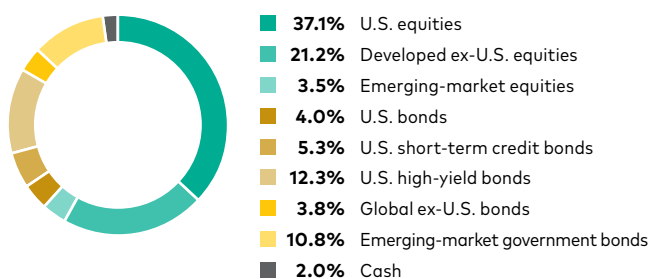
VAAM uses VCMM return forecasts over the next 10 years, which price in the current low yields and the chance of a rise in rates. This comparison allows us to assess the portfolio tilts that could be made to improve the outlook for an investor, given the current market environment.

For fairness, the optimized portfolio is calibrated to a level of risk aversion that incorporates a 60% equity allocation—the same as the typical advisor portfolio—and both portfolios contain the same assets. The optimized portfolio is subject to some relative constraints and requires a minimum of 2% allocation to cash for rebalancing purposes. We show both portfolios in **Figure 11**.

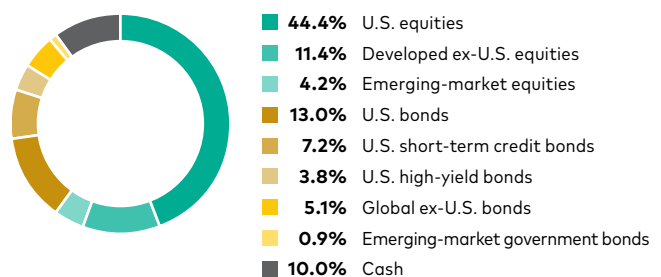
FIGURE 11.

Asset allocations for an optimized portfolio versus a "typical" U.S. advisor portfolio with 60% equity holdings

a. Optimized portfolio



b. U.S. advisor portfolio



Notes: VCMM simulations are as of March 31, 2021, in USD and use a 10-year investment horizon. The following constraints apply for the optimized portfolio: Emerging-market equity is no more than 20% of total equity; U.S. equity is at least 60% of total equity; U.S. high-yield bonds make up no more than 70% of the combined weight of U.S. credit bonds and U.S. high-yield bonds; U.S. high-yield bonds plus U.S. credit bonds are no more than 50% of total bonds; emerging-market government bonds are no more than 30% of total bonds; global ex-U.S. bonds are at least 10% of total bonds; and U.S. cash is at least 2% of the total portfolio. The U.S. advisor portfolio has been created by aggregating all advisors' model portfolios that are part of Vanguard's Portfolio Analytics & Consulting (PA&C) service in the United States as well as Vanguard's Online Portfolio Analytics Tool. Advisors' portfolios are aggregated by equally weighting each advisor's portfolio across every asset class. Vanguard's PA&C was servicing around 14,000 different portfolios as of January 2019.

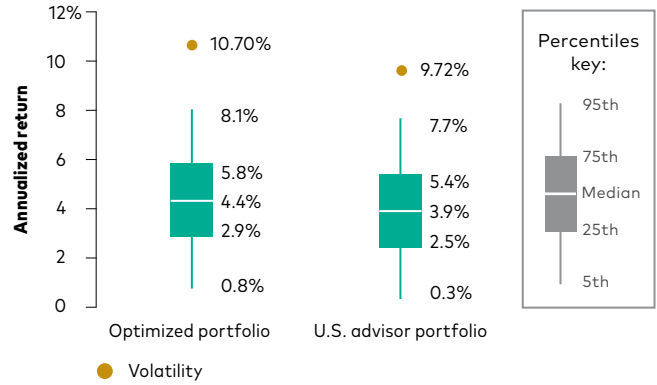
Source: Vanguard.

Though the focus of this paper is on the role of fixed income, we do offer one quick note on the equity allocation. Our optimized portfolio suggests that advisors could be overweighting U.S. equities. A higher developed-economy ex-U.S. equity allocation would be more suitable given our forecasts, which predict the annualized 10-year median return for developed ex-U.S. equities at 6.7% versus 3.6% for U.S. equities.

As for fixed income, we note that a typical U.S. advisor could actually shift some of the fixed income holdings out of safer U.S. bonds, for which we predict an annualized 10-year median return of 1.9%, and into slightly riskier fixed income assets such as U.S. high-yield bonds and emerging markets government bonds. We expect a median return of 2.7% for U.S. high-yield bonds and 2.6% for emerging markets government bonds. Importantly, we find that certain high-yielding assets, such as U.S. high-yield corporates and emerging markets government bonds, have non-zero weights in an optimized portfolio from a total return perspective, given their risk-return trade-offs.

To demonstrate the outperformance of the optimized portfolio in **Figure 12**, we report the distribution of the portfolios' returns and the accompanying volatility based on our forecasts over the next 10 years.

FIGURE 12.
Distribution of annualized returns and median volatility for an optimized portfolio versus a "typical" U.S. advisor portfolio with 60% equity holdings



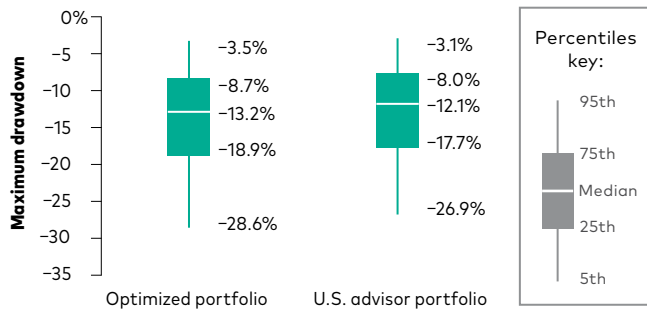
Notes: We use VCMM simulations as of March 31, 2021, in USD using a 10-year investment horizon. The following constraints apply for the optimized portfolio: Emerging-market equity is no more than 20% of total equity; U.S. equity is at least 60% of total equity; U.S. high-yield bonds make up no more than 70% of the combined weight of U.S. credit bonds and U.S. high-yield bonds; U.S. high-yield bonds plus U.S. credit bonds are no more than 50% of total bonds; emerging-market government bonds are no more than 30% of total bonds; global ex-U.S. bonds are at least 10% of total bonds; and U.S. cash is at least 2% of the total portfolio.

Source: Vanguard.

In Figure 12, we immediately notice that the median return of the optimized portfolio is greater than the advisor's portfolio (4.4% versus 3.9%). However, this does come with additional volatility (10.7% versus 9.7%). As a result, the optimized portfolio has a larger median Sharpe ratio than the advisor's portfolio (0.23 versus 0.20). Last but not least, the 5th percentile return of the optimized portfolio is higher than that of a typical portfolio.

Volatility is commonly used to quantify the risk of a portfolio, but there are other important risk dimensions to consider. One important measure is the maximum drawdown (the largest peak-to-trough decline over the investment horizon) of a portfolio. This measure of downside risk is worth considering, especially for investors who cannot bear shorter-term losses in their portfolio. In **Figure 13**, we show the distribution of the maximum drawdown for both portfolios.

FIGURE 13.
Distribution of maximum drawdowns for an optimized portfolio versus a "typical" U.S. advisor portfolio with 60% equity holdings



Notes: We use VCMM simulations as of March 31, 2021, in USD using a 10-year investment horizon. The following constraints apply for the optimized portfolio: Emerging-market equity is no more than 20% of total equity; U.S. equity is at least 60% of total equity; U.S. high-yield bonds are no more than 70% of U.S. credit bonds plus U.S. high-yield bonds; U.S. high-yield bonds plus U.S. credit bonds are no more than 50% of total bonds; emerging-market government bonds are no more than 30% of total bonds; global ex-U.S. bonds are at least 10% of total bonds; and U.S. cash is at least 2% of the total portfolio.

Source: Vanguard.

In this case, we see that the optimized portfolio has marginally greater drawdowns than the advisor's portfolio, suggesting that the optimized portfolio delivers in expected performance while exposing the investor to marginally more drawdown risk.

However, one advantage of using an expected utility maximization approach such as VAAM for constructing optimized portfolios is that two or more portfolios can be directly compared by computing their expected utility. In fact, the utility score captures both risk and return trade-offs in a single measure. The portfolio with the largest expected utility is deemed optimal.

Utility scores do not have any economic meaning, however—they are mathematical artifacts. The certainty equivalent (CE) allows us to compare the relative preference for different portfolios for an investor with a given level of risk aversion. Specifically, the CE is the guaranteed return that an investor would accept, rather than receive a potentially higher but uncertain return in the future. In our case, the difference in CE between the optimized portfolio and the advisor's portfolio is 0.45% per year. This means that, all else being equal, an investor would require 0.45% of risk-free return per year in addition to the return from the advisor's portfolio in order to find it as desirable as the optimized portfolio.

Conclusion

Given today's low-yield environment and associated low expected fixed income returns, investors are questioning the role of bonds in a portfolio. To be clear, the role of bonds is to act as ballast and provide downside protection during equity market drawdowns, rather than to generate outsized returns. Moreover, high-quality bonds have, on average, generated positive returns in both low-rate and high-rate environments. This key feature of bonds is even more important when the odds of an equity market correction are higher than normal, such as in the current environment.

While it is notoriously difficult to predict when rates will rise, it is critical to remember that rising rates result in short-term capital losses but long-term higher income. Very often, investors neglect the importance of the latter.

Given our market outlook and the current environment, we find that non-U.S. bonds and equities can add value to a portfolio based on their risk, return, and correlation properties. Also, certain high-yielding fixed income assets such as U.S. high-yield corporate bonds and emerging-market government bonds do have non-zero weights in an optimized portfolio. However, it is vital to construct such portfolios using a robust framework in order to manage drawdown risk and increase expected returns at the same time.

References

Aliaga-Díaz, Roger, Giulio Renzi-Ricci, Ankul Daga, and Harshdeep Ahluwalia, 2020. Portfolio Optimization With Active, Passive, and Factors: Removing the Ad Hoc Step. *The Journal of Portfolio Management* 46(4): 39–51.

Bupp, Jacob, David Pakula, Ankul Daga, and Andrew S. Clarke, 2021. *Total-Return Investing: A Smart Response to Shrinking Yields*. Valley Forge, Pa.: The Vanguard Group.

Davis, Joseph, Roger A. Aliaga-Díaz, Peter Westaway, Qian Wang, Andrew J. Patterson, Kevin DiCiurcio, Alexis Gray, Jonathan Lemco, and Joshua M. Hirt, 2020. *Vanguard Economic and Market Outlook for 2021: Approaching the Dawn*. Valley Forge, Pa.: The Vanguard Group.

Davis, Joseph H., Roger Aliaga-Díaz, Harshdeep Ahluwalia, Frank Polanco, and Christos Tasopoulos, 2014. *Vanguard Global Capital Markets Model*. Valley Forge, Pa.: The Vanguard Group.

Davis, Joseph, Roger Aliaga-Díaz, Donald Bennyhoff, Andrew Patterson, and Yan Zilbering, 2010. *Deficits, the Fed, and Rising Interest Rates: Implications and Considerations for Bond Investors*. Valley Forge, Pa.: The Vanguard Group.

Ilmanen, Antti, 1996. Market's Rate Expectations and Forward Rates. *The Journal of Fixed Income* 6(2): 8–22.

Ilmanen, Antti, 2003. Stock-Bond Correlations. *The Journal of Fixed Income* 13(2): 55–66.

Philips, Christopher B., Francis M. Kinniry Jr., Brian J. Scott, Michael A. DiJoseph, and David J. Walker, 2013. *Risk of Loss: Should the Prospect of Rising Rates Push Investors from High-Quality Bonds?* Valley Forge, Pa.: The Vanguard Group.

Philips, Christopher B., Joseph H. Davis, Andrew J. Patterson, and Charles J. Thomas, 2014. *Global Fixed Income: Considerations for Fixed Income Investors*. Valley Forge, Pa.: The Vanguard Group.

Renzi-Ricci, Giulio, and Lucas Baynes, 2021. *Hedging Equity Downside Risk With Bonds in the Low-Yield Environment*. Valley Forge, Pa.: The Vanguard Group.

Shen, Junying, and Noah Weisberger, 2021. *US Stock-Bond Correlation: What Are the Macroeconomic Drivers?* PGIM Institutional Advisory & Solutions.

Westaway, Peter, Todd Schlanger, and Savas Kesidis, 2015. *Bond Investing in a Rising Rate Environment*. Valley Forge, Pa.: The Vanguard Group.

Westaway, Peter, and Charles Thomas, 2013. *Why Own Bonds When Yields are Low?* Valley Forge, Pa.: The Vanguard Group.

Appendix

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.

Indexes for VCMM forecasts

Emerging-market equities

MSCI Emerging Markets Index

U.S. equities

MSCI US Broad Market Index

Global ex-U.S. equities

MSCI All Country World ex USA Index

Developed ex-U.S. equities

MSCI World ex USA Index

U.S. REITs

FTSE/NAREIT US Real Estate Index

Emerging-market government bonds

Bloomberg EM USD Sovereign—10% Country Capped

U.S. high-yield corporate bonds

Bloomberg U.S. High Yield Corporate Bond Index

Commodities

Bloomberg Commodity Index

Hedge fund returns

Credit Suisse Hedge Fund Index

U.S. corporate bonds

Bloomberg U.S. Credit Bond Index

Global ex-U.S. bonds

Bloomberg Global Aggregate ex-USD Index

U.S. bonds

Bloomberg U.S. Aggregate Bond Index

U.S. Treasury bonds

Bloomberg U.S. Treasury Index

U.S. short-term credit bonds

Bloomberg U.S. 1–3 Year Credit Bond Index

U.S. cash

U.S. 3-Month Treasury Bill rate

Connect with Vanguard®

All investing is subject to risk, including the possible loss of the money you invest.

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.

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.

Diversification does not ensure a profit or protect against a loss.

The Vanguard logo, featuring the word "Vanguard" in a bold, red, serif font with a registered trademark symbol.

© 2021 The Vanguard Group, Inc.
All rights reserved.

ISGROB 112021

Important Information

VIGVIGM, S.A. de C.V. Asesor en Inversiones Independiente ("Vanguard Mexico") registration number: 30119-001-(14831)-19/09/2018. The registration of Vanguard Mexico before the Comisión Nacional Bancaria y de Valores ("CNBV") as an Asesor en Inversiones Independiente is not a certification of Vanguard Mexico's compliance with regulation applicable to Advisory Investment Services (Servicios de Inversión Asesorados) nor a certification on the accuracy of the information provided herein. The supervision scope of the CNBV is limited to Advisory Investment Services only and not all services provided by Vanguard Mexico.

This material is solely for informational purposes and does not constitute an offer or solicitation to sell or a solicitation of an offer to buy any security, nor shall any such securities be offered or sold to any person, in any jurisdiction in which an offer, solicitation, purchase or sale would be unlawful under the securities law of that jurisdiction. Reliance upon information in this material is at the sole discretion of the recipient.

Securities information provided in this document must be reviewed together with the offering information of the securities which may be found on Vanguard's website: <https://www.vanguardmexico.com/web/cf/mexicoinstitutional/en/home> or www.vanguard.com

Vanguard Mexico may recommend products of The Vanguard Group Inc. and its affiliates and such affiliates and their clients may maintain positions in the securities recommended by Vanguard Mexico.

ETFs can be bought and sold only through a broker and cannot be redeemed with the issuing fund other than in very large aggregations. Investing in ETFs entails stockbroker commission and a bid-offer spread which should be considered fully before investing. The market price of ETF Shares may be more or less than net asset value.

All investments are subject to risk, including the possible loss of the money you invest. Investments in bond funds are subject to interest rate, credit, and inflation risk. Governmental backing of securities applies only to the underlying securities and does not prevent share-price fluctuations. 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.

There is no guarantee that any forecasts made will come to pass. Past performance is no guarantee of future results.

Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks. Funds that concentrate on a relatively narrow market sector face the risk of higher share-price volatility. Stocks of companies are subject to national and regional political and economic risks and to the risk of currency fluctuations, these risks are especially high in emerging markets. Changes in exchange rates may have an adverse effect on the value, price or income of a fund.

The information contained in this material derived from third-party sources is deemed reliable, however Vanguard Mexico and The Vanguard Group Inc. are not responsible and do not guarantee the completeness or accuracy of such information.

This document should not be considered as an investment recommendation, a recommendation can only be provided by Vanguard Mexico upon completion of the relevant profiling and legal processes.

This document is for educational purposes only and does not take into consideration your background and specific circumstances nor any other investment profiling circumstances that could be material for taking an investment decision. We recommend getting professional advice based on your individual circumstances before taking an investment decision.

These materials are intended for institutional and sophisticated investors use only and not for public distribution.

Materials are provided only for the recipient's exclusive use and shall not be distributed to any other individual or entity. Broker-dealers, advisers, and other intermediaries must determine whether their clients are eligible for investment in the products discussed herein.

The information contained herein does not constitute an offer or solicitation and may not be treated as such in any jurisdiction where such an offer or solicitation is against the law, or to anyone for whom it is unlawful to make such an offer or solicitation, or if the person making the offer or solicitation is not qualified to do so.

THESE MATERIALS ARE PROVIDED AT THE REQUEST OF AND FOR THE EXCLUSIVE USE OF RECIPIENT AND CONTAIN HIGHLY CONFIDENTIAL INFORMATION, WHICH SHALL NOT BE REPRODUCED OR TRANSMITTED TO ANY THIRD PARTIES WITHOUT VANGUARD'S PRIOR WRITTEN CONSENT. THE CONTENTS OF THESE MATERIALS SHALL NOT BE UNDERSTOOD AS AN OFFER OR SOLICITATION TO BUY OR SELL SECURITIES IN BRAZIL AND VANGUARD IS NOT MAKING ANY REPRESENTATION WITH RESPECT TO THE ELIGIBILITY OF ANY RECIPIENT OF THESE MATERIALS TO ACQUIRE THE INTERESTS IN THE SECURITIES DESCRIBED HEREIN UNDER THE LAWS OF BRAZIL. SUCH SECURITIES HAVE NOT BEEN REGISTERED IN BRAZIL AND NONE OF THE INTERESTS IN SUCH SECURITIES MAY BE OFFERED, SOLD, OR DELIVERED, DIRECTLY OR INDIRECTLY, IN BRAZIL OR TO ANY RESIDENT OF BRAZIL EXCEPT PURSUANT TO THE APPLICABLE LAWS AND REGULATIONS OF BRAZIL PROVIDED AT THE REQUEST OF AND FOR THE EXCLUSIVE USE OF THE RECIPIENT. THE CONTENTS OF THIS DOCUMENT SHALL NOT BE UNDERSTOOD AS AN OFFER OR SOLICITATION TO BUY OR SELL SECURITIES IN BRAZIL AND VANGUARD IS NOT MAKING ANY REPRESENTATION WITH RESPECT TO THE ELIGIBILITY OF ANY RECIPIENT OF THIS DOCUMENT TO INVEST IN SECURITIES DESCRIBED HEREIN

This document is provided at the request of and for the exclusive use of the recipient and does not constitute, and is not intended to constitute, a public offer in the Republic of Colombia, or an unlawful promotion of financial/capital market products. The offer of the financial products described herein is addressed to fewer than one hundred specifically identified investors. The financial products described herein may not be promoted or marketed in Colombia or to Colombian residents, unless such promotion and marketing is made in compliance with Decree 2555/2010 and other applicable rules and regulations related to the promotion of foreign financial/capital market products in Colombia.

The financial products described herein are not and will not be registered before the Colombian National Registry of Securities and Issuers (Registro Nacional de Valores y Emisores - RNVE) maintained by the Colombian Financial Superintendency, or before the Colombian Stock Exchange. Accordingly, the distribution of any documentation in regard to the financial products described here in will not constitute a public offering of securities in Colombia.

The financial products described herein may not be offered, sold or negotiated in Colombia, except under circumstances which do not constitute a public offering of securities under applicable Colombian securities laws and regulations; provided that, any authorized person of a firm authorized to offer foreign securities in Colombia must abide by the terms of Decree 2555/2010 to offer such products privately to its Colombian clients.

The distribution of this material and the offering of securities may be restricted in certain jurisdictions. The information contained in this material is for general guidance only, and it is the responsibility of any person or persons in possession of this material and wishing to make application for securities to inform themselves of, and to observe, all applicable laws and regulations of any relevant jurisdiction. Prospective applicants for securities should inform themselves of any applicable legal requirements, exchange control regulations and applicable taxes in the countries of their respective citizenship, residence or domicile.

This offer conforms to General Rule No. 336 of the Chilean Financial Market Commission (Comisión para el Mercado Financiero). The offer deals with securities not registered under Securities Market Law, nor in the Securities Registry nor in the Foreign Securities Registry of the Chilean Financial Market Commission, and therefore such securities are not subject to its oversight. Since such securities are not registered in Chile, the issuer is not obligated to provide public information in Chile regarding the securities. The securities shall not be subject to public offering unless they are duly registered in the corresponding Securities Registry in Chile. The issuer of the securities is not registered in the Registries maintained by the Chilean Financial Market Commission, therefore it is not subject to the supervision of the Chilean Financial Market Commission or the obligations of continuous information.

Esta oferta se acoge a la norma de carácter general No. 336 de la Comisión para el Mercado Financiero. La oferta versa sobre valores no inscritos bajo la Ley de Mercado de Valores en el Registro de Valores o en el Registro de Valores extranjeros que lleva la Comisión para el Mercado Financiero, por lo que tales valores no están sujetos a la fiscalización de ésta. Por tratarse de valores no inscritos, no existe la obligación por parte del emisor de entregar en Chile información pública respecto de esos valores. Los valores no podrán ser objeto de oferta pública mientras no sean inscritos en el Registro de Valores correspondiente.

El emisor de los valores no se encuentra inscrito en los Registros que mantiene la Comisión para el Mercado Financiero, por lo que no se encuentra sometido a la fiscalización de la Comisión para el Mercado financiero ni a las obligaciones de información continua.

The securities described herein have not been registered under the Peruvian Securities Market Law (Decreto Supremo No 093-2002-EF) or before the Superintendencia del Mercado de Valores (the "SMV"). There will be no public offering of the securities in Peru and the securities may only be offered or sold to institutional investors (as defined in Appendix I of the Institutional Investors Market Regulation) in Peru by means of a private placement. The securities offered and sold in Peru may not be sold or transferred to any person other than an institutional investor unless such securities have been registered with the Registro Público del Mercado de Valores kept by the SMV. The SMV has not reviewed the information provided to the investor. This material is for the exclusive use of institutional investors in Peru and is not for public distribution.

The financial products described herein may be offered or sold in Bermuda only in compliance with the provisions of the Investment Business Act 2003 of Bermuda. Additionally, non-Bermudian persons may not carry on or engage in any trade or business in Bermuda unless such persons are authorized to do so under applicable Bermuda legislation. Engaging in the activity of offering or marketing the financial products described herein in Bermuda to persons in Bermuda may be deemed to be carrying on business in Bermuda.

Vanguard does not intend, and is not licensed or registered, to conduct business in, from or within the Cayman Islands, and the interests in the financial products described herein shall not be offered to members of the public in the Cayman Islands.

The financial products described herein have not been and will not be registered with the Securities Commission of The Bahamas. The financial products described herein are offered to persons who are non-resident or otherwise deemed non-resident for Bahamian Exchange Control purposes. The financial products described herein are not intended for persons (natural persons or legal entities) for which an offer or purchase would contravene the laws of their state (on account of nationality or domicile/registered office of the person concerned or for other reasons). Further, the offer constitutes an exempt distribution for the purposes of the Securities Industry Act, 2011 and the Securities Industry Regulations, 2012 of the Commonwealth of The Bahamas.

This document is not, and is not intended as, a public offer or advertisement of, or solicitation in respect of, securities, investments, or other investment business in the British Virgin Islands ("BVI"), and is not an offer to sell, or a solicitation or invitation to make offers to purchase or subscribe for, any securities, other investments, or services constituting investment business in BVI. Neither the securities mentioned in this document nor any prospectus or other document relating to them have been or are intended to be registered or filed with the Financial Services Commission of BVI or any department thereof.

This document is not intended to be distributed to individuals that are members of the public in the BVI or otherwise to individuals in the BVI. The funds are only available to, and any invitation or offer to subscribe, purchase, or otherwise acquire such funds will be made only to, persons outside the BVI, with the exception of persons resident in the BVI solely by virtue of being a company incorporated in the BVI or persons who are not considered to be "members of the public" under the Securities and Investment Business Act, 2010 ("SIBA").

Any person who receives this document in the BVI (other than a person who is not considered a member of the public in the BVI for purposes of SIBA, or a person resident in the BVI solely by virtue of being a company incorporated in the BVI and this document is received at its registered office in the BVI) should not act or rely on this document or any of its contents.

Vanguard[®]

Connect with Vanguard[®] > vanguardmexico.com

© 2021 The Vanguard Group, Inc.
All rights reserved.

ISGFBY 062021