Madison INVESTMENTS

BOND CONCEPTS

Correlation: The Importance of Quality in Fixed Income Allocations

In portfolio construction, understanding how each investment or asset class complements one another can be your most valuable ally in achieving a specified financial goal. Many investors turn to correlations to analyze the behavior of one investment with another. For instance, when the value of investment A rises, will investment B also rise? Will it fall? And to what degree? Correlation can be analyzed between asset classes but also between segments of the same asset class. Within fixed income, for instance, credit quality will often dictate the relationship between a bond portfolio and the equity market.

What is Correlation in Investing?

Correlation measures the strength of the historical relationship between two investments or asset classes. A correlation of 1.0 indicates that the two asset classes have moved in tandem with each other. A correlation of -1.0 means the two asset classes moved in opposite directions. As you approach 0.0, the movement between the two asset classes becomes random – or uncorrelated.

Fixed income investments, often a cornerstone in investment portfolios, are known for their income and perceived stability. In theory, fixed income should serve as an uncorrelated diversifier to equities, offering stability when the stock market becomes volatile. In practice, however, we often find the opposite is true – due in part to the underappreciation of correlation.

The decade-long era of near-zero interest rates exacerbated the issue, as many investors took undue risk in search of higher yields, investing in segments of the fixed income market highly correlated with equities. This risk was especially pronounced in 2022 when lower-quality segments of the market dropped double digits alongside equities.

Correlation Analysis

While fixed income, as an asset class, exhibits a lower correlation with equity returns, it's important to recognize that correlation varies across the different segments within fixed income. Using long-term correlations, let's examine the relationship between the various segments of the fixed income market and equities.

Historical Correlations vs. S&P 500 Index

As of 11/30/2023	5-Year	10-Year	15-Year
U.S. Equities - *S&P 500*	1.00	1.00	1.00
High-Yield - *ICE BofA US High Yield*	0.84	0.80	0.71
Corporate Credit - *Bloomberg US Credit*	0.64	0.55	0.45
Credit A or Better - *ICE BofA 1-10Yr AAA-A US Corp*	0.58	0.48	0.42
Core Bond - *Bloomberg US Agg Bond*	0.44	0.35	0.25
Treasury - *ICE BofA 1-10 Yr US Treasury*	0.16	0.05	-0.01

High-quality bonds, such as Treasurys and corporate bonds rated A or better, tend to have a low correlation with equities, while bonds that pose greater credit risk have a higher correlation.

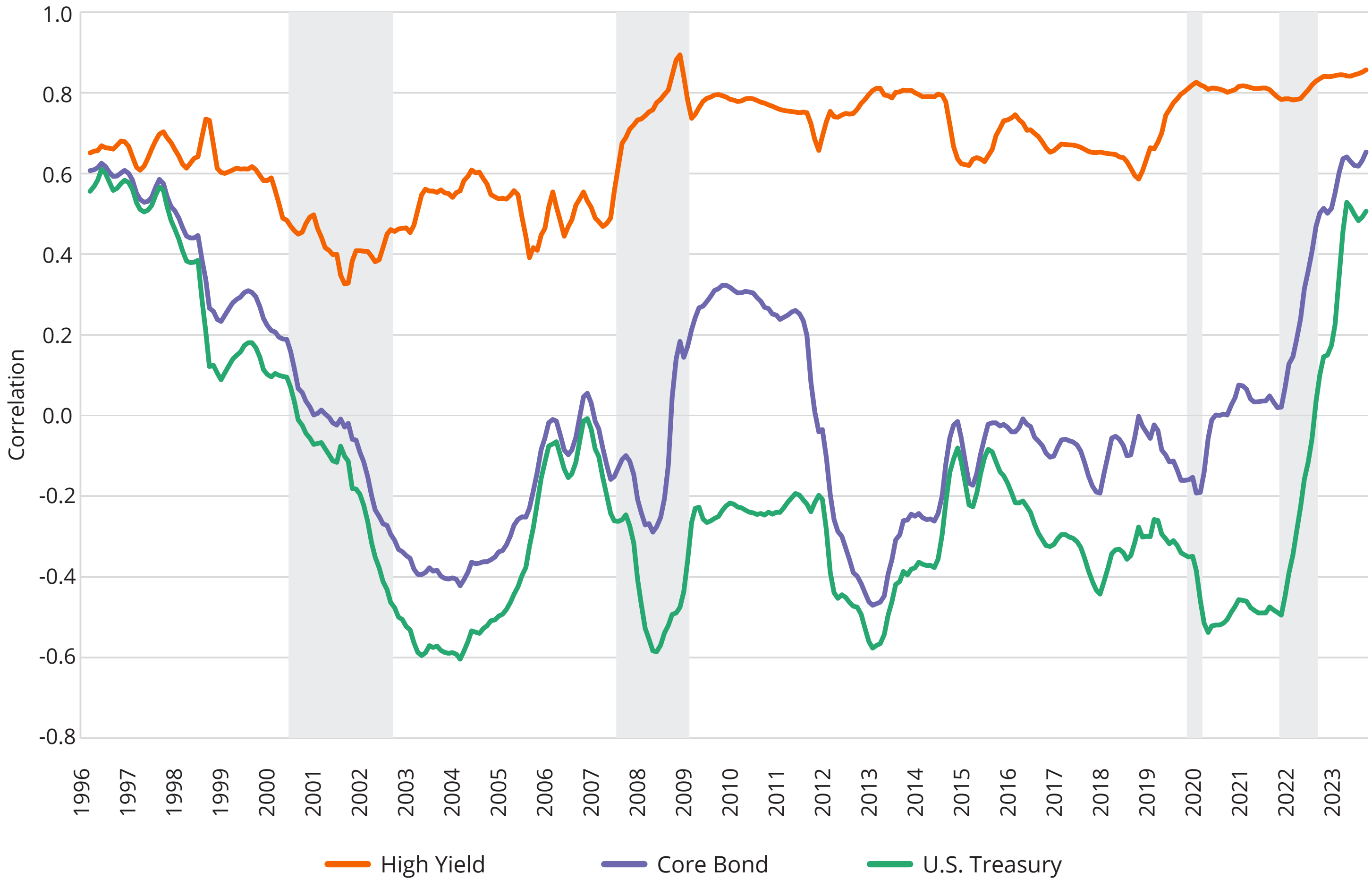
If you are allocating to fixed income to provide a hedge to your equity exposure, it is imperative to consider the historical correlation. Ignoring this risk may result in an unpleasant surprise when the equity market experiences a downturn.

Do Correlations Change Over Time?

Correlations are not static values; they evolve over time, influenced by market conditions, benchmark composition, interest rate dynamics, and various other factors. To further demonstrate the impact of quality on correlation, we plotted the rolling average correlation of different bond categories with equity market performance.

Historical Correlations vs. S&P 500

36 Month Rolling Correlations Based on Monthly Total Returns (3 Month Rolling Average)



Notice how high-quality treasury bonds (green line) tend to negatively correlate with equities. This should come as no surprise, as investors seek out the safe haven of treasuries in equity bear markets. On the other hand, high-yield bonds (orange line), often characterized as lower quality or "junk bonds" due to their elevated credit risk, display a much higher correlation with equities. These bonds tend to move in sync with the equity market, and, as you'll notice in the chart, the correlations grow stronger when equity markets come under pressure.

Stock and Bond Performance During a Recession

It often takes a severe market shock to appreciate the importance of correlation in a portfolio. Think back to the last three economic shocks in which the Federal Reserve cut interest rates in response to the economy slowing. From September 2000 to February 2003 (dot-com bubble), U.S. equities fell 42.5%. In 2008, during the Great Financial Crisis, stocks fell 50.9%. Even during the brief COVID-19 shock, stocks fell 19.6%. In each scenario, how a portfolio fared depended greatly on the types of fixed income it was invested in. Let's examine the performance of the different parts of the bond market during these three time periods.

Cumulative Returns (%)

	Dot-com Bubble *Sept 2000 - Feb 2003*	**Great Recession** *Nov 2007 - Feb 2009*	**COVID-19** *Jan 2020 - Mar 2020*
U.S. Equities	-42.5	-50.9	-19.6
High-Yield Bonds	1.0	-26.5	-13.1
Credit A or Better	27.9	-4.4	-0.6
Core Bonds	27.2	6.1	3.1
Treasury Bonds	24.2	12.4	5.3

Portfolio Implications: High-Quality Bonds vs. High-Yield Bonds

The key question for investors and advisors is why these differences in correlation exist. Given their stronger creditworthiness, high-quality bonds are less affected by economic downturns and market turbulence. In contrast, high-yield bonds are riskier, as they are issued by companies with lower credit ratings, making them more sensitive to market fluctuations.

As their name implies, high-yield bonds offer the potential for higher yields and may maintain a role in some portfolios. Higher quality bonds have shown the ability to preserve principal, especially when stock markets decline. Understanding how the wide range of fixed income options behave within a portfolio helps you take a more comprehensive approach to portfolio construction and risk management.

DISCLOSURES

"Madison" and/or "Madison Investments" is the unifying tradename of Madison Investment Holdings, Inc., Madison Asset Management, LLC ("MAM"), and Madison Investment Advisors, LLC ("MIA"). MAM and MIA are registered as investment advisers with the U.S. Securities and Exchange Commission. Madison Funds are distributed by MFD Distributor, LLC. MFD Distributor, LLC is registered with the U.S. Securities and Exchange Commission as a broker-dealer and is a member firm of the Financial Industry Regulatory Authority. The home office for each firm listed above is 550 Science Drive, Madison, WI 53711. Madison's toll-free number is 800-767-0300.

Any performance data shown represents past performance. Past performance is no guarantee of future results.

Non-deposit investment products are not federally insured, involve investment risk, may lose value and are not obligations of, or guaranteed by, any financial institution. Investment returns and principal value will fluctuate.

This report is for informational purposes only and is not intended as an offer or solicitation with respect to the purchase or sale of any security.

In addition to the ongoing market risk applicable to portfolio securities, bonds are subject to interest rate risk, credit risk and inflation risk. When interest rates rise, bond prices fall; generally, the longer a bond's maturity, the more sensitive it is to this risk. Credit risk is the possibility that the issuer of a security will be unable to make interest payments and repay the principal on its debt. Bonds may also be subject to call risk, which allows the issuer to retain the right to redeem the debt, fully or partially, before the scheduled maturity date. Proceeds from sales prior to maturity may be more or less than originally invested due to changes in market conditions or changes in the credit quality of the issuer.

Diversification does not assure a profit or protect against loss in a declining market.

INDEX DEFINITIONS

Indices are unmanaged. An investor cannot directly invest in an index. They are shown for illustrative purposes only, and do not represent the performance of any specific investment. Index returns do not include any expenses, fees or sales charges, which would lower performance.

U.S. Equities: The S&P 500® Index is an unmanaged index of large companies and is widely regarded as a standard for measuring large-cap and mid-cap U.S. stock-market performance. Results assume the reinvestment of all capital gain and dividend distributions. An investment cannot be made directly into an index.

High Yield: ICE BofA U.S. High Yield Index tracks the performance of U.S. dollar-denominated below investment-grade corporate debt publicly issued in the U.S. domestic market. Qualifying securities must have a rating below BBB (based on an average of Moody's, S&P and Fitch), a fixed coupon, and between one and ten years remaining term to final maturity.

Core Bond: Bloomberg U.S. Aggregate Bond Index is a broad-based flagship benchmark that measures the investment grade, U.S. dollar-denominated, fixed-rate taxable bond market. The index includes Treasuries, government-related and corporate securities, mortgage backed securities, asset-backed securities and corporate securities, with maturities greater than one year.

Corporate Credit: Bloomberg U.S. Credit Index measures the investment grade, U.S. dollar-denominated, fixed-rate, taxable corporate, and government-related bond markets. It is composed of the U.S. Corporate Index and a non-corporate component that includes foreign agencies, sovereigns, supranationals and local authorities.

Credit A or Better: ICE BofA 1-10 Year AAA-A US Corporate Index tracks the performance of U.S. dollar-denominated investment-grade corporate debt publicly issued in the U.S. domestic market. Qualifying securities must have a rating between A and AAA (based on an average of Moody's, S&P and Fitch), a fixed coupon, and between one and ten years remaining term to final maturity.

Treasury Bond: ICE BofA 1-10 Year U.S. Treasury Index tracks the total return performance of U.S. Treasury bonds with an outstanding par that is greater than or equal to $25 million. The maturity range of these securities is between one and ten years.

Madison INVESTMENTS