Theory to practice: Bond momentum for equities – and equity momentum for bonds

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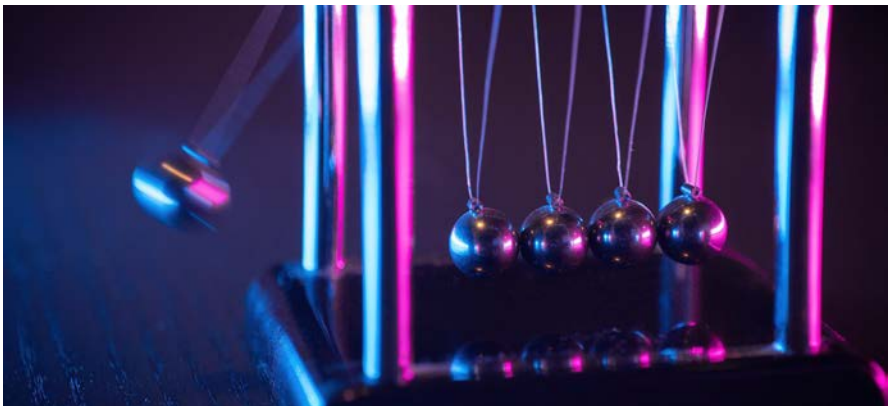
Factor investors use characteristics to explain asset risk and returns and for harvesting factor premia. The "characteristics" can be generalized as factors and are used to form investment portfolios. The academic literature is full of factors that claim to explain risk and return, but as documented by "factor zoo" (Cochrane 2011), not all factors are created equal.

A recent paper on "Factor Investing: From Theory to Practice" (Gupta, Raol and Roscovan) established a mechanism to navigate the factor zoo. We can parsimoniously evaluate factor existence within traditional asset classes. The approach is anchored by four pillars: Economic Theory, Robust Risk and Return Evidence, Cross-Asset and Across-Region Validation and Implementability. As an application of this framework, we look at momentum by examining the efficacy of bond momentum in equities and equity momentum in bonds. First, we review the economic rationale for momentum and theory behind the potential efficacy of momentum across assets.

Economic rationale

Momentum is the tendency for assets that have performed well (poorly) in the recent past to continue to perform well (poorly) in the future. (Jegadeesh and Titman [1993]). In addition to equity market momentum, the factor has been observed in currency and commodities markets (Gorton, Hayashi, and Rouwenhorst (2013)) as well as fixed income market (Jostova et al. (2013) and Barth, Scholz, and Stegmeier (2017)). There are two competing explanations for this phenomenon. The risk premia school explains momentum with: industry, beta, business cycle, market microstructure and stock-specific effects (Blitz, Huij, and Martens (2011)). The behavioral finance school explains it with the irrational behavior of investors who simply follow the crowd (Barberis, Shleifer, and Vishny (1998)). Whichever the driver, the empirical evidence is clear that within each asset class, momentum works.

But how does momentum work across asset classes? Why should bonds and equity momentum be linked? The Merton Model developed in 1974 provides strong intuition on the relationship between credit and equity markets. The model relates equities to corporate debt by linking the value of the equity as a call option on the



value of the company whose strike is equivalent to its liabilities or debt payments. This would imply that shocks to the value of assets should be valuable information for both debt and equity investors. Indeed, empirical studies have indeed observed a strong relationship between the default rates of corporate bonds and the value of stocks. Giesecke et al. (2011) look at 150 years of corporate bond defaults and potential drivers. Consistent with the Merton model, they find that both a fall in equity prices and an increase in equity volatility are associated with higher corporate bond default rates.

Matching equity and bond data

For the cross-asset class momentum portfolios, we used (1) a proxy for Russell 3000 universe and (2) the outstanding bonds in the Bloomberg US Investment Grade and Bloomberg High Yield indices from January 2000 to September 2022. For our analysis, we had to link the constituents of the two bond indices with those of the equity universe.

Matching a firm's equity and bond data is a challenge. First of all, firms typically have a single class of common shares, but may have multiple outstanding bonds with different maturities, seniorities, ratings and other structural differences. Sometimes, bonds are issued by different entities within the same firm. In addition, the equity and bond markets lack a common firm identifier. Even though identifiers such as CUSIP and ISIN can bridge these two markets to some extent, corporate actions such as mergers, acquisitions, spin-offs and name changes can break such links.

To create the equity and bond linking table, we first combined all bonds by the same issuer and mapped them to the corresponding equities by their exchange tickers. Next, we identified all the unmatched cases from merging using exchange tickers and attempted to join those via CUSIPs. According to CUSIP Global Services, a CUSIP is a 9-character code that identifies a financial security in the US and Canada. In addition, the first 6 characters uniquely identify the issuing entity. Hence, we could join the bond and equity data through their common first 6 characters of the CUSIPs. The resulting linking tables can match the majority of the constituents of both the equity and bond universes.

Table 1 shows the results achieved by the linking table on the US equity universe. It can match 54% of the large cap and mid cap universe, which represent 78% of total market capitalization. In addition, most constituents of the S&P 500 and Russell 1000 indices can be matched by the linking table (78% and 60%, respectively), which represent 85% and 80% in terms of market capitalization.

Table 2 shows the coverage results from the perspective of a fixed income investor. On average, we can match 82% in the US Investment Grade Index and 66% in the High Yield Index, which represents 80% and 69% in terms of market value. In general, we see that the match rate in the High Yield Index is meaningfully lower than the Investment Grade Index. This is because the High Yield Index consists of more private issuers which do not have an associated equity identifier.

Additional work is warranted in order to improve the matching results. In constructing the linking table, we primarily relied on the index providers to model mergers, acquisitions, spin-offs and name changes, all of which can be a source of noise. To tackle these issues, manual matching may be necessary. Furthermore, some constituents of the equity universe have outstanding bonds that are not covered by the linking table because they do not meet the inclusion requirements of the US Investment Grade or High Yield indices. In addition, some constituents of the bond universe are not covered because their issuing entities are private companies which are not included in the Russell 3000 universe.

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Table 1
Coverage of different US equity universes in the US Investment Grade and High Yield bond indices

	S&P500	Russell 1000	Large & mid cap	Small cap	All cap
By number of stocks	78%	60%	54%	18%	28%
By market capitalization	85%	80%	78%	31%	74%

Source: Invesco. Based on data from January 2000 to September 2022. Backtested data.

Table 2
Coverage of different US bond universes in a proxy for Russell 3000 universe

	US Investment Grade	US High Yield
By number of bonds	82%	66%
By market capitalization	80%	69%

Source: Invesco. Based on data from January 2000 to September 2022.

We constructed a bond momentum factor and analyzed its performance in the equity market.

Bond momentum in the equity market

In a four-step process, we then constructed a bond momentum factor and analyzed its performance in the equity market.

1. We first computed the aggregated bond return for each firm by aggregating all its outstanding bonds' excess returns based on market cap. We used excess return (in excess of duration-matched Treasury returns) rather than total return, because this more accurately represents changes in the issuing firms' credit risk and underlying fundamentals.

2. Then, we formed the bond momentum factor by cumulating the aggregate bond returns during the formation window of three months, including the most recent month (three-month momentum). The factor was then ranked and standardized.

3. From the standardized scores, we finally constructed a long-short bond momentum factor portfolio with a 100% long position in the top half and a 100% short position in the bottom half. We controlled for a selected number of risk factors such as beta and industry exposures. Consequently, the bond momentum factor portfolio is beta and industry neutral.

4. Lastly, we tested the bond momentum factor portfolio for the US large cap and mid cap sub-universes from table 1.

Table 3 shows the backtest performance statistics. The bond momentum factor would have generated an annualized return of 0.6% and an annualized standard deviation of 4.5%, resulting in an information ratio of 0.139. The portfolio turnover of 157.9% would have been higher than for a typical momentum factor. The portfolio would have had a large drawdown during the global financial crisis (-15.5%) followed by a strong reversal from 2009 to 2013. During the sample period, the bond momentum factor was positively correlated with the momentum factor (61%), slightly positively correlated with the quality factor (5.5%) and negatively correlated with the value factor (-29.2%). In the spanning test, the bond momentum factor generated a positive and significant alpha on top of the value factor portfolio. It also generated a positive, but insignificant, alpha on the momentum factor portfolio, quality factor portfolio and on the quality, momentum and value multi-factor portfolios.

Why a three-month formation window?

We chose the three-month formation window based on theoretical support and empirical evidence. The theoretical background is that the momentum factor in the bond market is typically shorter-term. Evidence shows that 3-month bond momentum works for both investment grade and high yield bonds, whereas longer-term bond momentum only works for high yield bonds. But our empirical results also supported a shorter formation window: We examined several possible formation windows, which varied by the length and the inclusion/exclusion of the most recent month. We found that performance generally decreased as the formation window extended from the past 3 months to the past 12 months, and the exclusion of the most recent month resulted in a significant decline in factor performance.[1]

Comparing bond and equity momentum factors

We now compare the performance of the bond momentum factor and the equity momentum factor for the US large cap and mid cap sub-universes (table 5). During the sample period, the bond momentum factor was substantially less volatile than that of the equity momentum factor (4.5% vs.

Table 3
Equities: Bond momentum factor portfolio analysis

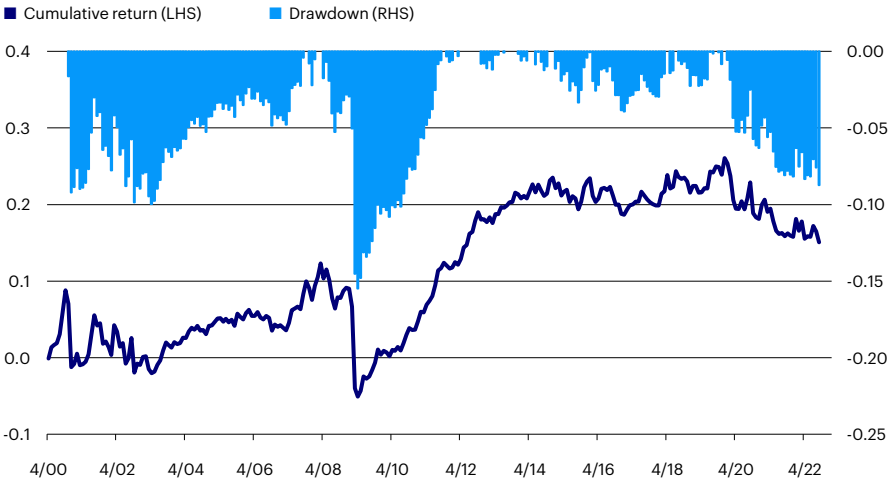
(A) Performance statistics	Bond momentum
Annualized return	0.60%
Annualized sd	4.50%
Information ratio	0.139
Realized beta	-0.084
Maximum drawdown	-15.50%
Turnover	157.90%

(C) Correlation	Momentum	Quality	Value
Return correlation	61.0%	5.5%	-29.2%

(D) Spanning tests

Market	Momentum	Quality	Value	Multi-factor
0.014	0.0002	0.0001	**0.018**	0.002
(1.516)	(0.024)	(1.44)	**(2.038)**	(0.203)

(B) Performance



Backtest results, based on data from April 2000 to September 2022. T-values in brackets. Backtested performance is not a guide to future returns. Source: Invesco.

Table 4
Equities: Performance of the bond momentum portfolio with different formation windows

	Formation window	Past 12 months	Past 9 months	Past 6 months	Past 3 months
Excluding month t-1	Information coefficient	0.01 (0.90)	0.01 (0.94)	0.00 (0.83)	**0.01 (2.30)**
	Spread return	-0.01 (-0.07)	0.02 (0.10)	0.00 (0.01)	**0.29 (2.05)**
	Information ratio	0.110	0.083	-0.019	0.172
	Annualized return	0.4%	0.4%	-0.1%	0.7%
	Annualized standard deviation	3.9%	4.3%	4.4%	4.2%
	Turnover	97%	107.9%	128.3%	189.6%
Including month t-1	Information coefficient	0.01 (1.16)	0.01 (1.21)	0.01 (1.12)	**0.01 (2.43)**
	Spread return	-0.01 (-0.03)	-0.01 (-0.08)	0.10 (0.57)	**0.33 (2.14)**
	Information ratio	0.155	0.151	0.091	0.139
	Annualized return	0.7%	0.7%	0.4%	0.6%
	Annualized standard deviation	4.3%	4.5%	4.7%	4.5%
	Turnover	91.9%	103.2%	119.9%	157.9%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T-values in brackets.

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We analyze how equity momentum can be informative in predicting a corporate bond’s performance.

6.8%), but it also underperformed (0.6% vs. 2.1%). Taken together, this resulted in a lower information ratio for bond momentum than for equity momentum (0.139 vs. 0.314). On the other hand, the bond momentum factor portfolio suffered a smaller maximum drawdown (-15.5% vs. -20.7%). Lastly, the bond momentum factor portfolio had a turnover of 157.9%, which was higher than the equity momentum factor portfolio (86.1%).

Equity momentum in the bond market

We now analyze how equity momentum can be informative in predicting a corporate bond’s performance. We used monthly historical data of Bloomberg US Corporate Investment Grade and High Yield indices from January 2000 to September 2022. We further limited our sample universe to those firms for which the bond-to-equity mapping table can find successful matches and the equity momentum data is present. To construct the bond factor based on issuer’s equity momentum, we proceeded with the following steps:

1. We started with the equity momentum factor scores. To make the predictive power somewhat independent relative to the length of the formation window, we combined multiple formation periods. That also helps to identify a cleaner trend and avoid riding on short-term reversals. Again, the factor scores were neutralized for market beta and industry exposure.[2]

2. At the beginning of each month, we ranked the bonds based on the equity momentum factor scores, breaking them into deciles. During the sorting process, we controlled for non-factor-driven risk exposures such as sector, rating and duration.

3. Finally, we took the bonds in the top decile and weighted them by market value to form a long-only factor. Again, we used excess return, defined here as returns in excess of duration-matched Treasury returns. We measured performance against the corresponding benchmark, i.e., the US Investment Grade Index and the US High Yield Index.

Table 5
Equities: Bond and equity momentum factor portfolios in comparison

	Bond momentum factor portfolio	Equity momentum factor portfolio
Information coefficient	0.01 (2.43)	0.01 (2.67)
Spread return	0.33 (2.14)	0.29 (1.76)
Annualized return	0.6%	2.1%
Annualized standard deviation	4.5%	6.8%
Information ratio	0.139	0.314
Realized beta	-0.084	-0.155
Maximum drawdown	-15.5%	-20.7%
Turnover	157.9%	86.1%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T-values in brackets. Backtested performance is not a guide to future returns.

Table 6 shows the backtest performance summary for the equity momentum factor. In US investment grade, the factor would have actively outperformed the benchmark by 61 bp. p.a. – with a tracking error of 1.16% on average – leading to an information ratio of 0.53 (with an annualized alpha of 0.71% and a beta of 0.87). At 397%, the annualized turnover would have been fairly high compared to our normal factor portfolio turnover of around 130%. Similarly, in the high yield market, equity momentum would also have beaten the index with an active excess return of 182 bp p.a., an average tracking error of 3.58% and an information ratio of 0.51 (with an annualized alpha of 2.31% and a beta of 0.81).

What drives the outperformance?

Next, we examine whether the outperformance of the equity momentum factor can be explained by traditional bond factors, such as sector, rating, duration and liquidity, as well as our proprietary factors carry, low volatility and value.

Table 7 shows the active excess return correlations of equity momentum against our existing factor portfolios. We see that, over the full sample period measured by beta-adjusted excess return, momentum has negative correlations of -36.5%, -17.4% and -20.6% to carry, value and low volatility in US investment grade. In US high yield, we see a negative correlation of -26.2% to carry, a positive correlation of 27.96% to low volatility and a close-to-zero correlation to value. These results suggest that adding an equity momentum factor into the current factor pool could potentially bring more diversification.

Furthermore, we ran a spanning test to see if equity momentum has significant unexplained returns on top of the index and the fixed income factors. Table 8 shows the intercept and the corresponding t-stats when regressing equity momentum excess returns against different factors. In both US investment grade and high yield, we find significant alpha after regressing against the market, the standalone factors and a combination of all factors. Therefore, we can conclude that the equity momentum factor is an additional return source that is not driven purely by loading on market or factor risks.

Next, we need to test whether the unexplained return premium can be explained by other risk factors, such as liquidity and the common fixed income risk exposures. To this end, we ran double-sort tests by controlling for different types of risk exposures that can potentially drive the risk premium of equity momentum (figure 9). Specifically, we formed long-short equity momentum portfolios by first neutralizing the momentum scores on a specified risk exposure and subsequently taking a long position in the top-decile portfolio, as well as a short position in the bottom-decile portfolio. We used a bond's age, issuance size, trading volume and liquidity score as proxies for its liquidity. In addition, we also tested with the standard fixed income risk exposures such as rating,

Table 6
Bonds: Equity momentum factor portfolio analysis

	US Investment Grade	US High Yield
Annualized excess return over US Treasuries	1.34%	4.38%
Annualized volatility	4.54%	8.88%
Sharpe Ratio	0.30	0.49
Skewness	-1.59%	-1.56%
CVaR	-3.18%	-6.41%
Maximum drawdown	22.14%	34.71%
Annualized active excess return over the index	0.61%	1.82%
Tracking error	1.16%	3.58%
Annualized alpha	0.71%	2.31%
Beta	0.87	0.81
Information ratio	0.53	0.51
Turnover	397%	375.57%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022.

Table 7
Bonds: Active excess return correlations, beta-adjusted

	Carry	Low volatility	Value
US Investment Grade	-36.6%	-17.4%	-20.6%
US High Yield	-26.2%	28.0%	-0.4%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T

Table 8
Bonds: Spanning test

	Market	Carry	Low volatility	Value	Multi
US Investment Grade	0.71 (3.548)	0.76 (4.070)	0.77 (3.893)	0.92 (4.480)	0.65 (3.346)
US High Yield	2.31 (3.626)	2.15 (3.510)	1.55 (2.463)	2.30 (3.626)	1.20 (2.006)

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T-values in brackets.

The outperformance of equity momentum in both US investment grade and high yield is not driven by factor constellations, liquidity risk or the traditional fixed income risk factors alone.

maturity, sector and DTS. For equity momentum factors in both the US investment grade and high yield universes, we found significant excess return alpha after residualizing these exposures. This further strengthens the argument that the outperformance of equity momentum in both US investment grade and high yield is not driven by factor constellations, liquidity risk or the traditional fixed income risk factors alone.

Comparing equity and bond momentum factors

As we did for equities, we also compared the performance of equity and bond momentum. For illustrative purposes, we chose 3-month cumulative returns as the signal and excluded bonds with missing mapping information or equity signals. Again, we took the top-decile portfolio by bond momentum scores, while controlling for sector, maturity and rating. Table 10 shows the performance summary; figure 1 shows the cumulative performance. In both markets, bond momentum underperformed equity momentum.

In US investment grade, the excess return tracking error of bond momentum is very close to that of equity momentum (1.14% vs. 1.16%). However, the active excess return is, on average, negative for bond momentum but positive for equity momentum (-0.68% vs. 0.61%). This results in a meaningful difference in information ratio, where bond momentum has -0.59 and equity momentum 0.53.

Similarly, in high yield the excess return tracking error of bond momentum is only slightly lower than that of equity momentum (3.35% vs. 3.58%), but the average active excess return of bond momentum is much lower than that of equity momentum (0.17% vs. 1.82%). Again, we find the information ratio for bond momentum to be significantly lower than that of equity momentum (0.05 vs. 0.51). Moreover, we also find excessive yearly turnover with bond momentum relative to equity momentum (618% vs. 397%), which points to implementation difficulties. As a result, we have been cautious in categorizing bond momentum as a risk premium factor for corporate bonds.

Merton revisited

We started with the Merton model, which suggests a fairly close correlation between equites and bonds of the same issuer, leading us to wonder whether equity and

Table 9
Bonds: Double-sort test

	Controlled exposure	Annualized excess return (10th – 1st decile)	Sharpe ratio
US Investment Grade	Age	1.88 (2.59)	0.40
	Liquidity score	1.68 (2.35)	0.37
	Size	2.11 (2.88)	0.46
	Volume	1.94 (2.64)	0.42
	Sector	1.25 (4.11)	0.56
	Rating	1.84 (3.07)	0.45
	Maturity	1.97 (2.76)	0.43
	DTS	2.01 (2.89)	0.48
US High Yield	Age	4.69 (3.64)	0.41
	Liquidity score	4.61 (3.86)	0.42
	Size	4.12 (3.23)	0.34
	Volume	4.17 (3.49	0.36
	Sector	4.6 (4.1)	0.55
	Rating	3.78 (3.51)	0.41
	Maturity	4.86 (3.7)	0.40
	DTS	2.75 (3.11)	0.47

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T-values in brackets.

Table 10
Bonds: Bond and equity momentum factor portfolios in comparison

		Bond momentum factor portfolio	Equity momentum factor portfolio
US Investment Grade	Annualized excess return	0.05%	1.34%
	Annualized volatility	4.83%	4.54%
	Sharpe ratio	0.01	0.30
	Skewness	-2.05%	-1.59%
	CVaR	-3.67%	-3.18%
	Maximum drawdown	27.64%	22.14%
	Annualized active excess return	-0.68%	0.61%
	Tracking error	1.14%	1.16%
	Annualized alpha	-0.62%	0.71%
	Beta	0.92	0.87
	Information ratio	-0,59	0.53
	Turnover	618%	397%
US High Yield	Annualized excess return	2.73%	4.38%
	Annualized volatility	9.33%	8.88%
	Sharpe ratio	0.29	0.49
	Skewness	-0.95%	-1.56%
	CVaR	-6.56%	-6.41%
	Maximum drawdown	36.31%	34.71%
	Annualized active excess return	0.17%	1.82%
	Tracking error	3.35%	3.58%
	Annualized alpha	0.54%	2.31%
	Beta	0.86	0.81
	Information ratio	0.05	0.51
	Turnover	610%	376%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022.

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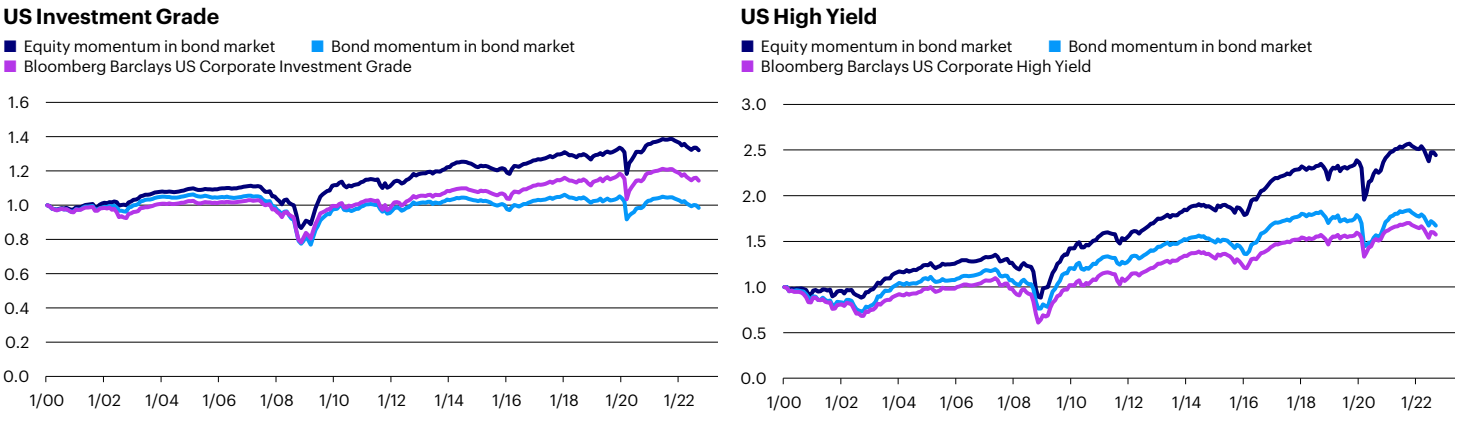
Equity momentum shares similar risk characteristics with bond momentum but produces additional sources of return.

bond momentum may also be correlated. To this end, we performed a regression of equity momentum in the bond market onto bond momentum in the bond market using beta-adjusted excess return (table 11). In both investment grade and high yield, we see positive correlations, with 31% and 46%, respectively. Moreover, we find highly significant alpha of 0.88% and 2.06% p.a. These results suggest that equity momentum shares similar risk characteristics with bond momentum but produces additional sources of return.

Figure 1
Bonds: Cumulative performance



Source: Invesco. Backtest results, based on data from April 2000 to September 2022.

Table 11
Bonds: Regression of equity momentum onto bond momentum

	Alpha	Beta	Correlation
US Investment Grade	0.88 (4.613)	0.28 (5.543)	31%
US High Yield	2.06 (3.655)	0.46 (8.528)	46%

Source: Invesco. Backtest results, based on data from April 2000 to September 2022. T-values in brackets.

Conclusion

Navigating the factor zoo can be difficult. If one is trying to understand momentum through the lens of the behavior versus risk premia debate only, it can be daunting. However, going from theory to practice by looking at strong evidence across assets can build confidence in factors. It would be very difficult for a factor by chance to show some efficacy in a few assets classes. Momentum in an asset class helps to predict future returns. That has been known for some time. However, it would be even less likely that – by mere chance – equity momentum would help predict bond returns and the other way around. For this reason, we have strong conviction in momentum as a factor. We believe there should be more work to understand the potential drivers of these cross-asset dynamics. One thing is clear: building portfolios on momentum, whether in bonds or equities, can benefit investors.

Notes
1 Both observations are in line with the findings by Dor and Xu (2015) in their cross-asset class momentum study.
2 As a robustness test, we also experimented with equity earnings momentum, and the predictive power did not suffer.

Disclosure: All information presented prior to the inception dates is backtested. Backtested performance is not actual performance but is hypothetical. Although back-tested data may be prepared with the benefit of hindsight, these calculations are based on the same methodology that was in effect when the index was officially launched. Index returns do not reflect payment of any sales charges or fees. Past performance cannot guarantee future results. An investment cannot be made in an index. All information presented prior to the index's inception date, Performance, actual or hypothetical, is not a guarantee future results. An investment cannot be made in an index. Diversification does not guarantee a profit or eliminate the risk of loss.

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II-GIRR-WP3-1-E GL2784502/2023