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Factor investing in government bonds

White paper
For professional investors
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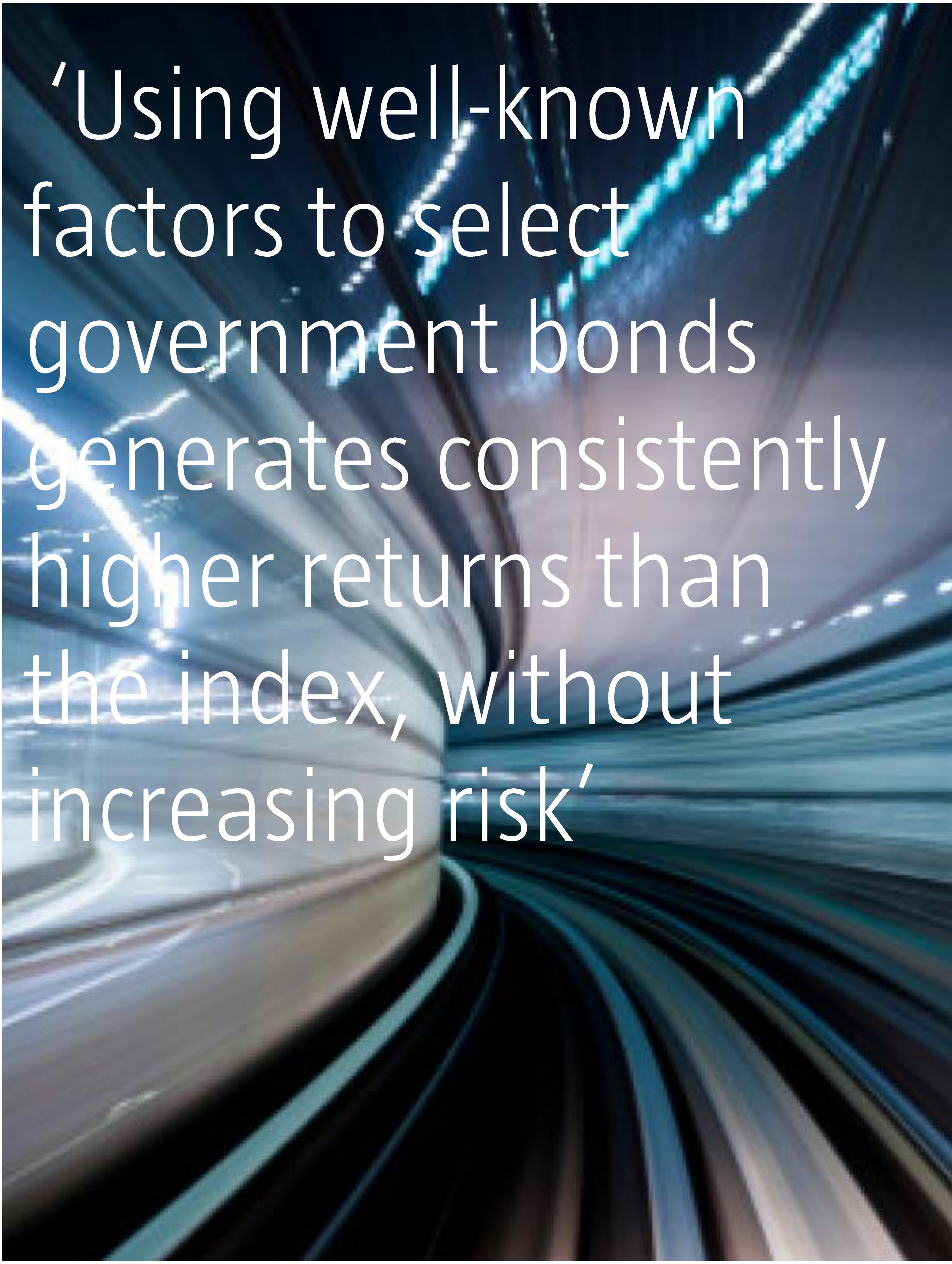
Olaf Penninga
Martin Martens
Casper Zomerdijk


‘Using well-known factors to select government bonds generates consistently higher returns than the index, without increasing risk’

Contents

Factor investing in government bonds

- Value, Momentum and Low Risk work for government bonds, too
- More than 40 years of academic evidence on factors
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In this paper we show that value, momentum and low-risk factors, which increasingly are being used in investment processes across various asset classes, can also be used to select outperforming government bonds. We explain how we apply these factors to government bonds and discuss academic evidence and empirical results. Bond portfolios with strong exposure to these factors generate consistently higher returns than the index, without taking on additional risk. A multi-factor government bond portfolio is thus an efficient way to take bond exposure and to add value by harvesting factor premiums.

Factor investing

Investors are increasingly allocating to factors across multiple asset classes. Factor investing differs from traditional investing in the sense that it follows a systematic, rules-based approach to select securities and harvest one or more factor premiums, such as the value, momentum and low risk premiums. There are two main reasons for this new investment paradigm. First, factor portfolios deliver higher Sharpe ratios than the market over the long term. Second, factors are responsible for a large part of the alpha that successful managers generate[1]. And because many traditional funds are often only implicitly or weakly tilted to factors, investors have started to strategically and explicitly allocate to factors to generate alpha. Although most factor research focuses on the equity market, the concept and benefits of factor investing apply equally well to the bond market.

Defining the factors for government bonds

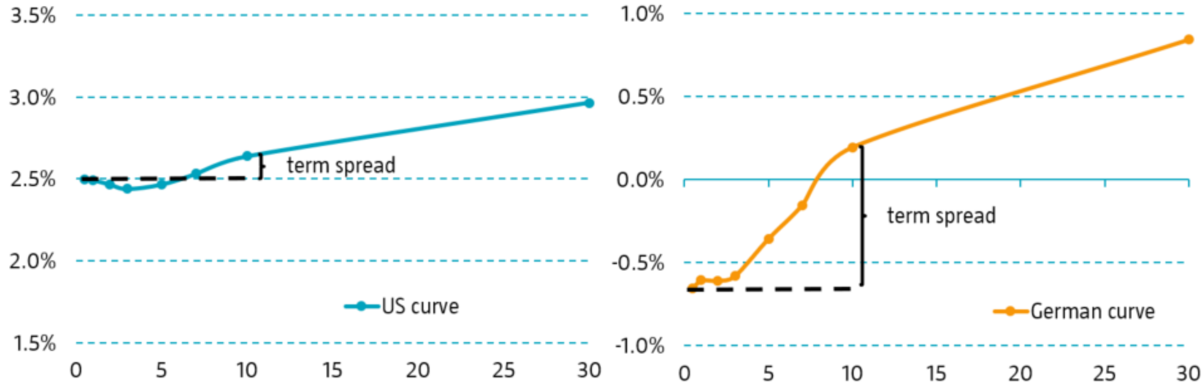
In the following sections we show how the well-known factors value, momentum and low risk are defined for government bonds. The low-risk effect was observed for government bonds as early as 1972, by Robert Haugen, and the foundations for value investing in government bonds were laid in the early 1980s by Eugene Fama, among others. More recent papers have developed these ideas further, turning them into factors and demonstrating the higher returns and Sharpe ratios of portfolios that allocate to these factors.

Value

Value investing entails buying cheap assets and avoiding expensive ones. This obviously requires a measure of value. In the case of stock selection, the price of a stock can be compared to its book value to measure whether the stock is over- or undervalued. For government bonds, however, there is no direct equivalent to the book value. A widely used value measure for government bonds in the academic literature is the term spread: the difference between the bond yield and the cash rate. In the example shown in Chart 1, the US 10-year yield of 2.65% is just 0.15% above the dollar cash rate of 2.5%, while the German 10-year yield of 0.2% is 0.85% above the euro cash rate of -0.65%. Put differently: a German bond pays its owner a premium of 0.85% per year to hold a 10-year bond rather than cash, while a US bond offers its buyer only 0.15% more than cash. The term spread is thus higher for German bonds than for US bonds, even though the US bond yield is higher than the German yield.

[1] See the articles "On Persistence in Mutual Fund Performance" by Carhart (1997), "Evaluation of Active Management of the Norwegian Government Pension Fund – Global" by Ang et al. (2009) and "Academic Knowledge Dissemination in the Mutual Fund Industry: Can Mutual Funds Successfully Adopt Factor Investing Strategies?" by Huij and van Gelderen (2014).

Chart 1 | US and German yield curve as of Jan 2019

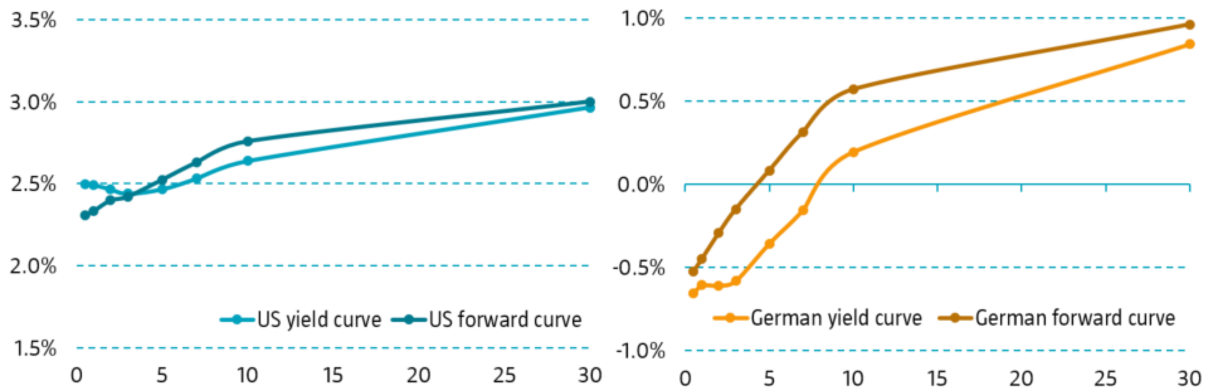


Source: Robeco, Bloomberg

The term spread is directly related to the yield available to an international bond investor who hedges currency risk. When hedging a foreign currency, one pays the foreign short-term rate and receives the local cash rate instead. The yield on a foreign bond investment, taking into account the FX hedging costs, is thus equal to the foreign bond yield minus the foreign cash rate, plus the local cash rate. In the example above, a US investor who buys the German bond and hedges the currency risk faces negative hedging costs of -0.65% - 2.5% = -3.15%. The yield of the German bond hedged to US dollar is thus 0.20% - (-3.15%) = 3.35%. This is indeed 0.85% higher than the US cash rate, with 0.85% being the German term spread. The term spread can thus be used to compare the valuation of bonds from different countries on an FX-hedged basis.

The academic foundation for the term spread as value measure is phrased in terms of forward rates. The term spread is large when yields on long-term bonds are higher than those on short-term bonds, so when future yield rises are already discounted in the current bond prices. In this case, the forward rate is higher than the current yield. Chart 2 shows the forward curves for the US and Germany next to the yield curves from the above example.

Chart 2 | Yield curve and forward curve as of January 2019, US (left panel) and Germany (right panel)



Source: Robeco, Bloomberg

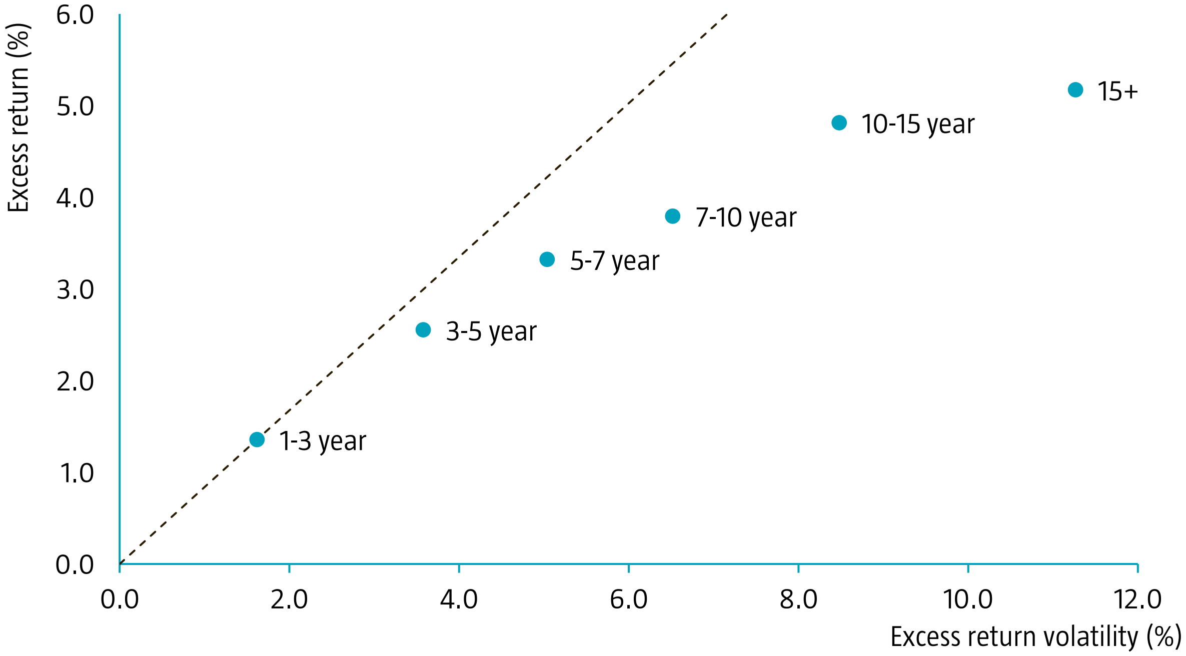
Fama already showed in 1984 that forward rates can be used to forecast bond returns: bonds for which large yield rises are discounted generally outperform bonds for which smaller yield rises are discounted[2]. This result thus underpins value investing in government bonds using the term spread as value measure.

[2] Fama (1984), "The information in the term structure", Journal of Financial Economics.

Momentum
The momentum effect is that past winners tend to be future winners and, similarly, that past losers tend to be future losers. The momentum factor for equities thus selects stocks that have performed better than their peers, as this outperformance is likely to continue. For government bonds this effect also exists and has been demonstrated in academic papers[3] comparing bonds from different countries. The momentum factor thus compares US Treasuries to, for example, Australian and Japanese government bonds, based on their recent performance. This performance is measured in terms of the excess return of the country's bonds over cash. This boils down to comparing international bonds based on currency-hedged returns, and thus purely based on the performance of the local bond market and independent of the movements in the currency. The momentum factor favors government bond markets that are performing well over the markets that lagged recently.

Low Risk
Haugen showed in a 1972 working paper[4] that US Treasury bonds with lower risk generate higher risk-adjusted returns. His paper goes against the basic CAPM notion that portfolios with higher risk should deliver higher returns. Surprisingly, the 1975 published article resulting from this working paper omitted the results for bonds entirely. The low-risk effect was therefore only formally documented in 2006 for US Treasuries, and in subsequent papers for international bonds[5]. Maturity is typically used as risk measure in these papers, as duration (interest rate sensitivity) rises with maturity. The low-risk effect in Treasuries thus means that shorter-dated bonds generate higher Sharpe ratios than longer-dated bonds. This can be seen in the following chart for US Treasuries: longer-dated bonds have generated higher returns, but not sufficiently so to compensate for the higher risk.

Chart 3 | Excess return over cash and excess return volatility for US Treasuries with different maturities, 1999-2018



Source: Robeco, JPMorgan

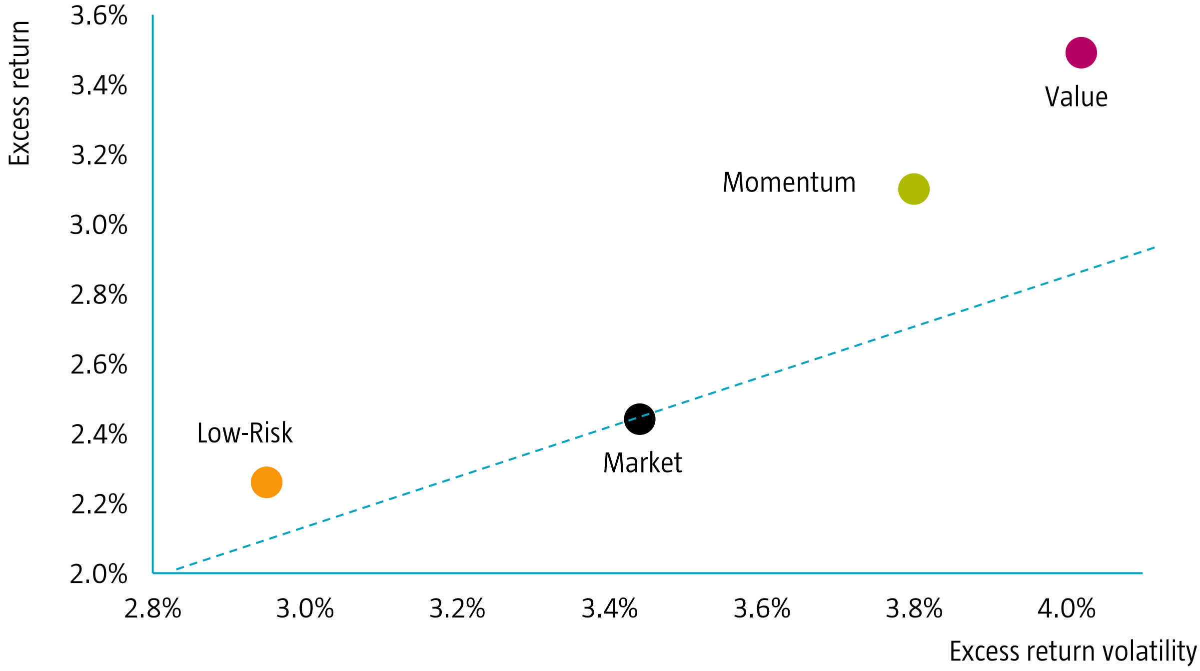
Pilotte et al. provide the following explanation: "Investors are restricted in terms of leveraging (at acceptable costs). Hence investors desiring high excess returns may have to use the longer-maturity bonds to accept a lower expected return per unit of risk (i.e. lower Sharpe ratio) to get a higher return on a fixed investment amount." The academic literature on equities provides further explanations for the low-risk effect[6]. Generally, these explanations are not specific for equities and can be applied to other asset classes, including government bonds, as well.

[3] Asness, Moskowitz, Pedersen (2013), "Value and Momentum Everywhere", Journal of Finance.
[4] Haugen, Heins (1972), "On the Evidence Supporting the Existence of Risk Premiums in the Capital Markets". Working Paper, http://ssrn.com/abstract=1783797.
[5] Pilotte, Sterbenz (2006), "Sharpe and Treynor Ratios on Treasury Bonds", The Journal of Business;
Frazzini, Pedersen (2013), "Betting against beta", Journal of Financial Economics.
[6] Blitz, Falkenstein, Van Vliet (2014), "Explanations for the Volatility Effect: An Overview Based on the CAPM Assumptions", Journal of Portfolio Management.

Factor portfolios show superior risk-adjusted returns

We now show the results for portfolios of government bonds, selected based on the value, momentum and low-risk factors. To evaluate the aforementioned factors, we use monthly data from 1986 to 2018 for the main developed government bond markets, split into maturity buckets. We use data for Australia, Canada, the US, Japan, the UK, Germany and Sweden. These are liquid bond markets, with free-floating currencies. Chart 4 plots the risk and return of the factor portfolios and of the market. The dotted line connects all risk/return combinations with the same Sharpe ratio as the market.

Chart 4 | Excess return and excess risk for factor portfolios, 1986-2018



Source: Robeco

All three factor portfolios are located above the dotted line, i.e. they achieve a higher risk-adjusted return than the market. Absolute return is somewhat lower for the low-risk portfolio than for the market, but this is more than compensated for by its lower risk. The value and momentum portfolios have a higher volatility, but this is more than offset by a higher return. The factor portfolios thus achieve higher Sharpe ratios than the bond market.

Enhancing the factors

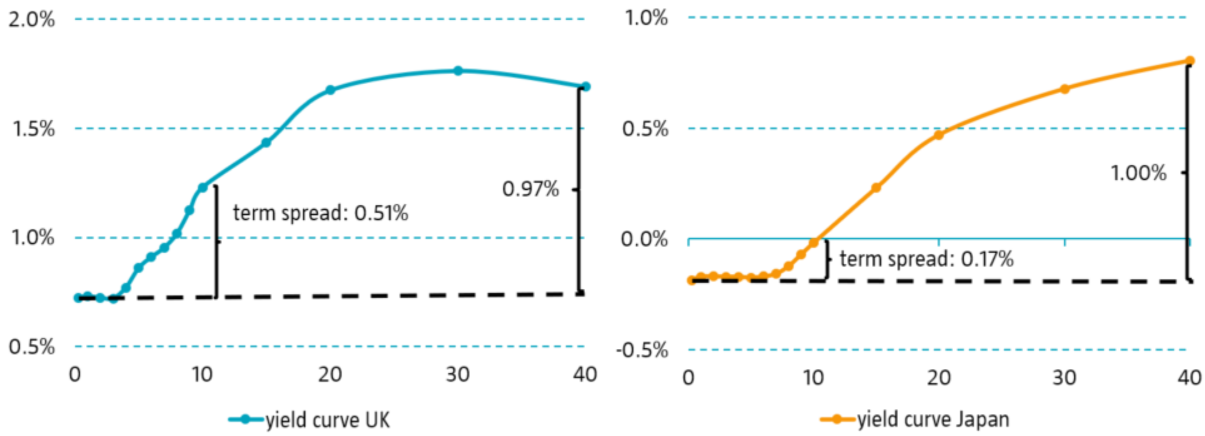
So far we described the factors using generic definitions from the academic literature. Robeco uses enhanced factor definitions and portfolio construction rules to build portfolios that harvest the factor premiums more efficiently. We build portfolios of bonds with strong exposure to the factors while taking practical considerations such as liquidity and transaction costs into account. We aim to avoid unrewarded risks and to reduce turnover. We first explain how we enhance the definitions of the factors.

Value

In the academic literature, valuation is usually measured for the entire bond market of a country. All bonds from that country are deemed over- or undervalued, based on a single measurement[7]. In some studies, bonds from only one maturity are used, usually 10 years. However, both approaches are suboptimal as different bonds from a country do not necessarily have the same valuation.

[7] The exception to the rule is the following paper, which applies country allocation separately for 2-year and for 10-year bonds: Ilmanen, Sayood (2002), "Quantitative Forecasting Models and Active Diversification for International Bonds", The Journal of Fixed Income. Our enhancement of the value factor generalizes this approach to all maturities.

Chart 5 | Yield curve as of January 2019, UK (left panel) and Japan (right panel)



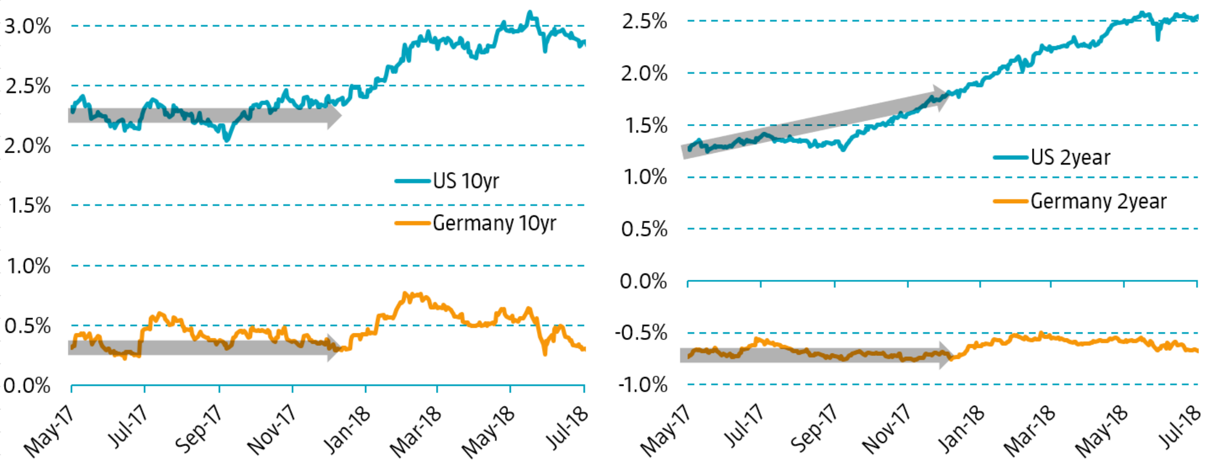
Source: Robeco, Bloomberg

Chart 5 illustrates this. We compare the yield curves for UK (left-hand panel) and Japanese government bonds (right-hand panel) as of early 2019. Just looking at the term spread for 10-year bonds, one might be tempted to conclude that the UK curve is far steeper than the Japanese curve and that UK bonds thus offer much better value than Japanese bonds. However, looking at the long end of the curve, we see that not all UK bonds are much more attractive than Japanese bonds of the same maturity. In fact, for 40-year bonds, the term spread is higher for Japanese bonds, albeit only slightly so. Whereas the generic value factor favors all UK bonds over similar Japanese bonds, the enhanced factor only favors UK bonds with a maturity of around 10 years over similar Japanese bonds. In 40-year maturities, this factor actually favors Japanese bonds over UK bonds. As a result, the UK-specific risk in the enhanced factor portfolio is smaller and it is better targeted at the most attractive maturities. We can thus enhance the value factor by determining a separate value score for each maturity, rather than judging all bonds from a country at once.

Momentum

Similarly, the momentum factor can also be enhanced by looking more carefully at different maturities. Correlations between developed government bond markets are generally high, but return differences can persist. Especially when the economic and monetary policy cycles of two countries diverge, bond markets can diverge substantially too. Such divergence in monetary policy can be observed most clearly in shorter-dated bonds. However, a bond market's return is driven mainly by long-dated bonds; short-dated bonds have, due to their lower duration, much less impact on market returns. We enhance the generic momentum factor by giving more weight to changes in shorter-dated yields, aiming to capture the persistent differences in country returns that are driven by divergent monetary policies.

Chart 6 | Evolution of German and US bond yields



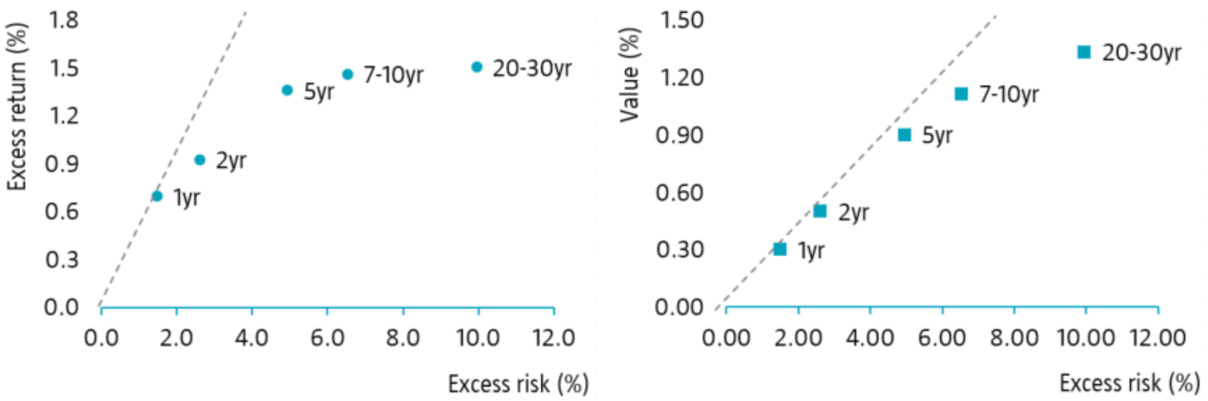
Source: Robeco, Bloomberg

Chart 6 illustrates this, using yields from US and German government bonds. In the left-hand panel we show 10-year yields for both countries; in the right-hand panel we show 2-year yields. The 10-year yields follow a similar pattern in the second half of 2017, with yields in both markets effectively unchanged over the indicated period. A generic momentum factor would thus hardly distinguish between these markets in late 2017. However, the US 2-year yield already diverges from the German 2-year yield in the last months of 2017. In 2018, this divergence continues for 2-year yields and also becomes visible for 10-year yields, as the Fed's rate hike cycle also pushes longer-dated bond yields up. Our enhanced momentum measure, which emphasizes the signal from short-term bond yields, signaled the underperformance of US bonds already in late 2017, several months before the generic measure detected it.

Low Risk

The generic low-risk factor favors short-dated bonds over long-dated bonds. The left-hand panel in Chart 7 shows the excess return over cash and the volatility of this return for US Treasury bonds with different maturities. We use data from the CRSP database from 1950 onwards. Like in Chart 3, we see that the returns of long-dated bonds have – on average – been higher than those of short-dated bonds, but not sufficiently so to compensate for the higher risk. The risk-adjusted returns of short-dated bonds have been higher than those of longer-dated bonds.

Chart 7 | Excess return over cash (left-hand panel) and value (right-hand panel) versus return volatility for US Treasuries with different maturities.



Source: Robeco, CRSP

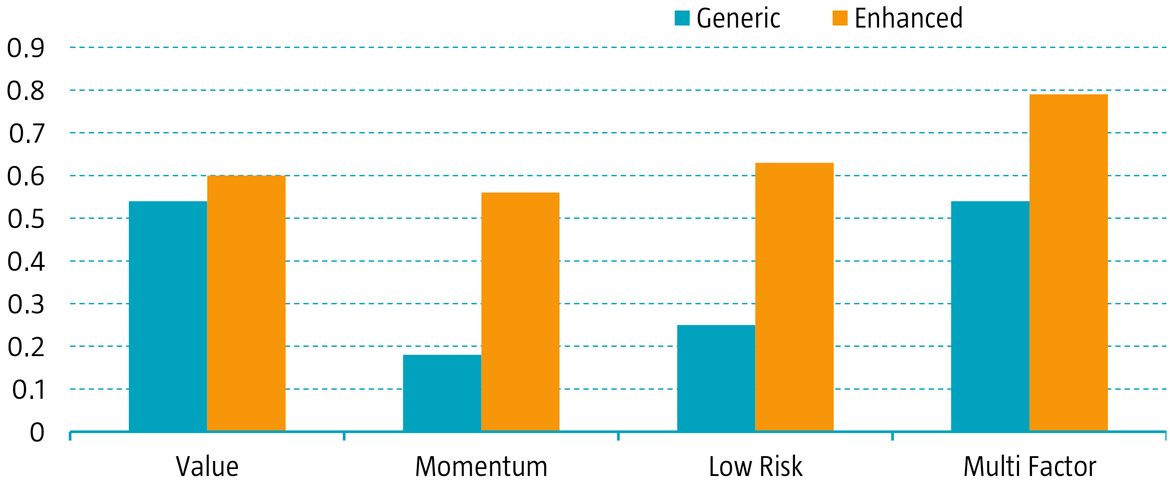
The right-hand panel in Chart 7 shows the average value measure for these bonds (remember that we define value as the yield pick-up versus cash). This demonstrates that longer-dated bonds have – on average – offered a better yield pick-up than shorter-dated bonds, but also a much higher risk. The value advantage of longer-dated bonds is generally insufficient to compensate for the higher risk. By observing this discrepancy between additional yield pick-up and additional risk, investors could already have expected better risk-adjusted returns for shorter-dated bonds.

We use this finding to harvest the low-risk premium more effectively by taking valuation into account. Our enhanced definition of the low-risk factor favors short-dated bonds over longer-dated bonds, unless the valuation of the short-dated bonds is not attractive.

Enhanced factors generate consistent outperformance

In Chart 8 we show the information ratios of the generic factors and our enhanced factors.

Chart 8 | Information ratio for generic and enhanced factors, 1986-2018



Source: Robeco

The generic value factor already generates strong results, but for the other generic factors the information ratios are modest as the factor portfolios take substantial risk versus the market. The enhanced factors clearly outperform the market in a more consistent manner, resulting in strong information ratios for all factors. Combining the three enhanced factors in a multi-factor portfolio leads to an even higher information ratio due to the diversification between the factors.

Enhancing portfolio construction rules

Besides enhanced factor definitions, we also use enhanced portfolio construction rules. In previous sections we defined and evaluated factor portfolios according to common practices in the academic literature. This means, for example, that we did not limit turnover in our analysis, and that we ignored transaction costs for the time being. In practice, of course, we do incur transaction costs and hence we do control turnover.

To harvest factor premiums efficiently, we implement factors prudently. We aim to reduce turnover and avoid unrewarded risks. Ensuring diversification when implementing factors limits exposure to idiosyncratic risk in countries or in specific maturity buckets within a country. Turnover can be reduced substantially by not immediately selling a bond when its factor exposure deteriorates. The reduced transaction costs from postponing the sale can exceed the impact on performance. For example, if bonds that are not included in the portfolio become only marginally more attractive from a valuation standpoint than those in the portfolio, it is not worthwhile incurring costs to replace these bonds immediately. Only when bonds that are not included in the portfolio have become more attractive, will incurring some trading costs be warranted to improve the value exposure of the portfolio. This requires a careful analysis of the tradeoff between maximizing alpha and minimizing transaction costs.

We use a robust portfolio construction algorithm to create a portfolio of government bonds with superior exposure to value, momentum and low-risk factors. To benefit from bond selection rather than market timing, we construct a duration-neutral portfolio, in other words a portfolio with the same interest rate risk as the index. We also ensure that the portfolio is well diversified over countries and maturities, to avoid unrewarded risks, and we limit the exposure to the least liquid segments of the market. We also limit the deviations from the index weights per country per maturity segment.

Multi-factor government bonds: consistent added value

We performed a historical simulation of our factor strategy, while taking into account the aforementioned restrictions and controlling turnover. Instead of building a portfolio from scratch every month, we now take the portfolio from the previous month as a starting point and use the updated factor scores to assess whether trading is needed to improve the factor exposures and how this can be done cost-efficiently. We also ensure that the new portfolio meets all restrictions. The following table summarizes the results of this simulation.

Table 1 | Performance statistics for multi-factor government bond strategy, applied with standard risk budget and with tighter restrictions. January 1985-September 2018

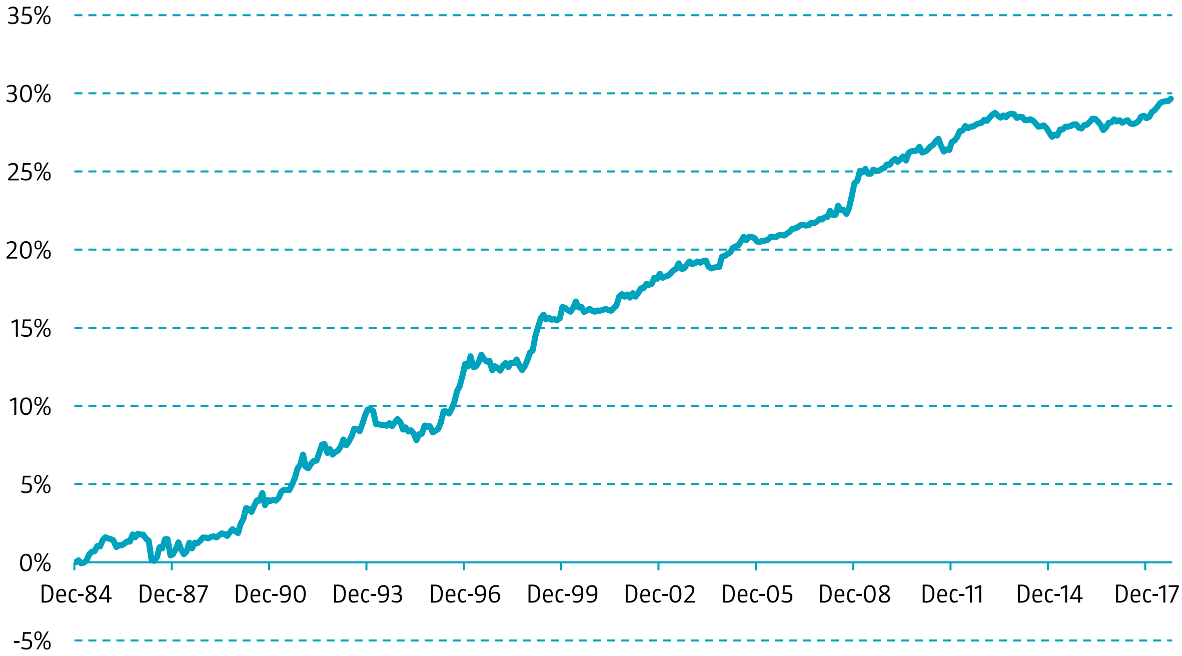
	MFGB	*MFGB - lower TE*	*market*
Return	6.43%	6.04%	5.55%
Risk	3.53%	3.45%	3.41%
Sharpe ratio	0.84	0.75	0.62
Outperformance	0.88%	0.49%	-
Tracking error	0.96%	0.52%	-
IR	0.92	0.94	-

Source: Robeco

The first column shows that the multi-factor strategy generates a higher return than the market at a comparable level of risk, thus resulting in a superior Sharpe ratio. The outperformance is high compared to the tracking error, resulting in a high information ratio. The tracking error of the strategy can be reduced by restricting the deviations per country and maturity bucket more tightly. The second column shows that this results in lower tracking error and outperformance, while hardly affecting the information ratio.

Chart 9 shows the relative performance of this simulated portfolio versus the index. These simulated results take transaction costs into account.

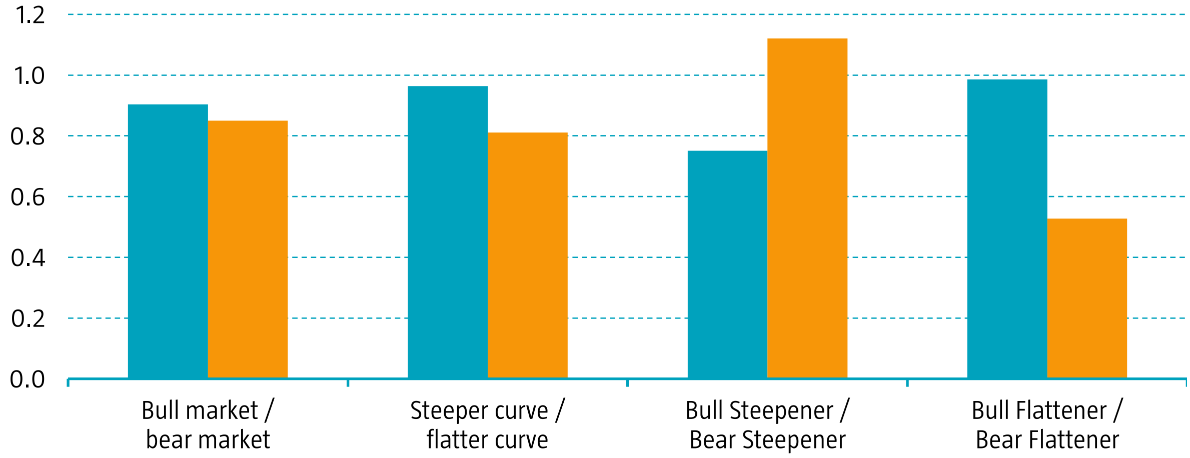
Chart 9 | Cumulative relative return multi-factor government bonds, 1984-2018



Source: Robeco

The simulation shows a consistent outperformance of the multi-factor government bonds portfolio over time. This is an advantage of the multi-factor approach. No single factor will outperform in every sub-period, but the diversification over factors results in a smooth performance. For example, when value underperforms, momentum and low risk can compensate. Furthermore, our portfolio construction also contributes to a stable performance versus the index by limiting the deviations from the index in terms of countries and maturity buckets. Finally, the interest rate sensitivity of the portfolio is always kept in line with the index, so the portfolio is not hurt by falling or rising interest rates.

Chart 10 | Annualized relative performance under various market circumstances



Source: Robeco

Chart 10 shows that the strategy has delivered on average similar-sized outperformance with falling and rising bond yields, and when yield curves steepen and when they flatten. Zooming in even further on these market circumstances, the strategy has added value in case of bull steepening, bear steepening, bull flattening and bear flattening. This confirms that the multi-factor strategy performs well in a variety of market circumstances.

Conclusions

We have shown academic and empirical evidence for the existence of the value, momentum and low-risk factor premiums in the government bond market. We have explained how these factors can be applied to government bonds and how we enhance the generic definitions. Finally, we have shown that these factor premiums can be harvested efficiently in a multi-factor government bond portfolio, taking into account practical considerations, such as turnover and transaction costs. This portfolio keeps its total exposure to interest rate risk constantly in line with the market, while aiming to take this risk in a smarter way, i.e. in the most attractive countries and maturities. Historical simulations show consistent outperformance for the multi-factor government bond portfolio.

Applications

Factor investing can be implemented in government bond markets as well as in credit portfolios. Our multi-factor bond strategy combines such government bond and credit factor strategies to construct an aggregate portfolio. The multi-factor government bond strategy can be applied as an active strategy or, with a lower tracking error, as an alternative to passive investing. As these strategies keep the portfolio duration constant, they can be part of liability-matching portfolios. They can also be combined with an active duration overlay for clients who do want to use market timing as a source of alpha.

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Some Funds referred to in this marketing material have been registered with the UAE Securities and Commodities Authority (the Authority). Details of all Registered Funds can be found on the Authority's website. The Authority assumes no liability for the accuracy of the information set out in this material/document, nor for the failure of any persons engaged in the investment Fund in performing their duties and responsibilities.

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The sale of the Fund qualifies as a private placement pursuant to section 2 of Uruguayan law 18,627. The Fund must not be offered or sold to the public in Uruguay, except in circumstances which do not constitute a public offering or distribution under Uruguayan laws and regulations. The Fund is not and will not be registered with the Financial Services Superintendency of the Central Bank of Uruguay. The Fund corresponds to investment funds that are not investment funds regulated by Uruguayan law 16,774 dated September 27, 1996, as amended.

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The RobecoSAM collective investment schemes ("RobecoSAM Funds") in scope are ub-Funds under the Undertakings for Collective Investment in Transferable Securities (UCITS) of MULTIPARTNER SICAV, managed by GAM (Luxembourg) S.A., ("Multipartner"). Multipartner SICAV is incorporated as a Société d'Investissement à Capital Variable which is governed by Luxembourg law. The custodian is State Street Bank Luxembourg S.C.A., 49, Avenue J. F. Kennedy, L-1855 Luxembourg. The prospectus, the Key Investor Information Documents (KIIDs), the articles of association, the annual and semi-annual reports of the RobecoSAM Funds, as well as the list of the purchases and sales which the RobecoSAM Fund(s) has undertaken during the financial year, may be obtained, on simple request and free of charge, via the website www.robecosam.com or www.funds.gam.com.

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