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Barclays Risk Analytics and Index Solutions

24 September 2015

Risk-Balanced Index Construction

Diversifying risks in fixed income portfolios

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Fixed income investors face an environment that few current managers have experienced in their professional careers. As the US appears to be entering a new monetary policy phase, investors are considering the possibility that a three and a half decade-long rally in the interest rates market may be coming to an end. During that time, broad market benchmark indices that guided most investment policy portfolios enjoyed remarkable returns. While these indices remain at the center of asset allocation policy portfolios, a number of investors have been seeking new alternatives to market value-weighted benchmark indices that are dominated by interest rate risk. We think the search for such alternative benchmark indices can be guided by advances in factor-based asset allocation and the emergence of the concept of "Smart Beta".

We have previously studied and discussed the development of factor-based investing. Within this context, a portfolio's basic building blocks are units with intuitive risk and return properties. In the absence of views on future performance, risk diversification across various risk premia is a robust and sensible allocation strategy. If investors do have views on the future performance of risk premia, they can apply those using tilts or risk budgeting techniques. In this publication, we consider how risk-based portfolio construction can be applied to create alternative fixed income benchmark indices. We explain how investors seeking to diversify their portfolios' fixed income exposure can:

- Isolate individual market risk premia and balance the portfolio's exposures to these premia—in the US fixed income universe these include **interest rates** (Treasuries), **credit** (corporate spreads) and **prepayment** (mortgage spreads) risk premia
- Incorporate additional compensated risk factors (**low volatility**, **high yield**)
- Create a benchmark index that is designed to be replicated and managed efficiently

Finally, we discuss the Barclays US Fixed Income Balanced Risk (FIBR) Indices. The indices employ volatility weighting to balance interest rate risk and spread risk while benefiting from the addition of the low volatility and high yield factors.

While deviating from market value weights may not be possible for all investors—particularly those with large portfolios—certain investors may find balanced-risk indices appealing. These indices would, of course, be of interest to investors seeking alternatives to traditional benchmark indices to reduce interest rate exposure during the course of a rising rates environment. In addition, however, they would also appeal to long-term investors who believe that over multiple business cycles portfolios that balance risks exposures to multiple risk premia will deliver better risk-adjusted returns than portfolios with concentrated risk exposures.

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Reviewing fixed income benchmarks

When former Federal Reserve Chairman Volcker was credited with successfully combating soaring inflation almost 35 years ago, it marked the start of a long bull market for fixed income investors in the US. Ten-year treasury yields declined from nearly 16% in September 1981 to their current level just above 2%, fueling gains in the benchmark Barclays US Aggregate Index of 8.5% per annum during this period. Returns for benchmark global bond indices were similarly robust over the past two decades: the Barclays Global Aggregate USD Hedged and Unhedged Indices both returned in excess of 6% per annum since 1990[1].

Nearly seven years on from the financial crisis of 2008, it appears that the US economy has recovered to a point that market participants expect that the Federal Reserve will begin increasing interest rates sometime in the next few months. In the face of these evolving changes, several investors think that the US fixed income market is on the cusp of entering a new phase. Investors are expressing concern about whether the fixed income benchmarks and investment policies that had served them well over the past few decades will still remain the best options in the coming years.

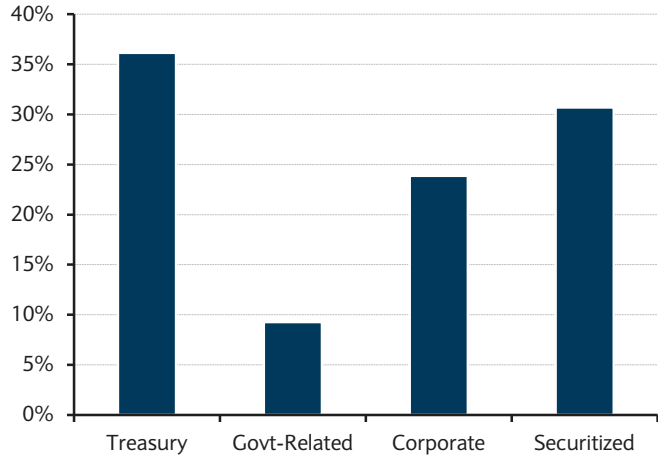
Market value-weighted benchmark indices have been widely used since the acceptance of Markowitz's Portfolio Theory nearly six decades ago. These indices have been almost universally adopted by asset allocators and are used to specify policy portfolios. They represent "The Market", which is the entire investment opportunity set in a particular asset class. More importantly, a large body of academic research suggests that in a one-factor (CAPM) world, the market portfolio is on the efficient frontier representing the best tradeoff between return and risk. Thus, even though there may be times when alternative-weighted portfolios may appear more attractive, market value-weighted benchmark indices have long been accepted to be the backbone of long-term, systematic asset allocation by the majority of market participants.

The Barclays US Aggregate index is one of the most widely followed benchmarks of the US investment grade fixed income market. It is composed of Treasuries, government-related bonds, corporate bonds, mortgage-backed securities and other securitized instruments (Figure 1). Investors allocating capital to the benchmark expect to be compensated for bearing exposure to a variety of risks: interest rate risk, credit risk and prepayment risk. Yet, a risk decomposition indicates that the index returns are dominated by interest rate risk (Figure 2). While exposure to interest rate risk was handsomely rewarded as interest rates in the US declined over the past 35 years, investors now need to carefully consider how this benchmark will perform in an environment in which interest rate exposure looks substantially less attractive.

[1] Returns data for the US Aggregate Index are available from 1976. Returns data from the Global Aggregate Index are available from 1990.

FIGURE 1

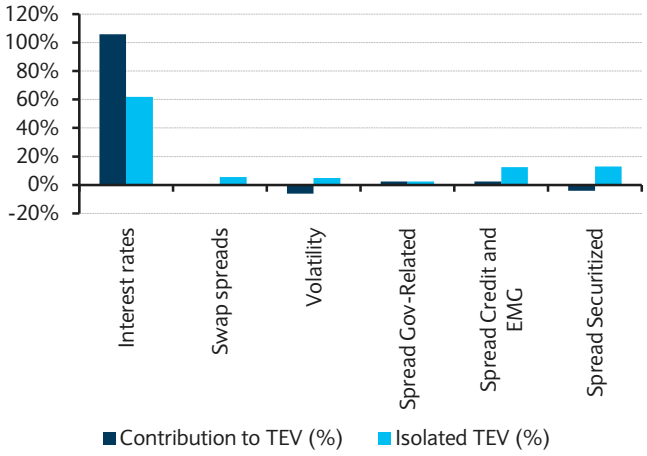
US Aggregate Index: Market value of constituents on June 30, 2015



Source: Barclays Risk Analytics and Index Solutions

FIGURE 2

US Aggregate Index: Risk decomposition on June 30, 2015



Note: TEV represents Tracking Error Volatility with respect to cash
Source: Barclays Risk Analytics and Index Solutions

The financial crisis of 2008 made investors painfully aware that a 60/40 (60% equities, 40% fixed income) portfolio, while notionally seemingly diversified, contains more than 90% equity risk. In the years that followed, attention shifted from examining asset class weights in a portfolio to identifying a portfolio's exposures to specific risk factors that affect returns. The acknowledgement of the importance of these factors has been responsible for the recent trend in portfolio management in which risk premia, rather than traditional asset classes, are viewed as the key building blocks of portfolios. These portfolios aim to benefit from better risk diversification and promise better potential risk-adjusted returns than traditional market value-weighted portfolios. These benefits are not costless though. Deviating from market value weights typically involves periodic portfolio rebalancing and incurs additional trading costs. Furthermore, investors with large portfolios may face capacity constraints in certain smaller or less-liquid sections of a market.

In the equities asset class, factor-based investing has already gained a sizeable following and Smart Beta products have garnered significant attention. However, the concept of Smart Beta in fixed income is not yet well defined. In this publication, we outline our view of what Smart Beta in fixed income is and we discuss how the ideas of factor-based investing can be applied to create risk-diversified fixed income benchmark indices. Investors considering the adoption of alternative fixed income benchmarks need to study their properties relative to the market value-weighted benchmarks not only relative to their historical performance but also with respect to their role as components of an overall multi-asset portfolio.

To the first point, risk-balanced fixed income portfolios will not necessarily compare favorably with market value-weighted benchmarks over the past few decades due to the extraordinarily good performance of the interest rates factor during this time. A risk-balanced portfolio of risk premia factors can be thought of as being mean-variance optimal under the assumption that the risk-adjusted returns of the various factors are equal. This claim is a fairly strong one and it can be contentious because there is not enough historical data to accept or reject this hypothesis with appropriate statistical significance. However, if one were to accept that risk premia are equally compensated in the long run, then it is not controversial to suggest that a portfolio that balances risks across identified risk premia is a superior option. This is because the risk-balanced portfolio aims to take advantage of the significant diversification potential of multiple risk factors that market value-weighted portfolios leave untapped. These benefits have been duly noted in

other asset classes and in multi-asset class portfolios where a single market risk factor has not outperformed all other risk factors in recent history.

With regards to the second point, market value-weighted fixed income benchmarks have served as the ballast for multi-asset class portfolios, more recently acting as a "flight-to-quality" asset that has complemented macroeconomic growth-oriented asset classes such as equities or commodities. This property is due to the overwhelming influence of interest rate risk in traditional fixed income benchmarks. If investors choose to modify this property by balancing the risks present in fixed income benchmarks, they need to be aware of how the risk-balanced fixed income portion of their portfolio will fit into the overall allocation. Our views on how to construct risk-balanced multi-asset class portfolios can be found in *Investing with Risk Premia Factors: Return sources, portfolio construction, and tail risk management*, July 2012, and in *Risk-Based Asset Allocation: Shaken, But Unstirred*, June 2014.

If investors decide to take advantage of the increased diversification benefit that risk balancing provides and they are able to implement this efficiently, it may better position their fixed income portfolios for the regime changes that are expected in the near future. In addition, risk-balanced fixed income portfolios may be more appealing than traditional benchmarks in the long run if the various embedded risk factors are compensated more equally than they had been over the past few decades when market value-weighted fixed income benchmarks turned out to be a very good default investment option.

Factor-based investing

Beta, Alternative Beta and Smart Beta

"Beta" (or "market beta" or "asset class beta") is typically thought to be a systematic (i.e. un-diversifiable) risk factor that all securities in an asset class have varying degrees of exposure to. In equities, where the concept is best known, the market beta has come to be defined as the portfolio of all stocks and is frequently represented by global or country-specific market value-weighted benchmark indices. Since the common "equity risk" factor cannot be diversified away from stock portfolios, there exists a market risk premium (the return in excess of the risk-free rate) that investors expect to earn as compensation for bearing exposure to this risk. It is this market risk premium that passive, long-term investors aim to collect by allocating a portion of their portfolios to equities.

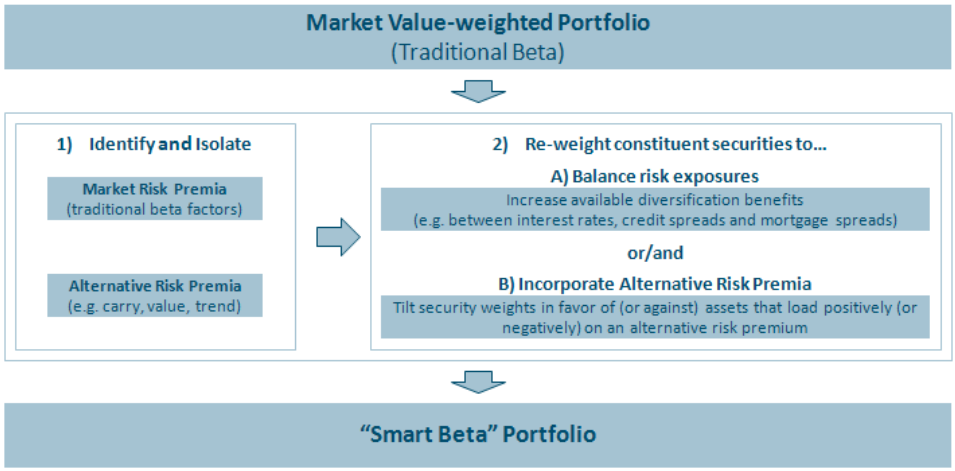
The fixed income asset class is slightly more nuanced. While "traditional beta" in fixed income is also represented by market value-weighted benchmarks of all securities in a defined universe, fixed income securities can contain exposure to more than one systematic risk factor. These include interest rate risk (almost universally present except in floating rate notes or pure credit instruments such as credit default swaps), credit risk (present in any security where interest payments and repayment of principle is not certain) and contraction or extension risk (typically found in callable bonds and mortgage securities where the exact life of the instrument is uncertain). Each of these factors has an associated risk premium and passive long-term investors aim to collect all three via investments in broad-based fixed income benchmark indices.

In addition to market risk premia, academics and practitioners have identified a number of risk factors across asset classes that have historically yielded excess returns. These "alternative risk premia" are generally uncorrelated with, or have low correlations with, their corresponding asset class risk premia and with each other. Some of them, such as size and value, may be familiar (e.g. small-cap, value equity portfolios), while examples of less well-known (until recently) alternative risk premia include carry, trend/momentum, low volatility, liquidity and event-driven premia such as merger arbitrage. These alternative risk premia can be isolated from the market risk premia that are present in all securities in an asset class

and exposure can be efficiently accessed via rules-based (typically long/short or market-neutral) trading strategies. We previously studied the properties and diversification benefits of alternative risk premia across asset classes in *Barclays Capital Risk Premia Family: Sequencing the strategy genome*, May 2011.

The ability to identify, isolate, and efficiently obtain exposure to individual risk premia—market risk premia and alternative risk premia—opens up the possibility for managers to enhance the properties of long-only, market value-weighted asset class portfolios or benchmark indices. Figure 3 illustrates how strategically deviating from market value weights is the underpinning of the Smart Beta idea. Thus, Smart Beta portfolios are expected to be superior to market value-weighted portfolios either because they are better diversified or/and they are expected to yield superior risk-adjusted returns due to the incorporation of alternative risk premia.

FIGURE 3
Building blocks of Smart Beta portfolios



Source: Barclays Risk Analytics and Index Solutions

Isolating fixed income factors

We have maintained that the investable universe should not be thought of solely in terms of asset classes. Instead, our preferred approach is to treat systematic sources of risk and return (i.e., risk premia—whether beta or alternative beta) as the fundamental building blocks in any systematic asset allocation process. Thus, managers should seek to incorporate as many compensated independent risk factors as their mandate allows.

Many fixed income managers are required to replicate or manage a portfolio in relation to a benchmark index that is typically market value-weighted. As a result, even though fixed income investors seek to capture returns from at least three distinct risk sources (interest rate, default and prepayment risks) when investing in a broad-based, diversified index, the amount of exposure they have to these risk sources is not dictated by their views on the risk-adjusted returns of these factors, but by the risk contributions that happen to be present in the benchmark index. This raises the question of whether the factor exposures in the market value-weighted benchmark index are optimal from a risk-return perspective.

We use the Barclays US Aggregate Index ("the Agg") as an example of a widely followed market value-weighted benchmark index. It is composed of more than 9,000 securities that represent the USD investment grade fixed income investable universe. The index's returns can be attributed primarily to returns on cash and returns derived from three factors: interest rates exposure, corporate spreads and mortgage spreads.

FIGURE 4

Historical returns of Treasuries, investment grade corporate bonds and MBS (September 1988–June 2015)

	Treasuries	IG Corp	MBS
Total return (annualized)	6.43%	7.30%	6.66%
Excess return (annualized)	3.05%	0.38%	0.36%
Annualized excess return volatility	4.44%	3.91%	1.33%
Sharpe ratio of excess return	0.69	0.10	0.27

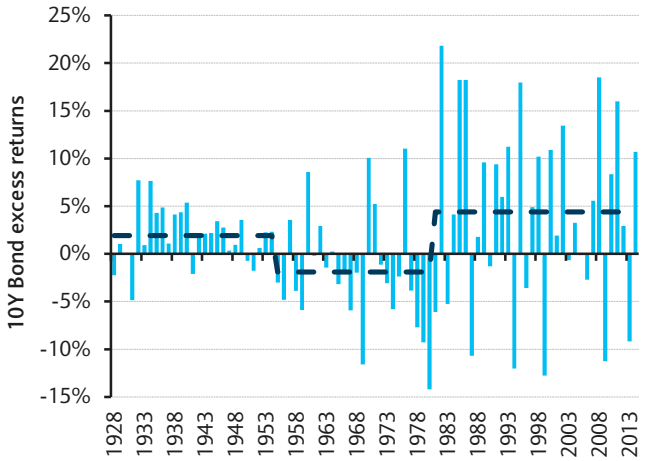
Note: Excess return for Treasuries is the return in excess of cash. Excess returns for IG Corp and MBS are the returns in excess of duration-matched Treasuries. Source: Barclays Risk Analytics and Index Solutions

While all three major components of the Agg earned healthy returns over the past 27 years (Figure 4), a large portion of their total returns were attributable to cash and interest rate exposure. The excess returns attributable to the two spread factors (IG Corp spreads and mortgage-backed securities (MBS) spreads) were significantly lower than the excess return earned for exposure to interest rates risk (Treasuries)2. Given that Treasuries had substantially higher risk-adjusted returns than either corporate spreads or mortgage spreads over this period, the fact that most of the risk in the benchmark was interest rates risk acted in favor of passive investors. Thus, if the returns from 1998 to 2015 are an accurate indicator of future returns, then the benchmark's risk exposures may well be near optimal and investors should continue using market value-weighted benchmarks for long-term systematic asset allocation and simply consider tactically lowering their interest rate exposure in the short term.

While we do not have reliable longer histories of the performance of credit spreads or mortgage spreads, there are available data that can provide more insight into the longer-term performance of interest rates risk exposure. The latter indicates just how unusual the past three and half decades have been for interest rates. There has clearly been cyclicality in performance: a hypothetical index of the US 10y bond would have had average annual excess (of cash) returns of 1.9% in the 27 years from 1928 to 1954, before returning -1.9% a year for the 26 years from 1955 to 1980 and then entering this current regime where it gained a remarkable 4.4% a year for 34 years (Figure 5 and Figure 6).

FIGURE 5

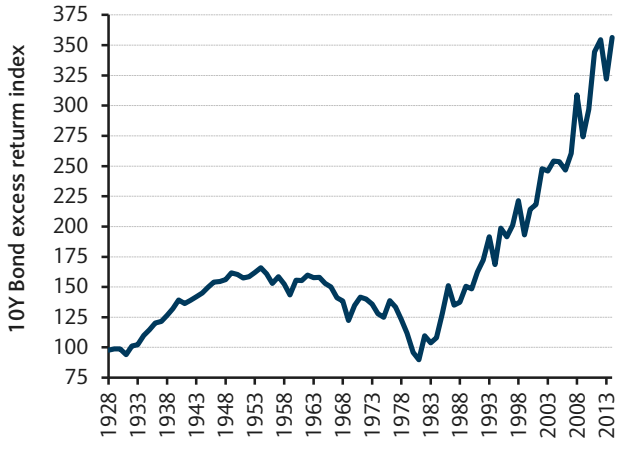
10y bond excess (of cash) returns



Source: Aswath Damodaran, New York University (http://www.stern.nyu.edu/~adamodar/New_Home_Page/data.html)

FIGURE 6

10y bond excess return index



Source: Aswath Damodaran, New York University (http://www.stern.nyu.edu/~adamodar/New_Home_Page/data.html)

[2] Here, excess return is defined as the return in excess of cash for Treasuries and the return in excess of duration-matched Treasuries for IG Corporate spreads and Mortgage-Backed Securities (MBS) spreads.

Viewed from this longer-term perspective, it seems evident that the past few decades have not been representative of the long-term nature of the interest rate risk factor's risks and returns. Accordingly, it would not be unreasonable to claim that the Sharpe ratios of Treasuries, corporate spreads and mortgage spreads are a lot closer to equal in the long run than they had been recently. Given the low average correlation between these three components (Figure 7 and Figure 8), this implies that the market value-weighted portfolio does not allocate optimally to these three risk premia because the concentrated risk exposure to Treasuries (interest rate risk) clearly does not take advantage of the significant diversification potential that is available.

FIGURE 7

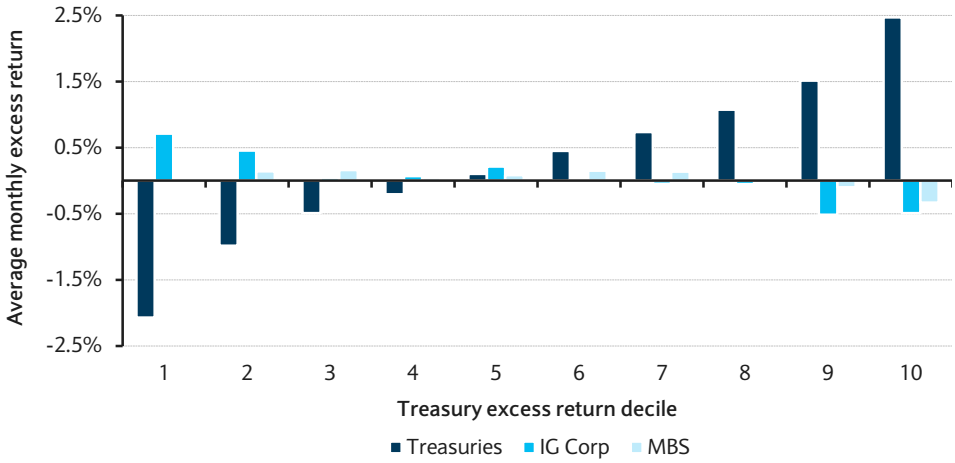
Correlation of monthly excess returns (September 1988–June 2015)

	Treasuries	IG Corp	MBS
Treasuries	100%	-30%	-23%
IG Corp		100%	40%
MBS			100%

Note: Excess return for Treasuries is the return in excess of cash. Excess returns for IG Corp and MBS are the returns in excess of duration-matched Treasuries. Source: Barclays Risk Analytics and Index Solutions

FIGURE 8

Average excess returns of Treasuries, IG corporates and MBS sorted by deciles of Treasury excess returns (September 1988–June 2015)



Note: Excess return for Treasuries is the return in excess of cash. Excess returns for IG Corp and MBS are the returns in excess of duration-matched Treasuries. Source: Barclays Risk Analytics and Index Solutions

In the next section, we explore how we can re-weight the components of the Agg to decrease the concentration of risk in Treasuries. We explain different portfolio construction methods that can be utilized to construct balanced risk portfolios and we discuss the assumptions under which these portfolios can be thought to be mean-variance optimal.

Balancing risk factors

While investing in an asset classes is a direct, straightforward process, "investing in a factor" requires the construction of a factor-replicating portfolio. Typically, this involves long/short portfolio construction to isolate the factor from the market risk premium that is also present in the selected securities. Thus, while interest rate risk exposure can be obtained simply by going long Treasuries, isolated exposure to credit spreads or mortgage spreads has to be obtained by

hedging credit or mortgage bonds with a short position in duration-matched Treasuries[3]. In this section, we discuss how to construct risk-balanced portfolios of Treasuries, corporate spreads, and mortgage spreads. We use Treasury returns (in excess of cash) to represent exposure the interest rate risk factor and corporate and mortgage excess returns (in excess of duration-matched Treasuries) to represent exposure to the two spread factors.

Risk balancing can be achieved by equalizing each portfolio component's risk contribution to the overall portfolio. A component's risk contribution is a function of its weight in the portfolio and its covariance with the other the portfolio's other components[4]. Even though risk balancing focuses solely on the risk characteristics of portfolios, it can be useful to think of the conditions under which variations of risk-balanced portfolios would be optimal portfolios in a mean-variance context (Figure 9).

FIGURE 9

Conditions under which different risk-balanced portfolios would be mean-variance optimal

Portfolio construction methodology	MVO conditions
Equal notional weights	Components have equal volatilities, equal pair-wise correlations and equal Sharpe ratios
Equal volatility weights	Components have equal pair-wise correlations and equal Sharpe ratios
Equal risk contributions	Components have equal Sharpe ratios

Source: Barclays Risk Analytics and Index Solutions

It is preferable to seek to balance risks at a factor (such as Treasuries, corporate spreads, and mortgage spreads) level rather than at the security (individual bond) level for several reasons. Diversification gains are inversely proportional to correlation. Thus, it makes sense to group highly correlated securities into buckets that share common characteristics or risk factors and to allocate equal risk weights across (lesser correlated) buckets. The securities within the buckets can remain market value weighted. If the buckets are carefully selected, the incremental diversification benefit that could be gained by re-weighting highly correlated securities within a bucket may not be worth the trading costs or the computational and operational costs of forecasting all of their volatilities and correlations. In addition, it may be easier and less costly to trade an entire bucket that is a well-defined market value-weighted market segment, such as US Treasuries or Investment Grade Corporates.

One note of caution merits mention here. Adopting non-market value weights can increase the diversification benefits among a portfolio's constituents; however, periodically rebalancing the portfolio will increase portfolio turnover and incur extra trading costs each rebalance period. More importantly, investors with very large portfolios may find that adopting non-market value-weighted positions could be unattractive if the liquidity costs of assigning relatively large weights to securities or sections of a market that have small market values are high. Nevertheless, if an investor is able to alter their portfolio in such a manner, there are significant potential gains to be reaped from better risk diversification. The trading costs associated with the segments of the market we discuss in the rest of this paper are not inordinately high and will not materially change the results shown later.

[3] This can be done efficiently with the use of government bond futures and the family of Barclays Duration Hedged Indices (DHIs) allows investors to customize their exposure to these various risks.

[4] The covariance, in turn, can be decomposed into the component's volatility and its correlation to the other components (see *Investing with Risk Premia Factors: Return sources, portfolio construction, and tail risk management*, July 2012)

The Equal Volatility-Weighted Portfolio

The US Aggregate Index is, for the most part, composed of Treasuries, corporate bonds and MBS. Even though notional weights are distributed somewhat evenly among these three components, since corporate bonds and MBS contain interest rate and spread risks, the notional amount effectively "allocated" to the interest rate factor is substantially higher than that allocated to the two spread factors (Figure 10). Furthermore, since interest rates had a significantly higher volatility than MBS spreads, the total risk in the portfolio was skewed even further in the direction of interest rate risk (Figure 2).

FIGURE 10

Average notional exposure to the interest rates, credit and prepayment factors in the Barclays US Aggregate Index (July 1993–June 2015)

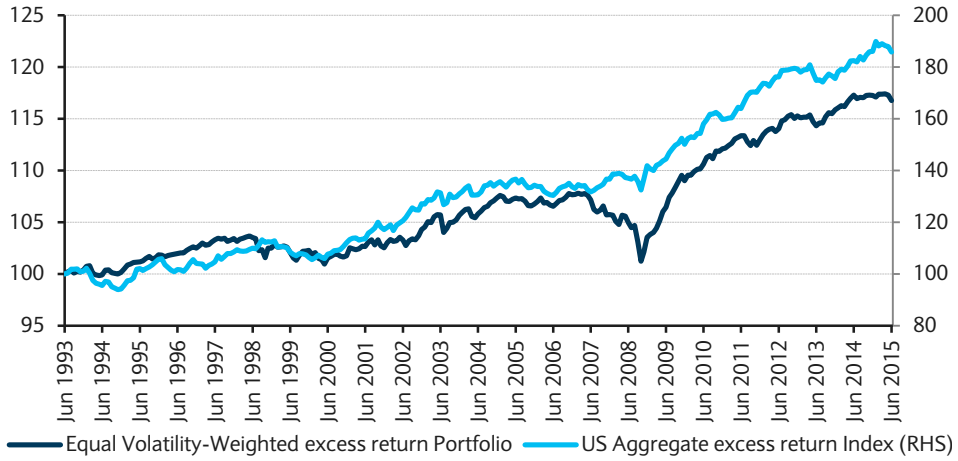
	Interest Rates	Credit	Prepayment
Average security weight	38%	23%	39%
Average duration	5.3	6.1	3.4
Average "effective" notional allocation	59%	15%	26%

Note: The average notional weights of Treasuries, IG corporate bonds and MBS in the US Aggregate Index were 38%, 23% and 39%, respectively. Since corporate bonds and MBS contain interest rate risk and spread risk, some portion of their notional allocations need to be allocated to interest rates exposure to obtain the notional exposures to the three factors. This is estimated here by assigning a duration-equivalent amount of notional of IG corporates and MBS to Treasuries and normalizing the resulting weights. Source: Barclays Risk Analytics and Index Solutions

Since the three primary market risk factors—Treasuries, IG Corporate spreads and MBS spreads—have different volatilities, an equal volatility-weighted portfolio (EVWP) is a first step toward re-weighting these three major components of the Agg with a view to improving its risk diversification. Accordingly, we construct the EVWP by using recent historical returns observations as forecasts for the volatility of each of the three factors and assigning the components weights that are inversely proportional to forecasted volatility each month. The performance of the EVWP and the US Aggregate index is shown in Figure 11 and Figure 12.

FIGURE 11

Historical performance of excess (of cash) return indices of the Equal Volatility-weighted Portfolio and US Aggregate Index



Source: Barclays Risk Analytics and Index Solutions

FIGURE 12
Historical performance of the Equal Volatility-weighted Portfolio the US Aggregate Index

(July 1993–June 2015)	Volatility-weighted portfolio	US Aggregate Index
Annualized total return	3.40%	5.60%
Annualized excess (of cash) return	0.71%	2.86%
Annualized excess return volatility	1.31%	3.63%
Sharpe ratio	0.54	0.79

Source: Barclays Risk Analytics and Index Solutions

The comparison of the EVWP and the Agg immediately lead to some interesting observations:

- The Agg performed significantly better than the EVWP
  - This should not be surprising, given that exposure to interest rate risk was compensated extremely well during this sample period. The transfer of exposure away from interest rate risk toward the two spread risk factors naturally leads to weaker historical performance over the period.
- The EVWP has a much lower volatility than the Agg
  - This is a consequence of improved risk diversification and a greater allocation to a low volatility component (MBS spreads).
  - As seen from Figure 10 and Figure 13, equal volatility weighting across factors more than doubled the notional amount that was effectively allocated to MBS spreads (from 26% to 54%).

FIGURE 13
Equal Volatility-Weighted Portfolio notional exposures and risk attribution

(July 1993–June 2015)	Treasuries	IG Corp spreads	MBS spreads
Average notional weight	16%	30%	54%
Average risk contribution	15%	44%	41%

Source: Barclays Risk Analytics and Index Solutions

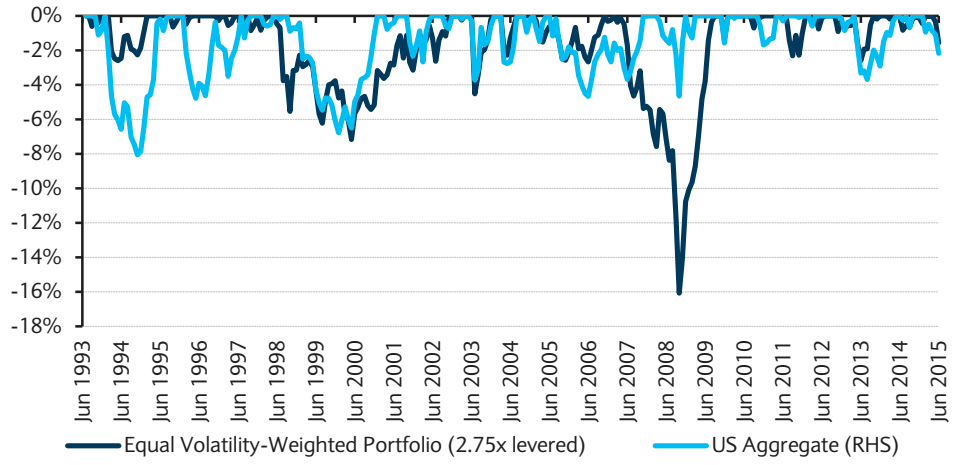
- The EVWP has a different risk contribution profile than the Agg
  - Figure 13 shows that the risk contribution shifted dramatically: from almost all interest rate risk in the Agg to mostly corporate and mortgage spread risk in the EVWP.
- The two portfolios are positively correlated, but the correlation is not extremely high, with several sub-periods of diverging performance
  - Average monthly return correlation was 55% over this sample period.
  - A look at the portfolios' drawdowns illustrates sub-periods of diverging performance. To compare drawdowns fairly (given the differences in the portfolios' volatilities), Figure 14 shows the drawdowns of the Agg and a 2.75x-leveraged version of the EVWP.
  - The drawdowns of the EVWP are dominated by the losses and subsequent sharp recovery of the spread factors in 2008 and 2009. Since Treasuries benefited from the

flight-to-quality that occurred during the financial crisis, the Agg performed much better than the EVWP over that period.

– Excluding the crisis period, the drawdowns of the two portfolios were comparable in magnitude. The differences in performance during the middle of the 1990s, when Treasuries suffered their largest drawdown in this sample period, serves to highlight the benefit of risk diversification.

FIGURE 14

Drawdowns of the Equal Volatility-Weighted excess (of cash) return Portfolio (2.75x leveraged) and the US Aggregate excess (of cash) return Index



Source: Barclays Risk Analytics and Index Solutions

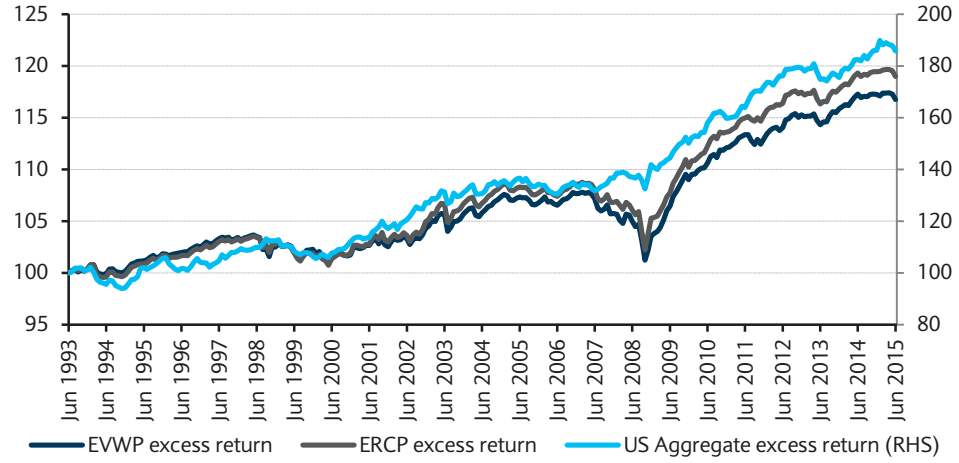
The Equal Risk Contribution Portfolio

The EVWP takes a big step toward improved risk diversification in a fixed income portfolio relative to a market value-weighted portfolio. However, while isolated risk (i.e. volatility) contributions of the three factors are approximately equal the EVWP, Figure 13 indicates that the risk contributions of the three factors remain unbalanced in the portfolio. This is because correlations across the factors were not equal over the sample period—the interest rate risk factor was negatively correlated to the two spreads risk factors. By taking correlations into account in portfolio construction, better risk diversification is possible.

Our preferred portfolio construction method to incorporate correlation is the Equal Risk Contribution Portfolio (ERCP). Other methods, such as Maximum Diversification, would also achieve this objective but they are not as robust to errors in forecasted correlation as the ERCP. The ERCP uses recently realized returns to forecast volatilities and correlations and each month assigns weights to the three components in a manner that equalizes their total risk contributions to the overall portfolio. A detailed discussion of portfolio construction methodologies can be found in *Investing with Risk Premia Factors: Return sources, portfolio construction, and tail risk management*, July 2012.

FIGURE 15

Historical performance of excess (of cash) return indices of the Equal Volatility-weighted Portfolio (EVWP), Equal Risk Contribution Portfolio (ERCP) and US Aggregate Index



Source: Barclays Risk Analytics and Index Solutions

FIGURE 16

Historical performance of excess (of cash) return indices of the Equal Volatility-weighted Portfolio (EVWP), Equal Risk Contribution Portfolio (ERCP) and US Aggregate Index

	EVWP	ERCP	US Aggregate
Annualized total return	3.40%	3.49%	5.60%
Annualized excess (of cash) return	0.71%	0.79%	2.86%
Annualized excess return volatility	1.31%	1.36%	3.63%
Sharpe ratio	0.54	0.58	0.79

Source: Barclays Risk Analytics and Index Solutions

The historical performance of the ERCP was similar to that of the EVWP (Figure 15 and Figure 16), indicating that equal volatility weighting goes a long way toward risk balancing. However, simple volatility weighting does not take advantage of the additional diversification benefits that portfolio components with a lower-than-average correlation can provide. Figure 17 shows how accounting for correlations brings the average risk contributions of the three components closer to equal. The difference in the ex-post realized risk contributions (32%, 38% and 50%) and the targeted equal risk contributions (33%, 33% and 33%) is due to differences in the forecasted and subsequently realized volatilities and correlations of the three factors.

FIGURE 17

Equal Volatility-Weighted Portfolio (EVWP) and Equal Risk Contribution Portfolio (ERCP) notional exposures and risk attribution

(Jul 1993 – Jun 2015)	Equal Volatility-Weighted Portfolio			Equal Risk Contribution Portfolio		
	Treasuries	IG Corp spreads	MBS spreads	Treasuries	IG Corp spreads	MBS spreads
Average Weight	16%	30%	54%	21%	29%	50%
Average Risk Contribution	15%	44%	41%	32%	38%	30%

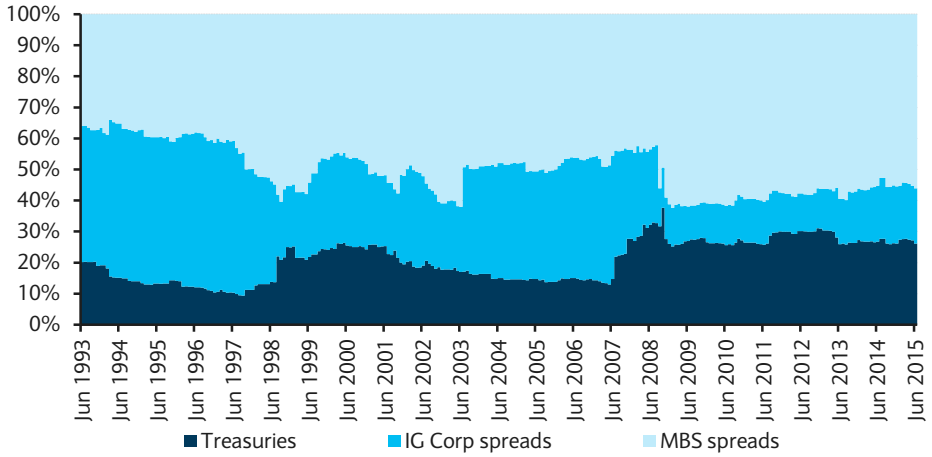
Source: Barclays Risk Analytics and Index Solutions

The notional weights allocated to Treasuries, IG Corp spreads and MBS spreads in the ERCP are shown in Figure 18. The dynamic nature of the portfolio construction process allowed

the allocations to vary over time as the risk properties of these three factors changed relative to each other.

FIGURE 18

Notional allocations to Treasuries, IG corp spreads and MBS spreads in the ERCP



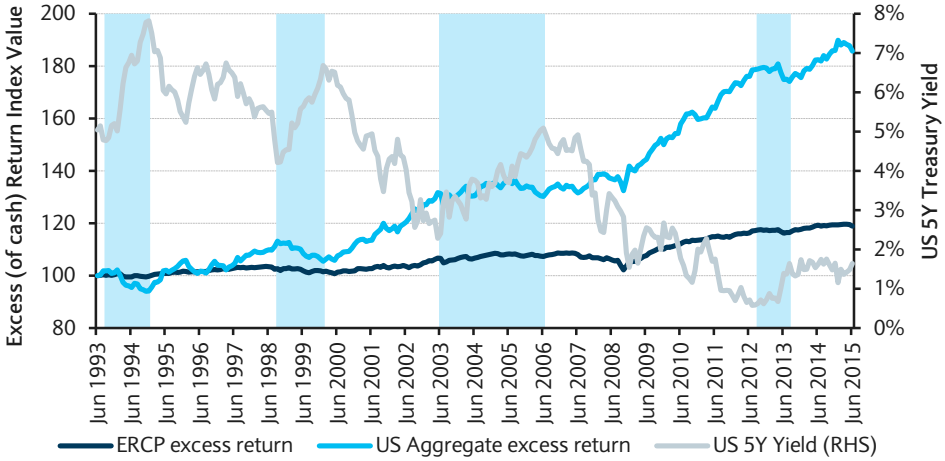
Source: Barclays Risk Analytics and Index Solutions

There were four periods of rising interest rates during this sample period:

- September 1993 to December 1994 (16 months)
- September 1998 to January 2000 (17 months)
- June 2003 to June 2006 (37 months)
- September 2012 to August 2013 (12 months)

FIGURE 19

Excess (of cash) return performance in rising rates environments



Source: Bloomberg, Barclays Risk Analytics and Index Solutions

As might be expected, the large exposure to interest rate risk in the Agg caused it to underperform the ERCP in all four episodes. Returns from spreads (credit and mortgage) were positive in each of these periods and the ERCP's better risk diversification led to better performance during these particular rising rates periods (Figure 20).

FIGURE 20
US Aggregate Index ("Agg") and ERCP returns in rising rates episodes

	Agg			ERCP		
	Return	Contribution from Interest Rates	Contribution from Spreads	**Return**	Contribution from Interest Rates	Contribution from Spreads
Sep 1993–Dec 1994						
Annualized total return	**-1.95%**			**3.67%**		
Annualized excess (of cash) return	**-5.89%**	-6.21%	0.32%	**-0.48%**	-1.08%	0.60%
Annualized excess return volatility	**3.87%**			**1.13%**		
Sep 1998–Jan 2000						
Annualized total return	**1.06%**			**4.80%**		
Annualized excess (of cash) return	**-4.18%**	-4.62%	0.45%	**-0.62%**	-1.05%	0.43%
Annualized excess return volatility	**3.09%**			**1.39%**		
Jun 2003–Jun 2006						
Annualized total return	**1.93%**			**2.77%**		
Annualized excess (of cash) return	**-0.61%**	-1.04%	0.42%	**0.21%**	-0.19%	0.40%
Annualized excess return volatility	**4.00%**			**1.40%**		
Sep 2012–Aug 2013						
Annualized total return	**-2.48%**			**-0.40%**		
Annualized excess (of cash) return	**-2.68%**	-3.30%	0.62%	**-0.60%**	-0.90%	0.30%
Annualized excess return volatility	**2.81%**			**1.01%**		

Source: Bloomberg, Barclays Risk Analytics and Index Solutions

Addressing low portfolio volatility

Balancing exposure to the various risks in a portfolio typically results in a portfolio with low volatility. As mentioned previously, this is because (a) portfolio components with low volatility (the less risky components) get assigned high notional weights and (b) better risk diversification from incorporating correlations further lowers portfolio volatility. Thus, investors that have high return targets or large risk budgets cannot take advantage of the better diversification properties of these portfolios without using leverage.

Incorporating Treasury futures and TBAs

While leverage brings its own set of risks, it is a critical and important tool for portfolio managers. Fixed income investors can obtain leveraged exposure to interest rate risk, credit risk and mortgage risk via the use of derivatives. Treasury futures and TBAs (effectively MBS forward contracts), in particular, trade in deep, liquid markets. These derivatives are well understood and have been used for hedging and risk management purposes for a long time. Credit default swaps (CDS) are a more recently developed derivative class, but compared with Treasury futures and TBAs, they are not as liquid and it is not as straightforward to create a portfolio of derivatives that tracks a market value-weighted cash bond benchmark index very well.

With this in mind, investors can directly address the issue of low risk-balanced portfolio volatility. Instead of considering borrowing to finance a leveraged position in all cash instruments (Treasuries, corporate bonds and MBS), investors can use most of their cash to purchase corporate bonds and the remainder to purchase a blend of Treasury bonds, MBS and (mostly unfunded) derivative positions in Treasury futures and TBAs. This technique of blending cash bond and liquid derivatives positions allows investors to gain greater notional risk exposure with the same amount of cash, thus efficiently increasing portfolio volatility.

There is an implicit ceiling to the amount of leverage that can be obtained in this manner. If all available cash is used to purchase corporate bonds, then the level of leverage in the portfolio will be determined each rebalance period by the additional amount of Treasury futures and TBAs that are each required to match the risk contribution of corporate spreads. Maximizing the leverage of the portfolio in this manner is not advisable though. The amount of leverage in the portfolio will vary each period as the forecasted covariance between corporate spreads, Treasuries, and mortgage spreads changes. This will result in the portfolio's total leverage increasing during periods when corporate spreads seem more risky than Treasuries or mortgage spreads and decreasing when they seem relatively less risky[5]. This can result in unpredictable portfolio behavior and the performance of the dynamically levered portfolio can vary significantly from the performance of an unlevered portfolio over time.

Instead it is prudent to take advantage of leverage in a more controlled fashion. Restricting total portfolio leverage would result in a portfolio in which the total amount of leverage would be relatively stable over time. Given the historical volatilities and correlations of the three factors used in the construction of this portfolio, a maximum leverage level of 125%–200% would have produced a dynamically leveraged portfolio that behaved very much like a statically leveraged version of the ERCP, with returns and volatilities that are more or less a static multiple of the chosen leverage cap.

Introducing notional exposure caps or volatility forecast floors

A subtle, yet important, detail regarding risk-balanced portfolios is the allocation of large notional weights to low volatility portfolio components. In the EVWP discussed earlier, mortgage spreads were allocated just below 55% of the notional weight of the portfolio, on average, while allocations in some periods approached 70% of portfolio notional. In the Equal Risk Contribution Portfolio, the allocation to MBS spreads was a bit lower—averaging just over 50%, but frequently exceeding 60%.

Portfolio managers may have two concerns about this type of result. First, they may want to limit the notional amount allocated to low volatility factors because they may prefer to limit the amount of derivatives—and, therefore, leverage—that they would expect to have to use to reach their return or volatility targets. Second, managers may prudently have concerns about model risk in their volatility forecasting model and allocating large notional amounts to a portfolio component based solely on the output of the volatility model may be considered too risky.

One way to address this would be to cap the notional allocation to any single portfolio component—in this case, for example, at 50%. However, that approach could result in somewhat arbitrary distortions from the risk-balanced target allocation. A better approach may be to account for the mean-reverting property of volatility and to introduce a volatility floor into the forecasting model. A suitably chosen volatility floor would impose a minimum bound on the volatility forecast—in turn limiting the notional allocation—of a component. This is useful when a component's recent volatility has temporarily dipped to an unusually low level from which it will likely mean-revert upward. The added benefit of the floor is that it also alleviates unnecessary portfolio turnover. An examination of the historical volatility of mortgage spreads indicates that a 1% volatility floor would be a reasonable constraint to introduce into both the EVWP and the ERCP portfolio construction models.

[5] As a simple example, consider a case when the forecasted volatility of corporate spreads increases proportionally more than that of Treasuries or mortgage spreads while forecasted correlations remain unchanged. This would make corporate spreads appear riskier (in relation to the other two factors) from one rebalance period to the next. Accordingly, the notional weight allocated to corporate spreads would decrease in an unlevered portfolio. However, if all available cash is always used to purchase corporate bonds then the relatively higher weights (and correspondingly higher notional amounts) assigned to the other two factors would get implemented using derivatives, resulting in a higher overall portfolio notional exposure (i.e. greater overall portfolio leverage).

Introducing other risk premia

In addition to balancing exposures to the market risk premia that are already present in a portfolio, a manager can introduce alternative risk premia into the portfolio. In a multi-asset class portfolio, a manager could isolate exposure to alternative risk premia across asset classes (typically by designing long/short, market-neutral strategies) and incorporate them into the portfolio via an overlay. However, long-only, single-asset class portfolio managers may be restricted from taking short positions or from investing in securities outside their asset class. Such managers can introduce alternative risk premia into their portfolios by selectively tilting the portfolio's securities' weights—increasing the weights of securities that load positively onto an alternative risk factor and decreasing the weights of securities that load negatively on that factor.

Carry and trend premia are well-established in the fixed income universe, having frequently been used by active managers as signals to tactically tilt portfolios. Furthermore, similar to equities, there may be additional value, quality or other style-based premia associated with fundamental factors relating to individual corporate issuers. In this report, we will limit our discussion to introducing two additional factors that have carry-like properties into our portfolio: the low volatility factor and the high yield factor.

Low Volatility

Academics and practitioners have empirically observed that across multiple asset classes, securities with low volatilities have historically outperformed high volatility securities in risk-adjusted terms. In the fixed income universe, volatility is linked to duration: duration has been inversely proportional to risk-adjusted returns. Low-duration Treasuries and credit spreads have had higher Sharpe ratios than high-duration securities (Figure 21).

FIGURE 21

Low duration in fixed income has been associated with higher risk-adjusted returns than high duration for both interest rate risk and credit spread risk

(July 1993–June 2015)	Treasuries			IG corp spreads		
Maturities	1y–5y	5y–10y	10y+	1y–5y	5y–10y	10y+
Average duration	2.52	6.25	12.80	2.83	6.10	11.43
Annualized excess return	1.6%	3.1%	4.5%	0.8%	0.4%	-0.1%
Annualized excess return volatility	2.1%	5.6%	10.1%	2.6%	4.5%	6.9%
Sharpe ratio	0.74	0.55	0.45	0.30	0.10	-0.01

Note: Average durations are calculated from August 2000 – June 2015. For Treasuries, duration is option-adjusted duration (OAD) and for IG corp spreads, duration is option-adjusted spread duration (OASD).
Source: Barclays Risk Analytics and Index Solutions

The cause of this difference in performance is yet to be agreed upon by the academic and professional communities. It may be driven by the make-up of market participants and a greater demand for long-maturity assets from asset-liability-matching pension funds or insurance companies (to avoid reinvestment risk). Another explanation that has been proposed to explain this phenomenon is "leverage aversion" (see "Leverage Aversion and Risk Parity", Asness (2012)). Clearly, there could be multiple causes that contribute to the existence of a particular premium. However, as long as investors understand what its causes might be, it should prevent situations in which they seek exposure to a risk premium multiple times, mistakenly believing each position provides exposure to distinct premia.

Accordingly, managers could take advantage of the identification of the low duration premium to enhance the risk-adjusted returns of either the Equal Volatility-Weighted Portfolio (EVWP) or the Equal Risk Contribution Portfolio (ERCP) that we discussed in the

previous section. A simple way to do so would be to divide the Treasury bucket into three sub-buckets that correspond to low-, medium- and high-duration Treasuries. Since the shortest duration bucket is expected to have the highest risk-adjusted returns, it could be allocated the greatest risk weight. However, this would result in an extremely concentrated (notional) allocation to short-duration securities. To balance concentration risk versus the benefits of the low volatility premium, it may be better to allocate equal risk weights to all three buckets. Relative to the Agg (in which the notional weights of all three buckets are approximately equal), allocating equal risk weights to the buckets would result in greater notional weight being allocated to lower duration buckets. A similar design could be implemented for IG corporate spreads.

High Yield

Until now, we have restricted our analysis of the fixed income market to the US investment grade universe. However, the corporate bond market also includes high yield (HY) securities and including them may allow managers to gain exposure to an additional, high yield-specific, credit risk factor. Over the past two decades, HY corporate spreads—represented as returns in excess of duration-matched Treasuries—have outperformed IG corporate spreads on both an absolute and on a risk-adjusted basis (Figure 22).

FIGURE 22

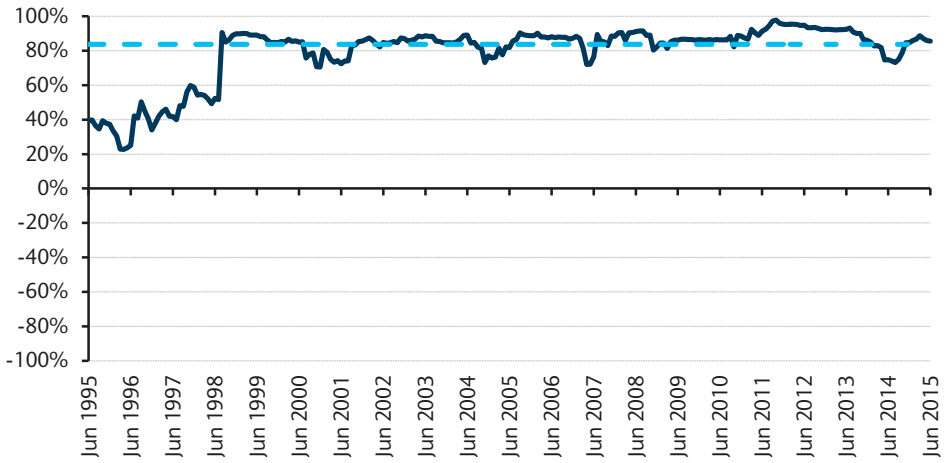
Excess (of duration-matched Treasuries) Returns of US investment grade and US high yield corporate Bonds

(July 1993–June 2015)	IG corp spreads	HY corp spreads
Average OAS	139	513
Annualized excess return	0.4%	1.9%
Annualized excess return volatility	4.3%	9.9%
Sharpe ratio	0.10	0.20

Source: Barclays Risk Analytics and Index Solutions

This observed "high yield premium" may exist because these two universes have largely distinct sets of investors and portfolio managers who may have different utility functions, investment objectives or constraints. The premium could also be partially explained by the "fallen angels" effect (see *Fallen Angels: Characteristics, Performance and Implications for Investors*, December 2010). It may, additionally, reflect a liquidity premium, as the market value of the US HY corporate bond universe is slightly less than one-third that of the US IG corporate bond universe. Despite the high current correlation between IG and HY excess returns (Figure 23), these differences between the IG and HY markets, along with the significantly lower correlation in the mid- to late-1990s, indicate that HY spreads may represent compensation for a related, yet distinct risk premium from IG spreads. Thus, the inclusion of a HY corp spread bucket within the credit bucket could diversify and enhance the EVWP and the ERCP.

FIGURE 23
Rolling 24-month correlation of excess returns of IG corp and HY corp excess returns



Source: Barclays Risk Analytics and Index Solutions

The method of isolating and incorporating the credit risk from HY corporate bonds is not identical to that of IG corporate bonds though. Corporate bonds contain exposure to interest rate risk and credit risk, but the proportion of each of these two risks varies over time and among bonds. Generally, higher-quality bonds have more interest rate risk exposure and less credit risk exposure (a detail that is corroborated by their ratings). The correlations between Treasuries and corporate bonds (shown in the Appendix) indicate that IG bonds contain a significant amount of interest rate risk. Thus, excess returns (calculated as returns in excess of analytical duration-matched Treasuries) are a good measure of the compensation for credit risk for IG bonds. However, HY bonds do not contain as much interest rate risk as IG bonds and the analytical duration-matched excess return model—originally calibrated and suitable for—IG bonds may not appropriately represent HY credit spreads. In fact, portfolio managers may find that using empirical durations—rather than analytical durations—or using the information from total return correlations would be a better way of isolating credit spreads in HY bonds.

Balancing risks: An example

In this section, we discuss The Barclays US Fixed Income Balanced Risk (FIBR) Indices. The design of these indices serves as an example of some of the implementation, practicality and tradability decisions that need to be made in a tradable portfolio. The FIBR indices seek to balance risks across the US taxable bond market (see *US Fixed Income Balanced Risk Index Factsheet*, May 2015). The choices made in the construction of the indices were influenced by a few essential considerations:

1. Create a replicable (i.e. tradable) fixed income benchmark index that offers potentially superior risk-adjusted returns to standard market value-weighted benchmark indices by increasing the diversification benefits available in primary market risk factors (interest rate, credit spread and mortgage spread risks)

2. Further enhance expected risk-adjusted returns by additionally incorporating alternative risk factors (low duration, high yield and constant corporate sector weights)

3. Manage computational, operational and trading complexity (using volatility weighting instead of risk weighting, assigning a static contribution to amount of interest rate exposure in high yield securities instead of dynamically estimating empirical durations)

4. Introduce leverage in a controlled fashion to achieve a desired expected return/volatility (incorporate TBAs and Treasury futures and limit exposure to low volatility components of the portfolio)

Creating a replicable fixed income benchmark

In our earlier discussion of the ERCP, we sought to balance risk contributions across three systematic risk factors (interest rates risk, credit risk and prepayment risk) that we represented using the excess of cash returns of Treasuries and the excess (of duration-matched Treasuries) returns of IG corporate bonds and MBS. The first consideration for the FIBR indices was to design a benchmark that is easily replicable. Accordingly:

- Instead of considering excess returns as investment blocks, the indices assign allocations to (the total returns of) corporate bonds and MBS.
- The volatility of interest rates risk exposure that is present in corporate bonds and MBS is determined along with the volatility contribution of the spread components.
- The interest rate risk and spread risk are then balanced by adjusting the interest rate risk exposure to match the estimated spread risk exposure.
  - If additional interest rates risk is required, a long position in the Barclays US Long 10+ Year Treasury index is added.
  - If interest rate risk needs to be reduced, this is achieved via short exposure to the Barclays US Long 10+ Year Treasury Mirror Futures Index (MFI).

Incorporating alternative risk factors

The next consideration in the index design is the introduction of the low duration factor (in both Treasuries and corporate spreads) and the high yield factor (in corporate spreads).

- The addition of these factors is expected to enhance the diversification and risk-adjusted returns of the interest rate and corporate spread factors relative to their market value-weighted counterparts.
- The improved expected risk-adjusted returns warrants a greater-than-equal share of risk allocation to the interest rates and corporate spreads buckets.
- As discussed subsequently, this is achieved by increasing the risk budget allocated to Treasuries and Corporates (i.e. allocate more to these buckets than to the MBS bucket).

Managing complexity

The next consideration deals with two elements of portfolio construction complexity: correlation forecasting and empirical duration estimation.

Correlations between factors' or assets' returns are time varying, can be unstable and are difficult to forecast accurately. Errors in forecasts can lead to unnecessary portfolio turnover and trading costs or, more crucially, to realized risk contributions that diverge from what is intended. Acknowledging the presence of forecasting errors in any model, our preferred portfolio construction methods are robust optimization techniques, such as the equal risk contribution method discussed earlier. Yet, managers may prefer to avoid having to forecast correlations each rebalance period and instead opt for a volatility-budgeting methodology that recognizes and incorporates differences in long-term correlations between factors or assets by setting the constituents' volatility budgets appropriately.

- The negative average correlation that exists between interest rates and the two (positively correlated) spread factors is accounted for by assigning the interest rate factor a greater volatility budget (50%) than the two spread factors.

To isolate the credit component of risk in high yield bonds we previously indicated that managers may want to consider removing Treasury risk using empirical durations rather than analytical durations. However, empirical durations are time varying and could introduce extra turnover. As a compromise, we prefer to analyze the historical relationship between the total returns of high yield bonds and Treasuries and to assign a static value to the relative amount of interest rate risk in the bonds.

- BB-rated bonds are hedged with only half as much Treasury hedging as that suggested by their analytical durations.
- B and lower rated bonds any not hedged at all as effectively all their risk is credit risk.

Isolating HY credit exposure in this manner would improve the historical risk-adjusted return advantage of HY spreads over IG spreads even more than what is indicated in Figure 22, further strengthening the case for assigning a higher risk budget to corporate spreads over MBS.

Controlling leverage

Allocating equal volatility weights or risk weights to a factor or asset that has a low volatility results in a large notional allocation to that factor or asset. This has two effects.

The first is model risk related: the volatility of the factor may have been underestimated, resulting in an over-allocation to the factor. While this is true for all factors (including high volatility factors), it is of particular importance when a single component may be allocated a large notional weight, potentially requiring greater deviations from market value weights.

The second effect is that the resulting risk-balanced portfolio has a low volatility and leverage is required to achieve a desired volatility or return target. A manager concerned with having to employ too much leverage may choose to forgo "perfect" risk balancing and explicitly limit or reduce the volatility budget assigned to a low volatility bucket in exchange for having to use less leverage to achieve the portfolio's desired risk target.

- The FIBR indices introduce leverage in two ways:
  - Instead of purchasing MBS, the FIBR Index allows up to 25% of total portfolio notional to be accessed via TBAs[6]
  - Both FIBR indices use Treasury futures to reduce interest rate risk
- To appropriately manage exposure to a low volatility component, both FIBR indices use 1% as a floor in the estimation of MBS spread volatility.

The Barclays US Fixed Income Balanced Risk (FIBR) Indices

With these design considerations in mind, the FIBR indices are constructed to allocate equal volatility weights to interest rate risk and (corporate and MBS) spread risks. The spread factors are accessed using five buckets:

- Investment Grade Corporate 1–5 Year
- Investment Grade Corporate 5–10 Year

[6] This only applies to the FIBR Index. The FIBR Core Index does not add leverage in this manner.

- High Yield Corporate Ba-rated
- High Yield Corporate < Ba-rated
- Mortgage Backed Securities (MBS)

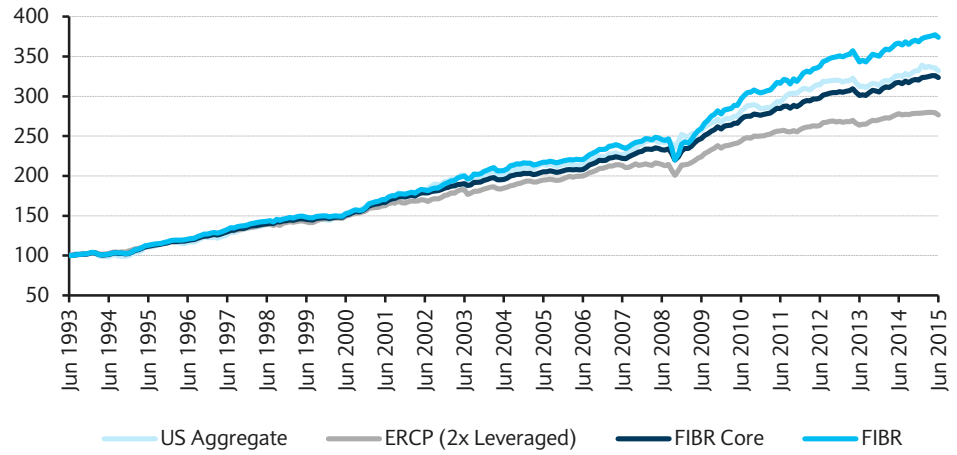
There are two versions of the FIBR indices:

- The FIBR Core Index
  - Allocates one unit of risk (volatility) to each IG Corporate and HY Corporate bucket (i.e., four units of risk in total to corporate spreads) and two units of risk (volatility) to MBS.
  - The net effect is that corporate spreads are allocated twice as much of a volatility budget as MBS spreads. This recognizes the superior expected risk-adjusted returns that the incorporation of multiple premia (credit spreads, low duration and high yield) should provide to the corporate buckets, as well as the detail that an equal risk allocation to MBS spreads would result in a portfolio with a very low volatility.
- The FIBR Index
  - Allocates one unit of risk (volatility) to each of the five spread buckets.
  - Rather than using market value-weighted portfolios, each of the four credit buckets uses constant sector weight portfolios (see *Issuance Dynamics and Performance of Corporate Bonds*, September 2014). The introduction of this additional factor merits even greater allocation to credit spreads over mortgage spreads.
  - The index allows up to 25% of the portfolio's notional weight to be accessed via TBAs, thus introducing leverage in the portfolio.

The historical performance of these indices is shown, along with that of the Agg and a 2x levered version of the ERCP, in Figure 24 and Figure 25.

FIGURE 24

Historical performance of the US Aggregate Index, the 2x leveraged Equal Risk Contribution Portfolio (ERCP), the FIBR Core and the FIBR Indices



Note: The 2x leveraged ERCP utilizes a 1% volatility floor for MBS spreads and allows up to 200% leverage.
Source: Barclays Risk Analytics and Index Solutions

FIGURE 25

Historical performance of the US Aggregate Index, the 2x leveraged Equal Risk Contribution Portfolio (ERCP), the FIBR Core and the FIBR Indices

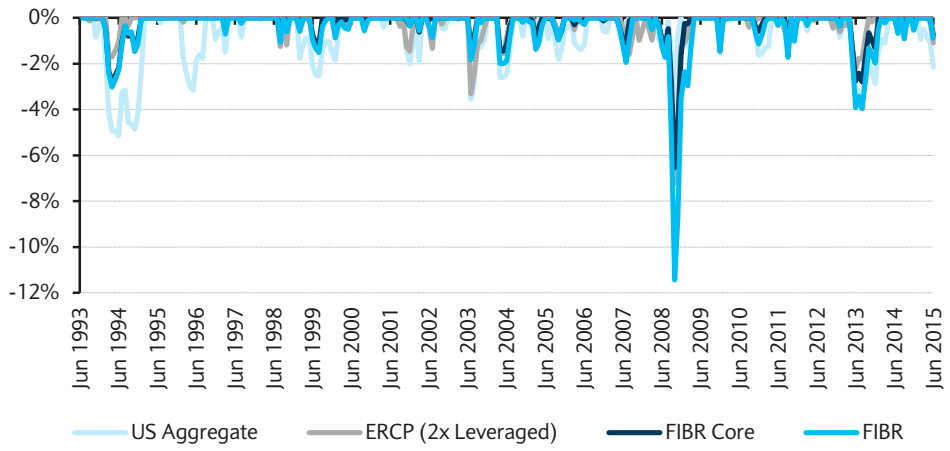
(July 1993–June 2015)	US Aggregate	ERCP (2x leveraged)	FIBR core	FIBR
Annualized total return	5.60%	4.73%	5.48%	6.18%
Annualized excess return	2.45%	1.61%	2.33%	3.01%
Annualized excess return volatility	3.63%	2.72%	2.68%	3.79%
Sharpe ratio	0.67	0.59	0.87	0.79
Maximum drawdown	5.15%	7.23%	6.53%	11.44%

Note: The 2x leveraged ERCP utilizes a 1% volatility floor for MBS spreads and allows up to 200% leverage.
Source: Barclays Risk Analytics and Index Solutions

Compared with the 2x leveraged ERCP, the FIBR Core index achieved a similar volatility and higher return (Figure 24 and Figure 25), due to the addition of the low duration and high yield factors in corporate spreads and the relative under-weighting to MBS spread risk. The FIBR index's use of leverage allowed it to realize a volatility comparable to that of the US Agg. The benefit of risk diversification in these portfolios was evident in the early part of the sample period when interest rates exposure (and the US Agg) did not perform very well (Figure 26).

FIGURE 26

Drawdowns of the US Aggregate Index, the 2x leveraged Equal Risk Contribution Portfolio (ERCP), the FIBR Core and the FIBR Indices



Note: The 2x leveraged ERCP utilizes a 1% volatility floor for MBS spreads and allows up to 200% leverage.
Source: Barclays Risk Analytics and Index Solutions

Conclusion

With government bond yields in the US having fallen to multi-decade lows, passive fixed income investors who have used traditional market value-weighted benchmarks have to question how attractive the future returns of these investments will be. This is because market value-weighted benchmark index performance is overwhelmingly influenced by the performance of a single dominant risk factor: interest rate risk. In light of this, investors are eager to find new strategies that will allow them to continue to invest passively in the asset class, but will provide better risk-adjusted return prospects than the indices that their investments have customarily been benchmarked against.

The advancement of factor-based portfolio construction has led to the "Smart Beta" concept to gain significant interest. Smart Beta strategies provide passive investors exposure to alternative risk premia and/or better diversification among existing risk premia, both of which could potentially enhance risk-adjusted returns relative to market value-weighted benchmarks. In this report, we have described how the Barclays Fixed Income Balanced Risk (FIBR) Indices fit this description.

Investors that adopt risk-balanced fixed income benchmarks should consider how these new benchmarks would interact with the rest of their portfolios. In particular, correlation to equities would be higher, relative to market value-weighted benchmarks, due to the increased exposure to the credit risk factor (see Figure 39, Figure 40 and Figure 41 in the Appendix). Similarly, drawdowns in balanced risk portfolios will be greater when negative growth shocks—such as those experienced in 2008—cause credit spreads to widen. Finally, the incorporation of the low duration premium in the FIBR indices (allocating greater notional exposure to the shorter ends of the Treasury and IG Corporate spread curves) will also introduce curve risk relative to a market value-weighted benchmark. Alternative weight benchmarks should be relatively easy for small investors to invest in. Large investors may find that the adoption of non-market value-weighted benchmarks can face headwinds from capacity restrictions in the market and create additional liquidity risks in the portfolio.

Finally, not everyone can hold the same "alternative weight" portfolio. In the hypothetical situation that this was indeed the case, the alternative weight portfolio would eventually become the market portfolio and cease to be "alternative". Simplistically, if all investors decided to adopt the same alternative weight portfolio it would cause the prices of assets with larger (smaller) portfolio weights than their market weights to rise (fall) due to increased (decreased) demand for them. Of course, this would reduce the future expected excess return, and the attractiveness, of the alternative risk premium being sought. The increased demand for these assets could, in turn, also encourage greater (lesser) issuance of the highly (less) demanded assets, eventually creating a new market equilibrium in which the assets' alternative weights are the same as their market value weights. At that point "alternative weighting" would obviously not yield any excess returns over market value weights as the two would be identical. Any potential benefits that were originally available would have accrued to those investors that adopted the alternative weights before the market as a whole "correctly" priced the identified alternative factors and converged to its new equilibrium.

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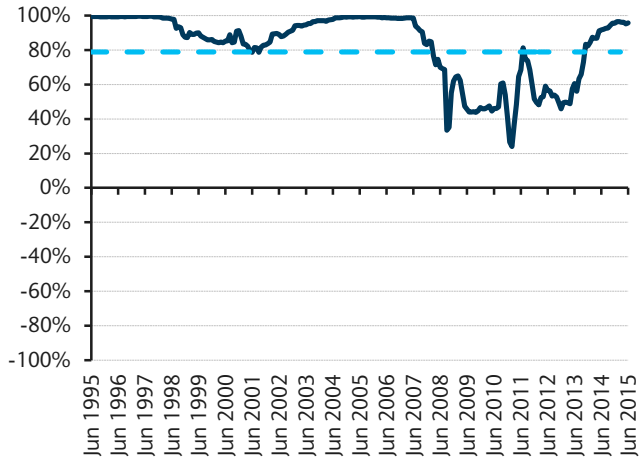
Appendix

Correlations of Treasuries and Corporate bond Total and Excess returns by Rating

FIGURE 27

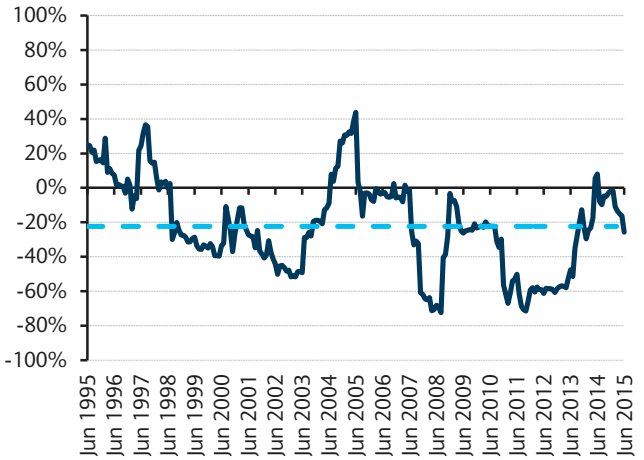
Rolling 24-month correlation of total returns of Treasuries and AAA-rated IG corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 28

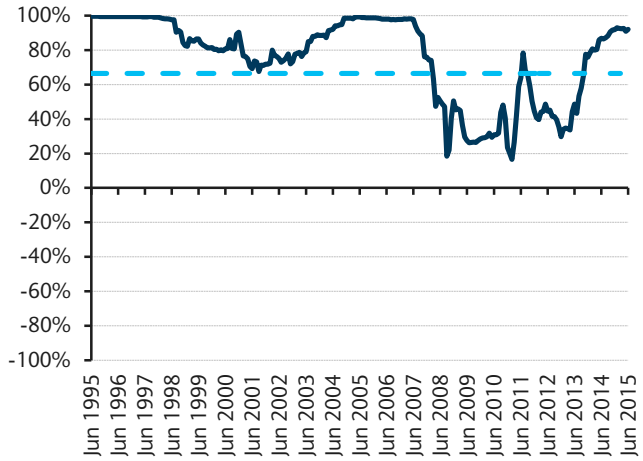
Rolling 24-month correlation of excess (of cash) returns of Treasuries and AAA-rated IG corporate spread returns



Source: Barclays Risk Analytics and Index Solutions

FIGURE 29

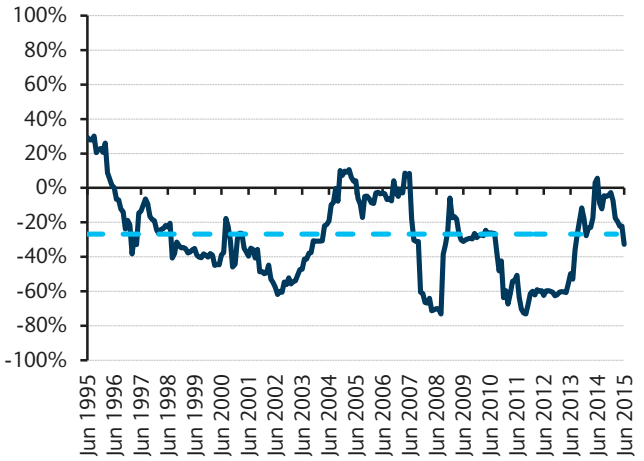
Rolling 24-month correlation of total returns of Treasuries and AA- and A-rated IG corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 30

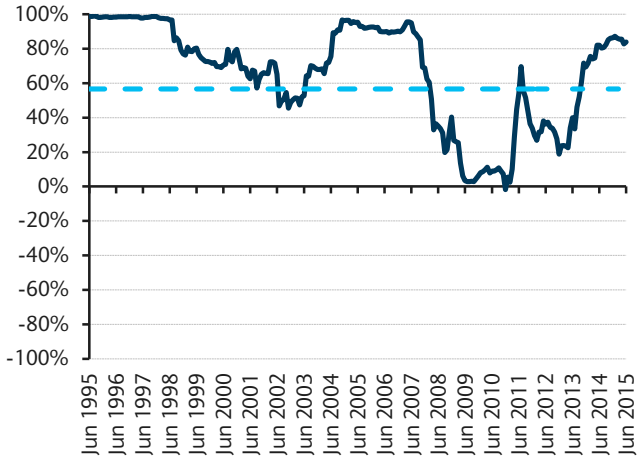
Rolling 24-month correlation of excess (of cash) returns of Treasuries and AA- and A-rated IG corporate spread returns



Source: Barclays Risk Analytics and Index Solutions

FIGURE 31

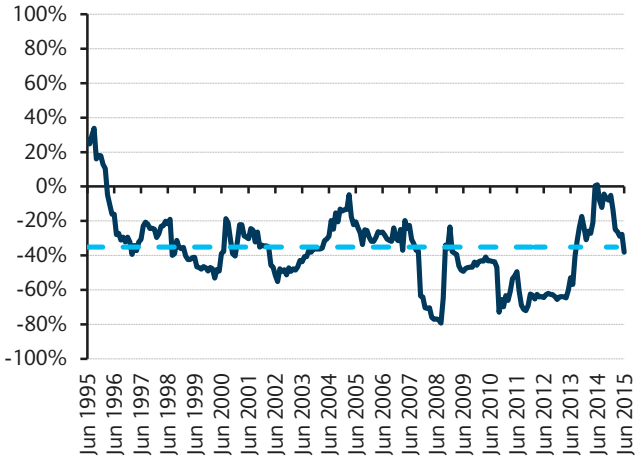
Rolling 24-month correlation of total returns of Treasuries and BBB-rated IG corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 32

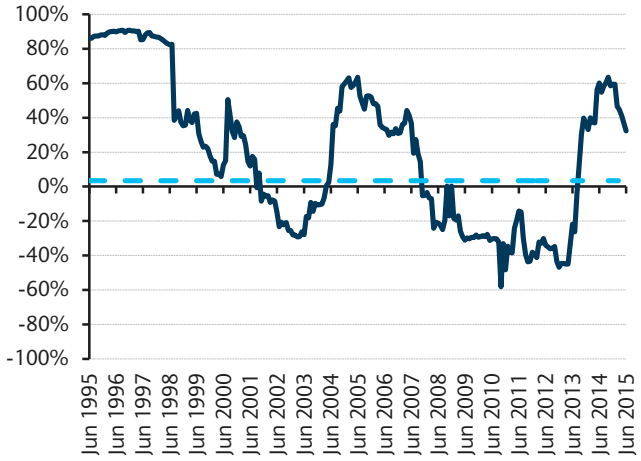
Rolling 24-month correlation of excess (of cash) returns of Treasuries and BBB-rated IG corporate spread returns



Source: Barclays Risk Analytics and Index Solutions

FIGURE 33

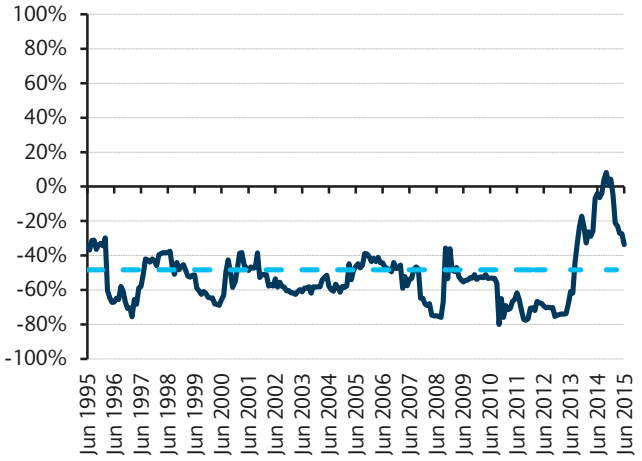
Rolling 24-month correlation of total returns of Treasuries and BB-rated HY corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 34

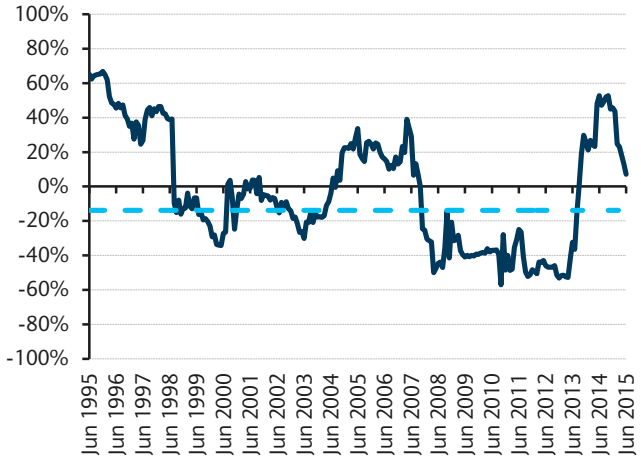
Rolling 24-month correlation of excess (of cash) returns of Treasuries and BB-rated HY corporate spread returns



Source: Barclays Risk Analytics and Index Solutions

FIGURE 35

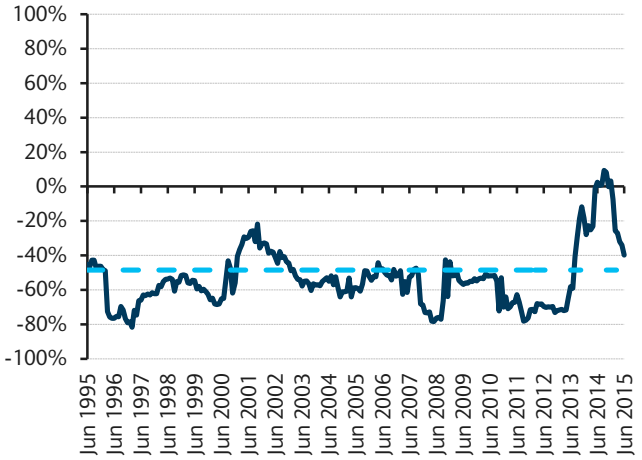
Rolling 24-month correlation of total returns of Treasuries and B-rated HY corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 36

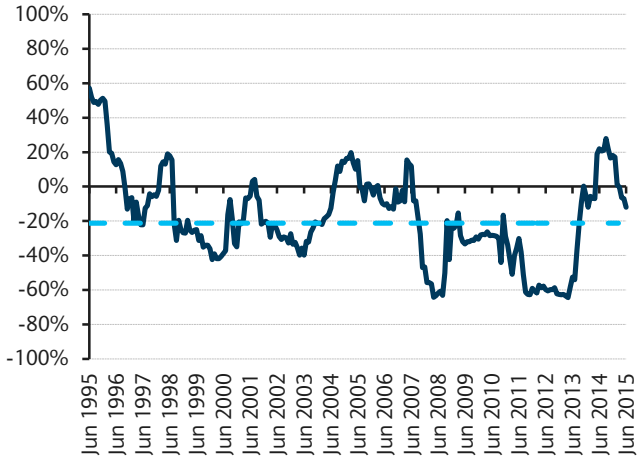
Rolling 24-month correlation of excess (of cash) returns of Treasuries and B-rated HY corporate spread returns



Source: Barclays Risk Analytics and Index Solutions

FIGURE 37

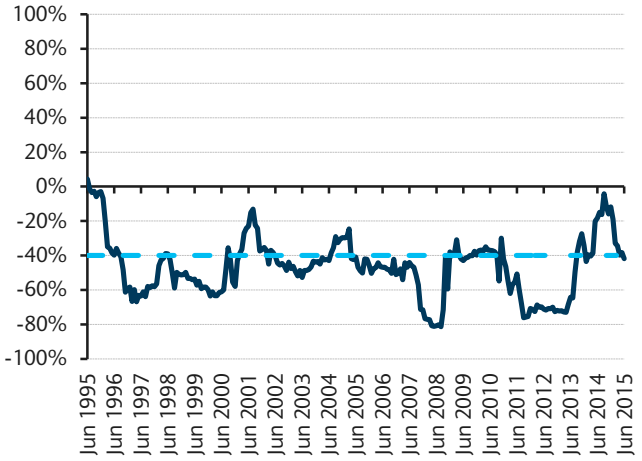
Rolling 24-month correlation of total returns of Treasuries and CCC and lower-rated HY corporate bonds



Source: Barclays Risk Analytics and Index Solutions

FIGURE 38

Rolling 24-month correlation of excess (of cash) returns of Treasuries and CCC and lower-rated HY corporate spread returns

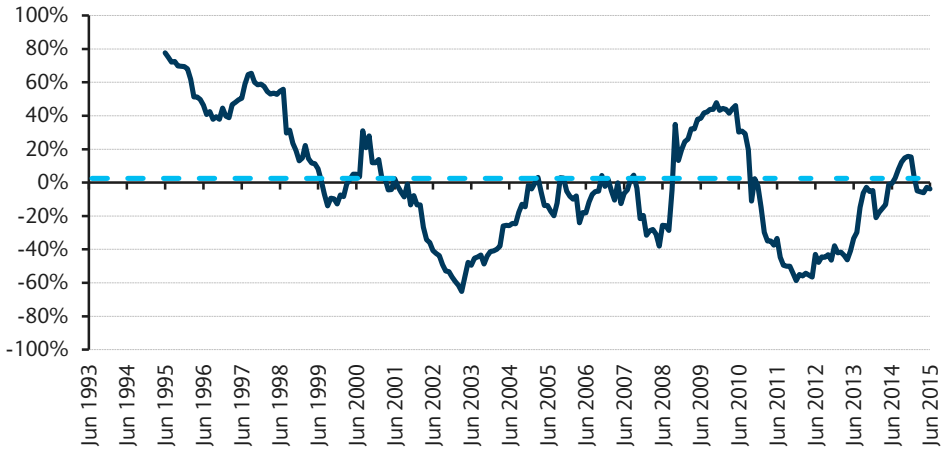


Source: Barclays Risk Analytics and Index Solutions

Correlations of Equity and Bond benchmark indices

FIGURE 39

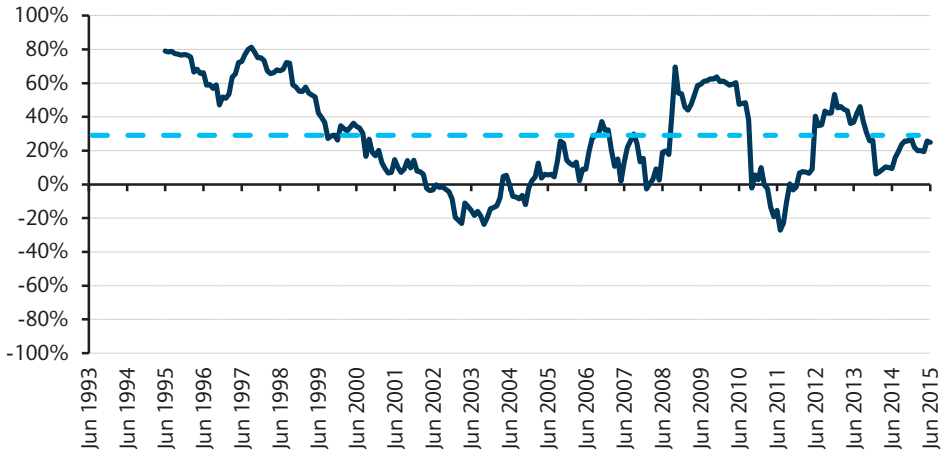
Rolling 24-month correlation of excess (of cash) returns of the S&P 500 Index and the Barclays US Aggregate Index



Source: Bloomberg, Barclays Risk Analytics and Index Solutions

FIGURE 40

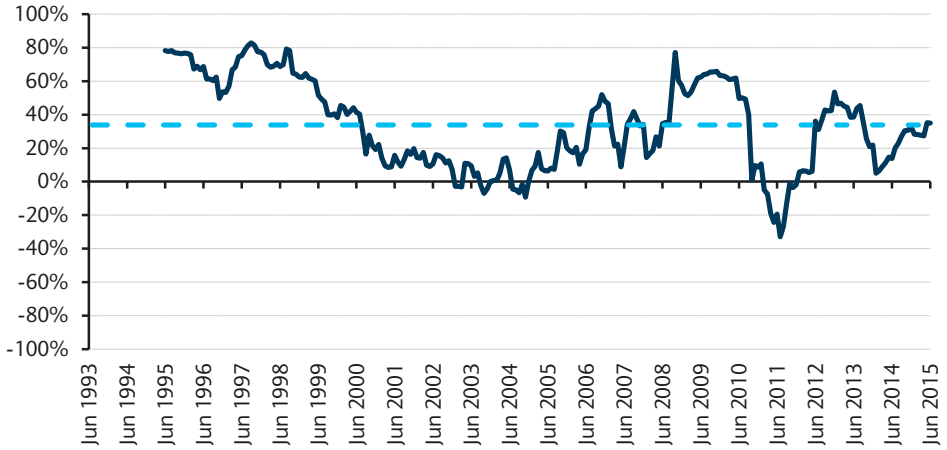
Rolling 24-month correlation of excess (of cash) returns of the S&P 500 Index and the Barclays FIBR Core Index



Source: Bloomberg, Barclays Risk Analytics and Index Solutions

FIGURE 41

Rolling 24-month correlation of excess (of cash) returns of the S&P 500 Index and the Barclays FIBR Index



Source: Bloomberg, Barclays Risk Analytics and Index Solutions

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