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Capturing the Opportunity of Constraints

Tapping the Value Created by Market Segmentation With Unconstrained Fixed Income

Fixed income markets contain a high proportion of investors whose goal of identifying the most attractive relative value is subverted by jurisdictional or self-imposed rules, regulations, and constraints, or is superseded by other non-economic objectives, such as accounting conventions. The substantial presence of these investors distorts valuations and contributes to structural, high dispersion in risk-adjusted returns across different parts of the fixed income markets.

This, in turn, creates opportunities for total return, multi-sector fixed income investors willing to consider broad investment guidelines and greater degrees of portfolio management freedom.

In addition to bottom-up relative value selection, a robust quantitative framework is required to identify and implement the optimal relative value through time. In this paper, we lay out:

1. *The fixed income market segmentation we observe and the resultant high dispersion in risk-adjusted reward;*
2. *Principles for identifying relative value and pitfalls to avoid;*
3. *An outline of our portfolio construction approach for building multi-sector portfolios.*

1. Fixed Income Fragmentation

Fixed income markets contain a disproportionately high level of rule bound, constrained, and regulated investors. See Figure 1 for some examples of these rules and constraints and the consequences for markets.

Figure 1: How Investor Constraints Affect Demand for Certain Asset Classes

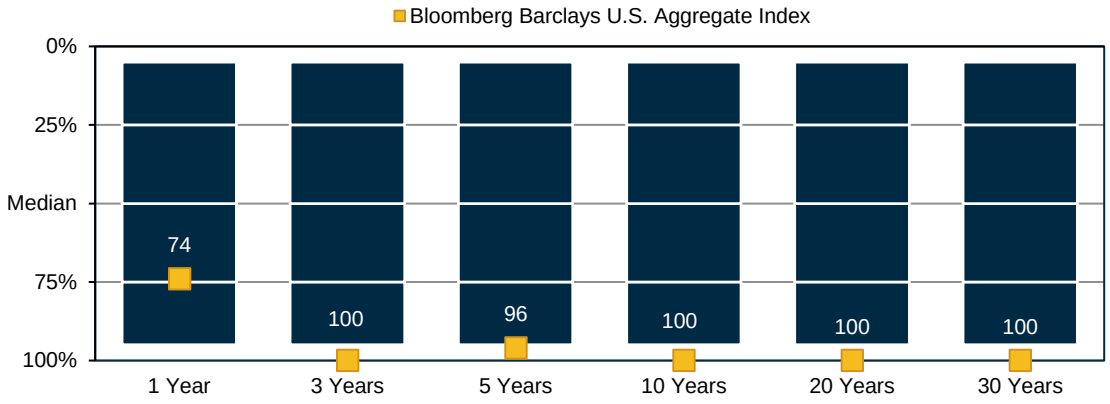
Constraint / Rule / Behavior	Consequence / Comment	Affecting Demand for…
Passive investors	Low tracking error objective largely constrains investment to index constituents	Securities that are included / excluded from market indices
Regulatory capital regimes	Risk-weighted assets capital frameworks for banks and insurers incent capital efficient investments over economic efficiency	Varies by jurisdiction and regulatory regime
Yield buyers	Can lead to the undervaluation of prepayment options and not isolating the credit risk premium	Mortgages, Prepayable Securities, Long Duration Credit
Pension valuation rules	Hedging strategies influence demand for securities used to value pension liabilities	Varies by jurisdiction
Mandatory pension inflation indexation	Hedging strategies influence demand for inflation hedging securities	Inflation-linked bonds
Interest-rate sensitive buyers	Changes in short term-interest rates can affect perceived value of certain securities	Fixed / floating rate securities
Money market investors	Constrains investments to securities with maturity of one year or less	Securities with maturity greater or less than 1 year
Forced selling upon downgrade	Requires forced sale of securities regardless of expected risk-adjusted return	Fallen angels
Derivative constraints	Reduces investors' ability to separate duration and excess return objectives	Long duration bonds, STRIPS
Credit quality constraints	Many investors restrict their fixed income to investment grade securities	Above / below investment grade securities
Securitized product constraints	Post-financial crisis many investors disallow investment in securitized products	Securitized products

Source: PGIM Fixed Income as of September 2019

The constraints, rules, and behaviors previously listed impact the demand for different sectors of the bond market for non-economic reasons. This, in turn, moves prices away from fair value and creates opportunities for investors not subject to these rules or constraints.

Additionally, we see little indication of these investment shackles loosening. Many of the constraints are persistent and structural. In fact, as passive fixed income continues to take market share, this segment of heavily-constrained investors should continue to grow. The historical performance of the Bloomberg Barclays U.S. Aggregate Index near the bottom of the Core Plus peer group tables hints at the potential cost of passive tracking error constraints.

Figure 2: Bloomberg Barclays U.S Aggregate Bond Index Return Ranking Within eVestment U.S. Core Plus Fixed Income Universe



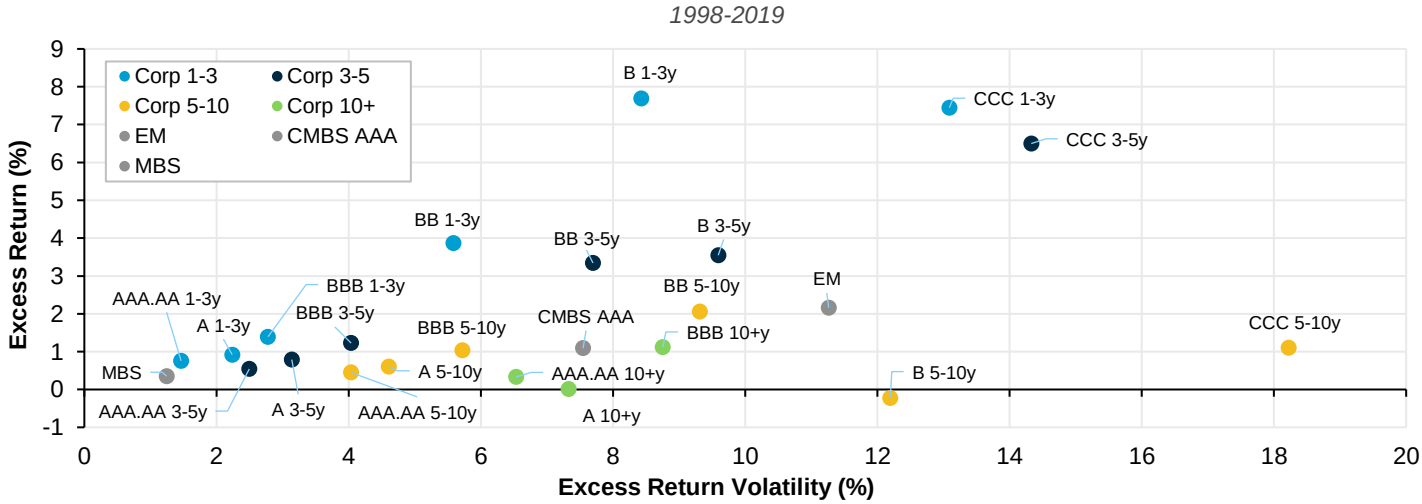
Source: eVestment as of March 31, 2019. Past performance is no guarantee of future results. An investment cannot be made into an index. Please see the Notice for important disclosures.

Market Segmentation Contributes to High Dispersion in Risk-Adjusted Reward

The myriad rules and constraints create dislocations across fixed income bond sectors as capital is forced into lower-information ratio endeavors or non-economic actions. While it is difficult to prove causation, we believe that fixed income market segmentation contributes to the high dispersion in risk-adjusted returns across different parts of the bond markets.

Figure 3 shows the realized excess returns and excess return volatility of a wide variety of bond market sub-sectors. In well-established portfolio theory and common-sense practice, investors should expect a return commensurately proportional to the risk. As such, investors should expect to see a roughly linear relationship in the graph.[1] However, the graph indicates more of a scattered relationship between risk and reward.

Figure 3: The Scattered Pattern of Realized Excess Return and Excess Return Volatility



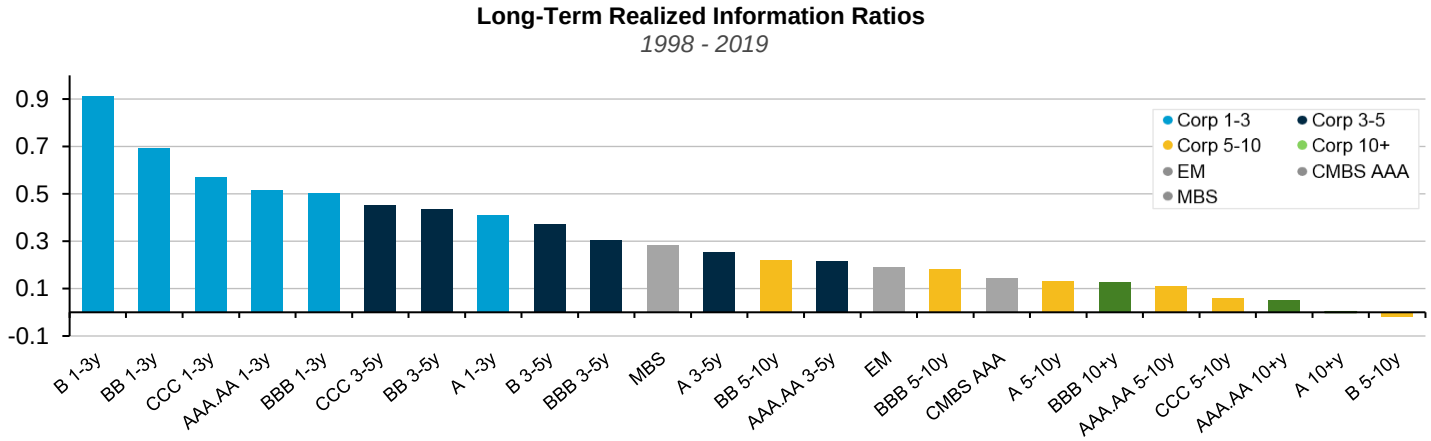
Source: Bloomberg Barclays, PGIM Fixed Income as of March 2019. Past performance is no guarantee of future results. Please see the Notice for important disclosures.

[1] *A leverage constrained investor may expect to see a convex relationship*

Figure 4 demonstrates the uneven dynamic of alpha capture by simply plotting the risk-adjusted returns of various fixed income asset classes. For example, on one end, single-B rated 1-3 year high yield corporates have a long-term realized information ratio of 0.9, while on the other end, longer-dated, single-B high yield corporates have a realized information ratio of -0.01. Clearly, all single-B high yield corporate bonds have not performed similarly. The high dispersion in risk-adjusted reward, both across and within sectors, is clear and creates opportunities for active, total return fixed income investors.

Capturing those opportunities requires some key principles for identifying relative value and measuring risk, which we discuss in the next section.

Figure 4: Uneven Information Ratios Across the Fixed Income Universe



Source: Bloomberg Barclays, PGIM Fixed Income as of March 2019. Past performance is no guarantee of future results. Please see the Notice for important disclosures.

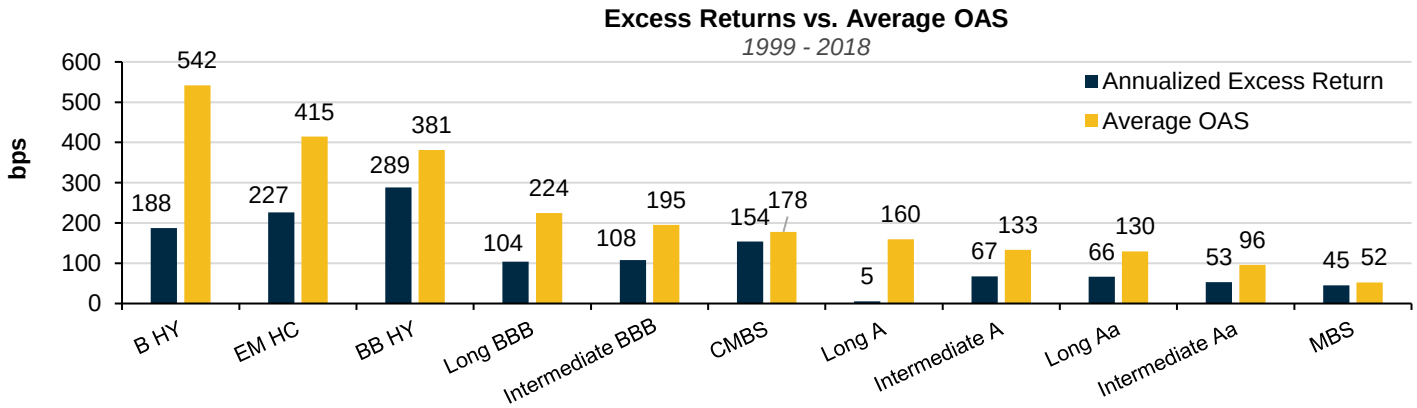
2. Identifying Relative Value and Risk

Due to rules or constraints, many fixed income investors focus on yield as their measure of expected return. However, yield obscures some key relative value considerations, including the amount of credit risk premium truly offered and whether that risk premium provides enough compensation for the risk.

Yield-to-maturity also fails to account for the embedded prepayment options in certain fixed income instruments. For example, in agency mortgage markets, where prepayment options can dramatically lower return potential. Failing to accurately value these options can lead an investor to overpay for the security.

Option adjusted spread (OAS) adjusts the nominal risk premium for any embedded options and is our starting point for return expectation. But OAS is not a realistic estimate of expected excess return due to the effects of credit migration. Over the long term, we have observed meaningful differences between what fixed income securities might offer (OAS) and what they have actually delivered (realized excess return), as illustrated in Figure 5.

Figure 5: Option Adjusted Spreads—What is Offered is Not Delivered



Source: Bloomberg Barclays and PGIM Fixed Income as of December 2018. Past performance is no guarantee of future results. Please see the Notice for important disclosures.

The large divergence between what is offered and what is ultimately delivered highlights the potentially devastating effects of credit migration on bond total returns. These results also highlight the cost of non-economic constraints and yield-oriented objectives—causing investors to overpay for bond market sectors where the credit migration risk is too high relative to the spread offered to invest.

Bond investors need to carefully consider expected returns net of expected credit migration costs. Additionally, over the short term, steep spread curves can contribute to total returns as spreads tighten due to the shortening of a bond's maturity (rolldown). Total return bond investors need to get the longer-term portfolio construction right while also exploiting shorter-term opportunities, such as rolldown.

OAS, rolldown, and credit migration are the three components within our expected excess return framework for fixed income. The benefit of this approach is that two of the three inputs (OAS and rolldown) are objectively observable with view-agnostic inputs. The dependence on observable variables means that the return framework quickly reflects new market prices and changes in relative attractiveness. Expected credit migration is view dependent and is one of the more rigorously debated inputs in our process, which is somewhat unsurprising given the previously mentioned large differences between average spreads and realized excess returns.

Measuring the Risk

There are numerous pitfalls and challenges to estimating portfolio risk for relative value analysis. Since interest rates are a common factor across all fixed income securities, and relatively more volatile than investment grade spreads, they tend to dominate the risk structure. Therefore, investors prioritizing excess return over yield require a risk structure that strips out the duration effect from each sector's returns and combines the portfolio exposures to provide an estimate of the portfolio's excess return volatility. Stripping out duration facilitates a deeper relative value examination of differences in the size of the credit risk premia as well as their volatilities and correlations.

Furthermore, unlike the return estimate, which we want to quickly reflect changes in market prices, the structure of systematic risk should be more stable and should *not* reflect short-term market changes. This belief aligns with our long-term investment approach and avoids the pitfalls of market-reactive risk measures, including Value-at-Risk (VaR) and Duration Times Spread (DTS). Risk models that focus too much on short-term price movements and vary portfolio risk estimates as either ex-post volatility or spread changes can result in a dangerously pro-cyclical incentive structure. This can encourage portfolio managers to adjust positioning at precisely the wrong times.

The proliferation of fixed income asset classes and security features also poses a distinct challenge with creating a comprehensive risk structure. Examples of these features include, but are not limited to: maturity, coupon, structure, seniority, credit enhancement, credit quality, covenants, amortization, and optionality. Additionally, features such as maturity, amortization, and credit enhancement change over time. The risk model needs to reflect the dynamic aspects of the security features and capture the impact of each on three key drivers of excess return volatility: spread duration, spread volatility, and correlation.

Having discussed our rationale for active multi-sector fixed income investing—market segmentation and highly disperse risk-adjusted returns—and outlined some principles for identifying relative value, we turn to integrating these factors with principles for portfolio construction.

3. Portfolio Construction

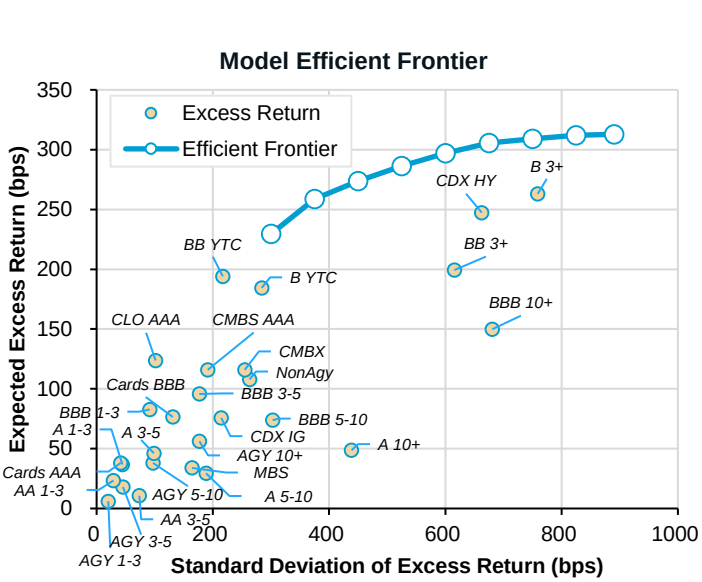
Sector Optimization: A Starting Point for Portfolio Construction

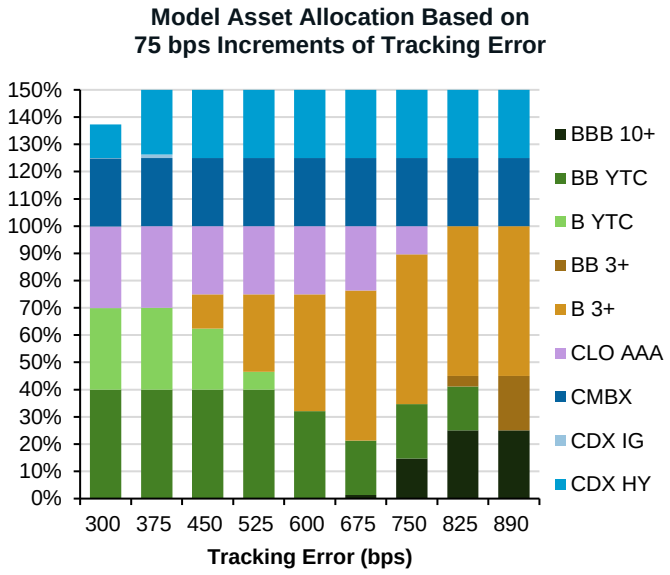
A wise quantitative investor once said, "all models are wrong, but some are useful." Portfolio optimization models are a gross simplification of the real world (and can be characterized as wrong), but can also be useful. They have many limitations including, but not limited to: a highly simplified view of risk and return, assumptions of symmetry and normality in returns, dependence on risk structure (which is typically backward looking), and high sensitivity to return estimates. Understanding the limitations should be a pre-requisite for use.

However, the relatively objective nature of our risk and return estimates means that a robust quantitative framework can be a useful starting point for determining the general direction of optimality. At the very least, the periodic changes in an optimal solution can indicate shifting relative value. Given a mandate benchmark, client guidelines, and a risk budget, the optimization process helps set expectations for sector alpha. In doing so, the optimization helps establish the most efficient broad sector exposures within the risk budget.

Figures 6 and 7 show a sample output from our internal asset allocation model for an unconstrained fixed income mandate (optimized against cash). The declining gradient of the frontier highlights the decreasing marginal efficiency of additional risk taking as we exhaust the lowest-hanging fruit (highest information-ratio opportunities) and move further out the risk spectrum. At this current market juncture, it is also instructive to highlight that increasing portfolio risk does not necessarily produce much additional reward.

Figures 6 and 7: The Modeled Efficient Frontier Shows the Decreasing Marginal Efficiency from Additional Risk, and How Asset Allocation Can Shift with Changes in Tracking Error Thresholds.





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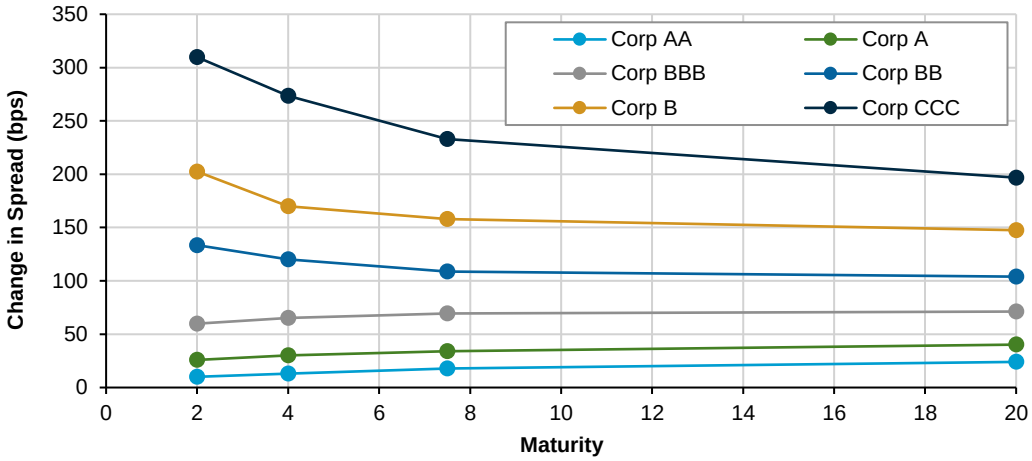
The Inclusion of Principal Component Analysis

While portfolio optimization can be a useful starting point and indicator of shifting relative value, there are far too many limitations to blindly implement the model output. Multi-sector portfolio managers need to layer on additional considerations, such as bottom-up relative value, liquidity, technicals, tail risks, subjective macro and economic assessments, and perspectives on other security features and characteristics not captured by a relatively simple mean-variance model.

It is also important to note that, while excess return volatility is a useful holistic measure of systematic spread risk, it is not a practical tool for portfolio allocation decisions. There are too many interdependencies for portfolio managers to consider how allocation decisions may impact risk. Therefore, principal component analysis (PCA) is a critical component to portfolio construction and risk assessment.

To us, PCA is an important dimension reduction technique which creates a key tool within our real-world, dynamic, multi-sector investment process. In simplified terms, PCA decomposes a covariance matrix into a set of independent scenarios which, in aggregate, explain total risk. In spreads, the first principal component typically explains most of the spread risk and can be loosely interpreted as the sensitivity to a general spread widening scenario (see Figure 8).

Figure 8: The First Principal Component is a Measure of Sensitivity to Widening Spreads



Source: PGIM Fixed Income as of May 2019

We refer to the first principal component of spreads as SPC1, the unit of risk used to allocate across different bond sectors. For example, since the dimensions have been reduced to a general sensitivity to widening spreads, 10 bps of SPC1 in high yield is an equivalent amount of portfolio risk as 10 bps of SPC1 in corporate bonds or in structured product. Principal components risk is additive so 10 bps of SPC1 of structured product risk plus 10 bps of high yield SPC1 equals 20 bps of portfolio SPC1. This is a much more practical unit of risk by which a multi-sector portfolio manager can manage systematic spread risk and vary their sector allocations.

To be clear, market or notional values are useful for measuring extreme downside or tail risks, but they fail to capture any notion of underlying spread risk. For instance, $10 million notional of a 10-year CCC rated security carries a much different risk profile than $10 million of a 3-year BB bond, ceteris paribus. This radically different risk profile is captured using SPC1 and not market value.

Rubber Meets the Road

At PGIM Fixed Income, multi-sector fixed income portfolios are managed by senior portfolio managers who are supported by sector specialists that select bonds in their respective sectors. SPC1 is a highly effective and efficient communication device used by the senior portfolio managers to dictate how much of a portfolio's risk should be allocated to each sector. By harmonizing risk measures across the various market segments, communicating a risk budget in SPC1 terms encompasses both duration contribution and spread volatility. As such, this creates greater degrees of freedom for the sector specialists to extract alpha across preferred issuers and industries at attractive points on the curve—i.e. a portfolio built from the bottom up. It is our strongly held view that PCs are the crucial tool that allow portfolios to *simultaneously* benefit from sector allocation and rotating the portfolio allocation across different bond market segments, while levering the actual bottom-up security selection expertise of sector specialists.

Conclusion

Risk-adjusted returns across different sectors of the global bond market are highly disperse, and relative value opportunities across and within these sectors abound. This is seemingly well understood by some active, fixed income asset managers considering the perennial presence of the Bloomberg Barclays U.S. Aggregate Bond Index's return at the bottom of the peer group tables.2 The persistence of these opportunities is linked to the persistence of the investment constraints of the many non-economic actors in the fixed income markets. There is no indication these constraints are loosening.

An investment process that simultaneously allows an investor's portfolio to be rotated across the most attractive sectors, while delegating the actual bond selection to sector specialists employing deep fundamental research, is the foundation required to tap these market opportunities. A robust quantitative risk management framework enables these two sources of alpha to work in concert, while managing downside risk.

Over time, we believe the total return fixed income investor willing to consider broad investment guidelines and empower a well-chosen investment manager to capture the fixed income market segmentation opportunity can experience a repeatable, high information ratio alpha stream.

[2] *Source: eVestment and PGIM Fixed Income as of March 31, 2019. Peer group represents the U.S. Core Plus Fixed Income Universe.*

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Source(s) of data (unless otherwise noted): PGIM Fixed Income as of September 2019.

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