In this paper, we discuss liability-driven investing (LDI) from a holistic perspective and present practical solutions for plans to consider. We structure our discussion in two parts.

First, we review how to determine and manage the allocation split between return-seeking assets (RSA) and liability-hedging assets (LHA).

Second, we analyze how to most effectively structure the LHA based on the allocation split. To do this, we employ a relative risk/return framework, construct efficient frontiers and evaluate the benefits of derivatives.
Determining and Managing the Allocation Split Between RSA and LHA

For plans seeking to improve their funding ratios through asset returns, the RSA/LHA allocation split should be based predominantly on the current funding ratio, plan status, expected contributions and long-term capital market assumptions. However, plans should also consider any unique attributes that could steer them to pursue more or less aggressive solutions. Further, given the dynamic nature of funding ratios, we advocate the use of glide paths as a systematic framework to help guide de-risking. We believe glide paths should have simple structures while also allowing for re-risking should funding ratios deteriorate.

Structuring the LHA Based on the Allocation Split

UNDERSTANDING THE INTERPLAY BETWEEN RSA AND LHA
The interplay between the RSA and LHA buckets means that the structure of the LHA depends on the RSA themselves. While equities in the RSA allocation do not exhibit meaningful interest rate duration, they do display noticeable correlations to the spread component of the liability returns. This implies that for small LHA allocations, the LHA should have extended duration and less credit relative to the liabilities; as the LHA allocation increases, however, the LHA should gradually look more and more like the liabilities themselves.

DESIGNING PRACTICAL LDI SOLUTIONS WITH AND WITHOUT DERIVATIVES
We believe in most cases, effective LHA cash solutions can be constructed by using only five building blocks: intermediate and long corporates, intermediate and long Treasurys, and Treasury STRIPS 25+. To evaluate the effectiveness of such solutions, we examine various RSA/LHA allocations through the lens of a relative risk/return framework that relies on historical risk measures and assumes constant valuations going forward. The results of the analysis demonstrate some of our key LDI beliefs:

- Solutions should be constructed within the context of the overall asset allocation.
- Solutions should seek an interest hedge ratio of 100% and reduced credit hedge ratio for higher RSA allocations.
- If tradeoffs need to be made between aligning various exposures, improving the interest hedge ratio should take priority.
- Solutions with typical RSA allocations should be simple and not overengineered.
- Use of derivatives, particularly in riskier allocations, can meaningfully improve solutions.

KEY RATE DURATION CONSIDERATIONS
We conclude our analysis by exploring the importance of key rate alignment. Overemphasizing key rate durations may be unnecessary in the cash-only space. In the presence of meaningful RSA allocations where plans need to add significant duration, the only way to achieve this is by overweighting the long key rates. Despite the resulting key rate mismatch, we believe improving the interest hedge ratio still leads to lower funding ratio volatility.
LDI: Taking A Holistic, Practical Approach

By the Loomis Sayles LDI Solutions Team

With the extensive defined benefit plan regulatory and accounting changes that have occurred over the past decade, liability-driven investing (LDI) has become accepted and adopted as a best practice in corporate pension plan asset management.

The idea is simple—assets should be managed in the context of the liabilities they are intended to pay off. In this paper, we discuss LDI from a holistic perspective and present practical solutions for plans to consider.

Setting Up the LDI Framework

The modern LDI framework calls for plans to think of their assets in two buckets: return-seeking assets (RSA) and liability-hedging assets (LHA), as shown in the figure below.

- RSA are charged with helping improve the funding ratio by generating return that exceeds that of the liabilities.
- LHA are intended to dampen the funding ratio volatility of the overall asset allocation relative to the liabilities.

This framework is designed to simplify the asset allocation problem into two more manageable sub-problems. It succeeds for the most part, though as we will discuss later, a degree of interplay between the two buckets dilutes some of the eloquence of the structure.
Having established this framework, the rest of this paper will address two key topics:

1. Determining and Managing the Allocation Split Between RSA and LHA
   - Translating funding ratio and risk tolerance into a target allocation
   - Constructing a glide path

2. Structuring the LHA Based on the Allocation Split
   - Understanding the interplay between RSA and LHA
   - Designing practical LDI solutions without derivatives
   - Designing practical LDI solutions with derivatives
   - Key rate duration considerations

Determining the Allocation Split Between RSA and LHA

TRANSLATING FUNDING RATIO AND RISK TOLERANCE INTO A TARGET ALLOCATION

To determine an appropriate allocation split, a plan needs to first evaluate the level of return its assets must generate in order to achieve its objectives. This is a function of several variables, but the answer depends primarily on the current funding ratio, the extent to which existing assets should work to cover any future service costs (for non-frozen plans) and the level of expected future contributions.

Once this return target is established, a plan must rely on long-term capital market assumptions to determine the RSA allocation necessary to achieve the required return. During this exercise, it is important to understand the embedded risk of the pursued allocation and pay special attention to unique plan attributes. For example, a corporation with a relatively small plan may be willing to be more aggressive with its assets than one with a relatively larger plan. Similarly, a company with strong financials or whose business is countercyclical can perhaps afford to be more aggressive than weaker or more cyclically exposed corporations. The figure below summarizes factors to consider in deciding an appropriate RSA allocation.

![Allocation to RSA Table]

**FACTORS TO CONSIDER IN DECIDING RSA ALLOCATION**

*Source: Loomis Sayles analysis.*
CONSTRUCTING A GLIDE PATH

To address the dynamic nature of funding ratios and plans’ natural desire to de-risk as their funded status improves, we recommend the use of glide paths. Glide paths have become common in LDI because they introduce a systematic framework for managing funding ratio changes, ultimately paving a risk-controlled path plans can follow to reach their target end state. To accomplish this, glide paths should create a link between the funding ratio and the appropriate RSA/LHA split. This link can be constructed using a linear interpolation between the plan’s recommended current and end states. A glide path should also allow for re-risking should the funding ratio deteriorate. Accordingly, funding ratio trigger points should be appropriately spaced to accommodate reasonable fluctuations without having to frequently toggle between allocations. The figure below demonstrates a hypothetical glide path.

<table>
<thead>
<tr>
<th>FUNDED STATUS</th>
<th>TARGET LHA ALLOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger: 75%</td>
<td>30%</td>
</tr>
<tr>
<td>Range: 70-80%</td>
<td></td>
</tr>
<tr>
<td>Trigger: 80%</td>
<td>40%</td>
</tr>
<tr>
<td>Range: 75-85%</td>
<td></td>
</tr>
<tr>
<td>Trigger: 85%</td>
<td>50%</td>
</tr>
<tr>
<td>Range: 80-90%</td>
<td></td>
</tr>
<tr>
<td>Trigger: 90%</td>
<td>60%</td>
</tr>
<tr>
<td>Range: 85-95%</td>
<td></td>
</tr>
<tr>
<td>Trigger: 95%</td>
<td>70%</td>
</tr>
<tr>
<td>Range: 90-105%</td>
<td></td>
</tr>
<tr>
<td>Trigger: 100%</td>
<td>80%</td>
</tr>
<tr>
<td>Range: &gt;95%</td>
<td></td>
</tr>
</tbody>
</table>

Finally, while many plans include additional market-driven parameters in their glide path design, we are cautious with such approaches. For example, plans commonly consider the level of interest rates, where lower rates encourage less aggressive de-risking and higher rates encourage more aggressive de-risking. Though such an approach may seem intuitive, it assumes that interest rate levels are indicative of the future relative performance of equities versus bonds—an assumption we need to be careful with. We believe systematically updating the glide path based on the most current capital market assumptions is a simpler, more effective way to proceed. It is also important to note that glide paths should guide the asset allocation at a strategic level, and plans should always consider tactical deviations from the glide path if market dislocations present themselves.
Structuring the LHA Based on the Allocation Split

UNDERSTANDING THE INTERPLAY BETWEEN RSA AND LHA

Having established a glide path to guide the RSA/LHA split, the question becomes how to structure the LHA so they can most effectively reduce overall funding ratio volatility. The reality is that interplay between the RSA and LHA buckets means that the structure of the LHA depends on the RSA themselves. To address this interplay, we focus on how equity exposure factors into the two key liability risks:

1. **Interest Rates**: do the RSA\(^1\) exhibit any form of duration?
2. **Credit Spreads**: do the RSA exhibit any correlation with the spread component of the liability returns?\(^2\)

**Hedging Interest Rates**

From a dividend discount valuation perspective, equities have meaningful interest rate duration. In fact, as S&P Indices\(^2\) calculated in a flow-through duration model over the period 1973-2011, the S&P 500® Index had an average 24-year duration—meaningfully longer than the duration of the typical liability stream. However, empirical correlations between realized equity returns and interest rate movements tell a very different story. In fact, the empirical duration of equities has been markedly lower than 24 years, quite volatile and even negative at times, as shown in the right-hand figure below. Based on this unreliable profile, for purposes of constructing the LHA, we will assume the RSA do not contribute to the duration of the overall asset allocation. This implies that the entire burden of hedging the liability Treasury rate risk should reside within the LHA, with a target interest hedge ratio of 100%.

\[^{1}\] For the purposes of this paper, we rely on the S&P 500 Index as a proxy for the RSA. We recognize that typical RSA allocations are comprised of multiple asset classes; however, the wide disparity in RSA structures makes it difficult to create a generic proxy. Due to the prevalence of large cap US equities in most RSA allocations, we chose to focus on the S&P 500 Index.

Hedging Credit Spreads

Next, we examine the extent to which equities are correlated to the spread component of the liability returns. Equities should generally move in the same direction as liability spread returns, but the question is to what degree? To address this, we historically regressed S&P 500 Index returns against the spread component of various liability returns. While the R-squares of the regressions are not very high, the correlations are clear and statistically significant. Furthermore, we find that equity returns have shown a very meaningful beta to the liability spread returns. When liability spreads change, equity returns tend to be directionally similar but more pronounced than the resulting liability spread returns.

The table below indicates the beta of the S&P 500 Index versus various duration liabilities and discount curves. As the table shows, the betas get lower as we move from a AA to a A-AAA discount curve and, similarly, are lower for the longer-duration liabilities than for the shorter ones. This is due to the fact that lower-quality discount curves and longer-duration liabilities both have greater sensitivity to market spread movements, which reduces the equity beta.

### Beta of S&P 500 Index Return Regressed Against Liability Spread Return

<table>
<thead>
<tr>
<th>CASH FLOWS</th>
<th>AA CURVE</th>
<th>A-AAA CURVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-year Duration</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>12-year Duration</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>14-year Duration</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>16-year Duration</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

With the understanding that equities exhibit meaningful beta to credit spreads, and knowing that curve quality and duration affect that beta, we can now approximate the credit hedge ratio expected to deliver the minimal funding ratio volatility portfolio for a given RSA allocation (assuming fully hedged interest rate exposure):

$$\text{Target Credit Hedge Ratio}_{\text{min vol}} = 1 - \text{wt}_{\text{RSA}} \times \beta_{\text{RSA}}$$

For example, for a liability stream with a 12-year duration discounted using a AA curve and a 40% RSA allocation to the S&P 500 Index ($\beta=1.4$), a minimal risk LHA portfolio should target a credit hedge ratio of roughly 45% (i.e., $1 - 40\% \times 1.4$). We will revisit this finding in the following section, where we construct portfolio frontiers for various interest hedge ratios and credit hedge ratios.
As our analysis of the RSA relative to the key liability risks has shown, the LHA should carry the burden of hedging the entire interest rate sensitivity of the liabilities, but it should work in concert with RSA to hedge the credit sensitivity of the liabilities. The figure below illustrates the two concepts and their implications: For small LHA allocations, the LHA should have extended duration and less credit relative to the liabilities. As the LHA allocation increases, however, the LHA should gradually look more and more like the liabilities themselves.

**Source:** Loomis Sayles analysis.

**LHA TO HEDGE ALL INTEREST RATE EXPOSURE BUT TO WORK IN CONCERT WITH RSA TO HEDGE CREDIT EXPOSURE**

To demonstrate and further explore these hedging concepts, we designed three RSA/LHA allocations (100% LHA, 60% LHA/40% RSA, 80% LHA/20% RSA) with various underlying interest and credit hedge ratios. For the purposes of this analysis, we used a 12-year duration liability stream discounted with the Citigroup AA Pension Discount Curve to represent the liabilities, and the S&P 500 Index to represent the RSA. For the LHA, we relied on five building blocks, as shown in the figure below. By adjusting the weights of the longer blocks and the Treasury STRIPS relative to the intermediate blocks, we were able to achieve various interest hedge ratios, and by adjusting the weights of the corporate blocks relative to the Treasury blocks, we were able to achieve various credit hedge ratios.\(^3\)

**DESIGNING PRACTICAL LDI SOLUTIONS WITHOUT DERIVATIVES**

3 The actual interest hedge ratios were calculated using the weighted sum of the durations of each underlying block relative to the liabilities, and the credit hedge ratios were calculated using the weighted sum of the duration times spread (DTS) of each underlying block relative to the liabilities.
To better understand each of these solutions, we examined them through a relative risk-return framework and assumed annual rebalancing. To estimate risk, we looked at the monthly historical funding ratio volatility of the overall assets (RSA + LHA) relative to the liabilities. For returns, we neglected the effects of any active management and made assumptions for each of the underlying blocks based on a static view of the future (i.e., equity valuations, yield levels and spreads remain unchanged). The justification for the different approaches is that unlike historical volatilities and correlations, historical returns are notoriously poor future predictors (especially in a secular falling rate environment). Below, we summarize the return assumptions used for each of the relevant building blocks/asset classes.

<table>
<thead>
<tr>
<th>ASSET CLASSES (Five Building Blocks)</th>
<th>RETURN ASSUMPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Intermediate Corporate</td>
<td>2.5%</td>
</tr>
<tr>
<td>2 Long Corporate</td>
<td>3.7</td>
</tr>
<tr>
<td>3 Intermediate Treasury</td>
<td>1.5</td>
</tr>
<tr>
<td>4 Long Treasury</td>
<td>2.9</td>
</tr>
<tr>
<td>5 Treasury STRIPS 25+</td>
<td>3.1</td>
</tr>
</tbody>
</table>

| RSA                                  | S&P 500 Index       | 7.0          |

| Derivatives                          | S&P 500 Index Futures | 6.6          |
|                                      | US Long Treasury Futures | 2.3          |

| Liabilities                          | 3.9                 |

*Liabilities: yield; Treasurys: yield. Intermediate Corporate: yield minus 40% of OAS. 40% derived based on Barclays historical excess return relative to OAS for longest period where starting and ending spreads were similar (10/31/1990-12/31/2015). Long Corporate: yield minus 60% of OAS. 60% derived based on Barclays historical excess return relative to OAS for longest period where starting and ending spreads were similar (12/31/1990-6/30/2014). S&P 500: 2% dividend yield + 5% nominal earnings growth. Derivatives: underlying instrument return minus 0.4% risk-free rate.
The following figure presents the result of the analysis.  

- **Grey contours**: Lines of constant interest hedge ratio (HR), with each dot on the contours representing 20% increments in credit hedge ratio (CHR).
- **Blue dots**: Portfolios where LHA are best matched to the liabilities themselves.
- **Cash efficient frontier**: The most efficient solutions for all RSA/LHA combinations.
- **Grey shaded region**: Liability return volatility due to unhedgeable discount curve constituent changes.

**Findings and Guiding Principles**

Based on our research, we have developed a list of guiding principles that we believe plans should try to adhere to when constructing cash-only LDI solutions. We will use the figure above to help explain these principles. It is important to note that our analysis assumes a static view of the future. Plans that have other near-term views about where equities, rates or spreads are headed should consider tactically overriding some of the principles we list below.

**Principle 1: Solutions should always be constructed within the context of the overall asset allocation**

In the presence of an RSA allocation, the liability-matched LHA (as indicated by the blue dots) lie below the cash efficient frontier. While these portfolios would effectively track the liabilities themselves, they underhedge the liabilities in the context of the overall asset allocation, resulting in increased risk and lower return.

**Principle 2: Solutions should seek an interest hedge ratio of 100%**

For all RSA/LHA combinations, the higher interest hedge ratio contours consistently deliver better results than their lower counterparts. This is because the liability risks are better matched, and the returns increase due to the positively sloped yield curve.

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Principle 3: As the RSA allocation increases, the credit hedge ratio should be reduced

In the 100% LHA portfolio, a 100% credit hedge ratio achieves the best results. However, as RSA increase, minimal risk solutions are achieved by lowering the credit hedge ratio. This is a result of the spread-like behavior of equities and, as discussed previously, is consistent with the concept that the LHA should work in concert with RSA to hedge the credit sensitivity of the liabilities. That said, higher credit hedge ratio levels may lead to improved risk/return outcomes, especially when the interest hedge ratio is below 100%.

Principle 4: If tradeoffs need to be made, improving the interest hedge ratio should come first

As allocations to RSA increase, there is not enough available cash to achieve the desired hedging. In these situations, cash should first be deployed to achieve the desired interest hedge ratio. Interest hedge ratio increases consistently improve solution performance regardless of the proportion of RSA, unlike credit hedge ratio increases.

Principle 5: Most solutions should be simple, not overengineered, focusing on primary risks

To achieve the best risk-adjusted results, plans need to focus predominantly on interest hedge ratio and credit hedge ratio. In the presence of typical RSA allocations, the performance sensitivity to the exact structure of the LHA goes down as equities dominate risk. For example, in the 60% LHA portfolio, increasing the interest hedge ratio from 80% to 100% and the credit hedge ratio from 20% to 40% only lowers the funding ratio volatility by 0.3%. We therefore cannot expect overly refined solutions to meaningfully improve outcomes. Such approaches can in fact be less efficient, as they may make it more difficult for managers to outperform their benchmark.

DESIGNING PRACTICAL LDI SOLUTIONS WITH DERIVATIVES

Having examined the problem within the cash space, we turn our attention to the possibility of using leverage. But first, we review how things work in a standard asset-only framework. The figure below depicts the standard capital asset pricing model (CAPM), including the capital allocation line (CAL), which meets the efficient frontier at the market portfolio. As a reminder, the CAL to the left of the market portfolio represents a portfolio split between a risk-free allocation and the market portfolio. The CAL to the right of the market portfolio represents a levered position in the market portfolio with borrowing at the risk-free rate. The shaded region between the efficient frontier and this portion of the CAL represents possible levered solutions.
To analyze how we can represent levered solutions in our relative framework, we incorporate derivative overlays into the previously discussed relative cash efficient frontier and present our results below. We constructed three levered allocation contours as well as a levered efficient frontier:

• **Contour A:** We overlaid various amounts of S&P 500 Index futures on a 100% LHA allocation with an interest hedge ratio of 100% and a credit hedge ratio of 0%. Each dot on the contours represents 20% increments in equity overlay.

• **Contour B:** We overlaid various amounts of S&P 500 Index futures on a 100% LHA allocation with an interest hedge ratio of 100% and a credit hedge ratio of 100%. Each dot on the contours represents 20% increments in equity overlay.

• **Contour C:** We overlaid various amounts of long US Treasury futures on a 20% LHA allocation comprised entirely of Treasury STRIPS. This allowed us to increase the interest hedge ratio where we were previously cash deprived. Each dot on the contours represents 20% increments in interest hedge ratio.

• **Levered efficient frontier:** The most efficient solutions for all RSA/LHA combinations when derivative overlays can be employed.

\[\text{RELATIVE LEVERED EFFICIENT FRONTIER FOR 12-YEAR DURATION LIABILITY STREAM DISCOUNTED WITH CITIGROUP AA CURVE}
\]

LHA: Five Building Blocks
RSA: S&P 500
Overlays: US Long Treasury Futures, S&P 500 Futures
Assumes annual rebalancing


5 To simplify the analysis, we neglect the need for collateral to fund initiation as well as variation margin for both equity and Treasury futures. While these assumptions are not realistic, they allow us to more easily observe the mechanics of incorporating derivatives. In a more practical implementation, cash would have to be set aside, which would reduce the performance of all the demonstrated levered solutions. Additional risks associated with derivatives, including liquidity constraints and general implications of leverage, should also be carefully evaluated.
Findings and Guiding Principles
Similar to the cash-only exercise, we have drawn on our research to identify a set of principles for derivative-based solutions. Once again, these principles assume a static view of the future, and we will use the previous figure to help explain them.

Principle 1: Derivatives improve solution performance and enhance the efficient frontier
Through a combination of risk reduction and return enhancement, the levered efficient frontier resides above the cash efficient frontier. This implies that solutions employing leverage may outperform cash-only solutions, with the benefits becoming more prominent in riskier allocations.

Principle 2: Treasury futures overlays can be used to increase interest hedge ratios, reducing risk and increasing potential return
Adding Treasury futures to the 20% LHA portfolio reduces risk and enhances potential return. This is a result of increasing the interest hedge ratio while also deriving additional return from the positive slope of the yield curve.

Principle 3: Equity futures overlays can be used to add equity exposure while preserving hedging benefits of high LHA allocations
Adding equity futures to either of the 100% LHA portfolios increased the expected return while preserving the full allocation to the LHA. Interestingly, these solutions outperform equivalent fully hedged cash-only solutions (i.e., 60% LHA portfolios). This is a direct result of improved key rate alignment in the LHA, where the duration is being derived in a more yield-enhancing way than in the cash-only solutions.

Principle 4: Equity futures overlays should be accompanied by corresponding credit hedge ratio reductions
As equity exposures increase, the equity overlay on the 0% credit hedge ratio portfolio starts outperforming the overlay on the 100% credit hedge ratio portfolio. Similar to what was observed in the cash-only space, the spread-like behavior of equities argues for reduced credit hedge ratios.

It is also interesting to note that the levered efficient frontier is higher than the equity-only overlay contours because it also incorporates an interest rate overlay. By allowing for solutions that overhedge interest rates, we were able to benefit from low or negative correlations and further improve on the equity-only overlays. However, in a more diversified RSA allocation, we do not expect to achieve benefits of the same magnitude.

Finally, the figure includes a hypothetical levered portfolio that resides on the efficient frontier. This portfolio offers some insights relative to risk-parity solutions. The portfolio is comprised of a 100% LHA allocation with equity and Treasury futures overlays. The LHA itself contains 26% intermediate Treasurys, 47% long Treasurys, 9% intermediate corporates and 17% long corporates, leading to an interest hedge ratio of 100% and a credit hedge ratio of 40%. The overlay, in turn, is comprised of 60% S&P 500 Index futures and 34% notional Treasury long futures, resulting an overheded solution (overall interest hedge ratio of 141%). When we translate this portfolio into overall exposures, we see the solution has 60% exposure to equity and 134% exposure to fixed income. Computing the contribution to risk from each of these asset classes in an asset-only framework reveals that they contribute roughly equally. Interestingly, this resembles one of the key elements of risk-parity strategies, which are designed to assign equal risk to each asset class.
KEY RATE DURATION CONSIDERATIONS
Throughout the previous discussion, we did not focus on alignment along the Treasury curve (i.e., key rate duration alignment). While aligning key rates is beneficial to the performance of any LDI solution, overemphasizing key rate durations may be unnecessary in the cash-only space because in most cases, there is limited room for improvement.

In the presence of typical RSA, where we frequently want to achieve durations that extend beyond the bounds of regular coupon-bearing indices, Treasury STRIPS are the only way to achieve this. Treasury STRIPS are a potent duration tool, as they bear no coupons and their duration can extend to almost 30 years—roughly twice the duration of the longest coupon-bearing indices. However, the longer, more potent STRIPS derive almost all of their duration from the 30-year key rate, a challenge that invariably introduces key rate mismatches. Nonetheless, ignoring these misalignments and pursuing holistic duration-matched solutions can lead to lower funding ratio volatility. The figure below demonstrates the funding ratio volatility benefits of pursuing such solutions at the cost of poor key rate alignment using three portfolios taken directly from the cash efficient frontier discussed on page 10.

Cash Flow Matched Solutions
In certain situations, a plan may choose to pursue a cash flow matched solution. While a fully cash flow matched solution may seem like the ultimate immunization strategy, these solutions are consistently short duration and exhibit higher funding ratio volatility than their duration-matched counterparts. This stems from the fact that the liability cash flows extend beyond 30 years while maturities in the investible bond universe generally do not.
The following figure demonstrates the source of the challenge in more detail. Roughly speaking, we can think of duration as the average maturity of the liability cash flows. If a portfolio were constructed to match all the liability cash flows up to 30 years, and then included the present value of all 30+ year cash flows as an additional 30-year cash flow, this would lead to a reduction in the average maturity of its cash flows, and as a result, a shorter duration than the liabilities. To address this shortfall, a portfolio can move some of its shorter cash flows closer to the 30-year mark. This way, the duration can match that of the liabilities, as shown in the right-hand figure. While the solution will be duration aligned, it introduces two new risks. First, it does not deliver all the required cash flows on the short end. Second, it includes an inadvertent overweight to the long end of the Treasury curve—a common structural bias in many LDI solutions. Despite these risks, in most cases, duration-matched solutions still reduce funding ratio volatility. Implicitly, in cases where there is no tradeoff with overall duration alignment, or where derivatives are allowed, pursuing key rate alignment can benefit performance (albeit to a limited degree depending on the situation).

**Conclusion**

As LDI continues to gain prominence as the investment approach of choice for pension plans, it is critical for plan sponsors to approach the asset allocation problem in its totality. It may be tempting to create very refined solutions in pursuit of enhanced performance, but plans can’t lose track of the big picture. Most plans have meaningful RSA exposure, and we believe they can achieve effective LHA cash solutions by employing only a handful of building blocks and focusing primarily on the overall interest hedge ratio and credit hedge ratio. We also believe derivatives can play a critical role as sources of potential risk reduction or additional excess return.
Disclosure

This report was previously published in June 2016. We have updated the content as necessary and otherwise believe the information is correct and relevant.

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The ability of an actual portfolio to deliver the required cash flows is not guaranteed and is subject to a variety of factors including, but not limited to, the availability of bonds, transaction costs, default risk, rebalancing risk, liquidity risk and management risk.

The analysis reflected in this presentation is limited to certain recent periods for which data is available. We make no representation that the experience of any other periods is comparable. It is not possible to invest directly in an index.

Past experience is not a guarantee of future performance.

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Definitions

Efficient Frontier: The set of optimal portfolios that offers the highest expected return for a defined level of risk or the lowest risk for a given level of expected return.

Empirical Duration: Empirical duration is estimated statistically using historical market-based asset price movements and historical market-based Treasury yields. When the historical yields change, the historical asset prices may also change, forming the basis for empirical duration. Regression analysis is the statistical process used to estimate empirical duration.

Glide Path: A framework that defines a pension plan’s asset allocation split between LHA and RSA based on funded status or other plan- or market-related parameters. The glide path creates an asset allocation that becomes more conservative (i.e., includes more LHA and fewer RSA) the closer a plan gets to fully funded status.

Implied Duration: As used in this paper, refers to flow-through model duration of equities. The flow-through model goes beyond a standard dividend discount model approach by also accounting for sensitivity to growth rates.