

Rocatōn

INSIGHTS

*Liability-Driven Investing
Principles for Pensions*

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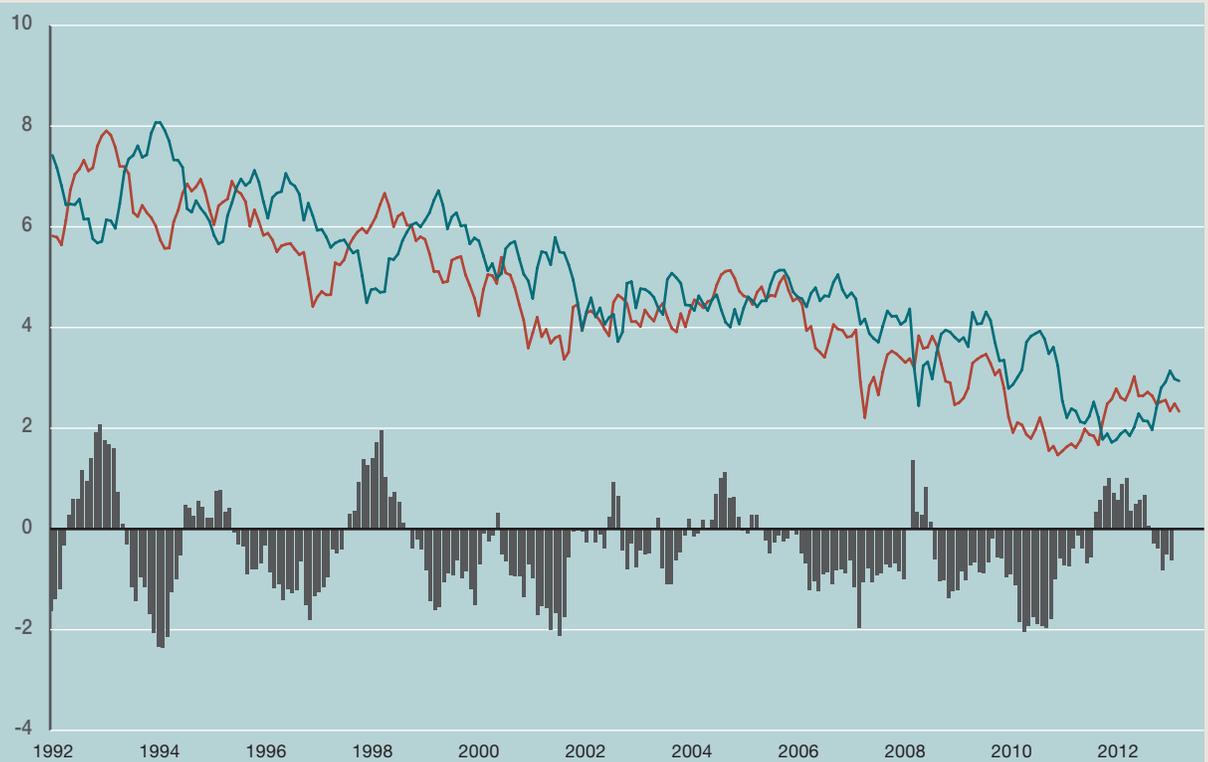
EXECUTIVE SUMMARY

Markets are fickle and difficult to predict. There are plenty of rational ways to forecast what should, could, or will happen to interest rates, equity markets, credit markets, and so on, but such forecasts do little to guarantee that those expectations will be met.

10 Year Treasury Rates: Forward Rates Versus Realized (%)

Legend:
 — Actual Minus Expected
 — 1-Year Forward Rate
 — Actual Rate 1 Year Later

Sources: Bloomberg, based on monthly data from November 30, 1992, to October 31, 2014



One-year forward rates on 10-year Treasuries have not predicted actual movements in rates particularly well. During the period shown, it may not be a surprise to see that forward rates have over-estimated the likelihood that rates would rise. The standard deviation of the difference between actual realized rates and forward implied rates is a staggering 89 basis points.

In developing an appropriate asset allocation for a pension plan, market volatility presents a plan sponsor with the age-old dilemma of balancing the appropriate amount of potential risk with expected return. This is further complicated by the fact that few can actually agree on market forecasts for risk and return.

It is important to remember that market volatility impacts the value of the plan’s liabilities as well as its assets. At its core, Liability Driven Investing (“LDI”) is a framework whereby a plan sponsor recognizes that liabilities have an economic value, and that the purpose of a plan’s assets is to maintain solvency and, ultimately, to provide benefits to participants as promised.

There are a number of principles we advocate that are covered in this paper in greater detail:

- * Plan sponsors should almost universally think about the risk versus reward tradeoffs of various investment portfolios in terms of both assets and liabilities (i.e., funded status), not just in terms of assets.
- * While markets are unpredictable, there are a number of investments that are much more likely to track changes in calculated liabilities or which can help a portfolio mitigate the impact of unexpected changes in their value.
- * In its most efficient form, liability-driven investing requires a holistic approach to asset allocation, rather than a bucketed approach through which the portfolio is partitioned into investments that on their own are designed to meet certain objectives.
- * While it is true that most pension plans are “long-term” investors, year-to-year changes in funded status matter—they impact contributions, PBGC premiums, balance sheets, income statements, etc.
- * Expectations are one thing. Risk is another. It is important to assess each in the context of the other.

This paper takes these principles and outlines various considerations and best practices associated with pursuing a liability-driven investing policy.

Introduction

Liability-driven investing (“LDI”) is sometimes oversimplified and misunderstood. While many simply define it as ramping up exposure to long-duration bonds to match asset interest rate exposure with liability interest rate exposure, there are many more dimensions involved in its implementation. As complicated as pension liabilities and LDI portfolio construction might appear, there are basic principles behind the concept which are fairly straightforward. In this paper, we outline our general philosophies as well as a framework for corporate pension plan sponsors to establish LDI objectives, portfolio structure, implementation, and monitoring.

At its most basic, LDI describes investing an asset portfolio with respect to the liabilities in order to manage the risk of outsized changes in funded status (assets minus liabilities). This requires a shift in mindset from thinking of risk in an asset-only context to defining and assessing risk relative to the plan liabilities (i.e., funded status risk). Pension liabilities, like any other set of cash flows, can be viewed on an economic basis with a corresponding present value.

LDI programs are built on asset portfolios that recognize the key drivers and magnitude of potential changes in the economic value of liabilities. Even for pension plans which determine it is more appropriate to seek long-term growth at the expense of closely matching liabilities, it is prudent to assess risk and return in the context of funded status. There are a number of consequences for plan sponsors when funded status declines sharply—unexpected contributions, PBGC premiums, and greater balance sheet liabilities and pension expense.

LDI views these financial variables as key measures in a comprehensive pension risk management framework.

Objectives for Liability-Hedging Assets

We start by broadly partitioning the universe of investment opportunities into two segments for simplicity:

Liability-Hedging Assets are structured to have high correlation to the sponsor's mark-to-market liability over time. Because liability cash flows are relatively predictable, generally fixed dollar obligations, they most resemble high quality corporate bonds, and total liabilities are calculated based on their yields. This category thus will focus on investment-grade bonds and assets with a low probability of default or permanent impairment. Like liabilities, the price changes of these assets are mostly driven by the movement of Treasury yields and corporate bond spreads.

Return-Seeking/Growth/Risk Assets for the purpose of this discussion are asset classes which are expected to generate returns in excess of the liability discount rate or growth rate. Generally, this will include assets such as public and private equities, high yield and emerging bonds, and other hybrid and alternative asset classes.

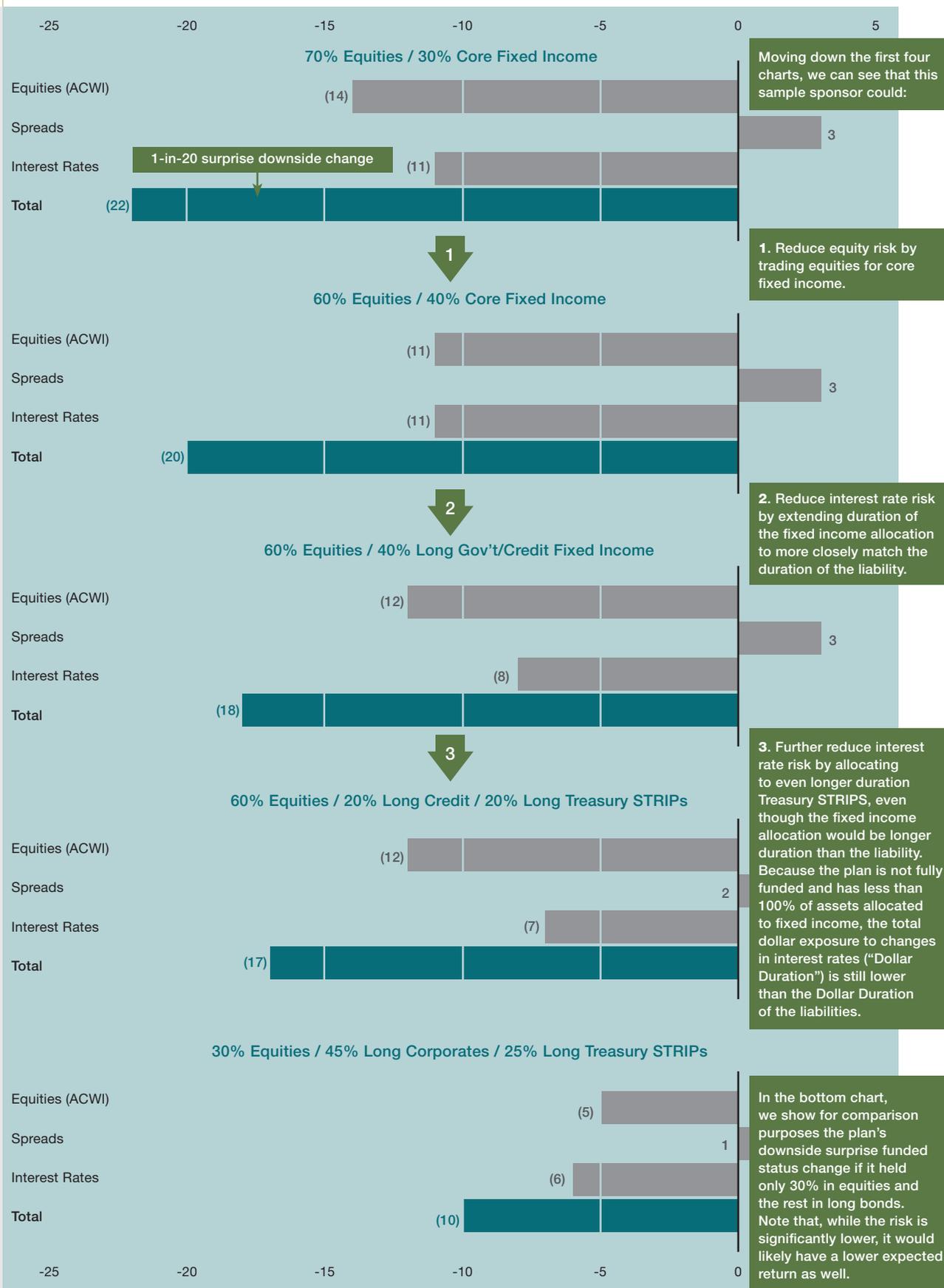
For a portfolio with a significant majority of its assets allocated to liability-hedging assets, those assets are likely in place for one of two reasons. The first is specifically for the portfolio to react to market changes, to the extent possible, in the same way that the liabilities do (to changes in interest rates and credit spreads) while keeping up with the increase in liability due to the passage of time (the interest cost). This is sometimes described as a "hibernation portfolio." The second reason could be to hold a "reference portfolio" that minimizes annuitization costs by holding a portfolio designed for an in-kind transfer given the target insurer's preferences. A reference portfolio likely still tracks economic liabilities at a high level but is more focused on reducing annuity purchase costs.

In cases where liability-hedging assets are not a significant majority of the overall portfolio, the liability-hedging assets are typically in place to mitigate the impact of liability changes on funded status due to market changes. This can mean holding assets which on their own do not necessarily track the liabilities, but which in the context of the total portfolio help to match the economic risk exposures of the liability. As described in greater detail later in this paper, this could mean having a fixed income portfolio which on its own has greater interest rate duration than that of the liability. Alternatively, this can simply mean diversifying exposure to more risky assets, such as equities, which tend to account for a significant portion of funded status risk. In this case, the assets which replace or complement equities are not so much "liability-hedging" assets as they are "funded-status-risk-reducing" assets. **Figure 1** below illustrates the attribution of funded status risk for a variety of portfolios a sample plan sponsor might hold.

Figure 1:
Funded Status
Risk Attribution for
Sample Plan with
Various Asset
Allocations.

Estimated 1-in-20
Downside Funded
Status Surprise (\$m).

Plan initially has
\$100m in liability
and \$80m in assets.
Liability duration
is roughly 14 years.



For plan sponsors on an LDI glide path, the objective of the strategy would likely evolve over time from the “funded-status-risk-reducing” framework towards the liability-hedging framework as funded status improves and fixed income becomes a larger portion of the assets.

Liability-hedging assets are generally not in place to keep up with plan growth due to benefit accruals (service cost) or new entrants, nor are they designed to track changes in the liability due to actuarial gains or losses. Therefore, for plans which expect growth from changes external to market changes, sponsors may choose to have less exposure to liability-hedging assets. Even plan sponsors in “hibernation” (frozen and well-funded with an LDI mentality) will often continue to hold a modest sleeve of return-seeking assets to, amongst other things, realize long-term growth which would serve as a buffer against surprise increase in liability unrelated to economic developments.

Targeting a Liability Measure to Hedge

As any plan sponsor knows, pension liabilities are quoted in many ways, are calculated for different purposes, and can often differ greatly from one another. We believe that there are a few liability measures that a plan sponsor could reasonably choose from when setting portfolio objectives and structuring the liability-hedging component of their asset portfolio.

Under U.S. GAAP, the Projected Benefit Obligation and under IFRS, the Defined Benefit Obligation mark-to-market measures of liability typically represent reasonable proxies for the economic value of liabilities. Changes in the value of either of these liabilities due to changes in Treasury yields and spreads will tend to approximate changes in the cost of purchasing annuities from insurance companies to settle liabilities.

Another viable option is to target an unsmoothed “PPA target liability” (note this would not be an official Target Liability) which calculates the liabilities on a mark-to-market basis using a corporate bond universe similar to that used under PPA (A-or-better corporate bonds).

In the case of cash balance plans, plan sponsors may view the actual total notional cash balance accounts across participants as the “true” economic liability, which can differ from other liability measures. Sponsors also may rely on measures which project interest crediting rates based on forward curves, which may not be the same methodology used by the actuary to calculate funding and/or balance sheet liabilities year-to-year (more on this in the next section).

While the details are beyond the scope of this paper, the sponsor should also note that there are not only various ways to choose the universe of bonds and yields used to discount the liabilities, but there are also various methodologies for actually incorporating that information in creating a liability discount curve.

Plan Features are an Important Consideration

Plan sponsors also need to understand the implications of their plan's design on their liabilities. There are a few common plan features that can impact a plan's ability to hedge or how the sponsor should think about hedging.

Cash balance plans, for instance, treat participant benefits as a notional account value that is periodically credited at some predefined interest crediting rate. This interest crediting rate is often based on Treasury yields, which are not investable because the crediting rate is only tied to the Treasury yield and not its total return. The liabilities of cash balance plans can be sensitive to changes in economic factors in different ways than traditional plan liabilities. Relevant sensitivities can depend on how the plan's actuary determines the liability value over time, or, if the plan sponsor chooses to hedge a different liability, on the methodology associated with calculating the chosen liability. How future interest crediting rates are projected can influence these sensitivities. Any floor on the interest crediting rate could further complicate the issue of how much interest rate duration the liability truly has.

Many plans also offer lump sums on an ongoing basis. Again, because certain discount rates are used to value the lump sums, this added variable can influence total liability sensitivity to changes in interest rates and credit spreads. This impact can depend on the normal form of benefit. That is, for a plan that calculates benefits as an annuity but offers lump sums, increases in the discount rate used to value lump sums will decrease the liability (increase total liability interest rate duration¹); for a plan that calculates benefits as a lump sum and offers annuities, the opposite would be the case.

The Liability-Hedging Opportunity Set

Pension liabilities for U.S. plan sponsors are generally fixed dollar obligations with a reasonable degree of predictability. As such, assets which offer more predictable cash flow properties such as investment-grade bonds provide the most natural hedge or match relative to liabilities. In a pure economic sense, the risk-free portfolio for a pension plan sponsor would be a portfolio of assets which provides guaranteed cash flows equal in magnitude and timing to the expected obligations to the plan's participants. High quality bonds with low risk of default are the most likely assets to offer the fixed and predictable cash flows pension sponsors desire to offset the obligations of their plans. Additionally, pension liabilities tend to extend far into the future, giving them a long duration. Thus, the largest component of a liability-hedging portfolio also tends to be long in duration.

Recognizing the economic nature of pension liabilities, regulatory and governing bodies have increasingly enforced rules which require liability values for various purposes to be measured using the yields on high quality corporate bonds (such as Aa rated or A-or-better bonds) which perhaps represents one of the largest publicly traded universes of securities which plan sponsors could access to immunize plan liabilities. Plan sponsors may not want to take the narrow

1 When compared to an "uninformed" estimate of duration that relies on a static set of projected cash flows which reflect the probability of participants electing optional benefit forms.

universe of bonds defined by these regulatory bodies as the strict definition of the investable universe for pension liability hedging. In most cases, the universe of bonds used to discount the liabilities is very narrow and can be quite concentrated either by issuer or sector. Most of the bonds in the Citigroup Pension Discount Curve Index have maturities of less than ten years and there can be significant concentration within certain maturity ranges. On top of that, pension liabilities extend further than the 30 years that tends to be a maximum maturity issue with few exceptions. Even if it were possible, creating a fixed income portfolio using only this universe of bonds would still leave a plan sponsor with a meaningful mismatch versus liabilities—what we refer to as basis risk.

While nearly any liability-hedging portfolio will have some basis risk versus liabilities, it is important to keep in mind the basic premise that assets which have low risk of default and relatively predictable cash flows are the most natural for liability-hedging portfolios. As a result, it would behoove plan sponsors to consider the full range of investable opportunities which possess these common characteristics.

Structuring a Liability-Hedging Portfolio

Before structuring the liability-hedging portfolio, the objectives of the overall portfolio need to be considered. Plans which are frozen and fully-funded, for example, likely have an objective to simply maintain a full-funded position and avoid any future contributions. Plans that have ongoing benefit accruals and are not fully-funded, on the other hand, might have an objective to cover benefit accruals and decrease the funding deficit with portfolio returns while limiting undue exposure to funded status risk.

Regardless of the sponsor's objectives or plan's status, the funded status risk is ultimately a function of the mismatch between liability market risk exposures and asset market risk exposures. Liabilities are discounted based on high-quality corporate bond yields and are therefore exposed to interest rate and credit spread risks. The asset portfolio can be exposed to a wide variety of market risks, which likely includes interest rate and credit spread risks. For a typical pension portfolio, equity risk tends to represent one of the largest sources of risk while liabilities are not explicitly exposed to equity risk. Because the sponsor is essentially short the liability and long the asset portfolio, asset exposure to interest rate risk and credit spread risk should reduce the funded status risk. On the contrary, equity risk in the asset portfolio is largely unrelated to the liabilities and will generally only amplify funded status risk.

For Plan A outlined in **Table 1** below, liability-hedging assets would likely account for a large portion of plan assets as the plan is frozen and well-funded.

For an underfunded open plan (represented by Plan B in **Table 1**), on the other hand, the sponsor may still choose to have a larger allocation to riskier assets which are unlikely on their own to mimic economic changes in the liabilities. For a plan like this that only allocates 40% to fixed income, the fixed income should generally be longer in duration than the liabilities to better match the amount of interest rate exposure inherent in the liabilities. Moreover, the fixed income allocation should be more focused on achieving interest rate exposure than on

credit exposure since the 60% allocated to riskier assets provides more than sufficient implicit exposure to changes in credit spreads. **Figure 2** illustrates that plans with lower allocations to fixed income should be more heavily allocated to Treasuries/Government Bonds and plans with higher allocations to fixed income should allocate more to Corporate/Credit.

Table 1:
Sample Plans and
Portfolio Structure

	Plan A	Plan B
Plan Status	Frozen	Open
Funded Ratio (1)	110%	80%
Allocation to Return-Seeking Assets*	10%	60%
Allocation to Investment Grade Fixed Income (2)	90%	40%
Fixed Income Duration (3)	12	20
Liability Duration (4)	12	12
Interest Rate Hedge Ratio (1) x (2) x (3) / (4)	99%	53%

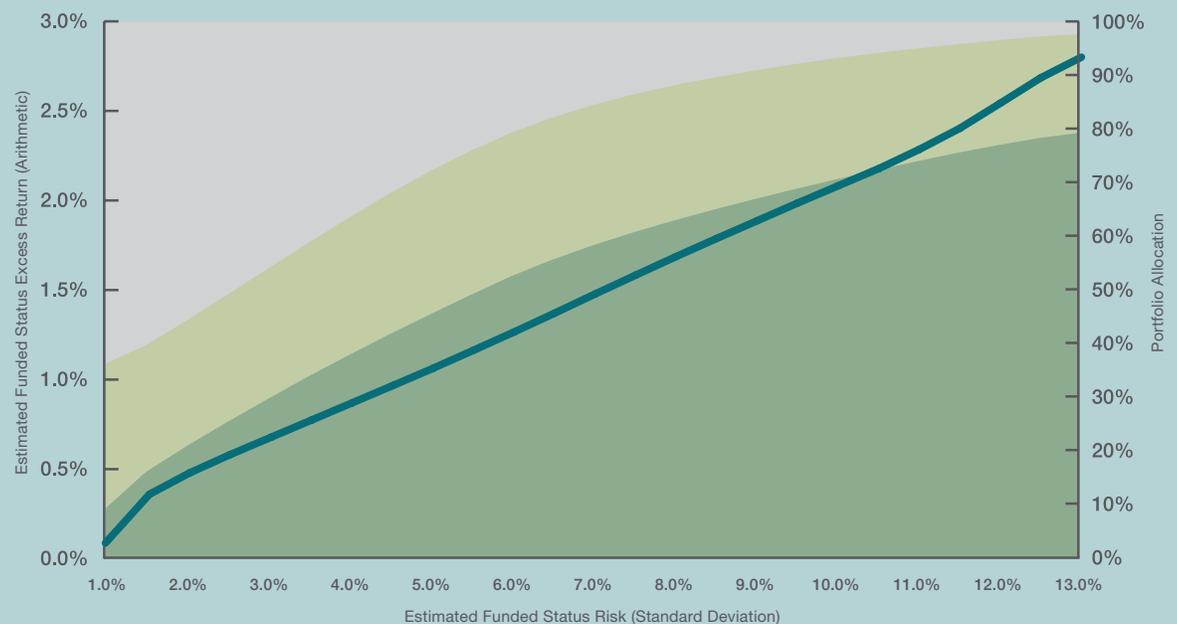
* Assumed to have an interest rate duration of 0.

Figure 2:
Funded Status
Efficient Frontier

Legend:

- % Inv. Grade Corporate Fixed income (RHS)
- % Gov't Related Fixed Income (RHS)
- % Return-Seeking Assets (RHS)
- Excess Return (LHS)

Based on Rocaton's September 30, 2014 Capital Market Assumptions. Assumes plan is 100% funded.



Shouldn't I Wait to Extend Duration?

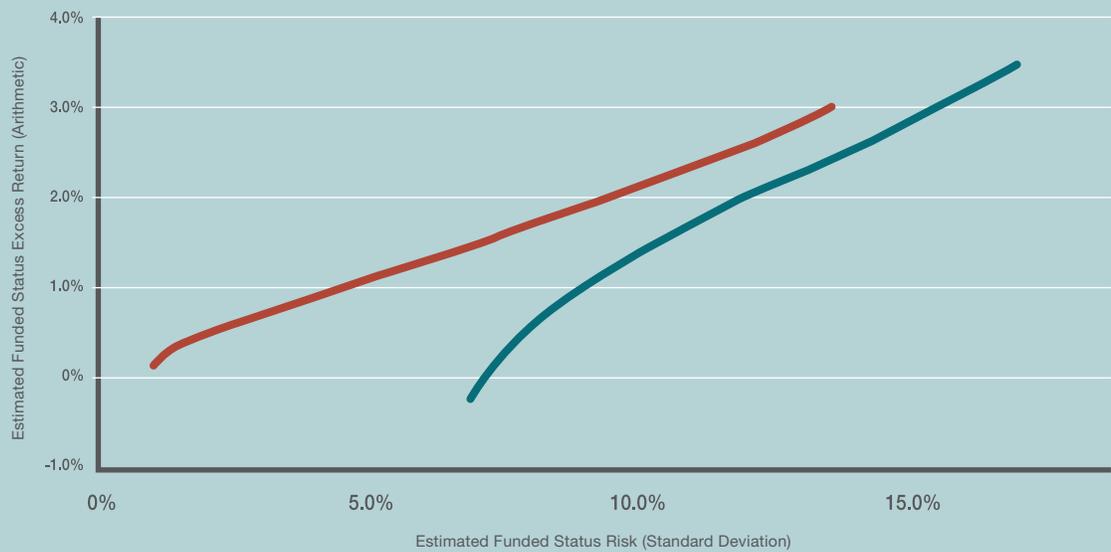
We are often told that, because interest rates have to rise, a given sponsor will wait until rates rise to more closely match their liability's interest rate duration. While we too expect interest rates to rise over time—and this is built into Rocaton's Capital Market Forecasts—there are a few points worth addressing.

First, expectations are one thing. Risk is another. While we expect interest rates to rise over time, we believe there is some probability that they will not, and that should not be dismissed. Any asset allocation decision should be made under a framework of risk versus reward. In the context of pension investing, “risk” should usually refer to funded status risk, not to asset-only risk. **Figure 3** below illustrates the inherent advantage of long duration bonds versus core fixed income in the funded status risk-reward framework. Even though our return expectations for long bonds are fairly modest and not better than those for core bonds², a funded status efficient frontier with long bonds dominates one with only core fixed income.

Figure 3:
Funded Status
Efficient Frontier

Legend:
— Core Bonds Only
— Long Bonds Only

Based on Rocaton's
September 30, 2014
Capital Market
Assumptions. Assumes
plan is 100% funded.



Second, even for a total return investor to favor core bonds over long bonds, they must inherently believe that interest rates will rise more than the market is already pricing in.

Finally, it is worth taking another look at **Table 2** above. For Plan A, the interest rate hedge ratio shown suggests that a parallel rise in interest rates should neither benefit nor harm the funded status. For Plan B, the interest rate hedge ratio is well below 100%; therefore, increases in interest rates should still improve the plan’s funded status. While being less than fully hedged can benefit a plan when rates rise, there is also always the possibility that rates fall. Better hedged plans will be better protected from funded status declines in falling rate environments.

Note that if markets reach extremes, it may be appropriate to consider reducing duration within the liability-hedging or fixed income assets in a portfolio. Such a decision is of course dependent on a number of factors, including market and regulatory factors, but importantly a particular sponsor’s situation and goals as well. In September 2012, in the wake of extremely low interest rates and the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21) we released a paper, “LDI in a Low Rate Environment,” which proposed that for some plan sponsors, the environment was particularly appropriate for such a consideration.

² As of September 30, 2014, our 10-year compound return forecast for core fixed income is 3.5% versus 3.9% for long corporate bonds, 2.7% for long Treasury bonds, and 2.1% for long Treasury STRIPS

With the recent passage of the Highway and Transportation Funding Act of 2014 (HATFA), which essentially extends the impacts of MAP-21, funding liabilities used to calculate contributions are less sensitive to short-term changes in interest rates and credit spreads. This does not, in our opinion, inherently demerit the advantages of an LDI strategy. Of course, we encourage our clients and plan sponsors to continue to work with their consultants to understand the implications of their portfolio asset allocations in terms of expectations and risks related to contribution requirements, PBGC premiums, balance sheet outcomes, and so on.

Conclusion

There are a number of considerations that should be taken into account in pursuing an LDI strategy and in appropriately investing a pension asset portfolio in general. How well-funded is your plan? How much funded status volatility can you tolerate given its impact on contributions, PBGC premiums, and the balance sheet and income statement. How much growth does the plan need to compensate for benefit accruals or for unknown or unanticipated increases in the liability?

A prudent LDI strategy is implemented based on a holistic process and—to the extent feasible—appropriately balances all the risks with all the anticipated rewards that come with investing. There is no single “correct” investment portfolio or solution that applies universally to all plan sponsors; but there are frameworks for thinking about pension investing that should be common to most, if not all, sponsors.

Appendix: What Measures Might Help to Compare My Assets to My Liabilities?

There are a number of useful measures to help the plan sponsor understand their liability profile and how it compares to the profile of their asset portfolio.

Duration provides a high level estimate of sensitivity to parallel changes in interest rates. A duration of D roughly says that a 1% parallel increase (decrease) in interest rates results in a decrease (increase) in value of D%. There are a number of ways to calculate duration that can yield somewhat different results, so it is important to compare assets and liabilities using the same methodology. Duration is also not constant—it changes with changes in interest rates (see “Convexity” below), and liability duration can change over time as plan demographics and assumptions change.

Dollar Duration multiplies duration (expressed as a decimal) by the total liability value or the total assets. It estimates the change in dollar value that results from a small parallel change in interest rates. Generally, under a liability-hedging framework, plan sponsors will seek to eventually match asset dollar duration with liability dollar duration.

Interest Rate Hedge Ratio divides the asset dollar duration by the liability dollar duration. A 100% ratio suggests that small parallel changes in interest rates will not result in significant changes in funded status (assets minus liabilities). This is often the primary goal in liability-driven investing.

Convexity to a large extent addresses the fact that duration changes with interest rates. It is a representation of the change in duration with a change in interest rates. Generally, plan sponsors will seek to have asset convexity that is greater than or equal to liability convexity so that duration increases more for the assets than for the liabilities with decreases in interest rates and so that duration decreases more for assets than for liabilities with increases in interest rates.

Key Rate Durations and *Contribution to Duration* are two measures that attempt to better address asset and liability exposures to changes in interest rates along the yield curve (rather than assuming parallel changes across the curve).

Yield should be kept in mind when comparing liabilities to a liability-hedging portfolio. If the liability-hedging portfolio is a very large portion of the total portfolio, it should provide yield that keeps up with the interest cost of the liability.

Spread is a common measure in bond analytics that describes the yield premium that the bondholder is getting over Treasury bonds for taking additional risk. There are multiple ways of measuring spread. Ultimately, though, the plan sponsor will want their portfolio to earn enough yield to keep up with liabilities, whose discount rate also has a spread to Treasuries.

Spread Duration is similar to duration and measures the sensitivity of a bond’s price to changes in spreads. It is important to understand that spread duration is often quoted relative to changes in a particular bond’s or index’s spread. So just because two bonds have the same spread duration does not necessarily mean changes in broad market credit spreads will impact those

bonds' returns equally, unless their spreads change in the same way. It is sometimes helpful to beta-adjust spread duration to compare bonds or portfolios on a more apples-to-apples basis.

Duration Times Spread (DTS) is exactly as it sounds. It is equal to spread duration multiplied by spread. It gives a sense of changes in a bond's or portfolio's price as a result of percentage changes in spreads. In comparing DTS across bonds or portfolios, one may be inherently assuming that when markets move the percentage change in spread is equal for all the bonds or portfolios (which is not guaranteed to be the case).

Cash Flows are also helpful to look at and compare.

Concentration in both the asset and liability portfolios should be managed and understood. The sponsor doesn't have control over issuer concentration in the liability calculation once a discount rate methodology is selected. The asset portfolio should be appropriately diversified.

Credit Quality of the asset portfolio is also important understand and manage.

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Liability-Driven Investing Principles for Pensions

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