UNDERSTANDING THE DURATION RISK IN PENSION PLANS: THE CASE FOR LDI

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Background: Why LDI?

Recent changes in the rules governing U.S. corporate pension plans (the Pension Protection Act of 2006 for contribution funding, and FASB 158 for balance-sheet accounting) move plans closer to "mark-to-market" measurement of assets and liabilities. These rule changes have prompted much discussion on the role of LDI in pension plans. While LDI has not yet been widely adopted in the U.S. market, one need only look to the United Kingdom for an example of how changes in pension rules can shape investment trends.

In the early 2000s, the U.K. adopted pension-accounting rules (FRS 17) that moved plans towards the marking to market of assets and liabilities. At that time, most U.K. plans had high allocations to equity and held virtually no longer-duration assets. However, as plans became increasingly aware of funding-status risk, they began to adopt LDI and also diversified away from equities to mitigate funding-status volatility. As the focus shifted from asset-only return and risks to the need to reduce the volatility of the plan's funding status, the adoption of LDI grew to become the norm among plans. The U.K. pension market's evolution can be thought of as a precursor to what NEPC believes is a current trend among U.S. corporate pension plans — namely, a shift from investing assets solely for return to the protection and improvement of funding status. LDI will play a key role in achieving this goal.

It is important to note that LDI can be consistent with the ERISA principle of investing solely for the best interest of plan beneficiaries. While LDI does help mitigate funding volatility for the sponsor, it also improves the certainty of benefit payments to participants. For that reason it has been endorsed by the U.S. Department of Labor.

For a plan sponsor considering the adoption of LDI, the first step is to gain a solid grasp of the inherent risks to the plan's funding status. NEPC strongly recommends that sponsors conduct a risk-budgeting analysis (See our paper "*Risk Budgeting: A Focus on the Pension Plan's Biggest Risks."*) and perhaps an asset/liability study as well, to develop a thorough understanding of these risks. Based on our experience, most sponsors will find that the two key risks to funding status are (1) a mismatch in duration (or interest-rate sensitivity) between assets and liabilities, and (2) a major risk allocation to equities.

LDI AIMS TO MORE CLOSELY MATCH ASSET AND LIABILITY DURATION: TYPICALLY THE LARGEST RISK TO A PLAN'S FUNDING STATUS

LDI aims to address what is usually the greatest risk to the funding status of corporate pension plans: the duration mismatch between assets and liabilities. The main goal of LDI is to narrow this gap by increasing the duration of assets.

In shifting the plan's investment focus to funding status, plan sponsors must understand the factors that drive changes to liabilities (other than alterations to benefit structures) and how asset-side

LDI solutions can help match those changes. To begin this process, NEPC recommends that sponsors focus on three key factors that drive plan liabilities: (1) the overall duration of liabilities, (2) the maturity profile of liabilities, and (3) the credit spread built into the discount rate.

Duration of Liabilities

By way of definition, duration (expressed in terms of years) is essentially the sensitivity of a change in value of an asset or liability based upon movements in interest rates. From a liability perspective, movements in interest rates cause the present value of pension liabilities to change, which will have a corresponding impact on funding status. The longer the duration of a liability, the greater the change in its value for a given movement in rates. Because of their commitment to typically paying life-long annuities to beneficiaries, defined-benefit plans usually have liabilities of fairly long duration, often between 10 and 15 years.

Duration is the typically the most important influence on the volatility of plan liabilities. Which assets can help mitigate that volatility? The duration of a plan's fixed-income assets can be readily quantified, but the duration of its equity holdings is subject to debate. For the purposes of this paper assume that equities carry zero duration.

Traditionally, pension plans' fixed-income assets have been invested in the investment-grade bond market in portfolios benchmarked to broad market indices such as the Barclays Capital Aggregate Index. Such core bond strategies usually carry durations of four to five years. From a return-only perspective, an investment in core bonds is viewed primarily as a diversifier to equities. From a funding-status perspective, however, the relatively short duration of a plan's fixed-income assets compared to its liabilities creates substantial risk.

To illustrate, let's assume that a pension plan has a 40% allocation to core bonds with a five-year duration. If equities are assumed to have zero duration, then the duration of the overall portfolio is approximately two years. Assume that the plan's liabilities have an aggregate duration of 12 years. This means that for every

Assuming a 10% decrease in Equity Markets

	Original Value (mils.)	Change (mils.)	Ending Value (mils.)
Equities	$ 600	$ (60)	$ 540
Fixed Income	400		400
Assets	1,000	(60)	940
Liabilities	1,050	-	1,050
Difference	(50)	(60)	(110)
Funded Percentage	**95%**		**90%**

Assuming a 100 basis point decline in rates across the yield curve

	Original Value (mils.)	Change (mils.)	Ending Value (mils.)
Equities	$ 600	$ -	$ 600
Fixed Income	400	20	420
Assets	1,000	-	1,020
Liabilities	1,050	126	1,176
Difference	(50)	(106)	(156)
Funded Percentage	**95%**		**87%**

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Assumes 5 year duration of core bonds, 13 year duration of liabilities one percent (100-basis-point) fluctuation in interest rates across the yield curve, the resulting change in the size of plan liabilities will be *six times greater* than the movement in plan assets. Hence even a modest decline in interest rates will spur a sharp deterioration in funding status, as liabilities rise six times more than assets. Conversely, if interest rates climb, funding status swells as liabilities fall six times more than assets. LDI aims to reduce the funding-status volatility inherent in this duration mismatch, so that assets move in closer synch with liabilities as interest rates change.

IT IS FEASIBLE TO HEDGE DURATION WHILE PRESERVING THE PORTFOLIO'S EARNING POTENTIAL

To appreciate the scale of the risk created by mismatched durations, consider a plan with a typical asset allocation of 60% equities and 40% core bonds. Above, the impact to the plan is analyzed of a one-percent (100-basis-point) drop in interest rates, and of a 10% decline in equities, each occurring independently.

The drop in equities reduces funding status by $60 million. However, the impact of the 100-bps decline in interest rates demonstrates the much greater risk to funding status posed by the duration mismatch between assets and liabilities. The decline in interest rates boosts fixed-income assets by $20 million, but increases liabilities by $126 million, causing a $106 million drop in funding status.

This basic example demonstrates why NEPC believes that corporate pension plans should consider LDI solutions to hedge liability movements and reduce funding-status volatility. Interest-rate movements of the magnitude illustrated above are not uncommon. In our view, all corporate plan sponsors should consider hedging a portion of liability-duration risk by extending asset duration, if they have not already done so.

Maturity Profile of Plan Liabilities

While reducing the duration mismatch between assets and liabilities is the first and most important step to managing funding-status risk, consideration must also be given to the maturity structure of liabilities. Similar to bonds and annuities, the liabilities of every pension plan have a unique profile of maturities across the yield curve. Ideally, a plan's LDI solution takes this profile into account, so that any shifts in interest rates along the yield curve will have a roughly equal impact on plan assets and liabilities. An LDI solution that more closely matches the stream of plan benefit payments creates an effective overall hedge against this risk.

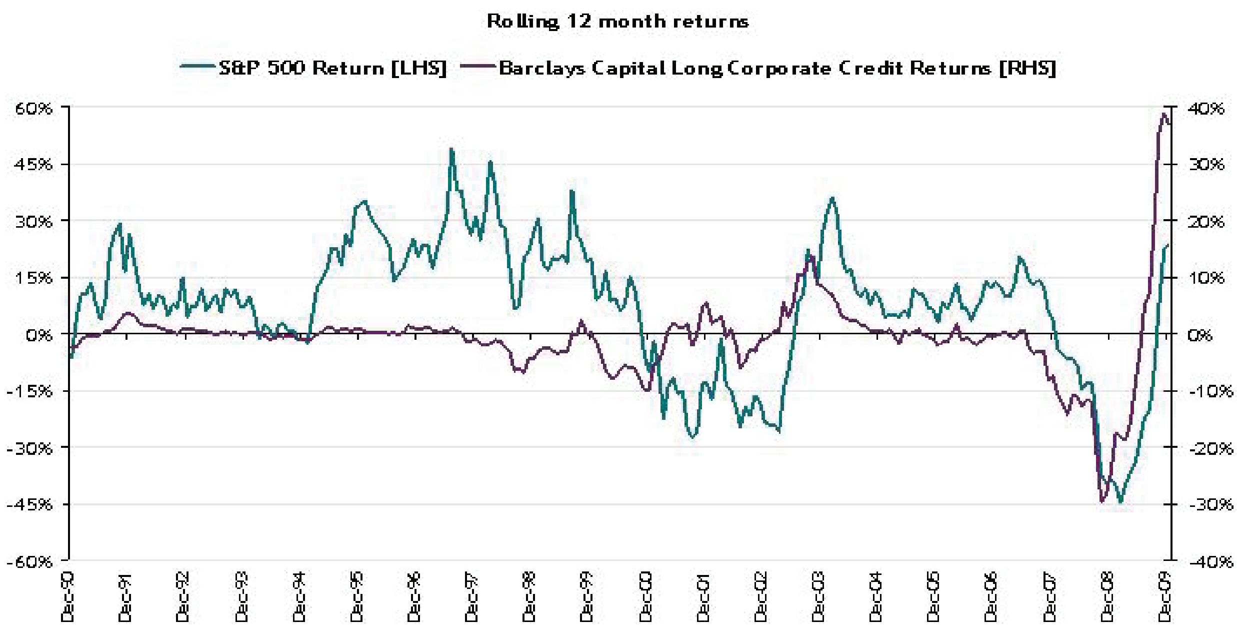
Most of the information needed to analyze plan liabilities can be obtained through the annual actuarial report and/or in consultation with the plan's actuary. Once this information is acquired, it should be compared to the how well the various LDI solutions will match this liability profile to determine the best possible alternative.

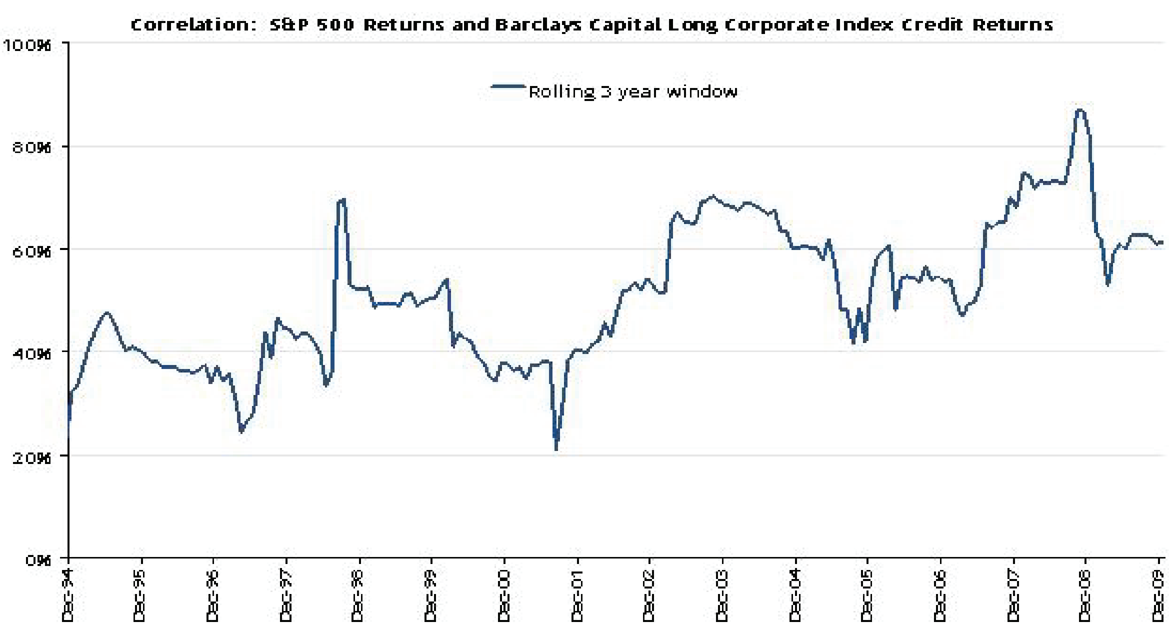
Credit Spread Reflected in the Discount Rate

The discount rate for a pension plan is based on corporate bond yields, which in turn are composed of U.S. Treasury yields (considered to be free of credit risk) plus a premium for credit risk. An LDI program may aim to hedge the discount rate of a pension plan; hedging the yield curve for corporate bonds, however, can be problematic. The basket of bonds used to construct the discount rate changes regularly as bonds that are downgraded leave the calculations. Furthermore, changes in credit spreads can cause problems if hedging is done through instruments other than corporate bonds. Prior to 2008, credit spreads were usually fairly steady over time, and therefore Treasury yields and corporate yields tended to move in tandem. Because of this consistency in credit spreads, and because of the underlying default risk reflected in corporate yields, many LDI solutions hedged liabilities through exposure to the Treasury yield curve. However, as the credit crisis of 2008 and the subsequent recovery in 2009 revealed, changes in spreads can have a material impact on discount rates. This underscores a key difficulty in trying to exactly replicate the discount rate: no market instrument exists to do so, and liability indices are not investable. Of note, NEPC has published a separate paper discussing the impact of credit spreads on hedging liabilities, "*Credit Spread Disparities Between Assets and Liabilities*," available at www.nepc.com

Although the credit component of the liability hedge creates a risk that must be monitored, it is usually secondary to the larger risk of matching asset and liability duration. Nonetheless, plan sponsors should assess how fluctuations in credit spreads might affect plan liabilities, and consider other sources of hedging this credit component that may already be embedded in the asset-side of the portfolio. For example, equity markets historically have tended to exhibit a high positive correlation to credit markets; and, in most plans, equities comprise a major portion of total portfolio risk. This correlation helps stabilize funded status as credit spreads rise and fall, by narrowing the credit-risk gap between assets and liabilities.

The graphs below map the AA credit spread against the S&P 500. While the graphs show that the S&P 500 does not perfectly hedge credit exposure, it does highlight the strong historical correlation between credit spreads and the equity portion of the portfolio (*source of both graphs BlackRock).*





In addition to equities, other asset classes such as high-yield bonds and some alternative-asset strategies may have credit exposure that can offset some of the credit-spread risk inherent in liabilities.

After the three main sources of liability volatility have been identified and assessed, a plan sponsor may elect to pursue an LDI solution to address funding-status risk. The next step is to decide how much of this risk to hedge by selecting a target duration hedge ratio.

THE TRUE MEASURE OF SUCCESS BECOMES THE PLAN'S PERFORMANCE FROM A FUNDING STATUS PERSPECTIVE

Setting the Target Duration Hedge Ratio

The plan's funding status is a key factor in determining an appropriate hedge ratio. Sponsors whose plans are in surplus may choose to target a higher hedge percentage (80% to 100%), as the risk to the surplus from declining interest rates may loom larger than potential surplus enhancement from rising rates. Sponsors whose plans are in deficit may pursue a lower hedge ratio, and focus more on other options, such as asset growth to supplement contributions, in order to close the funding gap. These same sponsors may aim to increase the hedge ratio as funding status improves.

For most sponsors, NEPC recommends a target duration hedge of approximately 70%, to be achieved over time. This ratio should allow plans to eliminate most interest-rate exposure, while still providing flexibility if the plan's structure changes. Targeting a 70% ratio also reflects the fact that the marginal benefit of further hedging diminishes as the hedge ratio is raised, and that there will always be basis risk because the liability index is not investable. Achieving the target hedge ratio will typically result in a sizeable jump in portfolio duration, as most plans without LDI have only about two years of asset duration. Given this significant lengthening in asset duration, we typically recommend that sponsors phase into the hedge through dollar-cost averaging to mitigate market-timing risk. Implementation strategies are discussed in more detail in NEPC's paper "*LDI Product Types and Implementation Strategies*."

Another consideration in setting the target duration hedge ratio is the proportion of assets that must be committed in order to achieve the desired hedge. Many may view the adoption of an LDI strategy as requiring a sacrifice of return, since assets might be shifted from investments with relatively high potential returns, such as equities, into bonds in order to gain duration. Yet there are LDI solutions that allow plan sponsors to maintain, and potentially enhance, the portfolio's return potential while still achieving the desired hedge. Zero-coupon bonds as well as futures and interest-rate swaps (if prudently used) are very capital-efficient vehicles for gaining duration exposure. Thus it is not only desirable but feasible to hedge duration while preserving the portfolio's earnings potential.

Funding status must also be considered when calculating the hedge ratio. Funding status is simply the ratio of assets to liabilities. If a pension plan is in a deficit position, its assets are less than its liabilities, so it will need to dedicate more assets to achieve the desired hedge. Conversely, if there is a surplus, fewer assets are needed to reach the target ratio.

For example, assume that two plans both have a liability duration of 13 years and aim to achieve a 70% hedge ratio; that is, each plan targets an asset duration of approximately 9 years. Plan A is 125% funded, and Plan B is 85% funded. Each wants to use an LDI solution that provides 20 years of duration. The estimated assets required for each plan are as follows:

Plan A:

$$\frac{13 \text{ years} \times 70\% \text{ hedge}}{20 \text{ years} \times 125\% \text{ funded}} = 36\% \text{ of portfolio assets}$$

Plan B:

$$\frac{13 \text{ years} \times 70\% \text{ hedge}}{20 \text{ years} \times 85\% \text{ funded}} = 54\% \text{ of portfolio assets}$$

Measuring Plan Performance by Focusing on the Only True Benchmark: Funding Status

The use of LDI requires a mindset shift when evaluating performance. The performance of plan assets should no longer be seen as the main measure of success. Comparisons to asset-only benchmarks and peers become increasingly less relevant. Instead, the true measure of success becomes the plan's performance from a funding-status perspective.

Thus, once the decision is made to pursue LDI, it is essential to modify performance reporting, shifting it from a focus on asset-only returns toward an emphasis on funding-status performance. While LDI programs and products will be the key to reducing funding-status risk, the lengthening in asset duration will lead to greater asset volatility.

NEPC recommends to our corporate clients, whether or not they use LDI, that they evaluate their plan's success by its funding status— that is, they should evaluate returns on plan assets *relative to the change in plan liabilities.* Since the true change in liabilities will not be known until the year-end actuarial report, a monthly proxy estimate of that change must be calculated. For some clients, the plan actuary will provide the estimate. However, for most clients, NEPC constructs an estimated change in monthly liabilities based on expected benefit payment data provided by the actuary (who also provides information on liability duration) and the estimated movement in a proxy discount rate. While this measure is not exact, it can provide a good barometer of changes in liabilities, and how closely asset values have tracked those movements.

While the evaluation of funding status will be the key metric, NEPC also recommends periodically evaluating the impact of LDI within the full portfolio. Since LDI strategies are usually only one component of total plan assets, it is important to take a separate look at assets held mainly as hedges or as higher-return vehicles, in order to measure the effectiveness of each of those asset pools.

One final thought: The process described above does not make allowances for the impact of any changes to the plan's structure (in benefits, actuarial assumptions, etc.). Thus we recommend that the LDI program be reviewed at least annually — typically after the actuarial report has been received. Such a review allows a plan sponsor to modify its strategy based on performance over the past year, taking into consideration any plan changes that may cause a shift in its optimal LDI solution.

Summary and Conclusion

Traditionally, pension assets have been invested with asset returns as the main measure of performance, leading to high equity allocations. In this framework, risk mitigation was achieved primarily through diversification into fixed income. But as pension rules move towards the marking-to-market of assets and liabilities, sponsors should consider re-orienting the plan toward the protection and/or improvement of funding status, by matching asset returns more closely to liability movements. Prior to implementing this reorientation, sponsors should gain a detailed understanding of the key forces that drive changes to plan liabilities: (1) the duration of liabilities, (2) yield-curve exposure, and (3) the credit spread reflected in the discount rate. After these factors have been considered, plan sponsors should decide on a target duration hedge ratio and how much in assets they can dedicate to achieve the desired hedge. A shift in focus to funding status, calls for a corresponding change to plan-performance reporting. Asset-only comparisons become decreasingly relevant; instead, reporting should be centered on the health of the plan's funding status. Finally, the LDI solution chosen should be reviewed at least annually, as changes to funding status and plan features may also change the plan's optimal LDI solution.