

June 25, 2010



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Fixed Income Commentary

The Changing Landscape for Pension Plans and the Evolution of Liability Driven Investing

Executive Summary

Long considered the birthright of the American worker, the traditional defined benefit (DB) pension plan has been under fire for some time. Defined contribution (DC) plans such as 401(k)s have increasingly replaced DB plans as corporations shift the risk and expense of providing for retirement from the company to the worker. This shift has accelerated in recent years as accounting and legislative changes have made DB plans even more onerous for most corporations. These changes have required corporate managements to view their DB plans differently and define risk more directly in how the plan assets change in relation to the pension liabilities. Many have adopted asset allocation plans that increase the amount of fixed income and move toward long duration and/or interest rate overlay approaches (often broadly referred to as liability driven investing or LDI).

There are many considerations that go into a successful implementation of an LDI program, including: (1) the funding status of the plan and the strategy to close any funding gaps, (2) tolerance for balance sheet volatility, (3) the dynamic nature of pension liability cash flows and the impact on liability duration, (4) convexity and curve differences between assets and liabilities, (5) basis risk (risk that the discount rate for liabilities changes differently than the yield on the assets or overlay), (6) the use of derivatives to achieve the desired asset-liability matching objective, and (7) the need for on-going monitoring of liabilities and management of the assets.

The current state of LDI programs in the U.S. pension market is being complicated by two main factors: (1) most pension plans are significantly underfunded, and (2) interest rates are generally viewed as being low and likely to rise over the long term. The combination of these factors has resulted in most plans being unwilling to currently implement full immunization or asset-liability matching programs for fear that this will lock in the current funding gap and increase the amount of contributions companies must make to their plans.

Accounting / Legislative Developments

Historically, defined benefit pension plans received little attention from the financial community. Relegated to the back pages and footnotes of the financial statements and given little consideration by equity analysts, the funding status of pensions were almost invisible to most investors. All that changed in the middle part of the last decade. Following the bursting of the equity market bubble and the attendant collapse of numerous businesses due to belated recognition by investors of “hidden” liabilities, accounting standards have moved steadily in the direction of requiring greater transparency.

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Specific to pension liabilities, concern grew that the U.S. pension system may be inadequate in delivering promised benefits to retirees. The declining financial condition of corporate DB plans and the Pension Benefit Guaranty Corporation (PBGC) was caused by a number of factors including the secular decline in interest rates (which has significantly increased the present value of pension liabilities), U.S. equity returns below expectations, the maturation of the U.S. workforce and a number of large corporate bankruptcies which resulted in corporations handing over their underfunded pension plans to the PBGC. The Financial Accounting Standards Board (FASB) and Congress reacted to the heightened public concern by embarking on reform efforts designed to improve the financial reporting and funding status of U.S. pension plans. The legislative result was the Pension Protection Act of 2006, which effectively forces pension plans to mark-to-market both assets and liabilities (as opposed to the previously used smoothing mechanisms) for purposes of determining contributions and required PBGC insurance premiums.

More significantly, in September 2006 FASB issued FAS 158 which amended FAS 87 and 106, and requires DB plans to recognize the difference between the fair value of pension assets and liabilities on their balance sheet. Previously, this information was only required in the footnotes of the financial statements. FASB is currently planning a second phase of changes that deal with the cost of post-retirement benefits and how these costs are recognized and displayed in the financial statements.

While the effect of changes to date has been to simply move information from the footnotes of the financial statement to the balance sheet, the implications for pension plans can be significant. In addition to having potential effects on shareholders equity and thus the compliance with financial covenants in bond indentures and loan agreements, moving the net funding status of the pension plan onto the balance sheet increases balance sheet volatility. This is particularly true for pension plans that are significantly underfunded and plans that have large allocations to equities and other high risk/return asset classes. There have been and likely will continue to be a number of likely policy responses by corporate management:

- Freezing or terminating the pension plan
- Increasing contributions to the plan
- Decreasing equity exposure/increasing fixed income exposure
- Increasing the duration of the fixed income allocation

Impact on Asset Allocation

With regard to asset allocation decisions, the framework is shifting toward managing the volatility of the funding status or surplus, as this has direct repercussions for the volatility of contributions that will need to be made to the pension plan and the volatility of shareholders equity on the balance sheet. Some of the factors influencing the mix of assets are as follows:

Funding Status	→ If close to fully funded	→ Favors Fixed Income
	→ If significantly underfunded	→ Favors Equity/high return assets
Time to Close Funding Gap	→ If short term	→ Favors Fixed Income
	→ If long term	→ Favors Equity/high return assets
Variability of Liability Cash Flows	→ If large	→ Favors Equity/high return assets
	→ If small	→ Favors Fixed Income
Tolerance for Variability in Pension Contributions	→ If small	→ Favors Fixed Income
	→ If large	→ Favors Equity/high return assets
Tolerance for Balance Sheet Volatility	→ If small	→ Favors Fixed Income
	→ If large	→ Favors Equity/high return assets

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A traditional asset focused approach to asset allocation would suggest that there is a tradeoff between the equity allocation and the fixed income allocation. Specifically, higher equity allocations lead to higher expected returns and lower pension contributions over time, but higher volatility of the pension funding status and shareholders equity. Conversely, higher fixed income allocations lead to a more stable funding status, but lower expected asset returns and potentially higher pension contributions.

LDI Implementation Approaches

There are three broad approaches to implement an LDI solution:

- Long Duration Fixed Income - usually involves lengthening the duration of the fixed income allocation from a broad Barclays Aggregate-type duration (~4-5 years) to a Barclays Long Government/Credit or Long Credit-type duration (~10-12 years).
- Interest Rate Overlay - involves using derivatives (either Treasury futures or interest rate swaps) to increase the duration of the assets without significantly impacting the existing asset allocation.
- Cash-flow Match to Liabilities - extreme case of dedicating all of plan's assets to high quality bonds, whose coupon and principal payments match the amount and timing of liability cash flows.

To illustrate the impact of the different approaches on the expected asset return, asset volatility and surplus volatility of a plan, let us consider a simple example of a hypothetical fully funded pension plan with the following characteristics:

Pension Liability (PBO):	\$10 million
Duration of liabilities:	12 years
Value of Assets	\$10 million
Asset Allocation:	
Equity	60%
Fixed Income (Barclays Agg)	40%

Let's also make the following capital market assumptions:

Expected Returns	
Barclays Aggregate	3.5%
Barclays Long Govt/Credit	5.2%
CF-matched Treasuries	2.8%
Equities	8.0%
Expected Volatility	
Barclays Aggregate	5.0%
Barclays Long GC	12.0%
CF-matched Treasuries	12.0%
Equities	20.0%
Interest rates (yield vol)	1.0%

Thus, our hypothetical plan would have the following characteristics:

Expected asset return	6.2%
Expected asset volatility	14.0%
Expected surplus volatility (interest rates)	10.0%
Expected surplus volatility (equities)	12.0%

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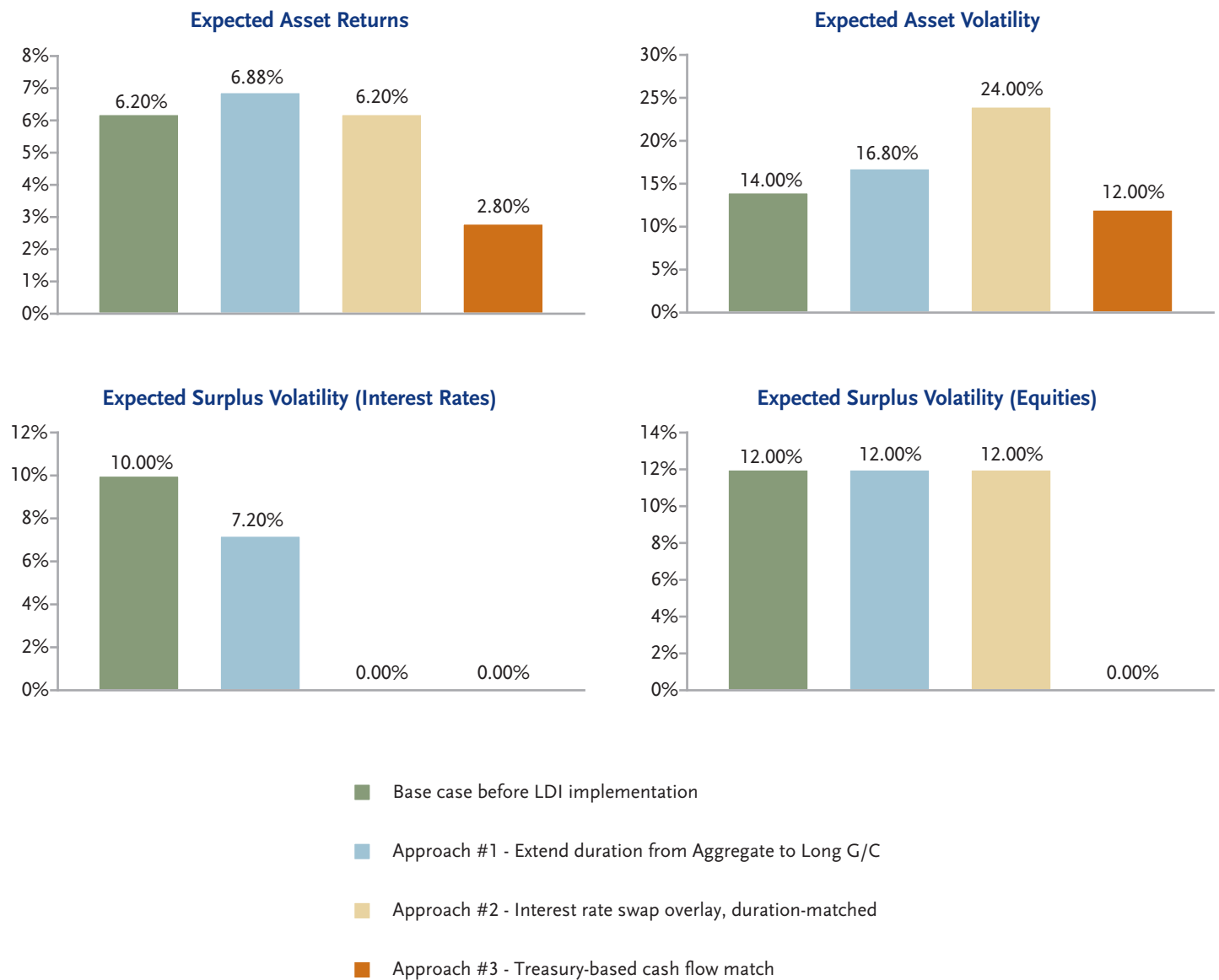
Now consider the following three potential LDI solutions:

Approach #1 - Extend the duration of the fixed income assets. Shift the 40% allocation in Barclays Aggregate (duration of 5) into Barclays Long Govt/Credit (duration of 12)

Approach #2 - Overlay. Leave existing asset allocation in place and purchase \$5.556 million notional of a 30-year interest rate swap. The effect would be to duration match the assets to the liabilities.

Approach #3 - Cash Flow Match. Shift all plan assets into Treasuries such that the coupon and principal payments match the liability cash flows.

The three approaches would have the following effects on the risk/return characteristics of the plan:



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As can be observed in the simplified example, extending the duration of the fixed income portfolio has very modest effects on the expected return and volatility of the plan's assets (increasing expected return by 0.7% and volatility by 2.8%), while decreasing surplus (or funding status) volatility by 2.8%.

A much more dramatic impact is observed in the overlay approach, which does not impact expected returns, but materially alters the expected asset volatility (nearly doubling from 14% to 24%) and expected surplus volatility, effectively eliminating interest rate risk and leaving equity volatility as the main risk to the surplus.

The extreme approach of cash flow matching the assets and the liabilities via shifting all assets into Treasuries has the most pronounced impact on expected asset returns (reducing them from 4.5% to 2.8%), but eliminates all surplus (funded status) risk.

While the third approach is the lowest risk from a funding status standpoint, it is somewhat impractical for most plans given that it would require sizable contributions to bring the funding status to the point where a cash flow match could be implemented.

The overlay approach appears to have the most appeal in terms of maintaining expected return, while significantly reducing interest rate risk. Nonetheless, overlays involve the use of derivatives (often in significant size relative to the overall plan) and still do not necessarily eliminate all forms of interest rate risk.

Hidden Risks in Overlay Strategies

While achieving a duration match to liabilities via an overlay strategy using futures or interest rate swaps is relatively straightforward, this does not ensure that the assets will move identically to the liabilities in response to interest rate movements. The lesser known or potentially "hidden" risks to a duration-match overlay strategy are:

- *Convexity Risk.* Though duration can be at target, durations move as interest rates move (otherwise referred to as convexity) and can result in assets and liabilities changing at a different rate even though they have identical durations. This is more prevalent for very long (30+ year) liability cash flows. While an overlay using standard interest rate swaps can hedge these long cash flows by increased notional exposure of the swaps, it is often challenging to match the high convexity of these long cash flows, which results in the liabilities outperforming the overlay as rates move both up and down. There are techniques to address the convexity mismatch problem, including using Treasury strips, buying options and using zero coupon swaps.
- *Curve Risk.* Again, while an overlay strategy can easily match asset and liability duration, the asset/overlay and liabilities may react differently to changes in the shape of the yield curve (i.e. the difference between short-term and long term interest rates). This can particularly be the case where the underlying bond portfolio is focused on intermediate maturities (e.g. the Barclays Aggregate) and the liabilities are more concentrated in longer maturities. Measuring key-rate or partial durations of the assets versus the liabilities and stress-testing the overlay in a wide range of yield curve environments are necessary to identify yield curve risk. Shifting the maturities of the bond portfolio as well as using different types of interest rate swaps (zero coupon and forward-starting swaps) are often required to manage and minimize curve risk.
- *Basis Risk.* Because liabilities are typically valued using a different discount rate (Aa rated corporate bond rate) than the interest rate used for overlays (Treasury rate or swap rate), there is a risk that overlay rate moves differently than the liabilities rate. The difference between the two rates (Aa corporate rate minus the swap rate) is called the "basis," and overlay strategies are inherently exposed to the risk that the basis changes because there does not exist a derivative instrument that tracks the same basket of corporate bonds used to value the liabilities. This basis risk can be significant, as it was in 2007-2008, when 30-year swap rates fell by 260 basis points, while Aa corporate yields fell by only 23 basis points. For a plan with a 50% overlay and a 12-year liability duration, that amounted to 14% tracking error for its overlay strategy. While there is not a specific instrument or strategy to perfectly eliminate basis risk, there are a few ways to reduce or address the issue: (a) use long corporate bonds as a significant part of the fixed income allocation,

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(b) use credit default swaps (i.e. sell credit protection) to increase the correlation of the overlay to the liabilities, or (c) view the equity allocation as part of the liability hedge (many studies have concluded that equities have spread duration, or basis, of around 8-10 years).

- *Counterparty and Collateral Management Risks.* Interest rate swaps are implemented via an over-the-counter agreement with a counterparty (bank or broker-dealer), using a standardized form of agreement called an ISDA (International Swaps and Derivatives Association). These agreements require the periodic payments of cash to and from the parties agreeing to pay a floating rate (e.g. 3-month LIBOR) and fixed rate (e.g. the 30-year swap rate at the time of the initiation of the agreement). The ISDAs also involve a daily mark-to-market process which requires the counterparties to post collateral in the event the value of the swap moves beyond a predetermined threshold. Thus, a pension plan using derivatives must be prepared to deliver cash as well as eligible collateral (typically Treasury and Agency securities). Depending upon the size of the interest rate swap overlay and the asset allocation of the pension plan, this might require the plan to hold more cash and liquid securities than it otherwise would, which would result in an "opportunity cost" versus the allocation to higher returning assets. Also, despite the collateral posting requirements of most ISDA agreements, there is some counterparty exposure when entering into a swap agreement due to the existence of an uncollateralized threshold amount and the reality that one or two days of market movement can occur without the posting of collateral in the event of a bankruptcy of the counterparty.

LDI: Implementation Issues

LDI duration-matching (immunization) strategies involve the structuring of fixed income assets to directly offset the interest rate sensitivity of its liabilities. Unfortunately, immunization in most cases is not as simple as calculating the duration of the liabilities, buying an asset(s) that matches the duration of the liabilities, then putting the assets and liabilities on auto pilot. Particularly for active pension plans, liability cash flows are not static, and liability market values and durations change over time. Except in rare cases in which the liability cash flows are fixed and relatively short term (less than 30 years), immunization requires on-going management.

The first step to immunizing or partially immunizing the interest rate sensitivity of a pension plan's liabilities is to properly measure the duration and convexity¹ characteristics of the pension liabilities. For active pension plans, the liability cash flows are dynamic and a function of many actuarial and economic assumptions: the number of employees, growth in wages, changes in benefits, the ages that employees choose to retire, the percentage of employees that choose lump sum payments, etc. Actuaries have sufficient data and experience to make assumptions regarding these and other variables to project liability cash flows. A simplistic approach to calculating the interest rate sensitivity of the liabilities would be to calculate the duration of the base case actuarial-derived cash flows. This approach implicitly assumes that the liability cash flows do not change with interest rates. In fact, for most pension plans the liability cash flows do vary with interest rates.

Some of the most common interest rate-related dynamics of liability cash flows are as follows:

1. Interest rate movements → correlate to movements in overall inflation → correlate to movements in wage inflation → imply movements in pension benefit payments
2. Interest rate movements → correlate to movements in overall inflation → imply movements in cost-of-living adjustments (COLAs) → imply movements in pension benefit payments
3. Interest rate movements → result in changes to the present value of lump sum payments to retirees → result in changes to pension benefit payments

To properly account for the interest rate-related dynamic nature of pension liabilities, one must calculate the *effective duration and convexity* by shifting interest rates up and down at various intervals (e.g. 25 basis points), changing the assumptions on the liability cash flows, and calculating the change in present value of the cash flows. From the observed changes in present value, one can impute the effective duration and convexity of the pension liabilities.

¹ Convexity measures the change in duration as interest rates change. Positive convexity implies that the duration increases as rates fall and decreases as rates rise.

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The next step in the immunization strategy is to select a fixed income portfolio combined with interest rate overlay that has the duration, convexity and yield curve characteristics that closely resemble the characteristics of the liability cash flows. There are many different combinations of fixed income assets and overlays that can achieve very similar duration, convexity and curve characteristics to that of the liabilities. Some LDI portfolios will have better liability tracking with lower expected return and some will have worse liability tracking with higher expected return. The degree of basis risk and the ability of LDI portfolios to meet the cash and collateral requirements of the ISDA agreements are important considerations that must be analyzed. TCW MetWest seeks to analyze and stress test a number of potential asset/overlay combinations under a wide variety of interest rate, yield curve and corporate spread environments to illustrate the tradeoffs to various LDI strategies. Ultimately, client risk/return preferences determine the proper LDI strategy, however most clients will favor LDI solutions that accomplish the following objectives:

- Low tracking error versus liabilities in a wide range of interest rate environments
- Sufficient cash reserve to meet the cash flow requirements of the overlay derivatives
- Sufficient liquid collateral (i.e. Treasuries) to meet the collateral posting requirements of the overlay derivatives
- Good total return versus other fixed income/overlay alternatives

Importantly, implementing an LDI strategy does not end with the selection of an asset/overlay portfolio. In fact, liability driven investing in most cases involves an active, dynamic plan. The duration characteristics of the assets and liabilities will change over time due to a variety of factors, including (a) changes to actuarial assumptions for the liabilities, (b) convexity, curve and basis differences between assets and liabilities, and (c) differing returns of the assets and liabilities. TCW MetWest recommends a dynamic approach that involves a monthly or quarterly rebalancing of assets and liabilities, whereby fixed income assets and/or derivative securities are either bought or sold at the end of each period to recalibrate to the original asset-liability matching objective.

Summary / Conclusions

The impact of pension reform and new accounting standards has greatly altered the landscape for U.S. defined benefit pension plans, effectively shifting pension plans from an asset-based perspective to one that focuses more acutely on the size and variability of its funding status. The U.S. pension community has shifted gradually in this direction over the past five years. While many early adopters moved toward near-full immunization strategies implemented via overlay programs in the 2005-2007 time period, the trend toward overlays appears to have slowed down in recent years. Instead, in 2008-2010 more modest duration extension LDI programs have been prevalent. These LDI programs generally involve switching from a Barclays Aggregate Index to a Barclays Long Govt/Credit or Long Credit Index. The reasons for a more modest and measured approach to LDI are likely: (1) the decline in interest rates and fall in the equity market in 2008 (while partially reversed in 2009) decreased the funded status significantly for most plans, (2) the divergent move in swap rates and corporate bond rates in 2008 highlighted the basis risk inherent in overlay strategies, (3) long corporate bonds are understood to have good hedging/tracking characteristics versus liabilities, and (4) interest rates are perceived as being low and likely to rise over the long term.

Should interest rates rise, we are likely to see a much more pronounced shift in LDI strategies toward interest rate overlays, as higher funded ratios and a greater willingness to "lock-in" yields will drive pension plans to more aggressively reduce surplus and balance sheet volatility.

LDI strategies should be implemented with the understanding that pension liability cash flows have interactions with interest rates beyond the simple discounting function that can affect the calculation of the true liability duration. In addition, changing liability assumptions, asset returns, and convexity, curve and basis differences between the assets and liabilities require that LDI strategies involving overlays be dynamically managed and frequently rebalanced.

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