

White Paper

Liability Driven Investments (LDI)

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White Paper

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Executive Summary

- The enactment of the Pension Protection Act of 2006 and the issuance of the Financial Accounting Standards Board Statement No. 158 will force defined benefit pension plans to focus more on managing the funding status of their plans than has been the case in the past. The requirement that funding shortfalls be reflected in corporate balance sheets as early as Dec. 15, 2006, will prompt a review of plan sponsors' approach to managing plan assets.
- Liability driven investment strategies (LDI) will increasingly be utilized to reduce the mismatch between the duration or interest rate sensitivity of a plan's liabilities relative to a plan's assets. LDI strategies are investment strategies that explicitly endeavor to reduce the mismatch between the projected cash flows of a plan's obligations relative to a plan's assets. The focus is on managing the surplus or funding status of the plan.
- The spectrum of LDI strategies range from asset portfolios that totally immunize pension liabilities against interest rate moves, to strategies that merely extend the duration of existing portfolios in order to partially reduce the interest rate sensitivity of the plan surplus. The tradeoff is between reducing plan surplus volatility and upside return potential.
- Our expectation is that plan sponsors will move incrementally to reduce their duration mismatch. Corporations that are sensitive to funding variability and the impact that funding shortfalls will now have on their balance sheets and funding requirements will probably move further toward hedging their duration mismatch than plans that are better funded and have a higher tolerance for funding variability.
- Principal Global Investors offers a broad array of liability-based investment solutions ranging from high quality long-duration bond portfolios to customized asset portfolios that match plan liabilities.



I. Introduction

The confluence of several years of sub-par performance in the stock market, a marked increase in pension liabilities due to the impact of sharply lower interest rates, and the failure of several large pension plans has spurred regulators and legislators to make long overdue changes to the pension regime. According to the U.S. Treasury Department, unfunded pension plan liabilities increased by \$286 billion to \$450 billion between 2001 and 2005.¹ The failure of major pension plans such as United Airlines, U.S. Airways, LTV Steel and Bethlehem Steel resulted in a sharp decline in the net financial position of the Pension Benefit Guarantee Corporation (PBGC) as the PBGC assumed these plan's unfunded liabilities. The collapse of Enron and WorldCom, which enraged the public, compounded the situation by destroying 401(k) savings.

Congress responded and passed the Pension Protection Act of 2006, which President Bush signed into law on Aug. 17, 2006. The new legislation impacts almost every aspect of retirement savings. In tandem with the passage of this new law, the Financial Accounting Standards Board (FASB) completed the first phase of its comprehensive project to improve the accounting and reporting standards governing defined benefit pensions and other postretirement plans with the issuance of FASB 158. The new standards result in significantly more transparency and accuracy in measuring a plan's position and, for the first time, require shortfalls to be reflected in the balance sheet.

In Europe, changes in the regulatory and accounting regime governing retirement benefits are more advanced and even more pressing and have driven many pension plans to radically alter the way they manage pension assets. Under the widely adopted International Accounting Standards and the U.K.'s FRS, assets and liabilities are valued at market rates and reflected in the balance sheet. As a consequence, European plan sponsors are acutely sensitive to mismatches between asset and liability durations and many have moved aggressively to reduce this mismatch.

The new regulatory and accounting regime will increasingly force plan sponsors to reevaluate their focus on total return management of plan assets over a medium- to long-time horizon and force them to concentrate more on managing the surplus (deficit) of the plan. Investment strategies that focus on managing the surplus – the difference between the fair value of plan assets relative to projected plan benefits – are generically referred to as liability driven investments (LDI).

¹Speech by Mark J. Warshawsky, Assistant Secretary, Department of Treasury, European Institute's Sovereign Funds Roundtable, May 17, 2006.

The new regime has effectively compressed the time frame that plan sponsors operate in. Under the previous regime, plan sponsors could take a long-term perspective and be confident that over long periods of time, equities would outperform bonds. Under the old regime, they could afford to focus on higher expected return asset classes and virtually ignore the mismatch between asset and liability durations. Funding shortfalls were only recorded in footnotes to the balance sheet and obfuscated by the treatment of credit balances.² Now, with the compression in smoothing periods for asset and liability valuations and the requirement that funding shortfalls be reflected in the balance sheet on a current basis, plan sponsors will, of necessity, be more sensitive to the mismatch between assets and liabilities and the funding volatility that is generated as a result.

A shift in plan sponsor focus, even by degrees, will necessitate a pronounced change in perspective and strategy. Along the compendium between the current norm of total return management to surplus management, there are many gradations. The transition of funds toward managing the surplus will be driven by many factors. The main factors will be a plan's funding status, the financial health of the company, the corporation's sensitivity to balance sheet volatility and funding shortfalls, the need to maintain specific credit ratings for funding purposes, peer group norms, and the size of the plan relative to the size of the corporation. What is clear, at this juncture, is that there will be a move to hold more fixed income assets and a generalized effort on the part of plan sponsors to extend asset durations to better match plan benefit durations.

II. LDI Defined

The phrase "liability driven investments" is a general term that encompasses a broad range of investment strategies that explicitly reference the liabilities of a plan sponsor. In a gross sense, assets are configured, to some degree, with an eye to matching some of the cash-flow and risk characteristics of the plan liabilities. The prime objective of liability driven investment schemes is to reduce the mismatch between the duration, or interest rate sensitivity, of plan liabilities relative to plan assets. Interest rate risk is critical as it determines the discount rates for valuing liabilities and exerts a dominant impact on changes in the value of plan liabilities. Interest rates also impact asset valuations as they drive fixed income returns and are used as a basis for discounting equity cash flows. Inflation risk is also a factor as future wage obligations are linked directly or indirectly to inflation. Inflationary expectations are embedded in benefit projections as they drive assumed wage and salary increases over time. Other risks,

²Credit balances are created when companies make contributions in excess of statutory required minimums. The flawed rules governing the treatment of credit balances enabled some underfunded plans to institute contribution holidays despite actual deficit positions.

such as unanticipated changes in mortality rates and employee turnover, receive considerably less attention from the perspective of asset management as changes in these components are difficult if not impossible to hedge given available financial instruments.

Liability driven investments imply a focus on the tracking error of asset portfolios relative to plan liabilities. This is a very different construct than the traditional mean-variance framework where plans manage their asset portfolios on a total return basis within predetermined risk parameters. A good example of the difference in the mind set required between the two frameworks is the role of cash and long-duration bonds under the two constructs. Within a mean-variance total return framework, cash is a low-risk asset while long-duration bonds are a risky asset. In an asset-liability management framework, where the focus is on the gap between the two, cash is a risky asset as it has a very low duration relative to the very long duration of the liabilities. Long-duration bonds, however, are a low risk asset as they have a high correlation with long-duration liabilities.

The theoretical framework and justification for focusing on liabilities when managing assets has been around for decades. Insurance companies have been the prime practitioners of this construct. The framework calls for managing the surplus – the difference between the fair market value of the assets and the present value of the plan’s projected benefit obligations. Indeed, in the 1980s, “surplus optimization” was discussed and considered extensively in the pension industry and in some cases implemented.³ However, relatively high interest rates and robust equity market returns eroded the attractiveness of implementing surplus management strategies.

The renewed interest in liability driven investments is a direct result of the economic and financial environment experienced during 2000, 2001 and 2002 and changes in the regulatory and accounting regime. During this period, defined benefit plans and other postretirement benefit plans saw a sharp increase in their liabilities combined with several years of disappointing equity market returns. This resulted in a pronounced increase in the number and magnitude of underfunded benefit plans. These funding shortfalls, and the impending accounting and regulatory changes that will make pension asset and liability valuations more volatile, have prompted a renewed interest in managing a pension plan’s surplus as opposed to the current practice of focusing on managing the total return of the plan’s assets. Déjà vu. We’ve been here before, but lost interest. Now, however, regulatory changes and new accounting rules are likely to hold our interest.

³Martin Liebowitz was a major proponent of “surplus optimization.”

III. Regulatory and Accounting Considerations

The regulatory landscape governing the valuation and accounting for pension plans is changing dramatically in the United States and Europe. These changes are forcing many pension plans to rethink their approach to managing plan assets. Regulatory changes in Europe are more advanced than in the United States and European scheme sponsors have already adopted strategies to reduce the mismatch between assets and liabilities. Now, regulatory and accounting changes in the United States could push U.S. plans to move in that direction.

On Sept. 29, 2006, FASB issued new standards in Statement No. 158 governing the accounting for defined benefit pension and other postretirement plans.⁵ The new standards constitute phase one of the Board's comprehensive review of the treatment of these plans. Employers will be required to fully recognize the obligations associated with single-employer defined benefit pension, retiree health care and other postretirement plans in their financial statements. The new standards are designed to improve financial transparency and the usefulness of the information reported.

Effective Dec. 15, 2006, companies with defined benefit pension and other post-employment benefit plans will be required to reflect their surplus or deficit position as an asset or liability on the balance sheet.⁶ Not-for-profit companies are also required to report. The new standard does not impact the income statement. For fiscal years after Dec. 15, 2008, plan assets and benefit obligations that determine its funding status must be broken out and reported. These new accounting standards will move the surplus (deficit) position from the footnotes to the balance sheet. In some extreme cases, these new accounting requirements may well wipe out shareholder equity. Companies with pension shortfalls will now be forced to explicitly recognize the deficit.⁷

In addition to the changes adopted by the Financial Accounting Standards Board, on Aug. 17, 2006, President Bush signed into law the comprehensive Pension Protection Act of 2006. The new law corrects many flaws in existing legislation and, inter alia, establishes a uniform liability discounting measure

⁵FASB 158 amends FASB 87, 88, 106 and 132R.

⁶For a pension plan, the surplus or deficit is measured as the difference between the fair value of plan assets (FVPA) less the projected benefit obligation (PBO). The PBO is the present value of the future benefits due to current retirees and the projected benefit rights of current employees based on their expected retirement date and final salary level. The discount rate to be used is to be determined by reference to returns on high-quality fixed income securities. (Unlike the Pension Protection Act, which references AAA-A corporate bonds, no specific quality or sector is referenced for discounting liabilities under FASB 158.) For any other postretirement benefit plan, the benefit obligation is the accumulated postretirement benefit obligation. Other post retirement benefit plans (OPEB) are generally unfunded as contributions are not required under ERISA and garner limited tax advantages.

⁷Credit rating agencies are already factoring in pension deficits when setting ratings.

based on a segmented corporate yield curve, reduces the time frame for asset and liability smoothing, requires deficits to be eliminated over seven years (some airlines excepted), and restricts the use of credit balances. Overall, the legislation should significantly improve pension fund asset and liability management and the viability of the pension system going forward.

Regulatory and Accounting Drivers of LDI Strategies

Financial Accounting Standards Board (FASB) Statement No. 158

- Defined benefit pension plan funding shortfalls must be reflected directly on company balance sheets

Pension Protection Act of 2006

- Funding requirements increased to 100%
- Seven year funding shortfall catch-up
- Asset and liability valuation smoothing reduced from five years to two years
- Valuations constrained to fall within 90% to 110% of valuations on the financial statement date
- Liabilities grouped and discounted using a segmented, high quality corporate yield curve

From an asset-liability management perspective, the most important feature of the new law is the prescribed methodology for discounting benefits and the new smoothing rules. For plan years beginning in 2006 and 2007, the new law provide for an extension of the interim discount rate calculations used for plan years 2004 and 2005.⁸ This requires the use of a four-year weighted average⁹ composite blend of three dealer-compiled¹⁰ long AAA-A corporate bond rate indices for discounting pension liabilities. The permissible range for the discount rate selected must fall within a corridor of 90% to 110% of the weighted average.

Beginning in 2008, corporate pension liabilities are to be grouped into three segments for discounting. The segments are: 0-5 years; 5-20 years; and benefits payable beyond 20 years. The discount rates are to be determined by referencing an AAA-A corporate yield curve segmented over the same three time periods and then averaged over two years.¹¹ The discount rates for each segment will be paired with the liability segments for discounting. The Treasury Department will determine

⁸The interim rate calculations were established under the Pension Funding Equity Act of 2004 (PFEA 2004).

⁹The weights used for smoothing purposes are 40%, 30%, 20%, and 10%, respectively, starting with the most recent year in the four-year period.

¹⁰Two or more dealers are periodically selected by the Secretary of the Treasury. Currently, there are three dealers: Merrill Lynch, Citigroup and Lehman.

¹¹Solely for purposes of determining minimum required contributions, plan sponsors may elect not to smooth the applicable interest rates.

the methodology for constructing the curve and publish the rates monthly.¹² The new methodology will be phased in beginning in 2008. The phase-in period will last for three years and will proceed in 33 1/3% increments.¹³

On the asset side of the ledger, assets are to be valued at fair market value as of the date all other corporate obligations are valued. This eliminates the lags previously permitted. The maximum asset averaging period is reduced from five years to two years and requires that the value lie between 90% and 110% of the market value.¹⁴ The shorter averaging period, combined with the narrower corridor, will result in greater volatility in plan assets valuations and funding requirements.

Plans are expected to be 100% funded by 2011 and plan sponsors are explicitly liable for funding.¹⁵ Transition relief is provided for 2008, 2009 and 2010. After that, plans are required to amortize funding shortfalls over seven years in level installments. In general, plans that fail to attain at least 80% funding in any prior year will be classified as "at-risk" and subject to special catch-up requirements. For plans that have been at risk for more than two years, special load factors are imposed. Underfunded plans will be subject to a variable Pension Benefit Guarantee premium penalty.¹⁶

In totality, the new regulatory environment and changes in accounting standards will erode the attractiveness of total return approaches in favor of strategies more cognizant of and focused on a plan's surplus position. The ongoing provision for smoothing both asset and liability valuations will, however, argue against any form of tight portfolio immunization.

Public funds are not impacted by the new regulatory regime since they are not subject to IRS/ERISA rules or FASB. They are not forced to mark-to-market their assets or liabilities and their actuarial assumptions change very gradually. Nevertheless, underfunded plans are increasingly coming under pressure and scrutiny. The funding status of some of the very large, highly visible public plans has become a significant political issue, which may well induce a move to reduce the mismatch between assets and liabilities.

In Europe, the accounting and regulatory regime is not dissimilar to the new regime promulgated in the United States. Under International Accounting Standards, (IAS 19),¹⁷ which are applied across the European Union, assets are valued at fair value at the balance sheet date and defined benefit scheme

¹²The yield curve is to reflect the average of the rates on all bonds.

¹³Phase-in will be complete in 2010.

¹⁴Previously the range was between 80% to 120%.

¹⁵The previous level of target funding was 90%.

¹⁶The Pension Benefit Guarantee Premiums rise from \$19 per participant to \$30 under the new law.

¹⁷IAS 19 is part of the International Financial Reporting Standards introduced in the EU in 2005.

liabilities are discounted using market yields on high quality corporate bonds, again, at the balance sheet date. The difference between the two is recognized in the balance sheet.¹⁸ Because liabilities are priced currently using market interest rates, they are extremely sensitive to changes in interest rates.

Accounting rules in the United Kingdom are similar. The rules in FRS 17 call for the valuation of plan liabilities referencing the rate on high quality corporate bonds with terms similar to the scheme liabilities.¹⁹ Assets in the scheme are measured at their fair value at the balance sheet date. The surplus or deficit is recognized by the company on the balance sheet. In the Netherlands, explicit rules for capital adequacy are being introduced with the new Financieel Toetsingskader (FTK) regulation that becomes effective in 2007. These rules require that the probability of the funding ratio falling below 105% over a one-year horizon be less than 2.5%. This has forced Dutch plans to be acutely aware of funding risk. In Japan, pension liabilities have been reported as a debt obligation of the plan sponsor since 2000.

IV. Total Return vs. Surplus Management

Historically, plan sponsors have worked with their actuaries and consultants to conduct a comprehensive asset-liability study and then decided on an appropriate asset mix to meet their long-term return objectives subject to pre-defined risk tolerances. The focus has been on long-term returns with portfolios constructed in a mean-variance framework. In this framework, risk is defined as the standard deviation of investment returns.

Surplus management focuses on managing the difference between plan assets and plan liabilities. As the focus is on managing the difference between the net present value of projected benefit obligations less the fair market value of plan assets, duration plays a dominant role. The risk measure is surplus tracking error and long-duration bonds become more important.

Under the total return framework, asset allocation for a typical pension plan centers on 65% equities, 30% bonds and 5% cash and other assets. Moreover, as equities generate a stream of cash flows out into the future, they are generally considered long duration assets. As such, they are assumed to be sensitive to changes in interest rates. Other factors, however, can at times swamp their sensitivity to interest rates. This was the case in 2000, 2001 and 2002. Equities were significantly overvalued going

¹⁸Actuarial gains and losses due to changes in actuarial assumptions can be recognized in full in the period in which they occur or spread out over the service lives of the employees. The option of reflecting these in full in the period in which they occur is consistent with the approach taken in FRS 17.

¹⁹Under FRS 17, the risk premium embedded in high quality corporate bonds is assumed to reflect the option of the scheme sponsor to reduce the assumed scheme liabilities, including the option to shut the scheme down. FRS calls for the use of market determined inflationary expectations to be built into the inflation component of the liability profile and suggests using break-even inflation rates implied in long-dated inflation-linked bonds relative to bonds with similar terms.

into the technology, media and telecommunications market correction. As a result, sharply falling interest rates over the next three years were not sufficient to generate positive equity market returns as might have been expected. The equity market’s sensitivity to interest rates was swamped by valuation considerations.

Consequently, the large exposure to equities in most defined benefit plans created a significant gap between the duration of plan liabilities relative to plan assets during this period. This was compounded by the fact that the fixed income portion of most plans was managed against the Lehman Aggregate Index or a similar benchmark with a duration under five years, compared to plan liability durations of 12 to 14 years.

Consider a typical plan’s interest rate risk assuming a similar situation where the equities in the portfolio do not respond to changes in interest rates or have a muted response.

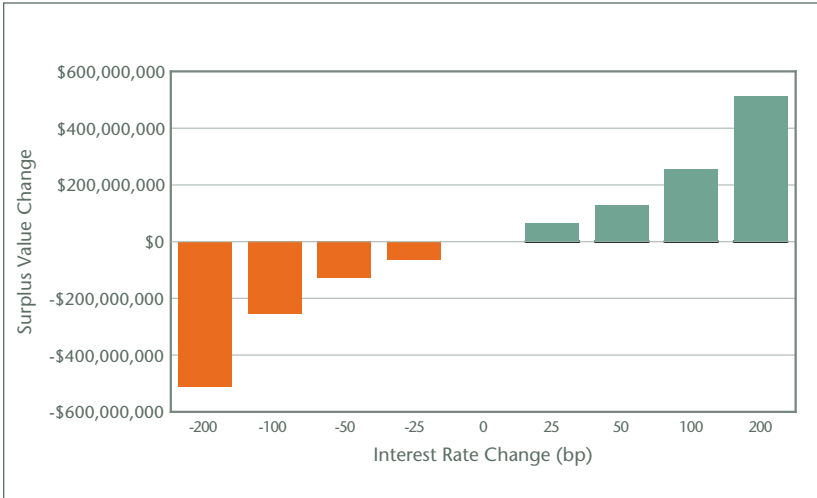
Example assumptions:

- Plan liabilities of \$2.5 billion
- Plan assets of \$2.5 billion
- Liability duration of 12.1 years
- Bond portfolio of \$1 billion or 40% of the portfolio
- Bond portfolio duration of 4.7 years

By computing the dollar duration of plan liabilities and plan assets, we can ascertain the dollar impact on the portfolio of changes in interest rates assuming other factors are held constant.

- Liability dollar duration: $(\$2.5 \text{ billion}) * (100.0 \%) * 12.1 = \30.25 billion
- Asset dollar duration: $(\$2.5 \text{ billion}) * (40.0\%) * (4.7) = \4.7 billion

Exhibit 1: \$2.5 Billion Defined Benefit Plan’s Exposure to Interest Rate Risk



Source: Principal Global Investors

Under this example, if interest rates fall by 100 basis points (bp), the plan's funding status will deteriorate by \$255.5 million, assuming equities do not respond to the move in interest rates or their response is offset by other factors as was the case in 2000 to 2002. Under most market conditions, this example overstates the risk as equities generally have a positive, albeit, less than perfect correlation with bonds and, as such, would offset some of this risk.

Some LDI advocates would argue that taking duration mismatch risk is uncompensated risk and that there is no expected payoff from taking this risk. In a strict duration context, this is true, but in a broader portfolio context this is considerably less straightforward. Some would argue that the risk is compensated to an extent since most plans that accept the duration mismatch do so for the explicit purpose of gaining exposure to equities and other assets with higher expected returns than bonds. Plans that wish to maintain their current exposure to other asset classes while reducing their duration risk are likely to convert their bond portfolios to long-duration bond portfolios or add a derivatives overlay to extend duration, or both.

V. Spectrum of Liability Driven Solutions

Liability driven investment solutions can vary extensively in the percent of the plan covered and the precision of the liability hedging or matching. At one extreme is a totally immunized portfolio where, as the name suggests, the portfolio is completely immunized against interest rate risk.²⁰ Another key element that is often explicitly managed is inflation risk. Inflation risk is important to manage as changes in inflationary expectations can alter wage and salary growth expectations embedded in actuarial projections.²¹ Inflation risk may be hedged in a cost-effective manner through the use of inflation linked bonds and inflation swaps.²² Despite the ability to precisely hedge interest and inflationary risk, a precise matching solution might not always be justified given the uncertainty

²⁰A dedicated portfolio, which is a subset of immunized portfolios, would match the cash flows of the projected benefit obligations and would provide a precise hedge of the liabilities of the plan.

²¹Changes in inflationary expectation impact projected benefit liabilities and the discount rate for determining the present value of liabilities. An increase in inflationary expectations will adversely impact actuarial assumptions regarding projected wage and salary growth and thus increase projected liabilities. However, other things being equal, it will also increase the discount rate via an increase in corporate bond yields and result in an overall decline in the present value of projected plan liabilities. Conversely, a decline in inflationary expectations will reduce projected wage and salary growth, but also will reduce the discount rate and increase the present value of overall plan liabilities. Thus, to some degree, the impacts of changes in inflationary expectation on liability valuations are offsetting.

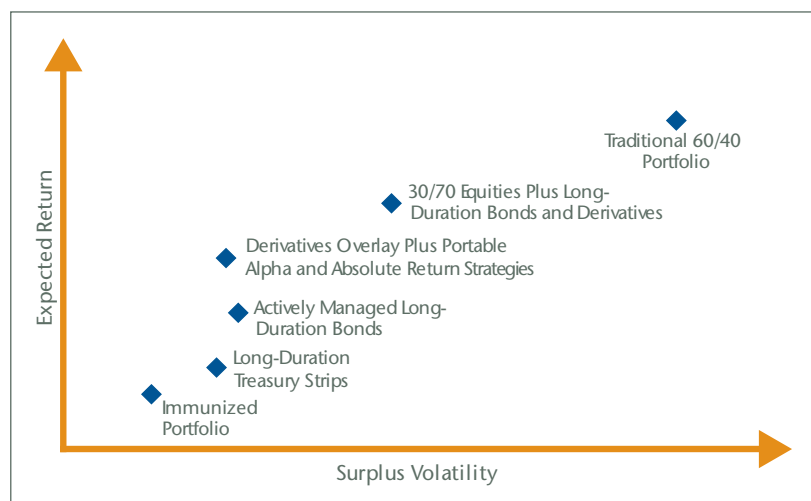
²²When decomposing projected pension benefit cash flows to construct an asset portfolio that precisely matches the liabilities, it is important to recognize that changes in inflationary expectations affect near-term years, but become less of an issue in far out years. This is because of a plan's employee retirement profile. Typically, once an employee retires, benefits are paid on a nominal basis going forward. Thus inflation is only a consideration for benefit projections up until the time the employee retires. For employees that have already retired, inflation does not factor into any hedge unless the pension is indexed to CPI. Inflation risk embedded in the early years of a plan's liabilities can easily be hedged using available TIPS (readily available out to 20 years as 30 year TIPS are no longer being issued), and inflation swaps that are liquid out to 10 years.

inherent in benefit liability estimation and the reduction in long-term expected returns. Subsequent actuarial adjustments may also materially alter the validity of the hedge and result in additional unanticipated costs to adjust the hedge. In addition, the ongoing smoothing of asset and liability valuations provided for under the Pension Protection Act argues for a looser construct.

It is safe to assert that most U.S. pension plans will not contemplate precise, total liability matching as this would necessitate moving the portfolio to predominantly fixed income assets with a very large holding in long-duration U.S. Treasury securities²³ or the extensive use of derivatives to extend duration. A move such as this would constitute a major departure from commonly accepted practices and position the plan far from peer group allocations. Indeed, the only plans that might consider a precise liability match would be either a plan that is extremely risk averse with respect to balance sheet volatility or a plan that is fully funded that wants to lock in its funding position. It is interesting to note that Dutch pension plans are keenly interested in LDI strategies as they are largely fully funded and face stringent solvency requirements.

Somewhere between the extreme of a fully immunized portfolio to a portfolio with a dominance of equities in the asset mix lie many incremental portfolio configurations that can be constructed to meet a plan's desire to reduce surplus or funding volatility while at the same time reflecting the plan's desire to add value in the higher expected return asset categories. A plan's risk appetite will, in turn be determined by corporate level considerations, the first and foremost of which will be the perspective of management regarding swings in the balance sheet.

Exhibit 2: Alpha Preservation in the LDI Framework



Source: Principal Global Investors

²³Primarily STRIPS.

An interim first step for many plans will undoubtedly be to allocate a portion of their bond portfolio to a long-duration strategy to lengthen the duration of their fixed income allocation. This will constitute a partial move to reduce the mismatch between the duration of plan liabilities and plan assets. The reference framework for many plans will probably remain total return optimization with long-duration bonds added to the asset mix.

It is also likely that some plans will wish to trial a portion of plan assets in a precise asset-liability match. The attraction of this approach is that it will enable the plan to gain experience in managing the tracking error between plan liabilities and the matched asset portfolio. Under this approach, the plan sponsor will gain first hand experience with the sensitivities and unforeseen risks inherent in a precise hedge of estimated liabilities.

Derivatives overlay strategies can be very attractive provided plan governance permits their usage. The major attraction of a derivatives overlay strategy is that it can be implemented without radically disturbing underlying portfolios. This will be very attractive for multi-manager situations. The prime objective of most derivatives overlays in an LDI framework is to extend the duration of plan assets.²⁴ Often, a secondary objective is to provide inflation protection. There are many advantages to using derivatives to reduce the mismatch between plan liabilities and plan assets. First and foremost is efficiency. The interest rate derivatives market is deep, liquid, and highly efficient and has performed well during periods of financial market stress. Derivatives, such as futures, interest rate swaps, options and swaptions, provide an efficient mechanism for extending asset duration and hedging inflation risk. Derivatives are also very cost effective and allow for a high degree of precision when implementing a liability driven investment strategy.

A shift in focus toward reducing surplus volatility does not necessitate abandoning asset classes traditionally included in a plan's portfolio.²⁵ Active management across a diverse range of asset classes will remain alive and well in a liability driven investment framework. What may occur is an increased focus on absolute return and portable alpha strategies. Portable alpha and absolute return strategies will be particularly attractive to plans that move aggressively to hedge their liabilities with long-dated derivatives. These strategies can be ported to the LDI strategy without adding beta risk or undermining the precision of the liability match.

In light of the new regulatory and accounting changes, our expectation is that most plan sponsors will incrementally move to reduce the tracking error between their benefit obligations and their plan assets. Early incremental steps will undoubtedly focus on adding long-duration bond portfolios to the asset mix or transitioning existing portfolios to longer duration portfolios.

²⁴This is generally implemented using interest rate swaps and, or, Treasury futures.

²⁵Surplus volatility can be measured using tracking error volatility (TEV), which is defined as the projected standard deviation of the monthly return differential between projected plan liabilities and the value of plan assets.

VI. Practical Considerations

Asset/Liability Modeling

Asset and liability modeling will remain the domain of plan sponsors and their consultants who will need to balance the demands of surplus management with asset only optimization. Once a plan has determined its overall perspective and the specific strategy it wants to pursue, then asset managers such as Principal Global Investors can work with the plan, or the plan’s consultant, to design liability driven strategies that facilitate the achievement of the plan’s goals.

Timing

To an extent, the adoption of LDI strategies will be driven by the economic environment and expectations about the environment ahead. The dominant consideration will be the expected trajectory of rates on high quality corporate debt as these rates are used to discount plan liabilities. Low interest rates translate into low discount rates and magnify liability valuations while high rates significantly reduce the net present value of plan liabilities. As such a low interest rate environment, such as we are currently experiencing, might not appear to be an ideal time to begin moving assets toward an LDI framework, but plan sponsors must realistically assess their ability to forecast interest rates and their ability to time such a move.

Exhibit 3: Historical AA Corporate Yields (January 1990 to October 2006)



Source: Citigroup

One need only remember the failure of many experienced asset managers to correctly anticipate and position for the move to the zero interest rate environment that Japan experienced to question the ability of practitioners to time any move. Indeed, many would argue that we have moved to a low rate environment for the foreseeable future given inflation targeting by central banks, extensive globalization and the resultant pressure on costs, and global liquidity driven by high savings rates in countries such as Japan and China. In fact, interest rates are currently considerably higher in the United States than many other major financial markets. Despite the risk inherent in trying to time any move to reduce the asset-liability mismatch, some underfunded plans will be loath to lock in liabilities at current rates. For those not inclined to try to time the move to LDI strategies, a phased, incremental approach will undoubtedly have appeal.

Benchmarks

Benchmarking is an important consideration as plan sponsors adopt liability driven strategies. The benchmark selected will not only provide a metric for modeling and evaluating the manager, but it will also establish many of the parameters that will drive manager behavior. The benchmark will influence the composition of the portfolio as manager constraints will be dictated by the benchmark. Increasingly, there are established long-duration benchmarks available that can be selected in an off-the-shelf basis. A few of the major indices are presented below:

Exhibit 4: Long Duration Bond Indices

Benchmark	Duration*
Citigroup Large Pension Fund Index	7.8
Citigroup Pension Fund 10+	11.5
Lehman Long Government/Credit Index	10.9
Lehman Long Credit Index	11.3
Lehman Treasury 20+ Year Index	13.1

*Modified Durations as of Nov. 15, 2006
 Source: Lehman Live and Citigroup

There are also some LDI benchmarks that have been established by the major index providers. Hybrid and customized benchmarks can also be designed to increase the precision of the assignment. Customized benchmarks can be designed by Principal Global Investors based on client input that will reflect client objectives and the specific liability profile of the plan. Additionally, we have worked with index providers to establish customized benchmarks, thus providing an objective third party maintained benchmark.

Leverage

Some liability driven investment strategies that focus on surplus management entail some form of leverage. This is particularly true for strategies that attempt to eliminate a substantial portion of the interest rate risk, while at the same time preserving meaningful exposure to equities and other high expected return assets. Leverage is a sensitive issue for many corporate treasurers and pension plan trustees. Indeed, many plans have explicit strictures against any form of leverage.

What is leverage? The answer seems obvious, but at times there are subtleties that are quite complex. One way to think of leverage is market exposure. If market exposure is greater than one, the plan is levered. This approach provides a good common sense working definition and is the definition that many plan sponsors employ. Thus, for example from a leverage perspective, a plan would be indifferent to having 100% of plan assets exposed to a portfolio that mimics the Lehman Aggregate vs. having 100% of plan assets exposed to a portfolio that mimics the Lehman Long Government/Corporate index, even though the duration of the Lehman Long Government/Corporate index is twice the duration of the Lehman Aggregate. Market exposure is the same although the interest rate sensitivity of the two portfolios is markedly different.

One way to think through the issue of leverage is to consider some hypothetical examples of LDI strategies. All of the examples assume a plan size of \$100 million.

1. Standard Widgets, Inc. has reviewed its defined benefit plan's strategic asset allocation and decided to reduce its asset and liability duration mismatch. It has decided to keep \$70 million, or 70% of plan assets, invested in the current configuration of 65/30/5. That is, Standard Widgets will keep \$45.5 million in equities, \$21 million in medium-term bonds and \$3.5 million in cash. To extend duration and mitigate duration risk the company purchases \$30 million in notional exposure to 30-year U.S. Treasury bond futures and holds \$30 million in cash/money market instruments to fund the futures position.²⁶ The plan is not levered. Total market exposure adds up to 100% of the value of the plan.
2. Creative Widgets, Inc.'s defined benefit plan also wants to reduce the duration mismatch risk, but does not want to give up the higher earnings potential of equities. The firm decides to keep 50% of the plan invested in equities and invest the remaining \$50 million in three commingled fixed income funds that are designed to match the segmented liability bundling and discounting approach mandated by the Pension Protection Act.²⁷ The three commingled funds are each levered

²⁶The cash plus the futures contracts creates the economic equivalent of \$30 million dollars worth of Treasury bond exposure.

²⁷See Section III, Regulatory and Accounting Considerations.

two times and the fund strategies are implemented using interest rate swaps. By investing \$50 million in the three funds that are each levered two times, the plan effectively has \$100 million in fixed income market exposure. When combined with the \$50 million exposed to equities, the plan has an effective market exposure of \$150 million. In this instance, the plan has 50% leverage because of the leverage embedded in the fixed income commingled funds. This is the case even though the plan has only invested \$50 million in the three fixed income funds. It is market exposure that is the determining factor.

3. Wall Street Wizards, Inc.'s pension plan has an aggressive allocation of \$70.0 million in equities, \$10.0 million in a bond portfolio managed against the Lehman Aggregate (duration around five years), and \$20 million in absolute return strategies of which \$15.0 million is in long-short market neutral strategies. The company decided to increase the overall plan duration by entering into \$25 million worth of long-duration zero coupon swaps. Is the plan levered? Probably. One could argue that the \$15 million in market neutral hedge fund strategies do not constitute market exposure as they are designed to generate LIBOR plus an increment so they are a cash proxy for backing \$15 million worth of the long-duration, zero coupon swaps. Unfortunately, however, they target LIBOR plus an increment, but the achievement of a LIBOR return is not assured. Thus one must be cautious when using these investments as cash proxies. Many practitioners, however, do treat these as cash proxies. Additionally, the bond portfolio managed against the Lehman Aggregate obviously has some cash and short-duration instruments that can be used to fund a portion of the long-duration swaps, but not the required \$10 million necessary to cover the remaining portion of the swaps. The position is levered.

Concerned about leverage, Wall Street Wizards decides to modify its strategy further and convert the bond portfolio to an absolute return strategy by buying a \$10 million total return Lehman Aggregate swap against the bond portfolio. This converts \$10 million to LIBOR. The company uses the total return swap rather than converting the bond portfolio to cash so that it preserves the alpha generated by the bond manager. Most market practitioners would treat the hedged \$10 million as synthetic cash as the swap generates a LIBOR return. However, because the bond portfolio is actively managed, LIBOR is not assured even though Wall Street Wizards receives LIBOR on the swap. This is because the bond manager may underperform the Lehman Aggregate and erode the swap return. Nevertheless, most practitioners would treat the hedged bond portfolio as a cash proxy.

Presumably, the prohibition most plan sponsors have against employing leverage is driven by risk considerations. Ironically, employing leverage in an asset-liability management framework may, in fact, reduce surplus variability, and thus, by implication, reduce plan sponsor risk. Clearly, many plan

sponsors who do not currently permit leverage will be reconsidering this issue to decide if there are circumstances when leverage may indeed be appropriate. Leverage is inherently a risk measure and needs to be evaluated in the context of the entire portfolio configuration.

One of the arguments against employing LDI is that using the strategy necessitates giving up higher long-term expected returns. Converting the bond portion of plan assets to long-duration portfolios will permit many plans to reduce their duration gap while preserving the long-term return outperformance expected from equities. Plans that permit the use of derivatives and leverage strives to eliminate their duration gap and preserve higher long-term expected returns.

In reality, many plan sponsors accept very high levels of leverage embedded in absolute return strategies offered by hedge funds. The consequence of this leverage was clearly manifest in the spectacular demise of Long Term Capital, the hedge fund that got caught on the wrong side of the credit spread blow-out of August and September 1998.

The use of leverage can be entirely appropriate but needs to be evaluated in the context of the risk of the entire asset portfolio and its relationship to the liabilities that these assets are earmarked to fund.

VII. Solutions

There are an array of solutions that can be crafted and utilized to meet the liability risk considerations of plan sponsors. Principal Global Investors offers the full spectrum of liability driven investment solutions for clients. These solutions range from high quality long-duration bond portfolios to sophisticated derivative overlay strategies. Our LDI capabilities include: immunization, duration extending, customized precise liability matching and derivatives overlay and portable alpha strategies.

Long-Duration Bond Portfolios

Clients that have predetermined that they want to extend the duration of their portfolios by hiring a long-duration bond manager can avail themselves of our extensive expertise in managing long-duration bonds. These portfolios can be managed against an established market-based benchmark or a custom benchmark determined by the client and Principal Global Investors. We have assisted clients in efficiently transitioning existing bond portfolios to long-duration portfolios. We can also match a specific duration target and then add value with a best ideas portfolio using the complete spectrum of fixed income investment opportunities.

Customized Solutions and Precise Liability Matching

Principal Global Investors provides customized LDI solutions that can precisely match pension plan liabilities. Our approach is to model the risk factors of the plan liabilities and to then design a custom solution that will be optimized against key risk factors. The greater the degree of specificity that a plan provides in terms of cash flow timing and the composition of cash flows, the more precise the asset portfolio can be. An active portfolio will then be managed relative to the liability matching portfolio with Principal Global Investors using our full range of alpha generating capabilities.

Principal Global Investors uses the following approach to design precise liability driven investment solutions for clients:

- We begin by working with the client to establish the liability cash flow profile and determine the sensitivity of the liabilities to changes in the level of interest rates, changes in the yield curve, changes in inflationary expectations, and changes in spreads.²⁸ In effect, we model the liabilities as a bond and analyze the risk factors using the same modeling technology that we utilize in our day-to-day portfolio management.
- With the risk factors specified, a portfolio of securities is optimized that match the risk profile of the client's liabilities. (The precision of the match will be driven, to a large extent, by the flexibility allowed in the client guidelines.)²⁹ The objective is to minimizing valuation variability between the liabilities and the customized liability matching portfolio.
- Using scenario analysis, we then stress test the customized liability matching portfolio under different interest rate scenarios to ensure a robust match and adjust as appropriate.
- The liability matching portfolio effectively becomes the benchmark.³⁰
- We then manage an active portfolio against the custom benchmark. The active portfolio would incorporate the full spectrum of alpha generating capabilities that our LDI portfolio managers typically use to add value within prescribed risk parameters.³¹

²⁸It is important to measure and manage spread risk as plan liabilities are discounted using rates on high quality corporate bonds. It is also important to deal with changes in inflationary expectations as significant changes will impact actuarial estimates of terminal wages and salaries. Inflation sensitive liability cash flows can either be broken out as a separate portfolio or hedged within the overall matching portfolio. TIPS and inflation linked swaps are utilized to hedge inflation risk.

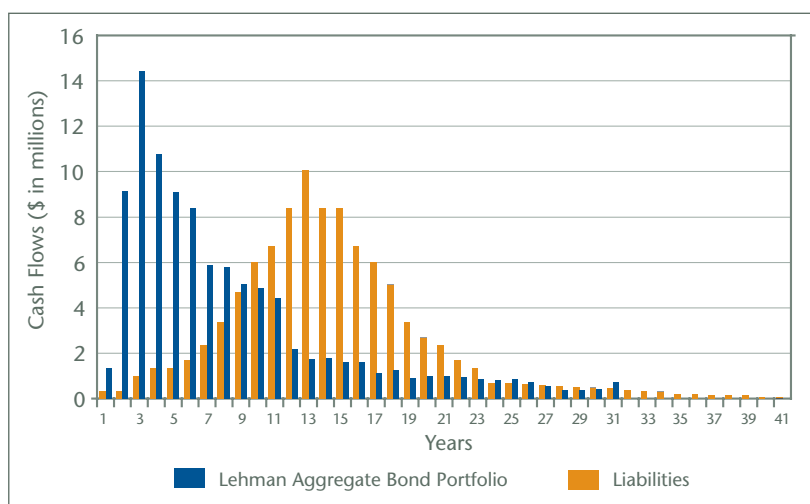
²⁹Our approach is to use key-rate duration segments and then optimize on partial durations to craft a precise duration match.

³⁰Index providers such as Lehman can be employed to maintain this custom benchmark, thus, establishing a third party to update and monitor the benchmark.

³¹In this case, risk is specified as tracking error relative to the customized benchmark. For the plan sponsor, this becomes the tracking error of assets relative to projected benefit obligations, which enables the client to manage the volatility of the plan's surplus.

Consider a liability driven investment solution in the context of a typical defined benefit plan. Exhibit 5 presents the liability cash flows of a typical plan matched against the cash flows of the Lehman Aggregate Index, which is a good proxy for the typical fixed income allocation of a defined benefit plan. Note the pronounced mismatch between the cash flows generated from the Lehman Aggregate and plan liabilities.³² In this example, the liabilities extend out for 41 years and have a duration of 12.1 years, while the plan’s bond portfolio possesses a duration of only 4.7 years.

Exhibit 5: Typical Pension Plan Liability Cash Flows Matched Against the Cash Flows of the Lehman Aggregate Bond Index



Source: Principal Global Investors and Citigroup Yieldbook

Next, consider what happens to the assets and liabilities under different interest rate scenarios over a one-year time horizon (see Exhibit 6). Note first that the assets in the portfolio generate income over the year of 4.83%, while the liabilities generate a gain of 4.60% due to the roll-off or amortization of one year worth of liabilities and a shortening of the term by one year. (This example ignores current year funding and current-year payouts.) Next, consider what happens when interest rates change. If interest rates decline by 100 bp, the value of the liabilities increases by 16.41%, but the value of the assets in the bond portfolio increases by only 7.91%. The gap is 8.5%. The increase in the value of the liabilities is due to the application of a lower discount rate and a one year roll-off, while the increase in the assets is attributable to capital gains and income.

In a rising rate environment, an increase in interest rates of 100 bp results in a decline in the present value of the liabilities by 6.25%, again, due to the change in the discount rate and a one year run-off, while the value of the assets increases by 1.34%. The return on the bond portfolio is positive even

³²Cash flows generated from the investment portfolio include coupon/interest payments, repayment of principal, and reinvestment of periodic interest payments.

though interest rates have increased as capital losses in the bond portfolio are offset by the income generated by the portfolio. In this case, the plan sponsor is better off by 7.59%.

Shifts in the shape of the yield curve also reflect the mismatch between the assets and liabilities. Take, for example, the case of a flattening yield curve where long rates decline by 100 bp while short term rates remain fairly stable (bull flattening). Under this scenario, the present value of plan liabilities increases by 17.62%, while offsetting assets increase by only 7.79%.

Exhibit 6: Asset and Liability Scenario Analysis: Typical Pension Plan Liabilities vs. a Lehman Aggregate Bond Portfolio

Asset & Liability Scenario Analysis³³			
Scenario	Liabilities	Lehman Aggregate	Difference
Bear Steepening	—7.39	1.40	8.79
Bear Flattening	—5.16	0.84	5.99
+100 bp	—6.25	1.34	7.59
Bull Flattening	17.62	7.79	—9.83
Bull Steepening	15.33	8.30	—7.03
—100 bp	16.41	7.91	—8.50
No Change	4.60	4.83	0.23

Source: Principal Global Investors and Citigroup Yieldbook

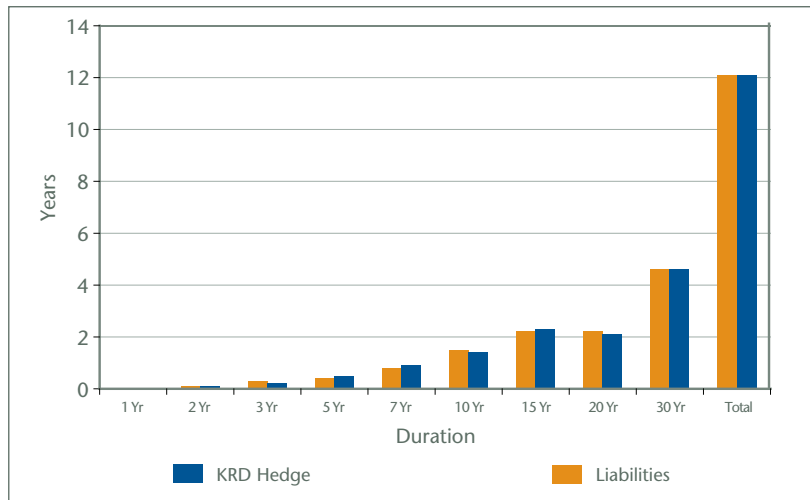
The poor offset provided by the Lehman Aggregate bond portfolio is to be expected given the mismatch between the durations of the two portfolios and the mismatch between the distributions of cash flows. A typical pension plan’s bond portfolio provides a very poor hedge against adverse interest rate moves from the perspective of managing a plan’s interest rate risk.

Now, take the same liability cash flows matched against a portfolio of zero coupon Treasury securities. In this case, the asset portfolio is simply optimized to match the partial or keyrate durations (KRD) of the liabilities while allowing for cash flow mismatches. Partial durations were centered on one, two, three, five, 10, 15, 20 and 30 years.³⁴ (See Exhibit 7)

³³Total rate of return analysis over a one-year time horizon. Yield curve shifts are hypothetical based on possible scenarios projected over the course of one year. Shift magnitudes are not uniform across the curve.

³⁴Partial duration matches were constrained so that any bond allocation was at least \$1 million to provide for reasonable trade size.

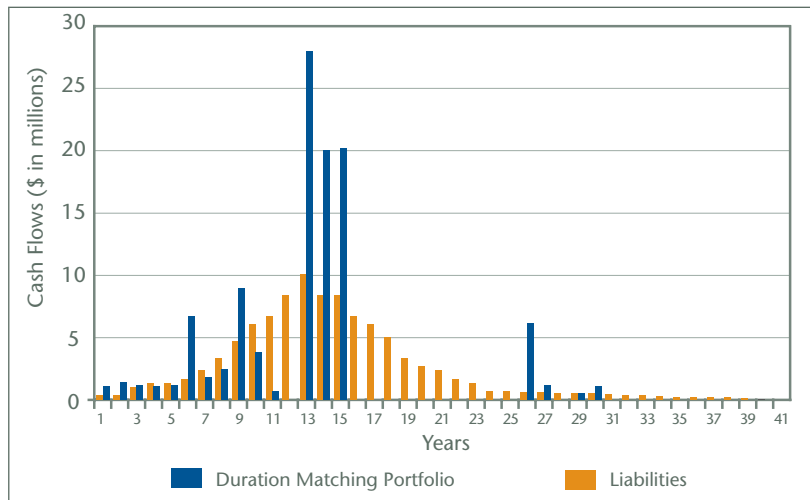
Exhibit 7: Key Rate Durations Optimized



Source: Principal Global Investors and Citigroup Yieldbook

The cash flow mismatches remain pronounced (see Exhibit 8), but the sensitivity of the portfolio to changes in interest rates now more closely matches the impact rate changes have on the plan's liabilities (see Exhibit 9).

Exhibit 8: Duration Matched Pension Plan Liabilities



Source: Principal Global Investors and Citigroup Yieldbook

Once again, note the income and liability roll-off in a static rate environment. The liabilities amortize at a 4.66% rate over the year while the running yield on the duration matching portfolio is 5.27%. As is evident in the table, changes in interest rates have a similar impact on the present value of liabilities and on assets. Additionally, non-parallel shifts in the yield curve are fairly well matched. Consider, for example, a steepening of the yield curve (bull steepening). Liabilities increase in value by 15.92% while the assets increase by 16.28%.

Exhibit 9: Asset and Liability Scenario Analysis: Typical Pension Plan Liabilities vs. a Customized Duration Matched Portfolio

Asset & Liability Scenario Analysis			
Scenario	Liabilities	Duration Matching Portfolio	Difference
Bear Steepening	—7.26	—6.64	0.62
Bear Flattening	—5.08	—4.26	0.82
+100 bp	—6.15	—5.43	0.72
Bull Flattening	18.42	18.97	0.55
Bull Steepening	15.92	16.28	0.36
—100 bp	17.10	17.53	0.43
No Change	4.66	5.27	0.65

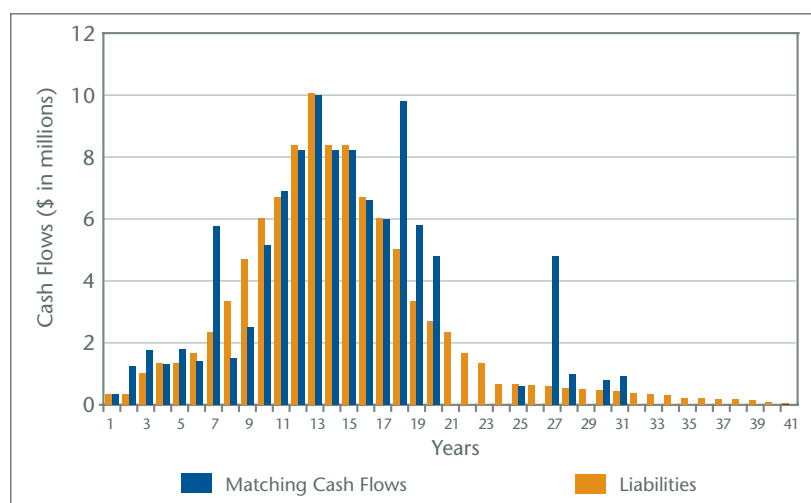
Source: Principal Global Investors and Citigroup Yieldbook

The remaining differences between the two portfolios are primarily attributable to mismatches in cash flows, convexity and yield. The convexity of the liabilities exceeds the convexity of the Treasury STRIPS used to match the liabilities.³⁵ Further refinement of the matching portfolio can largely eliminate these mismatches.

The more precise the detail provided by the plan sponsor regarding the structure and composition of liabilities, the more precisely we can design a portfolio to match the risk characteristics of the liabilities.

Exhibit 10 illustrates a portfolio that is further optimized in order to more closely match the liabilities both in terms of duration and cash flows.

Exhibit 10: Pension Plan Liabilities Matched with a Customized Active Portfolio



Source: Principal Global Investors and Citigroup Yieldbook

³⁵Convexity measures a bond's nonlinearity of price with respect to changes in yield. Non-callable bonds exhibit positive convexity in that their price rises more for a given yield decline than they fall for a given yield increase. Long-term bonds or liabilities have higher convexity than short-term bonds.

This example illustrates the various levels of optimization and risk matching that are possible. The more precisely liabilities are matched, the lower the alpha generating possibilities are. Clients will need to determine the degree of precision they require in their liability management and weigh that against their desire to generate higher expected returns.

Yield Curve Segmentation

On a phased-in basis beginning in 2008, pension plan benefit obligations will be segmented into three segments and then valued using a segmented yield curve methodology.³⁶ Principal Global Investors intends to provide segmented LDI strategies that precisely match these three segments and the risks associated with each segment when they are implemented. Within each segment, key-rate duration, yield curve, convexity and spread can be matched to provide a precise hedge for plan liability obligations. The three segments can be blended to match the distribution of the plan's liabilities.

- **Segment 1:** A portfolio of fixed income securities that match the composition of the first segment (0 to 5 years) of the AAA-A corporate yield curve.
- **Segment 2:** A portfolio of fixed income securities that match the composition of the second segment (5-20 years) of the AAA-A corporate yield curve.
- **Segment 3:** A portfolio of fixed income securities (and derivatives) that match the composition of the third segment (20+ years) of the AAA-A corporate yield curve.

Derivatives Overlay Strategies Combined with Portable Alpha and Total Return

Principal Global Investors has extensive experience in utilizing derivatives as part of fixed income portfolios. We utilize the full spectrum of derivative strategies including swaps, credit derivatives, futures, options, swaptions and options on futures. Optimal overlay strategies can be designed that meet a plan sponsor's specific risk management requirements. As derivative overlays can be complex, a monitoring and management infrastructure should be established to ensure a smooth interface between the manager and the plan sponsor.

A derivatives overlay strategy is ideally suited as a platform for porting, or adding on portable alpha and absolute return strategies. While derivatives themselves contain implicit leverage, our portable alpha strategies mitigate this by matching a cash collateral investment of similar maturity. As a result, there is no increased exposure to interest rates and, therefore, no explicit leverage is created.

³⁶The Pension Protection Act of 2006 provides for plan liabilities to be segmented into three maturity periods and then discounted using a segmented AAA-A corporate yield curve averaged over two years. Liabilities are to be grouped into three segments: 0-5 years; 5-20 years; and beyond 20 years.

VIII. Conclusion

It will make little sense for most U.S. plans to move from a long-term focus on the total return of a portfolio of diverse assets to a rigid liability matching profile. Nevertheless, the major swings we have witnessed in recent years in funding status argue persuasively for some truing up of the asset and liability profiles of plan sponsors. Indeed, the Department of Labor (DOL) has weighed in on the issue and has issued an advisory opinion stating that a plan fiduciary could “consider the liability obligations of the plan and the risks associated with such liability obligations in determining a prudent investment strategy for the plan.” The focus of this opinion clearly suggests that some move toward liability matching is covered under the “prudent man” standard embedded in ERISA.³⁷

Principal Global Investors is well positioned to manage liability driven investment strategies, drawing upon our disciplined multi-sector investment process and incorporating multiple sources of excess return and duration management techniques.

Our portfolio management strategies share a consistent focus on long-term fundamental value and disciplined risk management. The investment process is research driven with an emphasis on bottom-up portfolio construction techniques. While macroeconomic research is an integral part of our process, we do not make aggressive shifts in portfolio duration based on expectations for short-term movements in interest rates. Value is added primarily through individual security selection and sector allocation.

³⁷Under the Employee Retirement Income Security Act of 1974 (ERISA) a plan sponsor is required to manage a plan solely in the best interest of plan participants and beneficiaries. The DOL advisory opinion (2006-08A) issued in October 2006, by Louis Campagna, Division of Fiduciary Interpretations, Office of Regulations and Interpretations, states that LDI strategies that result in reduced volatility in the plan’s funding requirements would not violate ERISA.



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