

LDI Risk Management Metrics

Introduction

Corporate pension sponsors have increasingly been considering *liability-driven investment (LDI) strategies* as an approach to manage balance sheet and income statement volatility. A company that adopts an LDI strategy for its defined benefit pension plan reduces the level of financial risk within the plan, freeing the corporation to take smarter and greater risks in its core expertise areas.

This article describes some basic tools and analyses that allow pension sponsors who have implemented an LDI strategy to measure the strategy's effectiveness. Reams Asset Management provides *LDI risk management metrics* such as these in order to help our clients assess the effectiveness of current LDI strategies and identify residual sources of pension risk.

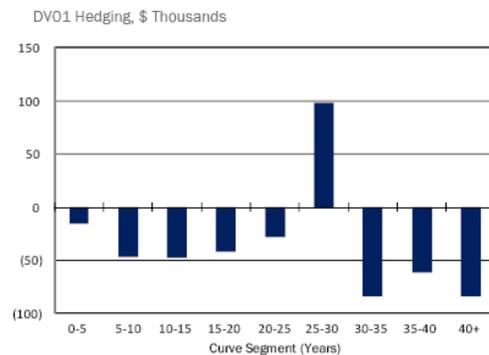
In this article, we focus on two sample reports that we have found useful for our clients: an *interest rate hedge summary report* and a *total plan return attribution report*.

Interest Rate Hedge Summary

XYZ Pension Plan: 6/30/20xx	Assets	Liability	Difference
Market Value (\$MM)	551.3	646.5	(95.2)
Fixed Income Yield/Current Liab. Discount Rate (%)	3.70	3.96	(0.26)
Duration (Years)	11.00	14.21	(3.21)
Fixed Income Duration (Years)	14.43	14.21	0.22
Fixed Income Quality	AA3	AA2	
Standard Deviation of Funding Ratio (%)	10.0		
Funding Ratio (%)	85.3		
Fixed Income Allocation (%)	76.3		
Duration Hedge Ratio (%)	66.0		

Credit Quality	Net CTD (Yrs)
AAA	7.23
AA	(13.23)
A	3.19
BBB	3.03
HY	0.00
Total	0.22

Yield Curve Exposure	Assets		Liability		Net
	CTD (Yrs)	DV01 (\$000)	CTD (Yrs)	DV01 (\$000)	DV01 (\$000)
Curve Segment (Yrs)					
0-5	0.31	17	0.51	33	(16)
5-10	0.89	49	1.48	96	(47)
10-15	1.57	87	2.09	135	(48)
15-20	1.95	108	2.32	150	(42)
20-25	2.11	116	2.22	144	(28)
25-30	3.98	219	1.87	121	98
30-35	0.13	7	1.41	91	(84)
35-40	0.03	2	0.97	63	(61)
40+	0.01	2	1.34	86	(84)
Total	11.00	607	14.21	919	(312)



- This chart shows the estimated dollar increase (decrease) in the plan's funded status resulting from a hypothetical one basis point decrease in a particular portion of the Treasury spot rate curve.

Exhibit A: Interest Rate Hedge Summary Report (sample – for illustrative purposes only)



REAMS ASSET MANAGEMENT
A Division of Scout Investments

1. Interest Rate Hedge Summary

The sample *interest rate hedge summary* report shown in Exhibit A includes several key LDI risk management metrics. In the following sections, we discuss portions of the report in further detail.

Funding Ratio

The desire to protect a pension plan's *funding ratio*¹ lies at the core of LDI strategies. As such, monitoring the plan's funding ratio is central to understanding the plan's impact on year-end corporate financials.

Between fiscal year ends, periodic funding status estimates will help a sponsor understand the plan's financial health and make informed decisions to manage financial risks. To that end, Reams assists plan sponsors by providing periodic updates of a pension plan's estimated funded status. We can provide monthly, weekly, or even daily estimates of funding status to interested plan sponsors. While these interim calculations are estimates (i.e., not certification quality), we believe this information can help sponsors keep a close watch on their pension plan's financial health.

In Exhibit A, one can see the current funding ratio estimate (85.3%) as well as the asset and liability values that comprise the estimate.

Our funding ratio estimates are calculated by credentialed actuaries who take into account all available information, potentially including the following:

- Liability cash flows and/or pension actuarial reports (if supplied by plan sponsor)
- Actual asset value updates, contribution amounts, benefit payment amounts, and expenses paid (if supplied by plan sponsor)
- Actual month-over-month changes in liability discount curves such as the Citigroup Pension Discount Curve
- Estimated changes in asset value (based on daily benchmark asset returns)
- Estimated changes in liability value (based on daily changes in AA-rated corporate bond yields)

Duration Hedge Ratio

A plan's *duration hedge ratio*² estimates the proportion of liability repricing (due to interest rate changes) that will be offset by changes in the market value of the plan's interest-rate-sensitive investments. The duration hedge ratio shown in Exhibit A is 66.0%. This means that, for every \$1 increase in pension liability due to interest rate changes, the sample plan's asset value is expected to increase by 66 cents.

¹ A plan's *funding ratio* is the ratio of the plan's assets to liabilities. For purposes of this article, *funding ratios* follow US GAAP accounting standards, which are a primary concern for many corporate pension plan sponsors. The concepts described in this paper also generally apply to funding ratio measurements for other purposes (e.g., US funding regulations or IFRS international accounting standards) but there are some differences in the details.

² *Duration* is a measure of the sensitivity of the market value of a fixed-income investment (or present value of a pension liability) to changes in interest rates. Roughly speaking, a 14.21 duration (as shown for the plan liability in the sample above) implies an increase (decrease) of 14.21% for every 100 basis point (1.00%) parallel decrease (increase) in interest rates.



Several variations of the duration hedge ratio metric exist within the investment management industry; the most basic of these calculations assume that all interest rate changes are parallel across the term structure and across the credit quality spectrum (i.e., all interest rate changes are due to underlying changes in risk-free interest rates).

A plan sponsor typically examines duration hedge ratios for potential LDI strategies during the design phase to ensure that the chosen strategy appropriately reflects the risk tolerance of the sponsor. After implementation of an LDI strategy, the duration hedge ratio tends to drift over time due to changes in interest rates, investments, or funding ratio. Monitoring the duration hedge ratio on a regular basis can help a plan sponsor ensure that the implemented strategy remains aligned with strategic objectives.

Dollar Value of a Basis Point (DV01)

Closely related to the duration hedge ratio calculation is the *dollar value of a basis point (DV01)*, which translates the plan's estimated interest rate sensitivity to dollar terms. In the bottom row of Exhibit A, one learns that a one basis point (0.01%) parallel decrease in interest rates is estimated to result in a \$607,000 increase in the sample plan's fixed income values and a \$919,000 increase in the plan's liability value. In other words, the plan's net funded status will decrease by \$312,000. Note also the consistency of this result with the duration hedge ratio, since approximately 66% of the \$919,000 liability increase is expected to be offset by a \$607,000 increase in asset value.

Contribution to Duration (CTD)

The duration hedge ratio previously described is useful and popular because of its relative simplicity; however, it relies on an unrealistic assumption that the entire universe of interest rates will move in parallel. In reality, daily movements in interest rates typically differ both across the term structure (i.e., long interest rates move differently than short rates) and across the credit quality spectrum (i.e., risk-free interest rates move differently than implied interest rates on riskier securities).

To help sponsors understand their plan's exposure to non-parallel changes in interest rates, Exhibit A includes *contribution to duration (CTD)* analyses both by term structure and by credit quality.

By looking at the yield curve exposure table in the lower left hand corner of Exhibit A, one sees the extent to which each maturity segment contributes to the sample plan's total asset duration of 11.00 or the total liability duration of 14.21. These CTD numbers are also translated to dollar terms in the DV01 columns, facilitating a greater understanding of the plan's sensitivity to interest rate changes in different parts of the term structure.

We calculate these CTD numbers using projected cash flow streams for both the plan's assets and liabilities. The liability cash flow streams are typically supplied by the plan's enrolled actuary. While projections of future cash flows are inherently imprecise (due to embedded options and other uncertainty both in the assets and liabilities), our methodology allows us to gain and communicate an in-depth understanding of a pension plan's potential and actual sources of funding status change. Exhibit B shows the projection of the sample plan's asset and liability cash flows.



Cash Flows

Fixed Income Benchmark vs. Liability Cash Flows (Discounted),
\$ Millions

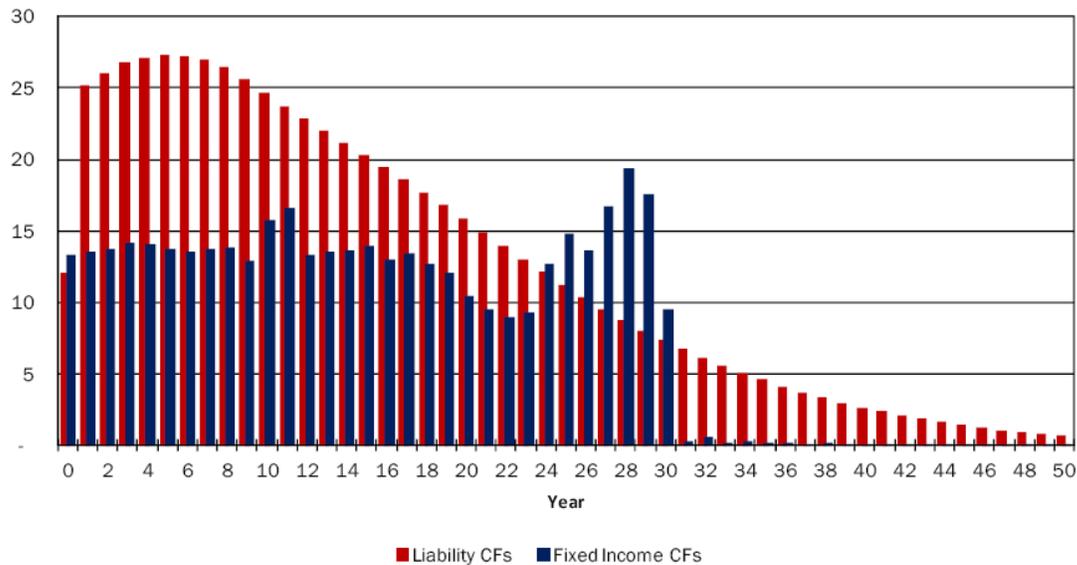


Exhibit B: Cash Flow Projection (sample – for illustrative purposes only)

Standard Deviation of Funding Ratio

A plan's *standard deviation of funding ratio*, also called *funding ratio tracking error*, is an estimate of a one-standard-deviation change in funding status within one year. In Exhibit A, the sample plan's current standard deviation of funding ratio is 10.0%. Therefore, if the expected funding ratio one year from now is 90% (i.e., improved from current funding ratio due to plan sponsor contributions or other forces), then a one-standard-deviation range for the funding ratio projection is 81% to 99% (i.e., 90% of 90% to 110% of 90%).

As a measure of pension risk, the standard deviation of funded status has substantial limitations. It assumes that investment returns are normally distributed (i.e., based on a bell curve) and it typically assumes that historical average returns, volatilities, and correlations between asset classes are applicable to future periods. Both of these assumptions are tenuous at best, particularly with respect to fixed income investments. Nevertheless, this is a commonly used metric in pension LDI analyses and it may be useful to plan sponsors from a broad perspective, so we do calculate it as part of our risk management analytics. In theory, a successfully-implemented LDI strategy should result in a reduced standard deviation of funding ratio.



Total Plan Return Attribution

Change in Funding Status Attributed by Source of Risk, \$Thousands

	Plan Assets	Plan Liabilities	Surplus/ (Deficit)	Funding Ratio
Estimated value at 5/31/20xx	\$549,335	\$627,430	(\$78,095)	87.6%
Fixed income portfolio yield/liability interest cost	1,529	2,303	(774)	
Impact of interest rate changes	10,626	18,740	(8,114)	
<i>Parallel change in Treasury yield curve (+8.9 bps)</i>	<i>(4,980)</i>	<i>(7,705)</i>	<i>2,725</i>	
<i>Change in shape of Treasury yield curve</i>	<i>(1,929)</i>	<i>(2,658)</i>	<i>729</i>	
<i>Change in AA credit spread (as implied by Citigroup Pension Discount Curve)</i>	<i>17,535</i>	<i>29,103</i>	<i>(11,568)</i>	
Fixed income benchmark - basis differential to Citigroup AA rates	(13,757)	-	(13,757)	
Impact of other economic risk sources	5,714	-	5,714	
<i>Equity exposure</i>	<i>5,219</i>	<i>-</i>	<i>5,219</i>	
<i>Active management</i>	<i>495</i>	<i>-</i>	<i>495</i>	
Impact of demographic risk sources	-	-	-	
<i>Liability service cost</i>	<i>-</i>	<i>-</i>	<i>-</i>	
<i>Change in actuarial cash flow projection *</i>	<i>-</i>	<i>-</i>	<i>-</i>	
Impact of external cash flows	(2,134)	(2,014)	(120)	
<i>Plan sponsor contributions</i>	<i>-</i>	<i>-</i>	<i>-</i>	
<i>Benefit payments</i>	<i>(2,014)</i>	<i>(2,014)</i>	<i>-</i>	
<i>Other</i>	<i>(120)</i>	<i>-</i>	<i>(120)</i>	
Estimated value at 6/30/20xx	551,312	646,458	(95,146)	85.3%
Total Changes	\$1,977	\$19,028	(\$17,051)	-2.3%

Exhibit C: Total Plan Return Attribution Report (sample – for illustrative purposes only)

2. Total Plan Return Attribution

The *total plan return attribution* report analyzes the key drivers of funding status changes over the prior month, quarter, or year. While the sample report shown in Exhibit C shown above provides a comprehensive level of detail, one can quickly glean several key pieces of information about the sample pension plan from the rows shaded in gray:

- At the end of May, the funding ratio was 87.6%, corresponding to a deficit of \$78.095 million.
- By the end of June, the funding ratio declined to 85.3%, corresponding to a deficit of \$95.146 million.

The remainder of the information shown in Exhibit C attributes the change in the sample plan's asset, liability, and deficit values to the following sources:

Fixed income portfolio yield/liability interest cost

This row shows the estimated value increase in the fixed income portion of the benchmark asset portfolio, together with the estimated liability increase, attributable to interest accruals.



Interest rate changes

This row shows the estimated change in benchmark asset and liability values due to repricing at current interest rates (as implied by changes in the Citigroup Pension Discount Curve). As corporate bond yields increase (or decrease), the value of fixed income assets and pension liabilities will typically both fall (or rise). As mentioned previously, management of interest rate risk is a key pillar of most pension LDI strategies and this portion of the analysis helps a plan sponsor see the extent to which the interest rate hedge strategy is actually working as intended.

Basis differential

This row shows the impact of a risk that is sometimes overlooked when formulating LDI strategies: mismatch between the plan's investment benchmark and the theoretical liability benchmark (the Citigroup Pension Discount Curve). Unfortunately, because the Citigroup Pension Discount Curve is not itself an investable asset benchmark, there will always be some amount of mismatch. In Exhibit C, there is a substantial funded status loss due to basis differential. In other words, the theoretical liability benchmark (Citigroup Pension Discount Curve) significantly outperformed the sample plan's asset benchmark during the month.

Other economic risk sources

This row shows the impact of equity returns within the benchmark asset portfolio as well as the impact of alpha (i.e., manager performance relative to the benchmark).

Demographic risk sources and external cash flows

For purposes of completeness, these sections show the changes in asset and liability values due to non-economic factors.

Performance analysis in the Reams-managed portfolio

In addition to the total plan return attribution report shown above, for the portion of the pension plan's fixed income portfolio that is managed by Reams Asset Management, we provide a monthly report that gives additional detail on sources of over- or under-performance in the managed asset portfolio relative to our assigned benchmark (e.g., duration, sector selection, or security selection).



Summary

Corporate pension plan sponsors who employ a liability-driven investment strategy should regularly monitor the strategy's effectiveness using objective, informative measurements. Reams Asset Management's investment staff includes credentialed actuaries who are available to assist plan sponsors in developing LDI reports and metrics such as the sample reports shown above. This article provides a summary of some but not all common metrics used in LDI risk management.

For More Information

We welcome the opportunity to speak with you further about how Reams Asset Management may help pension plan sponsors achieve their strategic pension objectives. For more information please visit our website (www.reamsasset.com) or contact us directly:

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