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TOPICS OF
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A practical understanding of LDI

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MICHAEL KAMELL,
CFA, CAIA
Senior Consultant

Abstract

LDI – or liability-driven-investing, involves defining risk relative to the objective of paying liabilities, rather than the objective of maximizing total return. For corporate pension plans, LDI can be an effective way to reduce the range of outcomes in funded status, which has particular appeal given the asymmetric trade-off associated with a declining funded status relative to a stronger funded status.

This paper aims to provide a practical introduction into these issues to assist plan sponsors in evaluating whether LDI makes sense for their organization. Once a plan sponsor embraces the concept of LDI as a way to manage surplus volatility, the next step in the process is generally to create a glidepath, which serves as the plan's road map for de-risking. A subsequent Topic of Interest will cover how and why glidepaths work, and how Verus goes about assisting plan sponsors in creating and implementing them.

The WHAT & WHY of LDI?

At the end of the day, most investors have a fairly straight-forward objective: **make as much money as possible**. Whether from interest, dividends, or capital appreciation, all investors seek to maximize their total return.

Where this becomes slightly more complex is that this objective doesn't

account for risk. Risk means different things to different people, and so identifying what risks to focus on in pursuit of these returns is really step one in the investment process.

The vast majority of investors think about risk in terms of the level of uncertainty around the portfolio's future returns – most often measured in terms of the expected standard deviation of those returns.

Liability Driven Investing (LDI) is a way of investing that defines risk differently. Instead of focusing on risk defined by the risk of the asset portfolio in isolation, LDI defines risk relative to the liabilities. The philosophical underpinning for this is obvious; if a portfolio exists for the sole purpose of paying a future liability, then the composition and evolution of that liability should influence how the portfolio is invested.

LDI has many different applications, depending on the nature of the institution's liabilities and the ecosystem in which the investor operates. Verus works with a range of clients to implement various forms of LDI. One example is plans with planned near-term cash flows which they hedge with a laddered bond portfolio, enabling more aggressive investment with the remaining portion of the portfolio; in such cases, risk is defined more by liquidity. Institutions with inflation-sensitive liabilities might allocate a greater portion of the portfolio to assets with a high correlation to changes in inflation. One could even consider life insurance and annuities as a form of LDI – an investment made for the purpose of hedging an individual's future liabilities.

While there are many different ways investors can apply LDI concepts in pursuit of their objectives, by far the most common institutional application is in corporate defined benefit plans. The reason that LDI has wider adoption within the corporate sector is two-fold:

- The net surplus or deficit is shown on the financial statements. For this reason, the volatility of the assets minus the liabilities is more important than the volatility of the assets in isolation. This relationship also impacts pension expense, which impacts earnings. This means that a volatile funded status can erode or offset the value generated for shareholders from normal operations.
- Liabilities are marked-to-market using long-term corporate bond yields. The rationale for this is it represents a transparent proxy for the sponsor's cost of capital. The implication of this is that the value of the liabilities can change materially with relatively small changes in market interest rates. This also means that there is a very efficient way of hedging the liability; the discount rate is reasonably investable.

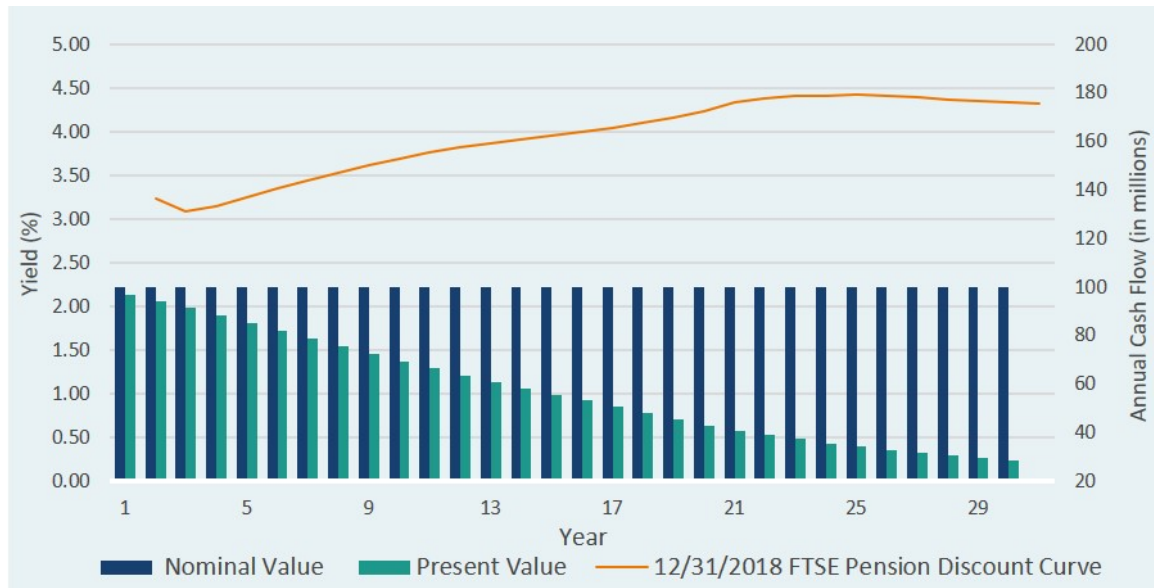
The balance of this paper will explore the various issues that plan sponsors should contemplate when adopting an LDI framework for managing corporate defined benefit plans.

Nuts & bolts

To understand the mechanics of LDI, it will be helpful to create a simple example. Let's assume a pension plan with annual benefit payments of \$100 million per year for each of the next 30 years. The nominal (future) value of these cash outflows is \$3 billion, but because of the time-value of money, the current (present) value of these cash outflows is something less than \$3 billion.

To determine the present value, we need to discount each future cash flow using the appropriate interest rate. The Society of Actuaries publishes monthly interest rate curves based on corporate bond yields. Figure 1 shows this interest rate curve as of 12/31/2018. When discounting the nominal value of \$100 million per year using the interest rate, the present value of the liability is \$1.71 billion (The sum of the green bars in Figure 1).

FIGURE 1: PENSION LIABILITY EXAMPLE



Source: Verus, <https://www.soa.org/sections/retirement/ftse-pension-discount-curve/>

To demonstrate this pension's sensitivity to changes in interest rates, we can re-calculate the present value of the liabilities assuming the interest rate curve in Figure 1 is adjusted up or down at different increments.

TABLE 1: LIABILITY SENSITIVITY TO DISCOUNT RATES

Interest rate	Value of liabilities	Percent change
+200 basis points	1,372,458,536	-19.9%
+150 basis points	1,447,011,553	-15.5%
+100 basis points	1,528,168,668	-10.8%
+50 basis points	1,616,667,725	-5.6%
12/31/2018 interest rate curve	1,713,341,546	0%
-50 basis points	1,819,131,440	6.2%
-100 basis points	1,935,102,781	12.9%
-150 basis points	2,062,463,007	20.4%
-200 basis points	2,202,582,423	28.6%

Source: Verus

Based on this information it is a mathematical certainty that, all else equal, if market interest rates decrease by 1%, this pension's liabilities will increase by 13%, and a 1.5% decrease in rates will result in a 20% increase in the liability; this risk is precisely what an LDI strategy seeks to manage. As we discussed, LDI is about maximizing total return *relative to the liabilities* – and if liabilities balloon in this fashion, traditional asset allocation strategies will find it hard to keep up.

Asset-liability matching

To illustrate how the liabilities can guide investment strategy, and how different investment strategies can mitigate this uncertainty, let's assume three different portfolio strategies, with a starting funded status of 90%.

- **The first strategy**, “Aggressive” is a relatively aggressive portfolio that is invested without any direct consideration of liabilities, with 30% in core bonds, benchmarked to the US Aggregate Index, and the remaining 70% invested in global equity. As you may expect, this portfolio has minimal interest rate risk, and instead, relies on strong returns from equities to ‘beat’ the liabilities over time.
- **The second strategy**, “Moderate” is a portfolio that could be characterized as liability-aware, with 50% in equities and 50% in bonds. Instead of investing in core bonds, the fixed income is invested in a strategy designed to match the credit and interest rate risk inherent in the liabilities. We will call this the “the LDI portfolio.”
- **The third strategy**, “Conservative” is a portfolio with 30% invested in equity and 70% invested in the same LDI portfolio discussed above. This allocation is likely more appropriate for a plan that is already far along in its implementation.

Verus' 2019 Capital market assumptions for global equities are for a 6.8% annualized return with a standard deviation of 17.1%. For the core bond portfolio, we will assume a starting yield of 3% and a duration of 5 years, representative of a core bond mandate.

By LDI we mean a portfolio of bonds that perfectly match the risk profile of the liabilities. In our modeling we will assume that this portfolio behaves identically to the liabilities. In practice, there are a variety of issues that make a “perfect hedge” neither feasible nor advisable. Index concentration, market liquidity, and credit downgrades are issues that need to be thought through relative to objectives and tracking error tolerance.

Heat maps provide a useful framework for analyzing these different asset portfolios relative to various interest rate and equity market scenarios. The following three figures highlight the range of outcomes for our three different portfolios relative to the same liability example discussed above, assuming a starting funded status of 90%.

FIGURE 2

		Equity Market Returns			
		-2σ	-1σ	Median	+1σ
Portfolio 1: Aggressive 70% equity, 30% core bonds		-27%	-10%	7%	24%
Interest Rate Changes	+200 basis points	85%	98%	111%	124%
	+150 basis points	81%	94%	106%	118%
	+100 basis points	78%	89%	101%	112%
	+50 basis points	74%	85%	96%	107%
	No change	71%	81%	91%	102%
	-50 basis points	67%	77%	87%	96%
	-100 basis points	64%	73%	82%	91%
	-150 basis points	60%	69%	77%	86%
	-200 basis points	57%	65%	73%	81%

Source: Verus

FIGURE 3

		<u>Equity Market Returns</u>			
		-2σ	-1σ	Median	+1σ
Portfolio 2: Moderate 50% equity, 50% LDI		-27%	-10%	7%	24%
<u>Interest Rate Changes</u>	<i>+200 basis points</i>	84%	93%	103%	112%
	<i>+150 basis points</i>	82%	91%	100%	108%
	<i>+100 basis points</i>	80%	88%	97%	105%
	<i>+50 basis points</i>	78%	86%	94%	102%
	<i>No change</i>	76%	84%	91%	99%
	<i>-50 basis points</i>	75%	81%	88%	95%
	<i>-100 basis points</i>	73%	79%	86%	92%
	<i>-150 basis points</i>	71%	77%	83%	89%
	<i>-200 basis points</i>	69%	75%	81%	87%

Source: Verus

FIGURE 4

		<u>Equity Market Returns</u>			
		-2σ	-1σ	Median	+1σ
Portfolio 3: Conservative 30% equity, 70% LDI		-27%	-10%	7%	24%
<u>Interest Rate Changes</u>	<i>+200 basis points</i>	86%	92%	98%	103%
	<i>+150 basis points</i>	85%	91%	96%	101%
	<i>+100 basis points</i>	84%	89%	94%	99%
	<i>+50 basis points</i>	83%	88%	92%	97%
	<i>No change</i>	82%	86%	91%	95%
	<i>-50 basis points</i>	81%	85%	89%	93%
	<i>-100 basis points</i>	80%	84%	88%	91%
	<i>-150 basis points</i>	79%	82%	86%	90%
	<i>-200 basis points</i>	78%	81%	85%	88%

Source: Verus

There are several takeaways from these examples, some more obvious than others:

1. Interest rate movements have a very large impact on funded status. Interest rate risk is generally measured in duration, in our example the duration is 11.8, which means that a 1% change in interest rates impacts the liability by approximately 12% in the opposite direction. While no two pension liabilities are the same, this duration profile is representative of the average plan.
2. As the portfolio strategy shifts from Aggressive, to Moderate, to Conservative, the range of outcomes is reduced – this is of course deliberate. Table 2 shows the reduction in the full range of outcomes (the difference between the best funded status outcome and the worst), and the reduction in the Base Case Range (which is illustrated by the inner square on each heat map, a proxy for the more common range of outcomes where equity markets are rangebound and interest rate moves are more muted). Table 2 also shows the reduction in the maximum drawdown from our starting funded status of 90%. For plan sponsors who define risk as impairment of funded status, clearly Portfolio 3 is most desirable.

TABLE 2: FUNDED STATUS - RANGE OF OUTCOMES

	Full Range	Base Case	Max Drawdown
Portfolio 1: Aggressive	67%	19%	33%
Portfolio 2: Moderate	43%	13%	21%
Portfolio 3: Conservative	25%	7%	12%

Source: Verus

3. In behavioral finance there is a concept called loss aversion, which reflects the fact that the typical perception of losses is worse than the comparable positive impact from gains. Generally behavioral economics seeks to explain what traditional economics cannot – as a rational person should derive the same utility from a 5% gain as the dis-utility from a 5% loss – and attributes this to simple behavioral biases. When discussing pensions, however, this is not just a behavioral phenomenon but is in fact implied by the statute. When a pension plan is over-funded – that is, the assets are greater than the liabilities – the company does not get to keep the excess or distribute it to shareholders. The assets in the pension plan must be used to pay benefits to current and future retirees. In a closed plan, there are no new participants while in a frozen plan, not only are there no new participants but existing participants can no longer accrue additional benefits.

This concept goes a long way towards articulating why the range of outcomes associated with the Aggressive portfolio are less desirable than the Conservative portfolio. Any upside in funded status past about 110% (the top right quadrants of each heat map) do not accrue an incremental benefit from the perspective of the plan sponsor, whereas all

of the downside risk (the bottom left quadrants) must be made up in the way of additional contributions and future investment income.

Who, when, and how much?

The asymmetry of benefit relative to detriment discussed above is a critical point in understanding when a plan sponsor should consider adopting an LDI program. When analyzing various characteristics of the Plan and the Plan sponsor through the lens of how this impacts upside and downside funded status volatility, we can refine when it makes sense to pursue LDI.

- **Closed & frozen plans:** When a plan has participants who are still accruing future benefits, and/or new members entering the plan, the future liability is growing, so gains in the asset portfolio reduce the amount of future contributions into the plan. Under this scenario there are three sources of liability growth:
 - **Normal cost** - The future cost of the benefits earned in the given period.
 - **Unfunded liability** - The portion of past benefits that have accrued but not yet been funded.
 - **Interest cost** - The growth in the liability due to the passage of time.

When a plan is open, LDI may still have merit, but not to the same extent, since the positive outcomes to funded status are less likely to result in a surplus scenario. Once a plan is frozen and thus, does not accumulate additional normal cost, the finish line is more certain. For this reason, LDI is most applicable to closed and frozen plans, all else equal.

- **Starting funded status:** A plan with a lower starting funded status is naturally further away from that desired end-state of at least 100% funded. Similar to a plan that is not yet frozen or closed, these plans also have less risk of ‘stranding’ excess assets relative to liabilities, by virtue of the fact that the 100% hurdle is further away. Under this scenario the benefit and risk of an aggressive unhedged allocation are symmetric, at least until funded status improves.

The plan sponsor of a poorly funded plan may not be able to stomach funded status volatility, and its potential impact on future contributions, and so LDI may still be desirable. With a lower starting funded status, the suitability of LDI is more driven by the plan sponsor’s risk tolerance, and in particular the balance they strike between market-generated upside/downside risk and the correlative lower/higher contributions required from them in the future.

- **Size of liability relative to plan sponsor:** In very mature industries it is not uncommon for the size of the pension to eclipse the market capitalization of the company that sponsors the pension. In such cases, small changes in funded status can have a large impact on the financial statements of the plan sponsor – obviously this situation lends itself to an LDI approach.

Conversely, a company with a small pension relative to operations may be more willing to reduce a funding gap through external factors such as higher interest rates and strong returns from risk assets. In this scenario, if those external factors mitigate the need for contributions, then the company is better off, conversely if equities and rates move against the funded status, the pension contributions are presumably still a manageable burden.

Next steps

Your consultant can assist you in determining whether LDI makes sense for your organization, and how to size the allocation relative to enterprise objectives. This requires careful consideration of the issues discussed in this paper relative to stakeholders' risk tolerance. Heat maps can be a very useful tool in analyzing the various trade-offs associated with different asset allocation approaches.

If LDI does make sense, the next step is conventionally to formulate a glide-path, whereby the allocation to LDI is increased as the funded status improves. The major considerations are starting point, desired end-state, and acceptable surplus volatility along the way. This is the subject of a forthcoming Topic of Interest.

Once the allocations have been finalized, the mechanics of the LDI portfolio need to be developed, typically in partnership with an established fixed income investment manager. There are a variety of considerations here, such as credit quality, permissible instruments, desired hedge ratios, and others, all of which your consultant can assist you in navigating.

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800 Fifth Avenue, Suite 3900
Seattle, Washington 98104
206-622-3700
verusinvestments.com

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