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Defined benefit (DB) plans are becoming less common in today’s environment. In a DB plan, the plan sponsor (usually an employer such as a corporation or government) guarantees a certain level of benefit (e.g., 40 percent of pay) and therefore takes on the risks associated with making that guarantee. Many corporate employers are moving to exclusively providing defined contribution (DC) benefits, such as 401(k) plans, which require only a contribution to an account with no guarantee about what the ultimate level of payout will be.

There are many other differences between the typical DB plan and the typical DC plan, but the employer guarantee and corresponding risk are the fundamental differentiators. Given the risk that the employer takes on in a DB plan, it makes sense for the employer and its investment advisors to understand the nature of the obligation and how they can manage the risk it entails.

That's why, in today's tumultuous environment, the investment strategies you design for pension plans must take into consideration more than the plans’ assets. Strategies also should incorporate the plans’ liabilities—the value of the benefits that will be paid out to employees. Understanding how those liabilities are calculated and their relationship to a plan's assets should make you better equipped to design a strategy that fits the plan's funded status and accounting requirements.

If you're working with a pension plan sponsor, chances are that you also are working with an actuary. As an actuary, I'm here to give you a high-level look at how actuaries calculate pension liabilities and how these liabilities can be applied to a plan's investment strategy.

(By the way, did you know that actuary was rated the #1 job recently by the Jobs Rated Almanac? Before you decide to switch careers, know that you'd need to take a lot of exams to become certified, a process that can last 8–10 years. This article will let you in on some of the fun without any of the hard work.)

What is a Pension Liability?

From a financial perspective, a pension plan is a promise by an employer to make future payments to an employee. A pension plan is debt, similar to a high-quality corporate bond in many ways. One can think of a pension plan as an employer’s agreement with employees to defer their wages to the future. The pension liability (also referred to as the pension obligation), then, is the value of the payments promised.

A pension liability is somewhat more complicated than a bond, however. Bond payments are known and scheduled, and with the exception of potential defaults, call provisions, and the like, they are predictable in amount and timing. Pension payments are not so predictable. They depend to varying degrees on when employees terminate or retire, how fast their salaries increase, what form of benefit they choose (e.g., lump sum or annuity), and their longevity, as well as inflation rates. Yet pension payments remain somewhat predictable because actuaries work to forecast the payments and calculate their present value.

The Purpose of Pension Liability Calculations

The two main questions answered by calculating pension liability are the following:

1. How much does the pension plan sponsor need to contribute to the pension trust fund now in order to pay for future benefits?
2. What numbers go on the accounting balance sheet and what numbers go into the income statement?

Funding calculations are governed by ERISA, amended most recently by the Pension Protection Act of 2006 (PPA). Accounting calculations are governed by Financial Accounting Standards (FAS) 87 (now known as ASC 715 under new codification by the Financial Accounting Standards Board, or FASB). However, the liability calculation is conceptually the same for both purposes.
Additional reasons for calculating pension liability include: creating reports for the Pension Benefit Guaranty Corporation, or PBGC (the quasi-government agency that guarantees pension payments for participants in corporate pension plans); and generating data for companies to use to analyze labor proposals, or merger-and-acquisition situations.

**Actuarial Valuation to Calculate the Liability**

The process for calculating a pension liability is called an actuarial valuation, which puts a value on the pension obligation. This valuation calls for the following three steps:

1. Estimate the amount of future payments.
2. Estimate the timing of future payments (when they will start and end).
3. Calculate the present value of the future payments.

Valuation is completed for each participant in a pension plan. The results for all participants are added up to arrive at the total pension liability.

The actuaries doing the valuation needs data for the plan participants, the written provisions of the pension plan, and assumptions about how long people work and live. The actuary customizes actuarial software for each plan's provisions and participant data, and the assumptions to be used.

**A Simple Example of the Valuation Process**

Pension plans come in many forms and varieties. They are like snowflakes: No two are exactly alike. Here is an example of a typical plan:

1. **Estimate the amount of future payments.** The actuary calculates the amount of benefits that already have been earned. The amount of the benefit is reduced to reflect the early start date. A Simple Example of the Valuation Process

   **TABLE 1: AN EXAMPLE OF THE VALUATION PROCESS**

<table>
<thead>
<tr>
<th>Payment Age</th>
<th>Payment Amount</th>
<th>Discount Rate</th>
<th>Discount Period</th>
<th>Present Value Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>$8,000</td>
<td>6%</td>
<td>20 years</td>
<td>$8,000 / 1.06^20 = $2,494</td>
</tr>
<tr>
<td>66</td>
<td>$8,000</td>
<td>6%</td>
<td>21 years</td>
<td>$8,000 / 1.06^21 = $2,353</td>
</tr>
<tr>
<td>67</td>
<td>$8,000</td>
<td>6%</td>
<td>22 years</td>
<td>$8,000 / 1.06^22 = $2,220</td>
</tr>
<tr>
<td>. . . . . .</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>$8,000</td>
<td>6%</td>
<td>39 years</td>
<td>$8,000 / 1.06^39 = $824</td>
</tr>
</tbody>
</table>

(Example: Veronica works for ABC Company, which sponsors a pension plan like the one above. Veronica is 45 years old and has worked 10 years for the company. Her annual salary is $80,000.

To estimate the amount of future payments, the actuary calculates the value of benefits that already have been earned. The liability for the plan sponsor does not include benefits that will be earned in the future because if the employee terminates or the plan is frozen, the current benefits are all that the plan would owe.

The benefit that Veronica has earned as of today is:

10 years of service x 1% x 80,000 = $8,000 per year payable starting at age 65.

To estimate the timing of future payments, the actuary uses workforce data to approximate when current participants will terminate and/or retire and thus start receiving their pension benefits. Mortality data is used to estimate when the benefit will stop.

Assuming that Veronica works until age 65, she will start her $8,000 benefit 20 years from now. Mortality data show that Veronica is likely to live until age 85. (An actuary does a more complicated calculation using the probability that the benefit will end at each age up to 110. But assuming 20 years of payments from age 65 to age 85 will get us roughly the same place.)

To calculate the present value of those payments, actuaries calculate today’s value of the expected future payments using a discount rate. Veronica’s benefit today would be $8,000 a year, starting 20 years from now and ending 40 years from now. The present value calculation is shown in table 1.

The total present value of these expected payments today (when Veronica is 45) is the sum of the values in the present value calculation column, or $30,328. Note how the calculation is similar to calculating the value of a bond investment.

Once we do this for all of Veronica’s coworkers, we add up all the values to get the total pension plan liability for active employees. We also need to calculate this value for retirees who already are receiving benefits. The calculation is easier for them because we already know the benefit amount and we just need to calculate the liability.

The size of the liability depends on three key factors: 1) the level of benefits promised, 2) the number of employees/reirees, and 3) the discount rate used to calculate the present value. An employer can lower its pension liability by decreasing benefits, of course, but in most situations employers cannot eliminate or decrease benefits that already have been earned. Thus once the pen-
sion benefit promise has been made and the benefits have been earned, the size of the liability is locked in, except for changes because of interest rates.

**Why the Discount Rate is Important**

The IRS publishes interest rates according to PPA rules for pension funding calculations; plan sponsors determine their own discount rates based on FASB/Securities and Exchange Commission guidance for accounting purposes. For both, interest rates for long-term, high-quality corporate bonds at each point along the yield curve are matched to a plan’s expected cash flow to determine the right discount rate (as I mentioned above, a pension plan is similar to a corporate bond because it pays benefits over a long time-period and the benefits have a high probability of being paid).

As you may know, the lower the discount rate, the higher the present value of a pension benefit that you calculate with it. As a result, pension liabilities change when interest rates change. When interest rates go down, pension liabilities go up, and vice-versa. The typical pension liability has a duration of 12–15 years, i.e., the liability will increase by 12–15 percent if interest rates drop by 100 basis points. However, pension plans come in all shapes and sizes and some plans—for example, cash balance plans—are not sensitive to interest rate changes at all. Understanding the interest rate sensitivity of the pension liability is especially important for the investment strategy for pension assets, which I’ll discuss shortly.

**The Relationship of Pension Liability to Pension Assets**

Most pension funds set aside assets in a trust fund while employees still are working and earning their benefits, so that the money is there to pay them when they retire. The relationship of assets to liability is important. If the assets are less than the liability, then the benefits that have been earned to date are not fully paid for and the sponsor will incur additional costs in the future to pay for the current deficit.

The relationship of the assets to the liability is called the funded status. A plan that has assets at least equal to the pension liability is called fully funded. The ratio of assets to liability is called the funding ratio or funded percent. For instance, a plan with $20 million in assets and a $25-million liability is said to be 80-percent funded.

The ideal situation is for a plan to be 100-percent funded because that means all the benefits earned to date are paid for. While some plan sponsors prefer to put off funding their benefits and use cash in other ways, this is not always a wise strategy. For corporate pension plans, various penalties and restrictions kick in if a plan falls below 80-percent funded. For any pension plan, an underfunded status means that costs have been deferred and must be paid by future financial stakeholders (i.e., shareholders of a corporation, or taxpayers in the case of a government pension plan).

**Funding and Accounting Requirements**

So now that we know the liability and funded status, what do we do with that information and why does it matter? Recall that the two primary uses for the pension liability calculation are funding and accounting. Contribution requirements and pension accounting information change when the relationship of pension assets to pension liability changes. Any system for tracking pension costs consists of two pieces: Paying for benefits earned in the next year (known as normal cost or service cost). Gradually paying off any difference between pension assets and pension liability. A negative funded status must be reduced gradually, while a positive funded status allows a reduction in the required contribution.

ERISA and PPA define how much plan sponsors must contribute to their pension trust funds. The regulations are extremely complicated, but the basic rule is that the plan sponsor must contribute an amount equal to at least:

- The value of benefits expected to be earned in the next year (service cost), plus
- A payment on a seven-year amortization of the excess of pension liability over pension assets

FAS 87 (ASC 715) explains how to calculate values for corporate balance sheets and income statements. In any 10-k, or annual report, for a company that sponsors a pension plan, a footnote to the financial statements will detail the financial value of its pension obligation.

The pension plan expense shown in the income statement is considered an operating expense and consists of the following:

- The value of benefits expected to be earned in the next year (service cost)
- Interest accruing on the liability (at a rate of interest equal to the discount rate)
- Investment earnings expected to be earned on the pension assets
- Amortization of items that have not yet been recognized in the pension expense

On the balance sheet, the difference between pension assets and pension liabilities will be shown as a corporate liability (if the difference is negative) or as a corporate asset (if the difference is positive). In addition, changes in the pension assets or pension liabilities that haven’t been recognized in the pension expense yet (i.e., items that will be recognized in the future) impact the equity portion of the balance sheet.

**Implications for Investment Strategy**

Saving for college? Buying a house? As in any investment endeavor, it’s important to understand your investment objec-

Continued on page 10
tive because the timing and amount of payments should drive the investing decision. Pension plans are no different. It’s important to understand the pension liability in order to determine an investment strategy and select the most appropriate assets to meet that obligation.

More plan sponsors are adopting what is called liability-driven investment (LDI) strategies. LDI strategies are designed to reduce funding volatility by investing in lower-risk assets that go up and down in value in the same direction as pension liabilities. These assets react to changes in interest rates in the same way that a plan’s liabilities do.

LDI strategies usually incorporate bonds because the pension liability is very similar to a bond. When a pension plan invests in bonds that are sensitive to interest rates in the same way that the pension liability is sensitive to interest rates, then the asset value moves up and down together with the liability and makes for a stable and predictable funded status. Because pension costs are driven in part by the funded status, a stable funded status means stable contributions and accounting information.

Other Situations
What we’ve covered so far describes the process for the corporation that sponsors a typical pension plan. Some situations are different. For example, organizations that don’t file public financial statements may not follow the same pension accounting procedures.

There’s also a big difference between what’s described above and how government pension plans fund and account for their pension plans. One of the key differences is that these organizations use an actuarial technique that discounts the estimated future payments with the expected asset returns on the pension assets.

A Holistic Investment Strategy Combines Liabilities and Assets
Pension liability calculations are complex, but the basic concepts are relative-

To take the CE quiz online, visit www.IMCA.org.

R. Evan Inglis, FSA, EA, is a principal and the chief actuary for Vanguard Strategic Retirement Consulting in Valley Forge, PA, where he works with Vanguard’s defined benefit business to provide advisory and other services to pension plans. He earned a BS in statistics from the University of Washington. Contact him at r_evan_english@vanguard.com.

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