



# In Brief

## **Immunization— Theory and Practice**

*Synopsis: The “perfect storm” for pension plans (jointly falling stocks and interest rates from 2000–2002) focused lots of attention on the diminished funded status of pension plans and the amount of contributions required from corporations to recoup pension funding deficits. One could equivocate, though, that, considering the lengthy contribution holidays which many plan sponsors enjoyed during the bull market of the 1990s, in terms of the level of contributions, plan sponsors have fared extremely well over the past 10 years or so.*

*The ramification of the perfect storm that cannot be argued away, however, is the consternation felt by plan sponsors over the volatility of pension costs. It is not hard to sympathize with CFOs and Treasurers who, after years of not having to make pension contributions, found themselves facing required contributions of tens or even hundreds of millions of dollars. Additionally, many companies also experienced a sudden and unwelcomed toggle from pension income to pension expense.*

*Some plan sponsors purport that they do not care so much about the level of pension costs as they do about the volatility of pension costs. This paper describes a readily available strategy which will produce a very predictable stream of future pension costs (both accounting and cash). Specifically, the strategy involves an immunized investment approach for pension assets, and such an approach may or may not be suitable for a given plan sponsor. This paper discusses the theory and the practical implications of immunization, enabling a plan sponsor to determine if such an approach might be a viable option.*

### **Immunization—Theory**

Immunization, simply described, is a strategy whereby an investor—having an identifiable future financial liability—invests a determinable amount of money in a way that guarantees that the future value of the investment will precisely equal the value of the liability when the liability comes due. For example, suppose a homeowner expects to replace their water heater in 10 years for a cost of \$1,000. Suppose also that a \$1,000 10-year zero-coupon Treasury bond yielding 5% per annum is available today. Under this scenario, the homeowner could purchase the bond for \$614 and will have thus “immunized” their future liability. In other words, the homeowner is certain to have \$1,000 in 10 years to pay for the new water heater.



For a pension plan, immunization is far more complicated than our simplistic example. In fact, for most plans, a true immunization strategy is not feasible. This is because pension liabilities are far more complex than our contrived liability and creating an investment portfolio to match up perfectly with an intricate liability stream is difficult, if not impossible. To be more specific, for true immunization to be possible, the following conditions must exist:

1. The liabilities must be 100% fixed and identifiable;
2. Assets must be invested in a duration-matched, riskless bond portfolio, with a yield equal to or greater than the liability discount rate; and
3. Assets must be equal to or greater than the present value of the liabilities.

Let us address how each of these criteria applies to a pension plan:

1. **Pension liabilities, in most cases, are neither fixed nor are they identifiable.** Pension liabilities are not fixed because active participants accrue an additional pension benefit for each incremental year of service to the company. This benefit accrual for future service is not reflected in any of the standard measures of pension liabilities (i.e., ABO, PBO, CL, AAL). Additionally, for most plans, the benefit participants ultimately receive is based on their salary at the time of retirement. Two liability measures (ABO and CL) calculate the liability based on participant salaries today, not reflecting future pay raises. The other two measures (PBO and AAL) reflect future pay raises; however, they reflect only a best guess as to what future pay raises might be. Pension liabilities are not fully identifiable because of the myriad of variables that must be estimated. In addition to future pay raises, variables such as new hires, early terminations, retirement ages, and mortality rates must all be estimated.
2. **A riskless return which equals the liability discount rate is unachievable.** The discount rates used to value pension liabilities for both accounting (per FAS 87) and funding (per a recent revision to the laws governing pension funding) are based on the yield that could be achieved by investing in a portfolio of “high-quality” corporate bonds. The problem is that “high-quality” does not equate to risk-free. Investing in corporate bonds exposes an investor to credit risk and probably call risk as well. Some corporate bonds default and some are called (paid back early) when interest rates fall. Either of these occurrences could derail an immunization strategy. The only way to achieve a riskless rate of return is to invest entirely in Treasury bonds and the yield on a portfolio of Treasury bonds would be significantly less than the liability discount rates based on corporate bond yields.
3. **Pension assets do not equal liabilities for most plans.** Per survey data compiled by Hewitt Associates, the average PBO funded level for Fortune 500 pension plans was 76% in 2002 and 82% in 2003.

As we have shown, most pension plans do not meet these basic criteria and, therefore, can not effect a true immunization approach.



### **Immunization—Practical Implications**

Because most pension plans cannot execute a true immunization strategy, what we are really referring to when we talk about “immunization” for a pension plan is an investment strategy where pension assets are invested in a fixed income portfolio that is duration-matched to the pension liabilities. While this approach should accomplish the goal of reducing the volatility of pension costs, it will not necessarily ensure that assets will exactly equal liabilities for reasons previously discussed.

Duration, as used in finance, is a measure of interest rate sensitivity. The common convention is that for every 1% change in interest rates, the value of a fixed income instrument having X years of duration will change by  $-X\%$ . For example, the liabilities of a typical pension plan have a duration of about 12–15 years. This implies that a 1% drop in interest rates will result in a 12–15% increase in the value of the liabilities (and vice-versa). An immunization strategy for a typical pension plan basically equates to investing the pension assets in a bond portfolio with a 12–15 year duration. Assuming the yield on the bond portfolio roughly equals the liability discount rate, assuming the bonds do not default, and assuming callable bonds have been properly accounted for in determining the duration of the portfolio, the value of the assets should move in-sync with the value of the existing liabilities (not including future benefit accruals) through time, regardless of what happens to interest rates.

### **Implementation Issues**

#### ***Extending Duration***

In practice, creating a fixed income portfolio with a 12–15 year duration is not easy. The bond portfolios most plan sponsors are accustomed to have a duration of around 5 years and are composed of a mixture of Treasuries, corporates, and mortgages. Getting to a 12–15 year duration would necessitate a very different type of bond portfolio. First, mortgages are basically out because the amortized payment of principal and the option to prepay both shorten the average maturity for mortgages such that their effective duration is similar to that of intermediate bonds. Second, there is a relatively thin supply of long-term corporate bonds and many longer-maturity corporate bonds are callable (which shortens their effective duration). The effective duration of the Lehman Long Corporate Bond Index is just 11 years and accounts for only \$338 billion of outstanding issuance.

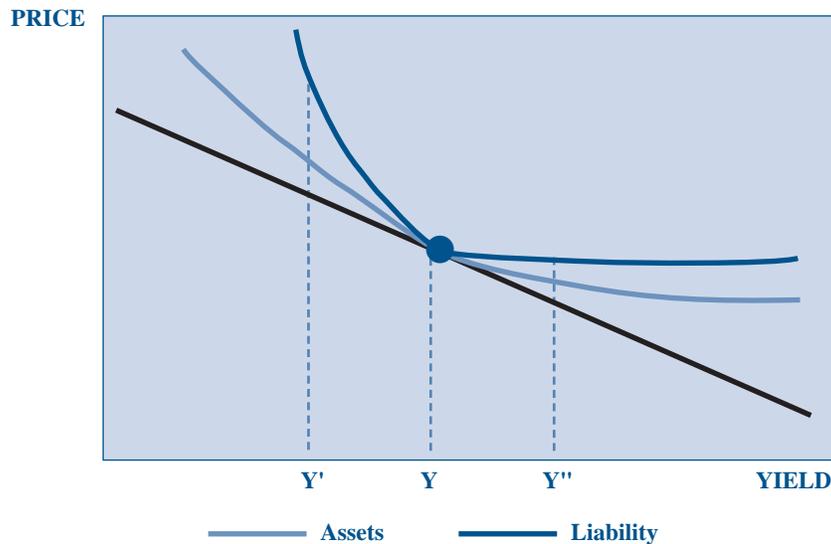
There are basically two options for creating a 12–15 year duration bond portfolio: 1) Invest predominantly in Treasury bonds, or 2) Invest in corporate bonds and synthetically extend duration with derivatives (e.g., interest rates swaps, Treasury bond futures). The deficiency of Option 1 is the yield give-up versus the liabilities (recall that the liability discount rates are based on corporate yields) and the shortcoming of Option 2 is the apprehension most plan sponsors have about entering into complicated derivative arrangements, not to mention the special documentation required to initiate and maintain such arrangements.

### Yield Curve Positioning/Convexity

The expectation that a duration-matched fixed income portfolio will realize the same price change as the liabilities when interest rates move is based on two assumptions: 1) Interest rates of all maturities move in tandem, and 2) The interest rate change is not large.

A duration-matched bond portfolio that does not have scheduled cash flows closely aligned with scheduled benefit payments will not realize the same change in value as the liabilities if interest rates for different maturities move by varying amounts.

Additionally, if the bond portfolio is duration-matched to the liabilities but not convexity-matched,<sup>1</sup> an interest rate movement that is more than incremental will result in the value of the assets changing by more or less than the value of the liabilities. In the example below, the liabilities have more positive convexity (curvature) than the bond portfolio even though they have the same duration (slope) at the initial point (Y). As rates move down to Y' or up to Y'', the bond portfolio is no longer duration-matched versus the liabilities nor is the value of the bond portfolio the same as the value of the liabilities.



Most competent fixed income managers are capable of creating and managing a bond portfolio that is duration-matched versus a pension plan's liabilities. There are a limited number of sophisticated fixed income managers which offer specialty products designed to not only match the duration of a pension plan's liabilities but the yield curve positioning/convexity as well.

<sup>1</sup>Duration measures the change in the price of a bond relative to a change in the yield (i.e., first derivative of price/yield relationship or slope). Convexity measures the change in duration relative to a change in yield (i.e., second derivative of price yield relationship or curvature).



## Which Plans Are Candidates for Immunization and Which Are Not

### *Frozen Plans/Very Mature Plans*

The obvious candidate for an immunization approach would be a frozen pension plan having no additional benefit accruals. For such a plan, the annual cost is simply the liability discount rate. Also, the only factors which remain variable for a frozen plan are retirement ages and mortality rates. If the liabilities are fully-funded, a duration-matched bond portfolio with a yield equal to the discount rate would result in a fairly pure form of immunization. Under such a scenario, a plan sponsor would expect to incur zero future pension costs (accounting or cash). In fact, the only potential benefit a plan sponsor (of a fully-funded frozen pension plan) might gain by not immunizing is the generation of pension income. Pension income has come under much scrutiny in the post-Sarbanes-Oxley world and there is an initiative underway (to be discussed momentarily) that aims to eliminate pension income.

Another candidate for immunization would be a plan that has a high portion of retirees. A somewhat common practice is for a plan sponsor to divest retired liabilities by purchasing insurance annuities to fund retiree benefit payments. This is actually the truest form of immunization that is widely practiced, as a plan sponsor that has purchased annuities is officially alleviated of responsibility for the retired liabilities.

### *Active Plans*

Despite the extensive hype that liability-oriented investment strategies received during and after the “perfect storm,” most corporate pension funds remain heavily invested in equities, as you can see below:

Percent of Assets*	
U.S. Equity	45.5%
International Equity	15.2%
Total Equity	<b>60.7%</b>
Fixed Income	29.3%
Real Estate	3.7%
Private Equity	3.6%
Hedge Funds	1.3%
Other	1.4%

Source: Greenwich Associates Market Characteristics 2003 Report

\*Survey shows dollar weighted asset mix of 838 corporate pension plans.

There are a multitude of complex actuarial calculations, but one very straightforward equation is that the true cost of a pension plan is the benefits paid, plus administrative expenses incurred, minus investment returns. There is no getting around the fact that higher investment returns ultimately lower the cost of maintaining a pension plan and stocks, over a long-term horizon, are almost certain to outperform bonds. A cost of a typical active pension plan is around 9–11% per year (6% interest cost plus 3–5% service cost). An all bond portfolio, with an expected return of around 6%, would require the plan sponsor to cover the remaining 3–5% of the annual pension cost with cash contributions. Most companies rely on the prospective higher returns generated by stocks to defray some of the cost of the pension plan and, thus, keep the plan affordable.

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**Other Considerations*****Tax Efficiency***

Corporate finance academics have put forth an argument that pension plans should be entirely invested in bonds for tax efficiency. The rationale goes something like this: A corporation, taken as a whole, is likely to have some exposure to equities and some exposure to bonds. Equities are tax-favored investments while bonds are not. Since corporations are taxable entities and pension funds are tax-exempt, the obvious choice is for corporations to have their fixed income exposure inside the pension fund and their equity exposure outside of the pension fund. While a comprehensive discussion of this theory is beyond the scope of this paper, we offer the following comment: The tax efficiency argument hinges on a presumption that corporations view the pension plan as a fully integrated component of the company—not only in terms of finance strategy, but also in terms of operational strategy. We find that presumption to be a bit of a stretch.

***Regulatory Issues***

There are several reform initiatives being proposed by the various legislative/regulatory agencies involved in the governance/accounting of corporate pension plans. We've identified a few of the initiatives below:

- Convergence of U.S. and International Accounting Standards leading to elimination of asset-smoothing
- Risk-based PBGC premiums based on asset-allocation of pension fund
- Introduction of core-earnings (which exclude pension income)

While a full discussion of these initiatives is also beyond the scope of this paper, the bottom-line is that each of these initiatives, were they to materialize, would encourage plan sponsors to move towards more fixed income-oriented investment strategies. In some cases, adoption of some or all of these initiatives may even cause a plan sponsor to freeze their pension plan. It is not presently clear, though, which, if any, of the current initiatives will come to fruition (most of them are being aggressively challenged) and none of them presently appear to be imminent.

**Conclusion**

Immunization is an investment strategy designed to insure that assets and liabilities move hand-in-hand with one another. For a pension plan with liabilities that behave like bonds, this implies investing pension assets in bonds. The primary benefit of such a strategy is the substantial reduction to the volatility of pension costs. For certain plan sponsors, where controlling the volatility of pension costs is more of a concern than minimizing the long-term cost of the plan, an immunization approach may be appropriate. The primary drawback of the strategy is that for many plans—particularly those with relatively young and/or growing participant bases—an immunization approach may be cost prohibitive.