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The Role of Bonds in Pension Asset Allocation

William F. Sharpe
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IMN
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The primary objective of a pension is to fund benefit payments (liabilities) such that contribution costs as a % of payroll are low and *stable* over the remaining active lives. The secondary objective is to reduce risk along the way. Risk is best defined as the "uncertainty" of funding the liability objective… not the volatility of returns.

However, most asset allocation models are given a target return on assets (ROA) as their objective. Liabilities are seldom seen in asset allocation models and performance measurement reports. As a result, assets are managed vs. assets (ROA and generic market indexes).

Custom Liability Index (CLI)

The first step in prudent pension management is to install a Custom Liability Index (CLI) to calculate and monitor the present and future value term structure, growth rate and interest rate sensitivity of the plan's liabilities. The CLI is the *proper benchmark* for any pension defined benefit plan. It is based on the actuarial projections of the future benefit payment schedule. The CLI will produce all of the critical calculations needed to manage and understand a pension: future value, present value, yield, duration, growth rate, term structure and interest rate sensitivity. Since contributions are the initial source to fund liabilities, current assets truly fund the ***net*** liabilities (after contributions). As a result, there needs to be both a gross and net CLI to show the significant differences in future values, present values, yield, duration, growth rates and interest rate sensitivity. It is rare to find a CLI installed in most pensions which leads to a misalignment of assets vs. liabilities. Beware of custom indexes that are a blend of generic bond indexes… where are the client's liabilities? Ron Ryan created the first CLI in 1991 and Ryan ALM is a leader in providing CLIs to plan sponsors. We will price

the CLI at any discount rate the client prefers: ASC 715, ROA, PPA, Treasury STRIPS. Since Moody's has adopted the ASC 715 discount rates (zero-coupon AA corporates) for Public pensions and FASB uses ASC 715 discount rates for corporations, the ASC 715 discount rates would be the logical choice to calculate liability present value to understand the true economic funded status and liability growth rate.

Asset Allocation (AA)

Asset allocation is the single most important asset decision since it affects all assets. The goal of AA is to enhance the funded ratio and funded status in a cost-effective manner with prudent risk. AA should be based on the funded ratio and funded status not the ROA. A pension plan with a surplus should have a radically different asset allocation than a plan with a major deficit. Yet if these two plans had the same ROA (return on asset assumption) they would most probably have the same asset allocation… totally inappropriate! Note once again, assets fund the net liabilities (after contributions). So it is the net liabilities that should be used to calculate a net funded ratio and funded status which drives the AA. It is this ***net*** funded ratio and funded status that should be the focus of asset allocation. It is critical that current assets know what they are funding… net liabilities!

Funded Ratios History

Most pensions had a surplus in the 1990s. Prudent fiduciary responsibility should have secured this surplus through an asset liability matching (ALM) strategy using bonds (i.e. cash flow matching, defeasance or immunization). But since bond interest rates were low and trending lower, asset allocation models went the other way and reduced their allocation to bonds consistently and skewed their allocation to more and more risky assets (i.e. equity) in an attempt to achieve the ROA. This became a fatal mistake as funded ratios eroded by about 50% in the 2000-2002 equity correction period and have stayed in a deficit position ever since. The old adage, "if you go down 50%, you have to go up 100% to get back to 0%"... rang true in pensions. Had asset allocation been ***responsive*** to the rising funded ratio in the 1990s, it would have transferred more and more assets to bonds in an ALM strategy. Moreover, there was no anchor or **core portfolio** to de-risk the plan (ALM strategy) that would have significantly reduced the volatility of the funded ratio and secured the surplus.

De-Risking a Pension

Pension plans should want to de-risk their plans consistently over time. The lowest risk assets for a pension are those that match the liability benefit payment schedule (future values) with *certainty*. By definition, Treasury zero-coupon bonds (STRIPS) and annuities would be the lowest risk assets for pension since they have a known future value… but they tend to come at a high cost since they are low yielding and have high fees (annuities). Given that the pension objective is a liability objective with cost constraints, then solving for cost while matching the liability benefit payment schedule would be the ideal way to de-risk a pension. This is best accomplished thru a ***cash flow matching*** strategy. A pension liability benefit payment schedule is a term structure or yield curve often referred to as the ***liability cash flow***. In order to match or de-risk the liability cash flow requires a matching cash flow from assets. Basically, only bonds and annuities produce a certain cash flow. That is why bonds and annuities are preferred as the way to defease, immunize and de-risk a pension plan.

Problem: Immunization Strategies (Duration Matching)

The initial problem with duration matching is where do you get the duration of each client's liabilities. The actuary does not calculate and provide the average duration of liabilities in the annual actuarial report. Most, if not all, duration matching strategies use a *generic* bond market index as the proxy for liabilities. How could one generic index represent each unique pension plan? Pension liabilities are like snowflakes, you will never find two alike… different labor force, salaries, mortality, plan amendments, etc. The difference in liability cash flows and durations could be quite significant. For every year you are off in duration, should represent a 1% difference in liability growth per 100 bp move in the discount rates. Without a *custom liability index,* duration matching is a futile effort.

Imagine a 12-year average duration liability benefit payment schedule. It could have many different term structure shapes to come up with an average 12-year average duration. Imagine a bond portfolio where 100% of the bond assets have a 12-year duration. If interest rates rose 50 basis points in a year the total assets and liabilities supposedly would both have a -6% price return (interest rate movement x duration (as a negative number)). If they had the same income return = 4% they would match again (note that assets usually don't match the income or yield of liabilities). However, if the matching assets are used to ***fund*** the liability cash flow of annual benefits then a -2% loss (-6% + 4% = -2%) on assets could be funding a

one-year liability which should have a small positive growth rate. Consequently, the assets could be taking a loss each year to fund the next liability payment if interest rates continue to rise. This could be a serious costly mismatch if interest rates began a secular trend to higher rates for the next five years. But the point is… there is **no cash flow match of the liability term structure**, only a duration match of total liabilities so there is serious funding risk!

Imagine another duration matching approach where you buy bonds that exactly match the duration of each liability payment. So you would buy a 3-year duration bond to fund a 3-year benefit payment, a 5-year bond to fund a 5-year benefit payment, etc. Using corporate bonds to duration match is difficult, if not impossible. First, there are no corporate zero-coupon bonds. Second, the duration of a coupon bond changes with interest rates so if interest rates go down the durations should go up and vice versa. This is not compatible with funding each benefit payment as they come due over time since liabilities behave like zero-coupon bonds. Third, duration matching does not match or fund each benefit payment (the benefit payment schedule). Last, there are no corporate coupon bonds whose durations exceed 16-years so you are forced into Treasury STRIPS to fund liabilities past 16 years. Treasury STRIPS will certainly match these longer liabilities but come at a high cost. You want to buy longer bonds whose cash flows match the liability benefit payment schedule but at a much lower cost. This requires long coupon bonds which would create a duration mismatch.

Interest rate swaps and futures (derivatives) are another immunization strategy. They are contracts not true assets. There is no cash flow or funds available to make the liability cash flow payments. They are certainly NOT de-risking strategies but hedges vs. the liability growth rate. In fact, these strategies introduce more risk: counter party risk, interest rate risk, non-matching risk of assets purchased (usually equities) vs. liabilities and leverage. In addition, interest rate swaps and futures have all of the problems associated with a liability duration proxy… as listed with duration matching.

Problems with Insurance Buyout Annuities (IBA)

The buyout annuity is certainly the least risky approach to de-risking a pension but it comes at the highest cost. The current trend is to price liabilities at the Treasury STRIPS yield curve and create a single discount rate (i.e. 3.00%) + a fee of around 4%. The plan sponsor would have to transfer assets and funds over to the insurance company such that the plan is fully funded (or even up to 105% funded) at this single discount rate.

The insurance buyout annuity should be more costly than defeasing the plan with Treasury STRIPS which was always considered the high cost de-risking strategy. Defeasance with Treasury STRIPS should also allow an accounting removal of the pension liability debt. Since the *primary pension objective is to fund liabilities at low and stable costs*, the buyout annuity should be given a second thought before executing. In addition, if the insurance company goes bankrupt there may be a claw back of pension liabilities to the plan sponsor.

Solution: Cash Flow Matching

As stated in the beginning, **matching the liability benefit payment schedule (liability cash flow) at the lowest cost is the ideal way to de-risk a pension plan.** Ryan ALM spent two years building a liability cash flow matching product, named the **Liability Beta Portfolio™ (LBP)**, as a cost optimization model that matches the liability benefit payment schedule at the lowest cost given the investment policy restrictions of our clients. Based on the same sample benefit payment schedule used above for the buyout annuity vs Treasury defeasance comparison, our LBP model shows a **26.84% funding cost savings vs. the buyout annuity and 26.54% vs. STRIPS!** This is a serious funding cost reduction and should be a major consideration of any de-risking strategy. Yes, the LBP model has some credit risk but very small since we are using investment grade bonds only. The funding cost savings + the extra yield vs. liabilities annually (@100 bps) provide a large value-added cushion vs. any credit problems. Since our LBP is matching and funding the liability benefit payment schedule (future values), there is no interest rate risk since future values are not interest rate sensitive.

The funded ratio should dictate the allocation to bonds. A surplus should have a high allocation to bonds matched to liabilities and vice versa for a deficit funded status. Unfortunately, asset allocation did not respond to the surplus status in the 1990s which led to the US pension crisis. I wrote a book **"The U.S. Pension Crisis"** detailing the causes and solutions of this enormous financial crisis. With funded ratios at 120% to 150% in the 1990s, why didn't pensions de-risk their plan (cash flow match) and secure this victory? Because pensions were focused on achieving the ROA (return on asset assumption) instead of focusing on the funded ratio and status, they reduced their bond allocations when bond yields went below the ROA… around 1988. Amazingly, instead of increasing their bond allocation in response to a growing funded ratio they reduced it consistently to the lowest bond allocations

in modern history by 1999. The equity correction of 2000-02 erased pension surpluses and created severe deficits that most pensions have not recovered from with spiking contribution costs ever since 2000.

Based on the allocation to bonds should determine how much of the liabilities we can cash flow match (i.e. 25% bond allocation could fund the next 10 years of net liabilities). Most current bond allocations are historically low. As a result, you cannot match and de-risk 100% of liabilities with a 25% bond allocation, especially if you have a funded status deficit. Such a 25% allocation could be used to match and de-risk either a % of total net liabilities or net liabilities ***chronologically…*** both methods will de-risk the plan gradually. There are advantages for each method.

Since liabilities are funded initially by contributions, using the LBP model to cash flow match net liabilities *chronologically* may be able to fund more liabilities than you think. Assume that a 25% bond allocation could match the next 10 years of net liability payments chronologically. Based on the Ryan ALM Liability Beta Portfolio™ (LBP) model we show a funding cost savings of about 4% to 6% on cash flow matching the first 10 years of liabilities versus the ASC 715 discount rate (AA corporate zero-coupon bonds). Note that Ryan ALM is one of few vendors who provide the ASC 715 discount rates since 2008. Our discount rates are consistently higher than the Citigroup rates providing a lower present value on liabilities and enhancing funded ratios and balance sheets. Price Waterhouse has been a subscriber to our ASC 715 discount rates since 2008.

Matching liabilities chronologically should also buy time for the non-bond assets (Alpha assets) to perform and outgrow liabilities (as measured by the CLI). Given time (10 years) most non-bond asset classes tend to outperform bonds. Since liabilities behave like bonds there is a high probability that non-bond asset classes should outperform liability growth over an extended time horizon especially at today's low yield on bonds (i.e. liabilities).

Since the pension liability objective is also a cost focus, cash flow matching a **% of total liabilities** would produce the ***optimal*** funding cost savings since the longer the bond the less it costs given the same future value. Our LBP model is back tested since 2009 showing a cost savings of 8% to 12% on cash flow matching a % of total net liabilities. For every $1 billion in bonds used in our LBP model could save about $100 million in cost savings vs. the ASC 715 present value of liabilities.

Core Bond Portfolio (De-Risk)

Pension consultants and plan sponsors should consider installing a LBP as the ***core portfolio*** in asset allocation. This would gradually de-risk the plan and facilitate portable alpha asset allocation. The best value in bonds is their cash flows. Bonds are usually not considered performance assets (Alpha assets) especially vs. pension liabilities which behave like bonds. The P&I performance study has proven for decades that fixed income managers have little or no value added vs. bond index benchmarks (after fees).

Given no change in the bond allocation… **replace high fee active bond management with a LBP that will de-risk the plan, reduce funding costs and reduce contribution volatility at a low asset management fee (@ 12 bps)**. As the Alpha assets (non-bonds) perform vs. liability growth (as measured by the CLI), thereby enhancing the economic funded ratio, such excess returns (liability Alpha) should be transferred over to the Liability Beta Portfolio™ (LBP) to de-risk more and more liabilities… **Portable Alpha**. Had this *portable Alpha* discipline been in place during the decade of the 1990s when funded ratios grew to their highest historical levels with true economic surpluses… there would be no U.S. pension crisis today!

Nota Bene **(Note Well)**

Please note that the definition of risk used in this research report is in sharp contrast to the traditional approach produced by the Nobel Prize winner Ph.D. William F. Sharpe back in 1966. Professor Sharpe proposed that risk is the volatility of total returns and that the three-month T-Bill was the default risk-free rate. He developed the Sharpe Ratio as a means of calculating the risk-adjusted return by subtracting the return of the three-month T-Bill from the mean return of the assets being analyzed and dividing the net return by the volatility of the return of the assets in review. For many decades the Sharpe Ratio was the standard measurement of risk-adjusted returns. In 1994 Prof. Sharpe called me and invited me to Stanford to discuss our unique custom liability index data and index reports. I had the unique pleasure to meet and debate with one of the finest intellects I ever met.

I proposed that risk is not a *generic* measurement but based on each client's objective. I referenced pensions where every client's liabilities are different (like snowflakes). As proof,

I asked him what is the risk-free asset for a 10-year liability payment? Prof. Sharpe answered… a 10-year Treasury zero-coupon bond that matches the liability payment with certainty. Prof. Sharpe identified that the three-month T-Bill would have 39 reinvestment moments of uncertainty, so there is no way the three-month T-Bill could match a 10-year liability future value with any certainty and would become a risky asset. Our discussion led to Prof. Sharpe re-inventing the Sharpe Ratio in 1994 to include the benchmark objective instead of the three-month T-Bill in the numerator and denominator such that the average return of the asset portfolio is reduced by the average return of the objective (numerator). This net average return is then divided by the standard deviation of the asset portfolio return vs. the objective return (tracking error). This is commonly called today… the **Information Ratio**.