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Pension Confusion: Present Value vs. Future Value!

The true pension objective is to *secure* promised benefits in a cost-effective manner (i.e. stable contribution costs) with prudent risk. Pension benefit payments are future value numbers. The least risky way to secure benefits is to ***cash flow match*** these future value benefit payments with U.S. Treasury STRIPS (zero-coupon bonds). However, STRIPS may be too costly since they have low yields. If a pension is fully funded (on an economic basis), buying STRIPS to cash flow match benefits (defeasance) may be a prudent strategy since the plan can afford this cost. It has been historically common to pre-refund municipal bonds, lotteries and Nuclear Decommissioning Trusts (NDT) through a defeasance strategy with U.S. Treasury STRIPS. In the 1960s thru the early 1980s dedication strategies (cash flow matching) was common for pensions. This defeasance strategy became less common with pensions as their accounting rules and actuarial practices focused on present values (i.e. Funded Ratio and Funded Status) not future values. This leads to great confusion as to how to calculate the present value of liabilities… and even assets (i.e. smoothing).

FASB (ASC 715) accounting rules favor using a liability discount rate based on a *hypothetical* AA corporate zero-coupon yield curve while GASB (and ASOP 27) favor using the Return On Asset (ROA) assumption. All are inaccurate measurements since they are not market rates that you can buy to settle (defease) the liabilities. What is clear is that the liability discount rate(s) must be zero-coupon rates since only a zero-coupon has a certain future value. The ROA is the most inaccurate since it is an educated guess on future asset

growth. How the ROA applies to liability growth is a mystery since liabilities behave like bonds and are extremely interest rate sensitive. The ROA behaves like an asset allocation heavily skewed to risky assets… no correlation to liabilities at all. AA corporate zeroes are inaccurate since they rarely exist in the fixed income market place, so you can't buy them either. The true acid test of any discount rate is: **1) does it cash flow match future value benefit payments; 2) can you buy the discount rate(s).** If the discount rate used fails any of these two criteria the discount rate is inappropriate if not dangerous in that it misleads the pension plan by calculating an erroneous funded ratio and funded status.

Solution: Custom Liability Index

Only a **Custom Liability Index (CLI)** could properly represent and measure any pension plan's liabilities providing all of the critical data calculations needed to manage assets vs liabilities and de-risk the plan. Given the extreme amount of work and calculations performed by the actuary, their report to the pension is usually received annually several months delinquent. This is understandable, but inappropriate for the asset side to function efficiently. Imagine if an important index benchmark (S&P 500) came out annually, months delinquent, could you manage assets effectively vs. this index? In 1991 Ron Ryan and his team designed the first Custom Liability Index (CLI) as a solution to this problem. Based on each client's unique projected liability benefit payment schedule, Ryan ALM produces *quarterly* CLI reports on:

Structure-(the Present Value, Average Duration, YTM, Price, etc.)

Growth Rate (Liability growth for month, year and since inception)

Interest Rate Sensitivity (PV change in % and $ given rate changes)

Future Value vs. Present Value

Actuarial practices use present values (PV) to calculate the funded ratio and funded status. But benefit payments are future values (FV). This suggests that the future value of assets vs. the future value of liabilities is the most critical evaluation. But most asset classes are difficult to ascertain their future value. This is why the PV is used. Only bonds (and insurance annuities) have a known future value and have historically been used to cash flow match liabilities (i.e. defeasance, dedication). To prove my point as to the potential misinformation with using a PV calculation, let's use a simple example below. Two pensions

both at $100 million market value would have the same funded ratio in PV$. But pension B is 100% invested in corporate bonds that outyield pension A (100% invested in Treasuries) by 100 bps per year. Certainly, plan B has a much greater future value (@ 20% higher) and funded status if we used future values. This suggests that the funded ratio and funded status are not that accurate or even good indicators of the true economic solvency:

Pension	Composition	YTM	PV	FV
A	**100% Treasuries**	**3.00%**	**$100 million**	**$150 million**
B	**100% Corporates**	**4.00%**	**$100 million**	**$180 million**

The point of all this is… that we need to focus more on the FV of assets vs. liabilities. If we value liabilities at market rates, they would have discount rates of AA corporates (FASB method) or even better U.S. Treasury STRIPS (defeasance method). A corporate bond portfolio matched to liabilities that outyields liabilities would enhance the funded ratio on a future value basis thereby reducing funding costs (i.e. contribution costs). This is why **"cash flow matching"** of liability future values is the most prudent risk and lowest cost methodology to de-risking a pension through asset liability management (ALM).

Duration Matching

Duration-matching strategies (Immunization, Interest Rate Swaps, futures, derivatives, risk overlays, etc.) are all hedging tools to help assets match the liability growth rate. **They are NOT true de-risking strategies since they do not match and fund the liability cash flows.** Duration matching has several difficult, if not erroneous, data gathering choices it uses:

1. **Average duration of liabilities**

   Where do you get the average duration of liabilities? Most, if not all, actuarial reports do not provide this calculation. Moreover, they do not provide the projected liability benefit payment schedule (FV), which you would need to calculate duration. In addition, actuarial reports are annual reports usually received months delinquent so there would be seriously delayed information. The duration calculation is at a precise moment in time: like a balance sheet. As time and interest rates change so will duration. Only a ***Custom Liability Index (CLI)*** based on each pension plan's unique liability benefit payment schedule could provide an accurate and current duration

profile. Any difference in yield and time creates a difference in the calculation of duration and liability growth rates.

2. **Discount Rates**

Since the duration of liabilities changes with interest rates (discount rates) this calculation needs to be refreshed and updated on a frequent and accurate basis. According to ASC 715 accounting rules (formerly FAS 158) liabilities are to be priced as high-quality corporate zero-coupon bonds. FASB accepts AA corporates as the interest rates in compliance. Since corporate zeroes do not exist in the market place, such discount rates are *hypothetical* interest rates. Ryan ALM is one of the few vendors who supply the ASC 715 discount rates. Price Waterhouse Coopers (PWC) has been our major client since FAS 158 became effective. Our discount rates are consistently higher than Citigroup providing clients with a lower present value of their pension liabilities thereby enhancing the balance sheet.

Important: Moody's has decided to use the FASB discount rate methodology to assess municipal credit ratings instead of the GASB ROA methodology.

3. **Generic Bond Indexes**

A common proxy for the average duration of liabilities is to use a generic bond market index… usually the Bloomberg Barclay's long corporate index. Such a proxy creates several erroneous data issues. This index has no bonds shorter than 10 years and no durations longer than 16 years. This certainly does not represent any pension liability schedule even if the average durations were similar. Every pension plan's liabilities are different and unique to that plan due to a different labor force, salaries, mortality and plan amendments. There is no way any generic bond market index could represent any pension plan liability term structure. Accounting standards and actuarial practices price liabilities as a portfolio of zero-coupon bonds with a *single average discount rate* based on the present value of this zero-coupon liability portfolio.

Note: There are no generic bond indexes that use zero-coupon bonds as their portfolio. Furthermore… there are no generic bond indexes that use any of the required pension accounting discount rates… they use market rates!

4. **Interest Rate Sensitivity**

For every one-year of duration difference between the liability proxy and the actual duration of each plan's benefit payment schedule would result in a 1% mismatch in liability growth for every 100 bps of discount rate change. The economic truth is… the duration mismatch is more likely to be three to five years rather than one year. Given that pension costs for the actuary, administration, asset managers, and consultant are usually less than 50 bps a year; such a duration mismatch could be very costly representing years of pension cost.

5. **Funding Liabilities**

Imagine a 12-year average duration liability benefit payment schedule with benefit payments due every month of every year. Imagine 100% of the assets in a 12-year duration bond portfolio. It could have many different term structure shapes to come up with an average 12-year duration. If interest rates rose 50 basis points in a year, 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 duration matching assets are used to ***fund*** liabilities then a -2% loss on assets (-6% + 4% = -2%) could be funding a one-year liability, which will have a small positive growth rate. So the assets could be taking a loss each year to fund the next liability payment if interest rates continue to rise. This could get to be a serious costly mismatch if interest rates began a secular trend to higher rates for the next five years. But the point is that **there is no cash flow match here, only a duration match so there is both a funding and interest rate risk!**

6. **Derivatives**

Interest rate swaps and futures are contracts not 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 proxy data gathering… as listed with duration matching.

SOLUTION: Cash Flow Matching

As stated in the beginning, **matching the liability benefit payment schedule (liability cash flows or FVs) in a cost effective manner is the quest of a pension plan.** Ryan ALM has built a liability cash flow matching product, named the **Liability Beta Portfolio™ (LBP)**, as a cost optimization model that matches the liability benefit payment schedule (FV) at the lowest cost given the investment policy restrictions of our clients. By focusing on future values we avoid all of the present value problems I cited with duration matching. **By matching future values, the LBP has eliminated interest rate risk, which dominates the present value behavior of bonds.** More importantly, the LBP is providing the cash flows to fund each and every benefit payment as they become due.

The **LBP historically provides a 6% - 8% funding cost savings vs. AA corporates and 15% - 20% cost savings vs. U.S. Treasury STRIPS!** This is a serious cost reduction and should be a major consideration of any pension asset allocation strategy. Yes, the LBP model has some credit risk but it remains very small since we are using investment grade bonds with credit filters (no bonds on negative watch list, low Bloomberg default risk, etc.) plus the cost savings provides a large value-added cushion.

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 funded status in the 1990s that led to the US pension crisis. With funded ratios at 120% to 150% then, why didn't pensions cash flow match and secure this victory? 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 allocation to bonds should determine how much of the liabilities we can cash flow match (20% bond allocation might fund the next seven to ten years of net liabilities). ***We recommend funding the next 10 years of Retired Lives on a net liability basis*** (after contributions). Indeed, current assets fund the net liabilities not the gross liabilities, as contributions are the initial funding source of liabilities. Our LBP model will calculate with precision the cost to fund liabilities (gross or net) in a cost-effective manner either as a

percentage of total liabilities or liabilities ***chronologically*** which will de-risk the plan gradually. There are advantages for each method.

Since liabilities are funded initially by contributions and then investment income, using the LBP model to cash flow match net liabilities *chronologically* may be able to fund more liabilities than you think. Assume that a 20% 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 cost savings of about 4% 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 very few vendors who have provided the ASC 715 discount rates since 2008. Our discount rates are consistently higher than the Citigroup rates providing a lower present value on liabilities thereby enhancing funded ratios and balance sheets.

Matching liabilities chronologically should also buy time for the non-bond assets (Alpha assets) to perform and outgrow liabilities. Given time (7-10 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 could outperform liability growth over an extended time horizon, especially at today's low yield on bonds (and liabilities).

Since the pension objective is a cost focus, cash flow matching a percentage of total liabilities would produce the ***optimal*** cost savings since the longer the bond's maturity 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 total liabilities. Incredibly, 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.

Pension consultants and plan sponsors should consider installing a LBP as the ***core portfolio*** in 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. As the Alpha assets (non-bonds) perform vs. liability growth, thereby enhancing the funded ratio, such excess returns should be transferred over to the Liability Beta Portfolio™ (LBP) to de-risk more and more liabilities. This is a concept known as **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!

Asset Exhaustion Test (AET)

GASB 67/68 requires an Asset Exhaustion Test (AET), which is a test of solvency and a valuable tool for all pensions (private and public). In the AET, GASB requires projected contributions to be subtracted from projected benefit payments to get ***net liabilities***. Current assets are then grown at the ROA to see if they fully fund "net liabilities". If they get exhausted, at this point GASB requires a new bifurcated discount rate to be used for future liabilities. This new discount rate is to be an AA 20-year municipal rate. As a result, GASB has introduced a market rate as part of this bifurcated discount rates as well as including contributions as a future asset. If you add contributions into the Funded Ratio this ratio will improve significantly, especially for Public Plans. Actuaries may argue that contributions are future assets and not a current asset. Well what do you call projected future liabilities that make up the funded ratio? Seems like what is good for the liability calculation should apply for the asset calculation.

The LBP is a perfect companion to the AET by cash flow matching each and every liability cash flow (FV benefits) up to its allocation amount. By matching future values, the LBP has eliminated interest rate risk, which dominates the present value behavior of bonds. The LBP enhances the *SOLVENCY* of any pension at a reduced funding cost.

ROA (Return on Assets)

The ROA tends to drive the pension asset allocation as a target or hurdle rate. Moreover, for Public Plans and Multiemployer plans it is the liability discount rate. The ROA calculation is certainly a mysterious number. Why would a plan with a 60% funded ratio and another with a 90% funded ratio have the same ROA? Why is the ROA so static when market returns are so volatile? How could liability growth be the same as asset growth when asset allocation is usually skewed to risky assets? The truth is that the ROA is **not a *calculated* number based on the funded status** but a target return based on what asset allocation can document to an auditor as its highest probable return. The ROA does not respond or focus on the funded status of a plan! Moreover, pension plans have been brain washed into thinking that if they don't earn the ROA they cannot become fully funded… this is incorrect thinking, In order to perform asset/liability management effectively, one needs to know the true economic value of the plan's liabilities. Below is an example to disprove this ROA mentality:

If we use market values for liabilities they become highly interest rate sensitive. Using Treasuries as a proxy for liabilities, a small increase in interest rates (+60 bp per year) would create ***negative growth*** in liabilities! Accordingly, any positive growth in assets would enhance the economic funded ratio. **In just five years a 60% funded ratio could be 89% funded with just 5% asset growth and a 70% funded ratio would be 104% funded!**

5-year Horizon

Liabilities (Treasuries) = Discount rate goes from 3.25% to 6.25%

Liabilities Growth Rate = (3.06%)

	----- Annual Growth Rate -----		
Assets	**5.00%**	**6.00%**	**7.00%**
Liabilities	**- 3.06%**	**-3.06%**	**- 3.06%**
Alpha (Annual)	**8.06%**	**9.06%**	**10.06%**
Funded Ratio = 60% …	**89.37%**	**93.79%**	**96.46%**
= 70% ...	**104.36%**	**109.41%**	**111.47%**

Contributions

Contributions are a very large future asset (FV) that are the first source to fund benefit payments and administrative expenses. As a result, current assets fund net liabilities (after contributions) as required in the asset exhaustion test (AET). Contributions should enhance the funded status and make the funding job of current assets much less costly. The actuarial calculation of projected contributions is based on the dollar difference in the growth of assets vs. liabilities and the amortization of any unfunded deficit. To calculate contributions, the actuary grows the actuarial valuation of both assets and liabilities at the ROA. The annual dollar growth difference and the amortization of the deficit is the projected contribution for each year. Notably, growing an unfunded plan at the same growth rates for assets and liabilities grows the projected deficit. **This actuarial methodology has no input for assets to outgrow liabilities.** As a result, the only way to cure a deficit under this actuarial method is to increase contributions. In the example below, $60 of assets and $100 of liabilities (60%

funded ratio) shows a $40 deficit growing by 46.9% in just five years, which requires higher contributions to cure (before the amortization of the $40 deficit):

Example: Funded Ratio = 60% Funded Status = ($40)

Growth Rate = 8% ROA

	Assets	$ Growth	Liabilities	$ Growth	Funded Ratio	Status
Start	$60.00	$ 4.80	$100.00	$ 8.00	60%	$ 40.00
Year 1	64.80	5.18	108.00	8.64	60	43.20
Year 2	69.98	5.60	116.64	9.33	60	46.66
Year 3	75.58	6.05	125.97	10.07	60	50.39
Year 4	81.63	6.53	136.05	10.88	60	54.42
Year 5	88.16	7.05	146.93	11.72	60	58.77

At same growth rate (ROA) Funded Ratio is stable… but deficit increases 46.9%!

In truth, current assets fund the *net* liabilities after contributions and not the *gross* projected liabilities! In truth, the actuarial ROA is not a calculated number! The calculation of the true economic ROA is required for current assets and asset allocation to understand its target return. This economic ROA is based on the economic funded status and should be dynamic and not static.

Asset Allocation (AA)

The worst consequence of this singular focus on the ROA is its effect on Asset Allocation! Because actuarial rules (ASOP 27) made the ROA the discount rate for liabilities, the ROA became the *target growth rate* for assets. Pension consultants were then required to validate this ROA thru their asset allocation (AA) models. Such AA models use an optimization technique based on historical index returns for every asset class but one… bonds. Bonds go in the AA model at their current yields. When bond yields went below the ROA, around 1988, AA models began to reduce the allocation to bonds since they would be a drag on achieving the ROA. By 1999 pensions had the lowest allocation to bonds in modern history, which has resulted in the $3.3 trillion mistake![1] When the equity correction arrived in 2000 thru 2002, pensions were hard hit due to their asset allocation skewness to equities. Most

[1] Robert Novy-Marx and Joshua Rauh, "The Crisis in Local Government Pensions in the U.S.", Oct. 2010

pension equity assets underperformed liability growth by over 70% in those three years (Ryan ALM Pension Letter)[2]!

In truth, assets and liabilities never grow at the ROA so the ROA is a bad growth forecast that leads to a lot of bad decisions… it all links! In the late 1990s most pension funds enjoyed surpluses wherein they reduced, if not eliminated, contribution costs. Benefit increases were also a beneficiary of these good times. One would think that the prudent pension plan would have altered their AA to more and more bonds ***cash flow matched*** to liability cash flows to secure this victory, de-risk the plan and lock in reduced contributions for the future. But **asset allocation models are based on achieving the ROA and never consider the Funded Ratio and Funded Status… a fatal flaw**.

AA should be responsive to the funded ratio on an economic basis. A surplus should have a radically different AA than a deep deficit. How could a 60% funded ratio have the same ROA as a 90% funded ratio? Because the ROA ignores the funded status, one plan with a deep deficit and another fully funded plan could have the same ROA and the same asset allocation… **totally inappropriate and non-responsive to the funding status**. In the 1990s AA should have secured pension plan surpluses by cash flow matching bond assets to liability cash flows (defeasance) to secure the surplus victory and stabilize the funded status. The surplus could be invested in riskier assets (similar to Life Insurance NAIC rules). Had pension plans behaved in this manner… there would be no pension crisis today!

Note Bene **(Note Well)**

We consider the role of actuaries vital to managing a pension. We understand and admire the great amount of work they perform. Our critique in this paper is strictly on the actuarial rules that we feel are not appropriate for pension assets and pension boards to function effectively. We desire to work with pension actuaries and translate their good work into economic models and data that help asset managers, boards, and consultants to function efficiently.

[2] Sources: Ryan ALM Pension Letter