Ryan ALM
Asset/Liability Management

Pension Risk Redefined

by
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In our risk/reward behavior financial world, it is risk that is the dominant and most critical factor. Most investment policies are written and shaped mainly by by risk tolerances. Such policies are created to minimize or avoid risk. Most of these risk constraints came about after some financial disaster affecting the client client or the marketplace in general. However, risk is often thought of rather improperly or calculated incorrectly based on the true objectives of the client. This can often lead to inappropriate asset allocation, improper asset management, and inaccurate performance measurement.

Genesis

In the beginning, risk was thought of as "losing money" or "losing principal". This concept of risk has deep roots originating in trust law. Many investment policies today stress the **preservation of principal** no matter what the stated objective or benchmark. That would be a most difficult and contradictory task if the stated objective were the S&P 500 or long-dated liabilities.

Efficient Frontier (Harry Markowitz)

Most of the risk-based modeling work of the last 70 years, are built upon the theories of Harry Markowitz developed in the early 1950s'. Markowitz developed the **efficient frontier model** where he derived the expected rate of return and the expected risk measure for an asset portfolio[1]. He showed how a portfolio of assets was ***efficient*** if no other portfolio had a higher expected return with the same risk (volatility) or vice-versa (lower risk with the same return). Markowitz relied upon variance from the mean return as a measurement of risk. This volatility measurement **(standard deviation) stands today as the principal measurement of risk**. Volatility measurements have expanded through time (e.g. duration, convexity, VAR, OAS) but all still miss the key focus...the client objective. What really matters is the ***relative volatility*** of assets versus the volatility of the client objective being measured… not absolute volatility.

Risk-Free Rate

William F. Sharpe won the Nobel Prize for his work done in the 1960s'. His capital market theory was designed to create a model that can price or assess any risky asset. His conclusion became the **capital asset pricing model (CAPM)**[2] which would measure the required rate of return for a risky asset. To measure risk, Sharpe compared assets to the **risk-free rate,** which was that rate any investor could lend at (bonds) or borrow at (loans). This risk-free rate was considered to be the three-month T-bill. Many investment models continue to use a short maturity T-Bill as the risk-free rate no matter what the objective, which in many cases is not appropriate (i.e. pensions, mutual funds, ETFs, etc.).

Beta (Treynor Measure)

The first composite measure of portfolio performance to include risk was developed by Jack Treynor in 1965.[3] Treynor recognized the need to measure risk in order to evaluate the performance of any portfolio. He hypothesized that risk had two components: first, was the risk of the market (market risk or systematic, non-diversifiable risk) and second, was the risk unique to the issues of that portfolio (non-systematic or diversifiable risk). His concept was that the higher the correlation of a portfolio to the market (**Beta**), the less issue risk there was and the more diversified was the portfolio. Since the first bond index wasn't developed until 1973, Beta was and still is a risk measurement for equity portfolios.

Sharpe Ratio (Old)

In 1966, Sharpe introduced a measure for the performance of mutual funds and proposed the term **reward-to-variability ratio** to describe it.[4] Soon after, it became known as **The Sharpe Ratio**. This ratio consisted of:

$$\frac{\textbf{Return of a portfolio - Risk-free rate}}{\textbf{Standard deviation of portfolio returns}}$$

The risk-free rate was calculated as the shortest T-Bill (30-day). The translation here was that all portfolios must be compared to the risk-free rate to understand the **"risk-adjusted return"** of that portfolio. Accordingly, **the lowest risk was the risk-free rate or the security with the lowest return volatility (30-day T-Bill)**. The Sharpe Ratio has become one of the fundamental measurements used today. Most practitioners consider ***absolute*** volatility when assessing risk such that higher volatility means higher risk no matter what the objective… **NOT TRUE!** Risk is better defined and measured as *relative* volatility to the objective.

Sharpe Ratio (New)

On September 16, 1993, I had the pleasure to spend a full day postulating with Bill Sharpe. He lived up to his reputation as one of the most refined and scholarly gentlemen I ever met. I told him that I thought risk was ill-defined. To prove it, I asked him two questions:

1st Q: If a client objective was the S&P 500, then what would be the least risky asset?
A: Bill Sharpe said it would be an S&P 500 index fund that provides the most certain achievement of that objective.

2nd Q: If a client objective was to fund a 10-year liability (i.e. pension) what is the least risky asset to meet that objective?
A: The Nobel prize-winner told me it was a U.S. Treasury 10-year zero-coupon bond (i.e. STRIPS) that matched the future value of that liability.

I agreed with the Nobel Prize winner and noted that cash could be more risky than equities or long duration bonds. Bill Sharpe said, "Yes... given those objectives. A 30-day T-Bill would have 120 reinvestment moments of uncertainty versus a 10-year liability. There is no way a 30-day T-Bill could match with certainty a 10-year liability" I concluded that **only the client objective could determine and measure risk**. **No "generic" definition of risk is valid.** ***Risk is best defined as the uncertainty of meeting the client objective!***

The more uncertainty... the more risk. The best way to measure risk is to compare any asset portfolio return behavior to the return behavior of the client objective. However, this requires a custom index that best represents the client objective. **Accordingly, risk is a *relative* measurement versus the client objective (as an index).** I believe my meeting had an effect on the Nobel Prize winner as four months later he introduced an enhanced version of his 1966 model...**The New Sharpe Ratio.**[5] This time the focus was on the client objective. His new formula (commonly referred to as the ***Information Ratio***) is:

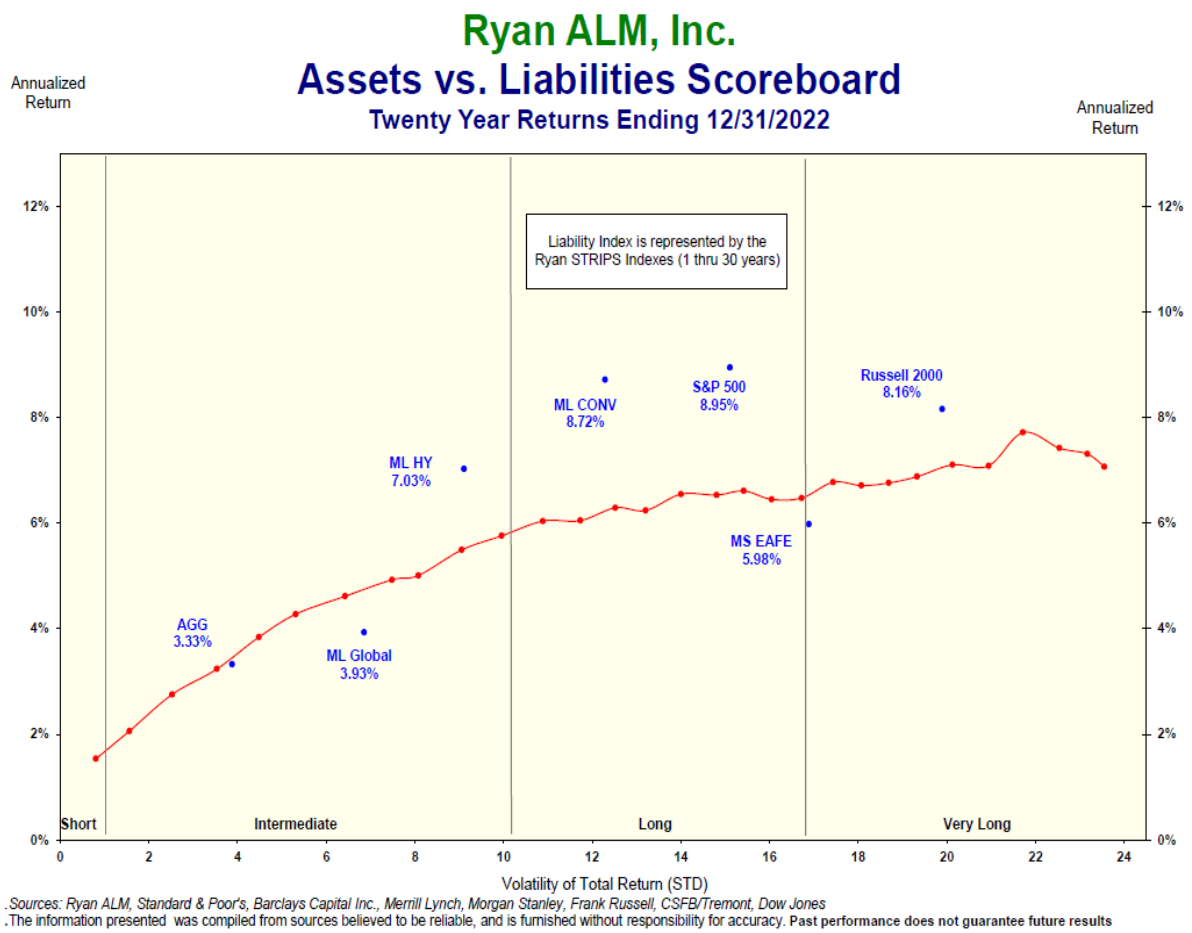
$$\frac{\text{Return of portfolio - Return of the Objective}}{\text{Standard Deviation of the Differential Return}}$$

Eureka! Bill Sharpe now agrees risk is a ***relative*** measurement based upon the asset's true objective. **The least risky asset is now the one that can meet or match the asset objective with the most certainty.**

Objective Index (Custom Liability Index (CLI))

For most institutional investors **funding liabilities** (e.g. debt service, insurance products, lotteries, NDT, OPEB, pensions, etc.) is the **sole purpose of their investment program**. However, most asset managers are given some type of **generic** market index(es) as their benchmark (objective). The reason for this is that liabilities (i.e. pensions) are normally calculated annually usually up to three months delinquent using prices that are actuarially driven not market driven. Moreover, the liability portfolio is not provided to the asset side so the liability payment term structure of such an objective is not known readily. It would be most difficult, if not impossible, for an asset manager to perform prudently versus such an ill-defined objective. In 1991, after two years of development, my team and I **introduced the 1st Custom Liability Index (CLI)** as the solution to this widespread problem. Our **CLI** is customized to the clients' actuarial liability payment schedule. Moreover, it provides transparent pricing (at market) of the liabilities allowing us to calculate the present value term structures, a liability growth rate, and a full spectrum of portfolio averages and summary statistics (duration, YTM, etc.). More than any generic market index, the **Custom Liability Index (CLI) best represents the client objective!** If assets outperform their index benchmark but underperform liabilities as best measured by the CLI… didn't the client lose?

Now that the objective is accurately measured by the CLI, one can measure the relative risk/reward of the asset side. Liabilities can be sub-divided into short, intermediate, long, very long, and total. Comparing assets to the liabilities they are funding (e.g. long assets versus long liabilities) would be the proper method. The graph below shows the last 20-year history of asset growth versus liability growth ending 12/31/22. The line is the generic *Ryan Liability Index* (U.S. Treasury STRIPS yield curve with 30 distinct maturities). The dots are index benchmarks for major asset classes. Most asset classes outgrew liability growth over the last 20-years. The graph clearly shows the volatility correlation of each asset class to a certain part of the liability term structure. Accordingly, It seems like it would not be prudent to buy equities to fund the short to intermediate liabilities since the expected risk/reward behavior (S&P = 18-year, EAFE = 20-year and Russell 2000 = 25-year) would not cash flow match or behave like 1-10-year liabilities. Accordingly, asset allocation should monitor the behavior of asset classes to determine what part of the plan's liabilities they are correlated to and should be funding.



Asset Allocation

The graph attached clearly demonstrates the risk/reward behavior of each asset class versus the liability line. Asset allocation would be wise to separate Beta from Alpha assets and Retired Lives from Active Lives. The goal is to become fully funded in a cost-efficient manner with reduced risk over the future. Keep in mind that the **no-risk portfolio is a Liability Index Fund** that matches the liability cash flows for the term structure it is funding (e.g. Retired Lives). Our **Liability Beta Portfolio (LBP)** is a Liability Index Fund that cash flow matches each benefit payment with certainty and should be the ***core portfolio*** of any liability driven objective. Since Retired Lives are the most certain and imminent liabilities, it would be wise to use the cash and bond allocation to fund Retired Lives for as far out as the allocation can fund. Since contributions are the initial source to fund benefits, the LBP would

be funding *net Retired Lives*. As the funded status improves, asset allocation should respond and transfer assets from the Alpha side (risky or growth assets) to the Beta side… *Portable Alpha*. Had pensions responded to their surplus funded status in the 1990s this way there would be no pension crisis today because responsive asset allocation would have transferred this surplus to bonds cash flow matched to liabilities thereby eliminating the volatility of the funded status and contribution costs. In Las Vegas, one should always take chips off the table when they are winning. Why should that strategy be different for pension management?

The LBP should be a key part of the asset allocation process as the *core portfolio* to secure liability benefits *chronologically* and as a parking lot for overvalued asset classes (risk neutral strategy). If an asset class is overvalued, don't go to cash (too risky) … transfer these assets to the LBP and be risk neutral. When the overvalued asset class is back in line then transfer back from the LBP to the Alpha asset class. The Liability Beta Portfolio is a key component in any dynamic or responsive asset allocation modeling.

Liability Beta Portfolio (LBP)

The pension objective is to fund liabilities in a cost-effective manner such that contribution costs remain low and stable. Pension plans also want to de-risk their plans over time. The lowest risk assets for a pension are those that match the liability benefit payment schedule 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 or have high fees. Given that the pension objective is a cost objective, then **solving for cost while matching the liability payment schedule would be the ideal way to de-risk a pension**.

A pension liability benefit payment schedule is a term structure or yield curve often referred to as the ***liability cash flows***. In order to match or de-risk each pension liability benefit payment requires a matching cash flow from assets. Basically, only bonds produce a certain cash flow (and perhaps, annuities). That is why bonds are used as the way to defease, immunize, and de-risk a pension plan. Our LBP is a portfolio of investment grade corporate bonds that cash flow matches each benefit payment at the ***lowest cost to the plan***. Our LBP should reduce funding costs, at current interest rates, by about 2%+ per year (1-10 years = 20%+).

Performance Measurement

Performance measurement should compare the risk/reward behavior of each asset class versus the liabilities they are to fund on a frequent basis in similar fashion to the graph

above. Moreover, total asset growth should be compared to total liability growth to determine the improvement in the funded status. There should be ***no investment review meeting without liabilities being presented!*** This is seldom done and an impossible task without the CLI. Measuring the growth rate behavior of each asset portfolio to the growth rate behavior of the liability objective (e.g. equity vs. long liabilities) would be the best way to determine the **true** risk/reward of that asset portfolio. Over any given time-horizon, if any asset portfolio outperformed a generic market index, but underperformed liabilities (as measured by the CLI), didn't the client lose? Wasn't this asset portfolio risky? Even more important, is the comparison of total asset growth versus total liability growth. Performance measurement is relative to the objective (liabilities) growth rate… **the CLI growth rate is the proper hurdle rate for total assets.** You want asset growth to exceed liability growth then secure that victory (liability Alpha) by transferring this excess return over to the LBP. Only a Custom Liability Index can accurately calculate the true economic growth of liabilities. Again, the **no-risk portfolio would be a Liability Beta Portfolio that matches the liabilities with certainty**. As a result, **the *core portfolio* for a liability objective is a low to no risk Liability Beta Portfolio.**

Conclusion

In summary, risk is best defined as the "uncertainty" of achieving the client objective. Risk is a relative measurement of assets versus the client objective. Since each client's objective is unique, only a custom objective index could properly represent the benchmark for assets. **Risk is then best measured as the relative volatility and cash flow behavior of assets versus a custom objective index (e.g. Custom Liability Index)**.

References

[1] Harry Markowitz, "Portfolio Selection, "Journal of Finance 7, no 1 (March 1952): 77-91 and Harry Markowitz, Portfolio Selection-Efficient Diversification.

[2] William F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk", Journal of Finance 19, no 3 (September 1964): 425-442

[3] Jack L. Treynor, "How to Rate Management of Investment Funds," Harvard Business Review 43, no. 1 (January-February 1965): 63-75

[4] William F. Sharpe, "Mutual Fund Performance", Journal of Business 39, no 1, Part 2 (January 1966): 119-138.

[5] William F. Sharpe, "The Sharpe Ratio", Research Paper Series #1287-Stanford Univ., (January 1994):1-15.