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Liability Index Fund: The Liability Beta Portfolio

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Abstract

Historically, the practice of trustees of defined benefit programs has been to make the asset allocation decision based on prevailing risk-return relationship for asset classes without regard to the plan's economic funded ratio, liability structure, and liability economic growth rate. Once the asset allocation decision is made, the market index that best represents that asset class is selected as the performance benchmark. Ignoring the liability structure has been the major reason

for the failure of both private and public pension funds to achieve their true objective of funding the liability benefit payment schedule at a stable and low cost to the plan sponsor. For trustees to properly manage pension assets in light of the true objective, they need a liability index customized to the fund's unique benefit payment schedule. In this article, we explain how this should be accomplished and how Alpha and Beta portfolios should be redefined in order to work in harmony with the plan's true objective.

In the 2004 Olympic Games in Athens, Matt Emmons of the U.S. was in the final round of a rifle shooting event. In this event, his score was so far ahead of his competitors that all he had to do was just hit the target and he would win the gold. Well, he hit a target, but he did not win the gold. In fact, he was placed eighth. What went wrong? He hit the wrong target on his last shot. That is what happens in life: hit the wrong target and your goals may not be achieved, a principle that corporate plan sponsors of defined benefit plans would be advised to remember when establishing investment policy.

In the late 1990s, most corporate pension funds had large surpluses with funded ratios above 130 percent. All corporate plan sponsors had to do was to match liabilities with a bond immunization-type strategy to secure this funding victory long term (i.e., no unfunded liability, no contribution costs, no pension expense, and little volatility for the funded ratio). Instead, plan sponsors in consultation with their financial advisors moved ever more aggressively away from bonds and into equities. In a span of three years, 2000 through 2002, most equity positions underperformed the plans' liability growth by over 60 percent, sending funded ratios to an unfunded position and causing contribution costs to spike upward. This trend continued throughout the decade of 2000 and led to an unfunded liability position of over U.S. \$3 trillion.¹

Index funds

Index funds are quite popular in America but liability index funds are not common. Given that the objective of most institutions and individuals is to fund some type of liability schedule, liability index funds should be a core investment. A liability index fund has all the benefits of an index fund plus valuable features no other index fund can have. An index fund or Beta portfolio by definition is supposed to match or duplicate the risk/reward of an index objective at a low tracking error.

Index funds became increasingly attractive due to four factors. First was the ability to purchase in one transaction (i.e., mutual fund or exchange-traded fund) a diversified portfolio that captured the efficiency of the market. Second, low to no tracking error versus the target index benchmark could be achieved. Third, the payment of lower fees for asset management services than imposed by active managers. Finally, realization of consistent performance versus an index objective compared to the variation in performance by active managers.

The well-documented difficulty of active managers to consistently outperform indexes (especially after fees) has led to index funds taking up an increasingly larger proportion of the overall assets or even becoming a core investment for many institutional and even retail investors in the last two decades. Some of the largest mutual funds consistently tend to be index funds (i.e., Vanguard's VIMX, VTSMX, and VFIAX). According to the Lipper rankings, the S&P 500 (SPDR) exchange-traded fund

(ETF) would be ranked as the largest equity mutual fund and the third largest mutual fund. In the last 20 years, ETFs have grown significantly to over U.S. \$1 trillion in assets and over 1,000 index fund products. Not included in these statistics are "closet" index funds that do not want the label of indexing (in order to charge higher fees for supposedly active management) but tend not to stray far away from the key characteristics and statistics comprising the index objective (i.e., weightings, sector stratification, yields, modified duration, ratings, etc.).

Custom liability index

The true objective of a defined benefit pension is to fund the liability benefit payment schedule at a stable and low cost to the plan sponsor. In order for assets to function and be managed versus this liability objective, liabilities need to be made transparent such that trustees can monitor the shape, size, and growth rate of liabilities frequently (in present value dollars). This requires a liability index customized to the unique benefit payment schedule of a plan sponsor to provide the data needed as the true benchmark objective for asset management.

Just like snowflakes, no two corporate pension plans are alike in their actuarial projected benefit schedules. Since each liability is weighted by its present value (market value), it is well known analytically that a 10-year average liability duration will behave much differently than a 20-year liability duration given the same parallel shift in interest rate change (i.e., 10 percent versus a 20 percent price difference for every 100 basis point change in yields). Since interest rates change every day, a daily custom liability index would be the most accurate monitor of liability size, shape, and risk/reward behavior (in present value dollars). Since liabilities are unique to each pension plan sponsor, there is no generic index that could accurately measure and represent any liability risk/reward behavior.

A custom liability index is always the proper measurement and representation of any liability valuation and risk/reward behavior. The financial moral here for trustees responsible for overseeing the investment policy of a defined benefit plan is simple: given the wrong index, the incorrect risk/reward will be realized. This has been the consistent problem in the management of both public and private defined benefit plans for decades – they have the wrong index objective(s). Consequently, should there be any surprise that corporations and municipalities that sponsor pension plans are facing financial difficulties because of misguided investment policies and poor advice? Until custom liability indexes are placed as the true pension benchmark, pension assets will continue to demonstrate a risk/reward rollercoaster behavior versus liabilities wherein the funded ratio and contribution rates remain quite volatile due to the mismatch of assets versus liabilities.

¹ Robert N-M. and J. Rauh, 2010, "The crisis in local government pensions in the U.S.," October

Beta redefined

By definition, an index fund is the correct Beta portfolio that matches the index benchmark with such accuracy that the tracking error is nil with the Beta calculation at 1.00 and the correlation at or near 100. With a liability-driven objective, only a liability index fund could qualify as the Beta or matching portfolio. A liability index fund, by definition, requires an index that reflects a pension fund's liability term structure. Since each liability structure is unique, this calls for the creation of a custom liability index (CLI). Until the asset portfolio's cash flows match each monthly liability payment (i.e., liability term structure), the interest rate risk (systematic risk) that dominates the risk/reward behavior of pension liabilities cannot be hedged.

Attempts to hedge pension liabilities by employing immunization and interest rate swaps have failed because they set the average duration of liabilities as the target. Such a target duration is incorrect because the proper target (i.e., the proper match) is the term structure of liabilities. Liabilities can be viewed as a yield curve of monthly benefit payments. The stripping and reconstituting of long Treasuries is a testimony to this mathematical disparity. Long 30-year Treasuries are stripped because the pieces (60 income STRIPS plus one principal STRIP) do not equal the whole (coupon bond), thereby allowing for an arbitrage of the differences. Moreover, one STRIP equal to the average duration of a 30-year Treasury coupon bond could not be purchased so as to match the entire yield curve behavior (60 income payments plus one principal payment). Only through a CLI could the present value calculations necessary to understand how to match and monitor the ever-changing shape and risk/reward behavior of a term structure (yield curve) of liabilities can a pension plan achieve its target. Moreover, strategies employing over-the-counter derivatives such as interest rate swaps introduce other risk such as counterparty risk.

The old Lehman Aggregate Index, now the Barclays Capital Aggregate Index, has been the standard index benchmark for most fixed income assets in pensions since 1983. Although this index is a good proxy for the bond market, it has little correlation to liabilities. Most pensions have long cash flow structures with volatile risk/reward behaviors that are quite different from the Barclays Aggregate. To illustrate the disparity between

	Barclays Aggregate	Ryan Liability Benchmark
Standard deviation	3.88	12.56
Annual total return	7.32	9.49
Tracking deviation (bps)	203	-
Information ratio	-0.23	-
Correlation between the two benchmarks: 0.88		

Table 1 – Risk/reward comparison of Barclays Aggregate versus Ryan Liability Benchmark (12/31/88 – 12/31/10)

generic traditional bond indexes and liabilities, Table 1 compares the Barclays Aggregate to the Ryan Liability Benchmark Index for the 22-year period ending December 31, 2010. The Ryan Liability Benchmark Index is the Treasury STRIPS yield curve (1-25 years) equally weighted with an average duration of around 13 years; the Barclay's Aggregate's duration tends to be around five years.

The comparison in Table 1 demonstrates that the most popular bond index benchmark does not behave or correlate well to pension liabilities. With a correlation of 0.88, a tracking deviation of 203 basis points, and an annual total return difference of -1.26 percent, the Lehman (Barclay's) Aggregate has proven to be a huge opportunity cost for the 22-year period covered in the table. The data provided in the table also emphasize that the market risk in bonds is interest rate risk which dominates the risk/reward behavior of liabilities. This is because the Ryan Liability Benchmark is 100 percent Treasuries which yield much less than the Lehman (Barclay's) Index. Consequently, the only way this index could outperform is through greater price return (three times longer duration index produces three times greater price return volatility). Historically, interest rate risk (market risk) represents over 95 percent of the total return of investment-grade bonds as documented in several studies and by the very high correlation of most bond indexes with similar maturity parameters.

No generic index should be used as a Beta portfolio for a liability-driven objective. Perhaps, the silliest notion of a liability Beta portfolio is the S&P 500 or any non-bond index. The S&P 500 as an index fund may be a market Beta portfolio but certainly as can be seen from Table 2, does not correlate or behave like any liability term structure – the correlation is only 0.02. A liability Beta portfolio can only be a 100 percent bond portfolio matched to the liability cash flow schedule. A CLI based on the client's actuarial projections of benefit payments is needed to create a Beta portfolio that matches the liability objective of pensions.

Alpha redefined

Alpha is defined as the excess return above the index objective's return. In liability-driven objectives, Alpha is correctly measured as the excess return above liability growth (as measured by the CLI). Outperforming generic market indexes but losing to liability growth (as measured by the

	S&P 500	Ryan Liability Benchmark
Standard deviation	15.08	12.56
Annual total return	9.47	9.49
Tracking deviation (bps)	416	-
Information ratio	0	-
Correlation between the two benchmarks: 0.02		

Table 2 – Risk/Reward Comparison of S&P 500 versus Ryan Liability Benchmark (12/31/88 – 12/31/10)

CLI) is certainly not earning Alpha from the pension plan sponsor point of view. To outperform a generic market coupled with a return less than the liability growth (CLI) is, in fact, underperformance from the pension's perspective. The infamous correction years for the stock market (2000 through 2002) certainly highlight this Alpha clarification. As hard as it is to believe, the S&P 500 underperformed a 13-year average duration Treasury STRIPS portfolio (Ryan Liability Benchmark Index) by -75.88 percent over those three years as shown in Table 3.

Assets versus liabilities

In the 10 years ending 2010, it is hard to find a single asset class except bonds that outperforms liabilities as measured by the Ryan Liability Benchmark Index (comprised of a yield curve of Treasury STRIPS). Figure 1 compares the popular generic market indexes against the Ryan Liability Benchmark Index, with each dot representing a one-year incremental maturity (which equally weighted comprise the Ryan Liability Benchmark Index). As hard as it is to believe, all non-bond indexes underperformed the Treasury STRIPS Index that had a similar standard deviation. Only the Lehman Aggregate and the Merrill-Lynch High Yield Index outperformed the Treasury STRIPS Index with a similar standard deviation, although by very little. Noticeably, extending duration on the liability curve (Treasury STRIPS yield curve), liability returns increased in a rather linear fashion. This shows how interest rate risk dominates the risk/reward of Treasuries and liabilities (systematic risk) and, therefore, why it is so critical to match the interest rate risk of liabilities. Since most pensions have an average duration of 10 to 15 years, focusing on the dots on the Treasury STRIPS yield curve between 10 and 15 years, it can be seen that no generic market index outperformed this area or average liabilities. Moreover, there are few generic market indexes that behave like 10- to 15-year Treasury STRIPS (The Merrill Lynch Convertible Index is the only index observation that came close).

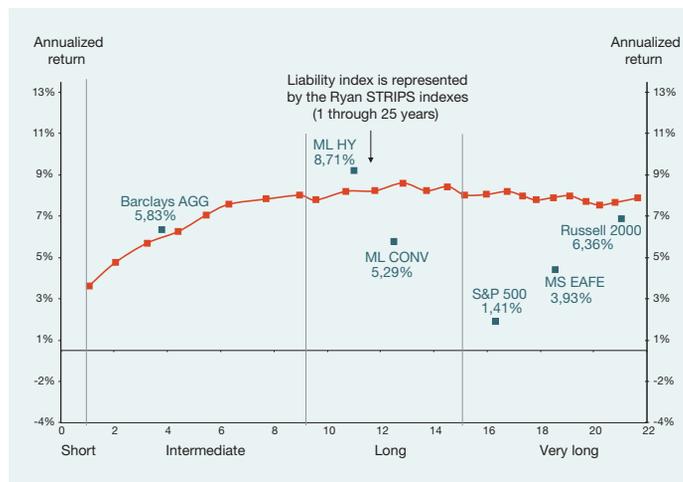


Figure 1 – Different asset indexes versus liabilities (Ryan Liability Benchmark Index): 10 years ending 2010

Portable Alpha

Portable Alpha strategies are supposed to port (transfer) excess returns (Alpha) over to a Beta portfolio to secure the Alpha victory. However, most portable Alpha strategies today not only measure Alpha versus a generic market index, but also use the generic index as their Beta portfolio (generic index fund). This is incorrect thinking and inconsistent with any liability-driven objective. Alpha is the excess return above the stated objective. If the stated objective is liability driven, then Alpha must be the excess growth above liability growth (as measured by a CLI) and Beta must be the portfolio that matches liabilities. The S&P 500 as an index fund could never represent the liability Beta portfolio. That is also true for every asset class except zero-coupon bonds matched to liabilities. Using inappropriate asset classes and generic portable Alpha strategies, a pension fund could lose at least three ways here: (1) the Alpha portfolio loses to liabilities (as measured by the CLI); (2) the Beta portfolio loses to liabilities (i.e., fails to match liabilities), and; (3) performance fees, if any, are paid on the wrong Alpha measurement.

The asset side must be synchronized with a liability-driven objective if the asset side is to function properly. Without a CLI, how could asset allocation, asset management, and performance measurement work properly? They all link to the liability objective as best measured by the CLI. There needs to be coordination and orchestration of all asset functions in harmony with the true goal of a pension: funding liabilities at low and stable cost with reduced risk to the plan sponsor.

Index funds as the risk-free assets

A central part of financial theory is the existence of a risk-free asset, as well in performance metrics such as the well-known Sharpe ratio. However, what is a risk-free asset in the design of a portfolio whose target is liabilities? One can argue that the risk-free asset is the asset that matched the objective with certainty rather than the asset whose return is known with certainty. In practice, the three-month Treasury bill is typically used as a proxy for the risk-free asset.

There are two reasons why to consider this argument. Consider first the case where the objective is the matching of the return on a generic market index (i.e., S&P 500). The lowest risk asset with this objective would be an S&P 500 index fund or ETF that matches the objective with certainty. The three-month Treasury bill would be very risky here because it could never match with any certainty the risk/reward behavior of the S&P 500.

Next, consider the case we have been discussing in the paper where the objective is the liabilities. Liabilities tend to be a schedule of monthly payments extending far out into the future. What is the lowest risk asset that can be purchased to fund the 10-year liability? As when the S&P 500 is the objective, the three-month Treasury bill would be very risky in this case since it would have 39 reinvestment moments, 39 moments of

uncertainty over a 10-year horizon. The risk-free asset would be a 10-year Treasury zero-coupon bond that matches the liability payment with certainty.

We can conclude that the objective decides what the risk-free asset is. There cannot be a generic risk-free asset that applies to all objectives, especially liability objectives since each liability is a unique set of cash flows (payment schedule). Risk is best defined as the uncertainty of not meeting the client objective; the greater the uncertainty, the greater is the risk. Accordingly, if the liability objective is best measured as a CLI then a CLI fund is the risk-free asset.

Conclusion

For corporate defined benefit plans, only a CLI is the appropriate asset benchmark for liability-driven objectives. With a CLI, Beta and Alpha portfolios are redefined and can work in harmony with the true objective. The asset management guidelines of a pension plan can then take into account the risk/reward behavior of the true economic objective in establishing investment policy, especially the liability Beta portfolio which should be installed as the core portfolio. Performance evaluation by plan sponsors can then properly assess the risk/reward behavior of assets versus the liability objective to monitor that the assets are on track to fund a unique set of cash flows. The asset allocation decision can then focus on the true economic funded ratio (assets/liabilities measured in terms of market value). A large deficit should certainly have a different asset allocation than a surplus position. Without a CLI, all asset functions are in jeopardy of being managed versus generic market indexes which will misinform and mislead plan sponsors regarding the assets and the funded ratio. With a CLI, all asset functions can now work in harmony with the true client objective (funding liabilities). The financial moral of our story is if the wrong index is established as the target, the wrong risk/reward will result.