

Changing Paradigms in Asset Allocation for Pension Plans

By James F. Moore

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Abstract

Implications of portfolio construction in an Asset-Liability framework are compared to results from a traditional Markowitz optimization in an Asset-Only world. Results from the Asset-Liability analysis are used as a point of departure to explore i) asset allocation and its potential impact on future surplus levels and sponsor credit rating, ii) the impact of funding level on asset allocation and surplus risk, iii) the role of synthetic assets, iv) differential valuation of alpha given its source, and v) the role of the sponsor's business enterprise in assessing asset choice. When plan assets are viewed in conjunction with plan liabilities and the individual nature of the sponsor's enterprise, it becomes clear that there is no unique perfect plan asset allocation.

Asset allocation is a process fraught with second-guessing and twenty-twenty hindsight. Many pension plan sponsors who sat on substantial surpluses in 2000 are sitting in a hole with equally large funding shortfalls today. The answer, in hindsight, would have been more bonds, particularly long duration bonds—at least until March of 2003. This brings up the classic problem of investment – asset allocations are determined ex-ante, not ex-post and good crystal balls are in precious short supply.

When the “answer” for 2000-2002 of “more bonds” is proposed, some plan Chief Investment Officers (CIOs) react with a fair degree of skepticism. They find the ex-ante returns that bonds promise to be unpalatable. They also tend to forget that the same “answer” looked just as unpalatable in 2000...or 1995...or 1990.... They are looking at the world in an asset-only framework—focused on prospects for absolute returns.

Interestingly, when the same “answer” is proposed to others, the reaction is likely to be a hard swallow and a response to the tune of “I see where you are going.” Why the difference? These executives are accustomed to looking at both sides of a balance sheet. They are keenly aware that all assets have associated liabilities. How plan surplus, a.k.a. shareholder’s equity, evolves is a function of the behavior of both assets and liabilities.

The emerging field of behavioral finance is shedding new light on decision-making and investment behavior. One key area is in the issue of framing. The context for viewing an investment decision—the set of information included, the weights given to various outside factors, beliefs about return distributions, the planning horizon—all affect the investment choice. Framing the problem in a particular way may lead to a very different answer than if the problem were cast in a different framework. Closely related to framing is the issue of anchoring.

The classic asset optimization framework as widely practiced has evolved little since pioneered by Harry Markowitz nearly half a century ago. Its ubiquity, combined with the belief that plan assets are invested for the long-run and in the long-run equities outperform bonds, has led to a rule-of-thumb benchmark for asset allocation for pension plan sponsors—two-thirds equity, one-third fixed income. This conceptual anchor is self-reinforcing. “Aggressive” plans are seen as those with equity allocations of 75% or more. “Conservative” plans are those with less than 60% in stocks or equity-like investments.

Over the last few decades as more asset classes have emerged, their acceptance has widened the choice set, but they have been relatively fringe investments for most—a few percent here, a few percent there. The anchoring power of the benchmark remains strong. Plan investment officers are evaluated versus their peers and median plan performance is widely reported in such industry publications as *Pensions & Investments* and *Institutional Investor*. Add to this a cadre of consultants who slice and dice plan performance and offer up exact percentile location relative to a universe of one’s peers. Falling short of the median is cause for concern. “What are we doing wrong?” It may not be so much that a plan is wrong, just different—perhaps with good reason.

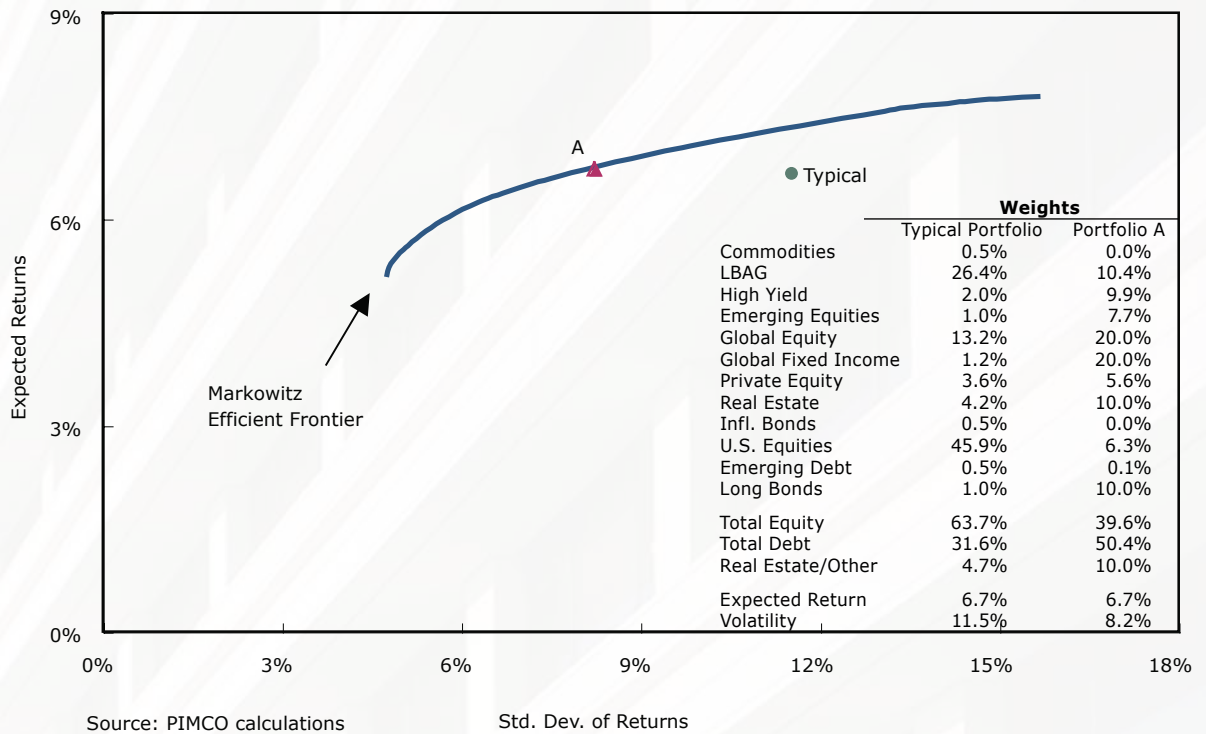
Recently, attention has been paid to a growing number of voices that have argued that the standard paradigm is wrong. These voices are not saying anything particularly new, but their echoes of writings by Black, Tepper, Leibowitz and others from past decades are ringing louder and truer than ever. The purpose of pension plan assets is to fund plan liabilities. As such, what matters is their return dynamics relative to the behavior of liabilities, not on an absolute basis. As plan beneficiaries have a secondary call on the plan sponsor, behavior of the assets and liabilities with respect to the sponsor’s business are important considerations as well.

Point of Departure: Asset-Only Efficient Frontiers

The pioneering work by Harry Markowitz has become a cornerstone of academic finance and the investment management field. Legions of junior faculty received tenure for their refinements and tweaks to the model. Yet by and large, the basic model is still the workhorse for many asset allocation studies. Figure 1 shows an efficient frontier using the traditional Markowitz methodology. (See appendix for return and correlation assumptions.)

The frontier in Figure 1 is constructed using mean, volatility, and correlation assumptions for 12 asset classes. Also indicated are a “typical” asset allocation, drawn from averages for the *Pensions & Investments* Top 1000 plans and a portfolio with the same expected return that lies on the frontier exhibiting lower volatility (Portfolio A). As is common practice, non-core asset classes are constrained to no more than a 10% weight and foreign equities and bonds are limited to a 20% weight.

Figure 1: Traditional Markowitz Asset Frontier



Source: PIMCO calculations

Much has been made regarding the propensity for optimizers to load-up on certain asset classes and create corner solutions. Here we see constraints binding for a number of assets—they are either at the maximum allowable, or have no weight. For example, inflation-indexed bonds and commodities are given no weight as their lower anticipated returns dominate their diversification benefits which have shown to be substantial for some time periods. At the other extreme, a small anticipated premium to global equities and fixed income over their domestic brethren, leads to maximum allowed allocations. Much of the problem lies in the set up. When Markowitz defined his model in the fifties a certain number of limitations were in place that had to be dealt with. Casting return distributions as jointly normal and imposing certainty with respect to expected returns and volatilities made the problem tractable. Today many of the reasons for limiting assumptions, predominantly computing power, no longer exist.

Advances have been made to address many of these limitations—Bayesian methods, Black-Litterman model, and various re-sampling techniques are among the technical advances of note.¹ Lessons learned from all these advances are important and adoption of any of these techniques would make frontier portfolios more robust, but change the frontier little qualitatively. Still there is one key thing missing from the picture presented above. **Liabilities are completely absent.**

¹Bernd Scherer's *Portfolio Construction and Risk Budgeting* provides a nice collected treatment of many models and techniques.

Refocusing to Asset-Liability Space

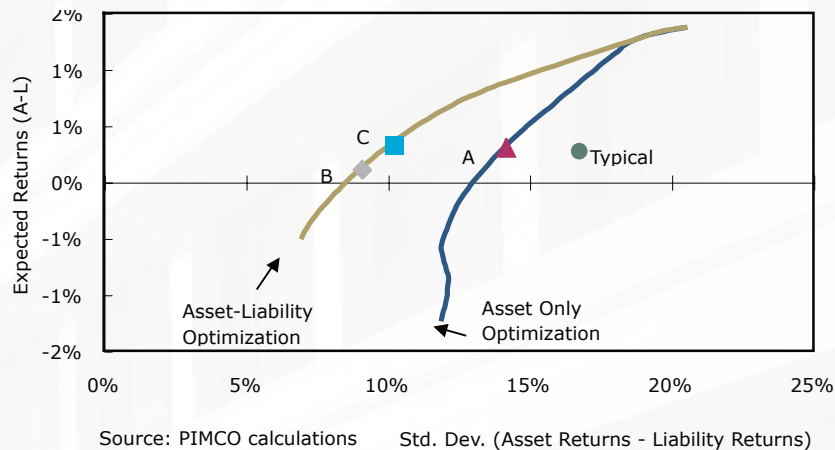
Adding liabilities as a short position fundamentally changes the picture. A common analogy used to convey the idea is baseball. In baseball, you win the game by scoring more runs than the other team. Scoring ten runs is good, but without knowing how many your opponent scored tells you nothing about who won. For a baseball manager, knowing how to fill in a day's lineup—trading off consistent contact hitters versus volatile power hitters—may be a function of how the other team is constructed, where and when the game is played, and who the other team is pitching that day. For the plan manager filling in an investment lineup, excluding liabilities from the analysis is like a baseball manager excluding the other team from his lineup considerations.

In asset-liability space, our expected return measure is relative as is our risk measure. Returns and risk reflect performance of asset portfolios less liability growth. Here we use the return series from the Ryan Labs Liability Benchmark as a proxy for the growth of liabilities in a typical plan. Volatility estimates are taken from the historic time series. Expected growth reflects expectations consistent with the expected asset returns and the duration of the underlying liabilities, approximately 14 years.

The methodology used here enables us to piggyback on the same Markowitz framework used previously and can be viewed as optimization in surplus or balance sheet framework. Other approaches that focus on income or cash flow (required contributions) require different modeling techniques, usually Monte Carlo simulations. These frameworks should yield qualitatively similar results. Where they do not, one or more fundamental modeling assumptions are usually driving results.²

Figure 2 shows an efficient frontier in asset-liability space. The efficient frontier from asset-only optimization is shown as well. Note that the asset-only frontier is shown to be a fair degree riskier when liabilities are considered. Portfolios with the same absolute volatility (Portfolio B) and return (Portfolio C) as Portfolio A are indicated as well.

Figure 2: Frontiers in Asset-Liability Space



Source: PIMCO calculations

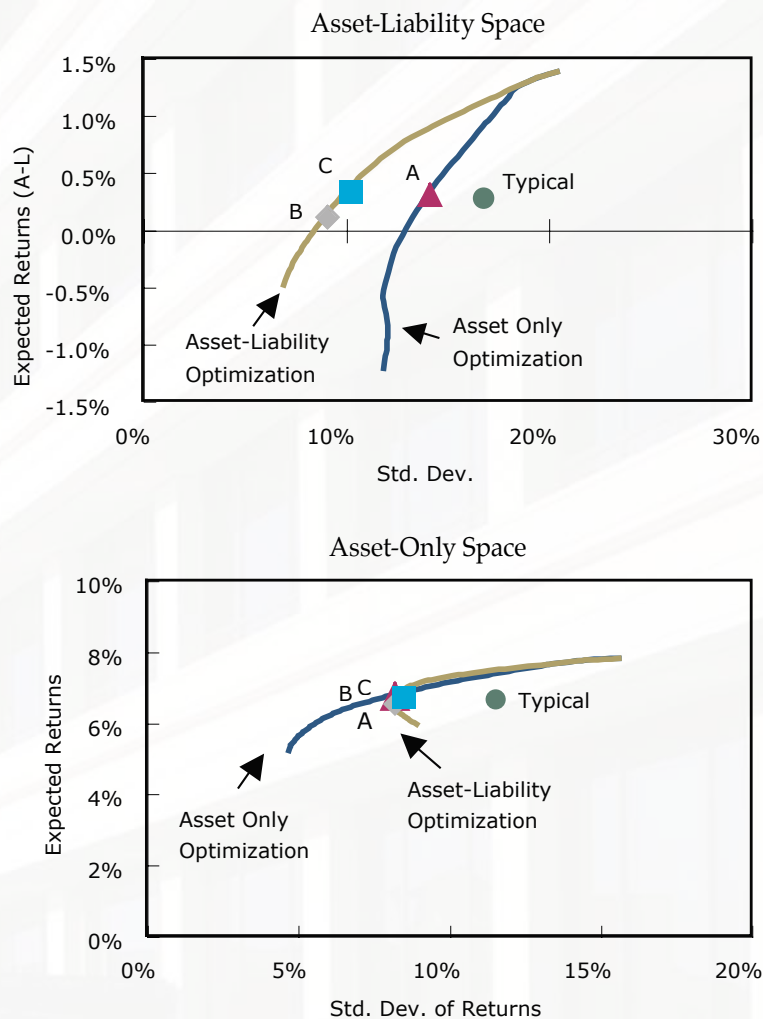
² The common principle drivers of materially different results are 1) very long time horizons for frontier estimation coupled with large assumed equity premia, 2) recognition of full value of terminal surpluses at horizon end, or 3) stochastic processes for equities that incorporate high risk premia and mean reversion.

It is worth noting that while a simple portfolio of two-thirds equities, one-third bonds has an absolute volatility of 12.5% in asset-only space, its volatility in asset-liability space is 17.3% if the plan is fully funded. Roughly 60% of the volatility is attributable to duration shortfall of the assets relative to the liabilities. In asset-liability space the riskless asset is not a short-term cash instrument that protects principal and has a low but certain return, it is the asset that perfectly mimics liability behavior. Among our asset classes, the closest thing to this is our Long Bond index. The furthest point to the left on the asset-liability efficient frontier is a portfolio of 100% long bonds.

Now let's look at the frontiers in asset-liability space and asset-only space side by side (Figure 3). In reality sponsors care both about mismatch and absolute return. Note that the portfolios that exhibit a fair degree of difference in asset-liability space on the left have quite similar risk-return characteristics—even if their compositions differ materially.

In other words, if a plan manager is looking at returns alone, there is little reason to change the portfolio allocation to include more bonds and change the composition of the bond portfolio. But when portfolios are analyzed on the basis of returns over and above liabilities, portfolios more heavily weighted to long bonds provide a similar expected excess return to portfolios with more equities, but funded status is significantly less volatile. Therefore, how we frame the problem makes a considerable difference in the investment decision.

Figure 3: Same Information—Two Different Paradigms



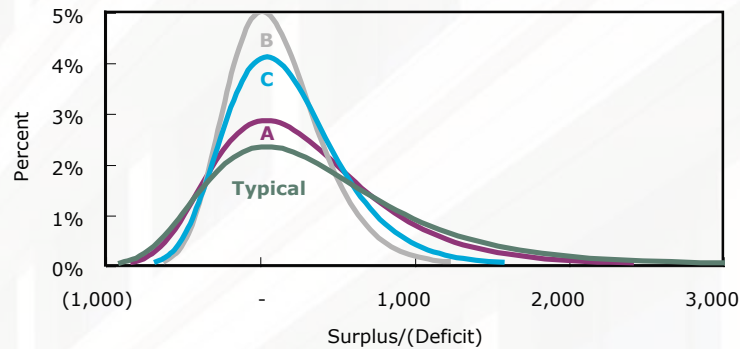
Source: PIMCO calculations

Surplus Volatility

The asset-liability frontiers can also be more informative for characterizing the range of future circumstances as well. As ratings agencies pay more attention to plan deficits and incorporate them into bond ratings, shortfalls in the pension plan have wider consequences for the firm. If lower ratings translate into higher spreads, running plan assets in an asset-liability-volatile manner presents the risk of higher financing cost to the firm.

Figure 4 shows distributions of funded status five years into the future given the various portfolio strategies. Assume that this current billion-dollar plan's future funded status can be mapped into ratings action—a \$300mm asset shortfall triggering a one-notch downgrade, a \$500mm shortfall causing a two-notch rating downgrade. This funding cost occurs in conjunction with additional costs in the form of PBGC variable rate premia. We see that the asset-liability-optimal portfolios give noticeably smaller probabilities of breaching our assumed downgrade triggers. Portfolios B and C cut the likelihood of any downgrade by roughly half. Probability of a severe downgrade triggered by the pension is even more dramatically reduced. Alternatively, this can be viewed as reduction in the likelihood of very large required plan contributions. Unless bankruptcy is a realistic option, the contributions need to be made eventually.

Figure 4: Five-Year Surplus Distributions



	Typical Portfolio	Portfolio A	Portfolio B	Portfolio C
Median Surplus (\$mm)	\$21	\$24	\$7	\$35
Prob (\$300mm shortfall)	22.6%	19.0%	10.5%	12.8%
Prob (\$500mm shortfall)	10.5%	6.7%	1.4%	2.1%

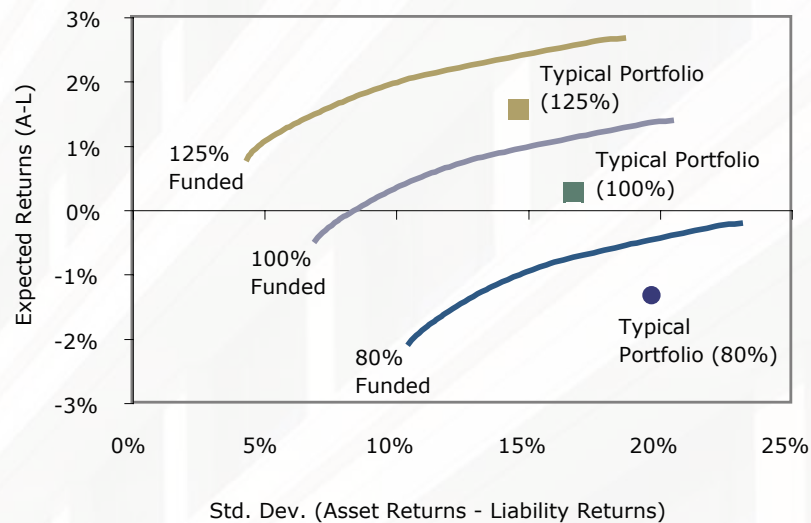
Source: PIMCO calculations

Funding Level and Asset Allocation

Some would contend that while the asset-liability-optimal portfolios chosen reduce downside risk, they also reduce likelihood of building a considerable surplus. This is true. But what is that considerable surplus really worth? Excess plan assets cannot be captured and distributed to shareholders without incurring substantial excise taxes. If plans are collectively bargained, unions may lay claim to the surplus and reduce it through negotiating higher plan benefits. Finally, not too long ago the majority of corporate pension plans enjoyed meaningful surpluses. Many of them now are facing funding deficits.

This raises the question of how the analysis changes with respect to funded status. Figure 5 shows the asset-liability picture altering the funded status from 100% funded to either 125% funded or 80% funded. The asset-liability risk/return profiles are also shown for our typical portfolio. As funding increases, the frontier moves to the Northwest indicating higher expected net returns and lower risk to surplus. The under-funded frontier displays lower net returns and higher volatility. The logic behind this is simple. The over-funded plan has \$125 dollars to cover \$100 of liabilities, each dollar only has to work 80% as hard to keep pace with liabilities. Also as duration shortfall is the biggest risk factor, more assets translate to more dollar duration and close some of the mismatch. The reverse holds for the under-funded plan—each dollar has to perform 125% of the work and the duration shortfall is magnified.

Figure 5: Asset-Liability Frontiers with Different Funding Levels



Source: PIMCO calculations

This translates into more risk for the plan sponsor and a higher likelihood of shortfall. For the fully-funded plan, there is a 55% probability of maintaining full funding in five years with our typical portfolio allocation. For the under-funded plan, there is a 36% probability of returning to full funding without making additional contributions. The likelihood of maintaining the same dollar shortfall is roughly half. This would indicate that the best course of action would be to bite the bullet and fund the plan, issuing debt if need be. Yet aside from a few notable exceptions, most sponsors have not made that choice.

The analysis above is for a static portfolio allocation. What happens when dynamic portfolios are considered? The answer here is usually highly model-dependent. One interesting asset allocation strategy is presented in a paper by Sundaresan and Zapatero.³ Their asset allocation is analogous to delta-hedging an option portfolio where the “delta” is determined by plan funding ratio. Over-funded plans invest more in risky assets, but bring asset allocations toward matching portfolios as the funding ratio approaches one.

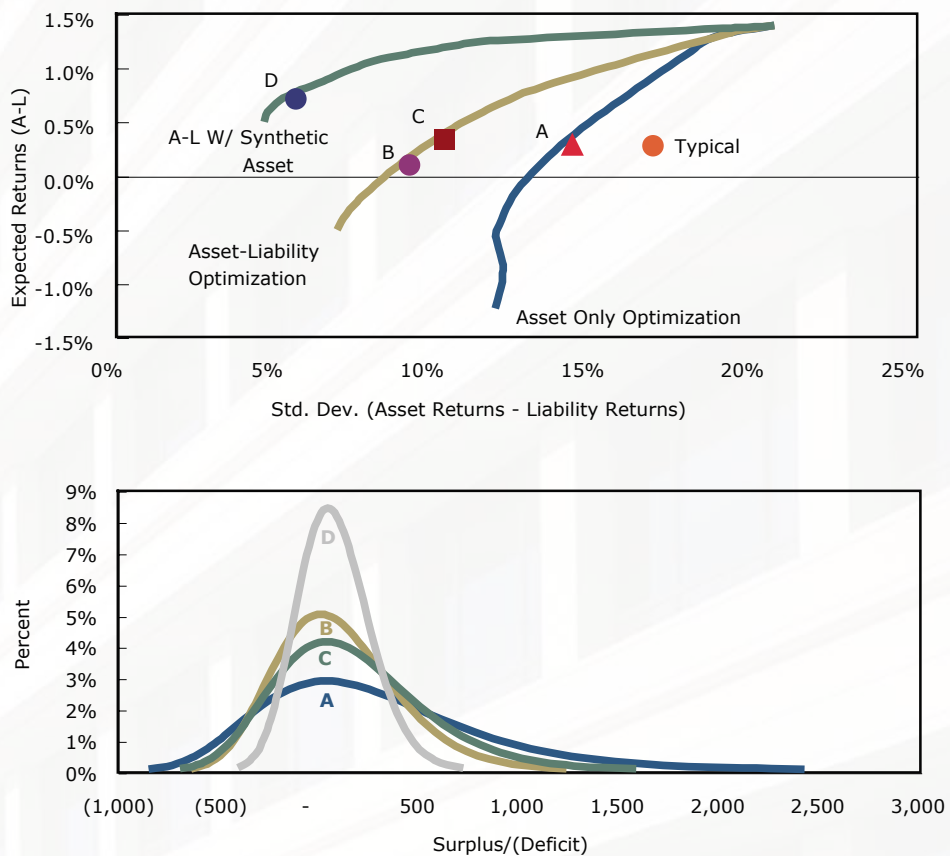
³ See Sundaresan and Zapatero, “Valuation, Optimal Asset Allocation and Retirement Incentives of Pension Plans,” *Review of Financial Studies*, 1997.

Increasing the Opportunity Set

While we have shown that moving into long bonds can reduce risk, inspection of the previous asset-liability frontiers indicates that a significant amount of mismatch risk still remains. Minimum net volatility is still 7% in the fully-funded case. The duration of the Lehman Long-Term Government/Credit (LLGC) index is currently slightly less than eleven years, still short of our liabilities.

To get a portfolio with closer duration a variety of methods can be used. Other indices can be chosen or strips can be used. Usually derivatives, futures or swaps, or leverage provide a more efficient means of providing a better match. Here we solved for a constant leverage level that minimized tracking error with respect to our liability index when applied to the LLGC on a historic basis. This amounts to leveraging the portfolio 1.5x—for every two dollars of notional investment, three dollars is invested in the LLGC and one dollar is short, paying LIBOR. The following figures present the efficient frontiers and five-year horizon surplus/(deficit) distributions.

Figure 6: Impact of Synthetic Assets



	Typical Portfolio	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Median Surplus (\$mm)	\$21	\$24	\$7	\$35	\$50
Prob (\$300mm shortfall)	22.6%	19.0%	10.5%	12.8%	1.1%
Prob (\$500mm shortfall)	10.5%	6.7%	1.4%	2.1%	< 0.1%

Source: PIMCO calculations

In Figure 6 we see that the frontier substituting the synthetic portfolio gives significantly better results. Portfolio D indicates a sample portfolio lying on the frontier. First, our levered portfolio has net volatility of 4.7%. Second, as the term structure is generally upward-sloped, expected returns for the levered LLGC were assumed to be one percent greater than for the unlevered index. In absolute terms, the levered portfolio is more volatile than the traditional portfolio, 13.5% versus 11.5%, but on a net basis it is dramatically less volatile.

This translates into dramatically lower funding risk. Probability of any downgrade attributable to the plan in the next five years falls to one-percent. Likelihood of a two-notch downgrade becomes quite small.

Not All Alpha is Created Equal

In his excellent book, *Pioneering Portfolio Management*, David Swensen, Chief Investment Officer of Yale contends:

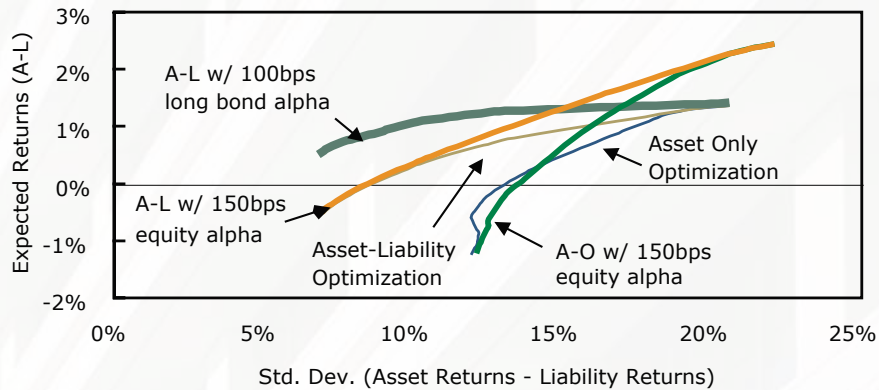
*Active management of high-quality fixed income makes little sense, as U.S. Treasury securities trade in the broadest, deepest, most liquid market in the world. On a bottom-up basis, in competing with the world's most sophisticated financial institutions, managers face little prospect of identifying mispriced assets. From a top-down perspective, when dealing with the staggering variety of variables influencing interest rates, managers face almost certain failure in attempting to time markets. Holding a passively managed portfolio of high-quality, long-term, noncallable bonds best serves a fixed income portfolio's fundamental mission.*⁴

While we at PIMCO would counter that our performance record would indicate otherwise, the purpose of this section is not to debate whether fixed income alpha is obtainable, but whether the fixed income component of the portfolio is the place to seek alpha. Viewed in an asset-liability framework, the answer is a zealous YES!

Identifying managers that can consistently deliver alpha is not an easy task. Suppose that a plan can identify either a manager who can consistently deliver 100 basis points of alpha over long bonds or 150 basis points of alpha on an equity portfolio, but not both. The more-is-always-better rationale would take the equity manager. In asset-liability space the better choice is probably the bond manager.

Figure 7 augments our original asset-liability frontier graph by adding frontiers that incorporate the alpha tradeoff. We see that the asset-liability frontier with the equity-alpha dominates the asset-only frontier with equity alpha. We also see that the asset-liability frontier with the bond-alpha provides a better risk-return tradeoff than asset-liability frontier with equity-alpha over much of the choice set. It is only when the sponsor is willing to entertain substantial asset-liability volatility that leaning towards alpha in equity space is superior.

Figure 7: Impact of Alternate Alpha Sources



Source: PIMCO calculations

Bringing the Sponsor into the Picture

Until now we have for the most part ignored the nature of the plan sponsor’s business in the analysis. Incorporating the sponsor’s business in a thorough way can be a major undertaking. Distilled, integrating the sponsor into the picture amounts to answering the following questions:

- How big is the pension relative to the sponsor? (i.e., PBO versus Market Cap)
- What do the cash flows of the company look like? How volatile and cyclical are they?
- How levered is the company? Alternatively, what is its credit rating?
- What are the demographics of the plan and company workforce?

It should be noted that much of this reasoning can be applied to public pension sponsors or endowments as well. As company cash flows are pseudo-assets that back actual plan assets, taxes play a similar role. States or municipalities that receive a substantial fraction of their income tax from capital gains or tax on individuals in the securities industry have essentially pro-cyclical “businesses.” States that rely heavily on corporate income tax for revenues can be viewed similarly. Logically, if alumni giving tracks market behavior, universities should have some pro-cyclicality as well.

The following table presents three hypothetical company profiles that are essentially composites of actual company fact patterns. Most real-life companies fit one of these fact-patterns or fall somewhere between.

	A	B	C
Industry	Pharmaceuticals	Technology/ Service	Autos
Pension/Firm Market Capitalization	0.1x	0.5x	2.5x
Corporate Revenues	Moderately Volatile, A-Cyclical	Moderately Volatile, Somewhat Cyclical	Volatile, Very Cyclical
Credit Rating (Leverage)	AA/AAA	A	BBB
Plan Demographics	Young 1 retiree : 3 actives	Middle-Aged 2 retirees : 3 actives	Old 3 retirees : 2 actives
Other Considerations	None	Strategic Flexibility	Large Retiree Healthcare Costs

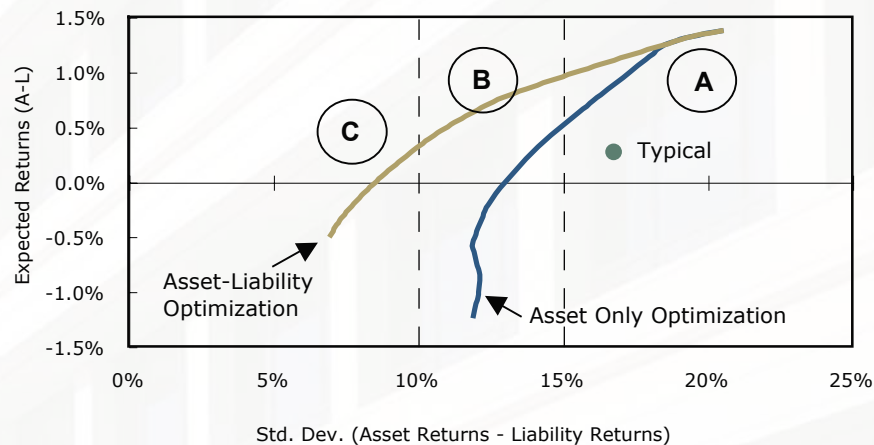
Company A is a pharmaceuticals manufacturer. It is quite large relative to its plan. Revenues are moderately volatile, but volatility is dependent on the success or failure of its research and development pipeline not fluctuations in the broader economy. The company's healthy cashflow and low leverage support a high investment grade rating. The plan's demographics are relatively young as the company has enjoyed tremendous growth over time.

Company B manufactures technology components and provides technology-related service. Its pension plan is a bit larger relative to the sponsor's market cap with more mature demographics. It carries a credit rating of 'A' reflecting moderate leverage and moderately volatile cashflows. The business is somewhat cyclical reflecting swings in hardware sales which are tempered by more predictable service revenues.

Company C is an auto manufacturer. Its pension liabilities are greater than its market cap as are its retiree healthcare liabilities. Making cars is a cyclical business. The pension plans are quite mature as producing cars has become a less labor-intensive business and auto workers can retire relatively earlier than the average American. Company C also has a large retiree medical liability that is largely unfunded and has some meaningful sensitivity to changes in interest rates. The company's credit rating reflects all of these factors.

Figure 8 factors these characteristics into portfolio range recommendations. In company C's case, the tail wags the proverbial dog. Anything more than a small investment in equities exacerbates the company's cyclicality. Company B can tolerate and may benefit from some equity exposure, but probably not a lot. Company A has the wherewithal to withstand a substantial equity exposure as the pension does not materially effect the business. Note that only Company A lies in a region where current levels of equity exposure may be considered prudent.

Figure 8: Taking the Sponsor into Consideration



Source: PIMCO calculations

Also note that the analysis does not include any consideration for taxes. The impact of taxes has been the principal underlying factor examined in the corporate finance-related pension asset allocation literature from Tepper and Black onward.⁵ Incorporating tax effects would move portfolio allocations further toward a higher bond allocation.

⁵ See Gold and Hudson, "Creating Value in Pension Plans – Gentlemen Prefer Bonds," *Journal of Applied Corporate Finance*, 2004 for a nice treatment of the arguments.

Conclusion

We are on the verge of a radically different pension landscape from where we were just a few short years ago. As America, her companies, and her citizens age, carefully managing pension plans becomes a more urgent task for the health of all three. Integrating liabilities and the circumstances of each sponsor into the asset allocation process is a critical step. Just as there is no single optimal capital structure, there is no one-size-fits-all portfolio when it comes to pension asset allocation.

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Appendix: Assumptions

	Return	Vol	Correlation												
Commodities	4.10%	21.00%	1.00	0.03	-0.15	0.09	0.03	-0.04	0.02	0.00	0.06	0.05	0.23	0.00	0.10
Lehman Aggregate	4.90%	6.00%	0.03	1.00	0.57	0.07	0.15	0.78	0.07	-0.05	0.84	0.18	0.36	0.85	0.80
High Yield	7.10%	11.00%	-0.15	0.57	1.00	0.11	0.30	0.49	0.08	-0.06	0.42	0.38	0.33	0.45	0.40
Emerging Equities	9.10%	30.00%	0.09	0.07	0.11	1.00	0.32	-0.01	0.13	-0.04	-0.12	0.24	0.26	0.00	0.00
Global Equity	7.70%	19.00%	0.03	0.15	0.30	0.32	1.00	0.24	0.32	0.09	0.15	0.61	0.21	0.10	0.10
Global Fixed Inc	5.00%	6.00%	-0.04	0.78	0.49	-0.01	0.24	1.00	0.00	0.00	0.75	0.17	0.20	0.65	0.55
Private Equity	9.90%	35.00%	0.02	0.07	0.08	0.13	0.32	0.00	1.00	0.14	0.00	0.61	0.10	0.00	0.00
Real Estate	6.70%	10.00%	0.00	-0.05	-0.06	-0.04	0.09	0.00	0.14	1.00	-0.03	0.15	0.00	0.00	0.00
Infl. Bonds	4.80%	5.00%	0.06	0.84	0.42	-0.12	0.15	0.75	0.00	-0.03	1.00	0.17	0.31	0.75	0.65
US Equities	7.20%	18.00%	0.05	0.18	0.38	0.24	0.61	0.17	0.61	0.15	0.17	1.00	0.21	0.15	0.10
Emerging Debt	7.20%	18.00%	0.23	0.36	0.33	0.26	0.21	0.20	0.10	0.00	0.31	0.21	1.00	0.25	0.20
Lehman Long	5.90%	9.00%	0.00	0.85	0.45	0.00	0.10	0.65	0.00	0.00	0.75	0.15	0.25	1.00	0.95
Liabilities	6.40%	15.00%	0.10	0.80	0.40	0.00	0.10	0.55	0.00	0.00	0.65	0.10	0.20	0.95	1.00

Sources: Rocaton Associates, Lehman Brothers, Ryan Labs, PIMCO estimates

Portfolio Weights and Return Statistics

	Weights				
	Typical Portfolio	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Commodities	0.5%	0.0%	0.0%	0.0%	0.0%
LBAG	26.4%	10.4%	0.0%	0.0%	0.0%
High Yield	2.0%	9.9%	10.0%	10.0%	3.5%
Emerging Equities	1.0%	7.7%	6.1%	10.0%	5.5%
Global Equity	13.2%	20.0%	0.0%	2.3%	0.0%
Global Fixed Income	1.2%	20.0%	0.0%	0.0%	0.0%
Private Equity	3.6%	5.6%	7.3%	10.0%	4.7%
Real Estate	4.2%	10.0%	0.0%	0.0%	0.0%
Infl. Bonds	0.5%	0.0%	0.0%	0.0%	0.0%
US Equities	45.9%	6.3%	0.0%	0.0%	0.0%
Emerging Debt	0.5%	0.1%	0.0%	2.3%	0.0%
Long Bonds	1.0%	10.0%	76.6%	65.4%	0.0%
Levered Long Bonds	0.0%	0.0%	0.0%	0.0%	88.3%
Total Equity	63.7%	39.6%	13.4%	22.3%	11.7%
Total Debt	31.6%	50.4%	86.6%	77.7%	88.3%
Real Estate/ Other	4.7%	10.0%	0.0%	0.0%	0.0%
Expected Return	6.7%	6.7%	6.5%	6.7%	7.2%
Volatility	11.5%	8.2%	8.2%	8.5%	13.5%

Source: PIMCO calculations

The base volatility and correlation assumptions are from consultant data. It is augmented by using the Lehman Long Govt. Credit as a proxy for long bonds and the Ryan Labs Liability Index for plan liabilities.

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Lehman Brothers Aggregate Index (LBAG) is an unmanaged index, considered generally representative of investment-grade fixed income securities issued within the U.S.

Base portfolio: Portfolio A, B, C and D. Past performance is no guarantee of future results. Certain assumptions were made in this analysis, which have resulted in the returns detailed herein. Transaction costs (such as commissions) are not included in the calculation of returns, and changes to the assumptions may have an impact on any returns detailed. Diversification does not ensure against loss. Duration is a measure of price sensitivity expressed in years. The use of derivative instruments for hedging purposes or as part of the investment strategy may involve certain costs and risks such as liquidity risk, interest rate risk, market risk, credit risk, management risk and the risk that a portfolio could not close out a position when it would be most advantageous to do so. Portfolios investing in derivatives could lose more than the principal amount invested.

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