



SOCIETY OF ACTUARIES

Article from:

# Risks and Rewards Newsletter

August 2006 – Issue No. 48

# RISKS AND REWARDS

THE NEWSLETTER OF THE  
INVESTMENT SECTION

PUBLISHED IN SCHAUMBURG, ILL.  
BY THE SOCIETY OF ACTUARIES

## Managing Funding Ratio Risk and Return

by Aaron Meder

**A** sset-liability management is at the top of many pension managers' minds. The key to successful pension-plan investing is finding an investment solution that manages the volatility of asset returns relative to liabilities and generates enough return so that the plan's commitment is fulfilled.

The traditional asset-only approach to pension investing has resulted in portfolios invested in 60 percent to 70 percent equities with the remainder in average duration nominal bonds. These investment policies may be efficient in an asset-only framework but are exposed to unrewarded risk when evaluated relative to liabilities. The asset-only framework does not properly integrate the liability's fundamental exposures to interest rates, inflation and growth. These unrewarded risks were masked by the bull market of the '90s, and subsequently exposed during the perfect storm of falling equities and falling interest rates during the 2000-2002 period.

Constructing an investment policy that achieves both objectives more efficiently is best demonstrated using a case example. We focus on the plan's funding ratio (value of assets divided by value of liability) since it is the funding ratio that ultimately drives plan costs. We will show how funding ratio risk (volatility of the funding ratio) can be significantly reduced without reducing expected return.

Our case example, ABC Corporation, currently has \$927 million in assets, a funding ratio of 90 percent, typical final salary liability profile and a typical asset allocation as described in Figure 1 and Figure 2 on page 5.



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by Aaron Meder

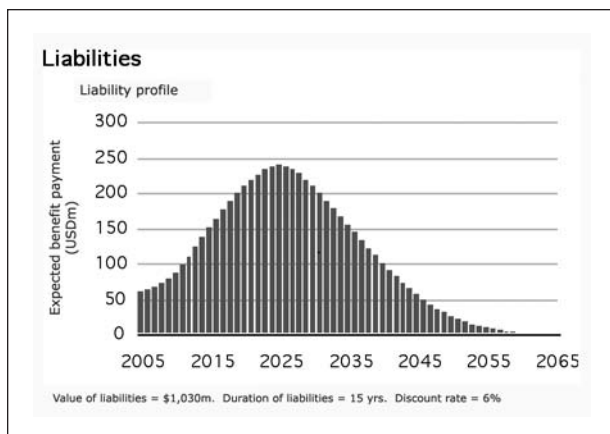
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Figure 1

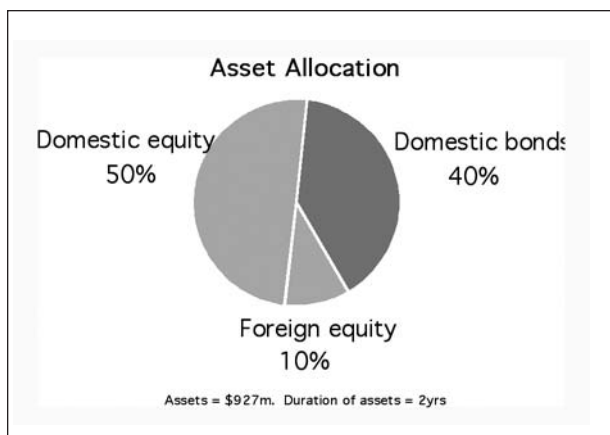


to these fundamental factors, we are able to derive correlations between assets and liabilities that capture the inflation and wage growth risks in addition to the interest rate risk of the liability. With these correlations, we can then develop a portfolio of assets that mimics the exposure of the liability.

For ABC Corporation this liability-mimicking asset portfolio (LMAP) consists of 80 percent long duration nominal bonds, 10 percent equities and 10 percent inflation-linked bonds. The LMAP is the low risk investment in our framework. This means that investing in this portfolio results in the best chance of tracking the liability as it grows and evolves over time. In addition, this is also the appropriate investment benchmark because if the return on the fund's assets beats the return on the LMAP, all stakeholders should be satisfied since the pension promises under-

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Figure 2



To evaluate how assets behave relative to liabilities we explicitly model the liability in the same framework in which we model assets. To do this, we focus on the fundamental factors that influence both assets and liabilities. Recognizing that pension liabilities are the present value of deferred wages and inherently sensitive to changes in interest rates and wage growth, the fundamental factors we select are real rates, inflation, economic growth, the equity premium and the bond premium. By understanding how sensitive both assets and pension liabilities are

Table 1

	Asset-only approach	Funding ratio focused approach
Liability exposures	None	Term structure, inflation, growth
Low risk investment / Benchmark	Cash	Liability mimicking asset portfolio

Table 2

Risk/Return (1yr)	Current (60/40)
Return vs. liability	2.3%
Correlation (A,L)	56%
Funding ratio risk	11%
Prob. FR below 80%	9%
VaR (5%, \$millions)	(150)

## From Page 5

lying the liability will be paid. Table 1 highlights the fundamental differences between the traditional asset-only framework and our funding ratio framework.

With the LMAP calculated, we are ready to analyze the funding ratio risk of ABC's pension plan. Since the LMAP is designed as a best offset to the liability's risks, funding ratio risk can be described as the volatility of a portfolio of assets that is long the investment policy and short the LMAP. Using our proprietary model we are able to analyze the funding ratio risk for ABC Corporation's pension plan given their current investment policy in Table 2.

ABC Corporation's current policy is expected to earn 2.3 percent in excess of the expected liability 'return' as denoted in Table 2. Expected liability return is defined as the return due to the passage of time, i.e., the interest cost of 6.0 percent. We've made the simplifying assumption that future service costs are met with future contributions for this case example, and therefore exclude future service costs from the calculation of liability 'return.'

**... the majority of the assets' interest rate exposure comes from the short end of the curve. This means that even if the level of interest rates stays the same, but the slope and/or shape of the yield curve changes, the plan's funding ratio may be impacted.**

While this return may be adequate to defease the plan's obligations over the long haul, the policy has a funding ratio risk of 11 percent, which means that the plan should expect its funding ratio to drop by at least 11 percent approximately once every seven years. In addition there is a 5 percent chance of the deficit increasing by at least \$150 million over the next year. Large drops in funding ratio and increases in the deficit can have significant adverse consequences, not only for a pension plan, but also for the plan sponsor's earnings, cash flow and balance sheet. Given the nature of looming pension reform, these large drops in funding ratio will carry more severe and immediate penalties. Further, for corporations where the plan is large relative to the

size of the company, the risk of a large drop in funding ratio should be carefully analyzed.

While there are many sources of funding ratio risk, there are three major sources:

**1. Interest rate risk or the duration mismatch between assets and liabilities:** When the duration of the portfolio differs from the duration of the liability, changes in the level of interest rates will impact the value of assets and liabilities in different amounts, thus causing a change in the funding ratio. ABC Corporation's current duration mismatch is large and amounts to approximately 13 years (15-year liability duration minus the two-year duration of the investment portfolio). Further, the majority of the liability's interest rate exposure comes from the long end of the curve and the majority of the assets' interest rate exposure comes from the short end of the curve. This means that even if the level of interest rates stays the same, but the slope and/or shape of the yield curve changes, the plan's funding ratio may be impacted. Thus, for ABC Corporation, large changes in the level, slope or shape of the yield curve can cause large changes in the plan's funding ratio.

**2. Inflation risk:** ABC's liabilities are linked to salary growth and thereby to wage inflation. In addition, many plans have benefit payments that are indexed to inflation (e.g., most of the U.K. plans and the majority of public sector U.S. plans). If actual inflation differs significantly from assumed inflation and the inflation exposure remains unhedged, the funding ratio will be exposed to inflation risk. ABC Corporation's current policy has no allocation to inflation-linked assets.

**3. Equity market risk:** Plans with high allocations to equities in their asset allocation are exposed to a third source of funding ratio risk—equity market risk. While a small allocation to equities will be beneficial for long-term hedging purposes, a high allocation to equities will increase short-horizon risk considerably. ABC Corporation currently has half of its pension plan's assets in domestic equities.

## The ALIS approach

There is no simple one-size-fits-all solution to the pension problem. We are faced with the challenge of building, measuring and managing investment policies that reduce funding-ratio risk while generating enough return to keep the expected cost of defeasing the obligation at a tolerable level.

ABC Corporation could invest in the LMAP and this would be the low risk investment. This means that investing in this portfolio results in the best chance of tracking the liability as it grows and evolves over time. However, by definition, the LMAP is meant to mimic the liability, not outperform it. Thus, it will not provide an expected return in excess of the liability and therefore future service benefits and benefits earned by future participants could only be defeased by future cash contributions.

Often, this low risk strategy will be too expensive for plan sponsors to maintain over the long run. Therefore, in most cases, we do not recommend investing in the low risk portfolio, but only measuring investment risk against it. The challenge is to find the most efficient way to allocate more assets to “higher returning” asset classes, such as equities, while minimizing the amount of unrewarded risk taken versus the liability. This can be approached in two steps. First, hedge unrewarded (liability) risk, and, second, generate returns more efficiently.

### Step 1: Hedge unrewarded risk

First, we must tackle the duration mismatch by reducing interest rate risk—the liability’s largest risk factor. Under most market conditions a plan is not rewarded for a duration mismatch between assets and liabilities. By reducing or eliminating it, we can decrease funding ratio risk significantly. Interest rate derivatives can be used to synthetically represent the interest rate exposure of the liability within selected key rate duration buckets, essentially eliminating the funding ratio risk attributable to changes in the level, slope, and shape of the yield curve. For example, interest rate swaps can be a very efficient way to accomplish this. Additionally, utilizing derivatives to hedge requires far less capital than cash investment, thus, freeing up capital to be invested in “higher returning” assets.

Next, we look at inflation risk. The active cash flows of ABC’s plan are sensitive to salary growth. One part of overall wage growth is wage inflation and wage inflation is linked to general inflation. As a result, the plan needs exposure to asset classes with cash flows that vary with inflation, such as inflation-linked bonds. This is exactly why ABC Corporation’s LMAP includes an allocation to inflation-linked bonds. Plans that provide inflation indexation to retirees are even more sensitive to inflation changes and would require a larger allocation to inflation-linked bonds or inflation swaps.

Finally, we consider real wage growth risk. The active cash flows of ABC’s plan are not only linked to wage inflation, but also to real wage growth. Real wage growth is linked with economic growth through labor’s share of productivity increases. Equities’ cash flows through corporate earnings are also related to economic growth and will provide a long-term link to changes in the liability cash flows attributable to future real wage growth. This is why ABC Corporation’s LMAP includes an allocation to equities.

Thus, by adding an interest rate swap overlay and shifting 10 percent of their assets from nominal bonds to inflation-linked bonds, ABC Corporation can hedge their liability risk with minimal changes to their current cash investment portfolio. The benefits of hedging liabilities this way can be seen below as the first step in Figure 3.

### Step 2: Efficient return generation

To defease the liability as it evolves over time and manage the long-horizon economic cost of the plan, we must also focus on return generation. ABC Corporation’s plan has three weaknesses in its approach to return generation.

- First, it concentrates almost all of the market exposure to domestic assets. Simply by diversifying their equity exposure across the globe, allocating a larger percentage of overall equity beta to foreign equity and emerging market equity, ABC Corporation can increase expected return and decrease funding ratio risk.

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- Second, ABC has a poor balance between alpha and beta. ABC Corporation’s current investment policy only has a 1 percent relative risk budget. By allocating more risk to active management, ABC Corporation can reduce its allocation to market risk and maintain or even increase the returns they need. As a result, allocating more risk towards active management provides an opportunity to further reduce funding ratio volatility and increase return.
- Lastly, ABC Corporation does not take advantage of the illiquidity premium that certain asset classes offer. Like most pension funds, many of ABC Corporation’s obligations don’t come due for over 30 years so they are in a unique position to take advantage of the illiquidity premium the market grants for assets classes such as private

equity and real estate. Taking this final step can further increase return while providing even more diversification.

Thus, to improve return generation we consequently allocate assets to a wider investment universe in search of alpha and we better diversify and dynamically manage the sources of market return. Visually, the benefits of first hedging the liability and then generating return more efficiently can be seen in Figure 3 below.

**Investment Proposal**

Our recommendation includes the use of bonds, and interest rate swaps to manage the impact interest rate changes have on the funding ratio. The remainder of the solution includes a well-diversified portfolio, including domestic equities and inflation linked

Figure 3

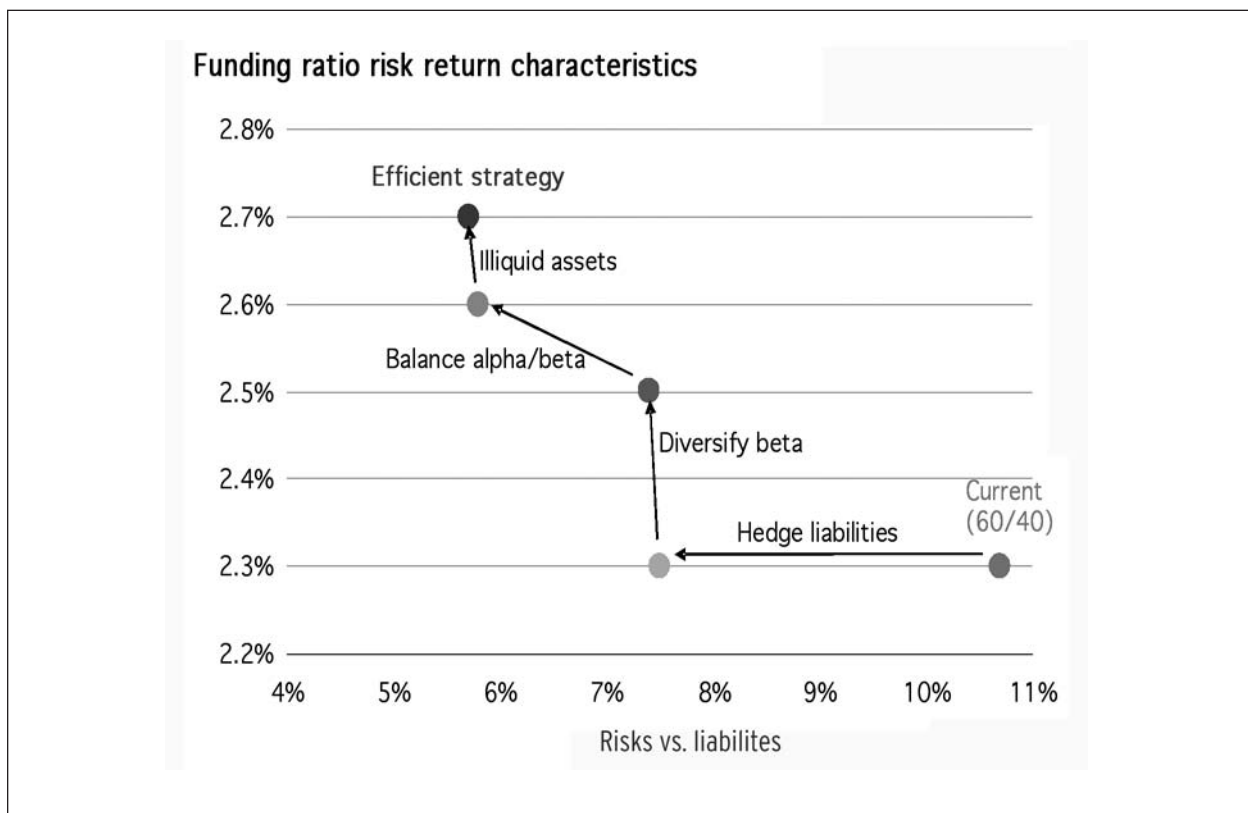




Table 3

Investment policy	60/40	Efficient
Domestic bonds	40%	33
Foreign bonds	0	12
Inflation-linked bonds	0	15
Domestic equity	50	15
Foreign equity	10	10
Emerging market equity	0	5
Private equity	0	5
Real Estate	0	5
<b>Total</b>	<b>100%</b>	<b>100%</b>
Active Risk	1%	2%
Information ratio	0.50	0.50
Asset Duration	2	4
Overlay Duration	0	11
Liability Duration	15	15
Duration Gap	-13	0
<b>Exp Return over liability</b>	<b>2.3%</b>	<b>2.7%</b>
<b>Correlation (A,L)</b>	<b>56%</b>	<b>94%</b>
<b>Funding ratio volatility</b>	<b>11%</b>	<b>6%</b>
<b>Prob. of FR below 80%</b>	<b>9%</b>	<b>&lt;1%</b>
<b>VaR (5%, \$millions)</b>	<b>(150)</b>	<b>(81)</b>

bonds to track the wage growth of the liabilities, and an allocation to illiquid assets to provide further diversification and additional expected return. We also allocate more risk to active management, which allows us to offset the reduced return from lowering the overall equity exposure. Of course, if the manager does not actually deliver a positive alpha, then the expected benefits of active management will not be realized. The current allocation and proposed “efficient” allocation can be seen in Table 3 above.

As Table 3 shows, by taking this approach:

- The correlation between assets and liabilities has been increased significantly and therefore the funding ratio risk has almost been cut in half.
- The probability to fall below 80 percent funding ratio decreased from 9 percent to <1 percent and the worst 5 percent of outcomes are now significantly more tolerable.
- The expected return on assets relative to liabilities has actually increased from 2.3 percent to 2.7

percent. This is mainly due to the fact that capturing a broader set of return opportunities and expected returns from dynamic management of market, currency and security selection and the allocation to the higher returning asset classes of private and emerging market equity more than offsets the reduced overall exposure to equity markets.

### Less Volatility, Better Returns

This example illustrates how modern investment tools along with innovative asset-liability modeling techniques can help pension plans reduce funding ratio risk while keeping or even increasing the expected returns. Thus, this concept offers a promising new approach to sponsors who are willing to lead the way and implement investment solutions that are based on their real objectives—their liabilities. **3**



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