



JENNISON ASSOCIATES

GOOD ALPHAS – BAD BENCHMARKS Recipe for Disappointment

What to Think About When Selecting a Fixed Income Benchmark for Defined Benefit Plans

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**Jennison Associates LLC
1000 Winter Street, Suite 4900
Waltham, MA 02451
781-487-0850**

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EXECUTIVE SUMMARY

- The decline in interest rates and lower asset returns have created serious problems for the many Defined Benefit (DB) plans that have asset/liability mismatches.
- Risk for a pension plan is the risk of underperforming the liabilities, not just having negative asset returns. Pension plans need to focus more on the difference in asset and liability returns.
- The best benchmark is therefore the liabilities themselves, not benchmarks based upon what is available in the asset marketplace. Each plan is different and should have a benchmark based upon its own liability schedule. It is easy to develop a custom benchmark that looks exactly like the liabilities and report the monthly returns. In fact, we recommend reporting the actual liability returns to upper management, along with the asset returns and any market benchmarks.
- Most DB plans have long liabilities, usually with double-digit durations and highly positive convexity – plan benchmarks for fixed income assets should have similar durations and convexities. The liabilities are the best neutral benchmark, and if a plan sponsor desires to make bets on interest rates, they should do so relative to that neutral benchmark – a constant core or core-plus strategy, which has an intermediate duration, is always betting that interest rates will increase.
- Alpha transfer or duration completion strategies based upon adding duration to core portfolios via futures or swaps are not the best ways to structure long duration portfolios for the following reasons:
 - The base index does not have the right duration or convexity characteristics.
 - An overlay strategy adds costs and perhaps negative convexity or a yield curve bet.
 - Good long managers have demonstrated higher alphas than good core managers.
 - While the universe of long securities is obviously smaller than the overall market, nothing precludes long benchmarked managers from using shorter securities when they are attractive. Futures and swaps can be used at that time to extend duration, but shouldn't be part of the strategy all the time.
 - Core-plus strategies may have higher alphas than core, but they don't have diversification value – (i.e., they do well when equities do well).
- The benefit of diversifying against poor equity returns argues for a high quality fixed income benchmark that is usually negatively correlated with equity returns when equity returns are negative.

GOOD ALPHAS – BAD BENCHMARKS

Recipe for Disappointment

Recent markets have been tough on Defined Benefit (DB) plans

With the declines in interest rates over the last several years and the dramatic sell-off in equities from the 2000 highs, DB plans have experienced large declines in asset values and large increases in the present value of their liabilities. Surpluses that existed in many plans have been reduced substantially or disappeared entirely. Those plans that were underfunded have seen very large increases in their level of underfunding. Many companies will be required to make contributions to plans that haven't seen any contributions for many years.

Even with good asset returns, a large decline in interest rates will dramatically increase the liability side of the pension fund balance sheet. We believe that pension sponsors need to refocus on the liability side and reassess what risks they are taking in their pension plans. In this paper we will discuss our ideas on how to benchmark the liabilities and the fixed income part of the asset mix in order to reconnect the asset and liability sides of DB plans. We will define risk for a pension plan, discuss some ways to hedge that risk, and define some possible benchmarks for fixed income that accomplish that goal. We **are not** saying that this is necessarily the right time to adjust your asset mix or your fixed income benchmark. We **are** saying that more focus should be given to the liabilities in establishing your asset strategy.

Risk in DB plans

First, we need to understand the idea that risk in a DB plan is the risk of underperforming the liabilities, not just the chance of having negative returns on assets. The zero-risk portfolio is, therefore, a portfolio of Treasury bonds that is perfectly cash-matched to the liabilities. If a plan has sufficient assets to do this, this portfolio could be put away in a drawer with the certainty that the liabilities would be met, no matter what happens in the markets.¹ The obvious problem with this solution is that you have exchanged complete security for a higher cost of meeting the liabilities. Most DB plans have not desired this level of security when it means sacrificing probable higher returns from markets other than Treasury bonds.

Instead, in an attempt to reduce the cost of funding DB plans, most companies have pursued other assets classes that, it is hoped, will generate higher returns, and a corresponding lower cost than just Treasury bonds. Initially, this meant moving into relatively high quality corporate bonds, but the pursuit of higher fixed income returns extended into mortgages, lower quality corporates (including high yield), foreign bonds, etc. The farther down the list, the greater the potential for additional return, but also, the smaller the correlation with Treasury returns and, therefore, with liability returns. The search for higher returns continued to domestic equities, foreign equities, private equity, and other non-fixed income instruments, many of which actually have, or often have, negative return correlation with the liabilities. This search for higher returns has resulted in many plans focusing on asset returns

¹ This paper is a broad overview of this subject and as such some simplifying assumptions are in order. Here we assume no actuarial changes from year to year in the liabilities. Obviously, yearly adjustments would need to be made in a real life situation.

only, and over the years, with good returns on non-Treasury asset classes, the goal of defeasing the liabilities has receded into the background. Absolute return has become the goal for the asset side of DB plans, with less and less regard for the liabilities.

Historical overview

The focus on absolute return led DB plans to greater and greater allocations to non-fixed income instruments, especially as the bond market performed poorly in the late 1970's and early 1980's. Even with the drop in rates that occurred in the mid-1980's, rates were still higher than in prior decades, and liability returns, if anyone had bothered to calculate them, were very low or negative. As a result, no one worried about the liability side of the equation as long as rates remained relatively high and the non-fixed income markets did well. Funding ratios expanded and contributions to DB plans disappeared into the 1990's and even into 2000. This has now changed as the decline in interest rates and the poor equity returns in 2001 and 2002 have refocused pension sponsors on the liability side of the plan. However, before looking at the effect of the reversal of equity returns and bond returns in the past decade, we need to look more at some of the effects of the high asset returns during the 1990's.

Since asset returns were the rage, specialization of equity management became important, and there was a proliferation of all kinds of "cap" managers – large cap, small cap, large cap growth, value, etc., etc., etc. Beating the market became the focus, whether the market was defined as the S&P 500, the Russell 1000 or any one of a number of other indices. And then, the really dangerous thing happened – this "beat the market" rationale was carried over into the fixed income market, and we saw the development of "broad market" indices that became the new benchmark to beat. Additionally, the broad fixed income market, which is, on average, intermediate in nature, became the benchmark of choice for fixed income assets in DB plans. Thus, all connection to the liabilities was lost. Core and Core-plus strategies were designed to beat the broad market benchmarks – no one cared about beating liability returns – only the asset side mattered.

The research during this time contributed to the disconnect between assets and liabilities in DB plans. The "efficient frontier" became a popular new buzz phrase and the concept was widely adopted as the way to structure a portfolio of assets to maximize return versus risk. The trouble is that the riskless asset was defined as cash. While it is true that cash is a riskless asset in that you can't lose money (ignoring inflation), it is absolutely not the riskless asset for a DB plan. We've already defined the riskless asset for a DB plan, and that is a portfolio of Treasuries cash matched to the liability schedule.

Not only was the riskless asset misdefined, but also many of these asset liability studies assumed a single return for fixed income, mainly based upon historical returns. There is a problem with this kind of approach. In times when the yield curve is strongly positive, or strongly negative, picking a single rate for fixed income is problematic – 5-year Treasuries at year-end 2003 yielded 3.25% and long Treasuries yielded 5.08% - which is the right one to select?

The right benchmark for DB plans

By now you may have gathered that we at Jennison believe that the benchmark for a DB plan should be the liabilities. In our opinion, liability matching (not necessarily with all Treasuries), should be the neutral position for DB plans. Tactical decisions should be made around that benchmark. If a plan sponsor wants to do some market timing, they should at least do so in the knowledge of what benchmark they are market timing around – those with core strategies over the last few years have always been making a bet that interest rates will rise.

Once you accept the premise that the liabilities should be the benchmark, you need to spend some time looking at the characteristics of the liabilities. First, for most plans, the liabilities are fairly long – even mature plans, with high current payouts to retirees, have double-digit durations. Some less mature plans, with generally younger lives, have durations in excess of 20 years. Second, the liabilities are positively convex – at a 10 year duration, most liability schedules would have convexities on the order of 2 years. At a 15 year duration, convexities are in the 3-4 range, depending on the exact pattern of the flows.

An appropriate benchmark should reflect these important characteristics of the liabilities. First, and most important is getting the duration right. But what is the right way to match the duration of the liabilities? Should we use a longer market benchmark – like the Lehman Long Government/Credit Index, which has a modified duration of about 11 years? Or should we construct a custom benchmark that looks very much like the liabilities? Or maybe we should use some overlay strategy that adds duration to existing core or core-plus strategies?

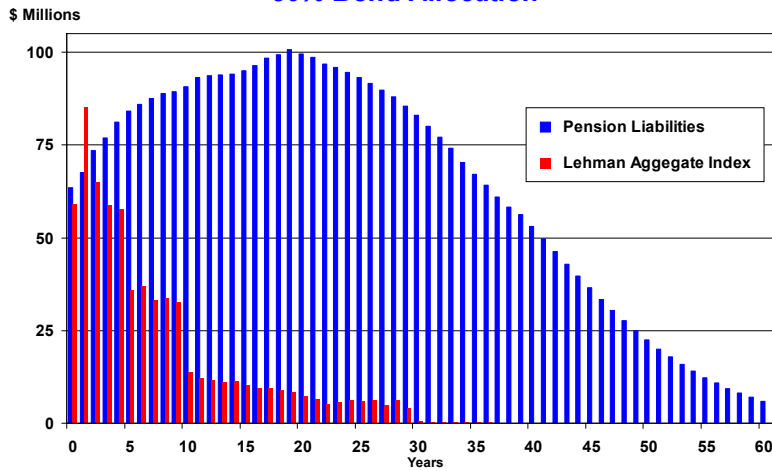
Overlay strategies

Let's deal with the last question first, and then move on to analyze other strategies. The argument for using an overlay strategy on top of existing core or core-plus strategies rests on two premises. The basic premise is that core or core-plus benchmarks are a good place to start because they represent "the market." While "the market" may be a reasonable benchmark for equity portfolios, there is no reason to think that that's true for fixed income markets. Fixed income instruments have durations that can be compared to the duration of the liabilities, and duration is the single largest determinant of liability returns as interest rates move. Why have a benchmark that starts with a duration that is intermediate in nature, when your liabilities are much longer? Why not just structure a market benchmark that reflects the liability duration from the start? By doing this, you don't force the manager to always have a duration extending derivative strategy on, even if futures or swaps are not necessarily attractive. Additionally, on the negative side, there is always some cost to putting on an overlay strategy no matter how it is done – why incur that cost at all?

Another drawback of the overlay strategy is that the core index is negatively convex. Adding futures, which is one way to lengthen duration, will often increase that negative convexity. As we pointed out earlier, liability schedules have significant positive convexity. It follows that it must be better to start with an index that has positive convexity. Additionally, beginning with a core benchmark may force the manager into a yield curve structure that is

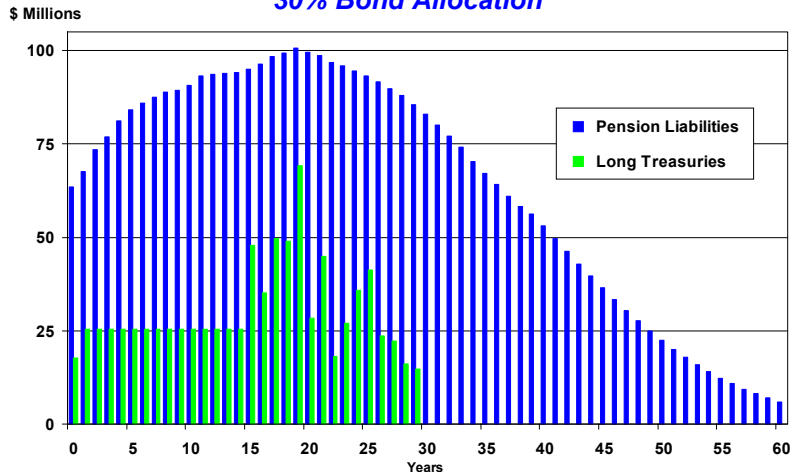
different from the liabilities. See the charts below comparing the cashflows of 30% allocations to the Lehman Aggregate Index and the Merrill Lynch Treasury 15+ Year Index against a typical liability schedule for a fairly mature plan (duration of about 10 years). Note how the Aggregate cashflows are much more front-loaded.

**PENSION LIABILITIES vs
LEHMAN AGGREGATE INDEX**
30% Bond Allocation



Source: Lehman Brothers / Jennison Associates

**PENSION LIABILITIES vs MERRILL LYNCH
LONG TREASURY INDEX (G802)**
30% Bond Allocation



Source: Merrill Lynch / Jennison Associates

The rationale for the overlay strategy also relies on the premise that managers can add a larger alpha with a core benchmark and that that alpha can be transferred to a longer duration strategy using futures, swaps or other derivative strategies. The argument here is that having a larger number of securities and sectors to choose from, as you do with a broad market benchmark, will result in higher alphas because there are more opportunities to bet against the benchmark. This idea confuses the benchmark with the universe of available securities that a manager is permitted to use in a portfolio. The two are not the same – the benchmark is what a manager is trying to beat – the permitted securities are set in the account guidelines – there is no reason that guidelines for a longer benchmarked account should proscribe the use of shorter securities. Indeed, the universe of available securities can be the same no matter what the benchmark as long as derivative strategies are permitted. It should be up to the manager to make judgments as to which sectors are cheap or rich and to decide on the most attractive way to match duration to the benchmark.

Simple bond mathematics suggests that for active managers, good sector or credit decisions on the long end of the market generate higher alphas than good decisions in intermediates. Look at the table below that shows the price change from changes in spreads across the yield curve.

TABLE I

LONG BONDS OFFER BIGGER PAYOFF FROM CORRECT SPREAD JUDGEMENTS (Instantaneous Shift)

6.00% Corporate Bond

<u>Beginning Maturity</u>	Bond Price Change if Yield Spreads:			
	<u>Narrow By:</u>		<u>Widen By:</u>	
	<u>50 bp</u>	<u>10 bp</u>	<u>10 bp</u>	<u>50 bp</u>
2 Year	+0.9%	+0.2%	-0.2%	-0.9%
5 Year	+2.2	+0.4	-0.4	-2.1
10 Year	+3.8	+0.7	-0.7	-3.6
30 Year	+7.3	+1.4	-1.4	-6.6

If an active manager makes a good spread decision on a long bond purchase, and the spread narrows by 10 basis points, that is a price gain of 1.4% - while a 10 basis point move on a 5-year bond only makes 0.4%. If you have confidence in the decision making of your manager, a long manager should have a higher alpha than an equally good decision maker in the intermediate area.

Can we prove the above theoretical analysis by looking at existing data? We believe that we can do a pretty good job by looking at the historical alphas of core and long managers. We looked at the published data from both Mercer² and Frank Russell³ showing the gross alpha for top quartile core managers over the last five and ten-year periods ending with the third quarter of 2003. For the Mercer data, the alphas were 40 and 30 basis points for 5 years and 10 years respectively. The corresponding alphas for the Russell universe were 59 and 50 basis points. We'd like to compare those top-quartile alphas to those of the top-quartile managers of long duration accounts but good data is much more difficult to obtain. Mercer has data versus the Lehman Long Government/Credit Index, and their 5 and 10-year alphas for the top quartile are 90 and 100 basis points respectively – which tends to prove our point. However, this is a much smaller universe of managers than the core universe so these results might be suspect. Generic long manager data from Piper⁴ is available but there is no specific benchmark for those managers. There is a wide difference in durations of many “long” benchmarks - anywhere from 7.3 (Salomon “Long” Pension Fund Index - which is not so long) to 25 years for some zero coupon benchmarks. Those ranges make it difficult to compare results and obtain a “long” duration alpha like the more homogeneous core (Lehman Aggregate or Salomon Broad) benchmarks. We can give the results for Jennison, however, and our long composite (about a 10 year duration) shows 5 and 10-year alphas of 92 and 63 basis points, and our extra-long composite (about a 14 year duration) shows corresponding alphas of 192 and 153 basis points respectively - significantly better than those for the top quartile core data.⁵

We would also point out that the Jennison long alpha was generated with quite high quality portfolios. Our long-term average credit quality has been better than double-A. We suspect that much of the alpha realized in the core and core-plus strategies has been accomplished by systematically investing in lower quality bonds.

In summary, we don't believe there is any justification for the argument that the alpha for core accounts is or should be higher than the alpha on longer benchmarked accounts. Furthermore, the characteristics of the typical core benchmark, like the Lehman Aggregate, are not at all similar to the characteristics of the liabilities. Not only would you have to pay the costs of a derivative overlay strategy, but there are other shortcomings as well. The most glaring shortcoming is that the convexity of the Lehman Aggregate as of year-end 2003 is -0.29 years. As stated above, liability schedules tend to have strongly positive convexities, usually well in excess of 2 years. (See the highlighted box in Appendix A for the effect of the positive convexity of a typical liability schedule.) This mismatch of convexity means an additional difficulty for duration overlay strategies, especially in volatile markets. Extending duration with long bond futures, for example, would result in an even more negatively convex benchmark as the long future has negative convexity on its own. Why bother with this kind of problem when most long benchmarks have positive convexity – i.e. the Lehman Long Government/Credit Index has a positive convexity of 1.81 years (If you use long

² *Source:* Mercer Manager Performance Analytics 2003

³ *Source:* Russell / Mellon Analytical Services LLC 2003

⁴ *Source:* Pensions & Investments Publication 2003

⁵ Please see important notes to performance at the end of this paper for more information on Jennison's long duration composites.

futures to add duration to the Lehman Aggregate the convexity would be approximately **negative** 1.04 years). And, if you need a longer benchmark than is available in the coupon market, consider long zero coupon indices or at least longer coupon indices that need a minimum of additional duration supplied by derivatives.

To put some numbers to the value of convexity, assume you have a \$1 billion fixed income portfolio with a duration of 12 and a convexity of 3. If rates drop 100 basis points, the portfolio will be up roughly 13.5% (12 plus ½ the convexity). If the portfolio has a zero convexity, it will only be up 12%. That's a difference of 150 basis points – a very big number relative to the alpha of even the best managers.

Using swaps to extend duration also has its drawbacks. There is not a viable long-term swap market – the 10-year swap is the longest liquid swap contract. This means that using swaps to extend a core portfolio forces a yield curve bet versus the liabilities. You could have to overweight the middle of the yield curve even when that is not an attractive part of the curve.

Existing Long Market Benchmarks

Better than the overlay strategies are existing long market benchmarks. Most of them have the basic characteristics that make up a good proxy for liabilities, i.e. long duration and positive convexity (see Table II below). If you can match these characteristics of a given benchmark to the liabilities, you at least have a good starting point.

TABLE II

As of 12/31/2003

<u>Index</u>	<u>Duration</u>	<u>Convexity</u>	<u>Quality*</u>
Salomon 25-Year Zero	22.85	5.34	10
Salomon 20-Year Zero	18.20	3.41	10
Salomon 30-Year Treasury	13.76	2.82	10
Lehman Treasury 20+	12.93	2.47	10
Merrill Lynch Treasury 15+	11.54	1.96	10
Lehman Long Gov/Credit	10.81	1.81	7
Lehman Treasury 10+	10.61	1.67	10
Salomon Large Pension Fund	7.26	0.32	8
Lehman Aggregate extended with Long Futures to Lehman Long G/C	10.81	-1.04	7
Lehman Aggregate	4.50	-0.29	7

* Where 10 is Treasury, 9 is Agency, 8 is AAA Corporate, 7 is AA Corporate, etc.

The next point to consider is the degree of diversification versus equities (assuming the plan is not all fixed income). Generally speaking, the higher the quality of the benchmark, the greater the negative correlation of returns with equity returns, at least in the times when equities are doing poorly – and long high quality bond returns have been negatively correlated with equities surprisingly often (see Table III below).

TABLE III

ARE LONG BONDS A GOOD DIVERSIFIER?

Return Correlation: Long Governments vs. Equities – 1926 – 2003

<u>Period / Condition</u>	<u># Years (5) Correlation Was:</u>		
	<u># of Years</u>	<u>Negative</u>	<u>Positive</u>
Entire Series	78	34 (44%)	44 (56%)
Stock Return Negative	23	18 (78%)	5 (22%)
Stock Return Negative and Inflation <4%	15	14 (93%)	1 (7%)

Source: Ibbotson Associates

This implies that the greater the percentage of equities held in the plan, the higher quality the fixed income benchmark should be. A DB plan with a very high percentage of equities might well want to have an all-Treasury or all-Government benchmark to gain maximum diversification as negative correlation produces “alpha” in its own right. If you maintain a constant mix (i.e., 70/30) between stocks and high quality bonds, the ability to rebalance between the two assets classes when they are negatively correlated can add as much as 50 basis points to the entire plan performance, depending upon volatility.⁶ Fixed income assets that are often positively correlated to equities (such as high yield), do not accrue this diversification benefit.

Customized Benchmarks

A benchmark customized to the liabilities (which we have created for several clients) consists of the actual liability payments viewed as a series of zero coupon Treasury bonds that precisely match the cashflows of the liability schedule. To that sequence of yields one can add a suitable spread (maybe the OAS of the Lehman Long Gov/Credit) and price that portfolio of zeroes each month at the Treasury rate plus the spread. Then one can calculate monthly returns and link them to calculate quarterly and annual benchmark returns. The bond portfolio returns could then be measured against this benchmark- a benchmark that precisely matches the liabilities, not only just in modified duration and convexity, but also in partial (key-rate) durations too.

⁶ Our 2001 study on the value of diversification in DB plans is available on request and goes into this discussion in more depth.

Other Considerations

Most of the above discussion assumes a DB plan has decided to use the duration of the liabilities for setting the duration of the benchmark for fixed income assets. It might be that even a liability matched benchmark is too short. Take, for example, a plan that is large relative to the size of the company itself. And assume that the stock/bond mix is 70/30 – a fairly typical asset mix. Even if the duration of the bond assets is equal to the duration of the liabilities, there is still substantial interest rate risk in the plan. Changes in the present value of the liabilities are 100% linked to interest rate moves, while only 30% of the assets are. If equities do not outperform the liability return (imagine a scenario just half as bad as what has occurred in Japan over the last 15 years), the present value of the liabilities will grow much more than the assets, and in an extreme enough situation, could affect the viability of the plan sponsor. In a case like this, a sponsor might want to hedge the change in liability present value (and the funded status) by extending the duration of the fixed income by a factor equal to 100% (total plan)/30% (the fixed income allocation), and thus take all the interest rate risk out of the plan.

To sort this all out we would typically do a number of scenarios with various assumptions for stock and bond returns to look at the resulting changes to funded status. The answer is different for every plan depending upon the stock/bond mix, the starting funded status, the size of the plan relative to the company, risk tolerance, and a number of other factors.

Conclusion

Whatever the final decision on the exact duration target, there are several points we would emphasize in setting the right benchmark:

1. Focus on the liability characteristics when setting the type of benchmark you want - benchmark duration **and** convexity are the most important considerations. **A great alpha on a bad benchmark doesn't get the job done.**
2. Assuming a plan has decided on having long duration exposure, a long market benchmark is a better starting point than a core benchmark, no matter what the final duration target is.
3. Consider a custom benchmark made up of Treasury zeroes, with or without a corporate spread added – all plans are different and customizing is easy.
4. The larger the equity exposure, the higher benchmark quality should be – diversification versus equities is very valuable. High quality bond returns are much more negatively correlated to equity returns than high yield and emerging markets.
5. Know what it is you are trying to hedge – interest rate exposure for just the fixed income assets, or for the entire plan.

APPENDIX A

Hedging Funded Status

Here is an example using the actual liability schedule from one of our clients. The issue here is what happens to funded status over a variety of scenarios. We are using a 65/35 stock/bond mix and beginning at year-end 2003. The first table shows the sensitivity of the present value of the liabilities to changes in rates. The central rate is 5.5%, approximately the yield on the Lehman Long Gov/Credit at year-end, and the horizon is one year. As you can see, at the central rate the present value of the liability schedule is about \$3 billion, the modified duration is 15.35 years, and the convexity is 3.6 years.

<u>Rate</u>	<u>Present Value (MM)</u>	<u>Percentage Change in Present Value</u>	<u>PV (\$MM) (1 yr horizon)</u>	<u>PV (\$MM) Change (1 yr horizon)</u>	<u>% Change (1 yr horizon)</u>
2.5%	\$4979	67%	\$5104	\$2114	70.70%
3.5	4140	38	4285	1295	43.31
4.5	3494	17	3651	661	22.11
5.5	2990	0	3154	164	5.50
6.5	2590	-13	2759	-231	-7.73
7.5	2270	-24	2440	-550	-18.39
8.5	2009	-33	2180	-810	-27.09

Notice especially the effects of positive convexity - in the third column of the above table the percentage increase in present value for down 300 basis points is much larger in magnitude than the percentage decline for up 300 basis points. This is why it is critical to have a positively convex benchmark that mimics this behavior of the liabilities.

The next set of tables shows the change in funded status for various assumptions and benchmarks. For equities we calculated 7 scenarios: up and down 30% in 10% increments. For fixed income we used the same assumptions for rate changes as in the above table. Each table below uses a different benchmark for the fixed income allocation and we calculate the funded status for each set of assumptions and for each benchmark. The scenarios that show a loss of funded status are highlighted in blue.

CHANGES IN FUNDED STATUS

1-year horizon – starting rate assumption 5.5%, \$3 billion liability present value

Lehman Long Government/Credit Index - modified duration = 10.81 Years

		Stock Return (%)					
Rate Change (bp)	<u>-30</u>	<u>-20</u>	<u>-10</u>	<u>0</u>	<u>10</u>	<u>20</u>	<u>30</u>
-300	-2209	-2015	-1821	-1626	-1432	-1238	-1043
-200	-1557	-1362	-1168	-974	-779	-585	-391
-100	-1063	-868	-674	-480	-285	-91	103
0	-686	-491	-297	-103	92	286	480
100	-393	-199	-4	190	384	579	773
200	-162	32	227	421	615	810	1004
300	23	218	412	606	801	995	1189

Lehman Treasury 20+ Index - modified duration = 12.93 Years

		Stock Return (%)					
Rate Change (bp)	<u>-30</u>	<u>-20</u>	<u>-10</u>	<u>0</u>	<u>10</u>	<u>20</u>	<u>30</u>
-300	-2095	-1901	-1707	-1512	-1318	-1124	-929
-200	-1495	-1301	-1106	-912	-718	-523	-329
-100	-1040	-846	-652	-457	-263	-69	126
0	-693	-499	-305	-110	84	278	473
100	-421	-227	-32	162	356	551	745
200	-205	-11	184	378	572	767	961
300	-31	163	358	552	746	941	1135

Salomon 25-Year Zero Index - modified duration = 22.85 Years

		Stock Return (%)					
Rate Change (bp)	<u>-30</u>	<u>-20</u>	<u>-10</u>	<u>0</u>	<u>10</u>	<u>20</u>	<u>30</u>
-300	-1484	-1290	-1096	-901	-707	-512	-318
-200	-1146	-951	-757	-562	-368	-174	21
-100	-889	-695	-500	-306	-112	83	277
0	-691	-497	-303	-108	86	280	475
100	-530	-335	-141	53	248	442	637
200	-397	-203	-9	186	380	574	769
300	-283	-89	105	300	494	689	883

Note that the longer the duration of the benchmark, the less the loss in funding status if rates drop, regardless of the equity return. Theoretically, if you wanted to hedge the funding risk to a certain rate move (assuming no equity change), say down 200 basis points, you can calculate the duration of the 35% bond position that would result in a no worse funding position if rates do drop by that much:

PV of liabilities at 3.5% = 4140 and at 5.5% on 12/31/03 = 2990 - so we need to earn 1150MM on the 1050 MM bond position - that is a 1150/1050 or a 110% return - then divide by 2 (move is 200 b.p.) and the duration you need is about 55 years. (The actual number is somewhat lower because of convexity effects.) Another way to get there is to take the duration of the liabilities (15.35) and multiply by 2.857 (100 divided by the 35% bond position) which gives you about 44 years - this has to be adjusted also for convexity as the liabilities get longer as rates drop and again you come to some number in the 50+ year duration area.

While we are not suggesting that a pension plan should hedge all of its interest rate risk, this kind of analysis shows the possible damage to funding status should we have an economic downturn for several years. A large drop in rates, combined with a flat or down stock market (as occurred in Japan for about 15 years), would be a disaster for most US pension plans, and possibly for the company sponsors too if the pension plan liability is large relative to the size of the company.

Notes:

Past performance is not indicative of future results. Performance results are calculated in US dollars and reflect reinvestment of income and other earnings. Performance results fluctuate, and there can be no assurances that objectives will be achieved.

The **Lehman US Aggregate Index** includes all fixed rate debt issues rated investment grade or higher by Moody's, Standard & Poor's or Fitch

The **Lehman Government/Credit Bond Index** is composed of all bonds that are investment grade (rated BAA or higher by Moody's or BBB or higher by S&P, if unrated by Moody's). Issues must have at least one year to maturity. Total return comprises price appreciation/depreciation and income as a percentage of the original investment.

The **Lehman US Long Government/Credit Index** consists of all bonds covered by the Lehman US Government/Credit Index with maturities of 10 years or greater. Total return comprises price appreciation/depreciation and income as a percentage of the original investment.

The **Lehman US Treasury Index** is composed of all US Treasury publicly issued obligations and includes only notes and bonds with a minimum maturity of one year. Flower bonds are excluded.

The **Lehman US 10+ Treasury Index** is comprised of all bonds covered by the Lehman US Treasury Index with maturities of 10 years or greater.

The **Lehman US 20+ Treasury Index** is comprised of all bonds covered by the Lehman US Treasury Index with maturities of 20 years or greater.

The **Merrill Lynch G802 15+ Year Index** is comprised of US Treasury securities with maturities over 15 years.

The **Salomon Broad Investment-Grade (BIG) Bond Index** The BIG Index is market capitalization weighted and includes fixed-rate Treasury, government-sponsored, mortgage, asset-backed, and investment-grade issues (BBB or Baa3) with a maturity of one year or longer. The minimum amount outstanding for US Treasury and government-sponsored issues is \$1 billion. For mortgage issues, the minimum amount outstanding is \$5 billion per coupon and \$1 billion per origination year generics for entry; and \$2.5 billion per coupon and \$1 billion per origination year generics for exit. For credit and asset-backed issues, the entry and exit amounts are \$250 million.

The **Salomon 30 Year Treasury Index** is comprised of the longest five coupon bearing Treasury issues outstanding.

The **Salomon Large Pension Fund (LPF) Baseline Index** includes Treasury, government-sponsored, asset-backed, and credit securities with a minimum maturity of seven years and a minimum amount outstanding of \$1 billion for US Treasuries and government-sponsored issues, and \$250 million for credit and asset-backed issues. Mortgage securities remain consistent with those in the Salomon Broad Index. This index is weighted 40% Treasury/Government-Sponsored, 30% Collateralized, and 30% Credit.

The **Salomon 20-Year Zero Index** is comprised of U.S. Treasury Principal and Coupon Strips with maturities averaging 20 years.

The **Salomon 25-Year Zero Index** is comprised of U.S. Treasury Principal and Coupon Strips with maturities averaging 25 years.

The **Standard & Poor's 500 (S&P 500) Index** is a market capitalization-weighted index of 500 companies primarily traded on the New York Stock Exchange.

The **Russell[®] 1000 Index** measures the performance of the 1,000 largest companies in the Russell[®] 3000 Index, which represents approximately 92% of the total market capitalization of the Russell[®] 3000 index. The inception date of the Russell[®] 1000 Growth Index was January 1, 1979. The Russell[®] Indices are a trademark/service mark of the Frank Russell Company. Russell[®] is a trademark of the Frank Russell Company.

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