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Downturn Consulting and Asset/Liability Management for Pensions

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ERIC BOYD FEINSTEIN

Summary: This session explores the potential cash-flow and financial accounting implications of the equity market decline. The discussion focuses on ways to present these results to clients and asset/liability matching techniques that can be used to dampen the significance of this change.

MR. ERIC BOYD FEINSTEIN: The main objective of this session will be to demonstrate the effect of the market downturn on pension costs and how asset/liability matching can, in fact, help plan sponsors in managing the costs.

I'm a corporate actuary with Ascension Health, and I've been there for about five months. Prior to joining Ascension Health I spent about 11 years in a major consulting firm; this presentation is a little bit dated in that I created it as part of my work there last fall for a client organization.

MR. CHRISTOPHER BARR: A lot of my part of the presentation might seem like it's at odds with Eric's. We planned it this way. We're kind of presenting this in a point-counterpoint-type forum. Also like Eric's, my presentation builds on some work we had done for some clients. Rest assured there are many facets to this issue. We will be presenting different views, and we will be presenting lots of support behind each one. I'm going to be drilling down to a lot of numbers essentially on the asset side of the asset/liability equation and specifically how you measure the risk in assets.

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MR. FEINSTEIN: I'm going to start with the effect of the market downturn on a client organization of ours and what it meant to pension funding and expense.

The contents of what I went through with this client were just the general issues affecting plans and what that meant from an accounting and funding perspective. Then I've also decided to include something that I didn't give them, but gave another client organization in a separate, but very short, case study.

First of all, what are the key issues affecting plans? As you know, the markets have declined in an unbelievable fashion, and I personally know that from savings and 401(k) account statements that I get. One of the things we were letting the client know is the effect of this decline hasn't even been felt even though their costs had jumped from 2001 to 2002. It hasn't been fully felt because we're using an actuarial asset smoothing method. Over the next several years, even if the market were to return what we're expecting, we are going to have investment losses being phased in and therefore increases in costs. Cost increases are also being driven in addition to the asset losses by interest rate declines. Short-term interest rates have come down, which increase the asset base, but our investments on the fixed income side are relatively of short duration. Those increases were barely felt in the asset base.

Long-term interest rates have come down, and our liability is of a fairly long duration. With the lower discount rates for FAS-87, we've got a fairly good jump in our pension liability for FAS-87. At the same time, the 30-year bond rates had come down, partially because of the market and partially because of the Treasury's decision to eliminate 30-year Treasuries. With that, current liability, which is a key factor in terms of pension funding, had gone up. That's actually becoming a driving factor in their pension contributions.

I went through some basic liability terminology with them and the actuarial assumptions used to value pension plans. I then went through a basic explanation of the rules for pension funding and then at a very high level. Our funding target is normally 100 percent of the actuarial accrued liability, which is based on our ongoing investment return assumption and assumed increase in pay rates. With a final average pay plan a deficit contribution override can occur if your plan is less than 90 percent funded on a current liability basis. Even with the assumed salary increase rates embedded in the fact that we're funding toward 100 percent of that actuarial accrued liability, we're having an issue in this plan with getting to 90 percent of current liability, which does not take into account the impact of future pay increases. The key thing to point out for deficit reduction contributions is really that the discount rate for current liability is normally 105 percent of a four-year weighted average of 30-year Treasury rates.

Since the delivery last August with the client, the government has passed the Economic Growth and Tax Relief Act. That increased the current liability interest

rate to 120 percent of that four-year average 30-year Treasury, so there's actually a little bit of relief in these funding rules since I first did this presentation.

The funding requirement, just to point out, really accelerates the funding of the deficit because you look at both the service cost or the normal cost on a current liability basis and then a very rapid amortization of the unfunded current liability if, in fact, this requirement applies.

The current liability interest rate is the driver for the fact that current liability requirements are overriding the normal ERISA funding rules. I've used 6.85 percent for the interest rate that applies for 2002, but, in fact, had the Economic Relief Act not been passed, that rate would have been just under 6 percent for 2002. It's a pretty low rate, which means again higher pension liability.

As we move into the numerical aspect of this, everything is still based on the assumptions and values in effect in August 2001. The plan's funded status came down, most significantly on a market value basis, but also even on an actuarial value, smooth asset basis. One thing that I made sure to point out was that, in fact, you had a 10–12 percent difference in the funded status when you looked at actuarial value versus market value. If the market were to return to what we expect, in fact, our funded status over the next few years would decline by an additional 12 percent. That was a pretty important message that we were giving them, that the cost increases were going to be there even if they return what they're expecting in the future.

The assets reflected all contributions that had been made at that point. In other words, at January 1, 2002, the values of assets that we're explaining reflected contributions made or anticipated to be made all the way through the end of 2001. We weren't anticipating at that point any 2002 contributions that might be counted for 2001 on the 2001 Schedule B. The plan has a little bit more of a conservative investment mix in that the normal investment mix for this plan is the classic 60-40 mix. They're in a master pension trust where there are several other plans, but, in fact, they've got some insurance contracts. During the late 1990s when other plans were perhaps getting the big boom from the market prior to the collapse, this was a little bit more dampened in terms of the amount of return we had to work from as we moved into 2001–2002 with the market declines from 2000 and thereafter.

The cost as a percentage of covered pay went from roughly about 3 percent, which it had been for some period of time, to 3.8 percent in 2001. We then gave them a forecast that looked at three scenarios. The baseline scenario was what you expect to return on this 55-45 equity fixed income mix. Scenario one is effectively an annual return that we calculated based on a stochastic asset projection of what kind of investment return we'd get. We looked at the 25th percentile cumulative return at each point in time and bootstrapped out these rates. We thought if, at any point in time, we have cumulative return at the 25th percentile (or under scenario two we looked at the 75th percentile), what kind of return would we have? It tends toward 8.5 percent over time, but, in fact, you have some pretty pessimistic and optimistic

rates within scenarios one and two. The idea was to give a little bit of a sense of the range or the sensitivity of what pension funding would look like over the next four or five years. All figures ignore the impact of the temporary economic relief that was just passed.

Funding went up almost threefold for 2002 under all scenarios. Then given the good investment return of the 75th percentile, it started to come back down. At the 25th percentile, it is getting up and staying near \$9 million; relative to what they've been funding at 3.8 percent of pay in 2002, that's a little bit more than 10 percent of pay out there. We're looking at a situation where a plan sponsor is thinking they're spending 30 percent or whatever of pay on benefits, and of that, maybe 3–4 percent might be a pension contribution. We're telling them that, no, it's going to be more like 10 percent, and it's going to be that way for several years on out. This is done using ERISA minimum funding, meaning they—the plan sponsor—would put in the minimum contribution in the prior year in each case. What if they adopted a policy where they made sure they funded themselves to 90 percent of current liability each year? It was just a slightly different pattern of contributions, but again very similar story.

There are several things you can do now to help yourself. They had understood there were cost increases on the way. I think these numbers were a little bit shocking to them, but we said that there are things we can do. We can look at demographic assumptions and just make sure that they're realistic. We probably don't have a lot of room to play in terms of funding and what we would see over the long term, but we can look at the investment mix. We can increase funding now to hopefully reduce it later. We can change and look at benefit design. All of those different things were things that we talked a little bit about. They've settled on looking at plan design, including going to defined contribution.

FROM THE FLOOR: Could you just tell me again what the rate of return was in that high-contribution scenario?

MR. FEINSTEIN: In the high-contribution scenario, it was at the 25th percentile, which is coming up around 7.8 percent through 2005. We weren't able to be as sophisticated as you'd like in terms of having a full stochastic forecast. What I did was, instead I took a stochastic forecast of the asset return and took cumulative return at the 25th percentile each of the years. In the first year, the 25th percentile is 1 percent. The second year, the 25th percentile might have been 5 percent average annual return. I get 1 percent in the first year, then I can back into the second year rate. I looked at the third year and thought if I've got my rates for the first two years, then I can back into the third year. That was what I sort of did to be approximate here. Those are annual rates of return.

We looked at all these different things. They settled on looking at plan design, and I'm not sure where it's gone because I left since then.

Now, moving over to FAS-87 accounting and the implications: I'm going to explain something that will be maybe a little bit surprising at first, but it's clearer as we get into it. I'm going to skip some of the basic terminology and assume that that's known. There are economic assumptions that they're using for FAS-87, and 9.5 percent is the return assumption given their asset mix.

We looked at where they stood as of a couple of different dates for funded status in market versus market-related value of assets. The chart would show a smooth value of assets pretty far in excess of the market value, so you're going to have investment losses embedded. Even if you earn 9.5 percent on the market, you're going to still have pension costs increase or at least some increase relative to the smooth value of the assets not returning what you expect.

Their FAS-87 expense goes up, both in terms of dollars and as a percentage of pay. When I looked at the forecast numbers, I thought, This can't be right. But, in fact, what we found when we looked back at this a little bit more carefully was the injection of the volume of contributions that they were making was driving down FAS-87 expense through the period. It's the combination of the contributions they were making with the fact that there's so much smoothing going on within FAS-87 because we were using five-year asset smoothing and a 10 percent amortization corridor. A lot of the losses as they were getting reflected in the asset base were never being amortized into the expense base. Expense would not, without these contributions, have gone up as quickly as funding, but, in fact, with the contributions, you see it going down. The picture is not complete because what you're missing if you just look at FAS-87 expense is the fact that they've either had to borrow or had to take capital that could have been used to generate return in other places in the company to get to this point. The story you get when you look just at FAS-87 expenses is not complete. This is under the ERISA minimum funding policy.

We then got into a little bit of a discussion on the balance sheet requirements under FAS-87, which, just as a way of background, require that you have a balance sheet liability that reflects at least your unfunded accumulated benefits obligation (ABO). Normally if your ABO is fully funded on a market value basis, then based on whatever your balance sheet liability is, just based on contributions you've made and expenses you've recorded, you may have a prepaid pension asset or an accrued pension liability. In fact, that just stands on your balance sheet and is left alone. But the moment you cross over that threshold of having a dollar of unfunded ABO, you have to make sure that at least a dollar of balance sheet liability is recorded.

As of March 31, 2001, we've got an unfunded ABO. We've already got a balance sheet liability of \$3.8 million, so we've got an additional liability to record of about a half million dollars in this example, though the standard allows you to offset your additional liability with an intangible asset if you've improved the plan over the last few years and have some unfunded plan improvement liability. But as we look out into the future, there is a fairly dramatic increase or potential increase or hit to the

equity. That occurs because the plan is not well funded, and, in fact, they're making contributions that are far in excess of expense. Even though they've got a balance sheet liability today, the picture that we were giving them is, when you make these contributions and you make only \$8 million in contributions and you record only \$2 million of expense, you've got a \$6 million swing in what's on your balance sheet in that particular year. Over time you're building up a big prepaid pension asset that if we hit, and in some of these scenarios we see a situation where we have unfunded ABOs, you're going to have to turn that around on the balance sheet.

I'd like to bridge now toward asset/liability matching and where that can have some impact without necessarily deviating and going all the way to full asset/liability matching with fixed income. I'd had another client organization that had not been required to fund, since 1992, and, in fact, projections that we made in 2000 before the market downturn showed no sign of funding requirements all the way through 2005. Those were stochastic projections we made, so those were looking at like zero to almost no probability of having to fund. The declines in the years 2000 and 2001 led to a significant contribution requirement—almost \$600 or \$700 million at the median level over a 10-year period ending in 2010.

We looked at an alternative asset mix. We looked at a way to better match the asset liability durations, so we looked at a long bond portfolio. We looked at smoothing the assets a little bit differently where we would value equities on a five-year smoothing but, in fact, value fixed income at market. As the interest rate changes and the liability goes up or down, at least the fixed income part of the portfolio would help the overall asset move in tandem with the liability.

The current scenario is roughly a 70-30 equity and fixed mix; the alternative is more like 50-50. We've got a significant portion of that in 25-year zero coupon bonds, so a very long-duration investment to kind of lever out the fixed income part of the portfolio and overall the duration of the portfolio.

We gave them a full stochastic projection of this. Under the current mix contributions stay near \$550 million over a 10-year period, but under the alternative mix it comes down to \$400 million over that same period of time. Even though you might be on the high side and give up some potential return, the bottom line for this organization is that cash flow is really the issue. In the alternative mix, even though you may give up some of that return, it might be a better fit for them.

When we did the 50-50 equity fix, we actually ran an efficient frontier, and we looked in the asset/liability space. We questioned, if our real threshold of pain is the funded ratio, let's find a point at which we could generate a better funded ratio for the same level of asset/liability risk. We went with an efficient frontier, and we said our current asset mix puts us at some risk level on the asset/liability funded ratio that's not on the efficient frontier. If we go to this same risk level—asset/liability funded ratio—but try to move our funded ratio up, what asset mix would do that? That's how we arrive at roughly 50-50. It really didn't have to do with the split of

active and inactive, although in that case there's a fairly significant amount of inactive liability, and my guess is that that split drove the efficient frontier that we ran.

MR. BARR: I'm really glad Eric mentioned some of the legislative changes that have just happened over the past couple of years, specifically with regard to the discount rate corridor. Eric spent a lot of time focusing on what I consider the most relevant liability issues—the FAS-87 issues—and how those will affect the funded status. At an earlier session, I mentioned a lot of the top 10 pensions in the country that have been coming to us for our thoughts on asset/liability matching. We run a lot of the same analyses that Eric has explained to you, and we get a lot of similar results. I'm going to be talking to another side of the issue that may, as I mentioned before, seem at odds with what Eric was presenting, but we've set it up that way.

There are actually lots of ways to look at this issue. To put it back into context, Eric showed how now that the corridor was widened out from 105 to 120 percent of the 30-year Treasury rate, and how Eric's number for this particular client went from just below 6 percent to 6.85 percent. That is an enormous jump in the discount rate.

One of the examples I used in the earlier session was a top 10 pension, which was in the several tens of billions of dollars in assets versus liabilities. They were shocked to know that every quarter percent change in the discount rate cost them a billion dollars on their liability. Why is that? It is because it has extremely long duration. Now, the question is, is the company sensitive to changes in the funded status? In Europe they are. In the United Kingdom specifically, FRS 17, the report, issues that made it market-value weighted.

Their assets and liabilities, instead of smooth, become a very big and critical issue with regard to earnings per share. Then the question is, Do the people in the pension department really care about earnings per share? Is that their job? They might and might not. Their CEO or the CIO might, and that's why we're getting a lot of inquiries regarding this.

Some of the largest plans in the country are still well funded. Why is that? There are a variety of reasons, none the least being incredible investment experience over the second half of the 1990s. I think in 1995–97 the S&P returned 40 percent in at least one of those years. To me it just seems inconceivable that you just plop your money in a mutual fund or a stock and you get 40 percent back the next year. It just got to the point that after so many years of incredible double-digit returns, people started thinking they were going to get those ad infinitum. The whole point of the actuarial assumptions is, no, you don't. There are good years, and there are bad years. That's what averaging is, that's what smoothing is. Well, now this whole end of the contribution holiday—I always hated that term because I don't think of it as taking a holiday; I think of it as actually just living up to the long-term-return

experience of the assets and liability—it's coming back to bite some people. There is a lot of concern about this, the biggest issue being that it's not just on one side the liabilities, or the other side the assets—it's both sides. We've been framing it as the perfect storm scenario, because the correlation between long-term interest rates and assets is typically such that even though it's not highly correlated, the movement between the two, when you need it the most, when liabilities are working against you, you tend to have better asset returns than not and vice versa.

First, let's discuss pensions and asset liability management (ALM), specifically the roles of equity in fixed income. ALM was really popular back in the early 1980s. The concept of ALM has been around for a long time, but essentially once you get the size and the liquidity and the assets out of the market, and once you have favorable rates, that is, double-digit returns, then it started making sense. When I say double-digit returns, I mean long bond yields that were 10–13 percent. That actually rivaled long-term equity returns. You tended to see this in the early to mid-1980s. It came right on the heels of recession. I remember the long gas lines and then inflation and then how we dug ourselves out of that. Incidentally, the Treasury got around that whole issue by issuing callable debt. Most of the Treasury bonds that are maturing between 2007 and 2014 are callable, but notwithstanding, when you have really high levels of interest rates, you'd be crazy not to look at your assets in the context of your liabilities.

It always amazes me when I talk to people about ALM that it's such a foreign concept to most pension funds. Insurance companies have long embraced ALM. In fact, of all the large insurers, I think only one has meaningful allocation to equities. Most of them understand that they've got a pretty good handle on their liabilities, and they know that there's absolutely nothing in it for them in the short run anyhow. They will pick and choose their risk. They'll take their risk in the form of credit, and they will lock in the fixed income relative to the liabilities. The insurance industry has been on this for a long time.

Why are pensions different? Obviously, you've got vested versus accrued versus projected, and the fact that FAS-87 recommends we look at projected sort of points us in the direction of thinking that we understand when people are going to get sick and when they're going to die. But do we really understand what the career paths are going to be, how much money they're going to make, and how long they're going to be at this particular job? At the end of the day, the pension industry has embraced this long-term total return framework. I'm still shocked that if you could put in front of somebody the proposition of If I assume that I know your liability, at least the more mature liabilities, if I can provide you with a return that will meet that liability, would you do that, or would you throw the "Hail Mary" and try and make double-digit returns in the stock market? Over the last 10 years the experience has been such that people would choose the latter. The role of equity has really become the anchor to windward in a pension portfolio, where that's exactly what fixed income is going to be. Now, people just think of fixed income as something that's there just to balance out or smooth out the equity side.

I am also going to talk about the mechanics of ALM, specifically duration and convexity. We're going to spend a lot of time on this. The Zen behind duration can be encapsulated with a few different examples—dollar duration, immunization, and cash-flow matching, which are the strategies we're going to talk about.

I will discuss the performance and the trends for my conclusion. I'm going to try to discuss these in the backdrop of what Eric explained as one of his case studies with one of his clients.

Not surprisingly, as I had mentioned before, the insurance industry is almost exclusively fixed income. Just a few large insurers are skewing that mix on the equity side. With pensions, on the other hand, typically 70–80 percent have stocks. They have 30 percent fixed income, which actually falls under a lot of different headings. The allocation mix really is just proving out the wisdom of the long term, basically Markowitz mean variance return models, which, say, over time go for the highest return you possibly can.

Then the question becomes, If we're looking at these even in the slightest way with regard to our liabilities, what's the relationship of equities and their liabilities?

FROM THE FLOOR: Do the allocations include their general fund? Returns are what they mean, and individual investments would be much different.

MR. BARR: That's a good point. There are several other asset classes that we're not really exploring here, but private placements and private equity are included. If you look at the fixed income and equity with regard especially to risk-based capital, insurance companies are restricted in actually a far greater way than pension funds are. We're not going to be talking about tax implications either. If we just look at pure economics, without any legislative activity, without any of the regulatory issues, it's probably best just to look at the framework as fixed income versus equities.

One thing I'm not mentioning a lot is a question that came up earlier in Eric's presentation about including contributions, service cost interest, and any of these scenario analyses. That sort of defeats the purpose of talking about the response of assets to liabilities because you cannot invest your way out of the risks inherent with contributions or with service and interest. Those are completely separate from the actual investment experience relative to interest rates, so it's a good point for the purpose of this conversation. Let's just assume it's that balance of fixed income and equity.

We go back to the duration of equities. This is kind of an academic discussion. There are several types of duration. None of them actually have anything to do with equities, because that becomes a question of correlations. Duration, again, is just a percentage change in price for a change in yield of an instrument, that instrument really being just a series of cash flows. The question is: Are equities sensitive to changes in rates? Sometimes they are, sometimes they aren't. Like I said before,

you don't have this nice, firm correlation between the two. Over time, we've seen anything but that. So then you can boil it down to inflation duration or dividend duration.

Fixed income does horrible in inflationary scenarios. Why? It does horrible because your income is fixed. Inflation is for fixed income's worst enemy. Inflation actually works for you on the equity side. Is there any inflation duration? Well, you could consider it infinite. Dividend duration: dividends are your cash flows, but the dividends are in perpetuity, so you don't have any cap on that. Is it infinite? It could be either/or. That's again kind of an academic discussion. I don't know that it warrants going into. The issue is, equities aren't really like the pensions with regard to liabilities. They're horrible for short-dated liabilities.

If you think about why you invest in stocks, it's never for the short run. If it is for the short run, you've probably chosen poorly, especially given the last few years' experience. If you're going to be in stocks, you should be in for at least a business cycle—hopefully two. What does that mean? That used to mean four or five years; now it may be 10 years. The point being, you don't put your money in stocks for liability that you might have in four or five months.

For long-dated liabilities, however, the total return framework has been extremely good for the asset class. The fixed income allocation that we see in pension allocation is really just the opposite of what I was saying for equities being the anchor windward. Fixed income then just becomes something to mitigate any deflation risk.

If we look at the asset allocation for the top 200 pensions, the lion's share is equity and equity-like products and then a modicum of fixed income. Why do pensions buy bonds? They are the anchor windward.

Then we look at the fixed income allocation; it doesn't look anything like liabilities. For the top 200 pensions in the country the average asset allocation is a mirror image of the Lehman aggregate, one of the indices that are out there. Solly Big is another index. The Merrill Domestic Master is another. The only fixed income benchmark that even tries to look like a pension liability is the Solly long pension fund, and that only has a seven-year duration. Typical pension liabilities call it between another 10 and 12 years. Even that doesn't look anything like it. You've got this very disparate weighting in Treasuries, agencies, corporates, and mortgages. Mortgages used to be a fraction of this index; Treasuries were over half of the index. Mortgages now are well over a third because the market's just exploded, and Treasuries are now less than a quarter. The reason for this is just market activity. The benchmarks are market weighted, so that just means that, as Eric mentioned, the Treasury just cut the 30-year issuance, and they're trying to take a lot of the debt off the table, or at least they were before this year. It's almost arbitrary what the weight is in these different asset classes. What always surprises me is, why are people choosing this benchmark, even if it is just for long-

It seems kind of arbitrary that you continue to go on this allocation. The industry isn't really willing to stand up and look at the allocation relative to the liabilities. Personally, I talk to an awful lot of pensions. I think they just enjoy the fact that stocks are sexy, and they have a lot of managers come out and talk about what the market's doing and how crazy it is. Now it's becoming relevant that people are starting to look at things like their equity mix and things like the mix within their fixed income relative to the liabilities.

The last thing I'd add, and the reason I underscored mortgages as being such a high component of the asset allocation, is that mortgages, as I will talk about in a little bit, are the largest sector in most fixed income portfolios for pensions. Mortgages have negative duration. Pension liabilities typically do not have negative duration. What this means is, mortgages three years ago had a duration of three to four years. It was pretty high. Rates rallied really hard over the last couple of years; everybody refinanced. All those premium coupons that made the bulk of the mortgage index, people paid down. All that means is, anyone who had a mortgage 2.5 years ago maybe had a rate of 7.5–7.75 percent. Fannie, Freddie, and Ginnie collect all those loans, pool them up, sell them to institutional investors, like pensions, and collect that premium spread even though it has pretty much the full faith and implied credit of the U.S. government. There is a spread over Treasuries (100 basis points risk adjusted; 200 basis points not risk adjusted, that means not option adjusted). People are willing to enter into that thinking that they're going to get their 7.5 coupon paying for the next 30 years or however many years in the mortgage. What happens is, rates drop, and everyone at 7.5 percent refinanced. They got a new mortgage, and they just refinanced at 6 percent. So then the person who was holding at 7.5 percent not only got the cash back when they thought they'd be having it invested for the next X number of years, now they've got to go out and reinvest it at 6 percent. The duration of that bond that originally on average was 4.5 years now just became a half to one year. Essentially, over the last two years you saw almost 80 percent of the entire mortgage market evaporate, which means all the bonds paid off, all the loans came back, but then they refinanced into the lower coupon.

What happens when you have a lower coupon? I have a 6 percent loan. That duration is about six years. What you saw was this radical change in characteristics of the entire portfolio because of this allocation, which has negative convexity. You had a four-year duration, which went down to a one-year duration as the bonds rolled off and were reinvested in lower coupons. It extended out now to around a 3.5 year duration. My point here is that a big chunk of your fixed income exposure had almost random changes in duration, which had absolutely nothing to do with your liabilities, and yet nobody is asking any questions about why this is an appropriate benchmark.

Let's switch gears a little to management styles. Active management just means total return; passive management means indexed and then dedicated, which is what we're going to talk about: asset liability. Active is really just trying to beat the Lehman Aggregate or your benchmark. Passive is just indexing. It's been shown through time that it's fairly easy for active managers to beat their benchmarks. That has been the case up until last year. Here's an interesting little kernel of information about specific risk and fixed income. Most active managers will take it beyond mortgages or agencies and invest in corporates, because a large chunk of the benchmark is corporates. There is over 25 percent in corporates. The lion's share of corporates are in AAA or BBB names. Over two-thirds of that sector is in those ratings.

That's really where you have to go to get all the yield. Now, over the last couple of years we've seen so much specific risk that people started to question where they should be because a big chunk of this is in corporates. That's where I thought I was going to get my alpha, and now all these companies are blowing up. I took a look at your average plan. I do not look at the plan that goes out and hires Pimco or Fidelity or whomever and manages thousands of bonds in the portfolio, but the smaller plans, who may have only 100 bonds in the corporate portfolio. If they're benchmarked, by definition they have to own some of the 100 largest issuers.

What's fascinating is that the number of investment grade defaults last year was seven, and that's the highest since they've started benchmarking. What that means is, it wasn't seven issuers who got downgraded from investment grade. Again, investment grade is BB or AAA or above according to Moody's. That means that seven defaulted. That means that at the beginning of last year, Moody said these companies were investment grade. They weren't speculative, they were solid companies, good earnings, plenty of cash flow, and by the end of the year they had defaulted. That just blew me away. That is why Moody's now is in a tailspin. The pendulum probably swung too far in the other direction. More importantly, the number of issues out there is in the thousands. In fact, the benchmark has about 4,000–5,000 bonds in it. But if you're that smaller manager, who may own only a hundred or so bonds, you're not going to own 4,000 or 5,000 bonds. You're not even going to own 400 or 500. You may own only 100 bonds, so you're going to have to own some of the 100 largest. It turns out that in 2001, three of the top 100 bond issuers investment grade defaulted. Those were obviously Enron, So Cal Ed, and PG&A. You don't hear about this. Every time I talk to smaller managers about it, they're shocked at this number. I think Moody's just wants to really keep it under wraps, because what are they being paid for if three of the top 100 issuers that they're saying are credit worthy, not just got downgraded, but defaulted last year? This year isn't going to be too much better. There's a tremendous amount of specific risk. I have a feeling that over the next few years, it isn't going to be as easy for bond managers to beat the benchmark because of this.

What is the role of fixed income, hedge against inflation, and the correlation of volatility and mitigation? The role of fixed income again is your anchor to windward. This is a good strategy when rates are high, which brings down your liability and

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also increases your coupon income and returns, and you have high absolute returns specifically on the equity side.

The problem is, rates are not high. The 30-year Treasury, which let's just call it for all intents and purposes, at least the way the IRS looks at it, that's their liability rate, is at an all-time low. On the equity side, I only use the NASDAQ because it's such a dramatic swing between 2000 and 2002. I know guys who got paid a bonus at the end of 1999, and they're just all fired up about running out and investing this money, and typically you get your number at the end of December. Then you get your paycheck for compensation. A lot of the income on Wall Street isn't paid that much during the year, and everybody works for bonus. That's sort of a way to keep everybody motivated and incentivized. You don't get your check until, say, February or March. There were a lot of young people who had cut their teeth in the tech industry over the prior few years, who went out and put their entire life savings and their bonus in the QQQ. I know guys that literally got in within a few points of 120, and only to give it back literally within a year. I think it went down from 120 to 30. That's essentially like losing everything. My point being, you need two things for the strategy to work: higher rates work well for the liability and high asset values. You have neither right now.

We going to talk about McCauley duration, modified duration, and effective duration quickly. It's not all that important to differentiate between them on a 30,000 foot level, but it is important if we're going to get down to things like negative convexity and callability in mortgages. McCauley duration simply defined is discounting the cash flows and weighting them and then dividing it all by the present value of the cash flows or the price. For bonds it's dividing it by the price for liability. It's literally just the discounted present value of those. That gives you a number, which in some way reflects the average percentage price change associated with the change in rates.

Modified duration normalizes it for semiannual compounding with a typical bond. You don't do that on the liability side.

The problem with McCauley and modified durations is, some of the other products out in the fixed income market right now have embedded options in them. A mortgage that was over 30 percent of the market has a huge embedded option. Everyone in this room has a mortgage. They can go out and refinance whatever they want. If I'm a California state pension, I have absolutely no control over when everyone goes out and refinances. If I'm invested heavily in mortgages, I'm sort of held hostage to what everyone wants to do with their mortgage. That is the inherent option that is shorted there.

Effective duration gets around this problem by actually shifting the curve up and down. All this means is, if you take all the cash flows of a bond, say, a mortgage bond, and then you shift rates up and you discount that cash flow, and then you shift rates down and discount that cash flow, it seems like that should really be the same as the previous two measures. In reality, what happens when you shift rates

down? I don't know what the sensitivity of most people is to change in rates. Personally, my threshold is very low because it's so easy to refinance right now. You can go on the Internet and say, "I've got a 7 percent mortgage, I live in an apartment in Washington, D.C. and I've got this much equity, how much can you refinance me for and what will it cost?" Within an hour, you could be refinancing. It's that easy now. They get back to you with a rate, and you can be done within a week. It's that easy to refinance, so that threshold could be very small. As rates go down, those cash flows become a lot different. Are you discounting cash flows that go out 30 years? Probably not. If we go down 100 basis points, a lot of the people will probably go out and refinance their mortgages. Those cash flows then go away. What happens is, effective duration takes account for embedded options.

To do a duration example where we actually do the price changes, we'll take a 6 percent coupon 10-year bond priced at par and then calculate the change in yield. What's interesting is the rates go up 100: the price changes again when rates go up, bond prices go down, and vice versa. The price drops to 9289 or a price change of -711. When rates go down, which is good for bond prices, it goes up to 10779. That's a different change in price dollar weighted. That's the convexity issue, which we'll talk about later. Duration takes the average of these. If you do the percentage change up and down and divide it by the yield change, you get 7.45 years. Right off the bat, you should see that there's a conflict here in the way the duration calculation is performed. In other words, this is just a regular bullet bond with no embedded options. What if this was that mortgage security? When rates go down on something with an embedded option, price is going to change much differently than a bullet bond. Why? Again, because as we said, if you have that mortgage and rates go way down, you're going to refinance. That price of the bond is going to reflect it. We can understand, using option-adjusted-spread (OAS) modeling, what the effect of the price is going to be given a change in rate. This is an enormous, enormous industry. It has been for more than 10 years. Understanding prepayment modeling and understanding option-adjusted spread calculations have become enormous, competitive, and very liquid.

If you think about it, yields are not going to go negative in a normal world. If yields did go negative, the price would hit some point, but that point is really infinity. The price is not going to go negative in a normal world. We see a lot of Far Eastern countries right now with big troubles in their economies with really low yields, but at some point it can run tangent to, almost, but it cannot touch any of those, axes. That is one of the reasons you get some of the effective convexity. All it is is the nonlinearity of the price-yield relationship. It's the part of the price change not explained by duration. If the change in price is your first derivative—I always think of it as velocity—convexity is just the second derivative, the acceleration of it.

You're not really worried about convexity for small changes in rates. The best way to look at that again is the mortgage. If rates go down five basis points, which can happen almost every day, do you run out and refinance? No, you don't. Convexity just doesn't matter much for small changes.

For example, we take another bond, price it at 96 and 11 ticks—that's $11/32$ —with a 13-year duration. We can calculate pretty easily with our formula what the value of the convexity is. With a 13-year duration with a 100 basis points change in rates, you should expect to see a 30 percent change in price. Yields fall by 10, which is a tenth of 100. We get a percentage price change of 1.3 percent, which is what you would expect. If yields fall by 200, you would expect to see a percentage price change of 26 percent, but you don't; you see 31.4 percent. That difference is convexity, and that can be a very big number as rates fall precipitously.

Convexity characteristics: These are kind of the rules of thumb. For equal maturity bonds, zeros have the most convexity. Why? It is because zeroes have the most sensitivity. All the cash flows lead up to a zero, and again a zero is just a zero coupon bond, meaning it pays no coupons. (There's just one payment out in the future somewhere.) They're also called strips. Some liabilities have the most convexity because, obviously, it being the farthest away, the exponent part of the present value calculation is that function of time or how far out. If there's no cash flows to mitigate it in the years prior to it, then that makes it the most sensitive.

Doubling duration more than doubles convexity. As yield increases, convexity decreases, and again that's a function of the cash flows in the middle of the bond, dampening the volatility on it. The greater the change in yield is, the greater the convexity correction.

You get paid to be convex. As rates go down, you want the most convex instrument, and if you have a negatively convexed bond with a call option in it or a mortgage, that's where you actually lose.

Let's move on to asset/liability management strategies. I guess the simplest of those is cash-flow matching. A lot of municipalities have to go out and diffuse their debt once they raise money. In other words, a state goes out, and they want to build a bridge, so they issue a bond to borrow the money for it. Then comes the time when they have money, and they want to go out and just pay that bond off. They want to take the debt off the books. How would you do that? Now you've got a fixed liability; it is known. It looks nothing like a pension liability where there are a lot of unknown variables. They know what the cash flows on those bonds are; they know it with certainty. What would you invest in? Stocks? Probably not. Corporate bonds? Maybe, but then there's that inherent credit risk.

Most municipalities will go out and use Treasuries to diffuse their liabilities. How do they figure out how much it's going to cost? Well, if you know the dollar value of each of those liabilities, and you know what the rates are for each of those points on the curve, essentially you can fund each of those liabilities by buying a strip or zero. If a fund owes \$10 million per year for 10 years starting in 2010, they can go out in the market and consider what the price is of buying a security that will fund any one of those liabilities for those years. The \$10 million total comes from our doing \$1 million per year times the price, giving a market. If you look at that price, all that is is how much it's going to cost today to fund that liability 10 years prior or

The cash-flow matching is at the very front end of this spectrum, which is defining your liabilities. Typical ALM strategies really range by virtue of their certainty or uncertainty to the cash flows. Bank CDs are very short, very known liabilities. That's where you would use the cash-flow match. You could also use it with life insurance companies: the amount is known; the timing is unknown. You may use a mixture between cash-flow matching and some sort of duration matching.

With floating rate liabilities, the amount is unknown, but the timing is known, and therefore you might use some mix as well. Pensions, the amount, and the timing are pretty much unknown, so if you were to use an ALM strategy, it would be something like immunization.

The way you go about optimizing for a cash-flow matching, instead of just going out and buying zeroes, because zeroes are pretty expensive because of liquidity, we can actually take the cash flows of any bond. You think of every coupon payment as just being a zero, throw it in a linear optimizer, and put in the constraints, being the cash flows.

Everyone who hears optimization thinks it's like the be-all, end-all, or it's very complicated. A linear optimization is a linear optimization. As long as you have the cash flows, you can run them on Bloomberg for any bond. You do it for universal bonds, drop it in a spreadsheet, and optimize. It is very straightforward.

What are the advantages? All future cash flows are met, and market conditions are good, with reference to spreads widening, tightening, defaults, assuming that you are buying Treasury strips.

They are completely independent. Disadvantages? It can be expensive, and the securities are not always available for all maturities, which means you're going to have to pay up to get something that gets in the area, and then the balance is going to be invested in cash.

FROM THE FLOOR: Are strips transaction costs, or is that on security costs?

MR. BARR: Totally opportunity cost. Strips are a liquidity premium because they're older securities. I was talking about the callable Treasuries between 2007 and 2014. You strip off the bond up to that, and you're uncertain. There are bonds that are going to be called between 2007 and 2014 that were issued when rates were very high. There's uncertainty as to those cash flows. Well, those have been stripped out, too, and sold. Nobody wants to buy them. Those are Treasury securities, but they are illiquid. The real cost is opportunity cost. I say they are expensive because there is the liquidity premium, but if you cannot nail the exact maturity, you may be forced to buy something that matures a year before the liability. Then what do you do? You were making, call it 6 percent on that asset,

and now it has to be invested in cash with LIBOR only at 1.90 percent right now. So you had a 6 percent asset that's got to sit at roughly 2 percent for the rest of the year.

We'll talk about immunization now. An asset/liability program is immune to rate changes if the value to assets is the value to liabilities. The duration is the same for both, and the convexity is the same or better. Let's consider the duration of liability as we did in the example before, calculating the cash flows. We are really just doing the present value of the cash flows times five. My example is that, in five years, I owe \$14.6 million, and I know that yield on the five-year, we're calling for an example, is 8 percent. Well, there's only one cash flow in five years, so I take the present value of that cash flow in five years, which is nothing more than taking that, discounting it by five years by that five-year rate, and I end up with the value. I get a McCauley duration of five years. As you noticed, a five-year zero is going to give you a five-year duration because there are no cash flows to shorten it up.

If we were to look at the asset side, I would satisfy the equation or the condition that present values have to be equal and the durations are equal. Now, if I have this liability that has a five-year duration and \$10 million size and the assets matched up, no matter what happens to rates, I will still end up with a cash flow at that date to match up liability. One of the neat things about duration is that at the target date, which is five years, even though you had an instrument that was a six-year duration, at five years, no matter what happens to rates, the market value of an asset will be the same. In other words, the cash flows with rates going down are reinvested at a lower rate. Therefore those coupon payments that have been pocketed aside to reinvest don't add up to as much as you thought they would if rates stayed the same. However, your principal value went up. Remember, rates go down; prices go up. We look at the horizon value at target date five years, whereas in the first case the rate is down 100, the coupon income made less money, but the principal did better. That value \$14,693,000 is the same within a few hundred dollars as rates unchanged and rates go up. The total value is the same in all scenarios at five years of the target date. That really is the wisdom behind the duration calculation in cash flows and reinvestment.

If it had been even a year earlier, the reinvestment losses in the rates-down scenario would have been lower, and the reinvestment gains greater as the years go farther out.

Now, the problem with this is that it assumes parallel shifts, and we never get parallel shifts. I think this is a good example just to show how, if you have an asset that you're trying to match to a liability, we're going to assume that it's a 15-year duration. You've got essentially several ways to do it. You can buy a one zero-duration asset that's 15 years out, or you could barbell it with a short end and a long end. There's a short liability and a long liability, and the asset is somewhere right in the middle. What happens if the curve twists? The long liability increases dramatically because the long duration obviously is more sensitive when rates go down. The short liability goes up, because that's just a flat cash short-term

investment fund at the LIBOR rate. With a curve twist at 50 basis points—and we tried to nail this by just a 15-year duration on the asset side—our assets and liabilities did not move in tandem, which is the curve risk. It is probably one of the biggest risks, and we lost.

There is a way to get around that using partial durations, functional durations, key rate durations. It's analytically used to shift little parts of the curve instead of the entire curve. Here is a case study. I kept the same dates and sizes as my earlier examples. We did this literally one day when some of my colleagues over in equity derivatives called up and said they had a fund that's getting out. They were moving some of their equities and moving some of their fixed income, but they wanted to keep that exposure, and they're duration matched with a bullet. It was pretty small, \$70 million. They had only one bullet cash flow hedging to that liability. We thought about how the market had been so volatile with the Fed, so why don't we just ladder this out with futures. We just took that one payment, and then we laddered it out to a two-, five-, 10-, and 30-year future position, which is just exposure in each of those markets.

The curve ended up flattening. Even though this was a small portfolio and relatively small change—7.5 basis points flattening on the day—that made them \$230,000, which effectively was paying them for keeping exposure across the curve instead of on one point.

The advantage for immunization is that it can be much more cost effective than cash-flow management. The disadvantages are that it requires parallel shifts unless you use partial durations. It requires small shifts—again, the convexity issue. Constant OAS is a spread issue with credit. You may have to rebalance frequently, and then cash-flow issues have to be accounted for.

Table 1

Dollar Duration
 "Net Worth" Immunization

Surplus without dollar duration matching		Market Value	Duration	Dollar Duration	Rates Up 100 bp	Rates Dn 100 bp
	Assets	\$100,000	10 yrs	1,000,000	\$90,000	\$110,000
	Liabilities	\$80,000	10 yrs	800,000	\$72,000	\$88,000
= exposure to changes in rates	Difference	\$20,000	0 yrs	-200,000	\$18,000	\$22,000



"Net Worth" variable with change in rates

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I'm going to move pretty quickly through net worth immunization. This occurs if you do have a liability, in other words, the liability is greater than your assets. In this case it's last; we're locking in a surplus. We have an asset that's greater than the liabilities.

If you're worried about the net worth, specifically the difference between your assets and liabilities and keeping that constant, all the variables have to be the same. In other words, the asset value has to be same in those liabilities, even if your duration is equal. You have the same duration, but by virtue of the fact that you just have more assets and the liabilities, as rates go up your difference is going to grow or shrink by a different amount.

I'm going to give an example here about locking in the deficit, which involves dollar duration matching. We had a client many years ago that was running a deficit. They had \$10 billion in liabilities, \$7 billion in assets. They said, "We want to go very long duration just to lock in that deficit so it doesn't grow any." The way you do that is just take the dollar duration or your market value of assets to liabilities, and multiply it times your duration. That gives you a dollar duration. So long as those are equal, the difference between the two will always stay the same.

Now, the problem with that is, although it does lock in a net worth or lock in the difference, it may not be appropriate for long-term growth. What I really mean by

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that is, the opportunity cost of not being in a more productive asset can be very expensive.

This is where we get down to the conclusions here. The opportunity cost of going very long duration at this point in time—and this is what may sound like at odds with what Eric was talking about earlier—is we're at the lowest rates we've had in my lifetime. If someone is sitting there right now with a questionable funded status, and they decided to go very long duration just to match their liabilities, well, they've already suffered negative 20 percent returns this year and negative 20 percent last year. They're already way behind the eight ball in terms of their experience over the last few years. If they go long duration right now with the 10-year bond at all time lows, rates aren't going to go negative so far as I know in this country. There's only so far you can go down with rates, and again fixed income goes up as rates go down.

All analysis right now suggests rates are going to start going up. Everyone's been saying that for the last six months and rates continue to drop, but should rates go up, then you start losing. Should rates go up when you're long duration, you start losing significantly. If you wanted to capture enough duration in a dollar duration sense to match your liabilities, and, say, your liabilities are 10 years and you're only doing half a year assets and fixed income, you'd need a 20-year duration. Well, if rates go up 100 basis points and you're at a 20-year duration, you've just lost another 20 percent. Does it make sense for most long-term plans to go long duration at this point? In a total return framework where your bogie is not the liability, where it is returning, say, 9.5 percent, no, it doesn't. It also doesn't make sense for very young, immature, and uncertain liabilities. But having said that, for older, more mature liabilities, it's getting a lot of traction right now for a lot of reasons, none the least of which is accounting issues.

The flip side of that is the liability, where what happens if rates do go up on the liability side? Well, you have pretty much the same issue.

All we're saying here is, over time, even with poor stock returns, assets have outperformed liabilities over the last 10 years, and rolling returns haven't suffered in 25 years.

FROM THE FLOOR: Can you tell me one more time why you're saying the insurance companies are so heavily invested in fixed income?

MR. BARR: Absolutely. Insurance companies have a much better handle on what their liabilities are. There is much more certainty. In other words, on the pension side, knowing when someone's going to die is just one part of the equation. Knowing how long they're going to work and knowing what their position is going to be, what their actual payout profile is going to be over the years, is probably the rest.