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APPLICATION OF ACTUARIAL ANALYSIS AND MODELS TO EVALUATE INVESTMENT FEATURES

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- o Valuation and experience assumptions in an actuarial model
- o Why use a stochastic model?
- o Forming a consistent model
- o Applications in investment decisions

MR. PAUL H. JACKSON: I got interested in asset matters when the Bank Administration Institute published a large volume on the *Investment Performance of Pension Funds.* I was particularly taken by the Appendix to that document that was prepared by Eugene Fama, a professor at the University of Chicago. Included in his bibliography were references to 70 or 80 papers. Of course, about ten or 12 of them were by Mr. Fama himself or in conjunction with someone else. One of them was an article entitled, *Benoit Mandlebrot and the Stable Paretian Hypothesis,* and I could recommend this article to any of you as good background literature.

The study demonstrated that investment returns are not normally distributed. This should not come as a surprise to anyone. Transactions are not sequentially independent and there are simply too many days when the return is the mean minus 100 or 200 standard deviations for anyone to accept the normal distribution hypothesis.

In any event, back when the study came out, I went to a number of clients and I asked them how much yield they were prepared to give up in order to reduce the standard deviation of returns under the pension fund. It didn't matter how much I was prepared to reduce the standard deviation, nobody was prepared to give up more than .5% or possibly 1% at the outside. This was off of a base of about a 12% yield. They might be willing to take it down to 11.5 or 11%.

One of the current measures used in the pension field is a risk adjusted yield which is the normal yield divided by the standard deviation. That suggests, implicitly, that someone would be willing to give up 12% of the yield in order to have a reduction of 20% in the standard deviation. I think you have to bear that sort of thing in mind in approaching these investment matters.

The discussion is about models and so I brought along a quotation from one of my favorite authors, Milton Friedman, who stated that a model is important if it explains much by little; that is, if it abstracts the common and crucial elements from the massive complex and detailed circumstances surrounding the phenomena to be explained and if it permits valid predictions on the basis of them alone. To be important, therefore, a hypothesis must be descriptively false in its assumptions. It takes account of, and accounts for, none of the many other attendant circumstances since its very success shows them to be irrelevant for the phenomena to be explained. To put this point less paradoxically, the relevant question to ask about the assumptions of a theory is not whether they are descriptively realistic, for they never are, but whether they are sufficiently good approximations for the purpose at hand. This question can be answered only by seeing whether the theory works. This means whether it yields sufficiently accurate predictions. And this is what modeling is all about.

Our two speakers are experts in the field of modeling. John Haley is a consulting actuary in the Washington office of the Wyatt Company and a member of the Asset Services Group which conducts our asset and liability forecasts countrywide. In the last two years alone, John has conducted forecasts for plans aggregating more than $50 billion in assets.

Dick Wendt has been a consultant with TPF&C for the last three years. He's responsible for the maintenance and development of their asset and liability forecasting system. Prior to joining TPF&C, Dick spent five years with Howard Winklevoss' firm and then, Winklevoss, Johnson and Higgins. There he also specialized in pension forecasting. Over the last eight years, Dick has worked on over 100 forecasting projects mostly for large corporations.

MR. JOHN J. HALEY: Dick and I are going to approach two different parts of this subject. I'm going to start off talking about how you construct these models and, particularly, focus on how actuaries might go about looking at them and what are some of the important things we have to think about. That quote from Milton Friedman really sums it up. What we want to do is get something which is descriptively simple.

What we're focusing on is what happens to the pension plan when we're looking at it as an economic whole. We want to be looking at what happens to both the liabilities and the assets and see how the two link together. We don't really know exactly what's going to happen and so the approach that's taken in this model building is to do simulations.

When you're not sure what's going to happen, you look at many different possibilities and we hope that we can pretty much cover the water front as to what's going on. If we do 500 simulations and you get a certain result 350 times, then you can say that 70% of the time such and such happens. That's the aim.

One question that comes up, of course, is how many are enough simulations? I think most people tend to do somewhere around 500. We did some theoretical work a few years ago to try to figure out exactly what was the right number of simulations to do. We concluded that, for most purposes, about 300 is probably sufficient. We ended up doing 500 because we knew a couple of other firms that did 500 and we didn't want to say that we did less than they did. Other than that, about 300 is probably enough.

I'd like to go over the different types of assumptions we have to look at. In our model building we have three different kinds we want to look at.

The first is the demographic assumptions. These are: rate of retirement, mortality, disability, terminations, etc. All these things are going to affect how many people we have in the covered group and what they're going to look like in terms of age and service, etc.

Next, we have the economic assumptions and here we're talking about economic assumptions that are used for the valuation or for moving the group ahead to future years. They would be interest rates, salary scale, expected return on assets for Financial Accounting Standards Statement No. 87 (FAS 87), etc.

Last is the assets and the risk-return relationship, how we're going to actually project that our various asset classes are going to perform over time. I will talk about each of these in turn.

DEMOGRAPHIC ASSUMPTIONS

These can be broken down into valuation assumptions and experience assumptions. When we're building a model of the pension plan, we're projecting it several years into the future. We'll be doing two things each year. We will say:

a) What assumptions we're using to value the plan in that particular year. For instance, what are the appropriate assumptions to be used in 1993 for the annual valuation.

b) What's going to happen to the group as it progresses, from 1993 to 1994 for example.

The demographic assumptions for the valuation are something that is usually fixed for the entire period. When I say they're fixed for the entire period, I don't mean that they are constant but they're known at the beginning. In other words, for any particular projection, we know exactly what the demographic assumptions are going to look like.

You'll probably want to use the current valuation assumptions unless there's some reason to think that the actuaries are going to change them. When doing one of these projections, we want to capture what is actually going to happen. What we want to ask ourselves is how things would

change as experience unfolds. The demographic assumptions are not things that we should, in general, be expecting to change all the time, particularly valuation demographic assumptions.

We may need to review the valuation assumptions to see whether they're appropriate experience assumptions. The latter are not necessarily the same as the valuation assumptions.

Let me give you an example of how that can happen. We've got valuation retirement rates and they are going to predict what kind of a group we're going to end up with year after year. We start off with 1,000 employees one year and we look at our various decrements (retirement rate, termination rates, etc.), and that gives us 920 employees expected at the next year. The client has told us that they expect to have about 1,050. So we've got to add about 130 employees during that year. We can do that by adding 130 new entrants. One of the things we'll have to do in our demographic assumptions is to build a new entry profile.

In the case where we end up with 920 expected employees and the client tells us they're going to have 850, we have a different kind of problem. We have to figure out how to kill off some of these extra people. You can do this in two ways. You can have extra retirements or extra terminations. The results are going to be very sensitive, of course, to the way you do it. Also, people are introducing early retirement windows to get out extra employees. You want to make sure you're reflecting that.

So, the experience assumptions that you're going to use in projecting forward are not necessarily going to be the same as the valuation assumptions.

You could say that some of the demographic assumptions could be affected by the investment performance, for instance, if there's a particularly large downturn in the economy. If you're dealing with an organization that is sensitive to that, then maybe they're going to be adding people when times are good and getting rid of them when times are bad. As a practical matter, that's not done. It's probably a little too complex for most of the models to handle at this point. Although, as a matter of theory, you might want to do that.

One thing that comes up with this sort of feedback from the investment results is your funding policy. I was talking with the treasurer of one of these corporations about what the funding policy of the organization is going to be. He told me it was a very simple one. When they have a good year, they fund the maximum. When they have a bad year, they fund the minimum. Projecting a profit, however, is not all that easy to do.

ECONOMIC ASSUMPTIONS

First, the discount rate for FAS 87 purposes should be stochastic. It should change as our economic situation changes over time. For instance, one of the things we're probably modeling is the interest rate on long term bonds. As that rate changes over time it's likely that the discount rate for the client will also change. FAS 87 actually requires that the discount rate should be set at the best estimate year after year. You're going to have to establish some kind of rule for how this discount rate is going to change. Setting a rule for determining the FAS 87 discount rate is something that most of my clients are pretty reluctant to do. However, for purposes of a projection, it's necessary to do something like that.

One of the things we found is that these models are useful for evaluating different approaches to changing the discount rate. For instance, I have one client that looked at what would happen if they changed the discount rate in step with the yield on long term bonds. If the yield on long term bonds is 9% in one year and 10% the next, then the FAS 87 discount rate increases by 1% over those two years. That gave them a great degree of volatility. So, we looked at a rule where they went halfway. The discount moved in the direction of the change but moderated somewhat. That gave them about the right kind of volatility, something they could live with.

It's important to establish these rules even if you don't think you'll follow them precisely. Of course, the rule that you select should be something that you think is reasonably related to what you're actually going to do.

If you have a client that is going to keep their FAS 87 discount rate constant, then you probably ought to keep it constant for the study even though that's not exactly what's called for.

The ERISA rate is something that's a little bit more difficult to deal with. Most clients looking at a study like this will want to have some sort of stochastic basis for the ERISA rate, but in general it's not nearly as volatile as the FAS 87 discount rate. Sometimes we wait until the change in the interest rate environment has moved two or three percentage points and treat the ERISA interest rate as sort of step function. It doesn't change until it hits a sufficiently large step. The important thing is to be descriptively realistic. In fact, for a number of clients, it turned out that the most appropriate thing for the ERISA interest rate was to keep it constant no matter what.

Should the expected return on assets be stochastic? Again, you get different answers from different clients. FAS 87 described the expected return on long term assets as your best estimate of some long run number. I've had a number of clients say their best estimate of long run return is not going to change that much. On the other hand, when you're doing your simulations you're simulating different economic opportunity sets. When you do 500 different simulations you're in 500 different economic environments. It's quite possible that if you move into one of these different environments it could change your expected long run return on assets. So it's a little bit harder to answer what the right thing to do is. I think it's something you have to investigate with specific clients.

Salary increases really break down into three different types of things to look at. First are the experience salary increases. That's what moves the group from one year to the next. We want to have the change in salaries consistent with the rest of the economy that we're projecting. So, if we have a high inflation scenario we probably want to have relatively high salary increases. If we have low inflation we want to have low increases. The approach that's typically taken is to use inflation and add on an amount for merit and productivity, maybe 1 to 2%.

Inflation is usually simulated almost as a separate asset class. That gives inflation a good correlation with the changes in all the separate asset classes that we're looking at. Generally, as a matter of theory, you probably ought to look at lagged inflation, but this is another one of those changes that is too complex and doesn't add that much. We've investigated using lagged inflation and it doesn't really change the results too much.

There's two different valuation salary increase rates that we need to look at. The first is for FAS 87. For that purpose, if your FAS 87 discount rate is going to be on a stochastic basis, then your salary increase assumption ought to be also. The ERISA salary assumption probably ought to be consistent with the ERISA interest rate. You probably want to keep the two either both stochastic or both not stochastic.

ASSETS AND RISK-RETURN RELATIONSHIPS

Generally, we want to look at the asset models in a capital asset pricing model framework. We want to look at the different asset classes and compare their risk-return characteristics. The basic idea here is that you are compensated for taking risk. As the riskiness of an asset increases so does its return.

There are two separate approaches that can be taken to building a model which is going to predict what happens to asset classes. The first is an economic approach and that's what happens in the large scale economic forecasting models, the Wharton Model, the MIT Federal Reserve Model. These are large models with thousands of explanatory variables that project what's going to happen to the economy in great detail. In general, these kinds of things are not needed and are much too sophisticated.

The approach that's usually taken for these types of models is on a time series basis. We build the asset classes up in two pieces. One is pattern and the other is randomness. We look at the behavior of assets over a long time and try and strip out what the pattern is. If we know what the pattern and the randomness components are to each of the assets classes, we can simulate randomness by drawing random numbers and then build the asset class up by adding the pattern back on top.

The time series approach is one that has been applied to a wide variety of different series and has ended up being very useful for predictive purposes. In fact, actually up until just a couple of years ago, time series models were probably better at predicting what was going to happen to the economy than some of the large scale forecasting models. Sort of like the weather. Up until a few

years ago, probably the best estimate of the weather one day was what yesterday's weather was and the large scale weather forecasting models didn't do too well.

In any event, these models do have very good predictive power. We don't necessarily care why a certain thing happened as much as how likely it is to happen. For instance, if we know that there's a 10% chance that assets are going to drop by 25% or more next year, that may be sufficient. We may not particularly care about all the variables that explain why that happened. Whereas, for one of the large scale economic forecasting models, they're trying to give policy prescriptions so they need to know why. Our models can be a lot simpler in that respect.

Let's take a look at what some of the data look like (Figure 1). This is on a logarithmic scale. These are five of the major U.S. asset classes. The bottom line is Treasury Bills and then moving up we have 20-year Government Bonds and just above that is 20-year corporate bonds. The next line is common stocks, S&P 500 type stocks, large capitalization equities. The last is small capitalization equities.

An interesting thing, about this in general, is that the series that has a great deal of variability, is the series that gives the largest return over time. The series that is as smooth as possible, the T-Bill series, is the one that's giving you the lowest return over time. The basic idea of the capital asset pricing model, that you expect to get some return for risk, certainly shows up here.

Another interesting thing is that this graph includes October 1987. If you look in the upper right hand corner you can see it in the two equity series, but it doesn't make as much of a difference as you might have thought at first. Part of that, of course, is the log scale. One reason we used a log scale was to fit it all on the same page.

The graph goes back to 1926. There's nothing particularly magical about that, but that's really the first year for which we have high quality data for all the asset classes. So, that's usually the starting point for the data bases. These are based on the Ibbotson and Sinquefield studies which review the major U.S. asset classes over that period.

What we want to do is take these series and figure out what they look like. Let's take the common stocks. We know that they're varying over time. What we would like to do is see what the pattern is in Figure 1 in a little more detail.

The interesting thing is that there's virtually no pattern at all. These returns look like they're pretty randomly distributed about something. The only thing that you might say is that there are both larger and smaller returns in the early part of the data, the 1930s. I think everybody knows that the 1930s was a time when there were very small returns, but it was also a time when there were very high returns, too. In fact, the highest monthly returns that you see on record occurred back in the 1930s. There has not really been much change in the average return since then. So, we have a series here that really looks like it's pretty random to begin with. We don't see a lot of pattern on the equities.

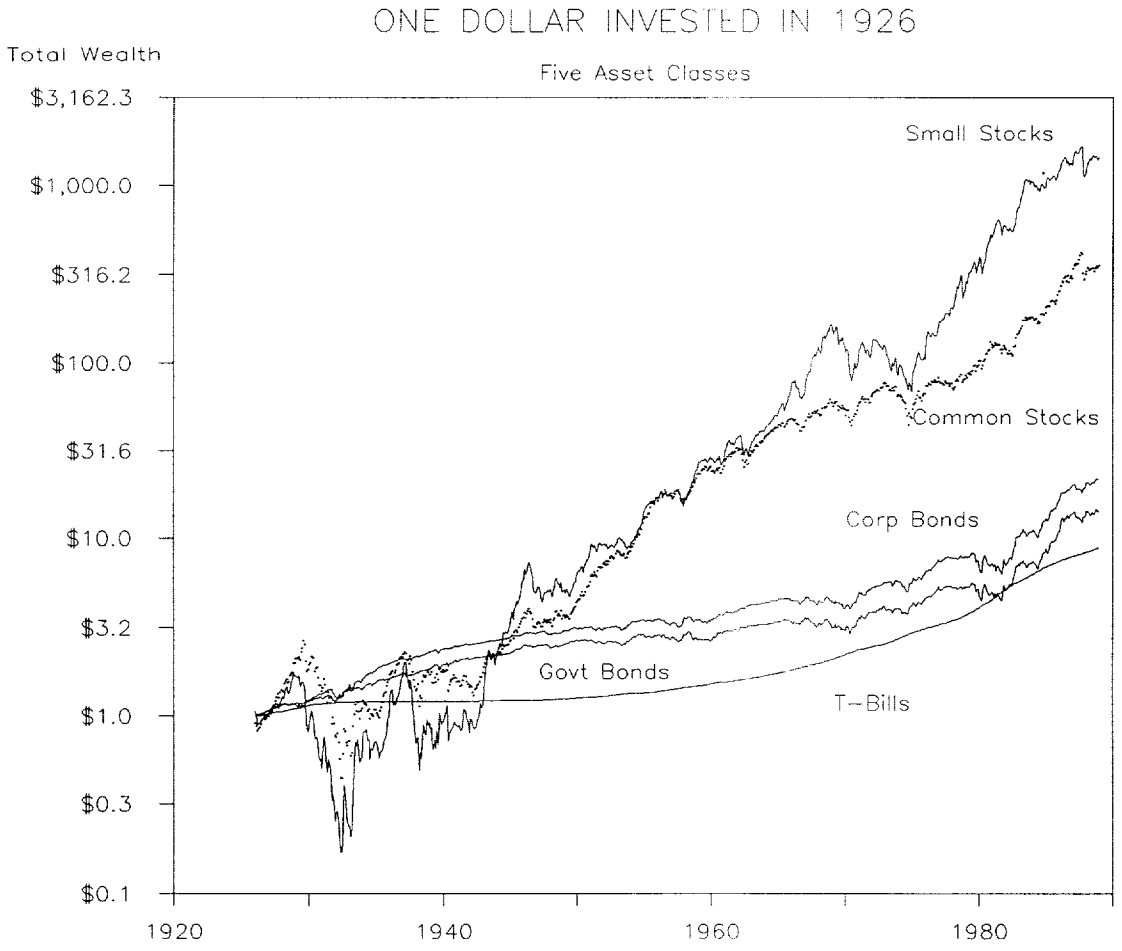
The small stock returns are small capitalization equities. We looked at all the New York Stock Exchange stocks and they're the lowest quintile by capitalization. Basically, they look pretty much the same as the large capitalization stocks except the returns are more spread out. There's more inherent variability and there's actually a somewhat higher return. Again, there's greater volatility in the 1930s, both high as well as low returns.

These are series where we start off not having a lot of pattern at all. They look like they're just random. We have done some statistical tests to take a look at that and it turns out that they are random around a mean.

One other thing we need to take a look at when we're looking at the various asset classes is how they move together.

If you have a good year in large capitalization equities, it's very likely that you have a good year in small capitalization equities. A bad year for one implies a bad year for the other. The correlation coefficient between these two classes is in excess of 85%, so they really move very closely together.

FIGURE 1


ONE DOLLAR INVESTED IN 1926
Total Wealth
Five Asset Classes
$3,162.3
$1,000.0
$316.2
$100.0
$31.6
$10.0
$3.2
$1.0
$0.3
$0.1
1920
1940
1960
1980
Small Stocks
Common Stocks
Corp Bonds
Govt Bonds
T-Bills

Correlation between two asset classes is something that's very important for us to look at in building a model because correlation, or lack of correlation, is really what makes diversification work.

In modeling equities we need to take a look at a couple of questions. First of all, what does the distribution function look like? The data look to be random and then we do some tests. There's very little pattern involved there. Now why should that be?

I think it's easy to construct an argument as to why you might expect to see returns distributed on a log normal basis. What investors care about is the percentage change in a stock. They don't care about the number of dollars it goes up. If you think that investors risk preferences are pretty much constant over time, then what you have is investors caring only about the percentage change and, pretty much, investing across the same type of assets over time with the same risk preferences. If you believe that, then what they're concerned with is a log of the changes, the log of the relative wealth values.

Since the risk preferences don't change over time, then the distribution is independent and identically distributed. No matter what the original distribution is, the sum of that distribution tends towards the normal. The log of the return over time is simply the sum of the logs of the separate returns. If you think that investors are concerned about the percentage change then you could easily reach the conclusion that it's log normal.

I think it's easy enough to construct a theoretical argument, but what you have to do is look at the data and see what that tells you. You can get some different ideas depending on what data you look at. If you look at daily returns, they are clearly not normal. The distribution's leptokurtic. It's higher in the exact center of the distribution and higher in the two tails, so it's somewhat more extreme than the normal.

That's not the case for the monthly returns and, of course, what we're really concerned with in doing any modeling may not even be monthly returns but quarterly or annual returns. That's what we're going to be focusing on when we actually get to our modeling. We may not care that it's exactly right in terms of daily returns. When we look at the monthly returns we get much closer to a normal distribution.

By the way, let me just mention one fallacy in the argument I just went through for the log normal. The central limit theorem only applies if you assume that the variance of your original distribution is finite. If you think that the variance of your original distribution is infinite then the central limit theorem doesn't apply. There's a different and expanded kind of central limit theorem that could apply and that gives rise to these Stable Paretian distributions. If you discover that you can have arbitrarily high changes in return from day to day, then you may still not think that returns are log normal. When Fama and Mandelbrot investigated this in the original paper, their conclusion was that it's not normal and could have arbitrarily high variance. For model building purposes something which has infinite variance or very, very high variance is pretty much the same thing, as Mandelbrot pointed out in a later paper. Now the assumption that most people use is, in fact, that the returns are log normal and sometimes you investigate what might happen if the variance is larger.

Actually the problems I've had in working with clients is getting the variance too small, particularly before October 1987. We would go in to do a modeling project and they would bring in their outside investment advisers. They would give us their own opinion as to what the return and standard deviation applicable to the various asset classes were.

I remember one we did. The adviser came back and gave us returns and standard deviations. They didn't really look like they were that far out of whack, but we just did some tests to see how likely the Depression was. People say that the economy's very different now than it was during Depression times. You have the Federal Reserve much more galvanized to act and to keep you from going into a real large scale Depression. Under this investment adviser's assumptions, in fact, it was likely a depression would occur only once every 5,000 years. Now, 50 centuries is really a long time and to say that this event that actually occurred in the 1930s would only occur once in the next 50 centuries seemed to me to be not enough of a probability. Since October 1987, it's been a lot easier to make the argument that maybe you should allow for some unusual events to occur.

One question that might come up is why small capitalization equities are a separate class to begin with? You could just model one equity class and say you can invest in things that are more or less risky in the class of equities and we can adjust for that by adjusting the return and the risk up or down. However, small capitalization equities have two things which are different.

First, they seem to get more return for the extra risk than would be justified if you're pricing them in line with the other assets. They seem to be a pretty good buy, generally.

The second thing is that they're really odd because they make all their money in January. Basically, the return on small capitalization equities is relatively low over the period from February to December and then in January they go way up. Figure 2 shows the small stock returns from 1926 through 1988, 63 years of data. As you can see, the average return for January, on an annualized basis, is about 120%. The return for all the other months is relatively small, although some of them do get up as high as 20% and some as low as minus 20%. Basically, January's the only month that's really funny. In fact, it all occurs in the first two or three weeks of January.

There have been a lot of different reasons put forth for this January effect, though nobody has put forth anything which fully explains it. Some people thought it might be a tax effect, but then there have been studies that have gone back to before we had an income tax and it looks like it occurred even then. It's been found to occur in Australia. You'd think it would be July there, because they're sort of standing on their heads, but it really has occurred in a lot of different ways.

This January effect for stocks is something that makes us suspicious that there is something that we don't know. Even if we don't know what the reason is, we want to try and make sure we keep them as a separate entity.

One other reason for keeping them as a separate entity is that you might want to put limits on how much a pension fund would be willing to sink into smaller capitalization stocks.

If you study the return on Treasury Bills during this period, you will note a remarkable pattern -- unlike the common stocks, which had virtually no pattern. Each monthly return is very close to the prior month's return. In fact, if you wanted to estimate what the T-Bill return was going to be for any month, an excellent estimate would be what it was the prior month. You'd never be very far wrong and often, you'd be right on the button.

The returns on T-Bills during the 1930s, the 1940s and up through 1951 were very, very low, down near zero. That was the time of the U.S. Treasury Federal Reserve Accord when, in fact, T-Bill rates were arbitrarily restricted. So, that might not tell us that much about the rest of the data. It might be something you need to throw out simply because that restriction doesn't apply in the rest of the period.

One other interesting thing is how much more volatile the T-Bill returns are in the later period. During the 1970s and 1980s you have significantly greater volatility. Nineteen seventy-nine was when the Federal Reserve stopped pegging interest rates. A lot of people say things are different now and we want to take a look at that as a separate period. However, the increased volatility in the T-Bill returns occurred even before that time.

If you look at T-Bill returns on a logarithmic scale, you don't nearly see the same change in volatility. What this may suggest is that the right way to model T-Bills is not like a geometric random log where you're saying the log of the return is a random walk. A variance which is changing over time, heteroscedasticity, is something that you have to eliminate in the course of model building. You can do that a number of different ways, one of which is an appropriate change of variable. For T-Bills, looking at the logs might be an appropriate change of variable.

I have mentioned a little bit about trends and returns already. Figure 3 shows the yearly returns on common stocks. I've taken the yearly returns and compared them to a confidence interval. The confidence interval is based on the mean over the full 63 year period and the standard deviation which is appropriate right around the year that the return occurred. It's a ten-year moving average centered on that year.

FIGURE 2

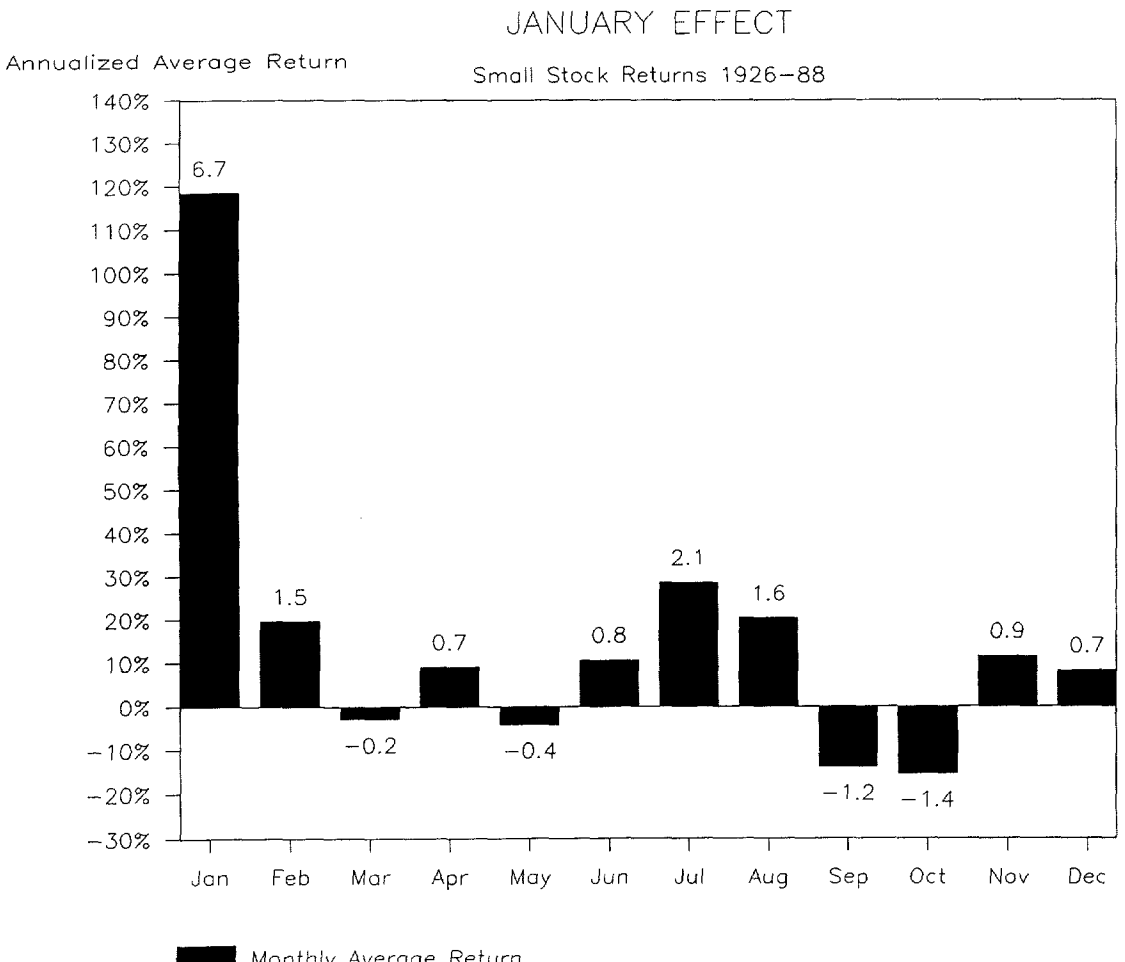
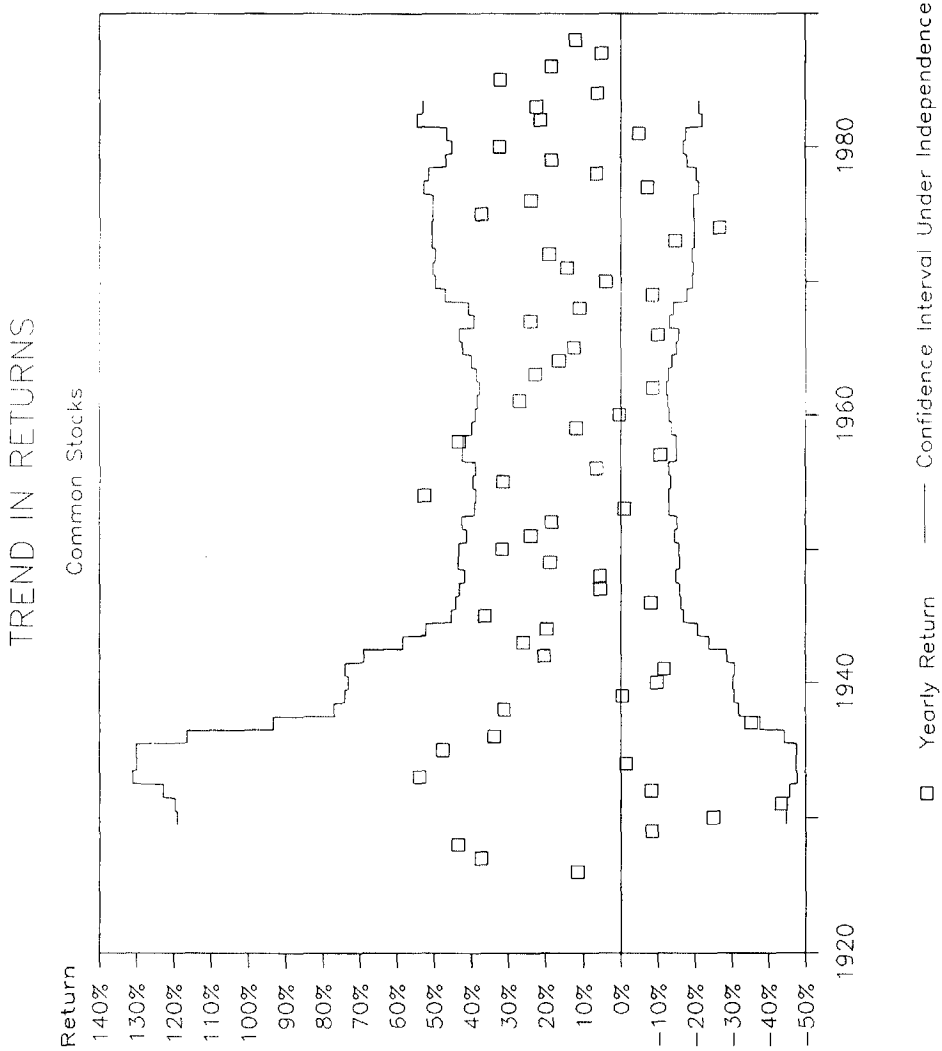

JANUARY EFFECT
Small Stock Returns 1926–88
Annualized Average Return
140%
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
−10%
−20%
−30%
6.7
1.5
−0.2
0.7
−0.4
0.8
2.1
1.6
−1.2
−1.4
0.9
0.7
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Monthly Average Return

FIGURE 3


TREND IN RETURNS
Common Stocks
Return
140%
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
1920
1940
1960
1980
Yearly Return
Confidence Interval Under Independence

We'd expect that, if these returns were completely independent year to year, we'd find about 5% of the returns outside of the two standard deviation lines and in fact, we do see about three or four that are outside, which is about what we would expect. So, again, when we look at the trend and returns for equities, we don't see any particular pattern evolving. One thing this does make clear, though, is the incredible change in variance that you see from the Depression down to today.

Figure 4 is the trend and return for government bonds on the same basic assumption. First, you see more of the government bonds outside the limits than you do for equities indicating that you probably need to model government bonds as something which has some pattern to it, although it is not as dramatic a pattern as T-Bills had.

Again, you've got to pick up a changing variance over time. So, we may need to take a look at the log of the bond return or at the log of the bond yield rate. By the way, the reason this works is that for so long the yields for Government Bonds and for T-Bills were very low and now they're very high. So, just a change of variable may be enough to explain the variance. It may be that you're always more likely to see a 50% drop in Government Bond yield when the Government Bond yield is 50% than to see a 50% drop when the Government Bond yield is 5%. It may be that it's more stable around 5%.

T-Bills, shown on Figure 5, are never where they should be. You can see they're always outside of the two standard deviation pattern. The correlation between one return and the immediate prior return is in excess of 95%. That's basically what we saw before, that the best estimate of T- Bills any month is what you got the month before. The reason that they're always outside of the two standard deviation line, again, is that they have momentum. Once they move outside they're kept outside. This is exactly the kind of change you would expect to see.

Let me just finish up here with a couple of things. Having gone through and analyzed assets in terms of building the pension plan liability model and the asset model, what do you do with it? Some studies have actually been done on how they work, but let me just mention a couple of other things that you need to think about.

First is the pension plan risk preferences. What is the definition of risk that's appropriate for a pension plan? Is it the level of expense that the pension plan is going to have or is it volatility in expense? I think you get different answers. Paul mentioned plan sponsors that didn't want to give up any return in order to lower their risk or they would give up very little. I've had clients tell me, though, they would much prefer to have a pension cost which was 6% of pay and know that it's stable year to year than to have one that's 4% of pay and know that there's a chance for substantial variation.

One of the nice things about these models is that you put things in real terms to clients. Having projected both the assets and liabilities, you can now do all these valuations and put the meaning in real terms.

Different clients are going to have different preferences. Expense level is one. The contribution level is something else they might be concerned about. They might even be concerned about surplus level. Of course, if you get into surplus, you've got to worry about an appropriate definition. Is it the accumulated benefit obligation (ABO) or is it the projected benefit obligation (PBO)? If it's the PBO, is it one that's indexed after retirement? Maybe that's what some people call the real economic liability of the pension plan. I had one CFO who wanted to use the full present value of benefits, although we talked him out of that in the end.

The next thing to take a look at is utility. It probably doesn't mean the same thing to lose an extra dollar of pension fund assets at all different wealth levels. As an example, if you have a plan where assets are exactly equal to the ABO and you're in a situation where every dollar you lose is an extra dollar of balance sheet liability, you may feel very differently than when the assets are twice the ABO and you're in no danger of any balance sheet effects. So, one of the things we need to incorporate into these models is a concept of utility, that there are different levels of pleasure or pain for getting an extra dollar of assets at any given time.

FIGURE 4

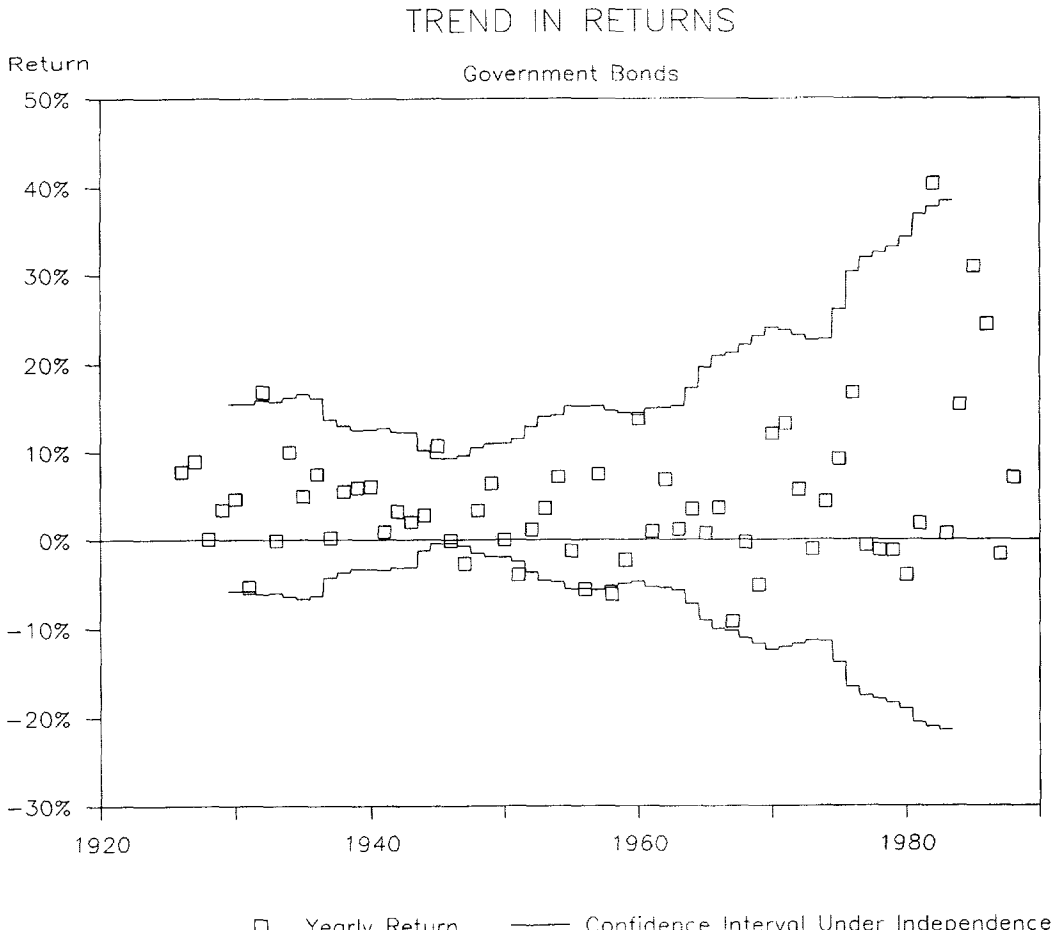
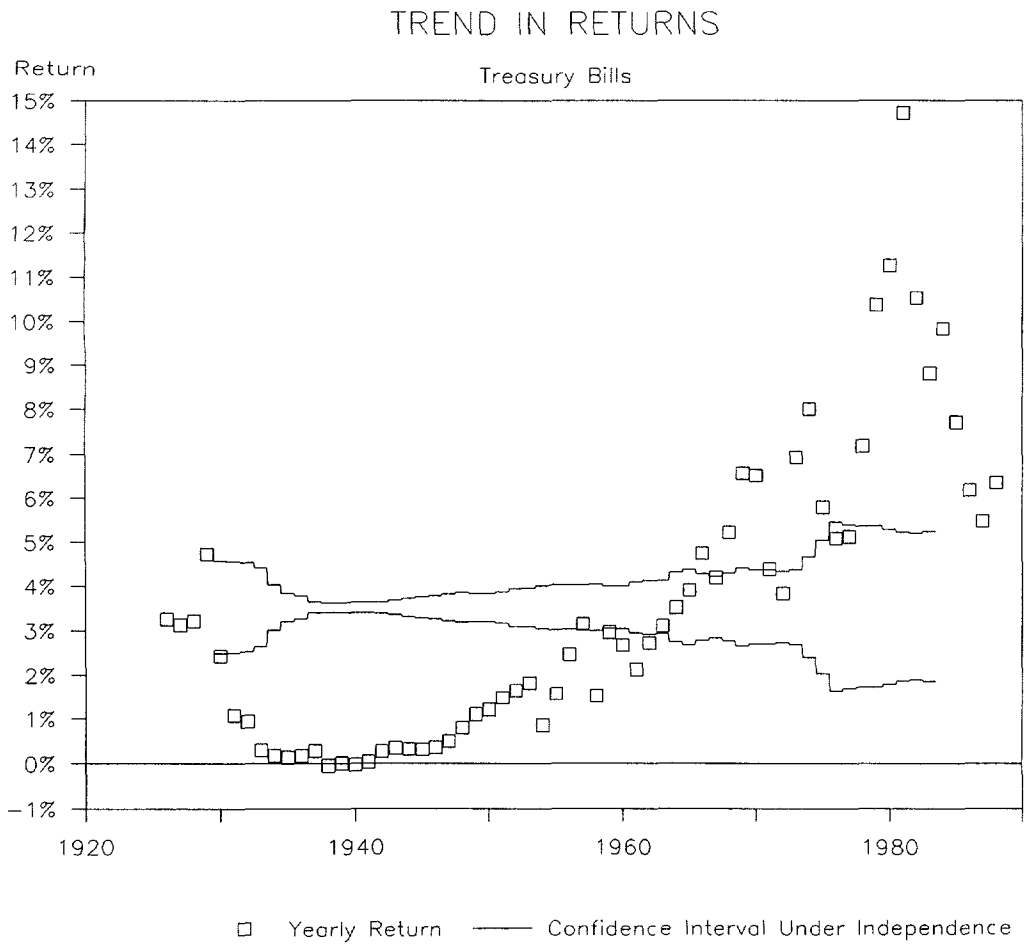

TREND IN RETURNS
Government Bonds
Return
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
1920
1940
1960
1980
Yearly Return
Confidence Interval Under Independence

FIGURE 5


TREND IN RETURNS
Return
Treasury Bills
15%
14%
13%
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
−1%
1920
1940
1960
1980
Yearly Return
Confidence Interval Under Independence

The utility argument actually cuts two ways. You have general economic theory which says as your level of wealth grows you're able to take on more risks. So, as a pension plan gets richer it probably ought to be riskier in what it's doing and go after more return.

The opposite side is that as a pension plan gets wealthier and wealthier then any change in the pension fund assets gets translated into huge effects in the incoming expense for the year and perhaps on the various executives bonuses for that year. That may not be what they want to do.

We need the goals of the pension plan. Are they to provide nominal benefits or real benefits? Do you want to look at the real economic liability, the PBO, or maybe just the ABO in terms of your surplus?

The other thing is surplus immunization. Surplus immunization is a very big deal right now and I think most large pension plans are looking at it in some degree. Even if they decide not to go ahead with a program, they're at least investigating it. Dick is going to tell us about the results of some studies on that.

MR. RICHARD Q. WENDT: John has talked a lot about the theory. I'm going to talk about some of the practical examples and I have three different case examples of an asset allocation study using some of the new technology that we bring to bear in the pension forecasting arena.

We're talking principally about the concept we're calling surplus risk which is looking at how the assets move in conjunction with the liabilities. Whereas, traditionally in the asset allocation arena we look strictly at the characteristics of the assets. It's quite crucial to see exactly how everything moves together with movements of liabilities.

What do we mean by surplus risk? First, it's that connection between the assets and liabilities. In a traditional efficient frontier type of calculation, we're optimizing expected return and portfolio risk. Here we're doing an efficient frontier calculation that optimizes expected return and surplus risk, surplus risk being defined as the volatility or change in surplus.

The traditional efficient frontier is basically independent of liabilities and it does not matter what the liability characteristics are. The surplus risk frontier is quite specific to two factors. First is the fund ratio. Whether the plan is underfunded, overfunded, or exactly at 100% funding will affect the type of efficient frontier calculation produced. Second is the liability characteristics. Whether it's an ABO type liability or a PBO type liability and whether it's concentrated in retired lives or active lives will affect the balance of the assets that will be brought into the optimization program.

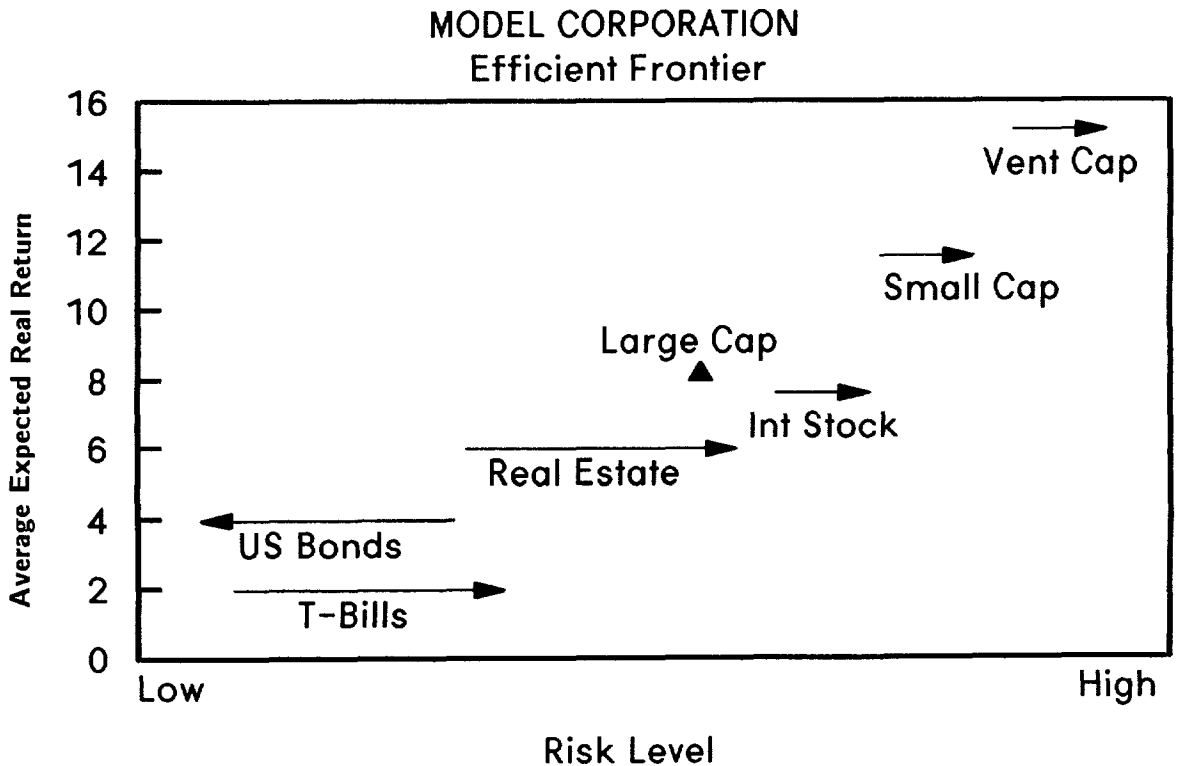
The implication is that you should actually be recalculating the efficient frontier as the facts change. If it's six months down the road and your funded ratio has changed from 150% to 125%, you should probably be doing another calculation to rebalance the assets according to the new funded ratio.

One of the other concepts we're bringing in, an independent concept but highly useful to solving many of the volatility questions, is the concept of a long duration asset. A normal 30-year Treasury Bond has a duration of about nine or ten years. A PBO type liability would typically have a duration of about 11 or 12 years. It's very hard to match the assets and liabilities and have them moving together unless you have an extremely high concentration of fixed income and Treasury Bonds.

One way of getting around that is to bring in an asset class with a very high duration. For instance, if we bring in a 30 year zero coupon bond, which is a principal payment only at the end of 30 years and has a duration of 30 years, we're able to have a much smaller proportion of fixed income components in a portfolio and, therefore, a much higher component of equity and raise the expected return in portfolio. That goes a long way to enhancing many of the portfolios.

Figure A is a little bit complicated. It's the market line compared on the old basis and the new basis. The tails of the arrows are based on the risk and return characteristics under the traditional efficient frontier, the mean and standard deviation John was talking about a couple of minutes ago. But, if we transform that into how the assets move with the liabilities, we see that we get movement and not always in the same direction. T-Bills, which have been thought of as

FIGURE A



Conclusion:

- Bonds less risky than T-Bills
- Large cap less risky than Real Estate

the least risky asset class, did not really move very well with liabilities and, in fact, they increase in risk. Bonds, on the other hand, which had been substantially riskier than T-Bills, do move fairly well with liabilities and, therefore, viewed in conjunction with the liabilities, they actually decrease in risk. In fact, bonds are now less risky than T-Bills when viewed in the concept of surplus risk.

The other interesting observation is real estate. Real estate doesn't move very well with liabilities. In many traditional asset allocation studies real estate was thought of as a very advantageous asset to bring in, but now, in this concept, it turns out that it's not as advantageous. The large capitalization, or S&P 500 type, stocks are, in fact, less risky than a real estate class and still provide higher returns. So, we have done many surplus risk efficient frontiers that bring in very little percentages of real estate. It's no longer the favorite asset class that it once was.

The other asset classes move as you would expect. The equity classes do not move well with the liabilities, so they're basically increasing in risk. The key thing is that bonds are now the least risky asset class.

Let's look at the efficient frontier itself, Figure B. The plan sponsor that has done a traditional efficient frontier study is basically pulling portfolios from that bottom line. What he's done is to expose himself to risk that he's not really aware of. If he wanted to actually reduce or stay at the same risk level and increase his expected return, he will be able to introduce the surplus risk concept and increase his expected return by 100 to 200 basis points while keeping the same risk level that he's implicitly at. For the client that's interested in the issues related to surplus risk, that's a very key difference in expected return.

Where, specifically, would we use surplus risk? There are really four major areas that we've identified.

With FAS 87, the volatility of pension expense is a very major issue. Many plan sponsors are looking for ways to control the change from one year to the next in the net periodic pension cost.

Next is tangible net worth. This relates to setting up the balance sheet liability for an unfunded pension plan. Once that liability is set up it reduces tangible assets and, therefore, reduces tangible net worth. Many corporations have financial arrangements that key off tangible net worth and it's crucial to them to minimize any fluctuations in the tangible net worth.

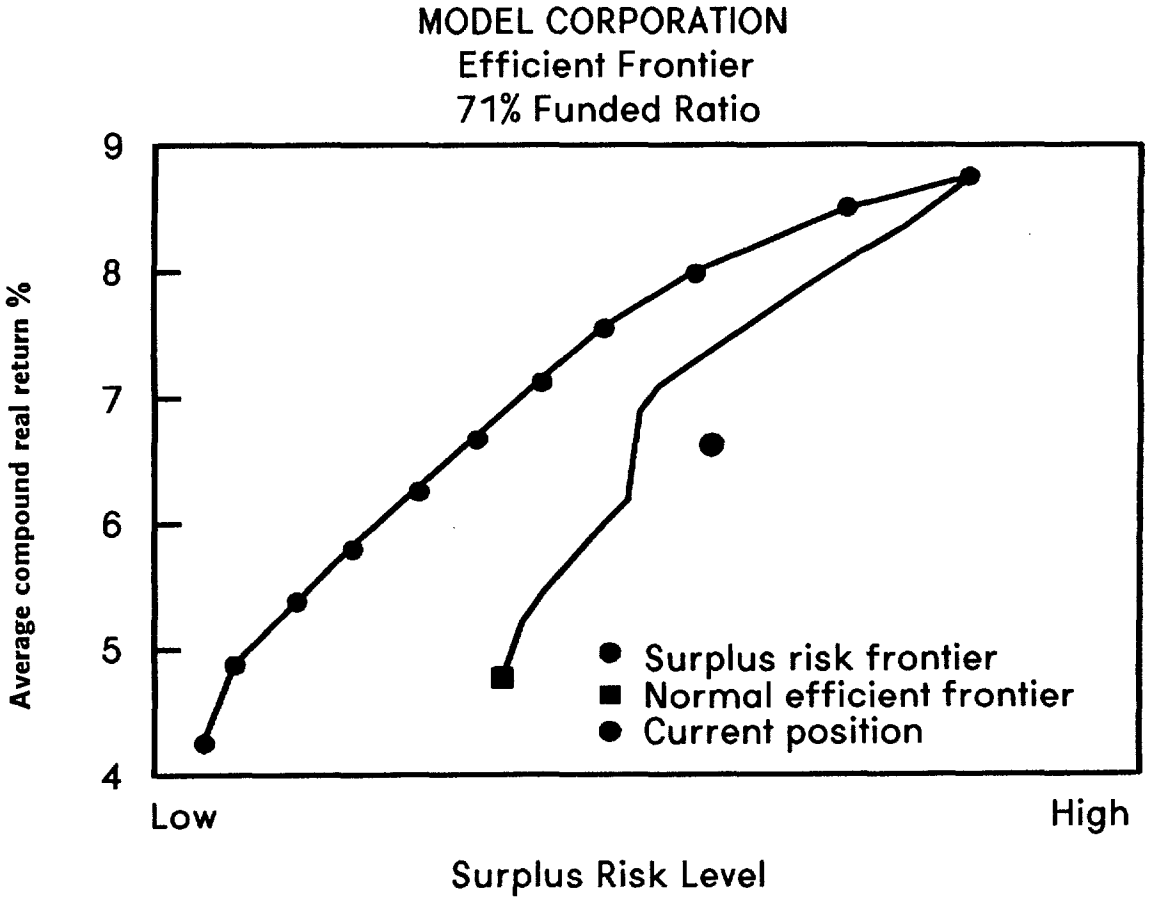
Shareholder equity is also related to the balance sheet impact. When setting up a liability on a balance sheet for the underfunded plan, the corporation is able to set up an offsetting asset but it is limited by the amount of unrecognized prior service costs. In some cases the limitation is such that the asset will be less than the liability and, therefore, there will be a charge to shareholder equity and a reduction in corporate net worth. Obviously, there are many corporations that want to minimize that reduction as much as possible and minimize the volatility of the balance sheet impact.

In the Omnibus Budget Reconciliation Act of 1987 (OBRA), a new concept has been introduced. Starting in 1989, there will be an additional minimum contribution for underfunded plans. They're called deficit reduction contributions. For many plans that are underfunded there will be a substantial cash item in addition to what they previously paid. Since the OBRA current liability changes with economic conditions more slowly than the settlement rate, but with the weighted average of Treasury Bonds, there will be a way to move the assets in accord with that particular liability measure.

What all these have in common is that the liability measures are moving with economic conditions at the time of calculation.

However, there are a couple of instances where we should not use surplus risk and those are the instances where the liabilities are not subject to interest rate volatility. For instance, if you're working on a government plan, it typically will not have a varying interest rate. It will have a long term interest rate which is usually assumed to be in effect for the length of the forecast. Also, fully funded plans will typically not be affected by the surplus risk concept. They usually will not need to have the assets moving well in conjunction with the liabilities. They would probably use the traditional efficient frontier type of calculation.

FIGURE B


MODEL CORPORATION
Efficient Frontier
71% Funded Ratio
Average compound real return %
9
8
7
6
5
4
Low
High
Surplus Risk Level
Surplus risk frontier
Normal efficient frontier
Current position

In this first example (Table 1), we have an hourly plan, meaning that it's a flat dollar type of plan in its benefit structure and, therefore, the ABO is equal to the PBO. This mathematical fact creates some interesting problems for the plan that's underfunded and trying to minimize the charge to shareholder equity.

TABLE 1
BALANCE SHEET IMPACT OF FAS 87

Accrued benefit obligation	=	$104 Million
Assets	=	76
Minimum liability	=	28
-- Accrued Expense	=	13
Additional liability	=	$ 15 Million
Intangible asset = minimum liability, limited by prior service costs		
Maximum intangible asset	=	$ 20 Million
Net liability	=	0

Let's go through an example of the calculations. Basically, $104 million ABO and assets of $76 million indicates that they have a minimum liability of $28 million. In this case, and this is based on an actual example, they already had an accrued expense of $13 million and, therefore, they had to set up an additional liability of $15 million. That creates a reduction in tangible net worth of $15 million.

They are able to set up an intangible asset up to the lesser of the $15 million or the unrecognized prior service costs. In this case, they're fortunate that the maximum intangible asset could be as much as $20 million. Therefore, they would set up $15 million and the charge to shareholder equity would, in fact, be zero.

So starting out, the plan sponsor would say what's the big deal? Its charge to equity is zero. There is a reduction in tangible net worth, but really no big problem.

What if the settlement rate declines 2% (Table 2)? Instead of $15 million additional liability there would, in fact, be a $32 million additional liability. The intangible asset is higher but it's still limited to $20 million. Now, they will show a charge to shareholder equity of $12 million. This is relative to a plan with a $100 million ABO, so it's a fairly large percentage of their liability. It does not go through the income statement but goes directly to net worth on the balance sheet.

TABLE 2
VOLATILITY OF NET LIABILITY

o Initial net liability		$ 0
o If settlement rate declines 2%,		
-- additional liability	=	$32 Million
-- intangible asset	=	20
-- net liability	=	$12 Million

What if assets declined 20% (Table 3)? In this case the additional liability would be $30 million. The intangible asset is still limited to $20 million and the charge to shareholder equity would be $10 million, a substantial amount.

TABLE 3
VOLATILITY OF NET LIABILITY

o If assets decline 20%,		
-- additional liability	=	$30 Million
-- intangible asset	=	20
-- net liability	=	$10 Million
o If settlement rate declines 2% and assets decline 20%,		
-- additional liability	=	$47 Million
-- intangible asset	=	20
-- net liability	=	$27 Million

If both unfortunate events were to occur simultaneously, $47 million, basically, 40 or 50% of the ABO, would have to be set up as an additional liability with a net result that there would be a charge to shareholder equity of $27 million. Again, this is for a plan that had only a $100 million ABO.

Therefore, the economic effects of the balance sheet liability for the typical underfunded plan can be quite dramatic.

As I mentioned before, it's more important for the hourly plan because their prior service costs are limited by the ABO at transition. For a salaried plan, the prior service costs are based on the PBO, which has a margin on top of the ABO. Therefore, they have a much higher capitalization for the intangible asset. We've seen very few salaried plans that are affected by the balance sheet liability, but the hourly plans, when they're underfunded, will have some very dramatic impacts.

What's the solution to this? Here's where we bring in stochastic forecasting. We'll use our economic model to generate a hundred economic scenarios, each scenario with a particular pattern of inflation, bond yields and portfolio return. Liabilities will be affected both by changes in inflation and by changes in bond yields which generate a change in the settlement rate. Portfolio return will, obviously, change the assets from year to year. We'll simulate the entire pension plan, contributions each year, balance sheet impact, expense, and pull out simply the charge to shareholder equity and see what the percentile distribution is.

For this modeled plan, and their current portfolio mix, the charge to equity would start in 1989 (Figure C). There's about a 10% chance that they could have a $13 million charge to equity or more. There's a 25% chance they could have a $7 million charge to equity. Again, relative to their $100 million ABO, 1990 could go even higher.

If you look at the charges as a percentage of payroll, it's as high as 30% of payroll. This particular plan was paying a pension expense of about 10% or 11% of pay, so they're staring at the possibility of some level of charge to the balance sheet, very similar to an expense in some ways, equivalent to three times their pension expense. So, it does have some very dramatic effects on a corporation. Over time we see that the 75th percentile diminishes to zero, but there is still a 10% chance of $12 million or more in charges to shareholder equity. The next step is to use our surplus risk portfolios. We're going to include the long duration assets which is a 30 year zero coupon bond. We do the efficient frontier calculation with all types of constraints to allow the corporation to choose realistic portfolios that they might select and we'll just show you what types of portfolios we would come out with.

The first column is the current portfolio (Table 4). Then we've chosen some other portfolios. One portfolio has equal return to the current portfolio. Another portfolio is equal risk to the current portfolio in the surplus risk concept. We chose a portfolio in the middle of the efficient frontier, the medium risk-return, and then two portfolios with a lower risk-return and a higher risk-return.

One of the interesting things to note is the proportion of the fixed income component in each category. The current mix has about 30% bonds and T-Bills. The lower risk-return is 78% fixed income comprised of 56% of the U.S. fixed and 22% of 30 year zeroes. The equal return portfolio is 60% fixed. The medium risk is 39%. The equal risk is 27% and the high risk is 0% fixed. Some corporations might say 60% fixed is too high, but we'll see that the portfolio with 39% fixed, and even 27% fixed, does provide satisfactory alternatives and improvements over the current mix.

Figure D shows what happens in 1989 for those mixes. The current mix has about a 10% chance of a $13 million net liability. Mix two, which is the most conservative and matches the liabilities best, can cut that down to a 10% chance at the $3 million level. Even mix four, which is 39% fixed income, has cut it down to around the $5 million level. Mix five is not as dramatic. Mix six, without any fixed income, just doesn't work and indicates that you can only take the risk so far. Mixes two, three and four, subject to how comfortable the client is with the fixed income components, are quite satisfactory alternatives to the current mix.

If we look at that sample plan over 100 scenarios, mixes two, three and four will actually increase the expected value of shareholder equity by about $4 million. Just by moving to a better asset allocation, basically, the expected payback would be $4 million, including all the trials that actually have no charge to shareholder equity.

FIGURE C

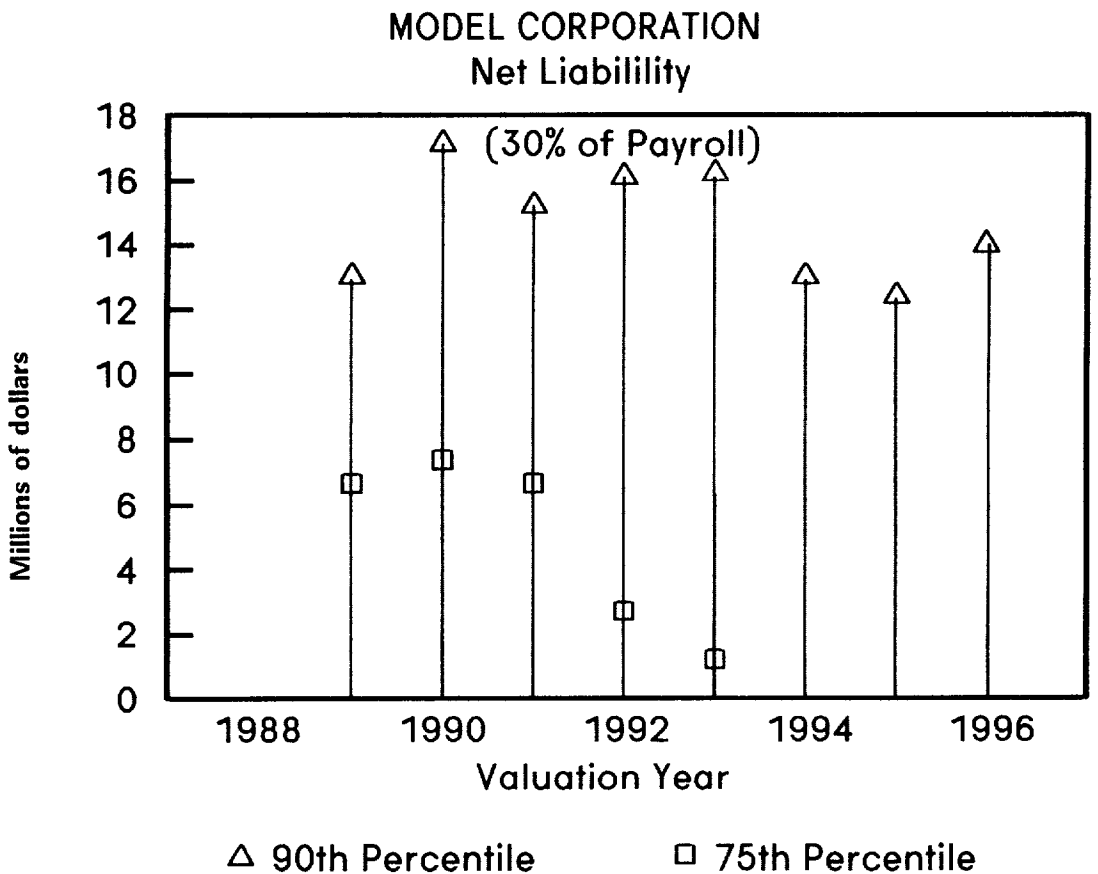
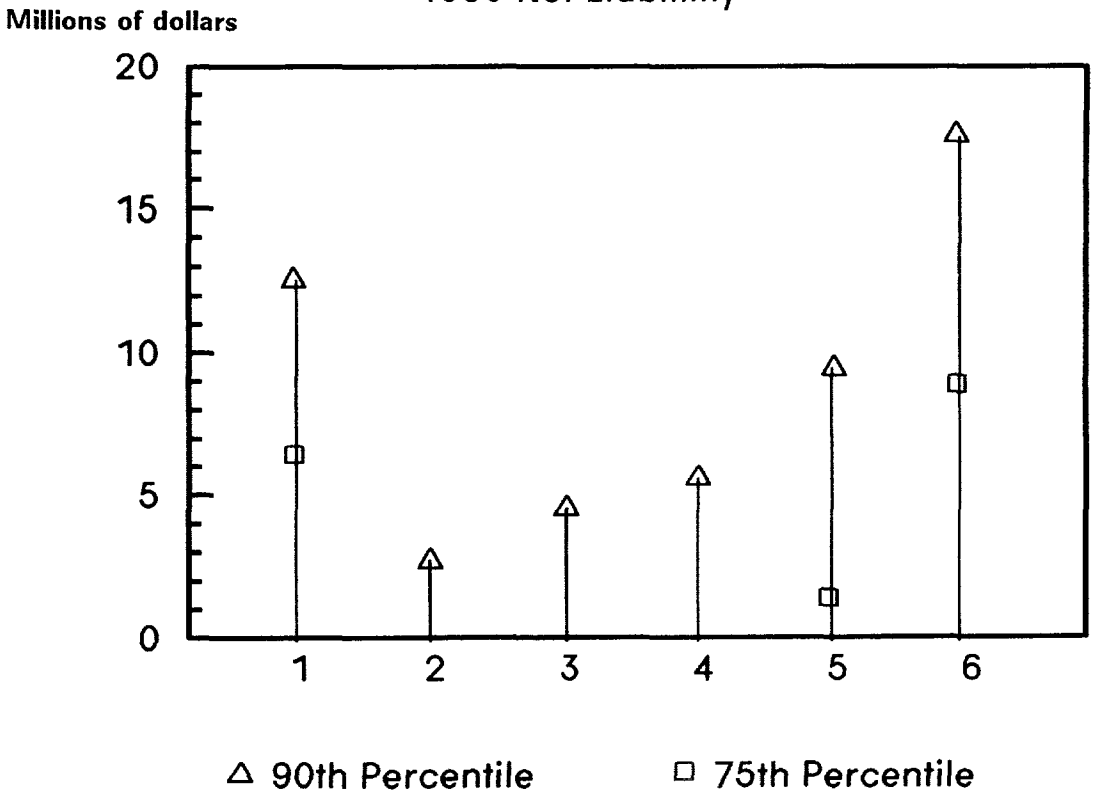

MODEL CORPORATION
Net Liabilility
(30% of Payroll)
Millions of dollars
18
16
14
12
10
8
6
4
2
0
1988
1990
1992
1994
1996
Valuation Year
90th Percentile
75th Percentile

TABLE 4

ALTERNATIVE ASSET MIXES

	Current	Lwr Risk/ Return	Equal Return	Med Risk/ Return	Equal Risk	Hghr Risk/ Return
T Bills	10 %	0 %	0 %	0 %	0 %	0 %
US Fixed	20	56	31	4	0	0
S&P 500	30	8	13	21	34	67
Int Equity	10	0	0	0	9	8
Small Cap	5	0	3	10	15	15
Vent Cap	5	7	10	10	10	10
Real Estate	20	7	14	20	5	0
30 year zero	0	22	29	35	27	0

FIGURE D


MODEL CORPORATION
1989 Net Liabilility
Millions of dollars
20
15
10
5
0
1
2
3
4
5
6
△ 90th Percentile
□ 75th Percentile

People might say, well, that's great for 1989 but aren't you giving up a lot of equity return by going into the major elements of fixed income, and probably, over time, it wouldn't work out.

Okay, so let's look at 1992, Figure E. Actually, it looks even better. Mix one, the current mix, still has a 10% chance of a $16 million impact. Mixes two and three have less than a 10% chance of any impact whatsoever. Mix four has a 10% chance of being down about the 1% level. Even over time, the surplus risk efficient mixes are quite satisfactory and look like they work very well.

Let's look at another example. This is for a salaried plan. It has a little different slant on it. It's a plan that's funded very well. Here their objective is to minimize the volatility of pension expense.

When we talked to the client we tried to identify how you measure expense volatility. What we came up with is to look at how often the pension expense increased by more than 2% of payroll. In other words, if it's 6% in 1988 and 9% in 1989, it's increased 3% of payroll and would be an unfavorable result. So, we're going to see how many favorable and how many unfavorable results we're going to get in our stochastic forecast.

The way we start this is with surplus risk. It's a different frontier because it's based on a different liability target. It's based on the PBO instead of the ABO. It's based on the exact distribution of actives and non-actives of this plan and it's based on the specific funded ratio of this particular plan.

Note here (Table 5), in the sample mixes, the current mix has about 40% fixed income and Treasury Bills. Mix A, which is a surplus risk efficient mix, is about 70% fixed income. Mix B is about 60%, mix C is 45%, and mix D is 25% fixed income.

It's basically a very simple exercise to run our system and simply count, out of 100, the number of times that pension expense increases more than 2% of payroll (Figure F). For the current mix, it was a 19% probability that the pension expense would increase by more than 2%.

It does turn out, by moving to any of the surplus risk efficient mixes, we're able to cut that quite substantially. Mix A, which is 70% fixed income, can cut that probability down to 4%. Mixes B and C, 60 and 45% of fixed income, respectively, are around the 5 and 7% level. This is solving the pension volatility question quite well and not giving up any return compared to the current mix.

The last example is again for an unfunded hourly plan. Here, the concern was not with expense, not with balance sheet impact, but with cash contributions. Priority was minimizing the amount of cash to pay out for minimum funding. Therefore, the objective was to minimize that additional deficit reduction contribution.

The same process was used in developing the surplus risk efficient frontier relative to the particular liability target, the current liability. The funded ratio relative to current liability comes out different with several alternative mixes. See how they measure up against the current mix (Figure G).

In this example the average deficit reduction contribution was measured over the first five years. Under the current mix, there's a 10% chance that they would have to pay between 2 and 2.5% of payroll (earnings) in extra contributions. There is a 25% chance that they would have to pay an extra 1% of payroll.

Let's try to minimize those extra amounts as much as possible. It does turn out that mixes two, three and four will cut it virtually in half and save that employer, basically, 1% of payroll, on average, over a five year period. This is, obviously, a fairly substantial amount of money relative to the plan.

The conclusion is that some corporations are mostly concerned with expense, some are concerned with the balance sheet impact, some are more concerned with the cash components, but it turns out that whatever the particular interest the corporation has, the surplus risk concept is able to come into play and solve the problem as long as the main ingredient is satisfied, that the liabilities are interest rate sensitive.

FIGURE E

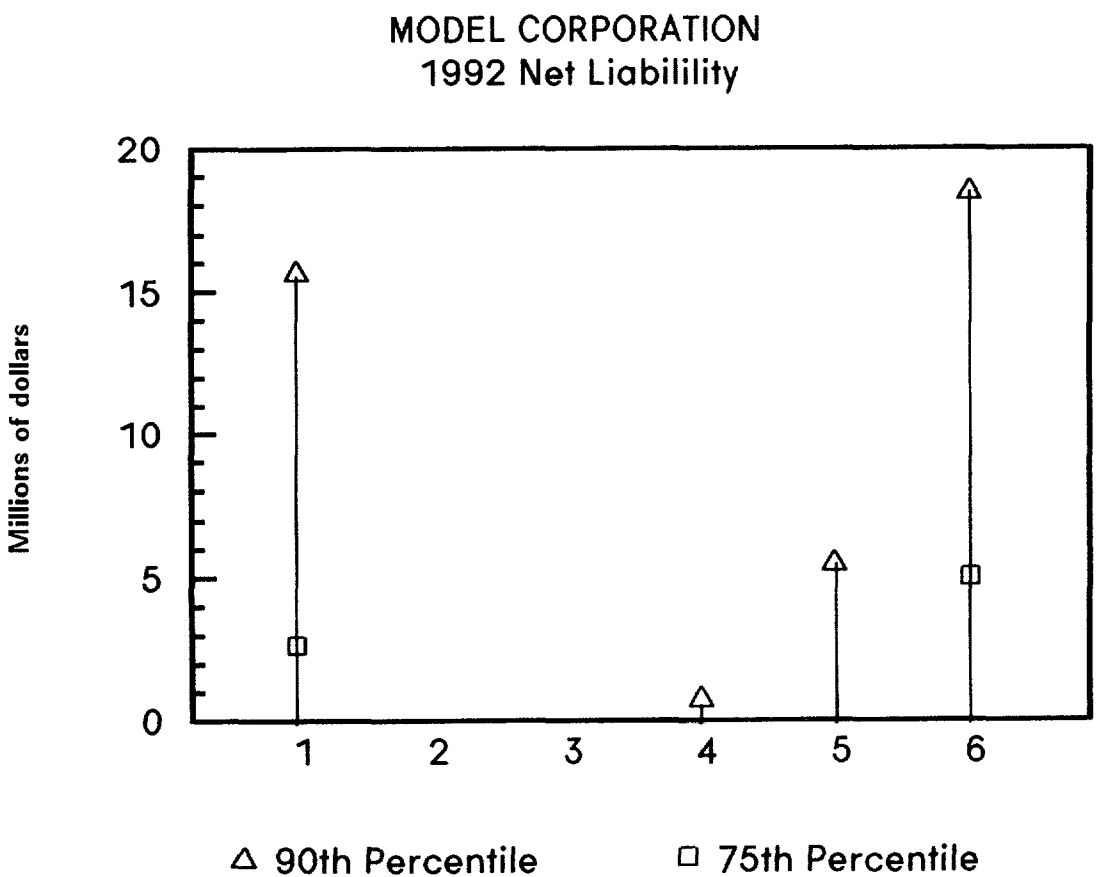

MODEL CORPORATION
1992 Net Liabilility
Millions of dollars
20
15
10
5
0
1
2
3
4
5
6
△ 90th Percentile
□ 75th Percentile

TABLE 5

ALTERNATIVE ASSET MIXES

	Current Mix	Mix A	Mix B	Mix C	Mix D
Large cap	35 %	15 %	20 %	27 %	37 %
Intermediate bonds	35	48	40	27	8
International equity	5	6	9	10	10
Small cap	10	0	0	4	8
Vent cap	5	9	10	10	10
Real estate	5	0	0	3	9
Cash	5	0	0	0	0
30 year zero	0	22	21	19	18

FIGURE F

PROBABILITY OF EXPENSE INCREASE
Greater Than 2% of Payroll

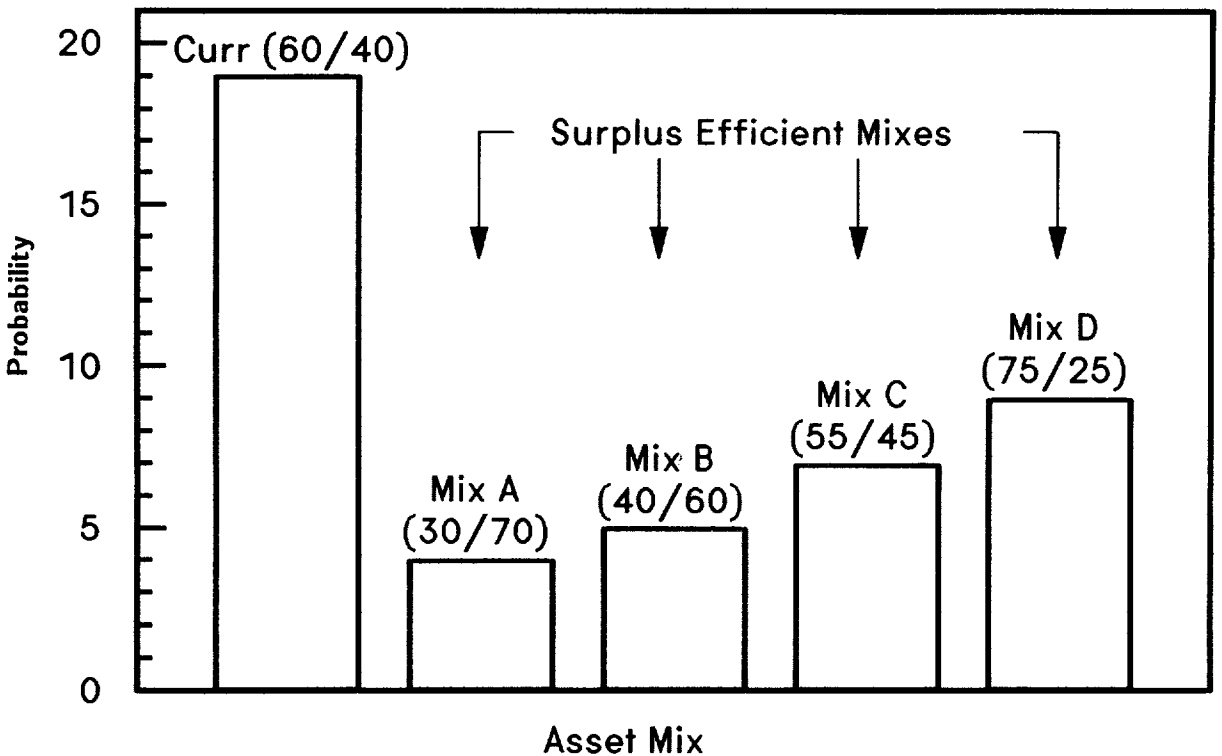
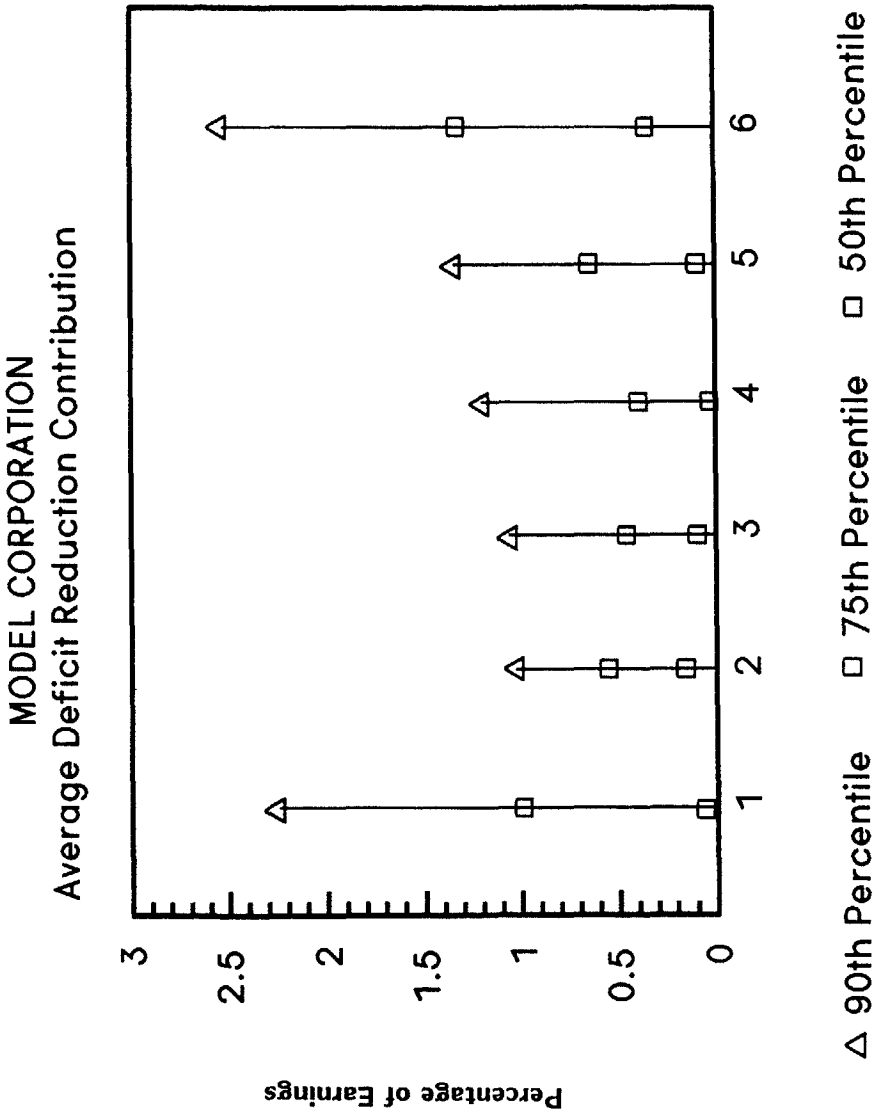


FIGURE G


MODEL CORPORATION
Average Deficit Reduction Contribution
Percentage of Earnings
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
6
△ 90th Percentile
□ 75th Percentile
□ 50th Percentile

MR. DAVID P. ROSENBERG: Mr. Wendt, this is an area that I really have no expertise in and so this whole presentation has been very enlightening to me. Apparently, the client would make changes in his portfolio decisions for the assets in his pension plan. What period of time does it take before the results that you have forecasted would become evident?

MR. WENDT: That's a very astute question. In our simulations we actually do not change the portfolio mix over a five or ten year period. We go through this process. We calculate the efficient frontier at the inception based on the funded status at that time and assume that those chosen mixes that we select from that efficient frontier do, in fact, stay in place for a ten year period. As you can see from the results, it does demonstrate that the results are superior to leaving the current mix in place for a ten year period.

We have not done an experiment where, for example, in trial one, at the end of the first year, our funded ratio has changed from 70-80% and, therefore, we should change our mix and go on to the next year. That is, obviously, a very technically difficult and challenging experiment. We may get to do that in the future but we have not done that yet.

Intuitively, it does appear that if in practice the client were to rebalance at the end of a year, or at the end of six months, based on the new funded ratio and based on the new characteristics or liability, the results would be even superior to the results that we show leaving the mix in place. Therefore, we are not necessarily showing the optimum. We are simply showing a path that you can go on that's better than where you are and will probably lead you to even better results.

MR. JACKSON: Supposing, as an employer, I would have called you in, you give me this information and I see that I'm going to have to change my investment mix. I also see that there's a process here that may involve the results coming out different at intervals of three months, six months, one year, and so on, into the future, so that every year I really ought to conduct something like this to see whether my pattern is holding up. It seems to me that there are pure investment analyses suggesting that some of these asset classes are overpriced at times or underpriced at times. In other words, there's at least one investment philosophy that the market has cyclical patterns and that everybody is first in one thing and then another and this overprices whatever they happen to be in. To what extent does that sort of analysis fit into your picture, let's say one year from now?

MR. WENDT: There's a couple things that would happen. In a real life situation, as you get experience in different asset classes, and let's say you had favorable investment experience in an equity or bond category, your funded ratio is going to improve. That by itself will generally cause a transfer from fixed income to equity components of your portfolio. So, there will be some rebalancing based on market action, which in some ways is similar to trying to anticipate market action.

It's also, I think, primarily designed to be a strategic investment policy. What I would see happening is that you do a very complicated study initially which would determine where the appropriate portfolio is along the efficient frontier. Then, it's very easy to do updates on the efficient frontier later without doing a full study, picking from approximately the right place and revising the asset mixes based on the new funded ratios, perhaps, new economic assumptions and whatever information is available. It would not necessarily require going back and doing a full blown study.

MR. HALEY: As you know, Paul, I don't think that assets are overpriced at times. I think the market always sets it at the right price. You can find times when the market comes up and times when it comes down, but there's absolutely no evidence that there are any predictable cycles to the market. Really no matter how you look at them, you do the spectral analysis or whatever, you'll find that there are no significant cycles there at all.

MR. JACKSON: I might point out that John managed to trap one of the investment experts in America who held to the cyclical theory by presenting him with patterns and asking him to pick out which pattern was the market. The others were random. They were all random, I believe, but he was able to see cycles in random numbers. He had a built-in mechanism in his mind and he could look at a scattered diagram that was just purely random and see a cycle.

MR. HALEY: That's right. He was a professor up at Harvard and he had a number of these different crazy ideas about things. One of them was that there were these cycles. Actually, we did six of them. Five of them were random and, I think, one was actual returns for equities but we spliced them so that we had one period out. He immediately knew which one it was but it was one of the random ones.

MR. JACKSON: Dick, another question for you. You mentioned that as the market goes up the pattern can change. As the market goes up in equity, say, the funded ratio may go up and this may shift you from one asset class to another. When that happens are you buying equities or selling equities as a result of a rise? In other words, is it comparable to portfolio insurance or the reverse?

MR. WENDT: It's not necessarily portfolio insurance, because it's the rise in funded ratio as opposed to the rise in assets or any other factor. But, as the funded ratio increases there would be less of a fixed income component in the portfolio and more of an emphasis on the equity components.

MR. HALEY: In effect, it's the reverse.

MR. JACKSON: If the ratio went up because equities were increasing you would buy more equities.

MR. WENDT: You'd buy more equities, yes. Or, if it went up because the settlement rate changed, you'd also buy more equities.

MR. HALEY: But looked at just from the asset side you're doing a reverse of the portfolio insurance, right?

MR. WENDT: It's really not similar. One of the things we found is that there are many investment advisers that advise their clients to choose the minimum risk portfolio, which is the portfolio where the assets exactly match the duration of the liabilities, taking into account the funded ratio. What that does is to give up an awful lot of expected return. If you remember that chart I showed about the efficient frontier, there was a big gap between the lowest level of minimum return on efficient frontier and moving up three or four percentage points to the highest level. I think it's a mistake to use the concept to choose that minimum risk portfolio. Our idea is that the client can choose anywhere along that efficient frontier, have a range of portfolios to choose from, and get the benefit of the higher expected return at the same time that he's minimizing the volatility of surplus.

MR. ROBERT M. KATZ: Since this is on the record, this is a personal question. It does not reflect my employer. Let's assume that I'm a very aggressive investor and let's assume that I believe in things like tactical asset allocation or some other method which implies a very dynamic and changing mix of assets, perhaps as frequently as daily. How do I model since it seems to me that: number one, it's very difficult to change the asset mix quickly and; number two, your returns are fairly well random and not pegged to having some insight on market movements?

MR. HALEY: That is a difficult question. The first thing to do would be to take a look at how you're constructing your tactical asset allocation model. Most have a fair degree of back testing and you could look at that almost as a separate asset class. You could try and derive some expected return and risk features for it and get some correlation with the other asset classes. I guess the second thing to do is look at the back testing and see how that's done, how it actually works. Is it looking at the ratio between the yield, say, of long duration assets, fixed income assets, and equities? Is it looking at some expected rate there? I think you could generally build that kind of a thing into a model, but it would depend on the specific features of your tactical asset allocation model.

MR. WENDT: I think it is fairly difficult to do. My understanding of many of the tactical asset models is that they are based on key economic indicators, not necessarily equity returns or interest rates but, perhaps, other factors that are pulled in from the economy. Now if your asset model is not predicting those particular variables, it's really impossible to have your tactical asset plan figure out how to invest at that particular time. Your tactical asset model has to be consistent with the data coming out of your economic simulation.

Secondly, I think it's very easy to have a fallacious example. Your tactical asset model may be based on a similar theory to your economic model or it may be based on a different theory. I think you have to resolve the conflicts there.

If they are based on the same theory all you may be proving is that they are consistent. Your assumptions work because you assume something in one case, follow that in the other case and, therefore, you get desirable results simply out of consistency.

On the other hand, if they're not consistent, there may not be a compatibility between trying to have a tactical asset model work one way and your economic simulation run another way. So I think you have some knotty problems to try to resolve.

MR. KATZ: Then do I understand that in the current state of modeling it would be very difficult to use this kind of asset investment strategy and get the kinds of results that you've just pointed out on something that's not quite so dynamic?

MR. WENDT: I'll talk about TPF&C. We have a model that we call a structural model, which is based on many different economic indicators coming into play. I think it could pass tactical asset theories with the sole requirement that the tactical asset plan be based on data available and produced by the model. So, I don't think we'd be able to work with all tactical asset models, but I think there will be some tactical asset models that we could test. In some ways that would be testing, possibly, some other person's tactical asset model versus our structural model and you have to judge whether results are reasonable.

MR. HALEY: I think the same thing is true for our model. There is a number of them we could test. Just to give you an example, one of the tactical asset allocation models which I'm familiar with has three major things it looks at. One of them is market sentiment in general. Market sentiment is not something that we're simulating right now.

MR. JACKSON: I would extend one word of caution to all of you in looking at all of these numbers. Sometimes one can come away from a session like this thinking that he has looked at the real world. I would like to caution you that a model is a model. It can develop something that is precise and accurate and tell you exactly what to do but the real world may or may not follow it.