RECORD OF SOCIETY OF ACTUARIES
1986 VOL. 12 NO. 1

PENSION ASSET-LIABILITY PROJECTION MODELING

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Existing practices, including:

- o What input is used?
- o How are assumptions selected?
- o What time horizons are used?
- o How are asset and liability projections merged?

MR. JOHN D. MARSHALL: I'm a consultant with the TPF&C Cleveland office. Before I introduce our panelists, I would like to provide some background on the importance of pension asset-liability projection modeling and the recent interest this topic has generated. For years, and particularly today, corporate management has become increasingly savvy in the matter of employee benefits programs. Perhaps as never before, management is concerned that the value of its programs, as instruments of corporate personnel and compensation policy, justifies their expense. Corporate management is reviewing its commitment to employee benefits with a calculating and skeptical eye.

From this perspective, the defined benefit plan is coming under an especially close scrutiny. Increasingly, management is disturbed by the financial uncertainty that attends the sponsorship of such plans. Adequacy of the plans, funding levels, the unpredictability of annual contributions, and the expense

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requirement and financial risk that the sponsor assumes are all matters that concern corporate management. The increase in popularity of defined contribution plans, in contrast, can be explained, at least in part, by their fiscal straightforwardness -- their relative definitiveness with regard to the categories of future contributions, funding adequacy, and financial risk.

Corporate management seeks to assert greater control over the financial consequences of its defined benefit plan commitment. It seeks to coordinate requirements of the plan with the requirements of the entire business enterprise. It has experienced instances where, when cash flow was tight, a large minimum contribution was a rude necessity. It has seen years when the corporate coffers were dense with taxable income, and the prospect of a generous tax deductible pension contribution was happily anticipated, only to find that the plan was fully funded, and no deductible contribution could be made. Corporate management has also explored and found ways to break the seal of the pension trust and take back excess plan assets for the use of other corporate pursuits. A corporate management disposed to maximally align its pension plan obligation with its larger corporate goals has a need of more information than is routinely available from the actuary's annual report. It wants more than one year's numbers; it wants the perspective of a period of years into the future. It wants to see the flow of the plan's operation over time, which brings us to the subject of this presentation.

As our clients come to want projections of pension plan numbers, we have to wrestle with questions pertaining to their production. What kind of projections will prove most useful? What methodologies are more appropriate? What assumptions are to be chosen? How can we maximize the credibility of our projections?

Our panelists today are well positioned to discuss these issues. The first is Debbie Benner, a senior actuary with Winklevoss & Associates, a division of Johnson & Higgins of Princeton, New Jersey. She has long hands-on experience with a projection model developed by Howard Winklevoss and is currently responsible for all research and development of that model. Following Debbie will be Colin Carlton, who is a principal with TPF&C's Toronto office. Colin is a major contributor to the creation and implementation of TPF&C's asset-liability

forecast system. We also have with us Randy King, an associate with Wilshire Associates, an investment consulting firm located in Santa Monica, California, which is involved in the projection of pension plan assets and liabilities. Randy offers us a particular advantage of providing a perspective on this subject which is derived from outside the actuarial consulting field.

MS. DEBBIE L. BENNER: I'd like to talk about some components of the forecasting process. First, why are we doing the forecasts in the first place? We have to know that to help structure the work that is to follow. Second, what are the steps involved in doing a forecast? I'll touch on some of the assumptions that have to be made and how they should relate to each other. Third, how should the results of a forecast be shown to the client?

There can be any number of reasons for doing a forecast, but our clients keep going back to the same ones again and again. The one that most generally comes up is to know the trend of future costs and the future funded status of their plan if things go on as expected. Are their costs going to be increasing, are they going to be decreasing, or just what's going to happen? So for every forecast study that we do, generally the first set of graphs that we'll present to the client is the one in Figure 1. We'll show them the total cost as a percentage of payroll and the funded status of their plan if they continue on with their current valuation assumptions, their current plan benefits, and current funding methods, as well as if the economic environment conforms to management's best estimate of what's going to happen in the future. Figure 1 represents a fairly typical scenario for our clients with a final salary based plan. The costs start out fairly high and decrease steadily over time until the plan hits full funding. Most of our clients would look at Figure 1 and say "This isn't acceptable. I'm more interested in a more level pattern of cost that seems to be a more fair distribution of cost between my shareholders, so what can you do for me? Is there some way you can level out that pattern?" Naturally, we can.

Another reason for doing a forecast is answering what-if questions: What if we have to go to five year vesting, or what if we change our benefit formula? How will that affect the general trend of cost? Is is significant or not?

FORECAST OF CURRENT FUNDING POLICY

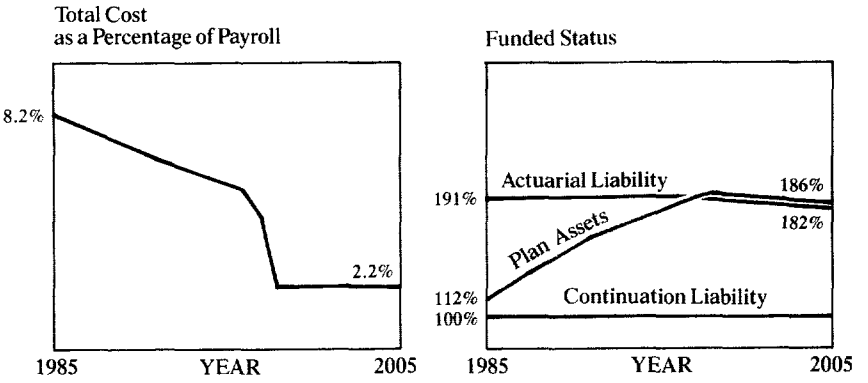


FIGURE 1

The stochastic forecasts give us the opportunity to analyze some probabilities. What's the probability that the plan will hit full funding, say in the next five years or the next ten years? What's the probability that the funding status on a FASB-35 basis would ever go below 100%. We can start answering some of these questions with a stochastic forecast.

Other specific uses of forecasting are in budgeting and planning, asset allocation analysis, examining some changes to the funding method, and examining changes to the benefit formulas.

We spend, I would say, at least a third of the time on a forecast on validating the model. We think that it's very important to have as good a model as possible of the plan, because we want to be able to stand behind it, when we go to the client and say, "If you change your funding method, this is what your costs are going to be." We don't want the client's actuary, who is often with a company other than ourselves, to come back and say, "you're wrong. If I change my assumptions to your recommendations, that's not the cost I get." So we want to have as good a model as we can of the plan.

On the other hand, we work on a time sharing basis, and generally with a fixed fee study, so we want to have the most efficient model that we can have. One of the ways that we help to increase that efficiency is to use a group methodology for our forecasting. For example, when we forecast a twenty thousand life plan, we don't have to forecast each one of those twenty thousand lives; we reduce that to six hundred and fifty cells, so it's much more cost effective to do the forecasting. Depending on the purpose of the forecast, there are other places where we might take some short-cuts to make the forecast more efficient. For instance, if the client is mostly interested in the trend of cost, then we wouldn't spend a lot of time modeling grandfathered benefits and minimum benefits that don't have much effect on the plan.

We're now ready to start the forecasting process. In our case, we divide that into two steps. In the first step, we do a population simulation. That's fairly straightforward. We start with the first year's empirical census, and using a bundle of experience assumptions, we create censuses for the next twenty years or so. That's our most common horizon. Basically, with the first

year's census, we subject all the active participants to the disability, death, retirement, and termination decrements. Anyone who leaves the plan with a benefit gets added to the non-active census. The people who stay in the active census get a salary increase, and that salary increase is based on management's best estimate of what salaries will actually be. The salary increase has no relation to what the actuary may be using as a valuation assumption. The non-actives in the plan, if they survive the year, will get an ad hoc COLA if the client generally gives them out. Any new entrants that have to come in to meet the client's growth assumptions would come in with an age and salary distribution that we and the client agree is representative of the plan.

You can see that several assumptions have to be made to do the population simulation. They basically fall into two categories, economic assumptions and demographic assumptions. The economic assumptions are all tied together by one link: the inflation assumption. We discuss with the client its estimate of inflation over the next twenty years. The best estimate of inflation usually falls into the 5 or 6% range. All of our economic assumptions will be tied to that. Salary inflation will be assumed to be inflation plus productivity increase of maybe one percent plus an attained age merit scale. Ad hoc COLAs will generally be some fraction of inflation. If it is an hourly plan, the benefits will generally be assumed to go up with inflation, maybe every three years. Career average updates are implicitly tied to inflation by the final average salary component.

The client provides us the demographic assumptions, including population growth. If there's going to be any growth at all, we have to enter an age and salary distribution; usually we just use an empirical distribution for maybe the last five years' history of the plan (unless the client feels that that doesn't fit with what's going to happen in the future). The decrement assumptions we use are basically the same as would be used in the valuation, but we may make changes. For instance, a lot of plans use retirement at age sixty-five as their retirement assumption, but we don't feel that's a good assumption to use for a population simulation. We want to use something a little closer to what would happen in real life. We don't particularly want that big discontinuity in the first year, when all people over sixty-five would be immediately assumed to retire. So we most often would change at least that

one assumption to be a range of assumptions. And we might change some other things, too -- for example, if the actuary seems to be using an unreasonable or non-realistic assumption for termination. We might use a different assumption for the population simulation. Then any difference between what we assume for the population simulation and what is used in evaluation falls out in the gains and losses of the plan.

Once we've simulated the population, it's fairly straightforward to come back to each of those twenty years of census and do valuations on that census data. There we use the valuation assumptions that the actuary is using, and we generally keep the valuation assumptions constant over the full twenty year horizon.

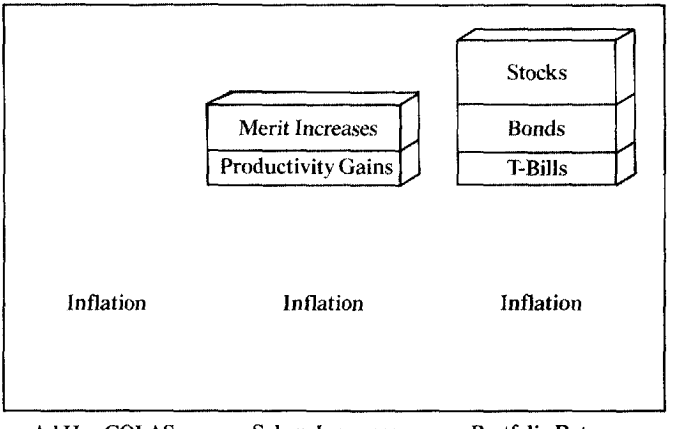
In the contribution forecast, we usually calculate cost under several different funding methods (up to eight) at once -- because all the funding methods basically rely on the same information, so it's very cost effective for us to do them all simultaneously. We also calculate the APB8 expense and the FASB-87 pension cost. We can calculate the cost, because we know what's happening to the unfunded liability. We know when there's going to be a benefit change, and we know how much that benefit change affects the liability, so we can keep track of those thirty year layers. Once we know what the thirty-year layers are, we can calculate the gains and losses every year. We've done a population simulation, so we know what the benefit payments are every year and can take them out of the assets. The client has provided us with a best estimate portfolio return, so we can keep track of the assets through time, subtracting out the benefits, adding the contributions, etc.

Once again I want to emphasize that all of our important economic assumptions are tied together in what we think is a theoretically correct manner -- by inflation. Our COLAs are some fraction of inflation; our salary increase is inflation plus productivity plus merit; and our portfolio return is inflation plus a real return component that's dependent on the client's portfolio. This is shown in Figure 2.

Once we've done a forecast, we're faced with the problem of how to present the results to management. We generally find that graphics are the best medium.

FIGURE 2

COMPONENTS UNDERLYING LONG-TERM ECONOMIC ASSUMPTIONS



We usually focus on two things: total cost as a percentage of payroll and the funded status under three different economic scenarios (Figure 3). The only thing we varied here is that inflation box in Figure 2. All the lines kind of track each other, because we only change one thing at a time to make it easier for the client to understand how different assumptions effect cost. Here we just change inflation, and the client can see that if inflation goes up, its costs go down and its funded status goes up, and vice versa.

Before we start the process, we talk to the client about the different ways that are available to measure the funded status of a plan, and together we settle on one that it feels best represents its commitment to the plan. We consistently use that same funded status measure throughout the procedure. As back-ups to these calculations, we'll show the funded status on all the different available measures, as well as show all the components of the cost, the assets each year, normal cost each year, benefit payments each year, etc. We might show some different information depending on the client's objectives.

In this particular case, (Figure 4) the client was only interested in a five year horizon. And it wanted to know what would the effect be on its plan's cost if it continued to use the frozen initial liability method or if it adopted projected unit credit. This client wanted to know how its decision would change if it just made the regular contribution and if it didn't contribute anything in the first year? So we presented both graphs and I think the client decided to stick with FIL, because it wasn't significant enough to change.

So far we have talked about what we call the deterministic forecast; we call it that because before we start, we or the client has specified exactly what the assumptions will be for the next twenty years. That's a useful way to forecast; it's easy to see how different components affect the trend of cost. However, it also gives a certain amount of false security, because we know that we can't predict the future, and we don't want to go to the client, and say, "this is it; your costs are going to be 80%, and this is exactly what they're going to be over the twenty years." That's not realistic, so we use stochastic forecasts to help get over the barrier.

FIGURE 3

FORECAST OF CURRENT FUNDING POLICIES UNDER LOW, MEDIUM AND HIGH BEST-ESTIMATE EXPERIENCE

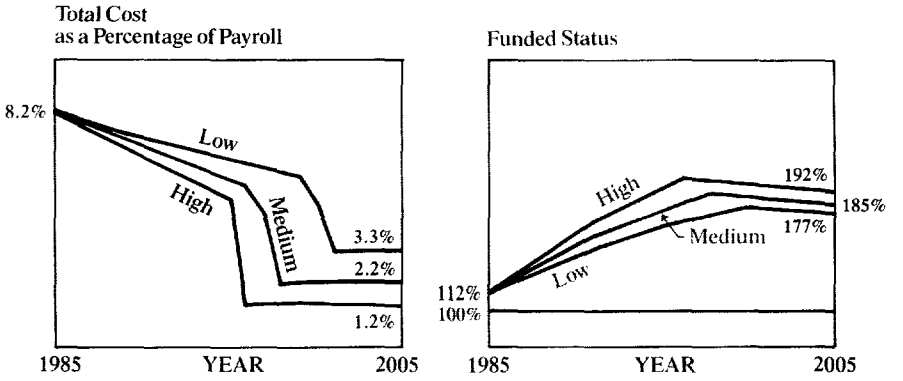
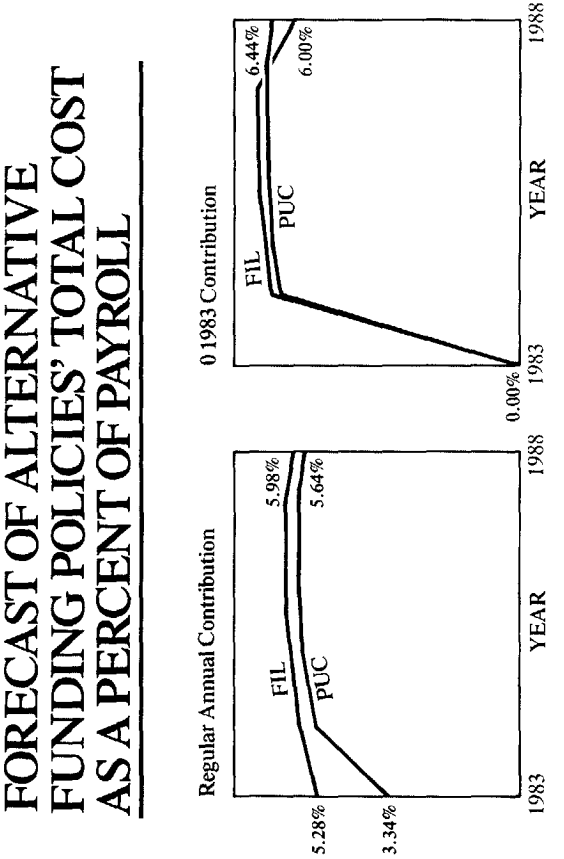


FIGURE 4

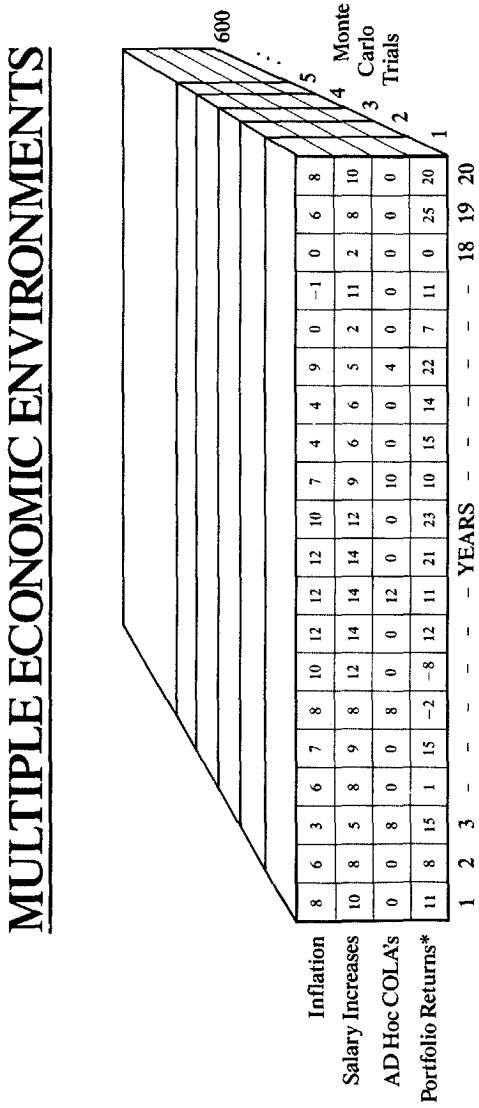

FORECAST OF ALTERNATIVE FUNDING POLICIES' TOTAL COST AS A PERCENT OF PAYROLL
Regular Annual Contribution
0 1983 Contribution
FIL
PUC
5.98%
5.64%
6.44%
6.00%
5.28%
3.34%
0.00%
1983
YEAR
1988

In a stochastic forecast rather than specify exactly what the assumptions will be, the client specifies the relationship of the assumptions to one another. For instance, the client tells us what the mean inflation will be, what the standard deviation will be, what the expected real return on its asset classes is, and what the standard deviation of each of those asset classes is. The client will also specify the correlation matrix, so we know how the different asset classes affect each other. Then we use a Monte Carlo process to generate random economic environments that fit the structure that the client sets down.

The client might say, for instance, that its best estimate of inflation is 6%, but it has a 2% standard deviation. So for each of the twenty years of our forecast (Figure 5) we'll generate five hundred different inflation numbers, which will be correlated (tied to one another) generally with a one year lag depending on the parameters. They'll have the standard deviation that the client provided, but they will be random. Then the inflation that we generate affects salary inflation and ad hoc COLAs, as we've seen before. We also generate the random portfolio returns, again fitting the pattern that the client set up, but nonetheless random. So when we generate this huge matrix of data, as shown in Figure 5, we can subject it to the pension plan. We can first calculate the effect on the assets of the plan; that's a fairly common thing to do. We have five hundred different real returns, and we can calculate the different portfolio returns and find out what happens to the assets. But since we've also simulated a random inflation, we can calculate the effect on the liabilities of the plan. Then we can put the two together and see what happens to the cost and the funded status of the plan.

You may say, "This seems a little complicated. Is it really worth all the trouble, and are you really learning anything from it?" First, assets and liabilities of a pension plan are complicated and are inter-related to each other, and stochastic forecasting is the way to explore that relationship a little bit better. Stochastic forecasts also give you some new options. You can determine the probability of full funding, for instance, and you can determine what the extremes of the contributions and the funding status might be.

FIGURE 5


MULTIPLE ECONOMIC ENVIRONMENTS
Inflation
Salary Increases
AD Hoc COLA's
Portfolio Returns*
1 2 3 – – – – – YEARS – – – – – 18 19 20
Monte Carlo Trials
1
2
3
4
5
600
*NOTE: Portfolio Returns will differ for different Asset Mixes.

Figures 6 and 7 show how we display the results of a stochastic forecast. We've essentially done five hundred deterministic forecasts. We have five hundred different economic environments, and we subjected the pension plan to each one of them. Then for the total cost, for instance, we rank all those five hundred forecasts, and we pull out percentiles (Figure 6). The top line on the total cost is a 95th percentile; it tells us that in each of the next twenty years, 95% of the time costs were below that line. So we can pretty well safely say that there's virtually no chance that for this plan, costs will increase over their present level. The percentiles represented on the graph are the 95th, 75th, 50th, 25th, and 5th. The bottom line hits full funding in about five years, so we can say there's a 5% chance that the plan will be in full funding by the end of five years. The 50th percentile line hits zero before the end of the period, so we can say there's in excess of a 50% chance that by the end of twenty years, the plan will be in full funding. We can see that the costs are grading down, but we know that already. On the funded status graph in Figure 6, the 5th percentile is at about 150 after twenty years, so there's no chance that this plan is going to become poorly funded.

Another valuable use of a stochastic forecast is in doing asset mix or portfolio mix analysis. We think this is a particularly valuable option of our model. People are used to doing asset allocation analysis, but mostly they just look at the assets. We know that the assets and the liabilities of a plan are both tied to inflation, so there must be some value added in looking at the two together before settling on the best asset mix. The problem with asset allocations, though, is that you must have a pretty good idea of your objectives before you try to interpret the results, or everything you look at will lead you to a different mix. The graphs in Figure 7 show the 5th and the 10th year costs for six different asset mixes. Mix number one, on the left, is the most conservative mix, mix number six is the least conservative mix, and they grade up. In Figure 7, if we were going to focus on the 10th year cost and our client said that it was interested in the lowest possible cost -- then we might say, "Go for the asset mix six. That has the lowest average cost and the highest probability of being in full funding." But we'd have to caution the client by saying, "That 95th percentile line is higher than the other mixes. You are taking the added risk that the cost will be higher because you have a riskier mix. And you're definitely going to have more variable cost, because

STOCHASTIC FORECAST OF CURRENT FUNDING POLICY

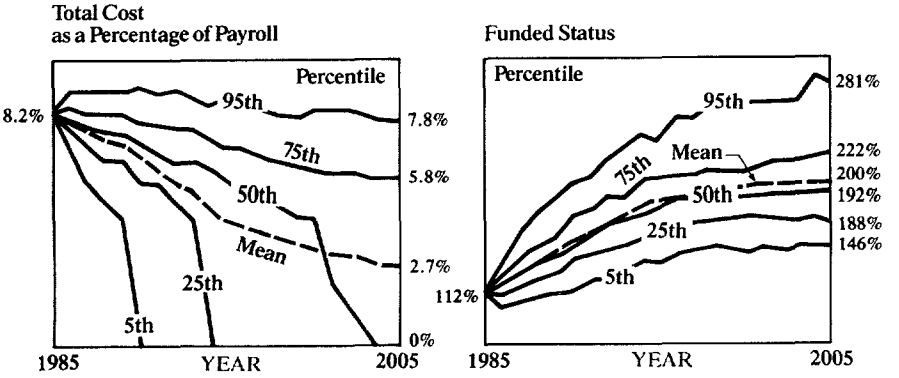
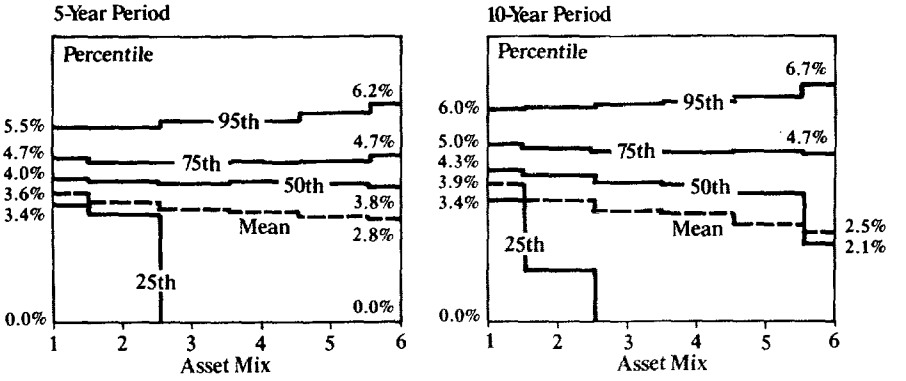


FIGURE 6

FIGURE 7

PENSION COST AS A PERCENTAGE OF PAYROLL UNDER ALTERNATIVE ASSET MIXES



the spread between the 5th and 95th percentiles is the widest for asset mix six." But say our client said, "I want stable cost, predictable costs. I don't care if they're lowest; I just want to know what they're going to be." Then we might say, "Go to asset mix one. That has the tightest distribution, the least distance between those 5th and 95th percentiles."

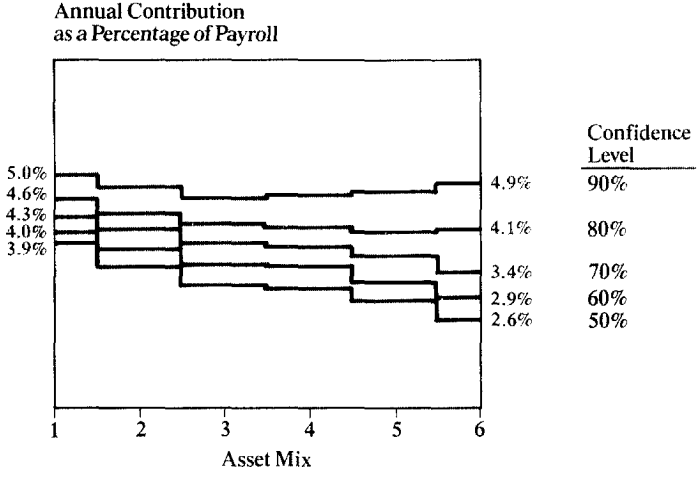
Another reason we might want to use a stochastic forecast is that it gives an added dimension to a funding policy analysis. We saw that projected unit credit had lower cost for that prior client than FIL, but maybe projected unit credit also had more variable cost. With a deterministic valuation, we couldn't tell; we just knew what the expected value costs were, not what the risk was. With a stochastic forecast, we can check that out.

Another interesting thing that we use stochastic forecasting for is target cost analysis. Our clients generally want to know an objective measure of how much money they should be putting in plan. We use the forecast funding or projection valuation method to come up with that number for them. Using the conventional way of doing that, we might come up with, say, 5% as the amount of money that the clients should put in the plan. However, if they closed their eyes and put 5% in the plan for the next twenty years, they'd only have a fifty-fifty chance that their assets would be up to their target liability -- and they generally want to be a little more conservative than that. With a stochastic forecast, we can generate a graph like Figure 8. For each one of our six asset mixes, this shows the target cost of the plan under five different confidence levels. For instance, if our client was invested in asset mix six, and it wanted to be 70% confident of meeting its target, it would put in 3.8% of pay. But if it were invested in asset mix one, it would have to put in 4.4% of pay if it wanted to be 70% confident. So a client can say, "This is my confidence level, and this is my target cost; you tell me what asset mix I should be invested in." If our client wanted to be 90% confident -- it wanted to be very conservative -- the mix it would pick would be mix number three, because that has the highest probability of having the lowest cost at the 90% confidence level.

I've tried to talk about some of the reasons why we do a forecast and show you the steps involved in doing a forecast, which are basically validate the

FIGURE 8

TARGET COSTS



models, in our case do a population simulation, and then do a contribution and liability forecast. If you want to do stochastic forecasting, do your capital market simulation and then subject that to your pension plan. I've talked about some of the assumptions that you have to make, primarily the economic assumptions, and how they're tied together. I've also given you several examples of how we present the results of a forecast to our clients.

MR. COLIN G. CARLTON: What I'm attempting to do here today is not to repeat the overall view that you had from Debbie about forecasting models, their applications, and how they work. I want to provide you with some examples of different types of output format and to discuss the somewhat new issues that are raised, particularly in view of FASB-87, which I think has made a major change in the ballgame. I haven't, in fact, got very much here on the subject of funding policy, because Debbie explained that extremely well already, and it is probably quite familiar to most of you as actuaries who have used forecasts of one kind or another in talking about funding policies.

I do want to talk a little bit initially about investment policy, and this is a matter of extreme interest to the Vice Presidents of Finance and upward in corporations. They generally find this an area where they really do want the use of forecast tools and stochastic tools as opposed to the traditional deterministic forecasts where we just say, "If we make 10% return or we make 12% return, where will we be?" Our approach generally follows Figure 9. We start with the concept that a pension plan is essentially a financial business. We point out that financial businesses go broke because they fail to match assets and liabilities, so let's at least determine what an approximate match of assets and liabilities is for our pension fund. Here we're interested in the term, or duration preferably, of liabilities and the degree of their inflation sensitivity. Split your liabilities into components -- let's say those who are now retired and those who are close to retirement -- and similarly split your assets; this provides you with a reference point from which to start the discussion about investment policy.

Second, we ask what return you would require to maintain your contributions at their present level or some other level that you prefer. Also, what downside return would be so bad as to cause a real split in your pension expense or your

FIGURE 9

INVESTMENT POLICY

- Determine broad "matching" of assets and liabilities by term (duration) and degree of inflation-sensitivity
- Consider return requirements in light of liabilities structure and desired contribution pattern
- Translate investment risks (volatility) into bottom line financial consequences
- Examine tolerance for these financial risks
- Establish long-term asset allocation to optimize achievement of objectives within risk constraints
- Develop multiple manager structure to maximize specialist skills within asset allocation

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pension contributions and affect the bottom line of your company? In other words, in the context of your total company operation, determine what is the downside minimum level of return that you really want to achieve with a high degree of confidence.

The third step is to examine the asset classes that are available in terms of their expected return and their degree of volatility, and translate those into bottom line financial consequences in terms of both long term cost and short term variability in that cost.

Next examine how much of the risk of either long term cost or short term changes the corporation can tolerate, because you don't get any additional return on lower cost without taking additional risk. From that, establish a long term asset allocation to optimize the achievement of your objectives within the risk constraints. You may use somewhat similar techniques to go one

further level down: instead of treating separate asset classes, you may treat individual managers as if they were individual asset classes, provided you can specify expected returns, volatility of returns, and the degree to which one manager's returns correlate with another's.

Thus, the typical types of assumptions that go into investment policy forecasting models would have at least six asset classes. Maybe mortgages would not be included, because this was a Canadian example, and mortgages at the time were a significant asset class, but certainly these five would be used -- equities, foreign equities, real estate, long bonds, short bonds -- and maybe also small capitalizations stocks, venture capital, international bonds, or whatever (Figure 10).

The input to the model requires an assumption about real returns and volatility of returns. In our model we also allow for the fact that as an asset mix is held through time, it won't stay constant. If you want to investigate an investment policy, you have to rebalance the asset max back to the original intention on perhaps an annual or quarterly basis. We allow for the cost of doing that. The fourth input is a degree of correlation. This is a Canadian example using Canadian equities that are highly correlated with U.S. equities, which we show as foreign. Hence you see the .8 correlation with foreign. Real estate is a fine diversifying vehicle, and you see low correlations between real estate and other asset classes.

Debbie talked in terms of six asset mixes going into their model. Where did the six asset mixes going into her sample model come from? Probably they would have come out of some kind of efficient frontier analysis (Figure 11) That is by simply specifying volatility of return, and correlation between the asset mixes, you can eliminate a vast number of combinations as not being "efficient." An efficient portfolio is one which maximizes return for a particular level of risk. Thus the model would compute all the combinations of asset mix that you could think of within the constraints you place on it and compute, for each, a level of return and a level of risk or volatility of return. Had we plotted every single asset mix, we would have a large number of dots on the graph in Figure 11. I've shown one dot in the current position. There are no portfolios that fall above, or to the left of, the line, so the

FIGURE 10

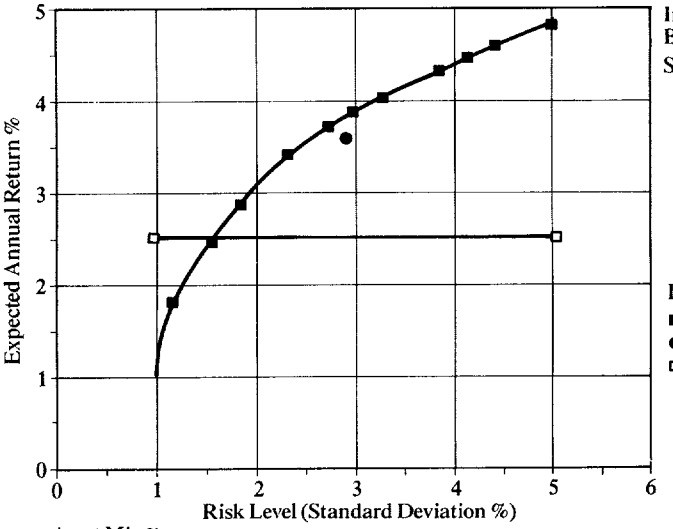
ASSETS - ASSUMPTIONS FOR REAL RETURNS -
CASE STUDY "BASE CASE SCENARIO"

	EQUITIES	FOREIGN	REAL ESTATE	LONG BONDS	MORT-GAGES	SHORT BONDS
REAL RETURN:						
- HISTORICAL	6.7%	7.0%	5.0%	1.1%	2.5%	0.5%
- ASSUMED (NET)	5.7	5.7	3.2	2.7	2.1	0.2
VOLATILITY:						
- HISTORICAL	20.2	18.0	6.0	8.9	4.3	4.3
- ASSUMED	20.0	20.0	8.0	10.0	4.0	2.5
ANNUAL REBALANCING COSTS:						
- BUY	2.0	2.0	0.0	0.5	1.0	0.5
- SELL	1.0	1.0	0.0	0.5	2.0	0.5
CORRELATIONS ASSUMED:						
EQUITIES	1.0					
FOREIGN	0.8	1.0				
REAL ESTATE	0.2	0.0	1.0			
LONG BONDS	0.1	0.0	0.0	1.0		
MORTGAGES	0.0	0.0	0.3	0.3	1.0	
SHORT BONDS	0.0	0.0	0.3	0.3	0.8	1.0

FIGURE 11

CASE STUDY

EFFICIENT FRONTIER
10 YEAR TIME HORIZON



Asset Mix %												CURRENT MIX %:
EQUITY	5.0	5.0	10.0	20.0	30.0	35.0	40.0	50.0	55.0	60.0	70.0	35.0
FOREIGN	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
REAL ESTATE	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	5.0	10.0
LONG BONDS	15.0	30.0	35.0	35.0	25.0	20.0	20.0	15.0	10.0	5.0	5.0	15.0
MORTGAGES	15.0	15.0	15.0	15.0	15.0	15.0	10.0	5.0	5.0	5.0	5.0	15.0
SHORT TERM	45.0	25.0	15.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	15.0

line is known as the efficient frontier, and on it are the particular combinations of asset mixes which do the job of maximizing return for a particular level of risk. There are an infinite number of these assets mixes, and our system produces eleven of them spaced across the range of risk.

That has narrowed us down from an infinite variety of portfolios to eleven in our case, and I could just take every second one and I would have six. However that doesn't tell me where on the efficient frontier I might prefer to place my asset mix. Do I want to be low risk, low return (that's efficient, the best I can do at that risk level), or do I want to be high risk, high return? This is where bringing in the financial impact is most valuable. We then have to say, "Let's take a broader look at the risk. Let's not consider risk to be just volatility of return; let's think about it a little more. What does it really mean for a pension fund?"

I would suggest that risk has four components (Figure 12). The risk that the costs have an adverse trend to them primarily driven by the way the demographics of the population are and will be and the benefit design. It is also clearly affected by the rate of return that may be achieved by alternative portfolios.

There's also an adverse shape to the cost. You may not have a particular trend, but the cost may have a hump or a dip in it because you hit the full funding limit and then come back out. You may prefer to avoid blips in the shape. Now that's primarily an actuarial method and margin issue and not so much an investment issue.

The impact to the return volatility on a short term basis is particularly important under the new rules, I believe, where I think we will see a much greater sensitivity of pension expense numbers to changes in economy and interest rates in the short term. Also, we want to be concerned with not only the expense level and the contribution level, but also with maintaining adequate security of benefits. This has become a lesser issue, but it could become a very large issue if assets fall to a level close to accumulated benefit liabilities. And if there is a significant possibility that assets

PENSION ASSET-LIABILITY PROJECTION MODELING

FIGURE 12

DYNAMIC APPROACH -
WHAT IS "RISK" TO ONGOING PENSION FUND?

- o Adverse *trend* of costs
  - Driven by benefit design and demographics, *but*
  - Affected by returns achieved
- o Adverse *shape* of costs
  - Driven by actuarial policy, *but*
  - Actuarial methods/margins will affect consequences of and propensity for investment risk-taking
- o Impact of returns *volatility* (short-term)
  - Expense/contribution fluctuation
  - Funded status versus minimum target
- *o* *Non-Matching* of assets and liabilities (long-term)
  - If unanticipated inflation, "variable" part of liabilities increases but market prices of bonds decrease
  - Uncertain returns versus "known" part of liabilities

---

fall below accumulated benefit liabilities, this will become a major issue, because now it will appear on corporate balance sheets.

Non-matching of assets and liabilities is the fourth risk. If the inflation you get is not what you anticipate and you're heavily invested in fixed income but have a plan which is heavily inflation driven, the variable part of your liabilities will increase, and market prices of the bonds will decrease at the same time, because they're a fixed income investment. On the other hand, there are fixed aspects of benefit pay-outs, and it makes sense to have a degree of matching of the fixed parts of benefit pay-outs with fixed income type liabilities.

The simplified case study that I'm going to show you concerns a plan which was basically a fairly mature final pay plan with an unfunded liability and a fairly conservative actuarial basis (Figure 13). The client was doing ad hoc pension updates from time to time and had current expense of 8% of payroll, which was also its contribution level. Its current asset mix policy was 35% equity, 55% fixed, and it was in the process of moving to 10% in real estate.

FIGURE 13

PENSION FINANCIAL MANAGEMENT POLICY - CASE STUDY

- o General characteristics of plan/fund
  - Fairly mature final earnings plan
  - Moderate unfunded liability
  - Typical actuarial valuation basis
  - Ad hoc pension adjustment policy
  - Current expense 8% of payroll
  - Current asset mix policy 35% equity + 55% fixed + going to 10% real estate

The client had a number of questions (Figure 14) of which the most important one was, For the investment policy, can we seek a higher return at an acceptable increased risk (risk now being broadly defined as opposed to just volatility)? In regard to our benefits policy, can we keep doing these ad hoc updates? We've had an open window program, and we have more retirees than we had before. Can we cut the contribution in the short term? If we do cut the contribution, will it just hurt us in the long run? And also, if we cut the contribution, will our coverage of assets over liabilities reach an unacceptably low level?

Those are fairly standard questions which the forecast is well designed to answer. We did initially do deterministic forecasts, but I don't have time to go into those. I think I can still illustrate it with a stochastic output.

PENSION ASSET-LIABILITY PROJECTION MODELING

FIGURE 14

PENSION FINANCIAL MANAGEMENT POLICY
CASE STUDY -- SPONSOR QUERIES

- Investment policy
  - Can we seek a higher return at acceptable increase risk?

- Benefits policy
  - Can we afford regular ad hoc pension increases, shorter final averaging period, and earlier vesting?

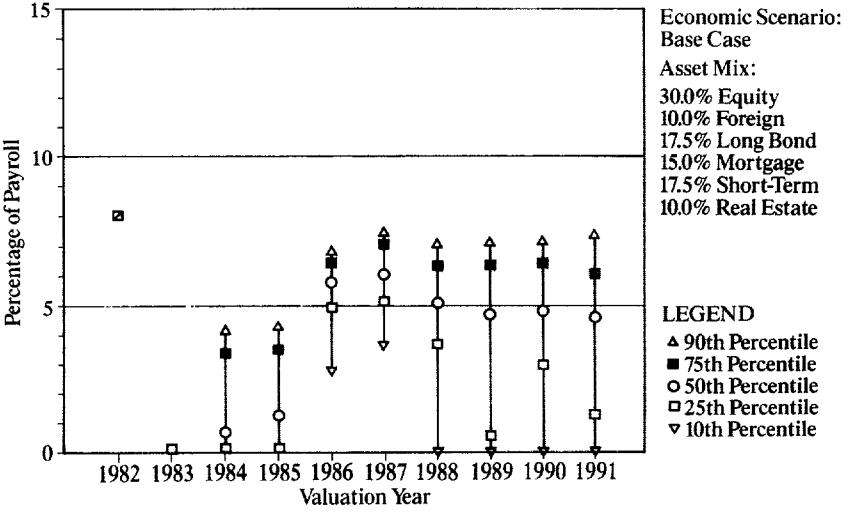
- Funding policy
  - Can we cut short-term contributions/expense?
  - Without major increase in long-term costs from present level?
  - And retaining sound funded ratio?

Our layout is a little different from what Debbie showed you, so I'm going to spend a minute explaining what it means. In Figure 15 the vertical bars are the range in which contributions in this case may fall. The length of the bar is described in the legend. There is a 90% chance that it will be below the top triangle (I used the 10% chance, but it could be higher than that). There is a 10% chance that it could be lower than the triangle at the bottom of the bar, with the median result being at the dot, the 50th percentile. This plan started in 1982 with an 8% contribution. We were able to suggest the change in basis which drove the contribution to zero in 1983, which was one of the corporate objectives. The question then comes up, Do we get back to 8% of the payroll within the ten year time horizon? It would appear that there is less than a 10% chance that contributions would return to 8% of payroll over the time horizon used there. In fact, at the median the dots, the expectation for longer term contributions, is on the order of 5% of payroll. So from a funding point of view, the company gets considerable confidence that it can change its actuarial assumptions of method and still have no unpleasant surprises in terms of funding down the road, or at least have 90% confidence it will have no surprise situation.

FIGURE 15

CASE STUDY—SALARIED—WITH PLAN CHANGES

EMPLOYER CONTRIBUTION PERCENTAGE EXCLUDING STATUTORY CONTRIBUTIONS



Moving to the investment question, Figure 15 shows the current asset mix with 30% equities, 10% foreign. What happens if we make a significant change in the asset mix to add more risk? One example that we looked at (Figure 16) had 20% more in equities and substantially less in the number of the other asset classes. The equity went up to 50%, the short term content was reduced to 7.5%, and the mortgage content was reduced to 5%. How did the bars shift? At the 90% upside cost, you will see that they didn't go up very much. In other words, taking significant additional risk in the investment policy does not create significant additional financial risk. The risk has gone up by about a half a percent of payroll with 10% probability of that happening. And at the 75th percentile, a three out of four chance, the possibilities are almost exactly the same. At the 50th percentile, the dots have moved down as you would expect. There is an expectation of lower contribution, and it takes a while to emerge. It takes ten years before you start to see some significant cost saving, and that's a result of the smoothing processes in asset valuation and also in amortizing gains and losses. This makes the employer realize the fact that if it takes a significantly additional invested risk in its investment policy and it does better, it may take a while before that proves out.

You may say, as many people do, that this model is only as good as the assumptions that we put into it. Clearly that's true. How do we form those assumptions? They aren't quite picked out of the air, although they sometimes look it. We like to say, let's take a look at the long term average. We're not going to use history, but those who ignore history are condemned to repeat the mistakes of it. And under the long term average, similar results apply in the U.S. In Figure 17, we see a real return on stocks of 6.8% from 1926 to 1984. It's a remarkably similar number in the U.S. Standard deviation of annual real return is about 20%. What I find interesting is that if I break that down into sub-periods of considerably different economic environments, the standard deviation of the riskiest asset class, with the exception of the crash and the Depression era, is a remarkably constant number. In other words, stocks are risky now, and they've been risky for the last forty years at about the same degree of riskiness; 17.9, 17.1, 17.1. This is true even for two ten-year time periods in which we had very different environments in some ways. There was a 16% standard deviation for the last ten years ending in 1984 and 19% for 1973

FIGURE 16

CASE STUDY—SALARIED—WITH PLAN CHANGES

EMPLOYER CONTRIBUTION PERCENTAGE EXCLUDING STATUTORY CONTRIBUTIONS

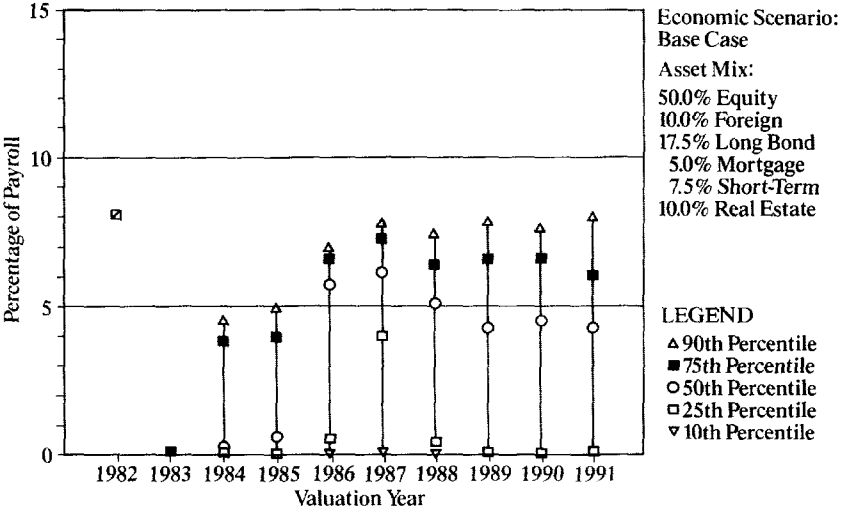


FIGURE 17

ASSUMPTIONS - REAL RETURN ON CANADIAN STOCKS

PERIOD	CHARACTERISTIC	COMPOUND RATES CPI	REAL GNP	REAL RETURN	STAND DEVN
1926-84	LONG TERM AVERAGE	3.3%	4.0%	6.8%	20.1%
1926-40	DEFLATION	-0.8	2.6	5.9	27.3
1941-51	CONTROLS	5.2	5.2	12.7	17.9
1952-65	LOW INFLATION	1.3	5.0	9.6	17.1
1966-81	RISING INFLATION	7.2	4.2	1.9	17.1
1975-84	RECOVERY	8.4	2.3	7.0	16.3
1973-82	OIL SHOCK	9.7	2.6	-0.3	19.5

FACTORS FOR LOWER FUTURE RETURN EXPECTATIONS:

- BOND RETURNS WERE LOW FOR MOST OF PERIOD : LOW COST TO CORPORATE BORROWERS SO MORE FOR SHAREHOLDERS
- LIMITED POTENTIAL FOR PRODUCTIVITY/GROWTH IN DEVELOPED COUNTRIES

to 1982; but there was an enormously different real return -- 7% for the ten years ending in 1984 and -0.3% for the ten years ending in 1982.

So it is true that you can justify almost any assumption that you like on stocks by picking a particular time horizon. I think having done that, you are forced back to the really long period of history and forced to ask, What can I use? I have to go to something close to this long term average and then say, what do I think about the future that might be different from that? In my view, one major feature of the long term history is that bond returns were very low as interest rates rose. So the cost of that corporate borrowing was effectively very low. If we don't think that's going to recur -- that interest rates are not going to rise as they did for the last fifty years -- then somebody is going to have to pay those bond interest rates, and it's going to come out of the shareholder. So I would expect lower returns to stocks than in the past. Second, there was a great scope of potential for productivity and growth in the developed countries in the last fifty years. Do I really feel that the scope is as great for the next fifty years? Probably not, but you will all have your own opinions as to what the scope should be.

Now we will do a similar analysis on bonds in Figure 18 to show the importance of what happens with interest rates. Through the total period, 1926 to 1984, interest rates rose from 4.9% to 11.7%, and bonds got a real return of a measly 1.3%. Most of the problem was the fact that the interest rates rose and we had capital losses. If we see a period, 1926 thru 1940, where we had the reverse effect -- where interest rates moved from 4.9% down to 3.1% -- we see very good real returns on bonds, 6.3%. The bond return is just as simple, in the long run, as where we think interest rates are going to go. That is the key to forecasting about long bonds -- whether you think they're going to rise or fall. The history is clearly very significantly biased in the sense of a rise in interest rates. Unless you think interest rates are going to double or triple again, I don't think you should be assuming historical bond returns for your forecast.

Real estate is, in some ways, toughest of all, because we don't have good data on the kinds of things that pension funds invest in. We have, in Canada, a property index that is somewhat similar in its construction to the Frank

FIGURE 18

ASSUMPTIONS - REAL RETURN ON CANADIAN LONG BONDS

PERIOD	CPI GROWTH	CURRENT YIELDS START	CURRENT YIELDS END	REAL RETURN	STANDARD DEVIATION
1926-84	4.0%	4.9%	11.7%	1.3%	8.9%
1926-40	2.6	4.9	3.1	6.3	7.8
51	5.2	3.1	3.5	-2.6	6.0
65	5.0	3.5	5.4	1.6	5.2
81	4.2	5.4	15.3	-3.3	8.7
82	2.3	7.1	11.7	-2.8	13.8
84	2.6	8.3	11.7	0.6	13.8

ACTORS FOR FUTURE

- HIGHER RISK PREMIUM IN CURRENT YIELDS AND GREATER VOLATILITY
- 1985 AND START 1986 SAW MAJOR FALL IN U.S. REAL RATES AND HENCE HIGH RETURNS FROM CAPITAL GAINS : HOW MUCH MORE?
- USE DURATION FOR ESTIMATING CAP GAINS FROM FORECAST YIELDS

Russell index here. In Figure 19 I've put down ten years' data and compared it with bonds and with stocks. The interesting thing is that real estate has a very high negative correlation with bonds. As interest rates rose, inflation went up, the bonds did poorly, and the property did well. The reverse occurred at the end of the period where bonds did well: interest rates were falling, inflation was falling, and the property results were not as good. That's an extremely high negative correlation: -0.7. If you look at the U.S. statistics, you'll find 0 to -0.2 maybe. There is an article by Zerbst and Cambon in *Journal of Portfolio Management*, Spring 1984, that lists several studies that you might refer to. The point to be made here is that the combination of bonds and real estate has a really powerful diversifying effect in a portfolio.

I now come to what I regard as the current problem. Inflation and interest rates are highly correlated. There's an 80% correlation in Canada between CPI and long government bond yields from 1960 to 1984. I don't know what the corresponding number is in the U.S., but I suspect it's similar. FASB-87 is forcing us to measure pension liabilities and calculate normal costs at so-called settlement rates, both for U.S. companies and for their Canadian subsidiaries. And given the way interest rates shift, that will quite possibly mean annual changes in your valuation basis of interest rates.

How big have those changes been? The average change in inflation, whether it was a plus change or a minus change from 1960 to 1984, was about 1.2%. In long bond yields, it was 0.9%. As for the impact on liabilities -- which we have attempted to model, and Debbie showed you some stochastic inflation output -- if the inflation is up 1.2% higher than you expected, then your liabilities, at most, would be up 1.2%. If your plan were fully indexed, your liabilities would exactly match that growth in unexpected inflation. But the change in bond yields of less than 1% would have a much bigger impact on your liabilities if you had to reflect it in your valuation basis. If your entire liability were in post-retirement pension, then even there you might see about an 8% impact on liability. If you have active lives as well -- a 50% impact, or perhaps more if you don't have an off-setting salary scale; if you just have a fixed dollar liability which you are now re-valuing at a 1% higher or lower interest rate -- the impact on your liabilities could be more than 15%. It could be 20%; a very young plan might be 25 or 30%. To some extent these

FIGURE 19

ASSUMPTIONS - REAL RETURN ON CANADIAN REAL ESTATE

	MORGUARD PROPERTY INDEX	McLEOD, YOUNG, WEIR 40 BOND INDEX	TSE 30 INDEX + DIVIDENDS
1975	6.5%	-1.5%	9.3%
1976	2.0	16.5	4.7
1977	5.4	0.2	0.4
1978	4.0	-3.7	19.3
1979	2.0	-10.8	31.4
1980	7.3	-7.9	16.8
1981	14.1	-11.7	-20.0
1982	-9.4	32.7	-3.4
1983	7.7	7.1	29.0
1984	8.0	14.5	-6.0
COMPOUND	4.6	2.7	7.0
STAND.DEVN.	6.1	14.2	16.2
CORRELATION	-	-0.7	-0.1

- NOTE: RETURNS ARE FOR APPRAISED UNIT VALUES : ACTUAL MARKET SELLING PRICES THOUGHT TO BE 2 TO 3 TIMES AS VOLATILE

- SEE JOURNAL OF PORTFOLIO MANAGEMENT, SPRING 1984 ISSUE, ZERBST AND CAMBON

numbers are offsetting in that when the inflation rises, the interest rates tend to rise and the liabilities tend to fall. In fact, changes correlate to about a 50% degree, and you can control them to some extent -- but not totally -- by whether you make a corresponding salary assumption change as the interest rates change. I don't believe that you can get a total off-set here.

It now seems to me that in our forecasting, perhaps the most important variable, which we really haven't been treating particularly accurately up to this point, is what we are going to do about the valuation basis year by year. We can do deterministic forecasts and say that, yes, interest rates in year two will go up by 2%, in year three they'll go down by 1%, and so on, but really what we need now is a stochastic model of interest rates which will provide a stochastic valuation of the liabilities. Instead of having one set of liabilities, we now have, as Debbie said, five hundred sets of liabilities, each calculated at a different string of interest rates over time. That's the biggest single impact on the volatility of the numbers. Maybe somebody has built such a model, although I doubt it.

I would like to show you the dimension of the problem that we're facing. As Figure 20 shows, U.S. long treasury bonds in 1981 yielded 12.5%; in 1982, 13.7%. Liabilities were getting smaller on that basis. In 1983 there was a 3% drop in interest rates. What would that have done to your valuation basis? It might have moved it from 2 to 2.5%. There would have been a major increase in liabilities had we had FASB-87 in 1983. In 1984 and 1985 U.S. long treasury bond yields were 12% and 11.6%. In 1986 there was another 2% drop in interest rates, and right now we're already down to 7.3%. We have been as high as 15.1% in October 1981, and we have been as low as 1.8% in November 1941.

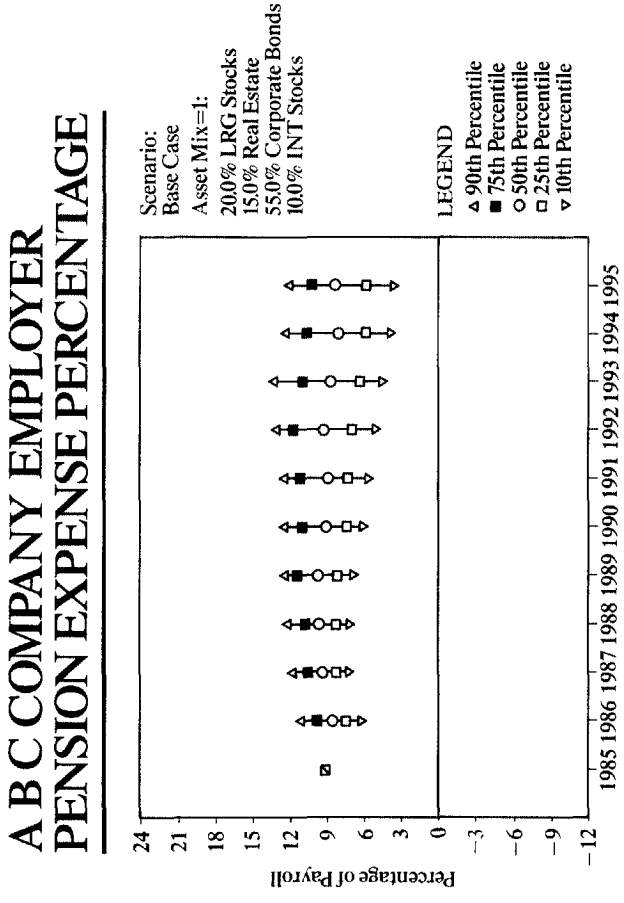
We did some approximations on the effect of interest rate changes on pension expense in Figure 21. This is by no means a perfect model at this point, but it shows pension expense over ten years for a portfolio which is heavily in bonds. Why did we put it heavily in bonds? A portfolio heavily in bonds will react somewhat similarly to the way that liabilities react. As interest rates rise, liabilities will go down, and bond prices will go down. We should get some reasonable degree of matching between the assets and the liabilities, and that should result in fairly smooth pension expense. Now the range that you

FIGURE 20

U.S. LONG TREASURY EXPERIENCE

	YIELD AT JAN. 1	RETURN IN YEAR
1981	12.5%	5.2%
1982	13.7	39.9
1983	10.6	1.0
1984	12.0	15.8
1985	11.6	32.0
1986	9.3	LARGE
CURRENT YIELD (APRIL 1986)		7.3%
1926 - 86 HIGH (OCTOBER 1981)		15.1
1926 - 86 LOW (NOVEMBER 1941)		1.8
1926 - 84 MEAN/STANDARD DEVIATION		4.8/3.1
DURATION 7 - 11 YEARS		

FIGURE 21


A B C COMPANY EMPLOYER
PENSION EXPENSE PERCENTAGE
Scenario:
Base Case
Asset Mix=1:
20.0% LRG Stocks
15.0% Real Estate
55.0% Corporate Bonds
10.0% INT Stocks
LEGEND
90th Percentile
75th Percentile
50th Percentile
25th Percentile
10th Percentile
Percentage of Payroll
24
21
18
15
12
9
6
3
0
−3
−6
−9
−12
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995
Valuation Year

see in Figure 21 over ten years -- the same type of display, 10th to 90th percentile, starting at a 9%-of-payroll level -- could be as low as about four to as high as twelve by the end of the period. It's still a pretty wide range, but it is within a 10% confidence in either range. The ranges in Figure 22 are enormously wider with the FASB proposals in there. It's not quite as bad as that. At least FASB gives us a 10% corridor on amortizing gains and losses; this does not have the 10% corridor number in it. My guess is that with the 10% corridor number, the 10th percentile would move to about the 25th percentile, but it would still be perhaps twice as volatile as it was before.

I wish I could tell you that we know all the solutions to this. It's not easy to simulate changes in evaluation assumptions year by year, but I think that's where we'll all be spending our time in the model-buildings business in the next few months or years.

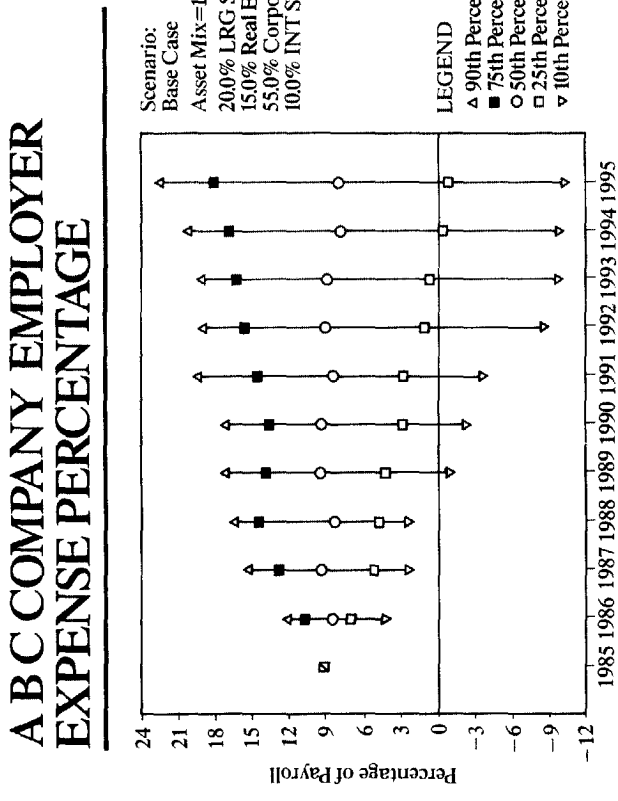
MR. RANDALL R. KING: Debbie and Colin have covered a great deal of material and haven't left much for me to talk about. What I am going to do is give you a quick lesson here in finance and statistics, both of which are very easy to forget. There is a great deal of difference between log normal distribution and the normal distribution. And when you compute statistics on the two distributions, you're supposed to do so in different ways.

Why do you even want to look at log normal and normal distributions? Generally when you're looking at stock market returns, the underlying assumption is we have a Brownian motion process going on. Actually it's called the geometric Brownian motion process. This means one year out, your return will be log normally distributed. If you take a log of that, then it's normally distributed.

Since returns are actually large enough to create problems for you, you have to be careful whether you take geometric averages or arithmetic averages. For geometric averages, you multiply your numbers together and then take the nth root. For arithmetic averages you add them up and divide by n.

Colin didn't point out in Figure 19 that down at the bottom it said "compound return." So Colin is doing it correctly. Not everybody does this correctly and it can mess you up if you use one statistic instead of the other one.

FIGURE 22


A B C COMPANY EMPLOYER
EXPENSE PERCENTAGE
Scenario:
Base Case
Asset Mix=1:
20.0% LRG Stocks
15.0% Real Estate
55.0% Corporate Bonds
10.0% INT Stocks
LEGEND
△ 90th Percentile
■ 75th Percentile
○ 50th Percentile
□ 25th Percentile
▽ 10th Percentile
Percentage of Payroll
24
21
18
15
12
9
6
3
0
−3
−6
−9
−12
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995
Valuation Year

When we at Wilshire look at what comes out of the simulation, whereas most people look at cost, we also look at various ratios of assets to liabilities. It depends on what liability you consider appropriate -- whether it's the total liability, the accrued liability, the vested liability, or the past service liability. We also look at distribution of market value of the assets and the actuarial value of assets. Those are more for the entertainment of the user than for really making asset allocation decisions.

A nice criterion for making asset allocation decisions is an ultimate cost. To determine the ultimate cost for a five year time horizon, for example, you would take your costs for the next five years and then the total unfunded amount -- in other words, total liability minus market value of assets -- and discount that back to this time at the actuarial interest rate. So you would discount the cost for each period, and also discount the total unfunded. The justification for looking at this is that you're going to be making these contributions anyway, and at the end of those five years, this total unfunded amount is still going to have to be taken care of over the lifetime of the pension plan.

One more issue that I wanted to deal with was the quality of the numbers that you use for your Monte Carlo simulation. You can use the random number generator from whatever program you have or whatever computer you have. Those numbers will not necessarily give you results as good as if your sample had the right statistics. If you're going to do five hundred simulations, it would be nice if the mean of those five hundred random draws were the mean that you wanted it to be. If you use one of these random number generators, the mean is going to be off just a little bit one way or the other because of sampling error. So when you are building up your random draws, you should try to actually have a set of random draws on hand that has a nice set of statistics that goes with it.

The Wilshire's asset liability model was one of the first asset liability models to come out. And one of its beauties was that when you entered your stock market information and your bond market information, you didn't have to think in terms of return and standard deviation or return and risk; money managers at the time were used to thinking of stocks in terms of what are

called beta data and r-squared. Two years ago I didn't even know about this. I had a good math background, but I didn't know a word of finance. I found out that I know everything about finance; I just don't know the terminology. Money managers think of stocks in terms of alpha, beta, and r-squared. Alpha is your excess return -- in this case, it's virtually nil -- and beta is the slope. These are just regression coefficients, a slope of the regression line, and the r-squared is the correlation.

Bonds are a little bit different. Bonds are very strange objects; they act backward. If your return is going up on your bonds, then interest rates go down, and vice versa. Our model asks for information on the maturity of the bond and the current yield. You then plot maturity, that's when the bond is payable, against the yield to maturity. What you get is a curve called a yield curve. What our model does now is fix the points, which are the Treasury bill rate, and the long bills rate. The underlying assumption is a little bit different from Colin's model. The return on your bonds is going to be log normally distributed with a given mean return and standard deviation. So if you've got a bond portfolio that doesn't lie on the yield curve, it's because it's a high grade bond. A low grade bond would put it above the yield curve.

MR. STEVEN G. VERNON: Debbie Benner mentioned that she had solutions or answers to a curve where the contributions went way down as a percentage of pay. I'd like to hear her comments on what her solutions are.

MS. BENNER: Generally what we do when we are faced with a client's decreasing cost, to get it more level, is simply to look at alternative funding methods and alternative interest and salary inflation assumptions and find one that produces a more level curve, usually within our target cost range. So for clients on FIL who want lower costs, I guess we usually have pretty good results with projected unit credit. We play around with the interest and salary assumptions until we get a more level curve.

MR. MARSHALL: Are you using assumption changes more frequently than funding method changes?

MS. BENNER: We definitely always change the assumptions and sometimes change the funding method, so I guess the answer is yes. What we would usually do for the client is start the process by giving it a matrix and say, "here are four funding methods; here are nine different combinations of salary and inflation; here are the costs that those numbers generate. Pick one or two that look like a good first year, and then we'll forecast them out and see if those patterns of cost are better." Naturally we'll make sure that all the assumptions would fit within the bounds of what's considered to be reasonable.

MR. CARLTON: I think that there's a real problem here. Sometimes you see on your best estimate expectation that the contributions are going to go to zero in three years because you're very well funded, so you say, "I don't want to be as well funded, so therefore I have to cut my contributions down." Any assumption change that cuts the contributions down usually brings the full funding closer, and you cannot do enough with the contributions to avoid going into full funding if you make any kind of reasonable gains on your assets. I think sometimes you're just faced with this situation which does not have a solution, and you have to ask, "When am I going to bite the bullet? Am I going to get to the zero contribution now or later?" Why would it be bad to go to a zero contribution? If you're in a regulated industry where you have been persuading the utilities commission that you should be collecting money from the rate payers at a high contribution level, now you would have to start explaining to them that you're really not interested in contributions anymore; you're interested in long term pension expense. I think there's a major issue here in educating regulators of utilities, which in many cases are very well funded maybe as a result of having over-collected in the past, using very conservative bases.

MR. CLAY R. CPREK: I have a question for Debbie and I guess anybody else who'd like to address this. In looking at your stochastic assumptions, it seems that those are heavily dependent on your initial best estimate deterministic assumptions. And it seems that a change -- perhaps a minor one such as the change in your growth, in your population -- would cause very dramatically different results in your stochastic analysis. I'm wondering what kind of sensitivity analysis or any type of analysis you'd perform to analyze the variations which may occur if the initial best estimate is off.

MS. BENNER: On the subject of growth assumptions, if the client is a little unsure about what the growth might be, we would usually do a couple of deterministic forecasts on alternative growth assumptions. We've generally found that that really doesn't affect the cost very much unless the client is talking about alternatives of, say, zero and 5%; then maybe it will affect the cost. More often clients are thinking alternative growth assumptions of either 1% or 2%, and that doesn't generally affect the cost. We've done a lot of sensitivity analysis on deterministic forecasts, and if the assumptions don't affect the deterministic forecast much, we don't usually get into those assumptions in the stochastic forecast. I guess if a client were particularly interested in that aspect of it, we might do a stochastic forecast. Stochastically, we usually just look at the effects of salary and interest and funding method changes as opposed to growth assumptions, productivity increases, or something else.

MR. VERNON: Has anyone done comparisons of projected unit credit forecasts with entry age normal forecasts? The reason I ask is that I'm starting to come to the conclusion that perhaps entry age normal funding methods overfund pension plans, and perhaps projected unit credit would be better. So I raise the question either to the panelists or the floor, if they've had any experience or thoughts on the matter.

MR. CARLTON: We've done a large number of forecasts of entry age normal versus unit credit, and entry age normal methods certainly build up assets, which, when compared to the old FASB 35 liability present value of accumulated benefits, get up to 180 or 200% of those numbers. And whether we as actuaries think that's right or wrong, our clients certainly don't generally feel that such a great margin over current accrued liabilities is necessary. And we generally find that PUC is better but builds up to 150 or 160% of PVAB liabilities. My own view is that entry age normal is, all else being equal as far as assumptions are concerned, an excessively conservative basis, tending to lead to, in most cases, declining costs over a period of time. When I do most forecasts, I very rarely find a different result than that.

MR. DAVID P. WARD: I would like any of the three of you to respond to the question of why or why not to use select economic assumption forecasting.

MS. BENNER: It's hard. We often use select, say, for experience basis; every year a client can have a different assumption if it wants. Usually it has a good idea of what's going to happen maybe in the next five years, or it thinks it does, and then it trends to a long term result. But using select assumptions as a valuation basis is just very expensive to do. We've done it a little bit in one or two special cases, but we try to avoid having to do it because of the cost and the complexity.

MR. CARLTON: I generally agree with that if by select you mean select economic assumptions. There is a problem even in using select assumptions for the experience if you're doing asset allocation work with bond returns, for example, assuming a decline in interest rates makes bond returns look very good for the next little while, so all your asset allocations that favor bonds tend to be the ones that you prefer. That may be right as a current tactical position but may not be what you would want as a longer term policy.

So I guess my preference in asset allocation work is not to use select type assumptions, but to say, "If I am attempting to form a long term policy here, what would the asset allocation look like or be, based on assumptions of an economy that I might say is in equilibrium as opposed to having a distinct trend to it?" And then I'd say, "Okay, having got my equilibrium asset allocation -- I'll go to select assumptions. How far off this equilibrium position do we want to be as a tactical asset decision as opposed to a long term policy?"

MR. N. S. KANDALGAONKAR: Do you connect demographic assumptions to your economic assumptions? For example, retirement and termination experience may be affected by your economic assumptions or projections.

MS. BENNER: I don't think we have ever tied demographic assumption to economic assumptions. We do tie them, for instance, if the client wants to consider some sort of early retirement or liberalization of the retirement benefits. Then we would change our retirement assumptions, our experience retirement assumption. But I don't think we've ever looked into having them affected by the economic environment, though I could see that maybe in an

inflationary environment people would be more likely to stay longer in the plan. But I don't think we've every done that.

MR. CARLTON: We've done that occasionally, and the result that I think of is the slow growth scenario where you feel that you're facing a recession type situation; then turnover tends to be lower. You may have some forced early retirement which you can put in, as Debbie says, and your growth rate tends to be zero and maybe even negative. So I don't think there are any formal linkages that we make, but we certainly discuss that with the client, and more often then not, it doesn't want to complicate the issue. There are others who have in-house economists and major funds. Ontario Hydro would be a case in point, I think, where you might very well want to make those linkages. But formal linkages are not something that we or I push or don't push; it's an individual judgment.