2nd AFIR Colloquium 1991, 2: 153-162

Pension Plans
Choosing Critical Assumptions

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Summary

Pension actuaries in the United States have not chosen realistic actuarial assumptions in the majority of instances. In particular, the interest rate used for discounting liabilities has generally been much lower than the expected rate of return on the plan assets. Consideration of the principles of measuring financial risk leads to the conclusion that liabilities and surplus would be more accurately measured if plans used the expected rate of return on assets to discount liabilities. This, however has implications for the choice of the other actuarial assumptions. In addition, the level of annual contributions to the plan could be stabilized if the liabilities were immunized with long term fixed income obligations.

Résumé

Plans de Retraite - Choix d'Hypothèses Critiques

Les actuaires de retraites aux Etats-Unis n'ont pas choisi, dans la majorité des cas, des hypothèses actuarielles réalistes. En particulier, le taux d'intérêt utilisé pour escompter les engagements a généralement été bien inférieur au taux de rendement attendu sur les actifs du plan. L'étude des principes de calcul du risque financier conduit à la conclusion qu'engagements et surplus seraient mesurés de façon plus exacte si les plans utilisaient le taux de rendement sur actif attendu pour escompter les engagements. Cependant, cela a des implications sur le choix des autres hypothèses actuarielles. De plus, le niveau des contributions annuelles au plan pourrait être stabilisé si les engagements étaient immunisés avec des obligations de revenu fixe à long terme.

Actuarial assumptions for pension plans fall into three categories. There are those that seem to be the exclusive province of the actuary, such as rates of mortality and disability. There are those that often depend on the special knowledge of the plan sponsor, such as expected termination rates and ages at which people are expected to retire. The third category contains the assumption on which everyone seems to be an expert: the rate for discounting liabilities, sometimes referred to as the interest rate or the expected rate of investment return.

In past years United States actuaries have used a variety of methods to select assumptions, some of them grounded in theory and some not. One method not based on theory has been to consult a survey of what other actuaries are doing and try to avoid being outside the bounds, frequently very wide bounds, of current practice. Often, before the advent of today's computer age, assumptions were left unchanged from year to year because changing them was too time consuming and expensive.

It is important for the actuarial profession that we be able to explain to clients and the public how assumptions, and especially the discounting rate, are selected. This is difficult to do unless there is some underlying theory that can be generally understood. Many believe that the discounting rate is or should be directly connected to the expected rate of investment return. The recent experience of some actuaries in dealing with pension plan assets and liabilities together suggests an approach which could be an appropriate guide for the future.

The purpose of the first part of this paper is to consider the relationship between the discounting rate and the expected rate of investment return. The second part will consider the effect on other key assumptions if an expected rate of investment return

is used for discounting liabilities.

I. Rate for Discounting Liabilities

The basic actuarial equation for a pension fund is

Fund + Expected Contributions + Expected Investment Income

= Expected Benefit Payments + Expected Expenses

The interesting thing about this equation is that, except for the fund, everything is "expected." We are dealing with the future, the unknown.

In pension actuarial calculations the usual objective is to determine the amount of current year contributions. The equation is first transformed to eliminate the investment income item by discounting the benefit payments, expenses and contributions to present value. The transformed equation is

Fund + Discounted Present Value of Expected Contributions

= Discounted Present Value of Expected Benefits and Expenses

A single discounting rate has been assumed in this paper. If multiple rates are to be used, the reasoning is similar.

Looking back at the equation, it is clear that the discounting rate is related in some way to the expected investment income, so that income needs to be expressed as a

rate of investment return. Next, one of various techniques called "actuarial cost methods" is applied to the Discounted Present Value of Expected Contributions to determine the range of contributions appropriate for the current year.

There are two schools of thought (perhaps more) about the expected rate of investment return for a pension fund over a period of thirty years or more. One school says that the expected return will vary depending on the fund's investment policy. The other says that when looking at a thirty year horizon the expectation of most funds is about the same because they are all investing in the same marketplace and they are all free to change investment policy and managers over the next thirty years. Put another way, since all funds are trying their best for the highest return consistent with safety and good sense, there is no reason for the expected rate for any particular fund to be higher or lower than the expected rate for any other fund; they should all really expect the same thing. Some investment theorists would say that the expected return increases as the fund is willing to take more risk, but each fund is free to take less risk or more risk over the next thirty years. Therefore, this school would still expect the same return for all funds, unless there is a reason for a particular fund to be more risk-averse or more risk-taking than other funds. The results of the funds' investment efforts will not be the same, but at any point in time the expected long range rate of return will be the same.

Whichever school one chooses to join, it is possible to estimate the expected rate of return. To use an oversimplified example, suppose that the investment policy of a pension fund is to invest 100% of the assets in United States Treasury bonds (which are assumed to have no default risk) with a duration such that the plan is immunized against changes in interest rates. In most cases this duration will be relatively long, but there are circumstances where it can be very short. If the assets are less than the

plan liabilities, the immunization can be effected by having a duration for the assets that is appropriately longer than the duration of the liabilities. This avoids having to consider whether it is appropriate to use a different, probably lower, discounting assumption for those liabilities which have not yet been funded, as some have suggested. In this paper we generally ignore the fact that different Treasuries have different yields, that yield curves are not flat. While this complicates matters, it does not affect the principles discussed.

The effect is interesting. Each year the plan liabilities (benefits and expenses in the basic equation) are discounted at the then prevailing yield rate for the Treasuries. If yields have decreased, the increase in the plan liabilities has been matched by an increase in the value of the portfolio. If yields have risen, the drop in the value of the portfolio has been matched by a drop in the value of the liabilities. The resulting effect on expected contributions is minimal.

In reality, of course, the liabilities of the fund cannot be perfectly immunized, but it is possible to come very close in many cases. It is not generally possible to immunize both funded status and contributions; contributions are based in part on benefits expected to be earned in the future and therefore involve greater liabilities than funded status.

It is unlikely that any pension fund follows the investment policy described above. Most would say that they are following a policy which expects a higher return over the long run than can be obtained on Treasuries. If that is the case, it would seem illogical for the actuary for such a fund to use a discounting rate lower than the current yield rate on Treasuries. If anything, since the expected return is higher, the actuary should use a higher discounting rate.

There are plans, primarily small plans, where most or all participants elect to receive their benefits in a lump sum instead of as an annuity. In many of these plans, the factors used to convert the pension amount to a lump sum do not change as market interest rates change. This can pose a special problem for the actuary. As each participant approaches retirement the duration of his liability approaches zero, complicating somewhat the determination of the duration needed for the assets and possibly requiring a set of discounting rates instead of a single rate. In this type of plan it is most important that the plan sponsor have an investment policy that will produce the cash as it becomes needed for benefit payments, some of which can be quite large. In the special case where the sole participant is assumed to retire immediately and is expected to elect a lump sum, the liability duration is zero.

Many actuaries have traditionally used discounting rates for pension calculations that are lower, often substantially lower, than prevailing expected rates of return. One reason given for this practice is that actuaries are "conservative" and that using a low discounting rate protects the participants in the plan. Another reason is that as long as all of the assumptions in the aggregate produce a reasonable result, it does not matter what any individual assumption is. Let's look at these reasons for a moment.

If each other assumption is reasonable and the actuary decides to use a lower discounting rate to protect the participants, what is happening? The lower rate increases the flow of funds into the plan for the current year and will cause the plan to reach a fully funded position more rapidly than would be the case if a higher discounting rate had been used. Faster funding can protect participants against three risks: first, that the fund may follow a risky investment policy that turns out badly; second, that the plan may be discontinued, either by the sponsor's conscious decision or because of the sponsor's bankruptcy; and third, that some small plans may not

have sufficient funds for a lump sum benefit if a major participant retires early. In any case, there is a question whether these reasons justify tinkering with the discounting assumption. One answer is "probably yes" as long as there is disclosure to the client. However, the third risk might more appropriately be handled by adjusting the assumption about rates of retirement.

If, on the other hand, one or more of the other assumptions is not reasonable and the actuary decides to use a lower discounting rate to offset the effect of the other assumption, a pragmatist would say that since the result is correct, the path for getting there is not relevant. However, in such a case, disclosure is appropriate.

Some have argued that if recent investment results have been poor, they should be considered in selecting the discounting rate. This is similar to using the recent results of tossing a coin to determine the probability that the next toss will be "heads." The actual results have nothing to do with expectations as to the future. This is not to say that investment results are not important. They are critical to the success of the pension plan; past investment results are reflected in the value of the fund. If a plan sponsor decides to follow a risky investment policy in the hope or expectation of a higher return, then that sponsor is deliberately accepting the risk that if future fund levels are below expectations, the required contributions will increase.

Some actuaries have pointed out that it may be appropriate for plans whose benefits are based on final salary to invest substantially in equities whose values many expect to be highly correlated over the long run with future salaries. If this is done and if it is successful, the investment policy will have protected the sponsor against the risk of changes in the liabilities caused by differences between the salary escalation assumption and the actual changes in salaries. However, it will not have protected

the sponsor against changes in contribution levels caused by volatility in interest rates. In any case, the expected rate of return on the portfolio of equities and fixed income obligations, which would normally be somewhat higher that the rate on Treasury bonds, would then be the appropriate rate for discounting the plan liabilities.

The conclusion is that generally the expected rate of investment return should be used for discounting liabilities. It is likely that the vast majority of expected returns in the United States are in a range of 200 basis points whose lower bound is slightly above Treasuries. The most "conservative" rate would be based on the Treasuries example described above. Of course, the actuary must conform to any laws or regulations that apply.

II. Effect on Other Actuarial Assumptions

In some actuarial situations there is high volatility of the Expected Benefit Payments term in the basic actuarial equation. By combining a mean value of the Expected Benefits Payments with a low discounting rate, many actuaries have achieved the degree of realism necessary in the final result. For example, it has been common practice for actuaries to use no discounting at all in determining levels of property and casualty loss reserves because of the extremely high volatility of the expected benefit payments. In pension calculations, it has been quite common to use a low discounting rate (although not zero) where the timing or the amount of payment of a large benefit has not been readily predictable. Since it is highly important that there be sufficient funds to make all benefit payments when due, this problem must be handled in a different manner if a market rate of return is to be used for discounting.

The uncertainty about a particular benefit payment can relate either to its amount, B, or the date, t years from the valuation date, when it is expected to be paid. If the standard deviation of these items is σ_B and σ_t, respectively, then an approach to moderate volatility would be to discount a benefit of $(B + \sigma_B)$ for a period of $(t - \sigma_t)$ years. An approach to extreme volatility would be to use 3σ instead of σ in one or both of the terms. This clearly is a matter requiring keen judgment and the actuary's report should disclose what has been done and why.

III. Summary and Conclusions

It has been customary for many pension actuaries to use discounting rates well below the expected rate of return on plan assets. This has been primarily for two reasons. First, there has been a perceived need to be safe or prudent, particularly when there is volatility in the expected amount and timing of benefit payments. Second, many pension actuaries have not considered how the assets and liabilities interact and how the effect on contributions of future changes in interest rates can be sharply reduced through immunization techniques. As a result, although the results of the actuary's work may well have been satisfactory, there has been widespread misunderstanding in many quarters of the reasons for selecting discounting rates with no relationship to rates of return available both to large and small pension funds.

This paper has tried to show that the expected rate of return on the plan assets is the proper rate for discounting liabilities. This is because there exists for almost every plan a portfolio of government bonds that will sharply reduce the volatility of the liabilities or the contributions. Where the expected rate of return is higher than that available on government bonds, a higher discounting rate is appropriate. In such cases the plan sponsor accepts the risks inherent in the alternative portfolio. In

addition, the authors have suggested an approach to the problem of volatility of expected benefit payments. Much work, of course, remains to be done on this second aspect of the problem. It is hoped that as actuaries find ways to deal with benefit volatility, either in the context of pensions or in other areas, their work can be published and scrutinized by the entire actuarial community.