CONTRIBUTION N° 12

PENSION FUND
PORTFOLIO
MANAGEMENT

PAR / BY

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GESTION DU PORTEFEUILLE
D'UNE CAISSE
DE RETRAITE
RESUME

L'auteur considère qu'il n'y a aucun espoir de trouver une définition à la fois pratique et universelle du risque d'investissement. Dans cet article, il utilise, dans le cas d'une caisse de retraite, une définition du risque qui est une fonction de la relation de cash flow entre les actifs et les engagements. Dans l'interprétation des conséquences du risque d'investissement, les objectifs stratégiques des administrateurs et de l'institution de patronage doivent être déterminants.

On présente une méthode de détermination de la combinaison d'actifs stratégiques à long terme, fondée sur cette définition du risque, et qui tient compte des facteurs de base qui influent sur le risque. Cette méthode utilise une technique de modélisation actifs-engagements pour essayer de déterminer la solution la plus efficace du point de vue du risque.

Une fois déterminée la combinaison stratégique d'actifs, il convient d'opérer un contrôle systématique des actifs et engagements. Pour être efficace, ce contrôle devrait être annuel.
1 - Introduction

Actuaries are rightly concerned with the mathematical analysis of risk. Many speakers at this first AFIR International Colloquium will present highly sophisticated mathematical models designed to give us more insight into the analysis of risks.

This mathematical basis for actuarial work is clearly vital. Yet I do sometimes feel that as a profession, we actuaries place more emphasis on the mathematical subtleties of our work than the realities of the world as our clients see them.

My primary concern is advising pension fund’s Trustees and Sponsors on their investment arrangement, including long-term asset allocation. This is an area which has long been hampered by no real agreement as to what constitutes risk in this context, and no real agreement as to how such risks should be measured. It is my belief that a major part of this problem has been that the analysis has been concentrated on trying to find definitive answers that will satisfy every pension fund, rather than seeking to provide solutions that cater for the risk tolerances of individual funds.

My paper will therefore deal with the following four areas:

1. The difficulty of providing universal definitions of risk for pension fund investment strategies.
2. The possible risk elements that should be considered in putting together an investment strategy for a pension fund.
3. Delivering risk-efficient solutions for individual pension funds through a combination of mathematical analysis and the clients objectives.
4. Monitoring as a tool for analysing deviations from risk-efficient position.

2 - Risk for Pension Fund Investment Strategies

The classical definition of "investment risk" was given by Markowitz (1) where the key concepts are that

(M1) the investment risk is a function of the uncertainty of the return; and
(M2) the investment risk can be measured by the dispersion of the return.

More recently, Clarkson (2) put forward a more general definition, where the key concepts are that

(C1) the investment return is a function of both the probability of the return being below a certain threshold and also of the severity of the financial consequences arising from these values of return; and
(C2) The investment risk can be measured by the expectation (using the probability distribution of the return) of an application specific weighting function satisfying a number of assumptions.

Markowitz definition is simple to understand and apply, but in my view it is unsatisfactory from the client's point of view as it completely ignore what is being risked as a result of the volatility. Clarkson's development is theoretically interesting, but I would find it difficult to apply in particular cases and to explain to the client.

From a practical point of view I believe that we need a formulation that is readily understandable by the client and, most importantly, measures the investment risk through quantities that the client finds of relevance. As an example, I would translate the investment risk into likely variability of the contribution rate (if its stability was of importance to the client). Each client will have his own areas of concern and with different levels of importance and severity of consequences attached to them, thus making it futile to try to have a universal measure of risk (even though from a purely axiomatic point of view Clarkson's formulation would be satisfactory).

One of my main functions is to provide strategic asset allocation advice on the investment of pension fund assets, and in this context I believe that the most relevant definition would be

1. The investment risk is a function of the relationship between the cashflows of the asset and liabilities; and

2. The investment risk can be measured by the effect of the dispersion of the net cashflow ("income" - "outgo") on a client defined objective.

The rationale for this approach is intuitively obvious. Pension fund exists to pay benefits (in cash form) to employed members and former members on the happening of certain events in the future (e.g. death, retirement), and in general these benefits will be based on the salary and service completed at the time they ceased to be employed members.

The fund's assets are normally not held in cash, and so the real investment risk is that the fund may not provide the necessary cash to meet the payments when due, by converting the non-cash assets into cash. Since the worth of the cash convertibility of an asset varies directly with the volatility of its investment return the two concepts are often used synonymously. However, there is a significant transient cash content in most assets, namely the investment income (and redemption value for redeemable securities at maturity). The conversion of assets to cash may therefore not be necessary if one can demonstrate that the receipts from the investments together with the contributions from the Sponsor (and members if any) are sufficient to meet the cash requirements of the liability stream

Clearly, this definition of risk is "client specific" and there is no hope of universal measure of risk being suitable in all cases. However, I believe this interpretation of "investment risk" gives us a universal approach to the measurement of risk.
3. Risk elements for "Benchmark" Portfolio

Investment risk lies mainly in not generating sufficient cashflows to pay the emerging benefits, varying in both the amount and incidence due to the uncertainty of economic (investment returns, inflation and earnings growth) and demographic (mortality, withdrawal and early retirements) factors, and having to realise some investments at the time when their market value is less than anticipated. This risk is minimised if the assets’ income profile is matched with the liability profile. The profile of a stream of payments (both benefits payments and income payments) can be summarised by:

(1) Duration - normally expressed as the weighted term of the payments, where the weights are the discounted present values of those payments. This can also be described as a measure of sensitivity to changes in rates of return, with long duration signifying that a small change in the expected rate of return will cause a large change in the present value of the asset or liability; and

(2) Sensitivity to economic factors - in particular price inflation and real earnings growth.

When the duration of assets and liabilities is matched, the actuarial values of the assets and liabilities change by a similar amount and the solvency ratio is therefore protected against changes in interest rates. However, the incidence of payments of the liabilities and the income from the assets can be quite different even when the durations are matched, thus exposing the fund to the risk of forced realisation of assets. Another important use of the duration of the liabilities is that it gives us the appropriate timescale over which to view the investment risk due to volatility. As duration increases, the volatility of the annualised investment returns decreases significantly; for example, over twenty year timescale the volatility is less than one-sixth of the volatility for a one year.

The complex process of finding the most risk-efficient mix of assets to meet the long term (liability driven) investment strategy is considered further later on.

The different types of assets and liabilities we would consider in our asset/liability model are:

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Protection against Price Inflation</th>
<th>Real returns positively Correlated with real UK economic growth (Salary increases)</th>
<th>Current Income Yield</th>
<th>Duration in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash (Variable Rate)</td>
<td>Limited</td>
<td>No</td>
<td>12.75</td>
<td>0.0</td>
</tr>
<tr>
<td>Fixed Rate Bonds</td>
<td>No</td>
<td>Limited</td>
<td>9.50</td>
<td>9.0</td>
</tr>
<tr>
<td>Indexed Bonds</td>
<td>Yes</td>
<td>Limited</td>
<td>3.00</td>
<td>14.0</td>
</tr>
<tr>
<td>Property</td>
<td>Some</td>
<td>Yes</td>
<td>6.00</td>
<td>16.7</td>
</tr>
<tr>
<td>UK Equities</td>
<td>Some</td>
<td>Yes</td>
<td>4.50</td>
<td>22.2</td>
</tr>
<tr>
<td>Overseas Equities</td>
<td>Some</td>
<td>No</td>
<td>2.00</td>
<td>50.0</td>
</tr>
</tbody>
</table>
It is common to look at assets in relation to past service liabilities, but as the fund is ongoing we can offset the current contributions against the pensioner's benefits. In the majority of Plans the current contributions (from employees and the Sponsor) are more than sufficient to cover the pensioner's benefits, and in those cases we can match the duration and sensitivity of the assets to the Current Employed Members and Deferred Pensioners. However, if it is at all likely that the plan might be discontinued we should exclude the future contribution income from our analysis. Current conditions in the UK (emergence of significant pension fund surpluses and new regulations on their treatment) often lead to the temporary suspension of the Sponsor's contributions and it is therefore necessary to consider the current funding levels before allowing for the Sponsor's contributions to continue.

As we stated previously, the objective of pension fund investment is to fund the liability cashflow. That may seem quite straightforward but note that it is a quite different objective from maximising either the value of the pension fund's assets or overall returns. The difference is akin to the difference between investment and speculation.

The assumption of anyone who acts to reduce risk is that the risk is bad and the less of it one is subject to the more comfortable one feels. Yet risk policy is the control lever on any investment portfolio; one cannot control returns except by eliminating risk and accepting a lower expectation of return.

It is well documented that certain risks, specifically market risks, are positively related to returns both historically and expectationally. The Trustees brief is not to simply minimise all risks, but to eliminate uncompensated risks and then to strike a balance between compensated risk/expected returns and the requirement to fund the liabilities with minimum cost and maximum stability. This balance requires a clear understanding of the goals of the pension fund, which are:
The Fiduciary Objective - maximising the probability that the fund meets its funding obligations.

The Funding Objective - minimising the cost of the funding source.

The Stability Objective - enhancing the predictability of demands on the plan Sponsor for funding finance.

The difficulty for the Trustees and the Sponsor is that these three goals are not compatible. In general high return strategies that best achieve their fiduciary and funding objectives are achieved only at the cost of stability. It is our view that when the Trustees and plan Sponsors concentrate on risk reduction, this emphasises stability, but is sacrificing the (possibility) more important objectives.

It is understandable that stability and risk reduction is important to corporate management. They often expend great effort on promoting more stability and growth of the company income, and volatile pension funding demands disrupt this corporate planning. SSAP 24 in the UK and FAS 87 in the USA cause pension experience to more strongly impact balance sheets and income statements, and plan Sponsors will be even more attracted to strategies that stabilise pension assets.

Clearly before a risk-efficient investment strategy can be considered in detail the client will have to decide which objectives are to be most important and what level of risk (expressed in their terms of reference, e.g. contribution level or solvency level) they are prepared to tolerate. Without detailed discussion of these principles with the Trustees and Sponsor it is likely that an unduly cautious strategy is adopted, at the cost of lower returns and ultimately higher costs to the Sponsor.

One key variable in the determination of what is risky is the time over which the investment strategy is to care good. A risk reduction strategy appropriate for longer time horizon may be quite dangerous if applied to an investment problem with a short horizon or vice versa. When the horizon covers a short period of time such as a year, the strategy is to match the current liabilities with current assets, for example cash. For a funding stream of intermediate horizon, such as the previously promised benefits for current pensioners, risk minimisation involves insuring against interest rate changes through the use of fixed income investments of appropriate duration to minimise the amount of selling. But bonds alone cannot cover all the risks of a pension plan since bonds do not participate in productivity gains.

The principal long-term risk (for employed members) has been previously identified as real wage growth risk; only equities with their automatic participation in productivity gains can adequately ensure against this long-term risk. It is our view that fixed interest investment has no natural place in a pension portfolio, except in special situations which would be identified through asset/liability modelling.

To carry out the asset/liability modelling exercise we:

(1) Determine the benefit cashflow over the next ten years, using the best estimates of demographic and economic factors unless given specific guidance about new
entra]]ts we would ignore them as their contribution to the cashflow analysis is generally beneficial).

(2) Taking the current pension fund portfolio as a starting point we carry out a projection of the investments, using best estimates of the investment returns (separating capital growth and current yields) and the future cashflow of contributions less benefits from (1).

(3) From the results in (2) we can see what combination of investment income and contributions is required to meet the payments to beneficiaries without having to resort to sales of investments and this gives us a first set of constraints (if any) on the strategic asset mix.

(4) Once we have agreed the basic investment areas that the Trustees would wish to be invested in, for example UK Equities, Overseas Equities, Property and Index Linked Gilts we can undertake an optimisation process to find asset combinations with the best return for a given level of risk (volatility of returns). The results will depend on the forecasted returns for each investment area, together with their expected variability and correlations.

(5) Using the strategic asset mixes (the client would usually want to see the consequences of several levels of investment return risk) we repeat step (2) with an allowance for the costs of restructuring. The results are then used later on in the determination of the emerging surplus which determines the future levels of solvency and the volatility of contributions.

(6) To complete the actuarial analysis of the liabilities we need to estimate the past service reserves in the future years. Using the economic and demographic assumptions as in (1) we project the current active and pensioner population for the next ten years (assuming a stable active membership profile) and carry out a valuation in each of the projection years using the current valuation assumptions.

(7) From (5) and (6) we can determine the actuarial surplus in each of the projection years on the expected basis, and we can estimate the likely trend of the overall contribution required to maintain a given level of solvency.

(8) The next step is to investigate the volatility of the surplus due to the variability of the economic scenario and investment returns. At present we use a combination of analytical and statistical tools to obtain the volatility of the surplus, and we are currently developing an approach based on the stochastic modelling techniques as described in Wilkie (3). This should provide us and the client with a greater insight into the 'shape' of the probability distribution of the surplus.

I believe that the establishment of a strategic benchmark portfolio asset mix after a full discussion of the nature of the liabilities, and the degree of tolerance to the acceptance of short-term and long-term risk is essential in establishing the ground rules for evaluation and monitoring of the investment manager's performance.
5 - Role of Monitoring

As stated above, the investment strategy for a pension fund should be related to its liabilities and the objectives of the Trustees and the Sponsor. When discussing with the client the need for a monitoring process once the strategy has been settled, it is helpful to think of the pension fund as one of the operating divisions of the Sponsor. It relies on the same source of cash as the other divisions and will have a significant effect on the Sponsor's cashflow (and balance sheet due to SSAP 24 in UK and FAS 87 in the US). It is very common for the size of the fund to be comparable with (and often greater than) the market capitalisation of the Sponsor and in my view it should be subject to the same standards of monitoring and controls as the other operating divisions.

When the strategic asset allocation policy is settled, it should be monitored on regular basis. The frequency could be subject to debate, but I would settle for annual reviews. What is important to realise here is that I am not only concerned with the normal investment performance monitoring process, which I would carry out on a quarterly basis, but with a complete reappraisal of the assets and liability structure.

However good our estimates of future events are, they are likely to be different from reality, and we need to check on our estimates by carrying out regular investigations. Some of my colleagues feel that the frequency of the actuarial valuations (typically three years in the UK) should be sufficient but I think that is too long a time to wait to discover that the liability profile changed from that assumed in our projections. More importantly, if stability of contributions and solvency levels is important it is probably better to have small adjustments annually then large adjustments every three years. I do not feel that it would be practical (or acceptable to the client) to actually carry out a full scale valuation every year, but as a part of the asset/liability model one can build a mathematical model of the liabilities that can be tested on an annual basis with relatively little input of data.

On the assets side, the strategic asset mix depends on the expectations of the future long term returns from the individual sectors and their correlations. Neither changes very quickly, but I feel one could be accuse of negligence not to at least examine on an annual basis whether the assumptions for the estimates are still valid.

With the growing acceptance of specialist management and detailed investment targets being given to the investment managers, the role of the performance measurer will change. At present, the measurers provide standard report ranking the manager among his peers. The approach can only be valid on the assumption that all the funds in their universe have the same target, namely maximise overall investment return. When specific investment brief is given to a manager, he can be only compared with another one with the same brief.

One possible scenario is that the measurer will provide the basic analyses and statistics, possibly including the risk analyses on both historical and current basis (as measured, for example, by the BARRA system) to the consultant who will then provide to the client customised reports analysing the performance in relation to the agreed benchmarks.
There will continue to be a need to monitor the manager from the point of view how his performance compares with his peers, but in a different form than at present. I confess that I do not know what form it should take to have some predictive power.

Synopsis

The author believes that there is no hope of finding a universal practical definition of investment risk. Instead the paper uses a definition of risk for a pension fund to be a function of the cashflow relationship between the assets and liabilities. In the interpretation of the consequences of the investment risk the business objectives of the Trustees and the Sponsor must be paramount.

Using this definition of risk, and having considered the basic factors that influence the risk, an approach to the determination of the long term strategic asset mix is presented. It uses asset/liability modelling techniques to try to find the most risk-efficient solution.

Having found the strategic asset mix, both the assets and liabilities need to be monitored. To achieve effective control this process should be on an annual basis.

Bibliography

(1) Markowitz, H. M. Portfolio Selection: Efficient diversification of Investment. (New York: John Wiley & Sons 1959)


(3) Wilkie, A.D. A Stochastic Investment Model for Actuarial Use. (Transactions of the Faculty of Actuaries 1986)