

# CONTRIBUTION N° 12

## PENSION FUND PORTFOLIO MANAGEMENT

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GESTION DU PORTEFEUILLE  
D'UNE CAISSE  
DE RETRAITE

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## 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**.

BY PETER LUDVIK

## 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 benefit 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 of 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 :

| Asset Type           | Protection against Price Inflation | Real returns positively Correlated with real UK economic growth (Salary increases) | Current Income Yield | Duration in years |
|----------------------|------------------------------------|--|----------------------|-------------------|
| Cash (Variable Rate) | Limited                            | No   | 12.75                | 0,0               |
| Fixed Rate Bonds     | No                                 | Limited  | 9,50                 | 9,0               |
| Indexed Bonds        | Yes                                | Limited  | 3,00                 | 14,0              |
| Property             | Some                               | Yes  | 6,00                 | 16,7              |
| UK Equities          | Some                               | Yes  | 4,50                 | 22,2              |
| Overseas Equities    | Some                               | No   | 2,00                 | 50,0              |

| Plans<br>Liability Types  | Linked to<br>Rice<br>Inflation | Increases positively<br>correlated with<br>UK economic growth | Range of<br>duration<br>in years | Typical<br>average<br>duration |
|---|--------------------------------|---|----------------------------------|--------------------------------|
| <b>Fixed/Guaranteed Esc'n</b>   |                                |   |                                  |                                |
| Pensions (No <b>discretionary increases</b> )                           | No                             | No  | 0-12                             | 7                              |
| Pensions with discretionary increases                                   | Yes                            | No  | 0-13                             | 8                              |
| Former Employees( <i>Deferred</i> Pensions)                             | Low                            | No  | 7-57                             | 37                             |
| <b>Current</b> employed Members (within <b>10</b> years of <b>NRA</b> ) | No                             | <b>Yes</b>  | <b>7-17</b>                      | <b>12</b>                      |
| Current Employed Members ( <b>possible</b> future withdrawal)           | Some                           | Yes   | <b>17-57</b>                     | <b>27</b>                      |

It is common to look at assets in relation to past service liabilities, but as the fund is on-going we can offset the current contributions against the pensioners'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.

#### 4 • Delivering risk - efficient solutions

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 **come** 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**

- entrants** 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**  $r$  at a given level of risk (**volatility** of returns). The results will depend **on the** forecasted returns  $r$  at **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**  $r$  at 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 than 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 accused 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 **shoud** 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.

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