

LIABILITY DRIVEN BENCHMARKS FOR UK DEFINED BENEFIT PENSION SCHEMES

BY A.J. CHAMBERS, A.E. BARNES, M. BARNES, L.J. BEUKES, D.E. DYER, P. FULCHER,
M.H.D. KEMP, A.M. LAWRENCE, C.D. TATHAM, N.M. WINTER

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ABSTRACT

This paper considers liability driven benchmarks for UK defined benefit pension schemes. We define a liability driven benchmark as an investible portfolio of assets constructed to closely match the expected liability cash flows of a pension scheme and minimise investment risks. This paper does not consider in detail wider investment strategy issues, including long term unconstrained mandates and dynamic asset allocation strategies. We consider the background to liability driven benchmarks for UK pension schemes and the reasons why pension scheme trustees might adopt this kind of benchmark. We discuss current market practice and different approaches to setting liability driven benchmarks, focusing on an example of a closed scheme with pensioner liabilities. We describe the practical issues faced in implementing a mandate of this kind, including the use of over-the-counter derivatives such as swap contracts. Finally, we briefly consider broader issues including extending liability driven benchmarks to active and deferred member liabilities, and active investment management against a liability driven benchmark.

KEYWORDS

Pensions, risk, liability driven investment, tracking error, performance management, risk budgeting, swaps, collateralisation, inflation, limited price indexation, duration, immunisation

CONTACT DETAILS

Alvar Chambers, Insight Investment, 33 Old Broad Street, London, EC2N 1HZ;

E-mail: alvar.chambers@insightinvestment.com

Andrew Barnes, Watson Wyatt LLP, Watson House, London Road, Reigate, Surrey, RH2 9HQ;

E-mail: andrew.barnes@eu.watsonwyatt.com

Matthew Barnes, Watson Wyatt LLP, 1 Falcon Way, Shire Park, Welwyn Garden City, Herts, AL7 1TW;

Email: matthew.barnes@eu.watsonwyatt.com

Leon Beukes, Hewitt, 6 More London Place, London, SE1 2DA; Email: leon.beukes@hewitt.com

David Dyer, AXA Investment Managers, 7 Newgate Street, London, EC1A 7NX;

Email: david.dyer@axa-im.com

Paul Fulcher, UBS Investment Bank, 100 Liverpool Street, London, EC2M 2RH;

E-mail: paul.fulcher@ubs.com

Malcolm Kemp, Threadneedle Asset Management, 60 St Mary's Axe, London, EC3A 8JQ;

E-mail: malcolm.kemp@threadneedle.co.uk

Adrian Lawrence, Henderson Global Investors Limited, 4 Broadgate, London, EC2M 2DA;

E-mail: adrian.lawrence@henderson.com

Charles Tatham, Legal and General Investment Management Ltd, Bucklersbury House, 3 Queen Victoria Street, London, EC4N 8NH; Email: charles.tatham@lgim.co.uk

Natalie Winter, PricewaterhouseCoopers, Plumtree Court, London, EC4A 4HT;

Email: natalie.winter@uk.pwc.com

1. Introduction and background

1.1 Purpose of working party and aims of paper

The working party has been set up to consider the issues of Liability Driven Benchmarks for UK pension schemes. The key output of the working party is this paper, which is due to be presented to the Finance & Investment Board Conference in June 2005.

The topic of Liability Driven Investment is the focus of much interest in the UK occupational pension scheme industry, in particular with respect to defined benefit schemes, however there is a fair amount of confusion over what it means. The working party has chosen to define a liability driven benchmark as an investible portfolio of assets constructed to closely match the expected liability cash flows of a pension scheme and minimise investment risks. This paper does not consider in detail wider investment strategy issues including long term unconstrained mandates and dynamic investment strategies, although we touch on these issues in the final section.

1.2 Structure of paper

Section 1 discusses the background to liability driven investment for UK pension schemes and the reasons why pension scheme trustees might adopt this type of mandate, along with the limitations of a liability driven approach. Appendices B and C expand on the issues of insurance buyouts, and mortality risk respectively.

In Section 2 we describe current market practice and compare the different approaches to setting a liability driven benchmark. In Appendix D we illustrate these approaches with an example based on a model scheme, which to simplify the issues involved is a closed scheme with only pensioner liabilities and fixed pensions in payment.

In Section 3 we consider the practical issues a pension scheme faces in implementing such a benchmark. These practical issues are discussed in more detail in Appendix A, which has been extracted, with the author's permission, from Kemp (2005)

Finally, in Section 4, we discuss wider issues around the subject of liability driven benchmarks, including the extension of this type of mandate to schemes with more complex liabilities than the model scheme considered in Appendix D.

Potential areas for further work are set out in Appendix E.

1.3 Historical and current industry practice in relating pension scheme benchmarks to liabilities

Industry practice in terms of both valuation of the liabilities and investment strategy has changed considerably over time.

Through the 1980s and 1990s it became common practice to value the assets using a smoothed actuarial value and compare this against projected liabilities discounted using a long-term investment return assumption. Most schemes followed a balanced investment strategy investing across a range of asset classes, with the benchmark being the median or average return on a peer group of pension schemes with a similar strategy. Over time, the average proportion invested in equities by the peer groups increased significantly. This strategy proved successful during the equity bull market, creating surpluses, which allowed contribution holidays and generous early retirement packages or other benefit improvements.

Towards the end of the 1990s it became increasingly apparent that defined benefit pension schemes were no longer a homogenous group, some schemes were much more mature than others and the peer group benchmark was increasingly inappropriate for these schemes. The implementation from 1997 of the Pensions Act 1995 also highlighted the need for trustees to consider the potential mismatch between assets and liabilities.

This resulted in a trend away from peer group benchmarks to scheme-specific asset allocation benchmarks that took some account of the schemes' liabilities, with market index benchmarks within each asset class. The Myners Report on Institutional Investment in March 2001 further encouraged this trend.

However, many schemes retained a high proportion in equities. As a result, many schemes suffered severe deteriorations in their funding positions during the equity bear market from the beginning of 2000 through to March 2003.

It also became apparent for those schemes that were transferring more assets into bonds, that conventional bond market indices were not necessarily a good match for deferred and pensioner liabilities, which tended to have much longer duration and include inflation linked components.

This has led to the rise of liability driven benchmark approaches, which seek to capture the characteristics of the liabilities and represent them as a portfolio of assets in which the scheme can invest. Increasing sophistication on the part of trustees to consider new approaches and a wider range of investment instruments including derivatives have allowed the development of more precise liability hedges. In many cases, investment banks have led the way in promoting these new approaches. Increasingly pension scheme investment managers are now offering dedicated liability driven investment services to their clients.

1.4 Why should pension schemes consider liability driven benchmarks?

Although pension scheme assets are invested for the long term, short term pressures have become increasingly the focus of attention. Pension scheme deficits following the equity bear market and increasing future accrual costs caused by longevity improvements and lower long term interest rate expectations have led to the long term viability of traditional final salary defined benefit pensions being questioned. Many defined benefit schemes have matured rapidly in recent years, with a move to defined contribution provision for future accrual accelerating this, and for many schemes the liabilities are large in relation to the sponsoring company. Increased focus on market value methods for accounting costs and solvency valuations has highlighted the mismatch between assets and liabilities on those measures. Finally the planned introduction of risk based premiums for the Pension Protection Fund will further highlight the relationship between assets and scheme liabilities.

All of these factors have combined to make it important for trustees and employers to better understand the relationship between the assets and liabilities of the pension scheme over the short term. Liability driven investment approaches can help trustees and sponsors understand these relationships, and may lead to more informed decision making on investment matters. At the same time, developments in investment markets and the instruments available over the last few years have permitted increasingly sophisticated approaches to implementing liability driven benchmarks.

1.5 The choice between a liability driven benchmark approach or buying out liabilities with an insurance company

A defined benefit pension scheme can choose to buy out some or all of its liabilities in respect of pensioner members, and in certain situations deferred members, with an insurance company, to reduce or remove investment and mortality risk. This could be viewed as an alternative approach to implementing a liability driven investment strategy. A detailed comparison of the two approaches is outside the scope of this paper, however in Appendix 1 we consider the key issues faced by trustees in choosing between the insurance buyout route and a liability driven investment approach. Further discussion can be found in Richards and Jones (2004) and, in the particular context of discontinued schemes, in Yiasoumi et al (2004).

1.6 The roles of and relationship between trustees, consultants, investment managers and investment banks

Trustees have responsibility for setting investment strategy. Under the Pensions Act 1995 they are generally required to appoint one or more investment manager(s), and to seek professional advice on the purchase or sale of any directly held investments.

The trustees are required to consult with the sponsoring employer, although the employer may not dictate the investment strategy. In many schemes, there is close co-operation between the trustees and sponsoring employer in setting investment strategy, although this is not always the case.

The trustee framework for managing pension schemes in the UK means that most trustees are not investment experts. Typically trustees will seek advice from an independent investment consultant to help them determine the investment strategy. The consultant may also advise them on selection and monitoring of investment managers.

The investment manager(s) will be responsible for managing the investments against the objectives and constraints they are set. Investment managers may work with the trustees and investment consultant in agreeing suitable investment benchmarks and an approach to implementation of the strategy.

Investment banks will advise on and undertake large transactions for pension schemes, in particular derivative hedging transactions. Investment banks can deal directly with the pension scheme or can work indirectly with the trustees through their investment consultant or investment manager.

1.7 A brief note on the asset allocation process

We do not attempt to describe fully an asset allocation process, but this section gives a brief overview on one possible way that trustees and other parties may determine a strategy.

A high level analysis using an asset-liability model may be used to illustrate the risk-return trade-off and to seek a consensus on an initial split between “risk-seeking” and “matching” assets. The key decision will often be the split between equities (and perhaps other risky assets) and bonds. The split will depend on a number of factors including: the scheme’s funding level, anticipated contributions, scheme maturity (i.e. proportions of active, deferred, pensioner members), the sponsor’s covenant, the trustees’ judgement of the appropriate level of risk for the scheme, and (to some extent) the sponsoring employer’s wishes. This is sometimes called “setting the risk budget”.

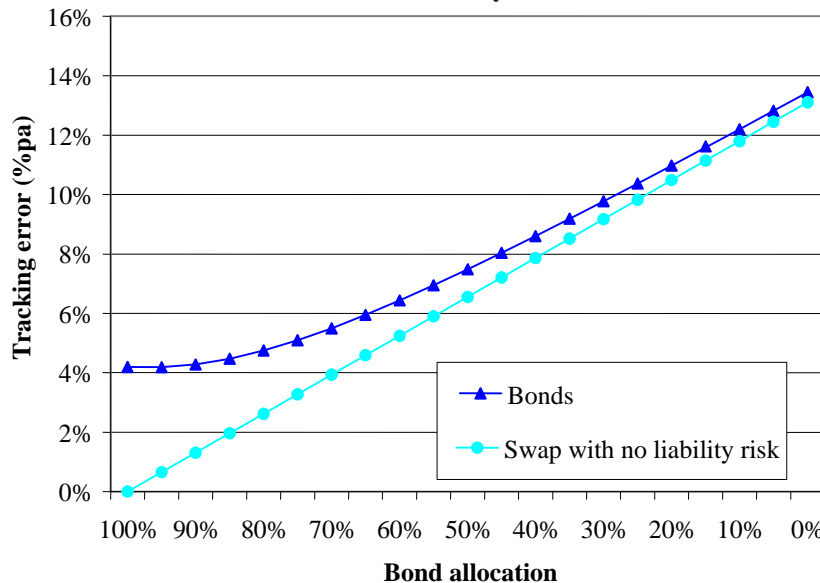
If scheme size, budgets and governance capability permit, this may then be followed by a refinement of the initial split, by inclusion of further asset classes and more detailed consideration of statistics, such as the “value at risk”, “information ratio” and “tracking error”. This could be considered “spending the risk budget” as the additional asset classes are intended to increase expected return without changing the chosen level of risk (or possibly reduce the risk without reducing the return).

For example, where the initial stage has identified an allocation to risk-seeking assets, other assets (e.g. property, hedge funds, high yield bonds, absolute return) may be combined with the equities to improve diversification.

Similarly, the “matching” bond element may be spread between index-linked and fixed interest, and between gilts and corporates. Further, the durations of the bonds should be addressed as, on detailed analysis, many bond indices may be poorly matched to the durations of the expected cashflows. Therefore, many portfolios may be unconsciously sub-optimal: taking unrewarded risks by systematically investing in bonds of the wrong duration. This paper primarily considers portfolios designed, using carefully chosen bonds and/or swaps, to closely match the expected cashflows of the whole, or part, of a scheme.

The following chart, Illustration 1.7.1, shows how increasing the bond allocation reduces risk, but does not eliminate it, as a typical bond portfolio is not a close match for liabilities. However, the use of swaps permits a more precise matching of the expected cashflows (i.e. nil “tracking error”). (Note, the chart assumes the scheme is fully-funded on a bond-related basis.)

Illustration 1.7.1: tracking error versus certain cashflows: a measure of investment risk in liability



Source: Watson Wyatt LLP

1.8 Limitations of liability driven benchmarks

In this paper we are careful to refer to matching the expected cashflows and Illustration 1.7.1 above was based on investment risks relative to the expected cashflows.

However, the liabilities are the obligation to pay the actual cashflows. Short of an insurance buyout, the differences between the actual and expected cashflows mean that strictly we cannot perfectly match the liabilities. Equities are a poor match of fixed payments, but fixed income is still a less than perfect match for unpredictable payments.

We have not attempted to analyse non-investment risk in full detail. However, a brief summary of the main non-investment risk follows, intended to give some context to the investment risk discussions elsewhere in this paper.

(a) Mortality.

This is the largest non-investment risk and effectively falls into 3 parts:

- (i) fitting given population to one or more model(s) or standard table(s)
- (ii) anticipation of future general trends
- (iii) random future experience within the scheme

Appendix C expands further on the potential impact of mortality risk, and a fuller discussion can be found in Richards and Jones (2004).

(b) Salary increases.

Future real salary increases cannot be matched by available investments. In theory, the sponsoring employer can also control this element of risk, although in practice decisions over salary increases typically do not take into account the consequent effect on pension liabilities. This is considered further in Section 4.1.

(c) Cash commutation.

This is a material risk, if commutation factors are not directly related to the underlying investments, as members have the option to crystallise over 25% of their entitlements.

(d) Transfers-out (including bulk transfers).

(e) Withdrawals from service.

(f) Retirement timing (including ill health retirements).

(g) Death before retirement.

(h) Taxation/regulation.

This would typically be an indirect effect, but could impact any of the above risks.

(i) Expenses.

Those costs of administering the scheme that can be attributed to the accrued liabilities should arguably be included in the expected cashflows and this represents a further area of uncertainty.

(j) Deferred revaluation.

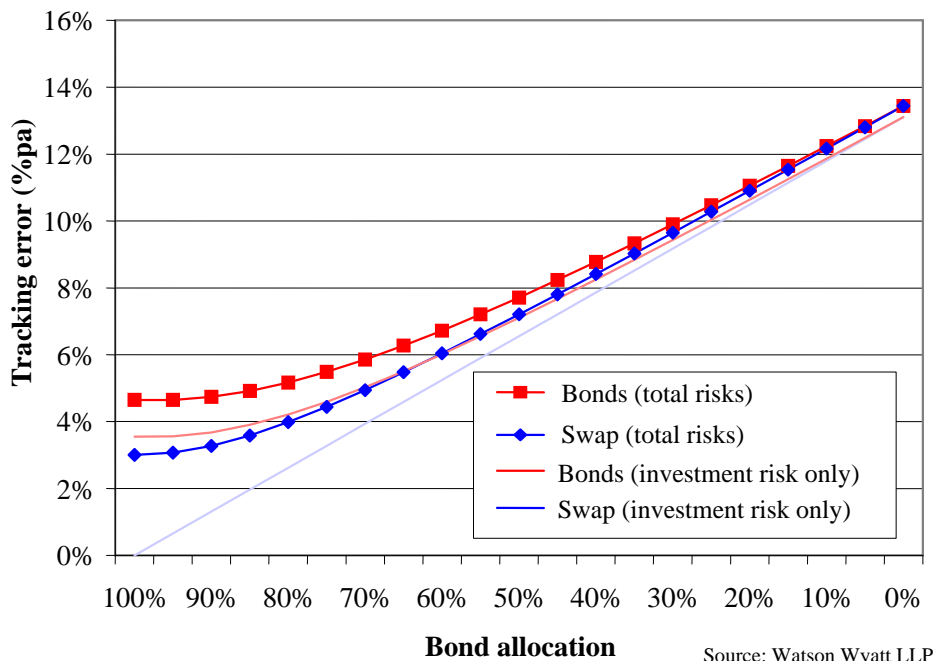
This is covered in Section 4.1 and sits on the edge of what is an investment or non-investment risk to the extent that it can or cannot be matched adequately by an investible portfolio.

In order to illustrate the potential impact of non-investment risks, in Illustration 1.8.1 we have reperformed the analysis in Illustration 1.7.1 above, but based on the tracking error versus actual, rather than expected cashflows. For Illustration 1.8.1 we have assumed

that non-investment risks might add around 3% per annum to the annual tracking error for large schemes.

Illustration 1.7.1 presumed the benchmark cashflows were certain and showed increasing bond allocations, and then refinement with swaps, materially reduced investment risk. When non-investment risks are included in Illustration 1.8.1, the benefit of precise matching is reduced. Firstly, the advantage of swaps over bonds remains but is diminished. Secondly, the benefit of bond against other assets is reduced. For example, a 100% allocation to matching bonds/swaps provide little tracking error reduction compared with around 85% allocation. The corresponding loss of expected return would therefore appear to purchase relatively little in terms of reduced risk on this measure because investment and non-investment risks are diversified. Of course, if instead we seek to absolutely guarantee the payments, full matching should be sought and reserves set aside for unmatchable risks, but the cost of this may be prohibitive.

**Illustration 1.8.1: tracking error versus uncertain cashflows:
a measure of total investment and non-investment risks in liability benchmark**



The point remains, however, that at all levels of bond allocation, risks can be reduced with closer matching (e.g. using swaps) and this might be pursued should the cost be acceptable.

Illustrations 1.7.1 and 1.8.1 assume that the scheme is 100% funded on a bond-basis. Section 4.3 of this paper comments on possible approaches for underfunded schemes.

Lastly, we note that Richards and Jones (2004) highlighted possible correlations between investment and non-investment risks. If this were the case, the illustrated risk diversification would need to be modified.

2 Types of liability driven benchmarks

2.1 Using a benchmark

The purpose of a benchmark is twofold. On the one hand it provides guidance to the manager on how to invest the assets and put risk into context. On the other hand it provides a yardstick against which to measure performance. A liability related benchmark should satisfy both of these criteria. In theory, if a fund manager is given a mandate with a liability related benchmark, the only investment risk to which a scheme is exposed should be active manager risk (arising from asset allocation and stock selection decisions taken by the manager that move the portfolio away from its benchmark). However in practice the choice of investible assets used to define the benchmark may introduce some investment risk. Also, not all schemes will continue (paying benefits as they fall due), but instead some will terminate with the payment of a bulk transfer value or insurance premium and the assets required in these circumstances may differ from the assets defined in the liability related benchmark.

2.2 Defining the liability driven benchmark

For funding purposes actuaries measure pension scheme liabilities in a variety of ways. However, in essence the funding assessment projects future benefit outgo and estimates the fund required to meet that outgo. In estimating the required fund allowance is made for future investment returns. The assumed rate of investment return is often arrived at by considering the expected return on assets invested in accordance with the scheme's investment strategy, perhaps deducting a margin for prudence, although some actuaries would use rates that are independent of the assets held. By contrast the liability related benchmark attempts to identify the portfolio of assets that matches the projected benefit outgo.

Looking ahead, we anticipate that trustees (and employers) will consider funding and investment strategy in a more integrated way, rather than as the separate exercises that have traditionally been carried out.

2.3 Liability Benchmark Portfolio ("LBP")

The paper 'Note on the relationship between pension assets and liabilities', by Speed *et al* (2003), addressed the question of how a liability related benchmark should be defined. This paper introduced the concept of a Liability Benchmark Portfolio (LBP). For a fully funded scheme the LBP was defined as "the portfolio of assets such that, in the absence of future contributions, benefit accrual or random fluctuations around demographic assumptions, the scheme maintains its current solvency level (the ratio of assets to liabilities) as economic conditions change."

We are in agreement with this paper that the LBP should take into account "the term structure of the nominal and real yield curves and the embedded options in the liabilities, for example caps and floors within the rules on pension increases" (see Section 4.1).

Theoretically a liability related benchmark should be based on a series of time specific cashflows, however simpler approaches could be taken such as defining the benchmark in terms of duration and convexity and higher order moments, or cashflows bucketed into broader bands, as discussed in Section 2.4. Either way this means the benchmark is typically defined by bond like investments with guaranteed fixed and/or inflation linked income.

In defining the LBP the Speed *et al* working party effectively made a number of assertions as to how an LBP should be described. Some of these are contentious in as much as they are not necessarily the liability that the trustees of a particular scheme will wish to match.

In particular, the LBP as proposed by Speed *et al* was based on accrued liabilities, reflecting future revaluation both in deferment and payment in accordance with the scheme provisions, but with no allowance for the effect of future salary increases. The Trustees will need to decide whether they would wish to match instead the projected benefit obligation, allowing for future salary increases for active members. This is discussed further in Section 4.1.

The Speed *et al* working party also proposed that for a scheme where solvency is below 100%, the LBP should be defined as that part of the liability that is covered through the priorities between beneficiaries of the scheme on winding up. Alternative approaches are possible, as discussed in Section 4.3.

2.4 Constructing the portfolio to meet a liability driven benchmark

Before agreeing a liability driven benchmark mandate with a fund manager, trustees should consider, in conjunction with their investment consultant and possibly, potential managers, how far they wish to go down the risk minimisation route. A balance needs to be struck between perfect matching and cost effective solutions – where any trustee board should get to on this will depend on attitude to risk as well as other factors such as the size of scheme, as some options may only be open to large schemes at an economical cost. The desire for a "perfect" hedge should also be kept in the context of other non-investments risks, as discussed in Section 1.8.

The range of liability driven benchmark options available to trustees (from simplest with significant potential investment mismatch through to the least risk and most sophisticated approaches) include:

1. Market index

Invest in bonds, benchmarking performance against a published bond index (it is arguable whether this should be categorised as a liability driven benchmark but it is worth considering as the simplistic starting point).

2. Immunised bond portfolio

Invest in a bond portfolio that has the same duration and greater convexity than that of the liabilities. The issuance of 50-year gilts and proposed 50-year index-linked gilts has made this more feasible [Debt Management Office (2005)].

This approach could be extended to match a higher number of moments of the liabilities than just duration and convexity.

3. Use of pooled bucket funds

There is a recent trend by investment managers to launch pooled funds for liability driven investment. Typically a range of these funds is offered which are designed to match cashflows for a future period. For example, a manager might launch seven fixed-interest funds offering uniform annual cashflows in years 2006-2010, years 2011-2015, etc out to years 2036-2040. Some of these pooled funds are designed to track benefits linked to RPI or LPI and can offer exposure to credit bonds. Swaps are typically used within these funds to achieve the desired cashflows, enabling schemes to benefit from the closer matching they can provide without the complications involved in directly owned swaps.

Trustees can then choose to invest in proportion of their assets in each bucket so as to match duration and broadly match the cash flow profile of their scheme. There are currently a range of approaches on offer with different trade-offs and compromises and several managers are working on funds for launch during the next year. Section 3.5 discusses some practical issues in relation to a pooled fund approach.

4. Cashflow matching with bonds.

Rather than concentrate solely on matching duration, the portfolio can be designed to match, as far as possible, with a portfolio of bonds (and bond strips). In theory, were low coupon bonds of every maturity to exist, a near perfect match could be achieved. A simple approach is to split the liability into time buckets and, for each time bucket, hold assets of the same duration of the liability duration. In practice some kind of risk optimisation will be preferable. The asset cash flows are likely to be less evenly distributed than the expected liability cashflows.

5. Cashflow matching with bonds and derivative instruments

Rather than restrict the portfolio to those bonds in issuance ‘pay LIBOR receive fixed’ interest rate swaps can be combined with cash to create synthetic bonds. This increases the universe of available instruments and provides access to payments at terms not filled by bonds. The resulting asset cash flows are likely to be less ‘lumpy’ relative to the liabilities than in method 3 above. (See Appendix D for an example based on our notional scheme). Matching of cash flows on a year-by-year, or even more precise, basis can be achieved by using just interest rate swaps (ie having no physical bonds in the portfolio).

In the following table below we have summarised the characteristics of approaches 1-5.

| | | 1)Market index | 2) Immunised bond portfolio | 3) Pooled fund buckets | 4) Cashflow matching using bonds | 5) Cashflow matching using bonds and swaps |
|-------------|---------------|---|---|---|---|---|
| Instruments | | Bonds within index | Longest dated government backed bonds | Swaps | Bond of all terms and the possibility for some strips | Bonds and swaps or a swap portfolio backed by cash |
| risks | Interest rate | <p>Benchmarking against market indices results in very poor matching for most schemes. A typical scheme may have duration of 20+ years but a long bond index duration is about 11. Typical active bond management takes duration positions of less than 2 years relative to their benchmarks but trustees using this approach could be taking short duration positions of 9 or more years (and spending a very significant part of their risk budget without good support for their apparent 'view' in interest rates).</p> <p>The approach could be more acceptable for shorter duration liabilities - e.g. pensioners with a high average age</p> <p>Initial issuance of 50 year gilts will increase duration of over 15 year gilt index by a negligible amount</p> | <p>Typically about 80% of interest rate risk can be removed through duration management if sufficiently long dated stock available e.g. Tr 4.25% 2055 gives duration of 21 years.</p> <p>Yield curve protection is poor as the portfolio is concentrated in very few stocks. Immunisation leaves a trustee exposed to non-parallel moves in the yield curve - e.g. changes in shape</p> | <p>Good out to limit of maturing of available bonds, as long as duration is still matched. Liability cashflows will probably go out beyond 50 years and the liability cashflows after 40 years may have longer duration than that of the longest bucket available.</p> <p>Holdings in other buckets may therefore need to be changed to reflect the need for more duration.</p> | <p>Good out to limit of maturity of available bonds as long as duration is still matched. Holding shorter bonds to match early year cashflows can shorten duration so some extra long bullet bonds may be needed to ensure the first moment is matched.</p> | <p>Interest rate risks fully hedged out to longest dated available (or liquid) swap</p> |
| | | | | | | |

| | | | | | |
|-------------|--|---|--|--|---|
| Inflation | Option mathematics can be used to get a theoretical optimal split between fixed interest and index-linked instruments. However since the duration is probably short the inflation duration is also likely to be short. | Option mathematics can be used to get an optimal split between fixed interest and index-linked bonds. 2% IL Tr 2035 has a similar duration to the longest liquid fixed interest gilt. | Cash flows can be split between inflation sensitive cash flows and cash flows fixed in nominal terms and matched separately using fixed and RPI buckets. LPI can also be separated out and LPI buckets used (although different caps and collars can complicate this) or option mathematics can be used to decide allocation to RPI and fixed buckets. | Cash flows can be split between inflation sensitive cash flows and cash flows fixed in nominal terms and matched separately (although caps and floors complicate matters requiring option mathematics) | Cash flows can be split between inflation sensitive cash flows and cash flows fixed in nominal terms and matched separately. LPI swaps could be used to match capped and floored increases |
| Mortality | No cover | No cover | No cover | No cover | No cover |
| Credit risk | No credit risk in a gilt portfolio but credit can be introduced by using a corporate index (although for adequate credit diversification a greater than 10 year index may be preferable to a greater than 15 year index) | In theory could use credit but there is limited diversification available in very long-dated sterling corporate bonds. | The pooled vehicle provider may offer buckets with credit or be able to introduce a credit overlay. In the LDI investment arena introducing credit through overlays (using credit default swaps) can be significantly less restrictive (ie credit positions can be taken at the shorter end if this is where credit appears attractive) | Schemes over c£80 million could construct a reasonably diversified credit portfolio, particularly in respect of shorter duration liabilities, but smaller schemes would suffer undue issuer concentration. Even for larger schemes the trade off between selecting a credit that is a good match for liability cashflows and one which is an attractively priced credit can cause complications. | Interest rate swaps may introduce counterparty risk but this risk can be almost fully mitigated through daily marking to market and appropriate controls on collateral Swaps allow the separation of the choice of credit and duration, so this approach should improve credit diversification and the selection of credit perceived to be attractive. |

| | | | | | | |
|--------|----------------|--|---|--|--|---|
| | Liquidity | Very good | Very good | Mixed. Investment into these pooled vehicles may be easy to implement from a trustee perspective but offer-mid and mid-bid spreads can be high and there may be restrictions on dealing dates. | Reasonable – getting to a high level of matching through physicals rather than derivative instruments could be achieved through extensive use of less liquid strips (liquidity is a particular issue for large schemes). | Swaps are not particularly liquid beyond 50 years and there may be uncertainty in regards to future liquidity for reversing out swap contracts (ideally an investor would wish to reverse a swap with the same party and there may be a premium for doing this). |
| | Operational | Very good – can use pooled funds | Good, although a segregated account will be required | Very good –use pooled funds | Segregated account required and some problems assessing manager performance | Best execution difficult to ascertain at less liquid long end. Maintenance of collateral account required |
| Issues | Cost (initial) | Low | Low | Can be high | May be some use of strips that are not competitively priced | Swaps depend on terms from investment banks, but typical transaction costs from 1bp-8bp of yield. Higher end of range applies for longer duration (e.g. over 30 years), inflation-swaps particularly with caps and floors and for large (e.g. £250 million +) trades. |
| | Cost (ongoing) | Low for all schemes (passive fees down to 3bp for large schemes). Ongoing transaction costs depend on need for rebalancing. | Segregated account may make this approach uneconomical for small schemes but not a costly solution for schemes over c£50-£100 million. Ongoing transaction costs depend on need for rebalancing. | Low. Typical fund management charge would be broadly comparable to a charge on a pooled cash vehicle. Ongoing transaction costs depend on need for rebalancing. | Segregated account may make this approach uneconomical for small schemes but not a costly solution for schemes over c£50-£100 million. Ongoing transaction costs depend on need for rebalancing. | Segregated account may make this approach uneconomical for small schemes but not a costly solution for schemes over c£50-£100 million. Ongoing transaction costs depend on need for rebalancing. |

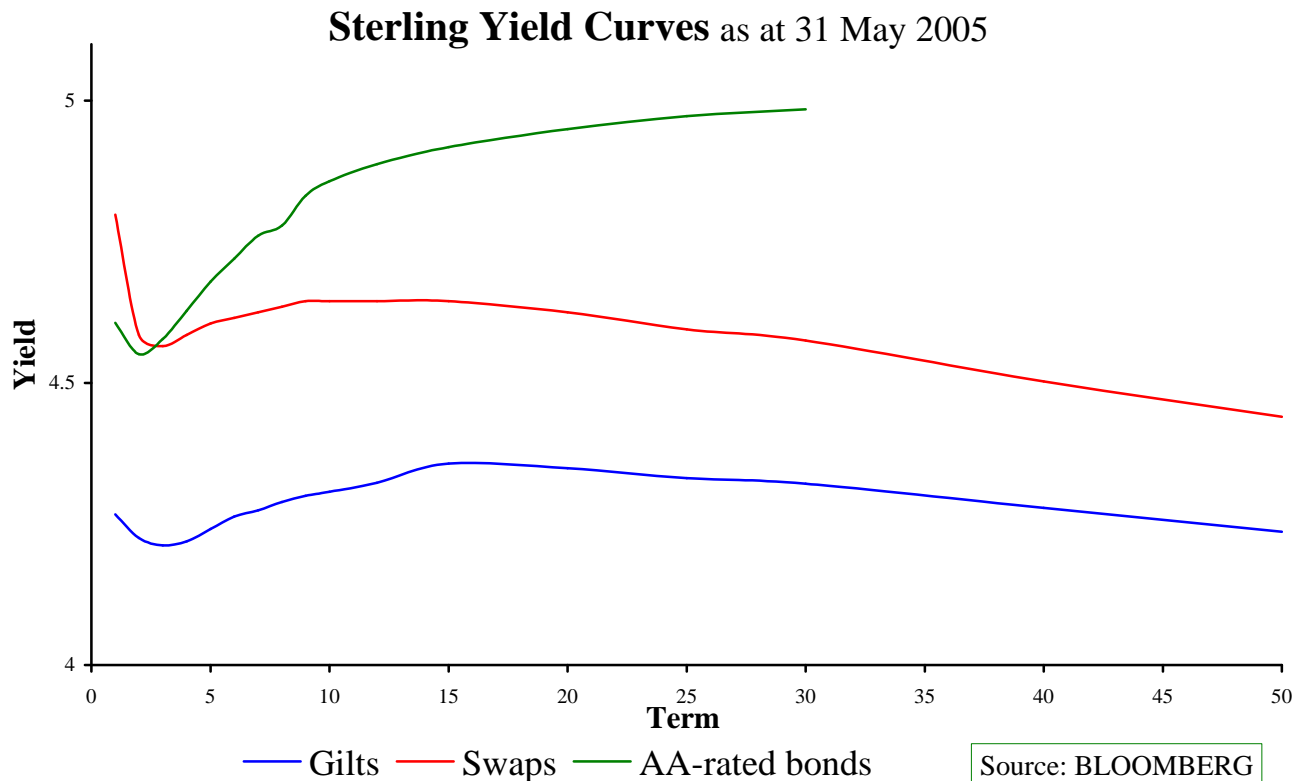
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|--|---------------------------|--------|----------------------------------|--|--|--|
| | Complexity/ monitoring | Simple | Simple but bespoke monitoring | Monitoring of performance could be complex where credit overlays are used. | Monitoring of asset cash flow profile against that of liabilities. | Monitoring of asset cash flow profile against that of liabilities. Trustee education required to understand swap use |
|--|---------------------------|--------|----------------------------------|--|--|--|

Overall, there is a wide range of possible solutions to the hedging problem, and the choice of benchmark will need to take account of the cost of the hedge and the accuracy of the hedge (in terms of cashflow matching, interest rate sensitivity and inflation sensitivity). Potentially the benchmark should also take into account the desired level of credit risk.

2.5 The current structure of the yield curve

Before discussing in a little more detail the idea of incorporating credit in the liability driven benchmark it is worth taking a moment to consider the current shape of the yield curve.

Illustration 2.5.1 – Comparison of yield curves for gilts, swaps and AA rated sterling credit



The yields available at the very long end of the yield curve are lower than those available at shorter maturities (although the downward slope of the curve at the longer end is less than it was before the recent issue of the 50 year gilt). Trustees and their advisors may like to consider whether this is a phenomenon driven by supply and demand or is a fair reflection of future interest rate expectations. The funding implication for investing in a lower yielding bond portfolio should be considered.

2.6 Allowing for credit risk/counterparty risk in the liability driven benchmark

Any of the approaches in Section 2.4 can allow for credit risk in the benchmark. A question exists as to the extent to which it is appropriate for any credit risk to be incorporated into a liability driven benchmark. The stance taken in the Government's latest legislation appears to have changed an employer's commitment to meet its pension promises from "best endeavours" to an obligation to pay under any circumstances short of insolvency.

Discounting the expected liabilities at a risk-free rate would seem to indicate the gilt curve is the appropriate yield curve off which to price the cashflows, and that it is the return on these benchmark gilts against which the managers performance should be assessed.

However it is common practice for the swaps curve to be used to price the liabilities. The swaps curve has the advantage that a highly liquid swap market exists out to 40 years with trading volumes significantly in excess of those in the gilt market. Nevertheless, a premium exists on the swaps curve over the gilt curve. Arguably this may reflect a negative liquidity premium on gilts rather than a credit risk premium swaps. Consequently, in the UK life sector, the actuarial profession has proposed a risk-free rate between gilts and swaps (see Guidance Note GN45) and current practice is to use a rate of gilts + 10 basis points, which currently equates to roughly swaps - 15 basis points.

Trustees wishing to have their interest rate risk managed but gain exposure to credit could set a benchmark without credit and an outperformance target that encourages the manager to take credit positions when the market appears attractive. However the trustees may wish to take a strategic credit position as there is a widely held view that credit is attractive to pension schemes as part of the credit yield compensates for liquidity, which is not required by a long term investor such as a pension scheme. Such trustees may like to incorporate credit into their liability driven benchmark.

The use of corporate bonds as part of the portfolio broadens the choice of matching assets and so could facilitate closer cashflow matching to the liabilities using cash assets. However, one difficulty is that the optimal portfolio of bonds to match the cashflows of the liabilities will not necessarily be optimal in terms of the choice of credit exposure. The use of swap overlays, as discussed in Section 3.2 Approach A, can allow both cashflow matching and credit exposure to be separately optimised.

Section 4.4 discusses further the incorporation of risk into liability driven investment.

3. Implementing liability driven benchmarks

3.1 Introduction

In Appendix A of this paper we include, with the permission of the author, Appendix A of the paper "Risk Management in a Fair Valuation World" by Kemp (2005). This contains an excellent discussion of the implementation of liability driven benchmarks and we have not sought to duplicate this work.

In this Section we draw out and expand on three specific issues that, in practice, can present practical barriers to implementation:

- Responsibilities for defining the benchmark
- Legal requirements for use of swaps in liability driven benchmarks
- Counterparty risk and collateralisation

The "Swaps Made Simple "and "Fixed-Income Derivatives Made Simple" guides produced by the NAPF (2005) also contains useful, and easy to understand, information on the practicalities of using swaps in a liability driven benchmark.

3.2 Responsibilities

In the Working Party's experience, one contentious issue is who takes responsibility for defining the liability driven benchmark, and in particular for any tracking error between the benchmark and the liabilities resulting from investment risks.

If not clearly defined at outset, this is an issue that may lead to disagreements in future if there proves to be any significant tracking error from an imperfect match.

There are two distinct approaches that might be taken to defining a liability driven benchmark. The difficulties typically result from mandates that fall between these extremes.

Approach A: Management against investible benchmark

The fund manager agrees with the pension scheme and investment consultant on an readily investible benchmark, for example a portfolio of gilts and index-linked gilts, against which performance can be measured. This may, but need not, closely resemble the liabilities.

To the extent that better matching is desired an overlay (e.g. using swaps, or less

liquid bonds) may be agreed between all parties and used to transform the interest-rate/FX/inflation risks of the investment manager's benchmark to the liability profile. The overlay may be rebalanced from time-to-time, for example as liabilities evolve, but is not actively managed.

The fund manager's performance is then measured actively against the benchmark, but does not include the performance of the overlay.

This is the main focus of Appendix A and most investment managers currently prefer it to approach B below.

Approach B: Benchmark based on expected liability cash flows

The fund manager is given the liabilities as a benchmark for measuring performance. That is, performance of the asset portfolio is measured against the change in the value of the projected cashflow stream of expected liabilities.

The fund manager and consultant will need to agree on the expected cashflow stream representing the liability at periodic intervals, e.g. annually. The investment manager would be responsible for matching the change in the value of the liabilities, over the following period, resulting from interest-rates and inflation, but not any change resulting from e.g. demographic factors.

They will also need to agree on the basis for recalculating the value of these cashflows at the end of the period. This will typically use a defined market curve (e.g. gilts or swaps), and incorporating inflation, with caps and floors, as appropriate (e.g. based on index-linked curve breakevens or the inflation swap curve). This can raise practical issues in respect of the method of measuring performance, particularly where there is not a market standard source of data - e.g. for inflation swaps.

The fund manager has the discretion to use swaps and inflation swaps as part of the portfolio to help closely match the liability stream, and the performance of any swaps is included in assessing overall performance.

This is often the preferred solution for the fund/consultant as this puts the onus to match liabilities, and any tracking error relative to liabilities, on to the fund manager.

It is less popular with most fund managers as it increases their unrewarded tracking error, and so has a negative impact on expected performance ratios.

However, a number of fund managers prefer to manage against such a benchmark, in particular where they consider themselves to have strong skills in managing complex risks, including the use of derivatives.

This is also discussed in Appendix A paragraph A.6.

Approach A is more flexible and transparent, particularly where the fund wishes to take active risk against the benchmark. There is no need to constrain the physical benchmark to closely resemble the liabilities. For example, for a portfolio permitted to invest in credit bonds, allowing a shorter-duration or FX-denominated benchmark increases diversification and the fund manager's ability to add value by active investment choices. The resulting interest, inflation and FX risks can be hedged by the passive overlay.

Approach A also allows access to a wider range of specialist fund managers, who may not be able to implement derivative based solutions, in which case any swap overlay may need to be managed separately.

Approach B requires the fund manager to be willing and able to manage against such a benchmark.

The distinction between A and B is most acute when the liabilities are not close in form to readily investible assets, for example ultra-long duration liabilities, or liabilities with complex inflation linkages (see Sections 4.1 and 4.2).

For example, consider LPI annuities in payment, linked to inflation but with an annual 0% floor and 5% cap, which can not be fully matched with a static combination of conventional and index-linked bonds. Under the two approaches:

- A. The investment consultant would derive an appropriate portfolio of gilts and index-linked gilts to approximately match the liabilities (for example, using the Black Scholes method to derive a delta hedge). The investment manager's performance would be measured against this benchmark and would not be penalised for any inaccuracy in the derivation of the hedging portfolio

The investment consultant and fund might decide to invest in an overlay to achieve closer matching. For example the fund could enter into a swap to pay RPI and receive LPI linked cashflows (in current conditions the fund would receive LPI plus a small yield pick-up), and then the investment management mandate could be based purely on index-linked bonds.

- B. In this case, the investment manager would determine the appropriate mix of physical assets and swaps to hedge the liabilities. If the investment manager chooses not to buy a static inflation-swap hedge they would be responsible for dynamically managing the mix of cash bonds to match the LPI liability. The investment manager would be responsible for the performance of the hedging strategy.

Performance measurement under approach B can be very complex as the benchmark would need to reflect the change in market value of the inflation options (with cap and floor) to ensure that the fund manager has an incentive to properly manage this risk.

3.3 Legal requirements for use of swaps in liability driven approaches

An interest-rate or inflation-swap is an over-the-counter (OTC) legal contract, typically between the pension scheme and an investment bank.

The first legal prerequisite to use swaps is to ensure that the pension scheme and trustees are authorised to use swaps, or not prohibited from doing so. The Working Party is aware of cases where this has required a modification to the existing Trust Deed. The Statement of Investment Principles may also need to be amended.

The counterparties then need to agree on the legal documentation for the trade. Swaps are normally documented under an industry standard legal agreement produced by ISDA (the International Swaps and Dealers Association), and the collateral arrangements (see below) are documented under an accompanying CSA (Credit Support Annex).

There are standard versions of the ISDA and CSA documentation - the so called Master Agreements, published by ISDA, but these are supplemented by Schedules specifically agreed between the counterparties, defining some of the parameters and modifying some provisions. Pension schemes agreeing such documentation will require legal advice.

To date, the ISDA and CSA has usually been individually agreed and negotiated between the pension scheme and the investment bank. This can be relatively time consuming, but may be preferred by larger funds and self-administered schemes.

For pension schemes with large corporate sponsors, the corporate will often be an active user of swaps. It is estimated that 95% of the top 500 global companies use swaps and derivatives [NAPF (2005)]. The Working Party is aware of cases where the treasury and finance departments of the corporate have assisted with the legal and other practical issues associated with implementation of swaps.

Recently, another approach has developed, involving the use of "umbrella ISDAs". The investment manager negotiates suitable ISDA and CSA terms with investment banks that can be applied for all of its clients wishing to use swaps. The pension schemes each agree to be bound under the terms of the umbrella ISDA and CSA, and the investment manager then deals with the investment banks directly, as agent for the pension schemes.

The umbrella ISDA removes the requirement for individual negotiation between each fund and investment banks. Each pension scheme is still, legally, entering into a contract with the bank, but has effectively delegated the responsibility for negotiating legal terms to their investment manager.

The investment manager is also delegated authority to transact swaps on behalf of the pension scheme, avoiding the need for each specific trade to be explicitly approved by the trustees. This is similar to the way that the investment manager would transact other investment business for the fund. The investment banks will need to ensure that the investment manager has the proper authority to act for the pension scheme.

The umbrella ISDA approach appears to offer significant advantages for pension schemes and their investment managers.

3.4 Counterparty risk and collateralisation

One major concern for pension schemes entering into swap contracts is the exposure that they take to the banking counterparty. Equally, the bank will need to consider its credit exposure to the fund.

Normally, swap contracts are written so that the value of the contract is zero at outset - i.e. the market value of the fixed / inflation linked flows is equal to that of the floating / nominal flows. However, as yields and inflation expectations change over time the swap will have a value to the pension scheme, or to the bank.

The resulting credit exposure is normally managed by collateral process. The counterparty who is out-of-the-money provides security in the form of collateral to the party who is in-the-money. This is similar to variation margin for exchange-traded derivatives.

Collateral is normally in the form of either cash or high-quality securities (e.g. government bonds). Securities with a lower credit rating will be subject to a haircut when assessing the amount that needs to be set aside. The collateral will typically be held in a separate earmarked account with the custodian.

Collateral arrangements have become an industry standard across the over-the-counter derivatives industry. The ISDA Margin Survey (2004) reported that there were an estimated 54,000 collateral arrangements in place, involving a total collateral pool of \$10 trillion, with 90% of all OTC interest-rate derivatives covered by collateral arrangements.

The majority of collateral arrangements, and all those for pension schemes in the Working Party's experience, are governed by standard CSA documentation. Further details can be found in ISDA (2005).

When agreeing the CSA, a number of defined parameters will be agreed regarding the operation of the collateral, such as the Threshold, Minimum Transfer Amount, Rounding Amount and the Valuation Dates. These parameters control the frequency at which collateral is exchanged and the amount of collateral that is posted.

- At each Valuation Date the mark-to-market value of the swap is calculated and agreed.
- Any mark-to-market exposure below the Threshold is not collateralised.

- Any exposure above the Threshold not covered by existing collateral requires a transfer of collateral.
- However, for practical reasons, collateral is only transferred if the amount required exceeds the Minimum Transfer Amount.
- Finally, the amount of collateral transfer is rounded according to the Rounding Amount (e.g. £10,000).

A small residual exposure remains, in particular for any exposure between the last Valuation Date and default, and for any threshold or minimum transfer amounts. There is a trade-off between minimising credit risk (low thresholds, minimum transfer amounts and rounding, frequent valuation dates) and practical convenience for both parties (avoiding frequent transfer of small amounts of collateral).

In practice, to date, pension schemes have proved to be very conservative in their choice of collateral arrangements, for example typically requiring zero Thresholds so that there is no systemic uncollateralised exposure. Minimum Transfer Amounts for larger funds (£500m plus) have typically been set in the range of £100,000 - £1 million. This contrasts to terms typically agreed by life offices using swaps to hedge their annuity portfolios, where Thresholds have often been set at £10 million or above, depending on the credit rating of the two counterparties.

Valuation dates, at which collateral is transferred, range from daily in some cases, to weekly or monthly, largely depending on the administrative capabilities of the pension scheme's collateral manager.

The small residual counterparty risk can be further mitigated by a two way posting of initial collateral from each party to the other, similar to initial margin in exchange-traded contracts. In a CSA this is referred to as the Independent Amount, since it is posted independently of the actual mark-to-market exposure, but in practice this approach has not to date been used by pension schemes.

Overall, collateral arrangements provide a significant reduction in counterparty credit exposure. The pension scheme will need to ensure that its custodian is able to deal with the administration required. Increasingly, a number of investment managers are providing collateral administration services, particularly under an umbrella ISDA arrangement.

3.5 Pooled liability driven investment funds

Another recent alternative is for pension schemes to use the newly developed liability driven investment pooled funds offered by a number of investment managers, as discussed in Section 2.4.

In this case, the pension scheme does not invest in derivatives directly, and hence does not need to enter into ISDA and CSA agreements. Collateral arrangements will also be the responsibility of the investment manager rather than the pension scheme.

However, the pension scheme benefits from a reduction in operational costs, and may benefit if the investment can achieve keener pricing than a fund dealing on its own. Hence this approach is likely to be particularly suitable as an introduction to liability driven investment, and for smaller pension schemes.

Pooled fund solutions are a developing area, and the advantages and disadvantages of the available products would be a useful area for future research.

4 Wider issues

4.1 Incorporating active and deferred liabilities within a liability driven benchmark

Precision in liability matching is more difficult for active or deferred liabilities, because non-pensioner liabilities tend to be longer-dated and the cashflows are forward starting. Furthermore, there is a greater level of non-investment risks as discussed in Section 1.8, and hence precise cashflow matching may be attractive from a risk/reward perspective. Nevertheless, a liability driven investment approach can still be used to reduce the investment risk against the liabilities.

To recap from Section 1.8, on the non-investment side, there may be uncertainties about when the benefit payments are expected to commence, the amount of benefit at retirement, and the nature of that benefit (pension/lump sum), which are not susceptible to an investment solution. The following discussion relates to the increases in the benefit up to retirement, and whether there are investments available to match this aspect of the liability.

(a) Statutory revaluation of deferred pensions

UK legislation requires minimum increases in deferment of RPI with a cumulative cap at 5% p.a. and floor at 0%, which is different to the increases applied to pensions in payment where inflation caps and floors are applied on an annual basis (see Section 4.2).

As a consequence deferred pensioner revaluation depends on when the members became a deferred member (left employment) and when they expect to retire. This would give a matrix of cohorts of members with different pension increase characteristics.

Due to the forward starting and long-dated nature of the liabilities, swap overlays (see Section 3.2) may have a greater role to play to improve the matching provided by bonds.

(b) Salary increases for active members

Under final salary arrangements, members' accrued benefits are linked to individual future salary progression.

Pension scheme trustees adopting a liability driven benchmark will need to consider whether they wish to base this on the liability for active members on an ongoing basis, allowing for future expected salary increases, or instead on a discontinuance basis, based on salary increases to date, plus future revaluation consistent with deferred benefits.

The rationale for the traditional approach, considering projected future salary increases, is that this is the benefit that the pension scheme expects to pay. The rationale for the alternative approach, considering the liability based only on salary increases to date, is that increases in the pension liability due to future salary increases are subject to

management discretion and hence should not be liabilities at the current point in time, but instead should be taken into account only at the point the salary increase is awarded.

If the discontinuance liability is used, then actives can be treated in the same way as deferred members.

If the liabilities to be matched are salary linked, then there is no perfect hedging asset. The best hedge is likely to be index-linked gilts, assuming salary increases are modelled as inflation plus an allowance for expected real salary growth.

For a more detailed discussion on the matching of salary related liabilities see Exley, Mehta and Smith (1997), Smith (1998) and Cardinale (2004).

In practice, schemes are likely to make simplifying assumptions in designing a hedge for active and deferred members because the extra work and cost in trying to hedge accurately, given the significant uncertainties, is likely to outweigh the potential benefit.

4.2 Different types of inflation increases

Index-linked gilts and inflation swaps can be used to hedge liabilities that are linked to RPI inflation (plus corporate index-linked bonds if available). However, in practice, the RPI linkage in index-linked gilts does not precisely match that offered by the pension scheme.

RPI linked pensions in payment typically have a 0% floor, that is pension payments do not decrease in nominal terms. Index-linked gilts in the UK do not floor the RPI indexation at 0%, so that coupons and principal payments would reduce if deflation occurs. To provide this floor, via the inflation swap market, costs of the order of 10bp of yield in current market conditions (May 2005).

Many pension schemes also apply Limited Price Indexation in payment, whereby the inflation-linked pension increases are capped at 5% per annum. In current inflation swap market conditions (May 2005), LPI liabilities, with a 0% floor and 5% cap, are cheaper, by around 5bp of yield, to hedge than RPI liabilities with no cap or floor.

For liabilities that are linked to inflation with a cap and/or a floor, there are two main approaches.

Firstly, the pension scheme could purchase a bespoke swap from an investment bank. This would exactly match the liability. However, the bank would include a contingency margin in the swap, which is likely to be higher than for a plain vanilla interest rate or inflation swap. That contingency margin may be hard to quantify due to the lack of an active market from which to measure mid-market pricing. The margin charged by the bank will reflect the complexity of the bespoke swap and the amount of work and cost involved for the bank in hedging their exposure, including whether the particular bank has an offsetting position available to it at that time.

Alternatively, the investment manager could try to hedge the liability dynamically. The initial hedge would be a mixture of fixed and inflation linked exposure (bonds and/or swaps) of appropriate duration, and the hedge ratio would be determined from market expectations of future inflation levels and volatility. The hedge would need to be monitored and rebalanced if market expectations of future inflation changed significantly, or significant tracking error could result. For example, the hedge might be rebalanced annually.

The dynamic hedging solution is likely to be initially cheaper than buying a bespoke hedge if the investment manager has the systems in place to manage the hedge, but a comparison should take account of the cost of ongoing trading should inflation expectations change. The bespoke hedge also protects the fund against changes in volatility (which might increase the cost of dynamic hedging).

A third possible approach would be to invest in the market for corporate LPI bonds (e.g. those issued by Tesco). The difficulty with this approach is that the market is currently very small and offers relatively limited diversification. Further not all pension schemes have the same LPI exposure – for example a number of schemes have floors on inflation above 0% (e.g. 3%), lower caps (e.g. on GMPs) or do not apply a cap to pension increases.

The topic of hedging complex inflation linkages is discussed further in Palin and Speed (2003).

4.3 Schemes with less than 100% solvency

Where a scheme is very significantly underfunded, the risks relating to the payment of deficiency contributions by the employer may substantially outweigh the risks relating to matching of the existing assets to the liability flows. The trustees' main focus may then be on increasing security rather than liability driven benchmarks.

For a scheme where the solvency is below 100%, Speed *et al* (2003) defined the Liability Benchmark Portfolio as that part of the liability that is covered through the priorities between beneficiaries of the scheme on winding up, i.e. the liabilities that the scheme can afford to pay on wind up based on its current assets. Closely matching the LBP on this

basis would ensure that these priority benefits would remain fully funded under fluctuations in investment conditions. However, it should be noted that the Government has frequently changed the statutory priority order in recent times, so that this may not prove to be a robust approach. Following implementation of the 2004 Pensions Act, the Pensions Protection Fund benefits (after allowing for expenses and money purchase benefits) have become top priority on winding up in the case of insolvency, although it is not clear how any residual assets should be apportioned.

Under this approach, the deficit will typically grow as interest rates fall. Firstly, the value of liabilities exceeds that of assets, so that the deficit would grow in monetary terms even if the assets were matched to the liabilities. Secondly, the overall deficit will grow in monetary and percentage terms because the priority liabilities, and hence the matching assets, will typically be of shorter duration than the total accrued liabilities, since, for example, pensioner benefits are given priority on discontinuance.

In our Working Party's opinion, while this is a potentially sensible strategy, a number of alternatives are possible, depending on the preferences and objectives of the trustees and other stakeholders. In particular, the trustees may prefer to protect solvency measured against the total accrued liabilities for all members, and so use these liabilities in defining the liability driven benchmark.

The trustees could then allow for the future contributions to restore the deficit, as agreed under the scheme specific funding standard. This "asset" itself has a cashflow profile, which can be factored into the analysis of the liability driven benchmark for the existing invested assets. A full asset-liability analysis involving future contributions should also consider the risks associated with these cashflows. The risk of sponsor default due to insolvency could potentially be protected with a credit default swap, but this will not protect against a change in the sponsor's funding philosophy or the size of the deficit.

If the trustees do not wish to take account of the future deficit contributions, then the value of assets will be less than the value of the expected liabilities the trustees hope to match. As alternatives to matching the priority liabilities, the trustees could then either:

- Choose to base the liability driven benchmark on the cashflow profile of the total accrued liabilities, scaled down to match the amount of assets available. The percentage funding level will then be protected (*), but as assets exceed liabilities, the deficit will grow in monetary terms if interest rates fall.

* NB The percentage funding level will inevitably fall as benefit payments are made, since 100% of the benefits are paid as they fall due.

or:

- Design a strategy to stabilise the monetary value of the deficit. This will require an asset benchmark of longer overall duration than the liabilities. Theoretically the pension scheme should go short cash (which has no duration) equal to the size of the deficit and use this to increase the assets that can be allocated to the cash flow

matched portfolio: in practice, this will be achieved with an unfunded swap overlay or the use of bond futures.

Finally, the trustees may consider investment in assets expected to produce higher returns as part of their strategy to reduce the size of the deficit. For example, short to medium dated cashflows might be closely matched by assets, with long-dated cashflows backed by performance assets expected to generate sufficient returns to ultimately achieve full funding. The trustees may also give out a benchmark requiring the manager to outperform, rather than match, a liability driven benchmark, where the anticipated outperformance itself would help restore the deficit. Such mandates are discussed further in Section 4.4.

4.4 Adding investment risk relative to the liability benchmark portfolio

As stated in Section 1.1, in this paper we have focused on a liability driven benchmark defined as an investible portfolio of assets constructed to closely match the expected liability cash flows of a pension scheme and minimise investment risks. However in a wider sense, liability driven investment arguably embraces any approach that takes account of the nature of the liabilities.

In particular, the label of liability driven investment is often extended to strategies that aim to consistently outperform the liabilities by taking investment risk, where the risk is measured relative to the liability benchmark portfolio.

There are two main sources of returns that can be used in different ways to give the desired level of outperformance and risk:

- Market exposure (Beta): This exposure is expected to produce unconditional returns – in the long run risk in a particular asset should be rewarded with higher returns, the expected additional returns being a compensation for the additional risk. Examples of this are an equity index-tracking fund or a passive exposure to a credit index.
- Active manager exposure (Alpha): Here the reward gained from this exposure is conditional on the manager's skill. For example, an actively managed equity fund, or actively managed currency overlays.

A liability driven benchmark can be combined with active investment management just like any other benchmark. There are a number of different ways this can be achieved, depending on the target outperformance, tolerance for risk against the liabilities, and range of investment opportunities that are permitted.

- Active management of bonds/strips/swaps relative to the liability driven benchmark, via taking conscious duration or inflation positions (e.g. a view on long-dated yields) or incorporation of credit risk

- Using a passive matched portfolio and adding alpha / beta separately:

- Portable alpha

Invest fully into the liability benchmark portfolio and add the alpha that was generated on other types of assets (e.g. market neutral hedge funds, active currency overlays).

This alpha could be transported using futures or other derivative overlay strategies.

For example, the beta risk in an actively managed equity fund aiming to outperform the FTSE can be hedged using FTSE futures, and the resulting alpha added to a portfolio based on a liability driven benchmark.

Most active absolute return strategies, e.g. hedge funds, will target cash + x% returns, which can then be hedged relative to liabilities for example using a swap overlay

- Adding Beta

Invest part of the portfolio in riskier assets such as equities to generate outperformance. The remaining part of the portfolio will be invested in the liability benchmark portfolio, for which similar options exist as for underfunded schemes (see Section 4.3). For example, the liability driven benchmark can be geared up so that the exposure to interest rates, inflation etc is the same size as the value of the liabilities.

- Adjusting the existing portfolio to improve tracking error relative to the liabilities. For example, the fund can seek to protect against exposures to investment risks such as interest rates or inflation within the liabilities, but without attempting a close cashflow match. One strategy is to add a liability overlay to an existing portfolio of assets.

A more crude strategy is to devise an asset allocation that is expected to deliver a long-term target return of liabilities + x%, where x targets high outperformance e.g. 3% per annum, but without significant management of the short-term tracking error between assets and liabilities. The trustees will retain most of the cashflow mismatch and inflation risk, but will try to minimise the expected volatility of returns by diversifying their sources of returns as much as possible. Such approaches are on the fringes of liability driven investment.

Ultimately, the approach will depend on:

- Integration between the investment strategy and the funding plan, in particular the return requirement of the fund relative to risk free rates, and the appetite for risk.
- The definition used for liability matching (e.g. duration matching, close cash flow matching, or just targeting a long-term rate of return of e.g. liabilities +3%).
- Scheme rules, trustees' comfort factor / familiarity with the instruments used (e.g. ISDA agreements - see Section 3.3), their conviction in some of the vehicles used (e.g. hedge funds) and possible liquidity needs. Trustees may receive support from the corporate in implementing more complex strategies, e.g. the corporate treasury of large companies are likely to be familiar with the use of swaps (see Section 3.3).
- Size of fund: larger funds will have more options in terms of using more sophisticated strategies such as portable alpha and swaps as they are better placed to cover the implementation, ongoing management and monitoring costs.

Appendix A – Practicalities of liability driven investment

The content of this Appendix represents the entirety of Appendix A, Liability Driven Investment For Defined Benefit Pension Schemes, of Malcolm Kemp's paper Risk Management In A Fair Valuation World, as presented to the Institute of Actuaries, 25 April 2005, with acknowledgement to the author.

A.1 A Typical Structure (for a U.K. Defined Benefit Pension Scheme)

A.1.1 There seems to be growing interest in the concept of *liability driven investment* for U.K. defined benefit pension schemes. Large mature schemes, with a greater bond focus, typically seem to be more interested in this type of investing than less mature, more equity focused, clients.

A.1.2 There are several different ways in which a liability driven investment portfolio might be structured. Perhaps the simplest involves two parts:

(a) *An underlying physical component*, typically consisting of an actively managed bond portfolio chosen, in broad terms, to look like the relevant liabilities. For example, if the liabilities are partly fixed in monetary terms and partly linked to movements in the Retail Price Index (RPI) (in other countries, the Consumer Price Index (CPI)), then it might incorporate some fixed interest and some index-linked bonds.

(b) *A swaps overlay component*. This would typically consist of one or more *swap contracts* (or other similar derivatives) that involve the pension fund giving up one set of future cash flows (e.g. ones like those arising from the portfolio in (a)), and receiving, in return, another set of future cash flows (e.g. ones more closely matching the relevant liabilities). Precisely how these swaps might be structured can vary. For example, there might be one swap that pays away to the bank cash flow akin to that arising from the portfolio in (a), in return for interest payments on some notional principal linked to prevailing LIBOR cash rates. There might then be a second swap that paid away this LIBOR cash flow in return for a cash flow that more closely matched the pension fund's expected liability outgo. Or there might be several swaps on each side that handled different parts of the cash flow (e.g. differentiating by term or by liability type). Or, all of the cash flows might be wrapped up in a single overarching swap.

A.1.3 The concept is similar to the actuarial theory of matching. Indeed, if the liabilities are short enough and the trustees want a passively managed low risk approach, then (b) might become superfluous and (a) might be merely involve a more traditional cash flow matched portfolio using, say, gilts.

A.1.4 The core "new" idea is the use of swaps or other similar derivatives. They are used because the liabilities are, typically, of too long duration to be matched merely using physical bonds. So, you need a 'synthetic' method of artificially lengthening the duration of the assets if you do not want to be exposed to the risk that very-long-dated yields will fall more than you expect.

A.1.5 If the liabilities are RPI linked (or contain inflation-linked characteristics such as Limited Price Indexation (LPI)), then the same overall concept is still applicable. The only difference is that the cash flows that the swaps pay to the pension fund need to include these features, i.e. they need to involve the investment banks selling *inflation* to the pension fund. Of course, banks typically want to hedge their exposures. So, they will be on the lookout for other market participants (e.g. utility companies or PFI projects) prepared to sell them inflation. The two sides do not need to be in identical form (e.g. one might be strictly increase in line with the RPI, the other might be more LPI in nature). The ‘art’ of good derivatives intermediation is to be able to access both sides of the flow, make a good return between the two and to keep the inevitable residual mismatches well controlled and hedged (and to charge an appropriate spread for carrying this risk).

A.2 *The (Typically Bond Based) Core Element of such a Structure*

A.2.1 An important advantage of the above structure is that it divorces the managing of the ‘core’ asset base from the ‘bespoke-ness’ needed to achieve a close match to the liabilities. The core can then be managed in a practical manner, e.g. along the lines of a manager’s standardised investment process against some relatively standard benchmark, offering potential economies of scale.

A.2.2 The precise structure of the core element can still express trustee preferences, but these preferences can now primarily refer to the assets in isolation, rather having simultaneously also to cater for the precise shape of the liabilities. For example, the core element might eschew gilts in favour of a greater proportion of less well rated credits. This might be because the yield spread of such bonds over gilts is believed by the trustees to over-compensate the holder for the likely future default loss experience on such bonds on the grounds of liquidity criteria [see Section 10 of Kemp (2005)]. It can also incorporate a wider range of assets. There are relatively few long duration bonds in either the government debt or corporate bond markets.

A.2.3 It is not necessary for the core component to be exclusively bond orientated. It could involve *portable alpha*. Nowadays swaps come in a very wide variety of forms. It is now possible to swap almost any sort of return stream, property-like, equity-like, bond-like, cash-like or inflation-like, into any other sort of return stream, embedding into the swap, if you so wished, caps, floors and other option-like characteristics. So, if you have confidence in a given active manager’s skill at adding value it can be in any asset class you like and you can still ‘port’ this added value onto a liability orientated benchmark merely by swapping the return on the relevant active manager’s benchmark into the return on the benchmark you set by reference to your liabilities.

A.2.4 However, whether such refinements are likely to be appreciated by most sets of trustees is less clear to me. A few asset managers do offer portable alpha products, but take-up to date has been relatively limited, perhaps because of the difficulties involved in educating trustees in the concepts involved (or in being sure that there is no leakage of value by the porting process). Also, one can argue that the swap contracts might be more keenly priced if they are swapping similar sorts of return streams. So, all other things

being equal, if your desired cash flows are akin to fixed or inflation-linked bonds (just rather longer than is easily available in the physical market place) then starting with similar sorts of cash flows may be preferable.

A.3 *The Swaps Element of such a Structure*

A.3.1 Divorcing the core physical portfolio from the derivatives overlay helps to clarify who is responsible for what decisions. The following parties are involved and would typically have the following responsibilities:

(a) The *trustees* carry ultimate legal responsibility for the fund. They would be responsible for choosing who manages the core element and the swaps overlay. In the above structure, they would also be responsible for instructing the investment manager when to execute exactly what swap transaction (although in practice there would have been prior liaison with the investment manager in choosing how best to frame these instructions).

(b) The *scheme actuary* would normally prepare any required liability cash flow projections, and update them as necessary at regular intervals. See below for what such projections might contain.

(c) The *investment consultant* would normally advise the trustees on overall investment strategy, on fund manager selection and on how to monitor the fund manager and measure the manager's performance. Together with the actuary, he would advise on exactly what liabilities to match (e.g. should it include pensions in payment, deferred pensions and/or actives' liabilities?).

(d) The *fund manager* is likely to be responsible for managing the underlying bond portfolio and for actual implementation of the swap transactions. The role in relation to the swaps overlay could perhaps best be classified as 'execution only' in the sense that the fund manager would probably help draft up any instructions formally given to it by the trustees and/or investment consultant, but otherwise the swap portfolio would be 'non-discretionary'. This would be in contrast to the core physical portfolio (which would, most typically, involve discretionary active management). The fund manager would most likely provide education to the trustees, views on transaction timing and valuations of the individual swaps. The fund manager would also most likely arrange for the collateralisation of the swap portfolios.

(e) The *investment bank* would be the trustees' actual swap counterparty, i.e. the entity whose balance sheet would honour the contractual obligations in any given swap transaction. In principle, trustees (or their consultants) could deal directly with such banks (subject to any overriding requirement on the trustees to avoid 'day-to-day' investment activity if they are not FSA regulated). But in practice, banks' derivatives desks are remunerated on a transaction-orientated basis. This is not obviously conducive to acting in the best interests of the trustees. It is most likely that the trustees would delegate choice of swap counterparty to their fund manager, who would make the choice by reference to the usual sorts of 'best execution' criteria that apply to fund manager dealing activity (subject to any overriding criteria set by the trustees such as a credit rating requirement). There could be several such banks, as the fund manager in principle needs to apply best execution criteria each time new swap transactions take place.

A.3.2 In practice, there is likely to be close liaison between the actuary/investment consultant and the fund manager when preparing suitable liability projections and hence a proposed structure. The fund manager might also typically work with a few well-chosen investment banks, who can help to identify what derivatives are most likely to meet the client's requirements.

A.3.3 There needs to be such interaction, because overly exact cash flow matching might result in an overly complex (and therefore expensive) structure, bearing in mind the inherent approximations involved in liability projections (and the inherent approximations involved in modelling how the actively managed core portfolio might behave). There are also minimum amounts below which it is impractical to effect swap contracts, which depend in part on how non-standard the swap is. An exact hedge of all of the risks embedded in the liabilities may be prohibitive or even impossible (e.g. liability driven 'investment' has rarely to date attempted to include scheme-specific longevity protection). Experience suggests that complicated overlay structures may initially be discussed with trustees and their consultants, but, typically, only relatively simple structures seem to be used in practice.

A.3.4 At regular intervals (say yearly), the client (in conjunction with its actuary/investment consultant) would probably revise its cash flow projections and, after discussion with the fund manager, would instruct the fund manager to alter the structure of the swaps within the swap portfolio. Again this would be done subject to the usual best execution rules, perhaps if necessary novating or cancelling previous swap transactions with new ones (to avoid building up large numbers of swap transactions that largely cancel each other out, and which might be burdensome to administer).

A.3.5 This flurry of activity contrasts with what happens the rest of the time. The fund manager does incur some ongoing costs, most notably the costs of sorting out the collateralisation of the swaps, as well as ongoing reporting/valuation. These costs are typically smaller than the costs of actively managing a portfolio, and might be absorbed within an all-in fee covering both arrangements. It would be possible for the fund manager of the swaps overlay to be different to the fund manager of the underlying physical bonds (just as a scheme's tactical asset allocation manager does not need to manage any of the underlying assets). However this may make collateralisation procedures more complicated.

A.4 *Mitigating Credit Risk within Swap Contracts using Collateralisation*

A.4.1 Normally the pension scheme would want the swap counterparty to *collateralise* the swap contract. The aim is to reduce the exposure that the pension fund has to the risk of default of the bank involved. The aim is to have moved some suitable form of collateral from the bank to the pension fund, whenever such a default might be costly to the pension fund. This involves marking to market the swap (by definition, this is the estimated cost of effecting a similar sort of swap with another counterparty), and whenever this builds up to be materially positive as far as the pension fund is concerned,

for additional collateral to be ‘posted’ by the bank to the fund. If the mark to market then declines, some of the collateral would be released and returned back to the counterparty.

A.4.2 The counterparty might, of course, also require the swap to be collateralised for the same reason but in reverse. Over the last few years, many life insurers entering into over-the-counter derivative transactions have discovered that they may be deemed less credit-worthy than their counterparties. Underfunded pension funds may face the same learning curve!

A.4.3 For most transactions of any size, it is now common for collateral flows to occur quite frequently, even daily (although there will typically be minimum thresholds and a minimum build-up of exposure, typically dependent on credit rating, before any flow occurs). It may be possible to pledge securities held within the underlying portfolio, or, it may be necessary to hold some cash buffer within the swap portfolio itself to meet such calls. If instead the bank is posting collateral to the scheme then it too needs looking after, since it may need to be returned at some stage.

A.4.5 Typically, the asset manager would negotiate collateralisation arrangements on behalf of its client via a *Credit Support Annexe* within its wider negotiation of the master International Swap Dealers Association (*ISDA*) legal documentation governing the overall relationship between the client and its bank counterparty. Normally the client would be one of the two parties to swap, with the asset manager merely acting as its agent. The pension fund might, therefore, want its own lawyers to review or negotiate these contracts, but, in practice, the investment manager is likely to have greater negotiating clout with the bank, given other relationships it may have. The investment manager may, therefore, adopt umbrella documentation relating to all of its clients that wish to transact with the relevant counterparty. Where the client has multiple swap transactions with the same counterparty it is normal to have them all netted off within the relevant *ISDA* and *Credit Support Annexe*. Otherwise, one party can find that in the event of the other party defaulting it owes money to the defaulted party on one transaction, but cannot recover what it is owed on another.

A.5 *Monitoring such a Structure*

A.5.1 There are three key elements to the above structure that might need monitoring:

(a) *The (actively managed) underlying bond portfolio*. This would be assessed as usual for the asset management product in question. For example, if it involved management of a credit portfolio against a market index, then performance and risk measurement and attribution analyses versus the benchmark in question might be reported as per the asset manager’s/pension fund’s usual reporting cycle.

(b) *The (passive) swaps overlay*. This might, for simplicity, also be reported upon to a similar frequency, although most attention would be focused on those occasions when the swap positions needed to be altered.

(c) *The effectiveness of the choice of swaps overlay structure in relation to the scheme’s liabilities*. Various approximations will have been interposed between the

precise liability model available from the actuary and the precise structure of the swap portfolio. The swap portfolio being ‘execution-only’ in nature, this element of the decision-making is actually one that lies with the trustees, albeit only after taking advice from other parties acting on their behalf.

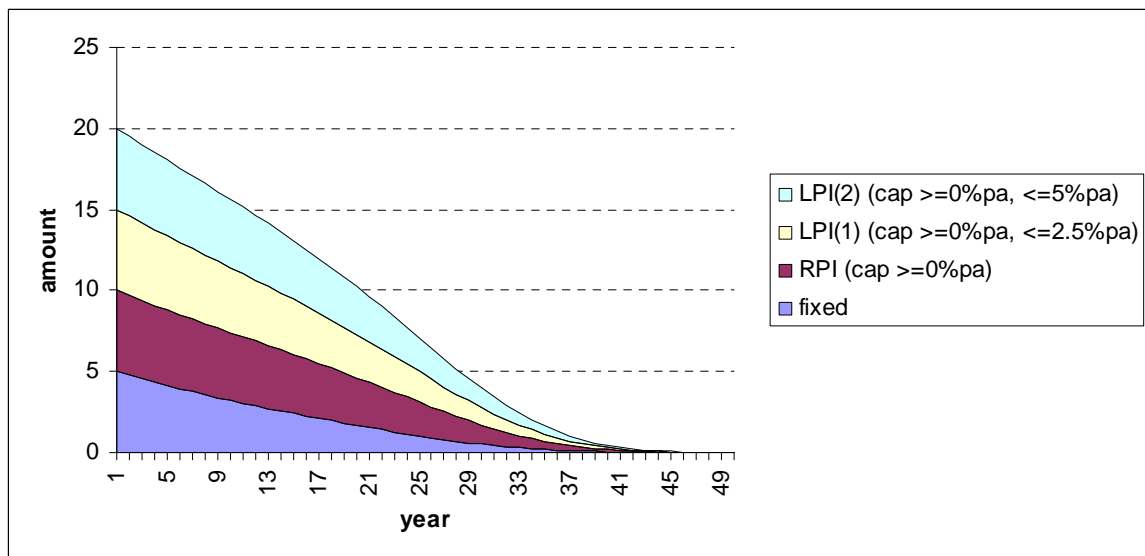
A.5.2 The key additional requirement is to construct some sort of *liability benchmark* (or *index*) that reflects, in a market-orientated way, the nature of the liabilities. Constructing such a benchmark may also directly guide the choice of swaps to hold within the overlay portfolio.

A.5.3 The most obvious way to proceed is first to develop some cash flow projections, differentiating between ones with different sorts of economic sensitivities (particularly those where the sensitivities have option-like characteristics, such as LPI). For example, the liability flows might be differentiated by year of projected payment into those that involve:

- (a) *fixed monetary sums*, e.g. those arising from benefits not subject to any increases;
- (b) *fully RPI inflation-linked sums*, e.g. benefits subject to full RPI linked increases;
- (c) *sums that increase on a year by year basis on some more complicated measure driven by inflation at that time*, e.g. LPI-type increases in payment since the expected outgo during a given future year can still be derived from a single expected amount at outset, together with the history of RPI increases since then. If different ceilings, say 2.5% and 5% pa caps, apply then these flows should, in principle, be differentiated, as swaps to match them exactly would also differ; and
- (d) *cash flows governed by more complex increase formulae dependent on multi-year investment or economic conditions*. At least in principle, benefits linked to LPI in deferment fit into this category. The big difference between these sorts of cash flows and the sorts referred to in (b) or (c) are that they, in principle, require multi-dimensional matrices to specify as they depend jointly on date of withdrawal, assumed date of retirement, assumed date of payment and (for those already deferred pensions at outset) on how large RPI increase were prior to the start of the projection relative to the caps and floors present in individual members’ benefits. As with (b) and (c), they also depend RPI increases post the start date of the projection.

A.5.4 The choice of numeraire (e.g. whether the cash flows are in nominal or real terms, or if they are expressed using some present value metric) is not particularly important, as long as the cash flow analysis ultimately precisely specifies the assumed cash flows. For example, suppose that we have some nominal liabilities, some RPI linked liabilities (with a floor of 0% pa annual increase) and some LPI in payment liabilities, some with an annual cap of 2.5% and floor of 0% and some with an annual cap of 5% and floor of 0%. The projected liabilities might then be expressed in present value terms (discounting, say, using a constant 4% p.a. discount factor) and using an assumed future inflation rate, say 3%, as per Figure A. It is possible to work backwards from these projections to derive what the cash flows would be had any other future inflation assumption been used (and any other term dependent discount factor used, including one calibrated to match actual prevailing yield curves). In this illustrative example we have assumed equal proportions at outset of each type of pension increase, with all scheme

members assumed to be aged 60 and to have just retired (and with the somewhat unreasonable assumption that pensions are payable yearly in advance). The mortality assumed in this example is that underlying the PMA92 tables (with 28 years of further mortality improvement incorporated). The average duration of the liabilities in this example is around 12.2 years in this instance, which would rise to 12.7 years if all of the liabilities were RPI linked.



Source: Threadneedle

Figure A: Illustrative cash flow projection, all cash flows discounted to the present time using a discount factor of 4% p.a., inflation assumed to be 3%pa in the future

A.5.5 One can now see why cash flows as per (d) are so problematic – they require lots more detail to specify precisely. It may be possible to develop suitable approximations that simplify them into a form that is more easily specifiable. It might also, in practice, be possible to simplify away liabilities of the form described in (c) above. It is also worth noting that the cash flows are not deterministic in nature. If the numbers of members involved is quite small then the random incidence of individual deaths will introduce uncertainty. For more sizeable schemes, the unpredictability of future changes in general levels of longevity is likely to be more significant (as is whether the mortality table in question is suitable for the actual type of individuals represented by the scheme membership).

A.5.6 Once the liabilities have been expressed in a suitably simplified form it becomes possible to structure swaps that capture the main characteristics of these cash flows. Liabilities that are fixed in nominal terms would be matched using swaps that generate fixed cash flows whilst those that are RPI would utilise inflation swaps. LPI linked liabilities can be catered for in a similar fashion, although often their costs seem

high to clients. This seems to be because clients worry less than the market as a whole does about the possibility of inflation becoming negative.

A.5.7 Performance (and risk) measurement and attribution of the swaps portfolio can then also be carried out by reference to the simplified cash flows, discounted (probably) at swap rates, versus mark to market movements in the value of the swaps.

A.5.8 There is a link between liability driven investment and fair valuation principles. The actuary will, typically, have placed some value on the liability cash flows. Assuming that the liability cash flow projections are truly correct (and ignoring some of the niceties surrounding credit risk on cash deposits etc), we might ask how we can tell if this sum would actually be sufficient to provide all of the projected cash flows. This depends on whether the actuary's valuation is bigger or smaller than the *fair value* of the liabilities derivable from the mark to market value of the swaps. It is *not* sufficient merely to compare the return on the liability driven portfolio with the movement in value placed on these liabilities by the actuary. The movement needs to be unbundled into its various parts, including, potentially, a part relating to the difference between the fair valuation and the actuary's valuation.

A.5.9 Even the above analysis involves simplifications. For example, there is an implicit assumption in the above that the fund's mortality experience can be well predicted at outset, but merely differentiating between nominal, real and LPI linked increases provides no protection against unexpected improvements in mortality. There may be future discretionary benefit improvements. Active members' liabilities are particularly difficult to project reliably in this context, given their sensitivity to uncertain future member specific salary increases. For a full picture, one would, in principle, differentiate between each such risk [as per section 4 of Kemp (2005)]. In practice this is likely to be challenging, although at least thinking about such matters may help to highlight what sorts of risks a liability driven investment portfolio does or does not hedge against.

A.6 *Alternative Approaches*

A.6.1 The above overlay approach clearly demarcates who is responsible for what, but trustees might prefer merely to set their investment manager a liability driven benchmark akin to the one described above, and say: "Get on with it", with the investment manager free to use whatever instruments it likes (including swaps and other derivatives), and whenever it likes, to match the liabilities or, preferably, to add value versus them.

A.6.2 Key requirements for such an approach are for the trustees and their consultants to craft very carefully an appropriate liability driven benchmark as above, for the fund manager to have good systems for measuring, at all times, how far its portfolio deviates from this benchmark, and for it to be very clear exactly what is expected of the fund manager. The bespoke nature of such a service is likely to make it practical only for larger accounts. It is worth noting that, if the fund manager cannot practically hedge a

particular part of the liability benchmark, then there will be a ‘random’ element to his performance. The fund manager may stress this whenever he thinks it has worked to his disadvantage, and the trustees may do the opposite whenever they think it has worked in the fund manager’s favour. Unfortunately, there is almost certain to be disagreement about which is the case, unless the whole arrangement is very carefully managed. An advantage of the swaps overlay approach, described above, is that it airs and manages these potential disagreements at outset, via the discussions needed around the formulation of the swaps overlay.

A.6.3 The trustees may deliberately want to adopt a strategy that deviates from the most precise liability driven benchmark. In these circumstances, a clear liability driven benchmark might still be defined, but then deliberately modified to focus on what the trustees want.

A.6.4 For example, the trustees may feel that banks might be quoting excessive prices for buying cash flows that embed option-like inflation characteristics such as those implicit in LPI linked benefits. Yet, they may still want some hedging of such risks. They might then ask the fund manager to hedge these risks in a more approximate way, using dynamic hedging, to avoid ceding this supposed profit margin to the bank. This could, perhaps, most easily be achieved by giving the investment manager a benchmark that changes in a dynamic fashion as the underlying economic parameters change. The aim would be to mimic the economic sensitivity of the fair value of the option-like characteristics, insofar as far as these depend on the parameters in question. A perfect hedging algorithm, were one to exist, would, of course, also depend on volatility, which would require the use of more complicated derivatives (but this would then defeat the point of seeking to avoid the use of such derivatives, because they are believed to offer poor value-for-money).

A.6.5 Some modification to the swaps overlay approach may be needed for smaller schemes. A single swap might be easier to have “segregated” in this context than a whole bond portfolio, but there are still implicit lower limits on the sizes at which they become practical. A better alternative may be to create specially tailored long duration pooled bond funds. Several investment managers appear to be designing such products. In real life, a portfolio of pension liabilities typically gets shorter over time, so any pooled approach is unlikely to match any particular scheme’s liabilities as well as a more bespoke approach.

Appendix B – Buyout with an insurer

B.1 Insuring the liabilities

The majority of this paper is concerned with the setting of liability driven benchmarks for self-administered occupational pension schemes (i.e. schemes where the trustees invest in assets other than an insurance policy). The next few paragraphs briefly consider the alternative, of using the assets of the scheme to purchase an insurance policy.

As has been mentioned earlier, it is not possible to fully match the liabilities of a scheme other than via the purchase of an insurance policy. Even then there may be residual risk for example if the insurer were to go insolvent. Note on full buyout of a pension scheme the policies are generally assigned to the individual members, so that the scheme can be terminated with no further liability.

B.2 What are the advantages of insuring the liabilities?

Sponsors and trustees are increasingly concerned with risk. The principal advantage of insuring the liabilities is that the (vast majority of) risk of meeting the benefits is passed on to the insurance company.

Trustees: no longer have to be concerned with whether the sponsor will continue to be able to meet any shortfall of assets against liabilities.

Members: have a high degree of certainty that their benefits will be paid.

Sponsor: no longer exposed to volatility in funding (contributions), or the corporate balance sheet.

B.3 And the disadvantages?

Insurance companies are not interested in providing policies to cover benefits where the value of the benefit to be paid may be influenced by the sponsor, trustees, or members. So, for example, an insurance company would not provide a policy to meet benefits that are linked to future salary inflation; benefits subject to the trustees' discretion, such as discretionary pension increases; benefits that vary in value according to the options exercised by members. Hence it is unlikely that an insurance policy would precisely match a scheme's benefit arrangements.

Insurance companies (in the UK) are subject to statutory reserving requirements. This is not the place to discuss this matter in detail, but in summary insurers have to retain sufficient assets to cover the value of the liabilities and in addition maintain a reserve. These requirements impact on both the capacity of insurance companies to take on new business and the terms for accepting business – the premium has to cover the cost of

capital as well as the expected value of the benefits payable. Currently, the capacity of the UK market is believed to be for annual premiums of about £3 billion. Several UK schemes have assets and liabilities significantly in excess of this figure.

The insurance companies active in the buyout market are proprietary companies that conduct business with the aim of making a profit.

B.4 When is it likely to be preferable to buyout liabilities?

In recent years a large number of ‘traditional’ defined benefit pension schemes have closed. Some of these have closed to new joiners, whilst others have ceased providing future service benefit accrual and broken the link between accrued benefits and future salaries.

Ultimately, these closed schemes will need to be bought out. If the sponsor becomes insolvent this may be through the new Pension Protection Fund (PPF), alternatively as part of a business reorganisation the scheme may be ‘bought out’ by being transferred to another scheme. However, it is likely that in most cases the scheme will be bought out with an insurance company.

Why?

At some point the cost of the scheme’s upkeep (investment, administration, accounting, valuation, documentation etc) will mean that it is no longer economically viable to keep the scheme going.

Trustees, who are charged with responsibility for determining a scheme’s investment arrangements, may take significant comfort from the ‘sleep easy’ factor provided by buying out the liabilities.

Where a scheme goes into wind up with a solvent employer, the employer is required under legislation to fund the scheme’s buyout cost (to the extent that the cost exceeds the scheme’s accumulated assets).

Even where there is no solvent sponsor, but the assets are greater than the buyout cost of the PPF liabilities (a restricted, simplified set of benefits) the trustees may opt to buy out the liabilities rather than run the scheme on. This avoids potential accusations that would follow if the scheme’s experience were such that benefits had to be cut back by more than on immediate buyout.

B.5 Partial buyout

The pricing of benefits payable to older members of a pension scheme (where benefit are expected to be payable for less than say 30 years) is relatively straight forward. However, the pricing of benefits payable to younger members is difficult; because of the significant reinvestment risk that the insurance company would be exposed to, although

this may be more closely hedged using derivatives. Hence, trustees may perceive that it is attractive to purchase policies covering pensions in payment, where the premium terms might appear attractive compared with the cost of managing and administering the pensioner liabilities and corresponding assets.

It should also be noted that insurance companies are developing products to facilitate the transition from self administered to insured status, a transition that might span several years.

B.6 Impact on investment policy

When trustees buyout the liabilities with an insurance company, the insurer has to invest the assets to generate a return (the premium will have been set assuming an expected return on the assets received). Over recent years, insurers have moved from backing such liabilities with gilts, to using a mixed portfolio of bonds and financial instruments. The bonds are likely to have a credit spread between gilt / AAA and A; they may also hold BBB rated stocks but this is more likely to be as a result of credit downgrades rather than actively purchasing stocks at this credit rating.

At the point that trustees become seriously interested in buying out the liabilities, even where this is expected to be at some date in the next few years, it would be sensible for the trustees to discuss their investment arrangements with potential insurers (currently there are only two insurers actively participating in this line of business in the UK). Alignment of the trustees' investment policy with that of the insurer would reduce the scope for fluctuations between the insurance premium and the assets held. It would also reduce any reinvestment costs, which would form part of the total premium, when the actual buyout takes place.

Appendix C – Impact of mortality risk

C.1 Impact on investment policy

Mortality risk effectively falls into 3 parts:

- (i) fitting given population to one or more model(s) or standard table(s)
- (ii) anticipation of future general trends
- (iii) random future experience within the scheme

Arguably the law of large numbers will help with (i) and (iii) for very large schemes. However, consideration of the minimum size may be enlightening. Richards and Jones (2004) identified scheme sizes required to achieve useful confidence levels for fitting mortality data and indicated a population of at least 1,000, preferably 10,000. Risk (iii) can still exist in a large population if a large proportion of the liability is concentrated in a few individual members.

C.2 Potential impact of random future experience

Even if we could identify an appropriate table, or tables, and a future trend, the randomness of future experience may still be significant for most schemes. The following Illustrations 3 and 4 provide a simple stochastic analysis of the survival of 100 pensioners initially all age 60. Assuming each had an annual pension of £1, Illustration C2.1 shows the range (95% confidence) of the possible aggregate scheme outgoes. After 25 years, a range of around £41 to £59 (+/- 18%) appears difficult to match.

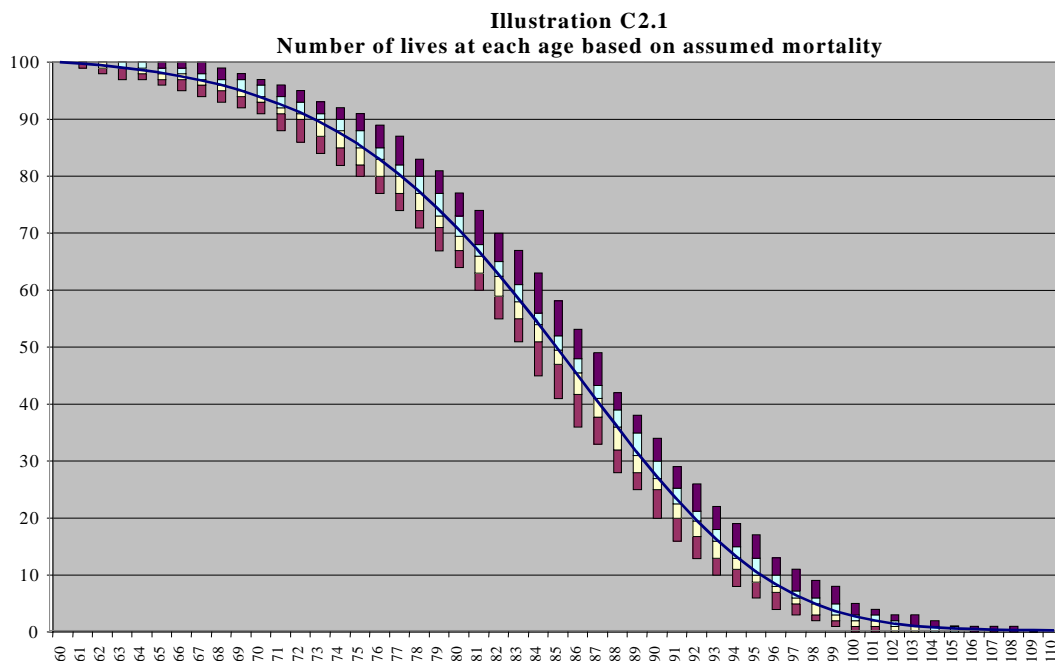
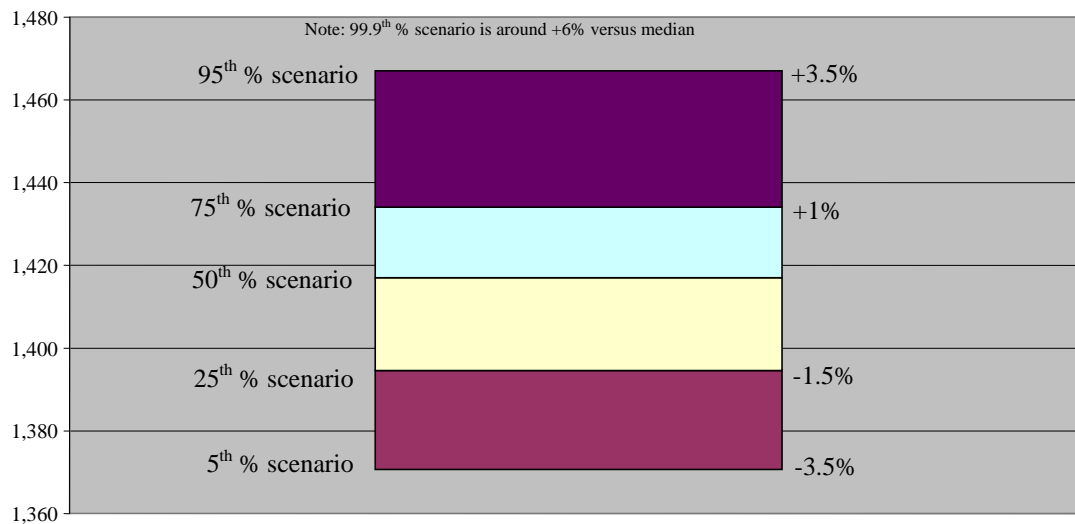


Illustration C2.2 shows the range of present values of payments for a single discount rate. If these are individual confidence intervals for each age presumably, if you have a whole scheme there will be diversification over different ages so the percentage confidence interval for the scheme should be less than that for any one age. In this example, a reserve of around 6% would be required to cover the random future experience within the scheme and virtually ensure all future payments could be met.

Illustration C2.2; discounted value of payments (5% pa) for stochastic analysis of 100 pensioners



C.3 Potential impact of future mortality trends

The “PA92” standard mortality tables built-in projections of about 0.25%-0.33% p.a. improvements. A measure of risk for future trends might be to consider a doubling of or eliminating the built-in projection (although the ultimate risk is of course the members living forever). If we anticipate a doubling of the expected improvements (say a further 0.25% pa), the effect on the present value of the cashflows could be around 5% for a typical scheme. A review of the mortality assumptions used for any given scheme over the last 15 years would further illuminate the mortality improvement risks.

An alternative measure of risk based on the PA92 tables might be the difference between the medium and long cohort projections, which increases the present value of future cashflows by around 4% for a typical pension scheme.

Insurers’ reserving requirements may also be considered in assessing mortality risks, both in respect of the pricing margins included in the price of insurance buyouts and also the reserves for mortality risk that insurers are now required to assess under their Individual Capital Assessments. Ultimately, the capital markets may provide a market price for hedging mortality risk, as discussed in C4 below.

C.4 Hedging longevity risk

This paper presupposes the trustees have decided not to buyout liabilities with insured annuities. Phased-buyout products allow the scheme to operate independently for a period with the mortality risk removed immediately. Otherwise, we are not aware of insurers taking on the mortality risk without also taking the assets, either immediately or on a phased basis although we understand that some reinsurers will consider such arrangements. In any event, it must be assumed that a premium must be paid to remove this risk.

The capital markets are beginning to develop products which may allow pension schemes to hedge mortality risk without the need for (re)insurance. To date, one such bond has been publicly offered to pension schemes, namely the proposed survivor bond launched by the European Investment Bank, Partner Re and BNP Paribas in November 2004. This took the form of a bond issued by EIB but where the coupon payments are linked to the proportion of a population aged 65 in 2003 who are still alive at the coupon date. If pensioner mortality improves more than expected, the bond coupons and hence returns will be higher, so in that sense investing in the bond provides an offset to longevity risk. Similarly if mortality improves less than expected the returns will be lower

The implicit mortality loading in the EIB bond is stated by BNP Paribas at approximately 0.2% per annum. That is if you price the expected flows based on expected mortality improvements, per the Government Actuary Department's projection basis for population mortality, then the yield on the bond is LIBOR - 35bps, compared to LIBOR -15bps on a normal fixed coupon EIB bond. This equates to a cost 170bp up front given the 8.5 year average duration of the bond. The breakeven equates to a 0.4 year improvement in life expectancy.

The intended issue size was £550 million but the working party understands there has not been sufficient demand to date to enable the bond to be issued. The working party further understands that a number of other investment banks are working on alternative solutions to passing longevity risk to the capital markets.

Appendix D – Practical example of liability driven benchmark approaches

D.1 Liability Driven Benchmark Examples

In this Appendix we illustrate three examples of approaches to liability driven benchmarks for a simplified model pension scheme. For each benchmark we show a graph comparing the expected liability cash flows with the asset cash flows, together with a summary of the asset allocation and the PV01 risk measure, tracking error and VAR measure. PV01 is a measure of the interest rate risk, and it is defined as the expected change in value of the assets relative to the liabilities for a 0.01% increase in interest rates across the whole term structure of the yield curve. In practice, other risk measures may also be considered to allow for possible changes in the shape of the yield curve.

Our analysis for each of these benchmarks is based on the liabilities discounted off the swap curve. The risk statistics have been calculated using a non-parametric distribution of investment returns based on historic data over the last 10 years.

The three benchmarks we have modelled are as follows:

1. Long dated gilt index benchmark

This benchmark has been chosen as an example of the type of benchmark typically given to investment managers historically, when the actuary or investment consultant has wished to set a bond benchmark that takes some account of the liabilities. We have chosen the FTSE over 5 years gilt index because it is a reasonable match for the duration of the liabilities of the model scheme

2. Gilts plus cash liability matched benchmark

This benchmark uses optimisation techniques to seek a trade off between matching cash flows as closely as possible and minimising interest rate risk. These risks cannot both be optimised in this example because the assets are discounted off the gilt curve and the liabilities are discounted off the swaps curve (for consistency between the different benchmarks).

3. Gilts, cash and swaps liability matched benchmark

This benchmark is similar to 2. above but the universe of available investment instruments is increased to include cash-backed interest rate swaps. For this example a very good match of both expected cash flows and interest rate risk can be achieved.

D2. Model Scheme liability profile

The key features of the model scheme are set out below.

- Membership: 1000 pensioners
- all members currently age 60
- Each member receives a pension of £4,000 pa payable annually in advance
- The pensions have no increases in payment
- Members experience PMA92C20 mortality

This is a simplistic example as it ignores pension increases in payments, dependents' benefits, early retirement etc. One consequence of these simplifications is that the duration of the model scheme liabilities at around 9 years is shorter than that for a typical scheme's pensioner liabilities.

The expected liability cash flows for the model scheme are illustrated below:

Illustration D2.1

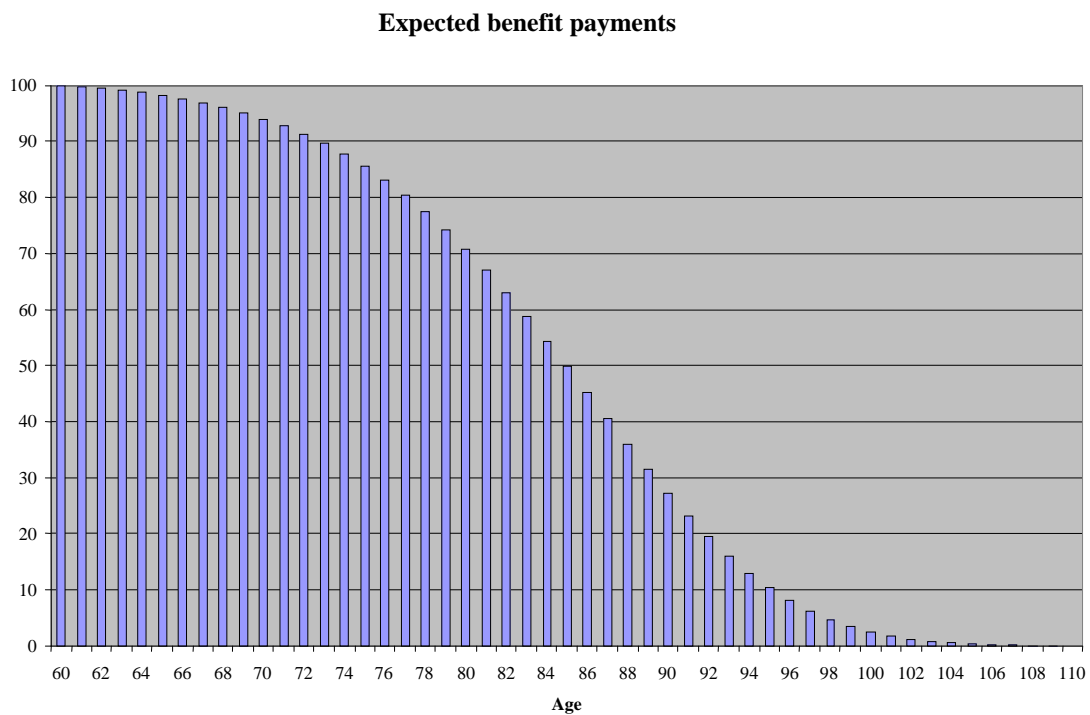
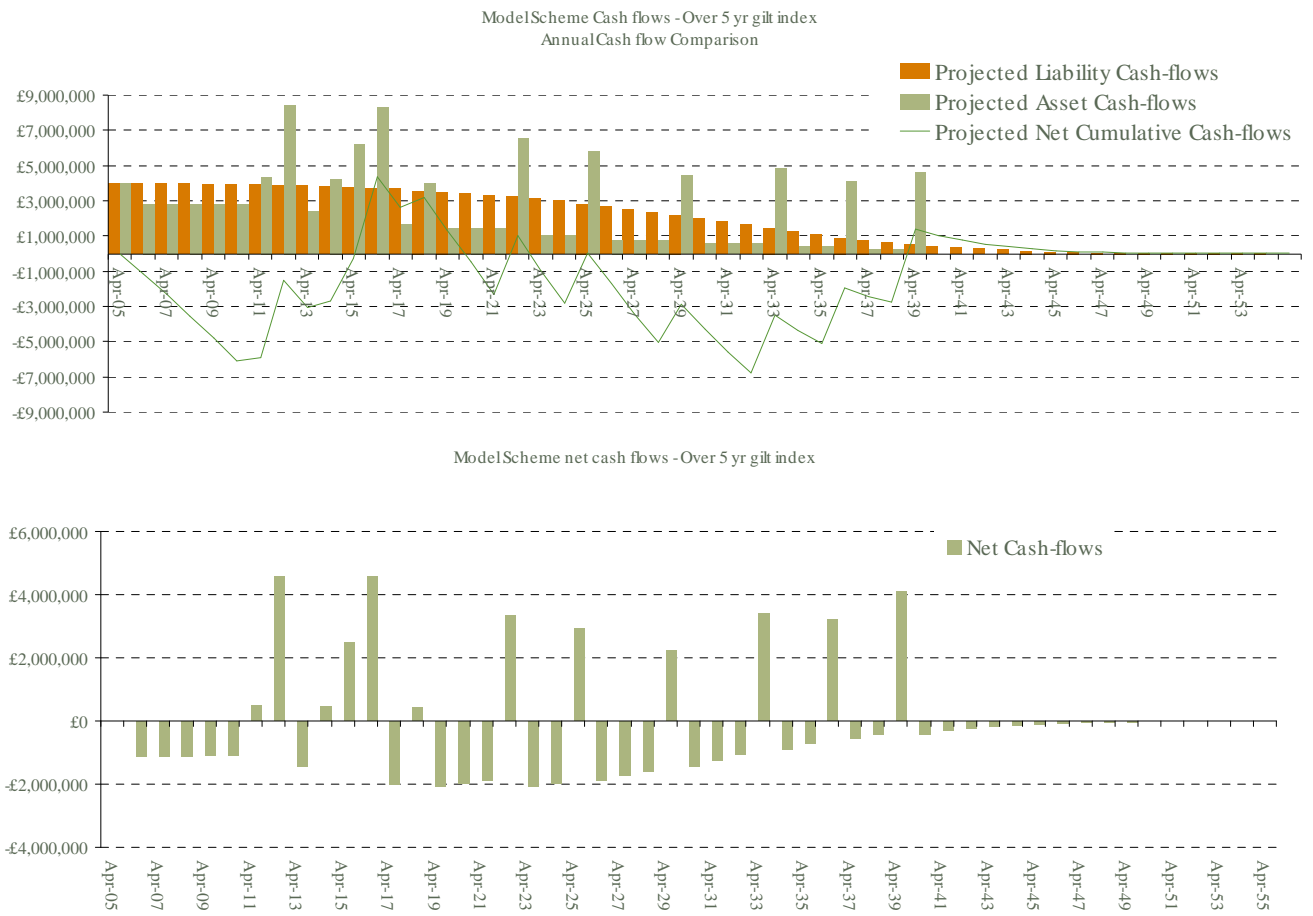
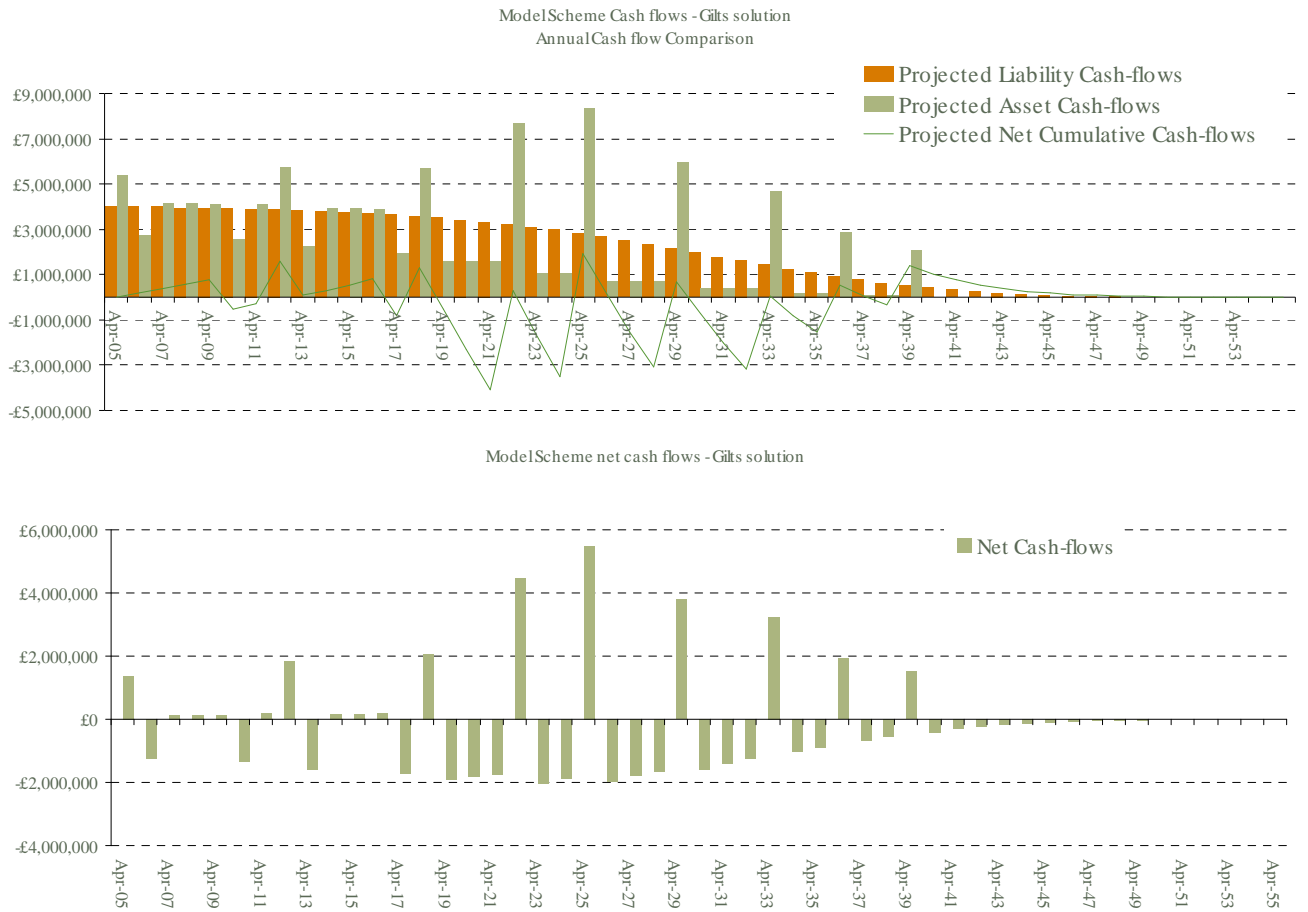


Illustration D2.2



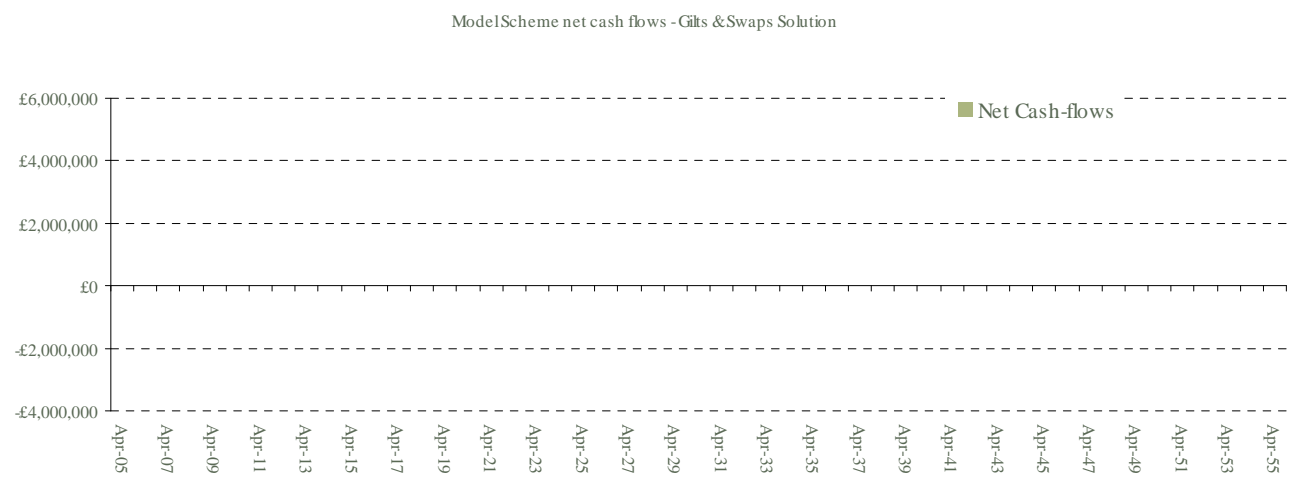
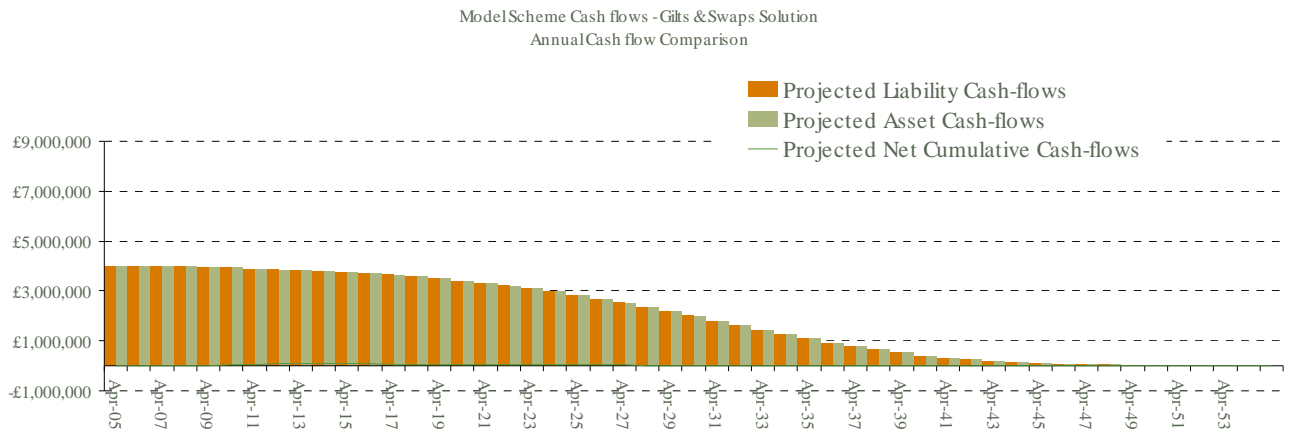
Source: Insight Investment

Illustration D2.3



Source: Insight Investment

Illustration D2.4



Source: Insight Investment

D.3 Key Assumptions

The optimisation uses a non-parametric distribution for all investment data based on at least 10 years of historic observations. Insight Investment's proprietary systems have been used for the optimisation.

The following additional assumptions have been made

- Investment data as at 8 April 2005
- Expected liability cashflows assumed due 8 April each year
- sufficient cash is held to ensure the first year's expected liability is met (this is relevant for the index benchmark where otherwise only coupon payments would be received in the first few years)
- Liabilities are discounted off the swap curve

D.4 Asset Allocation and Risk Measures

We summarise below the asset allocation for each of the benchmarks, together with the risk measures PV01, tracking error and VAR.

As at 8 April 2005, value of model scheme liabilities discounted off swap curve
£56,829,578

| | Over 5 year gilt index | Gilts & Cash solution | Gilts, Cash & swaps solution |
|--|------------------------|-----------------------|------------------------------|
| Asset Breakdown of solution | % | % | % |
| Gilts | 93.01% | 90.60% | 37.49% |
| Cash backed swaps | 0.00% | 0.00% | 55.49% |
| Cash | 6.99% | 9.40% | 7.02% |
| Total | 100.00% | 100.00% | 100.00% |
| | | | |
| | | | |
| Risk measures | bp of fund value | bp of fund value | bp of fund value |
| PV01 of assets relative to liabilities | -0.6 | -0.1 | 0.1 |
| Annualised tracking error | 261.5 | 252.3 | 25.4 |
| One month VAR 95% confidence interval | 124.2 | 119.7 | 12.1 |

Source: Insight Investment

Appendix E – Areas for further research

The working party believes that the following issues, which are raised in the paper, would be suitable areas for further, more detailed, research:

- Potential implications of the Pension Protection Fund, including the impact of a risk based levy (Section 1.4).
- Analysis of the costs and benefits of an insurance buyout versus a liability driven benchmark approach (Section 1.5, Appendix B).
- Quantifying the likely impact of non-investment risks, in a form that can be compared and integrated with investment risks, and deriving the implications for liability driven benchmarks (Section 1.8).
- The implications of potential capital market solutions to hedging longevity risk (Section 1.8, Appendix C).
- The advantages and disadvantages of the emerging pooled liability driven investment funds offered by a number of investment managers (Section 3.5).
- Optimal approaches if trustees desire to hedge salary inflation for active members (Section 4.1).
- Analysis of the costs and risks of dynamic hedging of complex inflation linkages, compared to a bespoke hedge from an investment bank (Section 4.2).
- Optimal approaches for underfunded schemes planning to adopt liability driven benchmarks for a substantial proportion of their assets (Section 4.3)
- Incorporating investment risk in liability driven benchmarks, i.e. designing a mandate to best deliver an annual return of liabilities + x%, where x can range from low (e.g. <50bpa) to high (>300bpa) levels with minimal tracking error (Section 4.4),
- Extending the model scheme examples to include longer-dated (e.g. deferred) and inflation-linked liabilities, and considering the potential role of corporate bonds (Appendix D)

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