Risk sharing and hybrid pension plans

A synopsis of the following research carried out on behalf of the Department for Work and Pensions:

- Hybrid Pension Plans: UK and International Experience

- Comparing Pension Outcomes from Hybrid Schemes
  by Dr Deborah R Cooper, Mercer HR Consulting, August 2005.

- The Optimal Allocation of Pension Risks in Employment Contracts
  by Dr David McCarthy, Tanaka Business School/Imperial College London, August 2005.
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Risk sharing and hybrid pension plans: background and overview

In June 2004 the Department for Work & Pensions commissioned three independent research projects into hybrid pension schemes, the financial (and other) risks associated with different forms of employer pension provision, and issues around the allocation of these risks between members and their employers. This document presents a summary account of each of the three resulting reports. The full individual reports are also published separately, and available on-line (www.dwp.gov.uk/asd/asd5):


- **Comparing Pension Outcomes from Hybrid Schemes**, Dr Deborah R Cooper, of Mercer HR Consulting, August 2005.

- **The Optimal Allocation of Pension Risks in Employment Contracts**, Dr David McCarthy, of Tanaka Business School/Imperial College London, August 2005.

The shift away from defined benefit pension (DB) schemes towards defined contribution (DC) schemes is well known, as is the consequent transfer of pension risks, thought to be largely with the plan sponsor in the case of DB, and in the case of DC largely with the plan holder/member. Less well known is that there are a number of other sources of uncertainty in addition to those arising from investment returns and changes in longevity, and that there are many alternative forms of DB (all with different risk sharing features, and indeed some are near DC schemes in design) of which final salary has been the most common in recent times.

There is an urgent need to better understand/acknowledge the inherent features and implications of the whole range of scheme types, including any non-conventional and innovative designs. This research is designed to inform the DWP and Government’s thinking on employer pension provision, and to facilitate greater awareness and
discussion across the industry, including companies, employee representatives and
advisers. The broad terms of reference for the research were as follows:

“to increase the knowledge of risk sharing and hybrid pension plans compared to
traditional final salary and pure defined contribution plans; and to promote
discussion and better understanding of these within Government and the wider
pensions world”

The range of approaches, insights and limitations across the three research pieces
means that it is important to look at all three reports together, in order to construct
a rounded view of the relevant issues.

Hybrid pension plans: UK and international experience

As a major player in the industry, Hewitt have brought their global experience,
contacts, and insights to bear on an examination of the practical issues in the UK, US
and selected countries of Continental Europe. Their report assesses the driving
factors in the changing landscape of employer pension provision, and the potential
for future growth in the UK of hybrid/risk sharing pension schemes – career average,
cash balance, sequential and combination DB and DC schemes among others. It
details the key features of these scheme designs, the overall pension context
(including the cultural, regulatory and tax environment) within which they operate,
and draws out implications and potential responses from key stakeholders.

The analysis reflects primarily the sponsoring company’s viewpoint, but also
includes the viewpoints of other stakeholders, in order to assess the direction of
future trends and identify what might be sustainable, and at the same time
acceptable, forms of pension scheme design in the long-term. While it is
acknowledged that other experts in the industry may have similar or different
emphases, this report covers a comprehensive range of issues which it brings
together into one accessible reference point.

Comparing pension outcomes from hybrid schemes

This research aims to compare objectively the expected level and variability of an
individual’s pension income across various scheme types. As such it relates almost
totally to the pension scheme member’s perspective. The author, at Mercer HR
Consulting, has applied extensive technical expertise to simplify highly complex
issues and provide a clear and intuitive way of comparing between different types of
pension schemes.

When comparing across different schemes, an important issue is to ensure that one
is comparing like-for-like. Hence, the analysis was devised such that the generosity/
total cost (or more specifically the risk-adjusted cost to the sponsoring company)
would be the same across all the scheme types. The results show graphically the
effect of investment risk, and interest rate risk at the annuitisation stage, on the
members’ potential pension in retirement. However, the analysis as constructed
means that, for simplicity, the employer is assumed to bear no investment risk.
The reader will note that accrual rates and other features of defined benefit type schemes in this report do not correspond to the rounded numbers that we see in real pension schemes (such as 1/60ths or 1/80ths). This is because in order to compare like-for-like, the analysis necessarily has to abstract from reality to some extent. The research gives an indication of which scheme design might look appealing and which might not, given the theoretical conditions described, and also given real world data such as financial market conditions, life expectancy, job tenure, lifetime wage profiles and lifetime working patterns.

The final answer on desirability very much depends on what type of person is making the assessment – in terms of their earnings and working characteristics, and their attitude to risk. The research explores how various characteristic individuals (low and high earners, those with a full working life and those with career breaks or periods of part-time work etc) fare under each type of scheme. Results are presented with clear graphics that enable quick and intuitive comparison across schemes and different types of people.

**The optimal allocation of pension risks in employment contracts**

This research is also grounded in a theoretical basis, with a range of real world data forming a necessary part of the analysis. The author draws on academic and specialist pensions and finance knowledge to undertake analysis of considerable sophistication. The following features are included in the research:

- The risk preferences of individuals and companies – thereby quantifying the effect of variability in pension outcomes, through assumptions about the degree of risk aversion
- The ability of firms and individuals to trade risks such as investment risk – which partly determines the extent to which risks can be shared between parties
- The ability of firms to bear risk – through pooling across plan membership for instance
- The ability of individuals to offset risks in a pensions portfolio with a savings portfolio elsewhere

The research first considers a world of perfect information and complete markets (for instance, the ability of pension plan holders to trade risks completely, and the existence of market prices for these risks). In this benchmark scenario individuals are shown to be indifferent between wages and pensions, and different types of pension scheme. The research then incorporates various types of market incompleteness (for instance, that cohort longevity risk is not easily traded, that individuals cannot purchase annuities at fair prices, that individuals face restrictions on the assets they can hold, and that individuals cannot borrow against their future wage or pension income to consume) to make the analysis progressively much more realistic, and further results are then presented.
As with any rigorous modelling, however, it is not feasible to capture the entire realism of the actual world. Some imperfections, such as myopia and differences in time preference (for individuals over time, or between employees and companies), costs of workplace information provision, the incentive effects of different types of pension plan and other factors are not considered.

The research provides a powerful means of assessing and comparing the most important features of pension schemes. It adds insight and clarity as to how we ought to think about occupational pension provision within a wider context. The output ranks the various scheme designs in terms of which offers the most optimal risk sharing. Optimal in this context is defined to be the scheme which costs the company the least, given the same level of satisfaction for a member in each scheme design (risk sharing arrangement).

**Summary**

The three reports bring together a rich set of intuitive analyses at a practical level, along with expert analyses combining economic theory and real world observations. Each piece follows a very different method of analysis, but they complement each other to form a comprehensive overall picture, which is presented in a way that we anticipate will be accessible and appealing to the full range of audience.

Pensions Analysis Directorate

Department for Work & Pensions

August 2005
Hybrid pension plans: UK and international experience

by Kevin Wesbroom & Tim Reay
1. Introduction

This research report, prepared by Hewitt, is one of three projects commissioned by the Department for Work & Pensions (DWP) into hybrid or risk sharing pension plans. The terms of reference for this research asked for a description of hybrids in the UK and other countries, consideration of the factors leading to the adoption of these plans (including how this is influenced by local taxation and regulation) and the prospects for the growth of hybrids in the UK.

For the purposes of this research we define hybrids as “private pension schemes which are neither pure Defined Benefit (DB) nor Defined Contribution (DC) arrangements, where pure DB arrangements are taken to mean final salary pension schemes”.

Specifically the following types of plans are included as hybrid plans:

- **Career average plans** - a type of Defined Benefit (DB) plan, offering a pension benefit on retirement based on the earnings throughout the period of membership. Where the earnings each year are subject to revaluation, these plans are often referred to as CARE plans – Career Average Revalued Earnings plans – or Indexed Pension plans.

- **Sequential hybrids** - those where a member may be in two separate arrangements during his period of membership, but with distinct benefit accrual at any point in time, such as nursery schemes.

- **Combination hybrids** - those where benefits accrue on two scales simultaneously; for example DB for part of benefits and DC for the balance of benefits.

- **Final salary lump sum plans** - plans which provide a benefit expressed in relation to final salary, but in lump sum rather than pension form.

- **Self-annuitising DC plans** - where the sponsor offers conversion into pension within the plan, rather than requiring the member to purchase an annuity in the open market with his DC “pot”.
• **Underpin arrangements** - where the benefits for a member are calculated on the basis of the better of two (or more) scales. So, for example, a DC plan may have an underpin calculated on a DB scale; when the DC benefit crystallises, it is compared with the promised defined benefit, and the greater amount is payable.

• **Cash balance** - or retirement balance plans, which are discussed further below.
2. Cash balance plans

One emerging type of hybrid plan in the UK is rather different from many of the hybrids considered above, in that there is a single plan or scale of benefits incorporating risk sharing between sponsor and member. These plans may be referred to as shared risk plans, cash balance plans or retirement balance plans. The member’s benefit is typically an entitlement to a capital sum at retirement which is converted into an annuity in a similar fashion to DC plans. However the differentiating characteristic is that, unlike DC plans, the amount in the member’s account is not directly related to the returns achieved on the underlying assets, but it may be guaranteed or smoothed or subject to some form of underwriting by the company. There are significant variations in the types of guarantees offered, and the terms for annuity conversion, which lead to these cash balance plans looking progressively more like DB plans or like DC plans. An example of how a simple cash balance plan might work from a member’s perspective is set out below.

The member earns £12,000 one year, £12,500 the next year, moves to part-time and earns £9,000 in her final year and then retires. The accrual rate is 10% and revaluation is in line with the RPI.

- At the end of the first year her balance is: 10% * £12,000 = £1,200

- At the end of the second year inflation has been 2% and her new balance is:

  £1,200 plus 2% inflation = £1,224 from year 1

  10% * £12,500 = £1,250 from year 2

  Total balance = £2,474

- At the end of the final year inflation has been 5% and her new balance is:

  £2,474 plus 5% inflation = £2,598 from earlier years

  10% * £9,000 = £900 from year 3

  Total balance = £3,498

The member chooses to take one quarter of her balance (£874) as a tax-free lump sum. This leaves £2,624 to be converted to pension. The market rate for an annuity at that time is that £20 cash buys £1 pa of pension (including a half-rate pension for her husband if she dies). Hence her pension is £2,624÷20 = £131 pa.
The differentiating factor in the cash balance example above – compared with a straightforward DC plan - is that the revaluation of the account is specified in advance, and does not depend on market conditions. If the sponsor actually pays 10% contributions but the assets backing the pension promise do not keep pace with the RPI, then a deficit will arise which the sponsor will need to meet. Equally if the assets deliver more than RPI then the cost to the sponsor will be less than the 10% credited, since part of the credit will, in effect, arise from future excess investment returns. The revaluation of the account may be guaranteed under the plan rules, or it may be subject to discretion – which will increase the funding flexibility for the sponsor.
3. Risk attribution

All pension arrangements are premised on the payment of income at a future date. The effect of unknown future events, between the date the promise is given and the date it is delivered, means that all pension promises are affected by these future events. One way of characterising different pension plans is by looking at who bears the consequences of that unknown future experience – be it good or bad. This risk allocation is illustrated in the diagram opposite, in the form of a risk spectrum.

Table 1 below develops this risk analysis by comparing three key types of risk inherent in pension plan design:

- **Investment risk** – where assets are set aside to meet future pension promises, the investment returns to be achieved on these assets cannot accurately be predicted or guaranteed in advance. The impact of the actual investment returns achieved may fall to the account of the sponsor or the member.

- **Annuity conversion risk** – in some cases the benefits may be expressed in terms of an amount of pension. In other cases benefits will be expressed in capital terms and the capital on retirement has to be converted into a lifetime income. Changes in the expected longevity of pensioners may result in increased cost for the sponsor or in a lower amount of annuity purchase for the member.
Risk attribution

- **Salary risk** – benefits may be defined in relation to the level of earnings close to retirement so that the pension bears a specified relationship to the standard of living prior to retirement. In other cases, pension benefits are defined independently of final salary and so the member cannot be assured that his pension at retirement will bear any pre-determined relation to his final standard of living as an employee.

**Table 1: Risk Attribution in Pension Plans**

<table>
<thead>
<tr>
<th>Risk Feature</th>
<th>Investment</th>
<th>Annuity Conversion</th>
<th>Salary Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Salary Pension</td>
<td>Sponsor</td>
<td>Sponsor</td>
<td>Sponsor</td>
</tr>
<tr>
<td>Final Salary Lump Sum</td>
<td>Sponsor</td>
<td>Member</td>
<td>Sponsor</td>
</tr>
<tr>
<td>Career Average/CARE</td>
<td>Sponsor</td>
<td>Sponsor</td>
<td>Member</td>
</tr>
<tr>
<td>Sequential Hybrid</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td>Combination Hybrid</td>
<td>Both</td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td>Final Salary Underpin</td>
<td>Sponsor</td>
<td>Sponsor</td>
<td>Sponsor</td>
</tr>
<tr>
<td>DC Underpin</td>
<td>Member</td>
<td>Member</td>
<td>Member</td>
</tr>
<tr>
<td>Cash Balance</td>
<td>Sponsor</td>
<td>Member</td>
<td>Member</td>
</tr>
<tr>
<td>Self annuitising DC</td>
<td>Member</td>
<td>Sponsor</td>
<td>Member</td>
</tr>
<tr>
<td>Defined Contribution</td>
<td>Member</td>
<td>Member</td>
<td>Member</td>
</tr>
</tbody>
</table>

This table is a summary and some entries above are discussed further in the main report. Although we have focused on three principal risks in Table 1 above, there are many other risks faced in pension plans which need to be considered in relation to either the sponsor or the member.

- **Tenure risk** – for an individual the risk that they may not stay with an employer until retirement from a pension scheme is a very real one. In a final salary plan, the member who leaves early generally receives a lower benefit than a colleague who stays through to retirement. In a DC scheme the value of the account to date is not affected by whether that member subsequently leaves service. In cash balance plans, the revaluation for deferred members is likely to be identical to that for active members, so that again there is no early leaver “penalty”.

- **Taxation risk** – aspects of taxation for pension plans may change. For example, the 1986 Finance Act required pension funds to identify whether, under certain actuarial assumptions, they had a surplus of 5% or more, and to take action to remove the surplus within five years, or else lose some part of their tax-exempt status. As further examples, in Finance Act 1993 there was a cut in both the dividend tax credit and Advance Corporation Tax, with both reduced from 25% to 20% by 1994, and in 1997 the dividend tax credit was withdrawn. Finally, for illustration, the new simplified regime, which comes into force in April 2006,
may reduce the cost of administering pension plans. Where these tax changes affect the cost of DB pension promises, it falls to the sponsor to make other adjustments as necessary. In a DC plan, the effect is to alter the size of the “pot” on retirement for the member, who therefore carries the risk.

- **Legislation risk** – the legislation governing pension plans may change. In recent years in the UK legislation has prevented “bad” practices and has converted certain types of discretions into guarantees. One effect of this has been to progressively increase benefit levels. Whilst this has undoubted advantages for members, it does have implications for plan sponsors. The requirement to provide LPI pension increases (Limited Price Indexation) added to the cost of defined benefit plans (particularly where the sponsor has not intended to provide these increases) whereas under a DC plan, a requirement to purchase a pension with LPI increases simply restricted the options available to the member. This cost of LPI is now lower, following the reduction of the LPI cap from 5% to 2.5% for DB plans, and its removal altogether for DC plans.
4. Relative attractions

Each type of plan design offers advantages and disadvantages to its members and the plan sponsor. We firstly consider the sponsor’s perspective, which helps give an insight as to why hybrid plans might be attractive. We then look at the relative advantages for members, as well as the issues facing other stakeholders in the market.

**Final salary**

- A specified level of benefit allows the sponsor and member to plan for retirement with greater certainty.

- Pre-funding of the benefit allows the spreading of cost over future periods of time, especially in the case of augmentations. (e.g. on redundancy or downsizing).

- Excess funding can lead to surpluses and contribution holidays. Equally deficits require additional contributions.

- The employer can, within limits, adjust his contributions to meet his corporate requirements and cash flows.

- The converse of this point is that the lack of certainty about the cost of past final salary obligations (e.g. as a result of unknown levels of future pay rises or investment returns) can lead to very volatile, unplanned contribution increases for the employer, especially in very mature schemes.

- There can be “benefit leakage”. If a significant surplus builds up there can be pressure from members and unions to use (part of) the surplus to augment benefits. This has sometimes been at significant cost to sponsors.

- The benefit design offers greater protection for “high flyers” who receive pay rises significantly higher than average. The sponsor may decide that these employees are valuable to the organisation and meet the extra cost of their benefits.

- Under current market conditions in the UK, a final salary scheme could be considered to offer the sponsor market advantage, in terms of recruitment and retention.
Career average

Career average plans are also defined benefit plans and so have many of the characteristics of final salary plans above. Key differences, from final salary plans, might be as follows:

- Removal of the final salary linkage makes these plans less generous and hence lower cost (e.g. than a final salary scheme with the same accrual rate) and hence may represent an opportunity to offer a more affordable, yet still, defined benefit, plan.
- The distribution of resources is more balanced in these plans with less bias in favour of high flyers.
- The opportunity to offer intended, rather than contractual, revaluation (in a CARE plan) may give a significant degree of funding flexibility lacking in more tightly defined final salary plans.

Defined contribution

- The sponsor is not exposed to investment risk, nor to the risk of improving longevity of pensioners.
- The capital nature of the benefit may lead to greater appreciation by members. However, the extremely variable range of potential outcomes can be a source of confusion and distraction for members.
- If benefits turn out to be less than expected, as a result of poor investment returns or otherwise, members may seek to defer their retirement. This could be in conflict with the sponsor’s retirement objectives.
- Members may have a poor understanding of investments and so may take suboptimal decisions. This may result in lower pensions than anticipated unless the sponsor takes a leading role in education and communication. Responsible sponsors will invest in upgrading the quality of investment knowledge of their members.
- Monitoring of investment options and performance may take on a greater significance, since results feed through directly to members’ eventual pensions. Concerns in this area may affect whether sponsors are prepared to take on a greater role (e.g. via trustees in an occupational DC scheme) or prefer a more “hands off” approach (e.g. a Stakeholder arrangement).
- Administration of individual accounts, with multiple investment options and switching potential, is more complex than defined benefit plans – and so should be more expensive (although the different types of administration players in the DB and DC market places may reduce this effect). Even where the sponsor does not directly meet the cost of administration, they feel the consequences of poor administration, in terms of member dissatisfaction.
Cash balance

- The volatility of outcomes (and annual account values) is reduced (compared with DC). This may have advantages for members (less downside risk, less likelihood of loss of capital value) and sponsors (greater appreciation and less uncertainty in the outcomes that influence retirement age).

- The sponsor can take a view of willingness to accept mortality risk, on either a permanent design basis or from time to time as circumstances warrant. They can do this by varying the extent and terms on which they offer annuity conversion through the plan.

- Still has the attraction of an “account based” approach to saving, which may lead to greater appreciation from members (where accounts cannot reduce). Administration however should be less costly than DC schemes, since investments are not allocated directly to members.

- There is an opportunity to introduce greater discretionary elements in the pre-retirement revaluation, thereby offering significant potential funding and investment freedom.

- Payment of less than the face value of the account in cases of transfer or early retirement may lead to dissatisfaction from members.

- In times of rising stock markets, members may prefer the full market exposure of DC plans.

Other hybrids

To the extent that the other types of hybrids identified are combinations of basic final salary and DC “building blocks” they will share the points noted above. The ways in which the building blocks are combined may give rise to new problems and opportunities. For example a DC plan with a DB underpin may give members downside protection from DC variability, but at a potential cost to the employer that the underpin bites more frequently, and more severely, than anticipated.

Members’ perspective

Table 2 below considers the issue of resource allocation and identifies which members are “favoured” under different plan designs. This offers us a member perspective on the different plan designs.
Table 2: “Winners and Losers” from Scheme Design

<table>
<thead>
<tr>
<th>Category</th>
<th>Final Salary</th>
<th>Career Average</th>
<th>Cash Balance</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stayers – i.e. long-term career staff</td>
<td>++</td>
<td>•</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Leavers – these with broken careers</td>
<td>-</td>
<td>•</td>
<td>•</td>
<td>++</td>
</tr>
<tr>
<td>Younger members</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Older members</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Married members</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Single members</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Highflyers – higher pay increases</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Moderate or reducing pay increases</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Healthier staff – higher longevity</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Less healthy staff – lower longevity</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Risk takers</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Risk avoiders</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: + denotes favoured, - denotes favoured against, • denotes neutral

Cash balance could be more attractive to DC members in some conditions. This will be heavily influenced by prevailing market conditions. For example, consider two DC members, each invested in units tracking the UK equity market during one of the following three year periods, respectively:

- 1997/1999: equity return: 20.4% pa, RPI 2.7% pa.

The second member may well see the merit of a cash balance plan design; the first member is likely to feel cheated if he were in a cash balance plan instead. This suggests that some sort of compromise with combinations of pure DC and some element of guaranteed benefits from the employer could strike a more reasonable balance of risk and return for members.

Other stakeholders

At present in the UK, local insurance markets do not offer cash balance plans. The development of these plans has been concentrated in the larger self administered schemes advised by the employee benefit consultants. The smaller end of the market is now predominantly a DC environment and there are few signs that many of the sponsors of these plans have the appetite to take on the risks that would be implied by moving to cash balance plans. Should insurers develop access to cash balance type funds on a unitised basis (that could be slotted into a DC structure) it is possible that we could see interest from the lower end of the market.

In many cases the types of commercial product that may be needed are some form of capital guarantee but with equity exposure to deliver some “upside”. This could
make a with-profits concept the solution although the well publicised problems
with this investment vehicle will deter providers, or could result in new incarnations
of the concept being offered. Insurers will be keen to ensure that any potential
market growth for hybrid products is not stifled by over-regulation or by a poor
perception amongst members and sponsors.
5. Hybrid attractions and issues

Hybrid plans may become more prevalent in the UK not just because of their inherent attractions, but because of experienced or perceived problems with traditional final salary and DC designs. The extent to which hybrid plans address these weaknesses may help explain their attraction.

Push factors away from final salary and defined contribution

The reasons for the decline in final salary schemes in the UK in the recent past are well documented and summarised as below. What may have started as a desire on the part of sponsors to control the volatility of pension costs, quickly turned into a desire to reduce pension costs, as those costs escalated. The key factors increasing the cost were:

- Lower interest rates and lower (or negative) investment returns.
- The impact of improved longevity.
- Tax changes.
- The conversion of discretions into guarantees and progressive improvements in benefits.

The above contributing factors led many employers to close their final salary schemes to new entrants and to offer DC schemes instead. In the relatively recent period since the introduction of these schemes, a number of issues have emerged which point to potential problems ahead.

- In general, contributions to DC schemes are significantly lower than the corresponding contributions to final salary schemes. Low contributions can arise from the basic employer contribution rate or from a failure of members to maximise the opportunities available to them. Many DC schemes offer “matching” contribution arrangements, but not all members take advantage of the maximum match available.
- The variability of outcomes of DC plans may deter members from saving, or add to their confusion and concern about pensions.

![Diagram showing range of ages at which a member of a DC plan might expect to accrue a pension of 50% of pay](image)

- Variability of outcomes, and the tendency of members not to retire when markets are low is a concern. The diagram opposite shows the range of ages at which a member of a DC plan (entering at age 25 and paying contributions of 10% of pay) might expect to accrue a pension of 50% of pay (darker shading shows more likely outcomes). The age depends on the investment strategy, but it can be seen that there is a huge range of potential outcomes for members who follow predominantly equity orientated strategies.

- Many UK employees are not willing or able to take the investment decisions needed to deliver sound benefits from quality DC plans. This has resulted in various approaches to help them – such as the use of default lifestyle investment strategies, and an increasing responsibility on sponsors to ensure effective communication with their employees.

**Pull factors – cash balance**

The cash balance plan investment risk for the sponsor is materially lower than the corresponding risk for a final salary scheme for two principal reasons:

- The investment objective is typically a lower, and largely investible, risk. There are no financial instruments that exactly match a final salary liability. However if the revaluation in a cash balance plan is equal to, say, the RPI then it is possible to buy government-backed index-linked securities that deliver this return with certainty. A sponsor may still choose to mismatch, with a view to capturing superior returns and reduce the cost of the benefits.

- The timescale for investment is shorter than in a final salary scheme, since it relates solely to the period up to the date of retirement. In a final salary, or CARE plan, the investment risk continues into retirement since pensions are provided from the scheme.
A number of recently introduced cash balance plans and CARE plans have reflected the problems arising from guaranteed benefits and have structured their benefit obligations differently going forward. The benefits promoted to members may not be the strict legal entitlement. Hence there may be no strict guarantees of revaluation but an intention to provide them. The terms under which the discretion may be exercised not to award a benefit determine the extent of protection which the sponsor receives – but equally they are a source of concern for members since they introduce greater uncertainty in the planning for their retirement. The sponsor should ensure that the true position is fully disclosed to members. A concern however for employers may be that in trying to be helpful to members – e.g. giving an indication of the scope and incidence of future discretionary awards – the employer may be setting an expectation which is difficult to subsequently match.

Cash balance plans may simply require members to purchase an annuity in the open market. In these cases there is no residual annuity conversion risk for the employer. However some employers would expect to provide the annuities through the scheme, particularly if there is a large mature final salary scheme with a substantial pensioner payroll in existence. In these cases the rates of conversion may be related to market rates, or they may be deliberately set to be more advantageous. Some sponsors may attempt to follow market annuity rates (in respect of e.g. mortality and investment returns) but look to strip out the expense margins, profit loading and cost of capital reserves that the commercial market incorporates. It could be argued that this is simply a benefit augmentation and so should be viewed accordingly. However the risk aspects are very different between the in-house and external purchase routes.

Cash balance plans are defined benefit plans with a given benefit payable from a normal pension age. If benefits are paid prior to this date, there would normally be an element of discounting to reflect the early payment. This arises in both early retirement and transfers to other schemes. The issue which arises is that the amount available for transfer would not necessarily be the face value of the member’s account, but the discounted value of the amount available at normal retirement. Failure to disclose and communicate this point to members may lead to significant dissatisfaction with this type of arrangement.

Consider a member aged 40 who is in a cash balance plan with a normal pension age of 60. The member has an account balance of £100,000 and the account is subject to annual revaluation in line with the RPI. The amount available for transfer is calculated by discounting the projected account balance back from age 60 to age 40. Given that the account is revalued in line with the RPI, the effective rate of discount can be taken as the “real” (i.e. inflation adjusted) yield on government debt. If this rate is, say, 2% p.a., then the transfer value is equal to the face value of the account discounted by 2% for 20 years i.e. $100,000 / ((1.02)^{20}) = £67,297$
6. A global perspective of hybrids

In the main report we consider some of the global context for hybrid schemes. We have looked in depth at four selected countries (in addition to the UK) which illustrate particular themes about hybrid plans. We have also considered a wider range of other countries where hybrid plans form a material part of the pensions landscape, and which offer insight into either general or specific points. The key learning points from each of the four major countries are set out below.

US

Cash balance plans (the most common form of hybrids in the US) were introduced in the 1980s, largely because they were perceived as being better understood and appreciated by employees (a “pot of money”) than a traditional final salary scheme. About a quarter of major US employers now offer such a design. The overall design is similar to UK cash balance plans outlined earlier, but the rates of revaluation are often different; and typically related to yields on long-dated government bonds. For the sponsors of these plans, the ability to provide a defined benefit related to bonds, but investing in equities which are expected to give a higher return, has been a useful way of reducing long-term costs (at least until the market downturns in recent years). Cash balance plans in the US have definitely been seen as a replacement for more conventional DB plans at least until the recent high-profile issue of whether US cash balance plans breach a specific aspect of their age discrimination legislation.

Switzerland

Plan design in Switzerland is in practice less varied than in the UK or US. Virtually all plans are effectively hybrid plans because of legislation: DC plans are required to offer a guaranteed minimum annual investment return, and DB plans are subject to a DC “underpin” on a certain slice of salary. It is interesting to note that the guaranteed investment return in a DC plan may be underwritten by an insurance company if the plan is insured. In this case, the plan design from the employee’s
perspective is clearly hybrid, even though from the employer’s perspective (and for accounting purposes) it can be regarded as a defined contribution plan.

**Netherlands**

50% of Dutch employees were members of final salary plans in 2003 but this declined to 10% in 2004. Employees are increasingly being given revalued career average benefits, or “combination” hybrids offering revalued career average benefits up to a salary limit and DC on salary over the limit. In many schemes “conditional indexation” of pensions takes place, under which indexation is only given if financial conditions permit.

**Belgium**

Again, legislation has led to the majority of plans being hybrid plans according to our definitions. From 2004, all DC plans have to offer a guaranteed minimum annual investment return. Also, most DB plans now define their benefit in lump sum terms, thus transferring the post-retirement mortality risk to the employees.

**Other countries**

Our review of other countries has concluded that in virtually all cases, the hybrid plans that do exist are as a result of constraining legislation, similar to Belgium and Switzerland above. For example, tax relief in Germany is much more generous for defined benefit plans, so companies wishing to move to DC often introduce a cash balance design. This is because a cash balance design is generally regarded as being the “furthest they can go” on the track to DC while remaining defined benefit as required for tax. Anecdotally, in our experience, the US and the UK are the most advanced in terms of development of hybrid plans, and their employers are perhaps the most willing to invest the time and effort to consider complex pension designs and communicate them to their employees.

It is important to distinguish between the imposition of a hybrid design by local legislation on the one hand, and the choice by employers to adopt hybrid designs in the context of flexible legislation on the other. Some of the barriers to the wider global development of hybrids that we have perceived are:

- The reluctance of employers to “rock the boat” in terms of pension scheme design, or to become involved in pension provision more than they have to.
- The perceived complexity and difficulty of communication of some hybrid designs.
- The absence of third parties such as insurance companies willing (on a cost-effective basis) to offer guarantees that employers themselves are reluctant to offer (e.g. investment guarantees).
- Members being suspicious of new designs and reluctant to embrace employee choice.
In other countries (in our experience) insurance companies tend to offer minimum investment returns only to the extent required by legislation; the current low-interest-rate investment environment makes offering any guaranteed return difficult. However, capital guarantees (i.e. a guarantee that the overall investment return will not be negative) are widespread, as the concept that “values can go down as well as up” is not widely understood or accepted by the general public in many countries, particularly in Continental Europe. Generally, the products offered by insurance companies tend to be relatively simple in design, with complexity and innovation focused on the investment return credited.
7. The potential growth of hybrids

In considering the prospects for the growth of hybrid plans in the UK we need to distinguish between the different types of hybrids, since the rationale behind the initial plan design will be a key factor in determining the growth prospects analysed by type of scheme. We set out below our opinions on the growth prospects. We look at these issues primarily from the perspective of the corporate sponsors.

**Career average plans**

- Will often be adopted by employers looking for pensions solutions that are still defined benefit, yet cheaper than final salary (through a lower salary risk) although this may be offset by changing the accrual rate.
- Greater elements of discretionary revaluation may appeal (e.g. in service and in deferment) but this will have an impact for members.
- Offers a more equitable distribution of pension cost than a final salary scheme.
- The development of these schemes will be largely amongst the larger private sector employers who still have final salary plans.
- It is unlikely that employers with DC plans will be persuaded to switch to career average plans.

**Final salary lump sum plans**

- Have not really “arrived” in the UK as yet. Growth prospects are muted.

**Sequential hybrids**

- It looks increasingly less likely that individuals will be able to “migrate” from the DC plan to joining the DB plan after an agreed waiting period. DB plans are more likely to close to all members.
Combination hybrids

- The key growth here will probably come from those companies who are reluctant to abandon defined benefit provision but who need to reduce their overall risk profile – hence will offer combinations of reduced accrual DB topped up by DC contributions.

- Whether this type of arrangement is sustainable longer term, or whether it will simply represent a transitional stage to pure DC remains to be seen.

Underpin plans

- The main attraction of these plans will continue to arise from the financial options surrounding contracting out of the State Second Pension (S2P).

- The financial terms for schemes which contract out of S2P on the Protected Rights basis are more attractive for an older workforce. As the average age of closed DB plans increases, we may see more employers adopting this route, and thereby creating underpin plans.

Cash balance plans from DB plans

- In our view the greatest growth potential for these plans will come from employers with current DB (e.g. final salary) plans who are reluctant to pass on all investment risk to members, but who become increasingly concerned about the effect of (unknown future) longevity improvements.

- In some cases the conversion of past benefit entitlements to cash balance may represent a further attempt to de-risk corporate pensions (e.g. where a final salary plan has already closed to new entrants or to future accruals).

- It should be noted that many of the influencers of corporate pension development may have vested interests in promoting the growth of hybrid plans. They probably present greater commercial opportunities and a stronger rationale for the use of actuaries. Trade organisations such as the NAPF may feel they have more influence in relation to defined benefit and cash balance plans rather than DC plans.

- There are increasing concerns that it could be argued as discriminatory (from an age discrimination perspective) or objectionable (from an HR perspective) to operate a closed (high cost) final salary plan and an open (low cost) DC plan. A common approach via a hybrid plan is one potential solution.
Cash balance plans from DC plans

- We have already witnessed some isolated examples of companies who have replaced a DC plan with a cash balance plan. The extent to which others will follow this trend is unclear.

- The issue is likely to centre on the extent to which some of the DC downslides noted earlier are believed to be material. Will issues such as the volatility of DC outcomes, the correlation of retirement and market downturns, inadequate contributions or poor take up rates persuade employers to switch to hybrid plans?

- Many employers have suffered significantly from the disruption of their business as a result of pension deficits and their consequences. Having made a move to DC as their longer-term benefit provision, they may be reluctant to move “back” to DB or hybrid plans.

- A counter to this would be if the competition for talent toughens in future years, as we expect it to as a result of demographic changes. In these circumstances, employers with DB plans can expect to promote these plans as part of their marketing to prospective employees. Cash balance plans should, presumably, occupy some sort of middle ground – more attractive than DC, but not as attractive as final salary.

In our view, one of the key factors that influences the development of hybrid plans is local legislation. Legislation can be a driver that either stimulates or discourages the development of hybrid plans. So for example in several of the European cases, the government’s insistence on minimum rates of return has automatically created a hybrid environment. In the US, cash balance plans did not, in contrast, arise out of legislation changes – they arose largely to address poor perception amongst members of their existing (DB) plans. However the future for these cash balance plans is now subject to significant uncertainty as a result of legislative developments – the age discrimination claim in the IBM case. The fact that this issue came to light some 10 years after the plans started to become popular is a major concern for US corporations who have introduced these plans.

In a UK context, the impact of regulation (current or potential) is crucial. We have highlighted in the main report a number of current themes (whilst noting that some of these may have been clarified by the time of publication) including:

- Statutory indexation of pensions in payment.
- Equal treatment issues.
- The treatment of discretionary benefits in relation to funding and disclosure to members.
8. Conclusions

The growth of hybrid plans in the UK is unlikely to be as dramatic as the growth in DC plans, because of the different drivers. The move to DC was part of a global trend, driven largely by financial considerations, as sponsors sought to take control of both the volatility and the overall cost of their defined benefit plans. Sponsors may be reluctant to move back to a position of taking on corporate risk in relation to employees’ pension promises. However many of the factors that may lead to a greater prevalence of hybrid plans stem from the very uncertain outcomes inherent in DC plans and the volatility of members’ accounts (where they follow equity-orientated strategies designed to maximise their future pensions):

- Some sponsors will be reluctant to pass on the investment risk to employees and so will offer career average, cash balance or combination plans instead. This could lead to a more balanced sharing of risk between sponsor and employee.

- Concerns about the susceptibility of members’ retirement dates to market conditions, may persuade DC sponsors to take on limited amounts of pension risk.

- Government may wish to consider whether the variability of DC plans is acting as a disincentive and that individuals are being discouraged from saving sufficiently for their own retirement.

- Members themselves, and their trade unions may reject DC benefits; labour market pressures may lead to some more controlled outcomes through hybrid plans.

The growth of hybrids may come from a variety of directions, with global precedents for each of the main forces of change. The moves away from the polarised scheme designs of pure final salary and pure DC look set to continue.
Comparing pension outcomes from hybrid schemes

by Dr Deborah R Cooper
1. Introduction

This report summarises the results of an analysis of what pension is likely to be paid to people at retirement, depending on their working history and the occupational pension schemes available to them.

The analysis looks at results produced using both fixed (deterministic) financial assumptions and a stochastic basis. A parallel investigation has been done to illustrate the variety of outcomes that could have emerged based on actual returns achieved in the past.

The scheme designs, which have been chosen as presenting different ways of sharing risk between the employer and employee, are:

- Final salary
- Career average
- Defined contribution (DC)
- Cash balance (with and without discretionary investment return ‘bonus’ allocation)
- Nursery (defined contribution before age 45; final salary after age 45)
- Defined contribution top up (final salary applying to pay up to twice the Lower Earnings Threshold. Those paid above the threshold pay into a defined contribution arrangement).

The first two schemes are ‘defined benefit’, where the pension paid depends solely on the scheme rules; in a defined contribution scheme, the pension depends solely on the contributions paid into the scheme, their investment performance and the cost of purchasing an annuity at retirement. The remaining three schemes are ‘hybrid’ designs, which combine the risk characteristics of defined benefit and defined contribution schemes.

The accrual rates of the different scheme types have been selected so that for an ‘average’ employee the cost to the employer of providing the benefit will be similar. We have assumed that the total contribution rate paid on behalf of all employees will
be 15% of pay\(^1\) and that the normal retirement age is 65, when all schemes provide (via annuity purchase for DC funds and the cash balance schemes) pensions with a 50% dependent’s benefit and increases in line with Limited Price Indexation (LPI) with a 2.5% cap.

The analysis allows for investment return until the pension is drawn, with contributions being invested in funds made up of a mixture of bonds and equities. The results for the defined contribution and hybrid schemes include outcomes for a variety of investment strategies, ranging from 100% bonds to 30% bonds and 70% equities. ‘Lifestyling’ (where the percentage of the fund invested in equities is reduced in the years prior to the retirement age) is also considered.

Other factors included are inflation, future salary growth and the probabilities of both death and withdrawal.

Based on analysis of typical employment trends the following working histories were considered, all starting from age 25:

- Full time, with a complete working history.
- Full time with moves (job moves at ages 26, 28, 31, 36 and 46)\(^2\).
- Part time and breaks (part time work until age 30 then 5 years out of formal employment then a gradual return via part time work).
- Full time and break (full time work until age 30 then 5 years out of formal employment then an immediate return to full time work).
- Flexible retirement (full time work until age 55 then a reduction in working hours up to retirement).

Three different salary paths have also been considered:

- A ‘professional’ earnings path, which assumes that real pay (that is, in excess of inflation) increases at 3% per annum until age 50, after which pay increases in line with inflation only.

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\(^1\) The Pensions Commission (Pensions: Challenges and Choices; The First report of the Pensions Commission, HMSO 2004) estimates that almost everyone over age 35 should be saving more than 10% of their pay to reach replacement ratios appropriate for their level of pay.

\(^2\) The ‘full time with moves’ working history has been included in one particular instance in the report to investigate the effect of frequent job changes on the benefit paid by final salary schemes. Job changes do not affect the benefit paid by the other schemes. So unless specified otherwise, the analysis throughout this report referring to the ‘full time’ working history is the full time with complete working history and no job moves.
• A ‘skilled’ earnings path, which assumes that real pay increases at 2% per annum until age 50, after which pay increases in line with inflation only.

• An ‘unskilled’ earnings path, which assumes that real pay increases at 2% per annum until age 35, after which pay increases in line with inflation only.

Various sets of results have been produced, allowing for different start ages, pension scheme histories, salary and employment histories. The aim is to provide an understanding of the value of the benefits employees could receive under different pension scheme structures.

Replacement ratios (a ratio of pension to pay) are used to compare the level of pension received at retirement to pay received before retirement. They provide a snapshot, taken at retirement, of what benefit a scheme provides and so an indication of how an individual might be able to maintain his or her standard of living. Three different replacement ratios are used, depending on the definition of pay, as indicators of pension outcomes:

• ‘Final pay’ ratios show the ratio of pension to final pay;

• ‘Annualised pay’ ratios scale up final pay for part-time employees, so that a more direct comparison with full-time employees can be made;

• ‘Revalued pay’ ratios, which show the ratio of pension to the individual’s average pay over their working lifetime, revalued to retirement.

Most of the analysis presented in this report is based on the revalued pay ratio.
2. Central outcomes – fixed financial assumptions

Direct comparisons between different schemes are simpler if variability of outcomes due to uncertainty in financial markets is ignored, so we begin with fixed financial assumptions (a deterministic approach). The main financial assumptions used are inflation of 2.5% per annum, equity returns of 8% per annum and fixed interest returns of 4.5% per annum.

Different scheme designs produce different outcomes depending on the circumstances of an employee’s working life. However, the deterministic results show that a member first joining an occupational pension at age 45 receives more or less identical value from each scheme type, assuming DC funds are invested 100% in bonds, and that the benefits targeted by each scheme are reasonably consistent (see Chart 2.1). This is because the scheme designs were developed assuming a membership with average age about 45 and 100% bond investment.
Differences between schemes start to emerge if we consider individuals who join the scheme at other ages and pursue different investment strategies, where they are given this choice. There are also differences in replacement ratios depending on working history – those people with career breaks and/or part time employment near the start of their working lifetimes receive pensions at lower replacement ratios than those with other working histories (see Chart 2.2).

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3 In all charts presented in this report, the investment split between bonds and equities referred to are the splits in the defined contribution scheme or the defined contribution elements of hybrid schemes. Where the pure defined contribution scheme includes any equity investment, the scheme incorporates a 5-year lifestyling strategy.
Chart 2.2

Revalued pay ratio for various schemes and work histories. A salary of £20,000 at a start age of 25. The retirement age is 65, salary increases are ‘skilled’ and investments are 50% bonds.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Full time</th>
<th>Part time with break</th>
<th>Full time with break</th>
<th>Flexible retirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final salary</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Defined contribution</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Career average</td>
<td>60%</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>Cash balance</td>
<td>70%</td>
<td>60%</td>
<td>50%</td>
<td>40%</td>
</tr>
<tr>
<td>Nursery</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>DC top up</td>
<td>90%</td>
<td>80%</td>
<td>70%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Working history

- In the final salary scheme, the lower replacement ratios for people with career breaks are largely due to accrual prior to the period out of paid work being treated as deferred pension. The deferred benefit increases in line with LPI and since, on average, salaries increase faster than prices, the eventual deferred benefit received is likely to be lower than it would have been if the member had remained an employee with that company (the ‘salary link’ is lost).

- We have assumed that the cash balance with bonus scheme would only distribute bonus to active members, so deferred members in this group will lose access to investment growth over and above LPI increases.

- In the defined contribution scheme, the difference is due to the break from paid work occurring in the early period of the individual’s working lifetime. Payments made longer before retirement contribute proportionately greater value than those made later, due to compound interest, so by either not contributing, or paying lower contributions, early on, it becomes more difficult to reach the ‘target’ replacement ratio.

Age of joining

- Schemes with a defined contribution element (except defined contribution top up) achieve higher replacement ratios for people who join at younger ages than schemes that are entirely defined benefit. This is because in defined contribution arrangements the 15% contribution accrued solely to the member on whose behalf it is paid, whereas in defined benefit arrangements there is cross subsidy from younger to older members. Thus, all else being equal, a fixed contribution
scheme tends to provide a greater rate of return for employees who join at younger ages, whereas defined benefit schemes tend to provide higher implicit returns for those who join at older ages.

- Nursery and defined contribution top up arrangements both offer employers the opportunity to manage their exposure to risk by combining defined contribution and defined benefit elements. The Nursery scheme under a deterministic approach shows good value for younger members but poorer value for people who join at older ages, since they do not get the same benefit from the relatively high contribution rate at younger ages. The net effect of a nursery arrangement is that both employees and employers can be exposed to all risks, but the extent depends on their age, career and salary profile.

**Investment strategy**

- Members in schemes which invest a proportion of the contributions in equities get the benefit of all equity ‘out-performance’ and therefore are able to achieve higher replacement ratios than those with purely defined benefit schemes. However, deterministic calculations do not show the risk inherent in this strategy.

**Salary history**

- In nearly all cases the replacement ratio is lower for people with higher rates of salary growth. This is because the difference between rate of growth in the accrued benefit and the rate of growth in pay is greater for those with low assumed salary growth, so they get a better relative rate of return from the scheme. Effectively, the real (relative to earnings) value of the benefit a low skilled person accrues each year is maintained better than it would be for a person with higher salary growth.

- The results show that the rate of salary progression does not affect the value provided under the final salary design. The salary progressions used in the analysis are based on typical career progressions and do not cover more unusual patterns, such as people receiving large pay awards immediately prior to retirement. As people approach a scheme’s normal retirement age, unless they are receiving high salary increases, each additional year of accrual in a final salary scheme will have less value than the previous year’s, since each extra year adds proportionately less to the final benefit. Thus, final salary schemes implicitly encourage early retirement, at least for those that can afford to forgo their salary – so this design feature is also likely to create possibly perverse incentives for the select group of ‘high fliers’.

- The defined contribution top up scheme balances the defined benefit and defined contribution risks differently to Nursery arrangements, since people on low pay will never be eligible for the top up part of the scheme. Thus, low paid people who do not expect much real salary growth will only ever be defined benefit members, so that their employer bears all the risk (setting aside insolvency risk),
whereas higher paid employees, particularly those with high expected rates of salary growth, will bear an increasing share of mortality, salary and investment risk. The result is that higher paid members of the defined contribution top up scheme can achieve higher replacement rates, since they are assumed to get the benefit of equity out-performance in the defined contribution section of the scheme.
3. Variability I – stochastic financial assumptions

The deterministic approach makes it very easy to see the differences between different scheme designs. However, it does not deal with the variability in outcomes and, therefore, the different risks which members are exposed to under different scheme designs. A stochastic analysis can be used to illustrate this variability and how members are exposed to more investment risk in some scheme designs than others.

The most important lesson for employers considering occupational pension provision is to understand the consequences of the different types of risk sharing inherent in the different scheme designs, particularly given the nature of their workforce (see, for example, Chart 3.1).

Chart 3.1

Revalued Pay Ratio statistics for various scheme types. Assumes a start age of 45, retirement age of 65, ‘full time’ work history and ‘skilled’ salary growth. The investment strategy is 100%:0% (bonds:equities).
The designs exposed to the underlying investment experience of the fund present a wide range of possibilities:

- The Cash balance scheme provides a benefit linked to LPI, with a 5% cap. Inflation and bond returns are closely associated in the stochastic model, and this is evident in a comparison between the pure defined contribution and cash balance outcomes. The spread of results under the cash balance plan is narrower, due to the absence of direct exposure to investment risk. The cost of buying an annuity at retirement also contributes to the variability in results under the defined contribution and cash balance plans, since annuity rates depend on bond yields at the time of purchase.

- The cash balance with bonus scheme produces an outcome that is much closer to the pure defined contribution result but with a relatively protected ‘downside’. This outcome is achieved partly via the rules that allocate investment bonus, which aim to ensure that the fund can continue to meet its guaranteed rate of revaluation even when it does not receive sufficient investment return during the year. Consequently, in years when investment return is high, not all of it is allocated to members. Even so there is a risk that over an individual’s lifetime as a member of the scheme, the fund ends up with an insufficient reserve. This risk is borne by the employer and is recognised in the lower accrual rate relative to the straightforward cash balance design.

- The distribution of outcomes under the final salary and career average schemes is very limited, because the benefit is so closely linked to the salary definition used to calculate the ratio. Thus, provided each member anticipates a retirement benefit in terms of a proportion of their final pay, they should not be disappointed, but if they are more concerned with absolute amounts there would be more variation than appears in Chart 3.1.

The variance in performance is more evident when scheme membership is viewed over a longer term. ‘Long term’ investment is sometimes considered as lower risk than short term, but this is not necessarily the case.

Comparing the results from different scheme types provides insight into how sharing investment risk between employer and employee affects outcomes. The pure defined contribution scheme has no risk sharing, but employees can mitigate their exposure to investment risk by investing partly in bonds and by adopting lifestyling prior to retirement. The more risk averse the member, the greater the proportion likely to be invested in bonds. As expected, this both reduces the mean outcome that could be achieved, which might not be desirable, but also the variability in outcomes, which is likely to be desirable.

Nursery schemes risk share by limiting pure defined contribution saving to employees’ at younger ages, which is the period when the contribution is most valuable. At older ages, employees join a final salary scheme, where investment (and other) risks are entirely with the employer. The risk ‘trend’ is similar to lifestyling, in that risk reduces as the employee nears retirement, but more extreme. The defined contribution
top up scheme also combines pure defined contribution with final salary provision, but distributes the risk sharing differently. Those employees with lower rates of pay remain solely in the ‘risk free’ final salary scheme and only higher paid employees have to bear any investment risk.

Pure defined contribution schemes can produce better results than most other designs, with a high degree of probability (see Chart 3.2), even when the underlying investment strategy is low risk (see Chart 3.1). Thus, defined contribution schemes are not inherently poor providers, as they are sometimes portrayed. The difficulty with many of the defined contribution schemes that have been established over the recent past is that they have been used to replace final salary schemes that targeted a high level of benefit.

**Chart 3.2**

Revalued Pay Ratio statistics for various scheme types. Assumes a start age of 25, retirement age of 65, ‘flexible retirement’ work history and ‘skilled’ salary growth. The investment strategy is 30%:70% (bonds:equities).
4. Variability II – past investment returns

This chapter summarises results using historical market indices to illustrate what might actually have happened based on investment experience in the past. The range of outcomes is quite similar to those described in the previous chapter. The market indices relied on for the analysis are:

- Price inflation (from the UK Retail Prices Index)
- Salary inflation (from the National Average Earnings Index)
- Equity returns (from the FTSE All Share total return index and the FTSE All Share price index)
- The yield on fixed interest stocks (from the FTSE Actuaries Government All Stocks total return index)

Monthly data points were gathered for the past 40 years, so that the periods being compared within each distribution are not always independent. For example, it is likely that a large proportion of the poorest outcomes were a result of people assumed to reach retirement in 2002, when markets had fallen considerably, whereas a high proportion of the better results will be due to retirements in 2000, just before the recent market crash.

The results clearly show the variability in pension replacement ratios for scheme types where the employee takes on the investment risk (see Chart 4.1).
Chart 4.1

Revalued Pay Ratio statistics for various scheme types. Assumes a start age of 45, retirement age of 65, ‘full time’ work history and ‘skilled’ salary growth. The investment strategy is 100%:0% (bonds:equities).
5. Unexpected events

This section investigates how outcomes might change if some event occurs that is unlikely to be predicted (a ‘shock’), such as a sudden and uncorrected fall in financial markets. The likely consequences to scheme members can be mitigated either by the employer through the choice of scheme design or, where the employee bears the risk, by judicious choice of investments. However, some risks cannot be removed entirely.

The most difficult risks to avoid are longevity risk, prior to annuity purchase, and longer term investment risks. These risks are borne entirely by employers in defined benefit schemes targeting pensions rather than lump sums (that is, the final salary and career average schemes). In defined contribution schemes, employees bear these risks.

When a ‘shock’ becomes a long term shift in market values, the cost of adjusting to the consequence is even harder.

**Longevity risk**

Unexpected longevity improvement causes problems in estimating how much to save in order to provide an ‘adequate’ annuity at retirement. By comparing annuities the results show us that (assuming our assumptions are borne out, and all else being equal) future generations of pensioner with defined contribution or cash balance plans are likely to have to pay about 12% more for an annuity than the current cohort of retirees.

In defined benefit schemes that target a pension, the cost of improvements in longevity will fall on employers. However, as the cost of pension provision rises, it is likely that employers will cut back on the level of provision they make, so there is a secondary effect on employees.

A potentially more significant and abrupt change in annuity prices could occur if bond yields fell suddenly. If the real yield available from bond investments fell from 2% (our assumption) to 1%, the cost for the same pension would increase by about 12%.
If people choose to drawdown their savings when they reach retirement, rather than buy an annuity, then they continue to be exposed to all the risks that they were exposed to whilst of working age (for example, investment and inflation). They also have to manage the timing of their annuity purchase and are exposed to two new risks: deciding the rate at which they drawdown on their saving and ‘mortality drag’. The latter is the extra cost incurred by those who purchase their annuities at older ages, because they lose the benefit of cross subsidy from those purchasing at a younger age and dying earlier than expected.

**Market falls**

The effect of a 20% fall in investments on a member of a defined contribution scheme would be mitigated if the fall was restricted to equity markets only, and the member had either invested largely in bonds or followed a lifestyling strategy in the years up to retirement. However, by pursuing this strategy, members also have to forgo the opportunity of equity outperformance in the last few years of their working lifetime. The distribution of outcomes is narrower if a lifestyling approach is used but there is also a significant chance that replacement ratios are lower. The set of possible outcomes a member would find most appealing will depend on their attitude to risk.

The consequences of a fall in investment markets can be mitigated if the member can defer retirement until their account balance recovers, although this is less likely to be an option in a cash balance scheme where the employer carries some of the risk. The ‘recovery’ could be via making additional contributions or through improved investment performance. However, if the investment fall occurs only shortly before reaching the scheme’s normal retirement age, there might not be the opportunity to continue in work, which is likely to be a necessary condition for making additional contributions.

In 2000, people were retiring on historically high levels of pension, to the extent that pensioners, as a class, were no longer (proportionately) the poorest group. This affect was partly a consequence of mature final salary schemes with surpluses, which enabled employees to retire with augmented benefits.

Since 2000, employers have become much more aware of the possible repercussions from this type of generosity and many more employees only have access to defined contribution schemes where there is no risk sharing. If the investment market trends apparent at the start of the 21st century continue and markets continue to stagnate, or fall further, then future generations of retirees will be exposed to high levels of poverty unless prices also fall. Once people have reached retirement, their opportunities to save are severely curtailed.
Scheme closure

A risk to employees that has often been understated in the past is that their scheme is wound up before they reach retirement. The greatest risk arises when defined benefit schemes are not sufficiently funded to buy out the accrued liabilities. The obligation recently imposed on solvent employers to fund wound up schemes to full buy out cost, and the Pension Protection Fund established under the Pensions Act 2004, have curtailed these risks.
6. Conclusions

No single pension scheme design produces the ‘best’ outcome in all circumstances and the designs that can produce the highest replacement ratios are also those with the greatest variability in outcome.

Higher pension can be expected the longer an employee contributes to a pension scheme. However, longer term investment is associated with a wider variation in outcomes, with some investors benefiting from very high returns, but others doing poorly.

Investment risk, together with the cost of buying an annuity at retirement, is responsible for a large part of the variability in outcome for schemes with a defined contribution element. In contrast, employers carry the risk (or some of the risk) in schemes with a defined benefit element. This provides more stable outcomes for members but also removes the possibility of higher pensions if investment returns are favourable. Losing this possible ‘upside’ is a cost of the security.

The final salary and career average schemes involve the least sharing of risk with employees and so the least variability in outcome. Employees have to bear the risk of employer insolvency but this is true of all defined benefit arrangements, and the effect has not been directly included in this analysis. Insolvency risk has reduced since the introduction of the Pension Protection Fund.

The cross subsidy that final salary schemes are supposed to impose from people with flat salary progression to those with higher salary progression is overstated. Most employees cannot manipulate their pay or career in such a way as to maximise the advantage from this design. Cross-subsidy does arise from job moves, however.

In the career average scheme, there is also the risk that employees’ salary growth will be significantly greater than benefit revaluation. Career average schemes provide close to final salary benefits for people with flat salary progression and, if they have higher accrual, will give higher benefits for people in this class.

Both the defined contribution and the cash balance designs pass on all mortality risk to employees, whereas other risk sharing schemes, such as nursery and defined
contribution top up schemes, share mortality, as well as the investment risk, with the employer. However, the degree of risk shared differs according to age (the nursery scheme) or rate of pay (the top up scheme). Whether this is desirable (to employees or employers) will depend on various factors including the employer’s objectives regarding pension provision and the employees’ age and salary profile.

The pure defined contribution scheme seems to produce the best outcomes in most cases, but also gives the highest probability of a poor outcome, i.e. there is a small (but statistically significant) probability that members will reach retirement without having maintained the value of their saving in real terms (based on largely equity based investment). Depending on the investment strategy, there is also a high probability of achieving a replacement ratio lower than that provided by the final salary scheme.

The cash balance with bonus scheme appears to mitigate the worst effects of pure defined contribution benefits by pooling investment risks and managing bonus distribution.

The degree to which the employer and employees share the risk that a ‘target’ benefit might not be delivered is fundamental to the variety of outcomes. The final salary scheme, for example, produces a consistent outcome with very little variability, but therefore misses some of the very good outcomes produced under the pure defined contribution and cash balance with bonus schemes. This is because employers that provide final salary schemes bear all the risk.

For those employees who want a certain level of benefit, and measure the certainty in terms of fractions of final salary, only one type of scheme will do. But final salary schemes place all the risks of pension provision on the employer and shareholders are increasingly reluctant to provide the capital to support these risks. On the other hand, the simple solution for shareholders is a pure defined contribution scheme (putting to one side ‘soft’ issues to do with employee relations, for example), since they require no capital support, but these impose the greatest risks on employees.
The optimal allocation of pension risks in employment contracts

by Dr David McCarthy
1. Introduction

This report examines the optimal allocation of pension risk between workers and firms under different types of occupational pension, including defined contribution, defined benefit and various hybrid pension scheme designs.

A basic assumption of the report is that pensions form a part of the total compensation package that employees receive in exchange for their services to the employer, and that workers care only about the utility they derive from the consumption that their total compensation package can support over their entire lifetimes. The employer chooses how much to pay workers in the form of pensions, and how much to pay them in the form of cash. To some extent, these two forms of compensation are substitutes: firms which pay large pensions do not need to pay as much cash salary, and vice versa.

However, paying employees in the form of pensions exposes employers and employees to risks different from the risks that they are exposed to if they are paid purely in cash. The risks that we focus on in this study are:

- investment risks, by which we mean unpredictable fluctuations in asset returns from year to year;
- individual mortality risks, by which we mean the possibility that individual workers may die very young, or live until they are very old;
- cohort mortality risks, by which we mean that the life expectancy of an entire cohort of workers may change in unanticipated ways;
- salary risks, by which we mean that workers do not know how much they are going to earn later on in their lives; and
- job tenure risk, by which we mean that employee’s actual tenure in jobs may be longer or shorter than anticipated.

If workers and firms could trade (for instance, in securities markets) unlimited quantities of all the risks to which they were exposed, and there were no moral hazard or information asymmetries between different market participants, then the report shows that the pension decision would be irrelevant. Workers and firms
would both value their pensions at the price at which they could be bought or sold in the market and they would adjust their actual portfolios to ensure that they were only exposed to risks that they were willing to bear at the traded market price of each risk. Stated in economic terms, if markets were complete then the amount that workers were paid in cash, or in pensions, or in pensions of different types, would be irrelevant to the workers' assessment of the value of their compensation. It would also be irrelevant to firms' assessments of how much different forms of compensation cost. This is a generalisation of a result by Blinder (1983).

However, markets are not complete: workers cannot sell their pensions, and they cannot buy or sell unlimited quantities of risks, even those risks which are traded in markets. They also cannot fully accommodate the investment and other risks that they are exposed to in their pensions by holding different assets in their private portfolios.

For this reason, the risks to which workers are exposed in their pensions may change how much they value those pensions. For example, a pension which protects workers from risks they already face would be more highly valued than a pension which exposes workers to new risks: workers would be willing to sacrifice more cash salary to get the first pension than they would for the second. If both types of pension were expected to cost the employer the same, it would be cheaper overall for the employer to give workers the first pension than the second.

It is only the fact that markets are incomplete that opens the possibility that pensions may create or destroy economic value by sharing risks in different ways.
2. Analysis – worker and firm preferences, sources of market incompleteness

In this report, we create a model of firms and workers to assess how pension risks can be shared optimally between workers and firms. We assume that employees only accept employment at a particular firm if their overall compensation contract, including wages and pensions, is sufficient to guarantee them a certain minimum level of well-being. To measure workers’ well-being, we specify a model of employee preferences. Firms, on the other hand, wish to minimise the overall risk-adjusted cost of employee compensation, while still meeting their employees’ needs. The optimal pension is that pension which minimises the employer’s overall risk-adjusted cost of compensation.

The model we choose for the preferences of workers is based on the standard life-cycle portfolio theory commonly used in finance and economics. It assumes that workers rationally assess the risks and returns of pensions and cash income forward to the end of their lives. The model is calibrated to fit the current environment of the UK, including the level of earnings and earnings risks, mortality and mortality risks, asset returns, and the taxation of wages, pensions, investment income, and the state pension. In the analysis, we assume that employees are unable to hedge themselves against mortality shocks at retirement, wage risks or job change risks, and that they cannot borrow against future wages or pension income in order to finance current consumption. This implies that the complete markets indifference result of pensions does not apply: in this framework, pensions may be valued by employees at more or less than their cost to employers.

We perform the analysis in real terms, ignoring the effects of uncertainty in inflation. Implicitly this means that we assume that the final salary, career average and cash balance pensions are all revalued in line with prices, both in deferment and for active members. It also implies that pensions in payment and annuities in payment are assumed to increase in line with prices for all types of pension plan.
We assume that employees are rational and not myopic (our chosen framework cannot reasonably accommodate otherwise) and that there are no transactions costs in the labour market or in capital markets. Although the assumption of rationality may be limiting, it provides a starting point for considering optimal pension scheme design without the added complexity of irrational and unpredictable behaviour.

We choose a simple model of firm preferences: we assume that firms care only about the expected value and the variance of the cost of each pension design, without addressing the reasons underlying this preference structure. We also assumed that firms are able to sell pensions to their employees at cheaper rates than employees could find on the open market.

The different sources of market incompleteness and how they are incorporated into the analysis are shown in table 2.1.

### Table 2.1 Sources of market incompleteness which affect employee’s valuation of pension benefits relative to cash

<table>
<thead>
<tr>
<th>Source of market incompleteness</th>
<th>Manner included in implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taxation.</strong> Pensions receive favourable tax treatment: pension contributions are not taxed as income in the hands of employees until the benefit is collected - when marginal tax rates tend to be lower. Income earned on investments in pension accounts also attracts a lower rate of tax than income outside pension accounts.</td>
<td>Approximate UK tax system, including taxes on wage, investment and annuity income. Tax benefits of pensions included. Capital gains taxes ignored. UK benefits ignored except for constant Basic State Pension. Minimum income guarantee, SERPS/S2P and Pension Credit ignored, as we focus on private pensions.</td>
</tr>
<tr>
<td><strong>Basis risk.</strong> Defined benefit pensions such as final salary pensions and career average pensions can not be replicated by trading in markets. This is because there are no markets in which the wage link of these pensions can be hedged.</td>
<td>Assume that wage risk cannot be hedged, except to the extent that it is correlated with the risky asset (in the base case, this correlation is set at a very low 5%).</td>
</tr>
<tr>
<td><strong>Annuity market access.</strong> Defined benefit and defined contribution pensions may give employees cheaper access to annuity markets when they retire.</td>
<td>Assume that employer provides annuities at cost and that adverse selection and other loadings in the private annuity market add 10% to private market annuity costs.</td>
</tr>
<tr>
<td><strong>Liquidity constraints.</strong> There are constraints on accessing pensions compensation before retirement. Therefore pensions savings cannot be used as precautionary savings.</td>
<td>Implementation assumes that employees cannot borrow at all against either pensions or future wages to finance current consumption.</td>
</tr>
</tbody>
</table>
Table 2.1 Continued

<table>
<thead>
<tr>
<th>Source of market incompleteness</th>
<th>Manner included in implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Portfolio restrictions.</strong> Individuals face portfolio restrictions on private assets and on pension assets. These affect their ability to reach their optimum asset allocation (and risk allocation). Portfolio restrictions may therefore cause the investment risks individuals are exposed to in their pensions to affect the optimal pension risk sharing arrangement.</td>
<td>Implementation assumes that employees cannot borrow cash to invest in equities, or borrow equities to invest in cash. This means that they may be unable to reach their overall optimal asset allocation.</td>
</tr>
<tr>
<td><strong>Annuity price risk.</strong> Individuals do not know what price will be charged for annuities when they retire.</td>
<td>We assume that there is an unhedgeable cohort mortality shock at retirement which affects the price of annuities in all the pension scheme designs. In some designs (e.g. final salary and career average pensions), this risk is borne by the employer; in others, it is borne by the employees themselves.</td>
</tr>
<tr>
<td><strong>Default risk.</strong> Underfunded defined benefit pension plans require the ongoing support of the company in order to meet their obligations. Workers may reduce the value they place on pensions if this support is uncertain. The presence of pension guarantee insurance reduces this effect.</td>
<td>Implementation assumes no pension default risk. Theoretical model shows that exposing workers to default risk in their pensions is expensive for employers.</td>
</tr>
</tbody>
</table>
3. Results – optimal scheme design, sensitivity analysis

We analyse several common occupational pension designs using this framework.

We find that:

- Paying workers with underfunded pensions is expensive, as workers are unable to diversify the consequent default risk away. We therefore assumed a best-case scenario that all pensions were default free in the rest of the analysis.

- Older workers are willing to sacrifice more of their salaries for pensions than younger workers. This is for two reasons – older workers are willing to pay more to protect themselves against annuity price risk (caused by cohort mortality shocks in this model) than younger workers. This is because younger workers are able to insure themselves in other ways - for instance by saving more - and because the risk is further away. Liquidity constraints are also more important for younger workers, reducing their willingness to enter into pension contracts. Of course, if workers have the option to extend their working lives, which workers in our models cannot do, then this will tend to lessen these effects.

- Workers with more private wealth prefer pensions more than workers with less private wealth. This is true for all the pension schemes we analysed, and is the result of the fact that richer workers are less affected by liquidity constraints, and so are more willing to set money aside for retirement in their pensions. This is despite the fact that we do not model any means-tested state benefits in retirement.

- Career average defined benefit pension schemes are preferred to final salary defined benefit schemes in the base case and in most of the sensitivity tests for most workers at most ages. This is because the career average final pension is unlikely to be as risky as a final salary defined benefit pension. This is because the benefit for a final salary pension depends only on the worker’s final salary, whereas a career average salary depends on salary in each year of work, and is therefore less affected by wage shocks.
• Defined contribution pension schemes are slightly preferred to cash balance schemes in the base case, and in most of the sensitivity tests. This is because of the exposure to equities that we assume in the defined contribution plan, which workers prefer to the bond investment that we assume in the cash balance plan. Offering employees investment choice in their defined contribution pensions would make the defined contribution plan even more attractive, unless the costs imposed on workers by giving them investment choice were also large. In this model, individuals are rewarded in the form of higher expected returns for taking on investment risk. They are not rewarded for taking on wage and liquidity risk in their pensions.

• Of the non-hybrid pensions, defined contribution pensions seemed to be the most cost-effective method of compensating employees in the base case as well as in most of the sensitivity analyses.

• Offering workers both career average defined benefit and defined contribution pension schemes simultaneously appeared to offer little economic value. In the scheme designs we examine, firms appear to choose only the defined contribution plan when considering a defined contribution plan and a career average defined benefit plan, and chose a limited career average defined benefit plan (where the pension only accrues on salary up to a certain level) over a defined contribution plan where the defined contribution pension is only paid on salary above the career average threshold.

• In our model, the optimal pension scheme design was defined to be the one that resulted in the lowest overall cost of compensation for the employer. The pension design which appeared to be the most economically efficient for our base case worker - a 35-year old male with median earnings for a male with a degree - was the pure defined contribution pension.

The results of our analysis are summarised in table 2.2, which shows the cost to the employer of a worker’s total compensation package (including cash wages and pensions) if the employer chooses to pay the employee’s pension in different forms. The reference employee is a 35-year old male, with a university degree, whose earnings are currently median wages for his age, sex and educational attainment, who has assets of £10,000 and who expects to earn median wages in the future (with wage risk). By construction, the employee is indifferent between each of the alternatives shown in the table.

The first column of table 2.2 describes each pension plan we examine. The second column shows the optimal accrual rate or contribution rate of each type of pension. This is the contribution rate or accrual rate that minimises the employer’s overall risk-adjusted cost of compensation. The second column shows the cash wages which the employee receives, as a percentage of the cash wages the employee would receive if he received no pension and his expected discounted lifetime utility were to be the same in both cases. The fourth column shows the expected cost of the optimal pension to the employer, and the fifth shows the additional costs imposed on the employer by the risks of the pension plan. The final column shows the total
risk-adjusted cost of compensation (cash wages, plus expected pension costs, plus the pension risk adjustment) of that combination of cash and pension to the employer.

The figures in the table show that an employer could reduce its compensation costs by 6% by switching from a final salary defined benefit to a defined contribution pension plan, while leaving its employees as well off. This assumes that the generosity of both the final salary defined benefit plan and the defined contribution plans are at the optimal levels shown in the second column of the table. It is difficult to know how material these cost savings are in general: this depends on a number of factors specific to each company (such as how important labour costs are in that firm’s cost structure) and each labour market (such as how transferable individual skills are between different companies).

Table 2.2 Optimal cost of compensation with different pension plan types for 35-year old median-wage male worker with a degree

<table>
<thead>
<tr>
<th>Pension type</th>
<th>Optimal accrual/contribution rate of pension</th>
<th>Cash Wages</th>
<th>Expected Pension Cost</th>
<th>Pension Risk Adjustment</th>
<th>Total optimal cost of compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pension</td>
<td>0.000</td>
<td>1.000</td>
<td>0.000</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Final salary defined benefit pension</td>
<td>0.005</td>
<td>0.951</td>
<td>0.039</td>
<td>0.003</td>
<td>0.994</td>
</tr>
<tr>
<td>Defined contribution pension</td>
<td>0.166</td>
<td>0.813</td>
<td>0.120</td>
<td>0.000</td>
<td>0.933</td>
</tr>
<tr>
<td>Cash balance pension</td>
<td>0.227</td>
<td>0.849</td>
<td>0.117</td>
<td>0.000</td>
<td>0.963</td>
</tr>
<tr>
<td>Career average defined benefit pension</td>
<td>0.015</td>
<td>0.870</td>
<td>0.100</td>
<td>0.002</td>
<td>0.971</td>
</tr>
</tbody>
</table>
| Career average defined benefit pension and defined contribution pension (simultaneous hybrid) | 0.166* (DC) | 0.813* | 0.120* | 0.000* | 0.933* Continued

Continued
Table 2.2 Continued

<table>
<thead>
<tr>
<th>Pension type</th>
<th>Optimal accrual/contribution rate of pension</th>
<th>Cash Wages</th>
<th>Expected Pension Cost</th>
<th>Pension Risk Adjustment</th>
<th>Total optimal cost of compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career average defined benefit pension on salary below £30,000 p.a. and defined contribution pension on salary above that level (combination hybrid)</td>
<td>0.00 (DC)</td>
<td>0.863</td>
<td>0.099</td>
<td>0.000</td>
<td>0.962</td>
</tr>
</tbody>
</table>

Note: All figures are scaled so that the expected cost of a worker paid only in cash is 1.00. The analysis ignores the effects that pensions may have on worker behaviour, which may be especially important for defined benefit pensions. *If employers could offer workers both pure career average pensions and pure defined contribution pensions, they would find it most cost-effective to pay workers only with defined contribution pensions. The figures shown are the more accurate figures from the DC-only run, which the hybrid run suggests is optimal.

The optimal cost of compensation differs by pension type because workers prefer different mixes between cash compensation and pension compensation, taking into account their preference for cash salary, savings, taxation of pensions, investment risks, and mortality risks. The more workers prefer pensions rather than cash, and the better the type of pension paid suits their needs, the cheaper overall compensation becomes for the employer because of the beneficial tax treatment of pensions compensation.

The optimal cost of compensation, shown in the last column of table 2.2, is the total optimal cost of compensation evaluated at the optimal pension generosity – not the cost of compensation evaluated at the pension scheme generosity observed in practice.

The difference between these optimal rates of pension generosity and pension accrual rates observed in practice are striking. In particular, the final salary accrual rate is much lower than that observed in practice, and the defined contribution plan generosity is much higher. A possible reason for the first effect is that employers may value the changes in behaviour that final salary pension schemes cause in employees (such as causing employees to stay longer at the firm and to retire at certain ages), or because the generosities typically found in final salary schemes were set many years ago when there were fewer indexation, vesting and transfer requirements, and inflation made true benefit levels more flexible than they are today. The high optimal defined contribution plan generosity may reflect a higher demand for liquidity among employees than we assume in our model – possibly because of a preference individuals have to invest in housing, or because of demographic effects which we do not model, such as the formation of families.
Sensitivity Analysis

We also perform a sensitivity analysis to test how the results in table 2.2 would change depending on the assumptions used to calibrate the model. We test wealthier individuals, older individuals, more and less risk-averse individuals, the effect of a higher equity risk premium, a higher risk free rate, lower wage variance, and higher and lower employer risk aversion, and employees with a high probability of job change, changing one parameter for each run. We find that the DC plan with 70% investment in equities was optimal in all of these scenarios. If the DC plan investment in equities was increased to 100%, then the DC plan was still optimal (and cheaper for the employer than a DC plan with 70% investment in equities), but if the DC investment in equities fell to 0% in the DC plan, then employers would prefer the cash balance plan over the DC plan.

Somewhat surprisingly, the results were found to be sensitive to the tax regime, with the optimal plan in the 1970’s tax regime being the cash balance plan, for the 1980’s being the DC plan and for the 1990’s being the career average DB plan.
4. Limitations of research

The analysis we have assumed here has several limitations:

- We assume that there are no transactions costs which differ between pensions of different types. Some types of pension scheme - such as defined benefit pensions or hybrid pensions - are more expensive to run than defined contribution pensions if the scheme is not very large, and vice versa. Expenses can affect pension costs significantly, especially over long periods of time.

- We assume that different pension designs have no effect on worker behaviour, even where such effects are quite plausible - for example productivity, job tenure, and the timing of retirement. The figures in table 2.2 can be used as a guide to the required size of these effects for each pension scheme type to be economically efficient. For a final salary defined benefit plan with accrual rate $\frac{1}{200}$ to be economically efficient, the effects of the pension on worker behaviour would have to increase firm income over the lifetime of the employee by roughly 6% of the employee’s lifetime compensation - around 1.5 years of wages.

- The analysis depends entirely on the chosen model of worker and firm preferences. Our assumed preference structure is incomplete, because it omits some real risks faced by firms and workers which may have an effect on the optimal decisions of workers and firms. For instance, workers may be worried about risks such as inflation and unemployment, which we have ignored, while firms may care about statutory risks and changes in taxation. The model may also not accurately reflect individual preferences if individuals value pensions irrationally.

- We assume that firms are able to sell deferred life annuities to their employees cheaper than employees could buy them on the open market. One reason why this may be the case is adverse selection costs on the open market, which employers may be able to mitigate because of the extra information they have about employees. There may also be marketing costs which the employer would not need to incur.

- In the more complex models (the simultaneous and combination hybrids) we make approximations to allow the model to run in a reasonable amount of time, which may have affected the precision of some of the calculations reported
here. This has been highlighted in the text where we believe it to be a significant issue.

- The specification of the state benefit system that we assume ignores SERPS/S2P, the Pension Credit, Incapacity Benefit and Jobseeker’s Allowance. As we assume that individuals cannot borrow against future income, the optimum level of benefits will be sensitive to the level of the state pension we assume in the model. The level of other benefits will affect the individual’s need for precautionary savings, and hence also affect how unwilling individuals are to save for pensions.

- Alternative investments such as housing may affect the demand for pensions, as would demographic effects we have not modelled, such as the formation of families. These factors are difficult to include in models of this type.
5. Further work

Further work which might be undertaken includes the following:

- Other simple pension designs could be examined. These include a flat defined benefit pension, where workers accrue a pension of a certain amount (fixed in real terms) for each year of service (very similar to the basic state pension), and a scheme which offers workers a choice between a limited career average defined benefit pension and a full defined contribution pension.

- More hybrid pensions could be examined, including top-up defined contribution schemes with varying levels of top-up,

- Using supercomputing time to examine the simultaneous and combination schemes more accurately.

- Using the model to assess what the sources of the inefficiencies and efficiencies of each pension plan design are. Preliminary work seems to suggest that in the case of the final salary pension plan, the wage uncertainty is a larger source of pension inefficiency than the liquidity risk, and that the tax benefits are a larger source of efficiency than the access to fair annuities or mortality protection, at least for younger workers.