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Its all Back to Front: Critical Issues in the Design of Defined Contribution Pension Plans

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6. It is all back to front: critical issues in the design of defined contribution pension plans

David Blake[1]

6.1 INTRODUCTION

If a defined contribution (DC) pension plan is well designed, it will be a single, integrated financial product that delivers at reasonable cost to the plan member a pension that provides a high degree of retirement income security. This pension will provide an adequate replacement income for the remaining life of the plan member (and possibly also his or her partner) and removes the risk that the member outlives his or her resources. A well-designed plan will therefore be designed from back to front, that is, from desired output to required inputs. A well-designed plan will also ensure that, at each stage in the delivery process, appropriate incentives are given to those delivering key services.

There are six critical issues in the design of DC plans: charges, lapses, investment strategy, investment performance, fund annuitization and provider incentives. This chapter examines how well Personal Pension Plans (PPPs) deal with these issues. PPPs are the the main type of individual DC plan operating in the UK. They were introduced in 1988 by the Thatcher government (Social Security Act 1986) to increase labour market flexibility by improving pension portability. Workers were allowed to leave their employer's occupational plan and start a PPP which could be transferred with them when they changed jobs.[2] We end by offering suggestions about how the design of individual DC plans can be improved.

6.2 CHARGES[3]

Charges are needed to pay for key services such as plan administration and fund management as well as provider profit, but the higher the charges, the lower the accumulated fund value at the retirement date and the lower the subsequent pension. At the same time, any particular charging structure has implications for the incentives offered to those delivering such key services.

An important problem facing plan members is not only that plan charges can be substantial, but also that charging structures can be complex and disguised and this provides a potential source of confusion.[4] Furthermore, these charging structures generally incorporate substantial front-loaded elements which can be detrimental for members, since they have the effect of tying them to potentially inefficient providers who, in consequence, have little incentive to improve their efficiency. Also front-loaded charges involve significant penalties for those plan members who exit early from plans, and, according to industry average estimates for the UK, around 84 per cent of plan members drop out of 25-year plans prior to maturity.[5]

It is important to understand both the nature of charges and also how those charges are reported.

6.2.1 Types of Charges

Pension plan charges can be levied on a number of bases:

1. Charges based on contributions:
   - entry charges, either related to or independent of contributions,
   - regular (periodic) charges, either related to or independent of contributions.
2. Charges based on asset values:
   - regular charges based on interim value,
   - exit charge based on redemption (that is, terminal, transfer or paid-up) value.

If charges are extracted prior to the delivery of the service to which they relate, they are said to be *front-loaded*; if they are extracted afterwards, they are said to be *back-loaded*. Front-loaded charges do not tend to provide the best incentive for providers to deliver good service.

To illustrate the effects of these charges on fund value, we define the following terms:

V_T Redemption value of the fund at period T.
V_t Value of the fund at the end of period t; t will take the value 0 at the start of the plan and T at the end of the last period of contribution.
g_t Realized growth rate in the fund's value achieved by the fund manager in period t.
C_t Contribution made in period t. We assume that contributions are made at the beginning of each period and that contributions grow

at an annual rate of e per cent (for example, the rate of growth might reflect the growth rate in national average earnings). Thus $C_t = C_{t-1}(1 + e_{t-1})$, where $e_0 = 0$.

M_t Policy fee for the period. This is assumed to be uprated at the rate of i per cent per annum (for example, i might be related to the rate of change in the consumer price index). Thus $M_t = M_{t-1}(1 + \mathrm{i}_{t-1})$, where $i_0 = 0$.

f Fund management fee (expressed as a proportion). This is assumed to be paid annually on the fee date and to be proportionate to the value of the fund at that date.

a Allocation of contributions to units, adjusted for levies on any capital units and any loyalty bonuses (expressed as a proportion).

s Bid–offer spread on contributions (expressed as a proportion).

x_t Redemption fee payable either at maturity (when $t = T$) or when the plan is transferred or converted to paid-up status (when $t < T$).

F_0 Policy set-up fee, paid at the start of the plan.

Z_0 Annuitized value of any set-up fee (e.g. the independent financial adviser's (IFA's) fee).

The value of the fund in period t is then given by the following iterative equation:

$$V_t = \{V_{t-1} + a(1-s)C_{t-1}(1+e_{t-1}) - M_{t-1}(1+i_{t-1})\}(1-f)(1+g_t)(1-x_t) - Z_0, \qquad (6.1)$$

which can also be expressed as:

$$V_t = \sum_{m=1}^{t}\left[\left\{Ca(1-s)\prod_{k=0}^{m-1}(1+e_k) - M\prod_{k=0}^{m-1}(1+i_k)\right\} \times (1-f)^{t-m+1}\prod_{k=1}^{t-m+1}(1+g_k)\right](1-x_t) - Z_0. \qquad (6.2)$$

In this equation, C represents the amount contributed by the plan member (which is uprated annually by e_t), while the g_t terms represent the realized returns achieved by the fund manager. *All other terms are related to charges.*

6.2.2 Reduction in Yield

The complexity of equation (6.2) means that there is no simple summary measure for the impact of charges. The conventional approach is to calculate the reduction in yield (RiY) resulting from the charges.

Suppose that g is the geometric mean of the g_t terms, then the RiY is defined as the difference between the geometric mean return (g) achieved by the plan in question and the plan's *effective yield* (g'), which is equal to the yield on a hypothetical zero-load plan (that is, one for which $a = 1$, $s = 0$, $M = 0$, $f = 0$, $x = 0$, $Z_0 = 0$) with the same gross contributions and having the same terminal value as the plan in question. Hence, g' is the solution to the following equation:

$$V_t = \sum_{m=1}^{t}\left[\left\{C\prod_{k=0}^{m-1}(1+e_k)\right\}(1+g')^{t-m+1}\right], \tag{6.3}$$

where V_t is defined as in (6.1) or (6.2). The reduction in yield is calculated as:

$$RiY = g - g'. \tag{6.4}$$

The higher the charges, the lower will be the net contributions invested; hence, the lower will be g' and the larger will be the reduction in yield.

The value of a particular fund at the end of a particular investment horizon will be affected both by the charges it imposes and by the *realized* growth rate, g_t, in assets achieved over the investment horizon. However, since the realized returns are not known until the end of the investment horizon, the UK financial regulator (the Financial Services Authority) requires that funds disclose their RiY, based on a standard *assumed* or *projected* growth rate (that is, calculations are required in which the growth rate g is *assumed* to be the same both for each year of the investment horizon and for all funds).

Table 6.1 illustrates both charges and reductions in yield for a regular premium PPP paying £200 per month as reported in the October 1998 *Money Management* survey when the FSA's standard assumed investment rate was 9 per cent per annum. The table shows that, for a five-year investment horizon, the best fund had a RiY of 1.26 per cent (equivalent to 3.1 per cent of the terminal fund value), while the worst fund had a RiY of 8.47 per cent (equivalent to 19.2 per cent of fund value). For 25-year plans, the RiY lay in the range 0.68–2.16 per cent and averaged 1.39 per cent, implying charges that average 19 per cent of fund value and rise to as high as 28 per cent. As a result of these high charges, the UK Government introduced a new low-cost individual DC plan in 2001 called a Stakeholder Pension Plan (SPP). SPPs originally had a maximum RiY of 1 per cent (equivalent to 13.7 per cent of fund value) and allow penalty-free transfers of assets between plans. However, they are not popular with pension plan providers who do not actively promote them and as a consequence very few of them

Table 6.1 Charges and reduction in yield in personal pension plans (percentages)

	5 years	10 years	15 years	20 years	25 years
Charges as a percentage of fund value					
Best overall[a]	3.1	4.1	7.2	8.5	9.8
Best commission loaded fund	4.0	4.1	7.4	8.9	10.6
Industry average	11.6	13.0	14.8	17.7	19.0
Worst fund	19.2	22.0	24.6	28.2	27.8
Reduction in yield (%)					
Best overall[a]	1.26	0.79	0.90	0.76	0.68
Best commission loaded fund	1.63	0.79	0.92	0.80	0.73
Industry average	4.91	2.65	1.93	1.68	1.39
Worst fund	8.47	4.76	3.43	2.88	2.16

Notes: Regular premium personal pension plan (£200/month); [a] lower of best commission-loaded and best commission-free.

Source: *Money Management* (October 1998).

have been sold. Under pressure from the pensions industry, the government increased the charge cap in 2005 to 1.5 per cent for the first 10 years, but even this has not been sufficient for the providers to begin actively promoting SPPs.

6.2.3 Reduction in Contributions

An even more striking way of reporting charges is the *reduction in contributions* (*RiC*). This is defined as the difference between the gross contributions (C) into a plan and the plan's *effective contributions* (C'), as a proportion of gross contributions. Effective contributions are equal to the contributions into a hypothetical zero-load plan with the same average return and with the same terminal value as the plan in question. The effective contribution is therefore the value of C' which solves the following equation:

$$V_t = \sum_{m=1}^{t} \left[\left\{ C' \prod_{k=0}^{m-1} (1 + e_k) \right\} (1 + g)^{t-m+1} \right], \tag{6.5}$$

where V_t is defined as in (6.1) or (6.2). The reduction in contributions is calculated as:

$$RiC = (C - C')/C. \tag{6.6}$$

Since the left-hand sides of equations (6.3) and (6.5) are identical, the right-hand sides must equal each other, which implies that the *RiC* is related to the gross and effective yields as follows:

$$RiC = 1 - \left[\sum_{m=1}^{t}\left\{\prod_{k=0}^{m-1}(1+e_k)\right\}(1+g')^{t-m+1}\right] \div \left[\sum_{m=1}^{t}\left\{\prod_{k=0}^{m-1}(1+e_k)\right\}(1+g)^{t-m+1}\right]. \quad (6.7)$$

If there is no inflation uprating, then this reduces to the following approximation:

$$RiC \approx t \times RiY/2. \quad (6.8)$$

Table 6.2 presents calculations of the *RiY* and *RiC* for a PPP with regular premiums of £200 per month and a typical charging structure. The first panel of the table shows that, as a result of a combination of the front-loading of charges and the effects of compounding, the effective yield on the fund rises with term to maturity and, as a consequence, the *RiY* falls with term from 5.7 per cent for a five-year plan to 1.7 per cent for a 25-year plan. However, although the *RiY* falls with term, it does not fall sufficiently rapidly to compensate for the effects of compounding and so the *RiC* rises with term (see (6.8)). The *RiC* is 13.4 per cent for a five-year plan and 23.2 per cent for a 25-year plan, marginally more than the tax relief on pension plans currently available to a basic rate taxpayer in the UK (i.e., 20 per cent). Similarly, the total compounded charge as a percentage of terminal fund value rises from 15.4 per cent to 30.2 per cent. Even the new SPPs, with their original maximum charge of 1 per cent of fund value, imply a *RiC* of 13.6 per cent over a 25-year investment horizon.

6.2.4 Frequently Changing and Disguised Charging Structures

An examination of *Money Management*'s annual *Personal Pensions* publications[6] reveals that funds change their charging structures on a regular basis. This makes it very difficult to compare funds over time and raises the question as to whether particular charging structures and changes to them are used to conceal the impact of costs, and thereby confuse the plan member.

One illustration of this relates to the treatment of paid-up plans (or PUPs), highlighted by Slade (1999). When plan holders move to a new pension plan, they have the choice of taking a transfer value with them or leaving their assets in the original plan, which is then converted into a

Table 6.2 Reduction in yield and reduction in contributions for a typical plan (percentages)

	5 years	10 years	15 years	20 years	25 years
Ignoring plan lapses					
Effective yield (*g*)	3.3	5.8	6.6	7.0	7.3
Reduction in yield (*RiY*)	5.7	3.2	2.4	2.0	1.7
Reduction in contributions (*RiC*)	13.4	15.5	17.9	20.5	23.2
Total compounded charges as a percentage of terminal fund value	15.4	18.4	21.8	25.7	30.2
Adjusting for plan lapses					
Effective yield (*g*)	−18.3	−11.9	−9.6	−8.3	−7.4
Reduction in yield (*LARiY*)	27.3	20.9	18.6	17.3	16.4
Reduction in contributions (*LARiC*)	50.2	64.6	74.9	82.3	87.6
Total compounded charges as a percentage of terminal fund value	20.1	27.3	38.5	54.9	78.7

Note: Regular premium personal pension plan (£200/month) with the following assumptions:

Component	*Symbol*	*Value*
Charging structure:		
Allocation	a	95%
Bid–offer spread	s	5%
Fund management fee	f	0.75%
Policy fee	M	£3 p.m.
Uprating factor for policy fee	i	4.5% p.a.
Other assumptions:		
Return	g	9% p.a.
Lapse rate in year 1	q_1	13.4%
Lapse rate in year 2	q_2	13.4%
Lapse rate in year 3	q_3	14.0%
Lapse rate in year 4	q_4	12.0%
Lapse rate from year 5	q_{5+}	6.5% p.a.

PUP: the assets cannot be liquidated prior to retirement. At present, only 15 per cent of plan holders take transfer values; the rest leave PUPs with the original provider. The regulator requires that pension plans disclose only transfer values and full maturity values. There is no obligation to quote PUP maturity values, and few providers do so.

There is clearly a trade-off between high transfer values and high full maturity values: plans with front-loaded charges will quote low transfer values and high maturity values relative to plans with level charges. Different providers compete on the basis of the transfer and full maturity values that they quote. However, PUP maturity values, which, in principle, should be related to transfer values, can turn out to be poor value for money, because the original providers can continue to extract charges similar to those that they would have done had the plan remained active. For example, Slade discusses the case of a particular insurance company which quotes the highest transfer value amongst 12 leading providers, but ranks twelfth for its PUP maturity value quote. It appears that some plans quote high transfer values to attract business, knowing that only 15 per cent of those plan members not going to full term are likely to take transfers, while the remaining 85 per cent end up with low PUP maturity values.

Another example of hidden charges comes from a survey of European fund management fees by Towers Perrin (1998): some fund managers do not report their full set of charges. The three key charges are for asset management, broking (that is, transaction execution) and custody. There are also charges for reporting, accounting and performance measurement.

Some fund managers report the asset management fee (as some proportion of the value of the net assets under management) only *after* deducting the broking and custody fee. Some fund managers justify this on the grounds that both the portfolio transactions and the safe keeping are conducted by a third party independent of the fund manager, typically the global custodian. Other fund managers operate full ‘clean fees’ (that is, report full charges, including third party fees which are merely passed through to the client). Yet other fund managers add a commission to third party fees before passing them through. In some cases, however, the broker or custodian is related to the fund manager (for example, is part of the same investment banking group) and, in such cases, it is more difficult to assess charges appropriately.

The lack of transparency can also lead to incentive problems. Brokerage fees are related to turnover which provides an incentive to churn (that is, overtrade) the portfolio; this is especially so if the transactions are executed by an in-house broker and the brokerage fee is hidden from the client. Some fund managers, in contrast, use discount brokers to reduce the cost to the client. Some clients impose turnover limits to reduce costs. However, the most effective means of keeping charges down is complete fee transparency and full disclosure for each fund management function and benchmark-related performance measurement (where the impact of hidden fees is exposed through poor performance).

In summary, we find that charging structures in PPPs are generally complex and disguised and this leads to customer confusion. Consumers are not able to compare charges across plans easily, which means that competitive forces do not operate effectively. As a consequence, charges tend to be very high and this reduces the net terminal value of the fund available for paying pensions.

6.3 LAPSES

6.3.1 The Impact of Low Persistency on Charges

A regular premium pension plan involves a substantial commitment of time and resources by both the plan's sponsor and its members if the desired objectives are to be achieved. Any significant front-loading of charges in plans means that members suffer a substantial loss if their contributions lapse prematurely. As the Personal Investment Authority (the predecessor to the Financial Services Authority) argues, 'if investors buy policies on the basis of good advice, they would not normally be expected to cancel premiums to their policies unless forced to do so by unexpected changes in their personal circumstances. This means that persistency is a powerful indicator of the quality of the selling process' (1998, p. 3). The PIA defines persistency as 'the proportion of investors who continue to pay regular contributions to their personal policies, or who do not surrender their single premium policy' (p. 3).

Table 6.3 shows that persistency rates (that is, the percentage of policies that have not lapsed) after four years of membership are between 57 per cent and 68 per cent. The persistency rate is higher for plans arranged by independent financial advisers than by company representatives, suggesting that

Table 6.3 Persistency rates for regular premium personal pension plans (percentages)

	Company representatives: after				Independent financial advisers: after			
	1 Year	2 Years	3 Years	4 Years	1 Year	2 Years	3 Years	4 Years
1993	84.1	72.3	63.6	56.7	91.5	83.3	76.6	70.5
1994	83.7	72.8	64.4		91.3	82.1	74.5	
1995	85.5	75.0			90.8	81.6		
1996	86.6				90.2			

Source: PIA (1998, Table 1).

the clients of the former are generally more satisfied with their policies than those of the latter. However, the one-year rates indicate a small improvement in the persistency rate of plans arranged by company representatives since 1993 and a small decline in that for plans arranged by IFAs. Nevertheless, although only four years of data are available, the table suggests that very few personal pension plan members are likely to maintain their membership of the plan long enough to build up an adequate pension.

The PIA regards these persistency rates as 'disturbing' (p. 10) and offers a number of explanations: members were missold pensions which were either unsuitable or too expensive; regular premium plans might be unsuitable for those with irregular earnings or uncertain long-term employment; a change of employment may lead to a member joining an occupational plan and abandoning their personal one; adverse general economic conditions could worsen persistency rates. The PIA also offers suggestions as to why the IFAs are more successful than company representatives. First, IFAs tend to advise clients on higher incomes, who are more likely to continue contributing; secondly, plans chosen by an IFA are likely to be from a wider range of policies than those offered by representatives of any single company, leading to a greater likelihood of the plan matching closely the particular needs of the client.

6.3.2 Reduction in Yield and Reduction in Contributions, Accounting for Plan Lapses

It is possible to incorporate the effect of plan lapses in the calculation of the RiY. If we define q_t as the lapse rate in period t for a particular provider, the expected value of a fund becomes:

$$V_t^* = \sum_{m=1}^{t} \left[\prod_{k=1}^{m} (1-q_k) \left\{ Ca(1-s) \prod_{k=0}^{m-1} (1+e_k) - M \prod_{k=0}^{m-1} (1+i_k) \right\} \times (1-f)^{t-m+1}(1+g)^{t-m+1} \right] (1-x_t) - Z_0 \tag{6.9}$$

and the *lapse-adjusted reduction in yield* ($LARiY$) experienced by that provider's plan holders will depend on the effective yield (g^*) that solves:

$$V_t^* = \sum_{m=1}^{t} \left[\left\{ C \prod_{k=0}^{m-1} (1+e_k) \right\} (1+g^*)^{t-m+1} \right], \tag{6.10}$$

where V_t^* is defined as in (6.9) and the product of the m terms in $(1 - q_k)$ measures the persistency rate over m periods. In the calculations below, we assume lapse rates for the first four years based on FSA data for company representatives, namely 13.4 per cent, 13.4 per cent, 14 per cent and 12 per cent (see Table 6.3), and then project forward from year 4 at the industry average annual lapse rate of 6.5 per cent. The industry average persistency rate over 25 years was estimated to be just 16 per cent.

These expressions indicate that the *LARiY* rises with higher average takes and falls with higher persistency. The latter result follows because the take at maturity is much higher than in earlier years, since the terminal bonus awarded in the final year is a very high proportion of the total value of the fund. So strong persistency means that lower *LARiY*s are needed to achieve the same average take. In other words, the effect of positive lapse rates is to increase the *LARiY* relative to the *RiY* since g^* is lower than g'.

The *lapse-adjusted reduction in contributions* (*LARiC*) is found by substituting the effective yield (g^*) from equation (6.10) into equation (6.7) in place of g'. The second panel of Table 6.2 shows the *LARiY* and *LARiC*. Lapses have a remarkable impact on charging measures: the likelihood of maintaining contributions for 25 years is so low for the average plan member that the effective contribution over this period is just 12p for every £1 of premium paid.

In summary, we find that high lapses can lead to pensions that are very poor value for the money invested. Some may argue that low persistency is a matter for the plan member alone and clearly there are many individuals who do not have the commitment to maintain contributions for the full term of the plan. But low persistency is as much an indicator of a bad product that was initially missold and subsequently followed by poor after-sales service.

6.4 INVESTMENT STRATEGY

With DC plans, the size of the pension depends critically on the level of net contributions. It also depends on the investment strategy pursued. There is a trade-off between the planned level of contributions and the investment strategy. The more conservative the investment strategy, the lower the anticipated return on investments and the higher the planned level of contributions the accruing fund will require in order to deliver a particular pension level in retirement. But there is another trade-off between investment strategy and risk. The less conservative the strategy, the greater the asset risk and the more volatile the contribution pattern if a desired pension target is to be achieved. There is also a bigger risk that the target pension will fail to be achieved. Risks are all-important in DC plans because they are borne entirely by plan members. Particularly critical are the risks faced right at the moment of retirement: as forced sellers of assets and forced buyers of life annuities, pension plan members are typically subject to potentially substantial investment risk (manifesting itself in the form of low asset values), interest rate risk (manifesting itself in the form of low interest rates and hence annuity rates) and longevity risk (manifesting itself in the form of higher future survival probabilities that again lower annuity rates) all on the same day.

6.4.1 The Nature of Risk in DC Plans

Because DC plans, unlike defined benefit (DB) plans, involve no promises about the size of the pension, they involve no risk to the plan provider. The risk of ending up with a low pension falls entirely on the plan member. A natural measure of this risk is the risk of falling short of the pension available from a fully-funded DB plan, that is, one with planned contributions and an investment strategy that are sufficient to build up a fund of the size needed to deliver a target pension in full. We therefore need to look more closely at how a DB plan works.

Figure 6.1 shows that the present value of the DC pension on the retirement date depends entirely on the value of the fund's assets on that date. Figure 6.2 shows that the present value of the DB target pension (L) is independent of the value of the fund's assets. Figure 6.3 shows that the DB pension can be replicated using an implicit long put option (*Put*) and an implicit short call option ($-Call$) on the underlying assets of the fund (A), both with the same exercise price (L) which equals the present value of the DB target pension payments at the member's retirement age. The put option is held by the plan member and written by the plan sponsor, while the call option is written by the member and held by the sponsor. On the retirement date of the member, which coincides with the expiry date of the options, if one of the options is in-the-money, it will be exercised. If the value of the fund's assets is less than the exercise price, so that the plan is showing an actuarial deficit, the member will exercise his or her put option against the sponsor who will then be required to make a deficiency payment ($L-A$). If, on the other hand, the value of the assets exceeds the exercise price, so that the plan is showing an actuarial surplus, the sponsor will exercise his or her call option against the member and recover the surplus ($A-L$). This implies that a DB plan is, in effect, a risk-free investment from the member's viewpoint: DB plan members end up with the same pension whatever the value of the underlying assets.

It is clear from this how DB and DC plans are related. A DC plan is invested only in the underlying financial assets. A DB plan is invested in a portfolio containing the underlying assets (and so is, in part, a DC plan) *plus* a put option *minus* a call option on these assets:

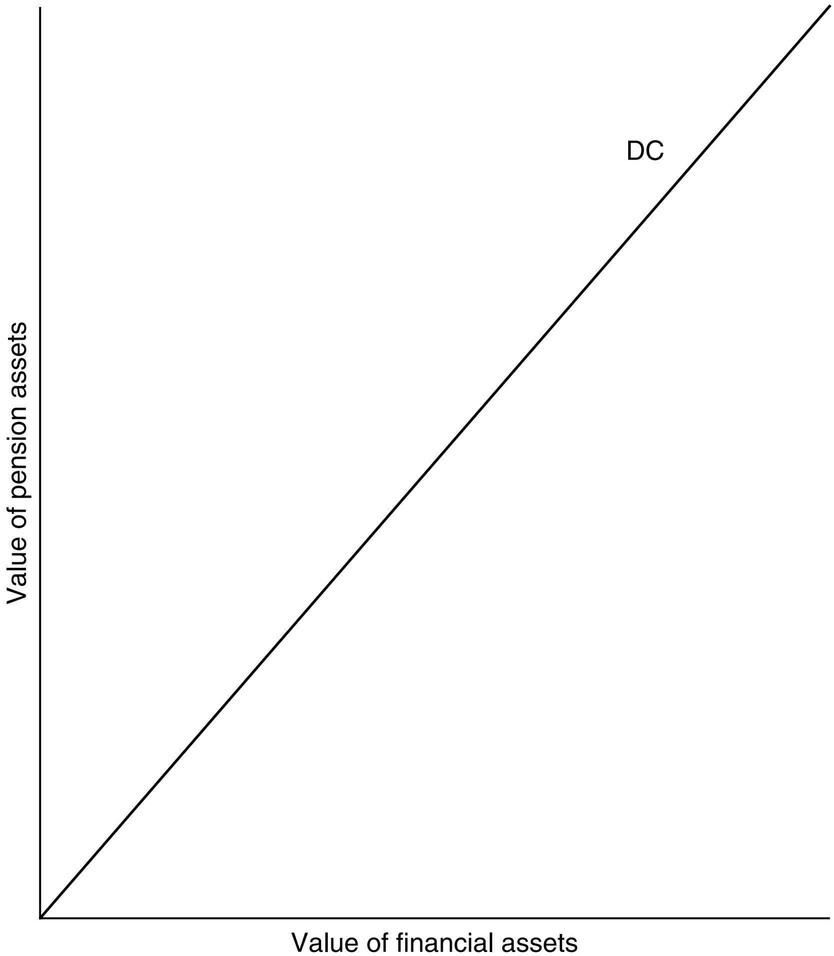


Figure 6.1 A defined contribution pension plan

$$\begin{aligned} DB &= L \\ &= A + Put - Call \\ &= DC + Put - Call. \end{aligned} \tag{6.11}$$

The actuarial surplus at time t (S_t) with a DB plan is defined as the difference between pension assets (A_t) and liabilities (L_t):

$$S_t = A_t - L_t. \tag{6.12}$$

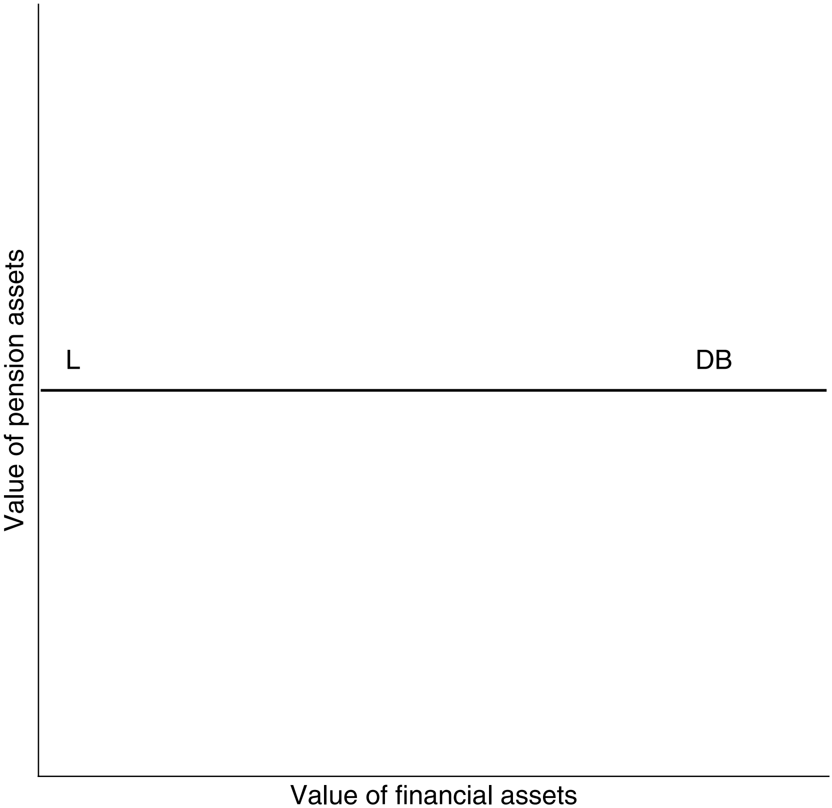


Figure 6.2 A defined benefit pension plan

The pension assets at time t comprise the accumulated financial assets *plus* the present value of the promised future contributions into the plan. The pension liabilities at time t are equal to the present value of the expected future pension payments from the plan.

Surplus risk (also called shortfall risk) at time t (σ^2_{St}) is given by the variance (that is, volatility) of S_t in (6.12):

$$\begin{aligned}\sigma^2_{St} &= \sigma^2_{At} + \sigma^2_{Lt} - 2\sigma_{At}\sigma_{Lt}\rho_{AL} \\ &= (\sigma_{At} - \sigma_{Lt})^2 \text{ if } \rho_{AL} = 1.\end{aligned} \tag{6.13}$$

It depends on the volatility of asset values (σ^2_{At}), the volatility of pension liabilities (σ^2_{Lt}) and the correlation (ρ_{AL}) between asset values and pension liabilities. The main sources of these volatilities are uncertainties

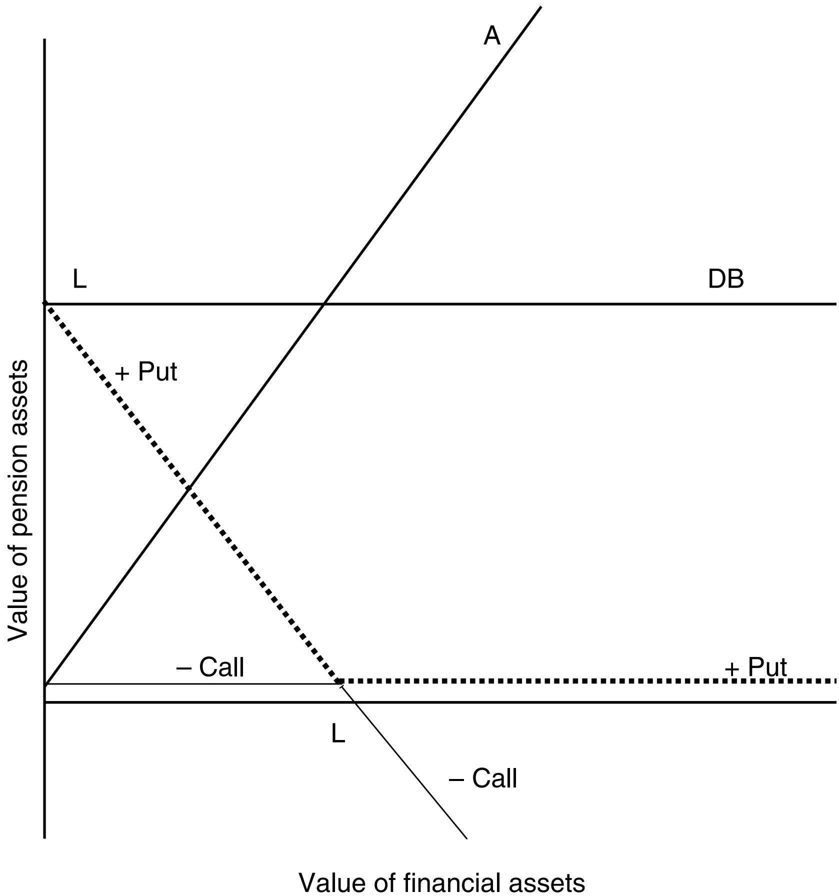


Figure 6.3 The option composition of a defined benefit pension plan

concerning future investment yields, real earnings (that is, productivity) growth rates and inflation rates. This is because investment yields determine the rate at which contributions into the pension fund accumulate over time, the growth rate in real earnings determines the size of both contributions into the plan and the pension liability at the retirement date, and the inflation rate determines the growth rate of pensions during retirement.

Equation (6.11) involves Fisher–Margrabe exchange options.[7] These are a variant of the more familiar Black–Scholes options which recognize that the options in equation (6.11), if exercised, exchange risky assets at an exercise price that is indexed to the uncertain value of the pension liabilities, in contrast with the standard model where the exercise price is constant. The value of the call option is given by:

$$Call_t = N_1(\sigma^2_{St})A_t - N_2(\sigma^2_{St})L_t, \quad (6.14)$$

where $N_1(\cdot)$ are cumulative normal distribution functions of σ^2_{St} (amongst other variables) which lie between zero and unity, taking the latter value when surplus risk is zero. The value of the put option is given by put–call parity:

$$\begin{aligned} Put_t &= Call_t + L_t - A_t \\ &= Call_t - S_t \end{aligned} \quad (6.15)$$

If both the surplus and surplus risk are maintained at zero, then it is clear from (6.14) and (6.15) that the call and put have zero value. If this is the case, they can be issued by, respectively, the plan member and plan sponsor free of charge since they will never be exercised.

Returning to (6.11), it follows that, if these conditions are satisfied, the DB and DC plans are equivalent in the sense of delivering the same pension in retirement. In other words, it is possible to manage a DC plan in such a way that it generates (with a high degree of probability) the same target pension as in a DB plan, so long as adequate contributions go into the DC plan.

6.4.2 Investment Strategy in DC Plans

In the light of these observations, there are two ways to manage the assets in a DC plan, which differ according to the objectives of the plan member.

6.4.2.1 Maximizing risk-adjusted expected value

The simplest investment strategy is to choose a particular contribution level into the fund and then select an investment strategy that maximizes the risk-adjusted expected terminal value ($\overline{A}^{RA}_T$) of the accumulating fund. This is defined as the expected terminal value of the pension assets ($\overline{A}_T$) net of a risk penalty, which is proportional to the product of the fund risk (as measured by the terminal variance of the fund's assets (σ^2_{AT})) and the degree of risk aversion of the plan member (R_A):

$$\overline{A}^{RA}_T = \overline{A}_T - 0.5R_A\sigma^2_{AT}. \quad (6.16)$$

The lower the degree of risk aversion, the greater the risk that can be borne by the plan's assets and hence the greater the expected value of the pension fund at the retirement date. It is possible to increase the expected value of the pension assets by taking on more risk (that is, increasing the terminal volatility of the fund's assets measured from the start date of the plan), but if too much additional risk is taken on, $\overline{A}_T^{RA}$ will fall, especially if R_A is high. The risk penalty measures the cost for a given individual of taking on more asset risk. $\overline{A}_T$ is set equal to the value of the pension assets needed to deliver the target pension in retirement. The contribution level is fixed at the beginning of the plan and does not change in the light of intermediate investment outcomes. Similarly, the investment strategy does not change over the life of the plan. In other words, there is no feedback control with this particular investment strategy.

Individual DC plans are provided by financial institutions such as insurance companies, banks, building societies, unit trusts (that is, open-ended mutual funds) and investment trusts (that is, close-ended mutual funds) and open-ended investment companies (OEICs). The plan provider will offer the member a choice of investment vehicle in which the pension assets will accumulate, ranging from low risk (such as a deposit administration plan), through medium risk (such as an endowment policy investing in a managed fund with an insurance company) to high risk (such as a unit-linked plan). The deposit administration plan is aimed at a plan member with a very high degree of risk aversion, while the unit-linked plan is aimed at a plan member with a low degree of risk aversion. However, it is arguable whether low-yielding deposits are a suitable investment vehicle for long-horizon investment programmes such as pension plans. Other asset categories, such as equities, offer much higher returns over the long term. Investing in deposit administration plans or bonds has been described as a strategy of 'reckless conservatism'.

Once a plan member has selected a particular type of plan, the fund manager's task is to choose the asset allocation (between T-bills or 'cash',[8] bonds and equities) that maximizes the value of $\overline{A}_T^{RA}$ in (6.16).[9] The resulting asset allocation is said to be myopic, that is, equivalent to that which will be determined in a single-period portfolio choice model (see, for example, Campbell and Viceira, 2002, ch. 2). Table 6.4 illustrates some different possible outcomes. Individuals with very high degrees of risk aversion (35 is the average for households in the UK as estimated in Blake, 1996) will choose very conservative investment strategies with a weighting above 90 per cent in low yielding T-bills. For a typical contribution rate in the UK (10 per cent of earnings, divided evenly between the member and his employer) this will generate a pension in retirement after 40 years of membership in the plan of less than 40 per cent of that available from a fully funded final salary plan, namely two-thirds of final salary:[10] it is only just over 30 per cent for a woman because of her greater anticipated longevity.[11]

Table 6.4 Maximizing risk-adjusted expected value

Risk aversion (R_A)	35 Male	35 Female	35 Male	35 Female	35 Male	35 Female	35 Male	35 Female
Net contribution rate (%)	10.0	10.0	15.0	15.0	20.0	20.0	24.75	29.85
Asset allocation (%):								
T-bills	92.69	92.69	92.69	92.69	92.69	92.69	92.69	92.29
Bonds	4.22	4.22	4.22	4.22	4.22	4.22	4.22	3.20
Equities	3.09	3.09	3.09	3.09	3.09	3.09	3.09	4.51
Financial assets:								
Return (%)	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.68
Risk (%)	4.04	4.04	4.04	4.04	4.04	4.04	4.04	4.04
Liabilities:								
Growth rate (%)	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
Risk (%)	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
Corrn. with assets (%)	17.99	17.99	17.99	17.99	17.99	17.99	17.99	18.24
Pension (% of target pen.)	39.74	32.75	59.94	49.40	80.37	66.25	100.00	100.00
Terminal fund risk (%)	120.35	99.20	143.52	118.30	167.88	138.38	191.91	180.11
Call (% of liabilities)	31.79	25.64	42.27	33.56	53.89	42.38	66.27	63.22
Put (% of liabilities)	92.06	92.89	82.34	84.16	73.52	76.14	66.27	63.22
Risk aversion (R_A)	8 Male	8 Female	8 Male	8 Female	1.5 Male	1.5 Female	1.0 Male	1.0 Female
Net contribution rate (%)	10.0	10.0	21.89	25.66	8.69	9.49	7.15	7.82
Asset allocation (%):								
T-bills	92.00	92.00	85.12	81.83	0.00	0.00	0.00	0.00
Bonds	2.45	2.45	5.19	7.17	56.19	52.55	45.62	37.74
Equities	5.56	5.56	9.69	11.00	43.81	47.45	54.38	62.26

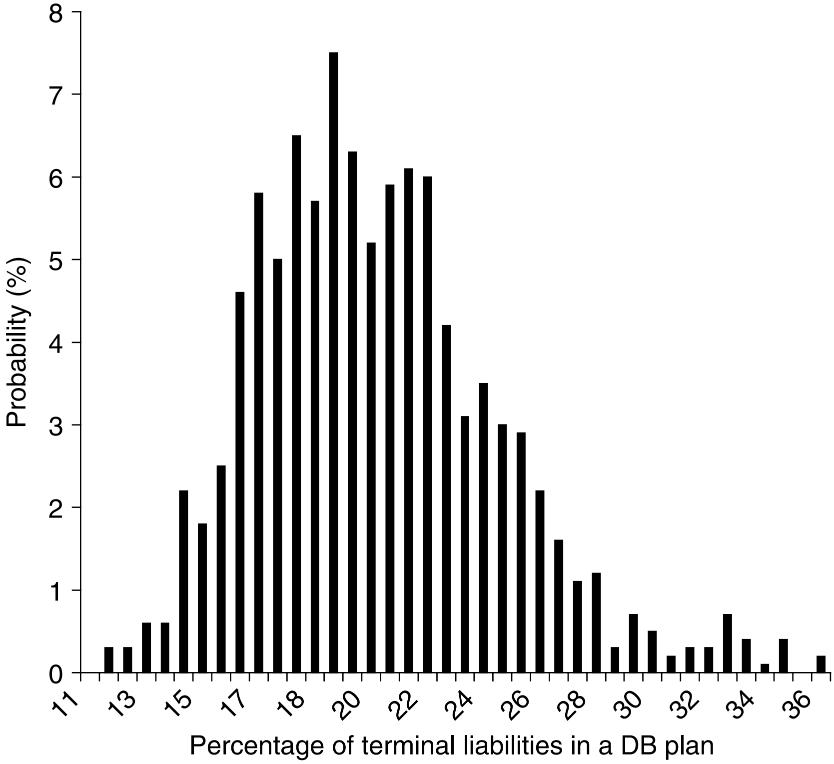
Financial assets:								
Return (%)	1.77	1.77	2.27	2.44	6.64	6.83	7.20	7.61
Risk (%)	4.04	4.04	4.19	4.31	11.15	11.58	12.50	13.69
Liabilities:								
Growth rate (%)	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
Risk (%)	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
Corrn. with assets (%)	18.43	18.43	19.73	19.77	20.06	19.56	16.99	14.06
Pension (% of target pen.)	41.34	34.08	100.00	100.00	100.00	100.00	100.00	100.00
Terminal fund risk (%)	171.00	140.94	148.73	92.13	304.97	303.11	324.65	364.03
Call (% of liabilities)	38.90	31.88	54.29	35.49	84.50	87.04	89.54	93.12
Put (% of liabilities)	97.56	97.80	54.29	35.49	84.50	87.04	89.54	93.12

It takes net contributions (after charges) of 25 per cent of male earnings and 30 per cent of female earnings into a DC plan to generate the same expected pension as a DB plan. High net worth individuals have a coefficient of risk aversion of around eight, but this still involves a very high weighting in T-bills and hence very high contribution rates are still needed to achieve a reasonable pension. As the coefficient of risk aversion falls, the weighting in equities rises: at 1.5, the weighting is still below 50 per cent. At unity (the risk aversion level typical of institutional investors), we begin to observe similar asset allocations to those of mature occupational pension plans in the UK, namely 60 per cent in equities and 40 per cent in bonds, and the target pension can be achieved with net contributions of below 8 per cent of earnings.

The table also shows the terminal fund risk (σ_{AT}). This is very high even for conservative investment strategies and it rises with the level of equity risk assumed, confirming the trade-offs outlined above between contribution rates, investment strategy and asset risk.

Figure 6.4 and 6.5 illustrate, using information in Table 6.4, some possible distributions of the terminal fund values as a proportion of that from a fully funded DB plan offering an index-linked pension of two-thirds of final salary. Figure 6.4 shows the distribution based on 1000 monte carlo simulations in the case of a male with $R_A = 35$ and contributing 10 per cent of earnings into a plan. The investment strategy is a very conservative one and this has two discernible effects: the average pension is very low (only 20 per cent of final salary) and so is the dispersion of the pension, with a semi-interquartile range of just five percentage points. Figure 6.5, in contrast, shows the wide dispersion of possible outcomes from the high risk–high return asset allocation chosen by a male with $R_A = 1$. It is possible to achieve on average the same pension as that from a DB plan with contributions of 7.15 per cent of earnings, and there is a 23 per cent chance of doing better than this. But this means that there is a 77 per cent chance of getting less than the DB pension and, in particular, there is a 44 per cent chance of ending up with a pension of less than 25 per cent of the DB pension.

Figure 6.6 shows that this dispersion can be reduced by adopting a 'deterministic lifestyle' (or age phasing) investment strategy. This is a commonly used investment strategy in DC plans intended to reduce the volatility of the pension fund's value as the retirement date approaches.[12] With this strategy, the contributions are initially invested entirely in equities, but the assets are systematically switched over to bonds and/or T-bills over a pre-set period (such as five years) leading up to the retirement date. If the switch is to T-bills, Table 6.4 shows that there is only a 7 per cent chance of getting less than 25 per cent of the DB pension, but only an 11 per cent



Note: For 40 years, contributions of 10% of male earnings are made into a pension plan and the portfolio is invested 92.69% in T-bills, 4.22% in bonds and 3.09% in equities and has a mean real return of 1.56% and a standard deviation of 4.04%. The properties of the distribution of terminal values (as a percentage of terminal liabilities) from 1000 monte carlo simulations are as follows:

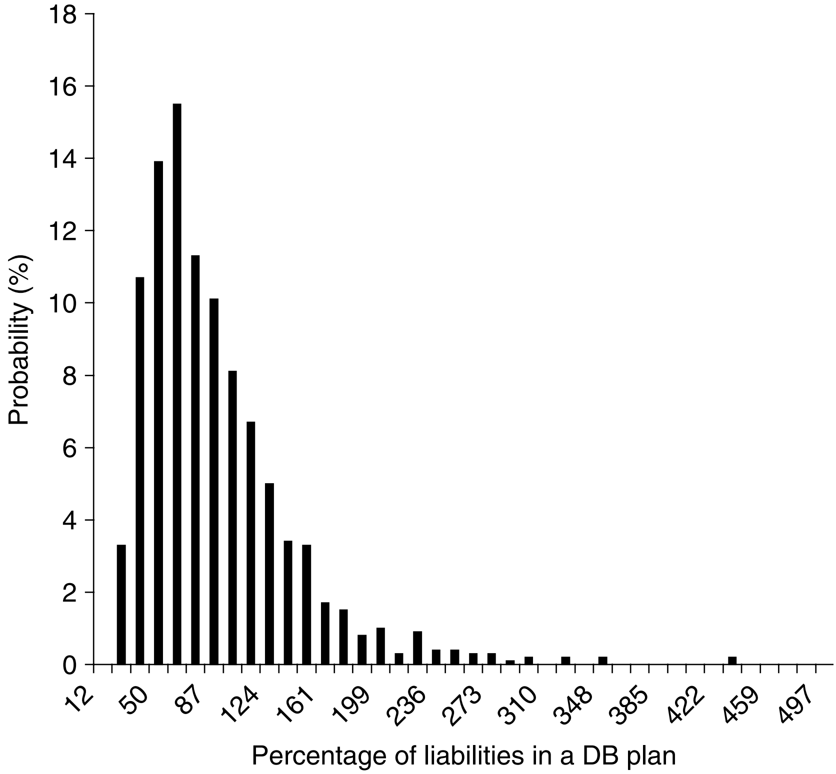
Probability	25%	Mode	Median	Mean	25%
Percentage of terminal liabilities	<17	20	20	20	>22

Figure 6.4 Frequency distribution of terminal fund values: a low-risk, low-return asset allocation

chance of getting more than 100 per cent. However, the cost in terms of a lower average pension is quite substantial: the average pension falls from 100 per cent to 63 per cent of the DB pension.

6.4.2.2 Minimizing the contribution rate and surplus risk

Suppose, instead, the plan member's objective is to target specifically a particular pension level, as happens in a DB pension plan, such as two-thirds

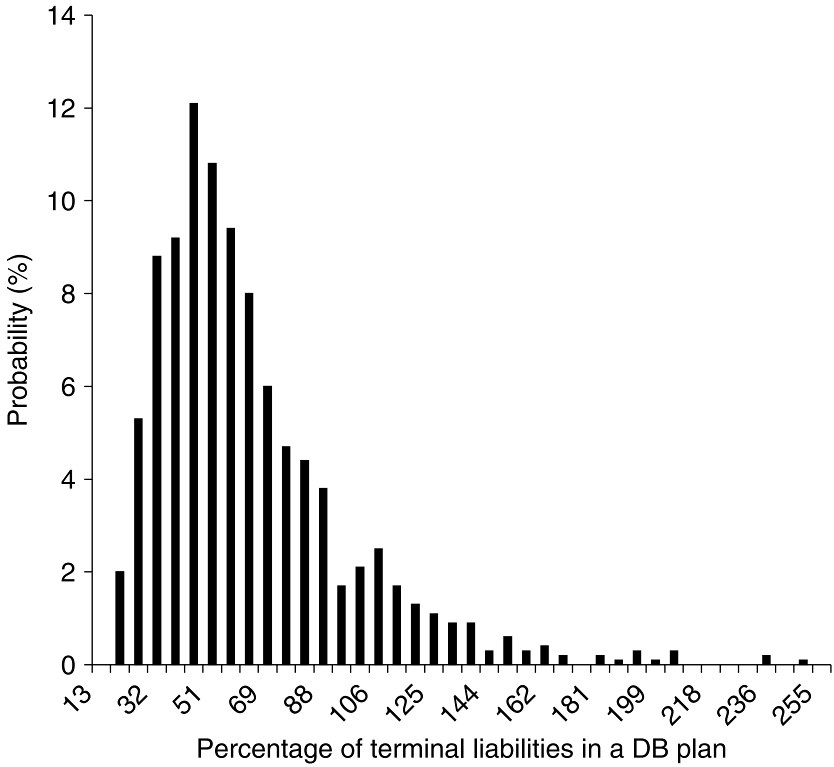


Note: For 40 years, contributions of 7.15% of male earnings are made into a pension plan and the portfolio is invested 45.62% in bonds and 54.38% in equities and has a mean real return of 7.2% and a standard deviation of 12.5%. The properties of the distribution of terminal values (as a percentage of terminal liabilities) from 1000 monte carlo simulations are as follows:

Probability	44%	Mode	Median	Mean	23%
Percentage of terminal liabilities	<25	52	66	100	>100

Figure 6.5 Frequency distribution of terminal fund values: high-risk, high-return asset allocation

of final salary. The DC plan can now be thought of as having ‘pension liabilities’, which equal the expected present value of the target pension payments between retirement and death. The appropriate investment management strategy is asset-liability management (also called surplus risk management or shortfall risk management). This involves constructing a portfolio of financial assets that minimizes the cost (in terms of planned contributions) of matching pension liabilities in two key respects: size and



Note: For 40 years, contributions of 7.15% of male earnings are made into a pension plan and for the first 35 years, the portfolio is invested 45.62% in bonds and 54.38% in equities and has a mean real return of 7.2% and a standard deviation of 12.5%; for the final five years, the fund is switched linearly into T-bills with a mean real return of 1.28% and a standard deviation of 4.04%. The properties of the distribution of terminal values from 1000 monte carlo simulations are as follows:

Probability	7%	Mode	Median	Mean	11%
Percentage of terminal liabilities	<25	44	48	63	>100

Figure 6.6 Frequency distribution of terminal fund values: deterministic lifestyle asset allocation

volatility. Formally, the fund manager's objective is to minimize each period the following loss function of the contribution rate and surplus risk:

$$\psi_t = \lambda C_t^2 + \sigma_{St}^2, \tag{6.17}$$

subject to the condition that the surplus (6.12) is always zero.[13] This is a dynamic programming problem with the contribution rate into the fund and the asset allocation as the control variables, and the trade-off between these variables is measured by the weighting parameter (λ).[14]

If pension plans are always fully funded, so that assets are always sufficient to meet liabilities in full (implying $A_t = L_t$ at all times), then it is clear from (6.12) that the surplus will always be zero. This is achieved by adjusting the contribution rate into the fund to ensure that (6.12) always holds.

Further, if the assets in the pension fund are selected in such a way that their aggregate volatility matches that of the liabilities, then it is clear from (6.13) that surplus risk can be reduced to zero, which, together with $S=0$, implies that the implicit options in the DB plan can be issued free of charge. This requires the assets in the pension fund to have both the same volatility as the pension liabilities ($\sigma^2_{At} = \sigma^2_{Lt}$) and to be perfectly correlated with them ($\rho_{AL} = 1$). This, in turn, requires the assets to constitute a liability-matching or liability-immunizing portfolio (LIP), that is, a portfolio that immunizes the productivity, inflation, interest rate and longevity risks embodied in the pension liabilities.

A plan member's future labour income is risky because there are uncertainties concerning future productivity growth and future inflation. This means that the member's final salary is uncertain. The pension payments, which are based on final salary, are uncertain because post-retirement inflation is risky, as is the member's life expectancy. Further, the value of the pension liabilities is risky, because of uncertainty over the interest rates used to discount the expected future pension payments. The pension plan's investment manager will therefore seek assets that are, where possible, correlated with shocks to productivity, inflation, interest rates and longevity. In practice, financial assets do not exist which are perfectly correlated with these shocks; that is, a perfect LIP cannot be constructed using existing financial assets. Nevertheless, the objective of asset-liability management is to construct a portfolio of assets whose returns are as highly correlated with changes in the value of the pension liabilities as possible.

Table 6.5 shows the required contribution rates into the plan to maintain the surplus at zero. They depend on the level of the trade-off parameter λ. From (6.17), it is clear that the higher the λ, the greater the penalty from having high contributions, and therefore the greater the weighting in higher returning but also more risky equities. For $\lambda = 1$, the minimum contribution rate for men is 10.58 per cent of earnings and the optimal asset allocation is 6.76 per cent in T-bills, 59.31 per cent in bonds and 33.94 per cent in equities. For $\lambda = 1000$, the optimal male contribution rate is 5.44 per cent and the optimal asset mix is 25.38 per cent in bonds and 74.62 per cent in equities. Tables 6.4 and 6.5 also show that the highest correlation between assets and liabilities is of the

Table 6.5 Minimizing the contribution rate and surplus risk

Weighting parameter (λ)	1 Male	1 Female	10 Male	10 Female	100 Male	100 Female	1000 Male	1000 Female
Net contribution rate (%)	10.58	10.87	10.07	10.73	8.83	10.30	5.44	6.42
Asset allocation (%):								
T-bills	6.76	4.06	3.14	3.78	2.46	2.10	0.00	0.00
Bonds	59.31	50.41	53.45	50.01	47.94	46.44	25.38	24.13
Equities	33.94	45.53	43.40	46.20	49.60	51.46	74.62	75.87
Financial assets:								
Return (%)	5.58	6.27	5.79	6.33	6.34	6.50	8.28	8.39
Risk (%)	11.30	13.26	12.94	13.38	14.16	14.54	18.00	18.19
Liabilities:								
Growth rate (%)	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09
Risk (%)	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
Corrn. with assets (%)	9.34	5.08	5.51	5.55	3.25	3.35	1.71	1.95
Pension (% of target pension)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Terminal surplus risk (%)	266.75	328.12	303.32	331.69	342.28	360.92	476.39	489.63
Call (ratio of liabilities, %)	81.77	89.91	87.06	90.28	91.30	92.89	98.28	98.56
Put (ratio of liabilities, %)	81.77	89.91	87.06	90.28	91.30	92.89	98.28	98.56

order of 20 per cent, well below the perfect positive correlation needed for $\sigma^2_{St} = 0$.

One important implication of this is that, while it is possible in practice to maintain an equality between the values of the implicit put and call options, it is not possible in practice to reduce this value to zero. Table 6.5 shows that, if the listed asset allocations are maintained for the whole investment horizon, the terminal surplus risk measured at the starting date of the plan will be very high. This leads to the call and put options taking values approaching 100 per cent of the value of the liabilities. Clearly no one would be prepared to buy these options separately, but, in combination, they provide a zero-cost option strategy that fully hedges the asset risk in the portfolio of assets, so long as the plan is fully funded. However, the absence of a market in long-term options means that in practice the reported asset allocations would not be maintained for the full investment horizon. What in practice tends to happen is that fund managers adopt the deterministic lifestyle investment strategy mentioned in the previous section. This is the only practical way of reducing the surplus risk and dealing with the problem of being a forced seller of volatile financial assets as the retirement date approaches.

In summary, we find that the investment strategy is another critical ingredient of the pension plan, and that it involves a complex set of trade-offs between contributions, asset allocation and asset risk. Conservative investment strategies will either lead to low pensions or require high compensating contribution rates. In contrast, a heavy equity component to the asset allocation will raise both the expected return on the portfolio and its risk: the first factor will have the effect of lowering the required contribution rate, while the second will raise surplus risk unless more conservative investment strategies are adopted as the retirement date approaches or the plan member is prepared to make additional contributions in the period just before retirement in the case where a deficiency emerges. These trade-offs are not well explained to plan members and, given the very high degree of risk aversion demonstrated by most of them, they will typically choose conservative investment strategies unsuited to a long-term investment horizon. Furthermore, none of the investment strategies discussed above specifically hedges interest rate (and annuity) risk on the retirement date: the main purpose of the deterministic life-styling strategy, for example, is to reduce exposure to equity risk on the retirement date. There is, in short, a complete disconnection in DC plans between the investment strategies of the accumulation and decumulation stages. But plan providers will be little concerned by any of this, since they have no contractual obligation to deliver a particular fund size on the retirement date.

6.5 INVESTMENT PERFORMANCE

Investment performance is critical to the size of the pension in the case of a DC plan. Even if the general investment strategy is suitable, the particular assets chosen by the fund manager can underperform and members of DC plans can find themselves locked into a poorly performing fund, facing very high costs of transferring to a better performing fund. In addition, the type of funds in which members invest can and do close down and then the assets have to be transferred to a different fund. In this section, we examine the investment performance of the two main classes of fund in which pension contributions are invested: unit-linked funds and managed funds.

6.5.1 The Investment Performance of Unit-linked Funds

The anticipated return from a high-risk investment is greater than from a low-risk investment, but there can be wide differences in realized returns, even for plans investing in the same risk class. Blake and Timmermann (1998) conducted a study of the investment performance of unit trusts (open-ended mutual funds) in the UK, one of the key investment vehicles for DC plans.[15] Table 6.6 shows the distribution of returns generated by unit trusts operating in the four largest sectors. These figures indicate enormous differences in performance, especially over the long life of a pension plan. For example, the 4.1 percentage point per annum difference between

Table 6.6 Distribution of returns generated by UK unit-linked funds, 1972–95

Sector	Top quartile	Median	Bottom quartile	Ratio of fund sizes
UK Equity Growth	16.0	13.6	11.9	3.2
UK Equity General	14.3	13.4	13.1	1.4
UK Equity Income	15.4	14.0	12.4	2.3
UK Smaller Companies	18.7	15.5	12.8	5.3

Note: The first three columns are averages measured in percentages per annum for the sample period 1972–95; the last column gives the ratio of fund sizes after 40 years, based on the top and bottom quartile returns. The formula is (assuming the same contribution stream):

$$\frac{(1+g_T)^T-1}{g_T} \div \frac{(1+g_B)^T-1}{g_B},$$

where $g_T = 0.160$, $g_B = 0.119$ and $T = 40$, etc.

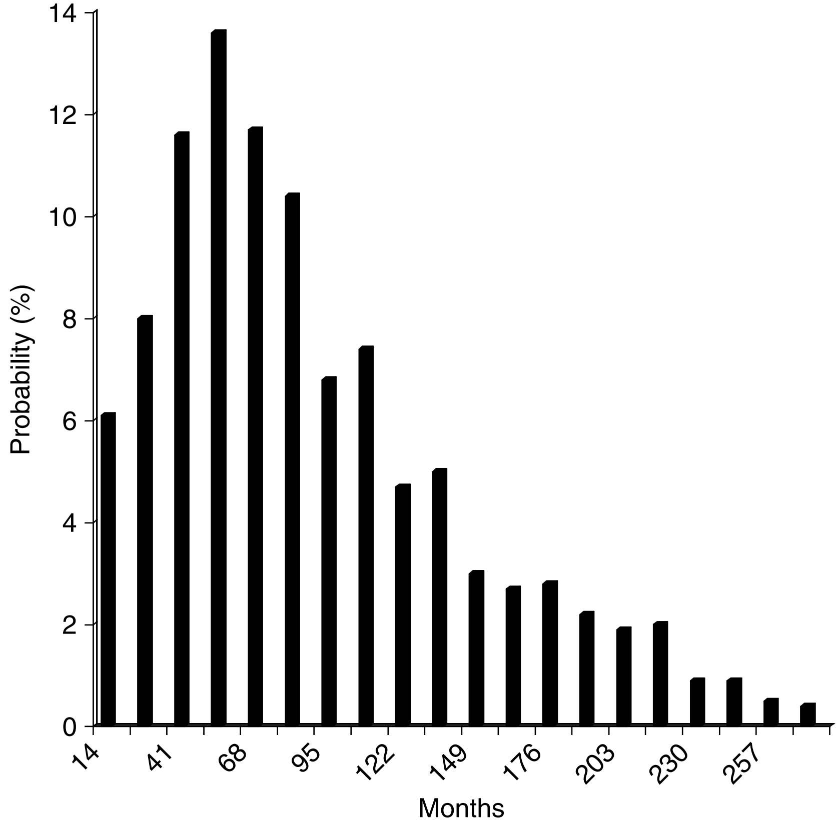
Source: Blake and Timmermann (1998) and Lunde, Timmermann and Blake (1999).

the best and worst performing unit trusts in the UK Equity Growth sector leads, over a 40-year investment horizon, to the accumulated fund in the top quartile being a factor of 3.2 times larger than the accumulated fund in the bottom quartile for the same pattern of contributions. The 5.9 percentage point per annum difference between the best and worst performing unit trusts in the UK Smaller Companies sector leads to an even larger fund size ratio after 40 years, of 5.3.[16]

This suggests that DC plan members can find themselves trapped in poorly performing funds. But should it not be the case in an efficient capital market that systematically underperforming funds fail to survive and are taken over by more efficient fund managers? Lunde, Timmermann and Blake (1999) investigated this possibility. They found that underperforming trusts are eventually merged with more successful trusts, but that on average it takes some time for this to occur. Figure 6.7 shows the distribution of durations across the whole unit trust industry of trusts that were eventually wound up or merged. The modal duration is 4.25 years (51 months), but the average duration is about 16 years. Across the whole unit trust industry, the average return on funds that survived the whole period was 13.7 per cent per annum, while the average return on funds that were wound up or merged during the period was 11.3 per cent per annum. This implies that a typical DC plan member might find themself locked into an underperforming trust that is eventually wound up or merged into a more successful fund, experiencing an underperformance of 2.4 per cent p.a., over a 16-year period. This translates into a fund value that is 19 per cent lower after 16 years than a fund that is not wound up or merged. So it seems that, in practice, PPP members cannot rely on the markets to provide them with a painless way of extricating them from an underperforming fund. They have to do it themselves, paying up to one-quarter of the value of their accumulated fund in transfer costs.[17]

6.5.2 The Investment Performance of Managed Funds

The investment performance of managed funds between 1986 and 1994 has been investigated in Blake, Lehmann and Timmermann (BLT) (1999, 2002).[18] While the average or median performance has been very good over the sample period, the median return conceals a wide distribution of performance. This can be seen from Table 6.7, which shows the cross-sectional distribution of returns realized by the pension funds in the sample over the period 1986–94 in the most important individual asset classes as well as for the total portfolio. The semi-interquartile range is quite tight, below two percentage points for most asset classes, and only just over one percentage point for the total portfolio return. This suggests evidence of a possible



Note: The diagram shows the distribution of the lifetimes in months of the 973 unit trusts which were wound up or merged during sample period 1972–75.

Source: Lunde, Timmermann and Blake (1999, Table 1).

Figure 6.7 Frequency distribution of durations of UK unit trusts from inception

herding effect in the behaviour of pension fund managers, which can be explained by the fact that the reputation of fund managers is based on their *relative* performance against each other.[19] Nevertheless, the difference between the best and worst performing funds is very great, as the last row of Table 6.7 indicates.

Table 6.8 shows how well UK pension funds have performed in comparison with other participants in the market. The fourth column reveals that the average UK pension fund underperformed the market average by 0.45

Table 6.7 Fractiles of total returns by asset class for UK managed funds, 1986–94, average annualized percentages

	UK equities	International equities	UK bonds	International bonds	UK index bonds	Cash/other inv'mnts	UK property	Total
Minimum	8.59	4.42	6.59	−0.64	5.59	2.67	3.05	7.22
5%	11.43	8.59	9.44	2.18	7.20	5.46	5.07	10.60
10%	11.85	9.03	9.95	7.56	7.81	7.60	6.58	10.96
25%	12.44	9.64	10.43	8.30	7.91	8.97	8.03	11.47
50%	13.13	10.65	10.79	11.37	8.22	10.25	8.75	12.06
75%	13.93	11.76	11.22	13.37	8.45	11.72	9.99	12.59
90%	14.81	12.52	11.70	14.55	8.80	14.20	10.84	13.13
95%	15.46	13.14	12.05	18.15	8.89	16.13	11.36	13.39
Max	17.39	14.68	17.23	26.34	10.07	19.73	13.53	15.03
Max–Min	8.80	10.26	10.64	26.98	4.48	17.06	10.48	7.81

Note: The table shows the fractiles of the cross-sectional distribution of returns on individual asset classes as well as on the total portfolio.

Source: Blake, Lehmann and Timmermann (1998, Table 1).

Table 6.8 Performance of UK managed funds in comparison with the market, 1986–94 (percentages)

	Average portfolio weight (%)	Average market return (%)	Average pension fund return (%)	Average out-performance (%)	Percentage out-performers
UK equities	53.7	13.30	12.97	−0.33	44.8
International equities	19.5	11.11	11.23	0.12	39.8
UK bonds	7.6	10.35	10.76	0.41	77.3
International bonds	2.2	8.64	10.03	1.39	68.8
UK index bonds	2.7	8.22	8.12	−0.10	51.7
Cash/other investments	4.5	9.90	9.01	−0.89	59.5
UK property	8.9	9.00	9.52	0.52	39.1
Total		12.18	11.73	−0.45	42.8

Note: International property is excluded since no market index was available.

Source: Blake, Lehmann and Timmermann (1999, Table 2).

per cent per annum; and this is before the fund manager's fee is taken into account. Further, only 42.8 per cent of funds outperform the market average. The main explanation for this is the relative underperformance in UK equities, the largest single category with an average portfolio weighting of 54 per cent over the sample period; the average underperformance is −0.33 per cent per annum and only 44.8 per cent of UK occupational pension funds beat the average return on UK equities. To be sure, relative performance is better in other asset categories, especially UK and international bonds, but the portfolio weights in these asset categories are not large enough to counteract the relative underperformance in UK equities.

Tables 6.7 and 6.8 together indicate how close the majority of the pension funds are to generating the average market return. The median fund generated an average total return of 12.06 per cent per annum, just 12 basis points short of the average market return, and 80 per cent of the funds are within one percentage point of the average market return. This suggests that, despite their claim to be active fund managers, the vast majority of UK pension fund managers are not only herding together, they are also closet index matchers.[20]

The final result concerns the abilities of UK pension fund managers in active fund management; that is, in their attempts to beat the market in comparison with a passive buy and hold strategy. The most important task of managed fund managers is to establish and maintain the strategic asset allocation. This is essentially a 'passive' fund management strategy. However, fund managers claim that they can 'add value' through the 'active' management of their fund's assets. There are two aspects to active management: security selection (also known as stock selection) and market timing (also known as tactical asset allocation). Security selection involves the search for undervalued securities (that is, it involves the reallocation of funds within asset categories) and market timing involves the search for undervalued sectors (involving the reallocation of funds between sectors or asset categories).

BLT decomposed the average total return (12.034 per cent p.a.) generated by fund managers into the following components (see appendix):

Component	Percentage
Strategic asset allocation	99.47
Security selection	2.68
Market timing	−1.64
Other	−0.51
Total	100.00

They found that 99.47 per cent of the total return generated by UK fund managers can be explained by the passive strategic asset allocation. In terms of active components, the average pension fund was unsuccessful at market timing, generating a negative contribution to the total return of −1.64 per cent. The average pension fund was, however, more successful in security selection, making a positive contribution to the total return of 2.68 per cent. But the overall contribution of active fund management was just over 1 per cent of the total return (or about 12 basis points p.a.), which is *less than the annual fee that active fund managers charge* (which range between 20 basis points for a £500m fund to 75 basis points for a £10m fund).[21]

In summary, we find that, although investment performance is another critical determinant of the size of the pension in retirement, there is little evidence that fund managers as a group can systematically deliver superior investment performance over long investment horizons from active fund management.[22] There is, however, strong evidence of both herding and closet index matching. There are also problems with assessing investment performance. First, the performance of fund managers seems to be so highly concentrated around the peer-group median that performance rankings are uninformative, because very small changes in performance of only a few basis points by a particular fund manager would produce very considerable changes in the rankings, without indicating any substantive change in the skill of the fund manager. Equally, the small numbers of managers at the extremes of the distribution have such wide differences in performance between themselves that even quite major changes in performance by one of these managers would result in no change in the rankings. This suggests that a fund manager's current ranking is likely to provide a very poor indicator of both absolute and relative future performance. Secondly, the benchmark return against which fund managers are to be judged must be interpreted with considerable caution. To illustrate, one of the key benchmarks is the peer-group benchmark, but the peer group does not remain constant over time, as some managers will drop out (that is, fail to survive) while other new ones will join. This makes it difficult to construct a consistent time series for the benchmark. In the case of some performance measurement services, the information on non-surviving funds is actually removed from their database. Since the non-surviving funds will generally have had poor performance prior to their demise, their deletion from the database will raise the average benchmark performance[23] and make the remaining funds appear to have worse performance relative to the now biased benchmark than is actually the case. Blake and Timmermann (1998) estimated the resulting survivorship bias to be approximately 0.8 per cent per annum.[24] It is difficult to avoid the conclusion that most PPP members would be better off by investing in passive index funds and paying the much lower fund management fees that passive managers charge.

6.6 FUND ANNUITIZATION

Eventually, and certainly by age 75, in the UK, the full value of the assets owing to the plan member must be liquidated and the proceeds used to purchase a life annuity. Generally, some of the proceeds can be taken as a cash lump sum. In many countries, such as the US, Japan, Germany and Australia, there is no formal requirement to take an annuity: the entire proceeds from the DC plan can be taken as a lump sum. But unless the plan member uses the lump sum to buy an annuity at some stage, he or she bears another type of risk, namely longevity risk, the risk of outliving one's resources.[25]

DC plans will only be considered a success if they can deliver adequate life-long pensions in retirement. But there is a major impediment to the provision of decent pensions during the retirement phase itself, namely the annuity market. The principal vehicle for delivering DC pensions is an annuity purchased from a life assurance company. Even in economies with well-developed annuity markets, the market for immediate annuities is highly concentrated with, for example, only around 10 serious providers at any one time from a potential market of more than 200 authorized life companies in the UK.[26] In this section, we review the problems facing annuity providers.

6.6.1 The Problems Faced by Annuitants and Annuity Providers

There are a number of problems facing both annuitants and annuity providers. First, there is interest rate risk. Annuity rates vary substantially over the interest rate cycle. They are related to the yields on government bonds of the same expected term. Since historically the yields on long-term government bonds have varied by up to 150 per cent over the cycle,[27] we can expect annuity rates to vary by the same order of magnitude. Secondly, there is inflation risk, the risk faced by those purchasing level annuities that unanticipated high inflation rapidly reduces the real value of the pension.

Thirdly, there is an adverse selection bias associated with longevity risk. This is the risk that only individuals who believe that they are likely to live longer than the average for the population of the same age will voluntarily choose to purchase annuities. Individuals have a good idea, on the basis of both their own personal medical and family histories, whether they are likely to experience lighter or heavier mortality. Insurance companies do not have access to this information with the same degree of reliability. There is therefore an *informational asymmetry* between the insurance company offering the annuity and the prospective annuity purchaser. The insurance company is not able to differentiate between prospective purchasers who will experience heavier mortality (and so make a profit for the insurance company) and those who will experience lighter mortality (and hence make a loss for the insurance company); however, it realizes that those most likely to purchase annuities will come from the latter group rather than the former group. To hedge this risk, the insurance company will base its annuity rates on the 'select group' that is most likely to purchase annuities. Annuities will therefore be poor value for money for members of the first group.

Fourthly, mortality rates tend to improve over time and there can be severe financial consequences if insurance companies underestimate mortality improvements. Mortality forecasts errors of 15–20 per cent over 10-year horizons are not uncommon[28] and some insurance companies in the UK have underestimated the average life expectancy of their pool of annuitants by up to two years.[29]

Fifthly, there is reinvestment risk. This is the risk faced by annuity providers that there are insufficient long-maturing matching assets (especially government bonds) available to provide the annuity payments, with the consequence that the proceeds from maturing assets may have to be reinvested on less favourable terms.

Table 6.9 shows that insurance companies impose charges of between 10 and 20 per cent of the fund value to cover the risks that they face. It is possible to decompose the charges on annuities extracted by life companies into the following components using estimates derived by Finkelstein and Poterba (2002, hereafter FP): a component arising from the selection risk associated with the type of people who purchase annuities, a component arising from the additional risk associated with the type of people who purchase annuities in the voluntary market, a component arising from escalation risk, and a component that covers administration costs and profit to the insurance company. It is also possible to identify a size effect, an age effect and a sex effect.

The basis for FP's analysis is the *money's worth of an annuity* which is defined as the ratio of the expected present value (EPV) to the premium, where the EPV is defined as:

$$EPV = \sum_{t=1}^{T} \frac{Y(1+\pi)^t P_t}{\prod_{k=1}^{t}(1+r_k)} \times 100, \tag{6.18}$$

where:

$Y =$ Nominal initial annuity payment,
$\pi =$ Escalation factor (zero for level annuity),
$r_k =$ Nominal spot yield for year k derived from the government bond spot yield curve,
$T =$ Maximum length of pension based on the assumption that no one lives beyond age 112, and
$P_t =$ Probability that the annuitant survives t years.

FP derive estimates of (6.18) based on three different sets of single-life mortality tables: the population mortality tables provided by the UK Government Actuary's Department, and the mortality tables for voluntary and compulsory annuitants provided by the Institute of Actuaries. The latter two sets of tables are the IM80 and IF80 tables for voluntary purchase male and female life annuities and the PM80 and PF80 tables for the compulsory purchase male and female life annuities that must be bought when someone retires from a PPP. These tables are based on the mortality experience of these two select groups during the period 1979–82 and have been adjusted to account for mortality improvements since that period.

Table 6.9 Decomposition of charges in annuities with £10 000 purchase price

	Level		Escalating at 5%	
	Compulsory	Voluntary	Compulsory	Voluntary
Male aged 65				
Initial annuity payment (£)	879.70	844.40	550.20	522.90
Total implied charge (%)[a]	10.3	13.5	14.2	19.6
composed of:				
volunteer premium (%)[b]	—	4.2	—	6.5
escalation premium (%)[c]	—	—	2.2	2.3
selection premium (%)[d]	4.7	4.6	6.4	6.1
administration cost and profit[e]	5.6	4.7	5.6	4.7
Size premium:[g]				
£10 000 to £50 000	−1.3	NA	NA	NA
£50 000 to £100 000	0.2	NA	NA	NA
Male aged 70				
Initial annuity payment (£)	1036.10	992.80	703.70	670.40
Total implied charge (%)[a]	13.1	16.3	17.1	21.4
composed of:				
volunteer premium (%)[b]	—	6.6	—	8.9
escalation premium (%)[c]	—	—	2.6	1.6
selection premium (%)[d]	4.7	4.6	6.1	5.8
administration cost and profit[e]	8.4	5.1	8.4	5.1
Age premium[f]	0.0	2.4	0.1	1.4
Size premium:[g]				
£10 000 to £50 000	−0.6	NA	NA	NA
£50 000 to £100 000	0.3	NA	NA	NA
Female aged 65				
Initial annuity payment (£)	768.50	727.60	445.4	420.3
Total implied charge (%)[a]	9.9	14.7	14.1	20.7
composed of:				
volunteer premium (%)[b]	—	3.2	—	4.7
escalation premium (%)[c]	—	—	3.1	3.5
selection premium (%)[d]	1.9	1.9	3.0	2.9
administration cost and profit[e]	8.0	9.6	8.0	9.6
Size premium:[g]				
£10 000 to £50 000	−1.4	NA	NA	NA
£50 000 to £100 000	0.5	NA	NA	NA

Table 6.9 (continued)

	Level		Escalating at 5%	
	Compulsory	Voluntary	Compulsory	Voluntary
Female aged 70				
Initial annuity payment (£)	885.20	843.50	560.80	532.10
Total implied charge (%)[a] composed of:	12.7	16.7	17.2	22.4
volunteer premium (%)[b]	—	4.5	—	5.9
escalation premium (%)[c]	—	—	3.4	3.4
selection premium (%)[d]	1.8	1.8	2.9	2.7
administration cost and profit[e]	10.9	10.4	10.9	10.4
Age premium[f]	−0.1	1.2	0.2	0.9
Size premium:[g]				
£10 000 to £50 000	−1.0	NA	NA	NA
£50 000 to £100 000	0.6	NA	NA	NA

Notes:

[a] The difference between an actuarially fair annuity (100%) and the money's worth of the annuity using the population mortality table (e.g. 100–89.7 for the level compulsory annuity for a 65-year-old male).

[b] For voluntary annuities only, the difference between the money's worth of the annuity using the voluntary mortality table and the money's worth using the compulsory mortality table (e.g. 95.3–91.1 for the level voluntary annuity for a 65-year-old male).

[c] For escalating annuities only, the difference between the money's worths of the level and escalating annuities, both evaluated using the own-market mortality table (e.g. 94.2–92.2 for the compulsory annuity for a 65-year-old male).

[d] The difference between the money's worth of the annuity using the own-market mortality table and the money's worth using the population mortality table (e.g. 94.4–89.7 for the level compulsory annuity for a 65-year-old male).

[e] The difference between the total implied charge and the sum of the volunteer, escalation and selection premiums.

[f] The difference between the sums of the volunteer, escalation and selection premiums at age 70 and 65.

[g] The difference in money's worth between the lower and higher valued annuities, both evaluated using population mortality tables (e.g. 89.7–91.0 for the £10 000 and £50 000 annuities for a 65-year-old male).

Source: Author's calculations based on the averages from a sample of nine insurance companies reported in Tables 2, 7 and 12 of Finkelstein and Poterba (2002).

If an annuity is fairly priced, its money's worth should be 100 per cent. In practice, though, it will be less than this because of the charge components outlined above. FP use data provided by Moneyfacts and Annuity Direct for November 1998: they analyse the money's worth of an immediate single-life annuity with monthly payments and a premium of £10 000. Their decomposition is presented in Table 6.9.

Take, for example, the case of a 65-year-old male and a level annuity. This pays £879.70 in the compulsory purchase market and £844.40 in the voluntary open market, the difference reflecting the greater life expectancy of those who purchase annuities on a voluntary basis over those who are required to do so as part of their pension plan (we denote this component of charges the 'volunteer premium'). The total implied charge is 10.3 per cent of the purchase price in the compulsory market and 13.5 per cent in the voluntary market. This is found as follows: calculate (6.18) using the population mortality table with $Y = £879.70$ for the compulsory annuity and £844.40 for the voluntary annuity and divide this by the purchase price (£10 000) to give the money's worth, which is then subtracted from 100 per cent. Using population mortality data to calculate (6.18) is equivalent to assuming the longevity experience of a typical member of the population as a whole.

If, using population mortality, the money's worth is below 100 per cent, this implies that there are additional longevity risks associated with the select group of the population who purchase annuities. We quantify these additional risks as follows. The 'selection premium' covers the additional longevity risk of someone who purchases an annuity in comparison with a typical member of the population at large of the same sex and age. The selection premium associated with compulsory annuities is 4.7 per cent: it is measured as the difference in money's worths calculated using (6.18) based on compulsory mortality tables and (6.18) based on population mortality tables. So even though members of PPPs have no choice about whether or not to buy an annuity, they, as a group, experience sufficiently lighter mortality than the population as a whole, that insurance companies need to charge 65-year-old men a premium of 4.7 per cent to cover this additional risk. The selection premium with voluntary annuities is, at 4.6 per cent, of a similar order of magnitude.

Since those who buy annuities voluntarily experience even lighter mortality than PPP members, insurance companies charge such purchasers an additional volunteer premium. This is calculated as the difference between the money's worth in the voluntary market using the voluntary mortality table and the money's worth in the voluntary market using the compulsory mortality table. For a 65-year-old male, the volunteer premium is 4.2 per cent.

The table also reports evidence of a size effect in annuity provision and two countervailing influences are apparent. The first is a scale effect: the cost of administering an annuity is independent of its size, so that insurance companies should be willing to pass scale economies on to high-valued plan members. The table shows that this happens, although evidence is only available on compulsory level annuities: the charge is 1.3 percentage points lower for a 65-year-old man when the purchase price is £50 000 than when it is £10 000. The second effect is a wealth effect: richer people tend to live longer than poorer people, and this should be reflected in a higher longevity premium. This effect begins to dominate the scale effect on annuities over £50 000: there is a small increase in charges of 0.2 percentage points as the plan size rises from £50 000 to £100 000.

We can assess the importance of the age effect by comparing these results with those relating to a male aged 70. There are two factors to consider: an older man has on average fewer remaining years of life than a younger man, but, because he has survived to a greater age than the younger man he has greater total life expectancy. The first factor will result in a higher annuity for the older man than for the younger man, but this will be partly counteracted by the second factor: the risk that an annuitant will live a very long time increases with the age at which he purchases the annuity. The second panel of the table shows that a 70-year-old man receives an annuity that is 18 per cent higher than that for a 65-year-old man in both the compulsory and voluntary level markets. However, the total charges for the 70-year-old are nearly three percentage points higher in each market. The selection premium remains the same in both markets, but the volunteer premium is 2.4 percentage points higher. We can interpret the figure of 2.4 per cent as the 'age premium' and note that, in the case of 65-year-old men, the age premium is present only in the voluntary market, not the compulsory market. A size effect is also present, although the orders of magnitude differ slightly in comparison with the 65-year-old male.

The final effect that we can identify is a sex effect: women tend to live longer than men and this is reflected in the size of the annuity they are offered for a given premium. A 65-year-old women receives a level annuity that is 13–14 per cent lower than that of a 65-year old man, while a 70-year-old woman receives broadly the same annuity as a 65-year-old man. The level and pattern of charges differs, however. The total charge for men is generally higher than for women in the compulsory market, but lower in the voluntary market. Both the selection and volunteer premiums are lower for women than for men. There is a positive age premium in the voluntary market, but at 1.2 per cent it is only half that for men, while in the compulsory market, the age premium is negative (−0.1 per cent): the age premium is the difference between the sums of the volunteer, selection and escalation premiums at age

70 and 65 years, respectively. The wealth component of the size effect is larger for women than for men (0.5 compared with 0.2 at age 65 and 0.6 compared with 0.3 at age 70).

The initial annuity payment with a 5 per cent escalating annuity is 37 per cent lower than for a level annuity for a 65-year-old man in the compulsory market and 38 per cent lower in the voluntary market. It takes six years for the escalating annuity to catch up with the level annuity and 13 years before the total cash payments under the two policies are equalized. In the case of a 65-year-old woman, the initial payment from the escalating annuity is 42 per cent lower for both the compulsory and voluntary markets. It takes around seven years for the two cash amounts to equalize and a further eight years before the total cash payments equalize.

The total implied charge is higher for escalating annuities than for level annuities. This is because both the volunteer and selection premiums are higher and there is an additional 'escalation premium' to take into account. The escalation premium covers a type of longevity risk that arises from the backloading of payments with escalating annuities: if the annuitant lives longer than anticipated, the additional payments will be rising with the escalating annuity but remain constant with the level annuity. It is calculated as the difference between the money's worths of the level and escalating annuities, each evaluated using own-market mortality tables. The escalation premium varies between 1.6 and 2.6 per cent for men and between 3.1 and 3.5 per cent for women.

To illustrate in the case of a 65-year-old man, the volunteer premium is 6.5 per cent with the escalating annuity and 4.2 per cent with the level annuity. The selection premium is 6.4 per cent compared with 4.7 per cent in the compulsory market and 6.1 per cent compared with 4.6 per cent in the voluntary market. In comparison, with a 65-year-old woman, the volunteer premium is 4.7 per cent with the escalating annuity and 3.2 per cent with the level annuity. The selection premium is 3.0 per cent compared with 1.9 per cent in the compulsory market and 2.9 per cent compared with 1.9 per cent in the voluntary market. The age premium is smaller for both men and women in the compulsory market (at 0.1 per cent and 0.2 per cent, respectively) than in the voluntary market (at 1.4 per cent and 0.9 per cent, respectively).

The allowance for administration costs and profit is calculated as the difference between the total implied charge and the sum of the volunteer, escalation and selection premiums. We find that compulsory annuities are generally more profitable than voluntary annuities, reflecting the fact that the compulsory market is a captive one, that female annuities are more profitable than male annuities and that the profit margin rises with age, especially in the compulsory market.

6.6.2 How Annuitants and Insurance Companies Currently Deal with these Problems

Insurance companies use the government (and high grade corporate) bond market to protect themselves against both interest rate and inflation risk arising *after* the annuity is purchased. When an insurance company sells a level annuity, it uses the proceeds to buy a fixed-income government bond of the same expected term as the annuity (typically 15–17 years) and then makes the annuity payments from the coupon payments received on the bond. Similarly, when an insurance company sells an indexed annuity, it buys an index-linked bond of the same expected term as the annuity; few if any insurance companies would take the risk of selling indexed annuities with expected maturities beyond that of the most distant trading indexed-linked government bond, although the emergence of an inflation swaps market is beginning to change this.

But annuitants themselves remain exposed to interest and inflation risk. If a DC plan member retires during an interest rate trough (as happened during the late 1990s and early 2000s in the UK, for example), he or she can end up with a very low pension. Similarly, if a 65-year-male old annuitant chooses a 5 per cent escalating annuity, he will receive an initial cash sum that is about 37 per cent lower than a level annuity, and it would take six years for the escalating annuity to exceed the level annuity. Since retired people also tend to underestimate how long they will continue to live,[30] most prefer to buy a level annuity and thereby retain the inflation risk. In 1995, as a result of falling interest rates, the UK Government was pressed into allowing income drawdown (also known as systematic withdrawal): it became possible to delay the drawing of an annuity until annuity rates improved (or until the age of 75) and in the interim take an income from the fund which remained fully invested.

So insurance companies use the financial markets (in particular they make use of financial instruments issued by the government, namely fixed-income and index-linked bonds) to hedge the interest and inflation rate risks that they face from the date that the annuity is purchased. But the interest rate risk up to the date of retirement is borne by the future annuitant, and the inflation risk after the retirement date is also borne by the annuitant unless he or she is willing to forgo a substantial cash sum at the start of retirement as a consequence of purchasing an indexed annuity. The longevity risk and the risk associated with underestimating improvements in mortality appear to be shared between insurance companies and annuitants: despite adding substantial cost loadings of 10–20 per cent to cover these risks, most insurance companies in the UK do not actively seek annuity business.

In summary, we find that annuities form the weak tail in DC pension provision. Not only do they involve substantial charges to cover longevity risk, some key risks, such as interest rate risk, are borne directly by the annuitant himself (as the forced purchaser of an annuity on the retirement date unless income drawdown is used) and the insurance industry has been particularly unimaginative in designing products that hedge such predictable risks.

6.7 IMPROVING THE DESIGN OF DC PENSION PLANS

If we add together the 30 per cent of fund value accounted for by charges during the accumulation stage for a typical plan (see Table 6.2) with the 10–20 per cent charge on annuities (see Table 6.9), we arrive at a figure for lifetime pension charges of between 40 and 50 per cent of the total fund size. That is an extraordinarily high proportion and is likely to lead to DC plans eventually falling into disrepute if it cannot be reduced. Apart from charges, there are also problems with lapses, investment strategy, investment performance, fund annuitization and provider incentives. There are also market failures which the government could help ameliorate. In this section, we examine ways of dealing with these issues, some of which are interrelated.

6.7.1 Charges, Investment Performance and Incentives

High charges and poor investment performance can both separately and together lead to the plan member having a low fund to annuitize on the retirement date. However, some people have argued that some of these factors can be offsetting. For example, one argument often put forward by pension professionals is that high charges can be justified by good investment performance. One provider's charges might be higher than another's because it has employed better (and more expensive) fund managers, but if this is more than matched by superior investment performance, then the net benefit to the customer could still be positive.

There are problems with this argument. The findings above suggest that there is a limit to how much superior performance could compensate for very high charges: a RiY of 20 per cent as a result of high charges, for example, is likely to swamp any realistic degree of superior performance that could be achieved. In addition, as Table 6.7 showed, the bulk of funds generate returns that are very close to each other. The difference between the best and worst funds is indeed large, but the difference between the fifth and ninety-fifth percentile of funds is quite small. As we have already argued, this means that most rankings will be very sensitive to small variations in market conditions and these variations in rankings will be economically insignificant. It is therefore very unlikely that any measure of expected superior performance would be sufficiently robust to differentiate clearly between two middle-ranked firms.

However, the greatest difficulty with this argument is that it would require estimates of *expected* superior performance (that is, alpha) over the remaining investment horizon of the plan, rather than *past* superior performance. Unfortunately, there is no way in which expected performance can be reliably estimated. Modern finance theory (as well as the empirical evidence reported above) suggests that, in an efficient financial system, it is impossible to achieve consistently superior net investment performance. While there may be differences in the academic literature about the degree of financial market efficiency at the margin, there is no academic support for the proposition that an institutional investor is able to obtain consistently superior investment performance over extended periods of time, after taking into account risk and transactions (that is, research and trading) costs. Similarly, while in any given period, some investors will perform better than the average and others will perform worse, there is nothing in the academic literature to suggest that any outperformance will persist over any extended period.

Table 6.10 provides empirical evidence that is consistent with this theoretical view. It shows the consistency of performance for each of three non-overlapping five-year periods achieved by a large number of UK managed

Table 6.10 Consistency of managed funds' investment performance (percentages)

Years above average	Total fund				UK equities				
	1980–84	1985–89	1992–96	Mean	1980–84	1985–89	1992–96	Mean	Chance
5	3	3	5	4	2	5	5	4	3
4	25	18	17	20	14	18	21	18	16
3	26	28	28	27	35	26	28	30	31
2	25	34	35	34	31	27	24	30	31
1	15	14	13	11	15	18	15	13	16
0	6	3	2	4	3	6	5	5	3

Notes: The table shows the percentage of firms achieving the given number of years of above average performance during each five-year period. The final column shows the percentages that would be expected if fund performance was purely random.

Source: CAPS *General Reports*, 1985, 1989, 1996.

funds. The table reveals that, across all three periods, only 4 per cent of funds managed to achieve consistently above-average performance in each of the five years, while another 4 per cent of funds underperformed in each of the five years. About half the funds had superior performance in three or more years and about half had below-average performance in three or more years. Comparing these figures with those in the final column confirms that this distribution is almost exactly what would be expected if above- (or below-) average performance arose entirely by chance in each year. This pattern is found consistently in each of the three five-year periods and is not affected by whether the investments considered are UK equities or more broadly based portfolios. Similar results have been found for UK unit trusts for periods in excess of three years.

Other studies did find some evidence that consistency of performance was possible, particularly in the top and bottom quartiles, but only over very short horizons. For example, Blake, Lehmann and Timmermann (1999) found that, in the case of managed pension funds, UK equity managers in the top quartile of performance in one year had a 37 per cent chance of being in the top quartile the following year, rather than the 25 per cent that would have been expected if relative performance arose purely by chance. Similarly, there was a 32 per cent chance of the UK equity managers in the bottom quartile for one year being in the bottom quartile the following year. There was also evidence of consistency in performance in the top and bottom quartiles for cash/other investments, with probabilities of remaining in these quartiles the following year of 35 per cent in each case. However, there was no evidence of consistency in performance for any other asset category or for the portfolio as a whole. Nor was there evidence of any consistency in performance over longer horizons than one year in any asset category or for the whole portfolio. Lunde, Timmermann and Blake (1999) found similar results for unit trusts: for example, a unit trust specializing in UK equity which was in the top quartile in one year had a 33 per cent chance of remaining in the top quartile the following year, while there was a 36 per cent chance of a trust remaining in the bottom quartile for two consecutive years. Thus the evidence is consistent with the suggestion that so-called 'hot hands' in investment performance is a very short-term phenomenon and that fund managers are unable to produce superior performance over extended periods.[31] [32]

The evidence in Section 5 above does, however, allow the rather limited suggestion that *gross* superior performance is possible, but *only* at the expense of matching higher investment costs.[33] Furthermore, the academic argument behind this view that *net* returns to investors will be the same whether or not they engage in costly research is powerful[34] and implies that assuming that particular funds will outperform (net of risk and transactions costs) in the future, even if they have outperformed temporarily in the past, could not be justified.

So, if there is no relationship between the level of charges and performance, there seems to be little alternative but to keep charges low. The best way of achieving this is for the regulatory authority to cap charges and to allow penalty-free transfers between plans, thereby forcing economies of scale on plan providers. This is what the UK Government introduced for Stakeholder Pension Plans in 2001 and what the UK Pensions Commission has proposed and the UK Government has accepted for the new system of Personal Accounts for low-income workers.[35]

Is there a relationship between charging structures and performance? The RiY and RiC are two measures that were discussed above for reporting charges. But they do not have any implications for whether it is better for the incidence of charges to be on contributions or on fund value. There is no reason why a fund could not have a simple fee based solely on contributions made. However, there is an important implication with a charging structure that is based solely on contributions: the total (compounded) charge (the take) as a proportion of the zero-load terminal fund value is independent of the realized return on investments. This is not the case if the charging structure is based on the fund value: the percentage take rises if the realized return exceeds the assumed or projected return (for example, 9 per cent) and falls if the realized return is below this. To illustrate, in the case of the 25-year plan discussed in Section 2.3, and either a fund-based charge of 1.7 per cent of the annual fund value or a contribution-based charge of 23.18 per cent of each contribution, the percentage take varies with the realized investment return as follows:

Realized return (%)	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Fund-based charges	20.81	21.5	22.09	22.64	23.18	23.68	24.16	24.61	25.03
Contribution-based charges	23.18	23.18	23.18	23.18	23.18	23.18	23.18	23.18	23.18

If a plan has the bulk of its charges based on the fund value, this provides a strong statement about the plan provider's own perception of his ability to deliver investment performance in excess of the assumed or projected rate. It is this argument that appears to have persuaded the UK Government to have only fund-based charges for SPPs and for the Pensions Commission to recommend the same for the new system of Personal Accounts (with a target of 30 basis points per annum of assets under management).

Certainly a charging structure based on a single proportionate charge on fund value would be much easier for consumers to understand. More importantly, a single charge would eliminate the front-loading of current charging structures that does so much damage to the net returns of plan members with low persistency rates. In doing so, it provides better incentives for providers to ensure that the plans they sell meet the genuine needs of their clients: company takes increase considerably if plan members maintain their contribution records.

At the same time, however, a single proportionate charge based on fund value provides, at best, only weak incentives to deliver superior investment performance. While fund managers receive higher fee incomes if they generate higher fund values, earning greater returns usually involves taking on greater risk, the result of which could be very poor performance relative to other fund managers, and this would be damaging for reputations. Thus, with charges based on fund values, the additional return that could be expected from choosing an active investment strategy that differed substantially from that of the median fund manager is unlikely to compensate for the risk of ending up in the fourth quartile and the resulting loss of reputation. The outcome is herding of both investment behaviour and performance, not only around the median fund manager, but also around the index.

One way to provide appropriate incentives to those fund managers who believe that they can generate superior investment performance (although there is strong evidence that they will be unable to do so consistently over time) is to use performance-related investment management fees. In one example of this, the fee is determined as some proportion, f_1, of the difference between the fund's realized performance and some benchmark, $g^{\#}$ (possibly the regulator's 9 per cent), plus a fee, f_2, to cover the fund manager's overhead costs based on the absolute value of the fund (V_t):

$$\text{Performance-related fee in period } t = f_1(g_t - g^{\#})V_t + f_2 V_t. \quad (6.19)$$

This would reward good ex post performance and penalize poor ex post performance, whatever promises about superior ex ante performance had been made by the fund: the fund would have to accept a reduced fee or even pay back the client if g_t was sufficiently below $g^{\#}$ (although the latter case generally involves credits against future fees rather than cash refunds).

Another possibility that is less extreme since it does not involve refunds is:

$$\text{Performance-related fee in period } t = f_i V_t, \quad (6.20)$$

where f_i is the fee if the fund manager's return is in the *ith* quartile. An example of (6.20) is the Newton Managed Fund:

Quartile rank	*Up to £10m*	*Fund size* *£10–£50m*	*Above £50m*
1st	0.94 per cent	0.59	0.04
2nd	0.79	0.44	0.03
Median	0.69	0.34	0.02
3rd	0.59	0.24	0.01
4th	0.44	0.09	0.01

Figure 6.8 presents the frequency distribution for this fee structure for a fund in the range £10–50m and a 25-year investment horizon, based on a monte carlo simulation with 1000 replications from a distribution of returns that is assumed to be normal with a nominal mean return of 9 per cent p.a. and standard deviation of 18 per cent.[36] The 90 per cent confidence interval for the fees lies between 0.22 and 0.45 per cent p.a., while there is a 25 per cent chance that the fee will exceed 0.37 per cent p.a. and a similar chance that it will be less than 0.31 per cent.

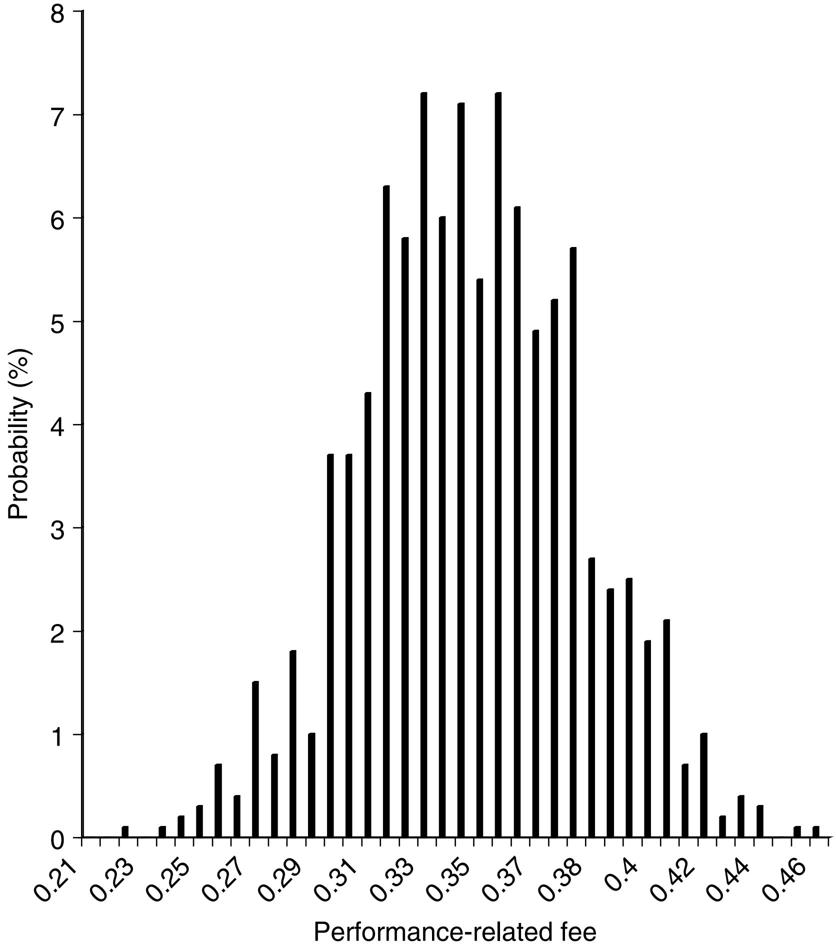
With front-loaded charging structures in the early years of a pension plan, the gap between high and low charges is, in the words of a former industry regulator, 'too great to be closed by superior performance. By year 10, over half of plan holders will have lapsed, and for them, charges will have been the key factor in their relative returns. Holders of high-charge plans who persist longer might be lucky enough to have performances that close charge gaps, but equally such gaps might be widened by poor performance'.[37]

The best way to reduce the probability of this occurring as well as providing the appropriate incentives for promoting the long-term commitment from both plan sponsors and members needed to deliver an adequate pension in retirement is to have charging structures that are simple, fully transparent, non-front-loaded and performance-related.

6.7.2 High Lapse Rates

The UK government is trying to deal with the problem of high lapse rates for its new system of Personal Accounts by using auto-enrolment, and there have also been some recent successes in the US with the 'save more tomorrow' pension plans introduced by Thaler and Benartzi (2004).

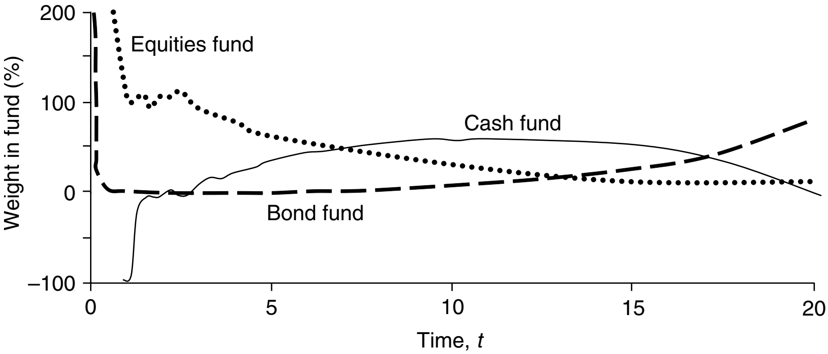
The government could also help to reduce lapse rates during the accumulation stage by making participation in second-pillar pension plans, such as PPPs, mandatory. There is a growing body of support for mandatory contributions into second pensions, including Field and Owen (1993), Borrie (1994), World Bank (1994), Dahrendorf (1995) and Anson (1996), as well



Note: The diagram shows the distribution of 1000 monte carlo simulations of performance-related fees (as an annual percentage of the fund value) in the Newton Managed Fund.

Figure 6.8 Frequency distribution of performance-related fees

as surveys of customers conducted by NatWest Bank and Coopers & Lybrand (reported in Field (1996, pp. 52–3)). Compulsory contributions are seen as one way of dealing with individual myopia and/or procrastination and the problem of moral hazard. The first issue arises because individuals either do not recognize the need and/or do not have the will power to make adequate provision for retirement when they are young: see Mitchell and



Source: Cairns et al. (2006, Fig. 5).

Figure 6.9 Stochastic life-styling

Utkus (2004). The latter problem arises when individuals deliberately avoid saving for retirement when they are young because they know the state will feel obliged not to let them live in dire poverty in retirement.

6.7.3 Investment Management and Annuitisation

The fund management industry has a poor track record of offering products that help PPP members hedge the risks that they are forced to assume. Yet there are strategies and instruments capable of doing this. One such strategy is 'stochastic life-styling' (see Cairns et al., 2006). This is an investment management strategy that hedges productivity risk and inflation risk during the accumulation stage and interest rate and annuity risk at the point of retirement. Three mutual funds are needed to implement the strategy: an equities fund, a bond fund and a T-bill or cash fund. Figure 6.9 depicts the optimal investment strategy for a plan member with $R_A = 6$ who starts his plan 20 years before retirement. The initial investment in the equities fund is very high, with an asset allocation well in excess of 100 per cent. The explanation for this is that a young plan member will be endowed with a large amount of human capital (the present value of expected future labour income which itself is risky owing to uncertainty concerning productivity growth over time), but will typically have a low amount of financial wealth. So, if they treat their human capital as an asset, young PPP members have very unbalanced and undiversified investment portfolios. In order to correct this, young members could use their pension plan to borrow cash and invest in financial assets, such as equities and bonds. The purpose of the equities fund is to hedge productivity shocks and to benefit from the equity risk premium. The purpose of the cash fund is first to finance the initial very high leveraged positions in equities and bonds, and then to hedge the inflation risk in labour income (the nominal return on cash will adjust to reflect inflationary expectations). The purpose of the bond fund is to hedge interest rate risk, given the inverse relationship between bond and hence annuity prices and interest rates.

The weight in the equities fund (q_{Et}) starts out very high, but falls over time as the accumulation stage progresses in line with the depletion of human capital and the increase in value of the accumulating pension fund (see Cairns et al., 2006, equation 25):

$$q_{Et} = \frac{V_t + PV_t}{R_A V_t}, \tag{6.21}$$

where PV_t is the present value of future contributions into the plan which, with a constant contribution rate, will be proportional to the present value of future labour income and hence human capital. Over time, PV_t will fall and V_t will (typically) rise and so q_{Et} falls over time. Towards the end of the accumulation stage, as annuity risk becomes a more important risk to hedge than inflation risk, the weight in the bond fund rises (q_{Bt}) and the weight in cash fund (q_{Ct}) falls:

$$q_{Bt} = \frac{(R_A - 1)(V_t + PV_t)e^{-K(T-t)}}{R_A V_t} \tag{6.22}$$

$$q_{Ct} = -\frac{PV_t}{V_t} + \frac{(R_A - 1)(V_t + PV_t)(1 - e^{-K(T-t)})}{R_A V_t}, \tag{6.23}$$

where T is the retirement date and K measures the speed of adjustment of interest rates when out of long-run equilibrium. Since both V_t and PV_t evolve stochastically over time, so will q_{Et}, q_{Bt} and q_{Ct}, hence the name of the strategy: 'stochastic lifestyling'. Note that the three funds can be index funds, that is, they do not need to be actively managed.

Annuity risk can be hedged in other ways. The simplest strategy is a planned programme of phased annuity purchases, using the principle of dollar cost averaging. This strategy could be used as a cheaper alternative to the lifestyle investment strategy mentioned above: rather than switching out of equities into bonds, the proceeds from selling the equities could be used to buy deferred annuities during the switchover period prior to retirement (see Horneff et al., 2006). A more sophisticated form of pre-retirement planning is protected annuity funds which employ derivative instruments. One example places a fraction (such as 95 per cent) of the funds on deposit and the rest in call options on bond futures contracts: if interest rates fall during the life of the option, the profit on the options will compensate for the reduced interest rate. Another example places a fraction of the funds in bonds and the rest in call options on an equity index, thereby gaining from any rise in the stock market over the life of the options.

The investment strategy during the decumulation phase can also be improved. Most PPP members in the UK purchase a level (that is, non-index-linked) annuity on their retirement date. This locks them into a bond-like investment for the remainder of their lives, which could be in excess of 20 years. Further, this 'investment' dies when they die, since it is not possible to bequeath an annuity when the annuitant dies.

Blake et al. (2003) considered some alternatives to the standard annuity that allows some investment flexibility. These investment-linked decumulation programmes come in two variations: (a) an income drawdown (or systematic withdrawal) variation, in which an income is drawn from the pension fund (which otherwise remains invested in higher return assets such as equities) with the residual fund paid as a bequest to the plan member's estate if he dies before age 75,[38] and (b) an annuity variation, in which the residual fund reverts to the insurer, in return for which the insurer agrees to pay a survival credit at the start of each year while the plan member is still alive:

- *Flexible income programme* with a life annuity purchased at age 75: each year an income is drawn from a managed fund equal to the annuitization value of the pension fund. If the fund falls in value, the income received has to fall in tandem, so there is some volatility to the annuity in contrast with a level annuity. But since the pension from a level annuity is based on the yield on government bonds, it is likely that the pension from an investment-linked programme such as this, based as it is on the return on equities, will generate a higher overall income, assuming the plan member lives long enough.
- *Flexible income programme with a deferred annuity* purchased at retirement age and payable at age 75: in this case the plan member purchases a deferred annuity at age 65 which will provide an income from age 75 equal to that which would be payable at that age from an immediate annuity bought at age 65. He invests the remaining monies at age 65 in a managed fund. He then draws an income from the fund on the same basis as the flexible income programme above, up to age 75 when the deferred annuity comes into payment. On death before age 75, the value of the deferred annuity policy is lost. It is cheaper to purchase at age 65 a deferred annuity that comes into payment at age 75 than to wait to purchase the annuity at age 75; this is because there is some chance that the purchaser will not live long enough to

receive the annuity payments and this is reflected in the deferred annuity price.

- *Unit-linked programme* with a life annuity purchased at age 75: in this case, the plan member uses his retirement fund to purchase a fixed number of units in a managed fund at age 65. The number of units received will depend on the forecasts for mortality made at age 65. Each year a number of units are sold and the plan member's income will change in line with changes in the price of these units. At age 75, assuming he lives that long, he uses the residual fund to purchase a life annuity. The outcome will be similar to that of the flexible income programme described above, and identical in the case where a survival credit is payable. In the US, they are known as variable annuities.[39]
- *Collared income programme* with a life annuity purchased at age 75: this programme is similar to the flexible income programme, but involves a smoothing out of investment returns. Instead of investing solely in a managed portfolio, the fund invests in a mixed portfolio of equities and put and call options with the aim of achieving significant protection against downside equity risk. For each unit of equity held, the portfolio is long one at-the-money put option and short one call option. The strike price of the call option is chosen so that the prices of the put and call options are equal. This means that the net cost of the resulting collar is zero. As a result, we have 100 per cent participation in equity returns subject to the cap and floor. This is one way of selling some of the upside potential to pay for downside protection. The resulting smoothing of investment returns is similar in some respects to a with-profits policy, although in the present case the smoothing method is much more explicit.
- *Floored income programme* with a life annuity purchased at age 75: like the collared income programme, this programme involves forgoing some upside potential to pay for downside protection. The plan member is guaranteed to get a minimum return of zero (that is, holds an implicit at-the-money put option), and pays for this by selling off a proportion of the equity performance above 0 per cent. He will get some proportion (say, k) of the rise in the value of equities, with the difference of $(1 - k)$ being used to 'pay for' the put. In effect, a fraction $(1 - k)$ of an at-the-money call option is sold to pay for the put option. This annual return structure can also be achieved in a more simple way by investing in cash plus k at-the-money call options. This programme is also sometimes known as a participating-equity or guaranteed-equity programme.

6.7.4 Government Amelioration of Market Failures

Greater innovation by the private sector can only go so far and where innovations have proved too expensive to manage they have been dropped.[40] The government could therefore do more to ameliorate market failures in the private provision of annuities which arise, in part, from aggregate risks that are difficult if not impossible for private insurance companies to hedge. Two key examples are inflation risk and longevity risk.

A number of proposals have been suggested recently to help private sector pension plan providers hedge inflation risk. For example, in order to help the private sector hedge against inflation risk more effectively, the Goode Report (1993, section 4.4.44) in the UK suggested that the government introduce a new type of bond, with income and capital linked to the retail price index, but with payment of income deferred for a period. Such bonds were given the name 'deferred income government securities' (DIGS). DIGS could be introduced with different starting and termination dates and would allow all deferred pensions to be indexed to prices. DIGS had not been introduced in the UK by 1997, although the introduction of the government bond (gilt) strips market in the same year could help UK insurance companies construct DIGS synthetically.

The introduction of 'limited price index bonds' would allow annuities to be partially indexed to inflation: annuitants could have higher starting pensions if they were to accept that the subsequent uprating of the pension would compensate for inflation only up to a stated limit (for example, 2.5 per cent p.a.).

The main causes of private market failure in annuity provision are the risks associated with adverse selection and longevity risk. Again, making participation in second-pillar pensions mandatory rather than voluntary would do much to remove the adverse selection bias in the demand for annuities. There are a number of ways in which the government could also help insurance companies hedge the risk associated with underestimating mortality improvements. It has been argued that the government should take some responsibility here since mortality improvements arise at least in part from public health campaigns and so on. The state could sell annuities directly to the public. It would therefore be bearing both the aggregate and the specific risks associated with mortality improvements. This is effectively what the state does when it provides state pensions.

Alternatively, the state could issue 'survivor' (or 'longevity') bonds, a suggestion made in Blake and Burrows (2001). These are bonds whose future coupon payments depend on the percentage of the population of retirement age on the issue date of each bond who are still alive on the date of each future coupon payment. For a bond issued in 2000, for instance, the coupon in 2010 will be directly proportional to the amount, on average, that an insurance company has to pay out as an annuity at that time. The insurance company which buys such a security bears no aggregate longevity risk and, as a consequence, cost loadings fall. The coupon payments fall over time, but continue in payment until the last members of the cohort have died. The insurance company would still retain the specific risk associated with the pool of annuitants that purchase its annuities (for example, it might explicitly market annuities to groups such as non-smokers who can be expected to experience lighter than average mortality), but this is likely to be a smaller and more forecastable risk than the risk associated with underestimating aggregate mortality improvements many years ahead.[41]

6.8 CONCLUSION

A well-designed pension plan is designed from back to front. Working backwards from the anticipated death date of the member, the plan should ascertain what size pension the member desires and then calculate the requisite fund size on the nominated retirement date. Depending on the member's attitude to risk and desire to make a bequest, the pension can be paid either in the form of a life annuity or using an income drawdown programme. Working backwards again and taking into account the length of the accumulation period and the plan member's risk-aversion parameter and salary profile, the plan will determine the optimal (stochastic lifestyling) investment strategy and the required net contributions. Finally, the plan determines the gross contributions needed to cover the plan provider's costs and profit.

There is little evidence that DC pension plans in the UK have been well-designed as a single integrated financial product. The key design failures are high charges and lapse rates, inappropriate investment strategies, no evidence of outperformance from active investment management, and poorly designed annuity and income drawdown programmes.[42] On top of this, those delivering key services have little incentive to treat a pension plan as a single integrated financial product with the long-term goal of securing a reasonable income replacement in retirement. Sales staff receive up-front commission from the initial contributions into the plan and so have no financial interest in ensuring the plan's long-term suitability to the member; investment managers take whatever net contributions are available and invest these the best that they can, but generally have no particular target fund level to achieve; and the annuity provider takes whatever fund size is available on the retirement date and offers the best annuity available on that particular day. Further, no one on the provider side has any particular incentive to minimize costs to the plan member or to set and then meet any particular performance targets.

The best way of delivering value in the pensions industry is to have charging structures that are simple, fully transparent, non-front-loaded and performance-related. Although it is possible for good investment performance to compensate for high charges, there are limits and we have shown that it is virtually impossible for superior investment performance to be delivered over the long investment horizon needed to build up a decent pension in retirement. It is difficult, therefore, to disagree with view of the Office of Fair Trading (1999b) that 'The best way [to run a simplified defined contribution pension plan] is to embrace passive fund management, thus requiring funds to compete in terms of their administration costs, not their spurious promises of future excess returns'.[43]

There are not many economic activities in which the provider of a service extracts up to 50 per cent of the value of the product in charges. But this is what happens with individual DC pensions in the UK. It is hard to argue that this represents good value for money and certainly institutional customers would not accept charges of this size. If something is not done to improve product design and to reduce costs, the very concept of DC pension plans will fall into disrepute. If that happens, where else can workers turn for retirement income security, given the gradual demise globally of state pay-as-you-go pension plans and occupational final-salary plans?

NOTES

1. The author is grateful to Solange Berstein for very useful comments on an earlier draft.
2. For further details about PPPs see Blake (2003).
3. This section draws on Blake and Board (2000).
4. Office of Fair Trading (1997, 1999a).
5. Slade (1999).
6. Financial Times Business Publications, London.
7. See Blake (1998).
8. Cash is the term that fund managers use as a short hand for low-risk assets such as Treasury bills.
9. The expected value of the fund T years from its inception is given by:

$$\overline{A}_T = C\frac{((1+r)^{T+1} - (1+\pi)^T(1+r))}{(r-\pi)},$$

where C is the value of the initial annual contribution into the fund, π is the expected annual real rate of increase in contributions and r is the expected annual real rate of return on the investments in the fund. The terminal fund risk (σ_{AT}) is given by the standard deviation of $\overline{A}_T$ which will be a complex function of the standard deviations of π and r and the covariance between them. Table 6.4 reports the terminal fund risk after 40 years ($\sigma_{A,40}$). See Blake (2003, ch.13) or Blake (2000, ch.14).

10. A typical final-salary plan in the UK has an accrual rate of $\frac{1}{60}$th and hence will generate a pension of two-thirds of final salary after 40 years of service.
11. The liabilities in a DB plan will be proportional to a term involving the product of the accrued benefit after 40 years of plan membership (two-thirds of final salary) and an annuity factor (*PA*92): $0.667 \times (1 + \pi)^{40} \times PA92$ (where π is the expected annual real growth rate in earnings). The annuity factor is the present value of one unit of pension payable for the life of the pensioner. In the UK, this will be based on the Institute of Actuaries' *PA*92 mortality tables and its successors. For a 65-year-old male the annuity factor is 13.6, while for a 65-year-old female it is 16.5, reflecting her greater longevity.
12. Samuelson (1963, 1989, 1991). See also Blake et al. (2001).
13. See, e.g., Fabozzi and Konishi (1991), Blake (2003, ch.13) and Haberman and Sung (1994). Haberman and Sung (1994) suggest some alternatives to (6.17), namely that the term in C_t^2 is replaced by the squared deviation from planned contributions, $(C_t - \overline{C})^2$, or by the variance of contributions, $\text{var}(C_t)$.
14. Standard dynamic programming problems are solved over the full investment horizon using backward solution techniques based on, for example, Bellman's optimality principle. Such problems can be reduced to a series of single-period optimization problems if the objective function is time-separable and if the state variables (in this case the asset returns) are time-independent processes.
15. The data were provided by Standard & Poor's Micropal.
16. However, as we shall see later on, it is highly unlikely that the same fund will find itself in the top quartile (or indeed the bottom quartile) for 40 years in a row.
17. Blake (2003).
18. The data set for this study was provided by the WM Company and covers the managed funds of occupational pension plans. However, given the highly concentrated nature of the UK fund management industry, very similar results can be expected for the managed funds of personal pension plans. Furthermore, very similar results have been found for the US; see Lakonishok et al. (1992).
19. Davis (1988) reports a survey of UK and US fund managers in which they acknowledge the existence of a herding effect. More recent studies from the US confirm the importance in the assessment of fund managers performance of their performance relative to a peer-group benchmark (see Brown, Harlow and Starks (1996), Chevalier and Ellison (1997)).
20. There are other features of UK pension fund performance worthy of note. First, there was some evidence of spillover effects in performance, but only between UK and international equities. In other words, the funds that performed well or badly in UK equities also performed well or badly in international equities. This suggests that some fund managers were good at identifying undervalued stocks in different markets. This result is somewhat surprising since the world's equity markets are much less highly integrated than the world's bond markets, yet there was no evidence of spillover effects in performance across bond markets. Secondly, there was evidence of a size effect in performance. Large funds tended to underperform smaller funds: 32 per cent of the quartile containing the largest funds were also in the quartile containing the worst performing funds, whereas only 15 per cent of the quartile containing the smallest funds were also in the quartile of worst performing funds. These results confirm the often-quoted view that 'size is the anchor of performance': because large pension funds are dominant players in the markets, this severely restricts their abilities to outperform the market.
21. *Pensions Management*, September 1998.
22. There is some recent evidence that 'star' fund managers do exist, but they are very few in number and it takes a long performance history to identify them, see Kosowski et al. (2006).
23. This effect is called survivorship bias or median drag.
24. Using US data, survivorship biases of up to 1.4 per cent per annum have been reported, see Malkiel (1995).
25. See Bodie (1990).

26. Association of British Insurers. More than half the world's life annuities are sold in the UK (300,000 in 2005, with premiums of £8bn: see HM Treasury (2006)).
27. Barclays Capital (2006).
28. MacDonald (1996).
29. William Burrows of William Burrows Annuities.
30. According to O'Brien et al. (2005), British males under-estimate their life expectancy by 4.62 years, while British females underestimate theirs by 5.95 years, compared with the estimates of the UK Government Actuary's Department.
31. Again very similar results have been found in the US, see Grinblatt and Titman (1992), Hendricks et al. (1993), Brown and Goetzmann (1995), Carhart (1997).
32. There is, however, some evidence that a small number of fund managers do have genuine and persistent skills (see Kosowski et al. (2006)).
33. These costs, typically for increased research and as salaries to skilled fund managers (so-called stars), will usually be passed on to the policy holders; see Berk and Green (2004).
34. The theoretical justification for this position was originally stated by Grossman and Stiglitz (1980) who found that an efficient equilibrium in financial markets is characterized as offering the same *net* returns to all investors, after allowing for differences in risk, research costs and transactions costs. This means that there is no incentive for any investor to change his or her investment strategy. This means that the *gross* return to investors who engage in research may be higher that the *gross* return of those who do not. However, the increased return must be exactly offset by the costs of this research; if it is greater there will be incentives for more people to engage in research, which will drive down the profits from such research; if it is less then investors will cease research, raising the gains to those who remain engaged in research.
35. Pensions Commission (2005).
36. We assume that the asset portfolio has the same mean return as the regulator's assumed return of 9 per cent p.a. Based on long-run returns reported in Barclays Capital (2006), such a portfolio would be invested 35 per cent in equities and 65 per cent in bonds and would have a standard deviation of about 18 per cent p.a.
37. Chapman (1998, p. 88).
38. In the UK, it is mandatory to purchase a life annuity with a DC plan by age 75 at the latest.
39. These were first issued in 1952 in the US by the TIAA-CREF, the Teachers Insurance and Annuity Association of America – College Retirement Equity Fund.
40. For example, although derivative-related annuities are offered (e.g. by AIG), some providers stopped selling them because of the management costs involved (e.g., Prudential), see Bulman (1999).
41. In March 2007, JPMorgan, in collaboration with Watson Wyatt and the Pensions Institute, released LifeMetrics, a toolkit for measuring and managing longevity risk. This comprises the LifeMetrics Index on current and historical mortality and longevity; the LifeMetrics Framework which consists of tools for measuring and managing longevity and mortality risk; and LifeMetrics Software for forecasting future mortality. The aim of LifeMetrics is to encourage the development of a capital market in longevity risk transference by providing the relevant benchmarks against which instruments such as longevity bonds and swaps can trade. For more details, see www.jpmorgan.com/lifemetrics.
42. There are other design failures in DC pension plans that are beyond the scope of this study, such as poor mapping between actions (e.g. implementing an investment strategy) and results (e.g. subsequent investment performance), poor feedback (e.g. about the result of actions) and poor fail safety (if the plan member does nothing, does this lead to a good or bad outcome?); see Norman (2002) for more on the principles of good design.
43. Office of Fair Trading (1999b, p. 2).

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APPENDIX: THE DECOMPOSITION OF TOTAL RETURN

The decomposition of the total return on the portfolio is due to Brinson et al. (1986). Assume that there are M asset categories in the portfolio and define:

θ_{sjt} = strategic asset allocation in the j^{th} asset class at time t,
θ_{ajt} = actual weight in the j^{th} asset class at time t,
r_{sjt} = strategic return in the j^{th} asset class at time t,
r_{ajt} = actual return in the j^{th} asset class at time t.

As an arithmetic identity:

$$\sum_{j=1}^{M}\theta_{ajt}r_{ajt} = \sum_{j=1}^{M}\theta_{sjt}\,r_{sjt} + \sum_{j=1}^{M}\theta_{sjt}(r_{ajt} - r_{sjt}) + \sum_{j=1}^{M}(\theta_{ajt} - \theta_{sjt})r_{sjt} + \sum_{j=1}^{M}(\theta_{ajt} - \theta_{sjt})(r_{ajt} - r_{sjt})$$

or Total Return = Strategic Return + Return from Security Selection + Return from Market Timing + Residual Return. The strategic asset allocation is typically specified by the client in the light of an asset-liability modelling exercise. The strategic return is the return on an agreed benchmark, such as a market or peer-group index.

Discussion of 'It is all back to front: critical issues in the design of defined contribution pension plans'

Solange Berstein

Blake's interesting chapter puts forward solid arguments to back up his main idea: pension plans should be designed considering all links of the chain that go from the contributions to the pension payout. Moreover, every link should take into account what the purpose of a DC pension plan is: to provide an adequate pension in accordance with the contributions made throughout the life cycle. Throughout the chapter, Blake is able to depict a convincing argument showing that DC pension plans in the UK seem not to follow this rule, since each link looks as if it has been designed in isolation from the whole chain. The conclusions of the chapter are easily extrapolated to other DC pension systems, which both extends its relevance and increases the necessity to clarify some issues regarding the implementation of some of its recommendations. In the following, I will concentrate on the most relevant conclusions from the point of view of mandatory DC pension systems.

This chapter analyses six issues: charges, lapses, investment strategy, investment performance, fund annuitization and the incentives for managers. These all are, certainly, relevant aspects in the design of a pension system. In my comment I would like to add another three elements which I consider as important as the six considered by the author, especially from the viewpoint of a mandatory DC scheme, although they might not be less relevant for any DC system. These elements are income profile, regulation and financial literacy.

Why is income profile important in a DC scheme? It is important because the whole history of contributions of a worker has an impact on his/her final pension; even in some DB schemes the benefit formulas are being modified to incorporate elements which make benefits closer to contributions. Therefore, knowing what income profiles look like might be an important consideration for pension plan design. In fact, if our concern is replacement rates in terms of final salary, in a DC scheme early contributions are very important in determining the final pension. This implies that higher contribution rates might be required if income profiles are particularly steep.

Another element that is relevant is regulation, especially for mandatory systems which are heavily regulated. The reason for this heavy regulation has to do with information asymmetries and (implicit or explicit) guarantees (Berstein and Chumacero, 2006). It is not rare to hear in some discussions that pension funds should be regulated in a certain way because that would help the development of the capital market or other specific sectors. However, if we think of it as if it is stated in the chapter, that *the* purpose of pension fund plans should be to provide adequate pension benefits, the argument for establishing a regulation should not be founded on something else. It might be argued that the development of those specific sectors, because of general equilibrium considerations, also benefits pension funds, but then the argument should follow from that point. How regulation is designed could have an important impact on the benefits level and also on the volatility of those benefits.

A final issue which I would like to mention as an important element for pension plan design is financial literacy. This is in direct relation to how paternalistic the design should be. An excessive number of choices might imply that people are not able to make the right decision. Furthermore, the evidence shows that people might not even be able to make a decision at all. This implies that the design of the default option is crucial, because most participants would end up accepting that default (Weaver, 2005).

The chapter stresses the fact that all the six elements have to be seen in an integrated way and I would add these last three to that argument. As is mentioned in the chapter, there seems to be a temptation to separate the accumulation and decumulation phases in the case of DC pension schemes. In fact, sometimes there are totally different industries as providers and even different regulators and supervisors. Therefore, a special effort must be made to see the pension cycle as a unified package. This might be particularly important at the moment of retirement, where the annuitization risk has to be correctly managed and mitigated, which is one of the six elements mentioned by the author. The main argument that supports the fact that, in DC schemes, or at least in the UK, future retirees face an important interest rate risk is that there is a fixed date for annuitization. This is not necessarily the case in every DC scheme, as there are systems where it is possible for the individual to handle the risk of annuitization better. However, just being able to choose the annuitization date, by having the alternative of a drawdown for some period of time, might not be enough. In the case of Chile, where there is the possibility of having a programmed withdrawal and switching to an annuity when convenient for the individual, it must be said that annuities are 'sold' and not 'bought'. Therefore, the information provided is not necessarily the best, given that the sales agents receive a commission only if the retiree buys an annuity.

In the following I will comment on two other important elements mentioned by the author: charges and investment strategy. With respect to charges, after showing some interesting ways to measure their impact, in terms of the terminal value of the retirement account, Blake concludes that, owing to the strong arguments against a clear relationship between charges and performance, the best alternative to keep charges low is for the regulatory authority to cap charges and to allow penalty-free transfers between plans. Furthermore, he proposes that charging structures should be kept simple and fully transparent (to help consumers to understand), non-front loaded and performance-based. In this regard, it is fair to say that there is more agreement on how to implement a simple and transparent charge structure than with respect to the way to implement a performance-based charging structure, which in fact might be going in the opposite direction. Some recent papers have discussed the implications of performance-based charging schemes for portfolio managers (Carpenter, 2000; Basak et al., 2005), and some of the lessons point towards the need for a careful design in terms of considering potential side-effects, such as risk taking problems. Additionally, elements such as different investment horizons and risk appetite could potentially misalign the investment decisions of pension fund portfolio managers with respect to what would be desired by pension plan members. Therefore, even if there might be a benefit, this is uncertain, according to what the same author argues when he discusses investment performance, and it could imply important costs.

With respect to price caps, it has to be said that this is not easy to contrive and that there are some risks. It is difficult to set a price cap at the right level: if too high, there is somehow a validation of a high price and it might even constitute a focal point for collusion (Knittel and Stango, 2003). If too low, you might be getting the industry into financial trouble, which could lead to serious financial distress; or the quality of service could be critically affected, not only with respect to performance, but also as regards the other activities that are involved in the management of retirement accounts.

Portability of pension funds, or penalty-free transfers between plans, is also part of the author's recommendations in relation to charges. I think this is very important in achieving market discipline. I would say that, if we want prices to be as low as possible, we need competition to drive them down. Competition is only effective if there are low switching costs (Klemperer, 1995), otherwise there is important monopoly power of providers. In summary, simplicity in the fee structure and portability are crucial: first, to make it easy for the workers saving for retirement to figure out what is the effective price they are paying and, second, to make it possible for people to switch if they realize their provider is too expensive. In fact, in the case of Chile, there are only two types of fees, a fixed fee and a percentage over salary fee, this makes the price unique for every individual and no provider can claim to be the cheapest of all providers, because it would depend on the salary of the worker. This makes communication of this type of information extremely difficult. Given the lack of knowledge in the case of Chile,[1] it is mandatory for every pension fund manager to send, together with the pension statement to their clients, a sheet that has the computed individual fee for that person for each of the possible managers. Providing this information would be significantly easier if there was only one price.

In terms of investment strategies, Blake proposes to design investment strategies around some focal pension level which is to be determined from some preference specification (quadratic-mean-variance or some more general concave utility index) or some reasonable benchmark (such as a replacement ratio). Once the pension target has been determined, the remaining steps are just a matter of characterizing the investment strategy that delivers the desired pension level (that is, a problem of contingent claim replication). As an example, Blake recommends the adoption of the investment strategy that is the solution of a utility maximization problem having the particularity of considering a more suitable 'numeraire' (a replacement ratio), which implicitly takes into account the 'annuity risk', since the utility function has the annuity factor as one of its arguments. Alternatively, he suggests the use of deferred annuities and investment strategies involving derivatives as a way to immunize pension funds against interest rate risk. By and large, Blake's recommendations point in the right direction: the investment strategies of DC pension plans should be designed around a sensible pension target. What remains to be determined, though, is the target to be pursued, which is among the most relevant questions policy makers and regulators of DC pension systems around the world are trying to figure out. Indeed, the determination of such a target would allow the implementation of more sensible (pension) risk-based investment rules, better suited for long-term investors.

Investment strategies among Latin-American mandatory DC pension systems are subject to several of the features identified by the author. Herding is a recognized issue, and portfolio managers seem to be markedly risk-averse in the dimensions they are concerned about: underperforming their peers. Unfortunately, their concerns and those of the pension plan members sometimes diverge on important matters. Policy makers and regulators would like to have a better idea of what an investment strategy aimed at delivering an adequate pension should look like. This would certainly help better to align incentives between portfolio managers and pension plan members.

Overall, David Blake's chapter is an important contribution, and its observations should not pass unnoticed. Pension plans should be understood as an integrated financial product, with all elements involved in both the accumulation and disbursement phase blended together to deliver adequate retirement income. Still, many questions remain to be answered by the academic and policy making community. What should be the target with respect to pensions? How to deal with the heterogeneity among pension plan members? How to communicate information consistently? And, finally, how much freedom to choose should be given to individuals?

NOTE

1. According to the EPS 2002, a survey that represents all affiliates to the pension system, only 3 per cent said they knew how much they were charged and from those almost none gave the right figure when asked how much that was.

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