Financial System Requirements for Successful Pension Reform

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This version: June 2003

First version presented at *Policy Options for Pension Reform in Asia: Challenges in Design and Implementation*, a joint conference of the Asian Development Bank and the Pacific Pension Institute, Manila, Philippines, 3-5 December 1998.

Abstract

This paper examines the financial system prerequisites needed for the successful delivery of funded private pensions. In particular, it examines the financial instruments and investment strategies required during both the accumulation and decumulation stages. It does so within the context of a specific developed economy with a mature pension system, namely the United Kingdom. The lessons learned can help to inform the debate in developing countries that are in the process of undertaking pension reform.

JEL: E21, G11, G23

Key words: funded pension scheme, defined benefit, defined contribution, fund management, performance measurement, annuities

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1. Introduction

Retirement income is an extremely important component of every individual's life cycle. It can come from one of the four pillars of support in old age: unfunded state pensions (that is, transfers from the current working population via the tax system), funded private pensions (that is, from savings accumulated in private sector pension schemes), direct private savings, and post-retirement work. Throughout the world, governments are looking to funded private pension schemes to solve the problem of providing pensions to their ageing populations. There are two main types of funded scheme: the defined benefit (DB) scheme and the defined contribution (DC) scheme (the differences between these schemes are explained in appendix A)[1]. This paper examines the financial system requirements to run DB and DC schemes effectively during both the accumulation stage and distribution (or payout) stage. We will argue that financial instruments and investment strategies are more important for the effective delivery of pensions than the nature of either the financial markets (i.e., their depth, breadth, resilience and microstructure) in which the financial instruments trade or the particular set of financial institutions managing pension scheme assets during the accumulation and payout stages (namely, fund managers and life assurers, respectively). The analysis is based on a developed financial system with a mature funded pension system: it can be used to inform the debate in countries with developing financial systems which are in the process of introducing pension reform.

2. Financial System Requirements During the Accumulation Stage

2.1 The relationship between DB and DC schemes

The first task is to understand the relationship between the two types of scheme. To do this, we will use an approach developed in Blake (1998).[2] This will make it easier to understand the different investment management strategies appropriate for DB and DC schemes.

Fig.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, while Fig.2 shows that the present value of the DB pension (L) is independent of the value of the fund's assets. Fig.3 shows that the DB pension can be replicated using an implicit long put option ($+P$) and an implicit short call option ($-C$) on the underlying assets of the fund (A), both with the same exercise price (L) which equals the present value of the DB pension at the member's retirement age. The put option is held by the scheme member and written by the scheme 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 scheme 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 scheme 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 fully funded DB scheme is, in effect, a risk-free investment from the member's viewpoint: DB scheme members end up with the same pension whatever the value of the underlying assets.

It is clear from this how DB and DC schemes are related. A DC scheme is invested only in the underlying financial assets. A DB scheme is invested in a portfolio containing: the underlying assets (and so is, in part, a DC scheme) *plus* a put option *minus* a call option on these assets. The actuarial surplus with a DB scheme is defined as the difference between the values of the pension assets and liabilities. The pension assets at any time comprise the financial assets accumulated by that time *plus* the expected present value of the promised future contributions into the scheme. The pension liabilities at any time are equal to the expected present value of the future pension payments from the scheme assuming the scheme member remains in the scheme until retirement[3]. By definition, the surplus is always zero with a DC scheme. The surplus risk (i.e., the volatility of the surplus) with a DB scheme depends on both the difference between the volatilities of the pension asset and pension liability values and on the correlation between these values. The main sources of these volatilities during the accumulation stage are uncertainties concerning future investment returns, real earnings growth rates and inflation rates. This is because investment returns 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 scheme and the pension liability at the retirement date, and the inflation rate influences the growth rate of pensions after retirement. With a DC scheme, the surplus risk is zero by definition.

The options embodied in a DB scheme are known as exchange options. They are a variant of the more familiar Black-Scholes options which recognise that, if exercised, risky assets are exchanged 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 these options depends on the magnitude of both the surplus and surplus risk. In particular, if both the surplus and surplus risk can be maintained at zero, the call and the put both have zero value. It follows that if these conditions are satisfied, DB and DC schemes are equivalent in the sense of delivering the same pension in retirement. In other words, it is possible to manage a DC scheme in such a way that it generates the same pension in retirement as a final salary DB scheme: such schemes are known as targeted money purchase (TMP) schemes.

2.2 The optimal management of DB and DC schemes

2.2.1 DC schemes: maximising risk-adjusted expected value

The optimal management of a DC scheme is fairly straightforward, once the critical task of determining the attitude to risk of the scheme member has been undertaken. This usually involves assessing the degree of risk tolerance of the scheme member. The greater the degree of risk tolerance, the greater the risk that can be borne by the scheme's assets and hence the greater the expected value of the pension fund at the retirement date. This can be explained in terms of the risk-adjusted expected value of the asset portfolio which is defined as the expected value of the pension assets net of a risk penalty, where the latter equals the ratio of the volatility of the fund's assets to the member's degree of risk tolerance. The higher the asset risk and the lower the risk tolerance, the greater the risk penalty. The fund manager's task is to maximise the risk-adjusted expected value. It is possible to increase the expected value of the pension assets by taking on more risk, but if too much additional risk is taken on, the risk-adjusted expected value will fall, especially if risk tolerance is low. The risk penalty shows the cost of taking on more

risk.

Individual DC (i.e., personal pension) schemes in the UK are provided by financial institutions such as insurance companies, banks, building societies, unit trusts (i.e., open-ended mutual funds), investment trusts (i.e., close-ended mutual funds), and open-ended investment companies. The scheme provider will offer the scheme member a choice of investment vehicles in which the pension assets will accumulate, ranging from 'low' risk (e.g. a deposit administration scheme), through 'medium' risk (e.g. an endowment scheme from an insurance company) to 'high' risk (e.g. a unit-linked scheme). The deposit administration scheme is targeted at a scheme member with a very low degree of risk tolerance, while the unit-linked scheme is targeted at a scheme member with a high degree of risk tolerance. However, it is arguable whether low-yielding deposits are a suitable investment vehicle for long-horizon investment programmes such as pension schemes. Other asset categories, such as equities, tend to offer much higher returns over the long term[4]: equities may have high short-term volatility, but they tend to offer much more stable real returns over the long term. Investing in deposit administration schemes or bonds has been described as a strategy of 'reckless conservatism': these assets, while having stable capital values in nominal terms over short horizons, do not tend to have long-term real returns that match the real growth rate in earnings. Despite this, surveys of personal pension scheme members in the UK and elsewhere tend to show that fear of short-term capital losses drives many individuals towards investment strategies that are recklessly conservative in the long run. Once a scheme member has selected a particular type of scheme, the fund manager's task is to choose the asset mix (between equities, bonds, property etc.) that maximises the risk-adjusted expected value of the assets[5].

2.2.2 DB schemes: asset-liability management

The appropriate investment management strategy for pension funds running DB schemes is asset-liability management (ALM) (also called surplus risk management)[6]. This involves constructing a portfolio of financial assets that (together with promised future pension contributions) matches the pension liabilities in two key respects: size and volatility.

First, if pension schemes are always fully funded, so that assets are always sufficient to meet liabilities in full, then the surplus in the fund will always be zero. This can be achieved by adjusting the contribution rate (especially the employer's contribution rate) into the fund. In practice, there are usually some tolerance limits. In the UK, for example, it is permissible for the value of assets to vary between 90% and 105% of the value of liabilities (although the surplus and deficit valuation bases differ). If the value of assets exceeds the 105% limit (on the statutory valuation basis), the scheme has up to 5 years to reduce the value to 100% of liabilities (Finance Act 1986). The most common means of doing this is the employer's contribution holiday, although other means are available: an employee's contribution holiday, improved pension benefits or selling off financial assets, the proceeds from which are returned to the sponsor subject to a 35% tax. If the value of assets falls below 90% of the value of liabilities (on the MFR valuation basis), the scheme has three years to raise the value of assets to 90% of liabilities and up to a further 7 years to raise it back to 100% (Pensions Act 1995). The most common means of doing this is additional employer contributions (i.e., deficiency payments), since most DB schemes operate on a balance-of-cost basis.

Second, if the assets in the pension fund are selected in such a way that their aggregate volatility matches that of the liabilities, then the surplus risk can be reduced to zero, which

combined with a zero surplus, implies that the implicit options in the DB scheme can be issued free of charge. This requires the assets in the pension fund to have both the same volatility as the pension liabilities and to be perfectly correlated with them (although it is unlikely in practice that financial assets with these precise properties exist). This, in turn, requires the assets to constitute a 'liability immunising portfolio', that is, a portfolio that immunises the investment yield, real earnings growth rate and inflation rate risks embodied in the pension liabilities[7].

Structuring the liability immunising portfolio is the most important part of determining the fund's strategic asset allocation (SAA). The SAA is determined by the fund's actuary or investment consultant. Given the nature of the fund's liabilities (which are typically indexed to real wage growth), the liability immunising portfolio during the early life (i.e., immature stage) of a pension scheme will contain a high proportion of equities and other 'real' assets such as property, on the grounds that, the shares of factors of production in national income tend to be relatively stable, so that the returns to capital (equity) and land (property) will over the long run match that on labour (real wages) . The actuary's advice will be based on an asset-liability modelling (ALM) exercise. ALM is a quantitative technique used to help structure asset portfolios in relation to the maturity structure of liabilities. There are two common versions of ALM, one based on scenario analysis, the other based on stochastic modelling. Both versions involve forecasts about how a pension fund's liabilities are going to accrue over a particular time horizon, that might be 5, 10 or 15 years ahead. To do this, assumptions concerning salary growth rates, staff turnover, and the age distribution and sex composition of the workforce have to be made. Then forecasts concerning the funding position of the pension scheme have to be generated. This involves making projections of future contribution rates and also assessing the value of assets in relation to accrued liabilities. These forecasts and projections can be made under different scenarios concerning likely outcomes. Typically three scenarios are adopted: most likely, best-case and worst-case. This provides a realistic range of possible outcomes, and, in the latter case, spells out the extent of the risks that the pension fund sponsor faces. With stochastic modelling on the other hand, tools such as monte carlo simulation are used to prepare a distribution of possible outcomes for both assets and liabilities at the end of the relevant time horizon and the sponsor is presented with a range of contribution rates needed to achieve full funding over the period. The most sensitive factor in any stochastic ALM model is the size chosen for the equity risk premium, the projected excess return on equities over bonds. Small increases in this premium will tend to signal large switches in the SAA in favour of equities and away from bonds.

There are two main uses of ALM. The first is to indicate the consequences of adopting any particular investment strategy. The second is to discover alternative strategies that increase the likelihood of meeting the fund's objectives. Proponents of asset-liability modelling argue that the strategy allows pension funds to generate higher returns without any consequential increase in risk. The modelling exercise might indicate, for example, that if current investment returns are sustained, there would be no need to change the employer contribution rate into the pension fund over the next 5 years. However, the worst-case scenario might indicate the employer contribution rate might have to rise by 10% over the next 5 years. The exercise therefore allows the scheme sponsor to plan for this possibility. As another illustration, the modelling exercise might indicate that because a pension fund is maturing, it should switch systematically out of equities into fixed-income bonds (in the five or so years prior to retirement), which are more likely to meet pension liabilities with lower risk of employer deficiency payments; this is known as 'lifestyle' fund management (or 'age phasing').

Some fund managers are concerned that ALM gives an unwarranted role to outsiders, such as actuaries, in designing the strategic asset allocation. Actuaries have always had a role in determining the value of a pension scheme's liabilities. But with the advent of ALM, actuaries have begun to have a role in setting the long-term or strategic asset allocation over, say, a 10-year horizon. Some fund managers claim they are being reduced to the subsidiary role of determining tactical asset allocation (or market timing) and stock selection relative to this new long-term strategic asset allocation benchmark. However, not all fund managers are critical of the redefinition of their respective roles. Many fund managers have positively welcomed the formal separation of long-term policy decisions from short-term tactical decisions that ALM allows.

Another potential problem concerns the interpretation of measures of investment performance in the light of the technique. ALM justifies different pension funds pursuing different investment policies. For example, small, fast-growing funds might pursue very aggressive investment policies, while large mature funds might adopt more passive investment policies. This makes it very difficult to interpret a single performance league table drawn up on the assumption that all funds are pursuing the same objective of maximising expected returns. Performance measurement services have begun to take this into account by constructing peer-group performance league tables, drawn up for sub-groups of funds following similar objectives. We now discuss performance measurement in more detail.

2.3 The importance of investment performance

Good or bad investment performance by DB and DC pension schemes have very different consequences for scheme members. With DB schemes, the investment performance of the fund's assets is of no direct relevance to the scheme member, since the pension depends on the final salary and years of service only and not on investment performance. The scheme member can rely on the sponsoring company to bail out the fund with a deficiency payment if assets perform very badly (i.e., the member exercises the implicit put option against the sponsor). In extreme circumstances, however, it is possible for a firm and possibly the scheme to become insolvent[8]. Of course, if the assets perform well, the surplus is retained by the sponsor (who exercises the implicit call option against the member in this case).

However, investment performance is critical to the size of the pension in the case of a DC scheme: scheme members bear all the investment risk in such schemes. Scheme members, especially personal pension scheme members, 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 personal pension scheme members invest can and do close down and then the assets do have to be transferred to a different fund. In this section, we examine the investment performance of pension scheme assets, beginning with those of DC schemes.

2.3.1 Investment performance of DC schemes

The anticipated return in a high-risk investment vehicle is greater than in a low-risk investment vehicle, but there can be wide differences in realised returns, even for schemes in the same risk

class. Blake and Timmermann (1998)[9] conducted a study of the investment performance of unit trusts in the UK, one of the key investment vehicles for DC schemes. Table 1 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 scheme. For example, the 4.1 percentage point per annum difference between the best and worst performing unit trusts in the UK Equity Growth sector leads, over a 40-year investment horizon, to the accumulated fund[10] 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.

So personal pension scheme members can find themselves locked into poorly performing funds[11]. 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)[12] 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. Fig. 4 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 annum, while the average return on funds that were wound up or merged during the period was 11.3% per annum. This implies that a typical personal pension scheme member might find him or herself locked into an underperforming trust that is eventually wound up or merged into a more successful fund, experiencing an underperformance of 2.4% p.a., over a 16 year period. This translates into a fund value that is 19% lower after 16 years than a fund that is not wound up or merged. So it seems that in practice personal pension scheme 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-third of the value of their accumulated fund in transfer costs[13].

2.3.2 The investment performance of DB schemes

The investment performance of DB pension funds is much more important for the scheme sponsor than for the scheme member. The recent history of the UK pension fund industry embraces a period of substantial deficiency payments in the 1970s (arising from the UK stock market crash in 1974-75), and the build up of huge surpluses during the bull markets of the 1980s and 1990s. These surpluses have enabled sponsors to reduce their contributions into their schemes (i.e. to take employer's contribution holidays). In other words, during the 1980s and 1990s, UK pension scheme sponsors have benefited enormously from the investment successes of their fund managers.

The investment performance of DB pension fund managers in the UK between 1986 and 1994 has been investigated in Blake, Lehmann and Timmermann (1999, 2002)[14]. The data set used covers the externally appointed fund managers of more than 300 medium-to-large pension funds. The UK pension fund industry is highly concentrated and most of these managers come from just five groups of professional fund managers (UBS Global Asset Management, Merrill Lynch Investment Management, Deutschebank Asset Management, Schroder Investment Management and Gartmore Pension Fund Managers).

While the 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 2 which shows the cross-sectional distribution of returns realised 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 interquartile range is quite tight, below 2 percentage points for most asset classes and only just over 1 percentage point for the total portfolio return. This suggests evidence of a possible herding effect in the behaviour of pension fund managers since fund managers do not like their *relative* performance to get too much out of line with each other[15]. Nevertheless, the difference between the best and worst performing funds is very large, as the last row of Table 2 indicates.

Table 3 shows how well UK pension funds have performed in comparison with other participants in the market. The fourth column shows that the average UK pension fund underperformed the market average by 0.45% per annum; and this is before the fund manager's fee is taken into account. Further only 42.8% of funds outperformed 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% over the sample period; the average underperformance is -0.33% per annum and only 44.8% of UK 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 2 and 3 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 annum, just 12 basis points short of the average market return, and 80% of the funds were within one percentage point of the average market return. This suggests that, despite their claims to be active fund managers, the vast majority of UK pension fund managers are not only herding together, they are also closet index matchers.

There are some other features of UK pension fund performance worthy of note. First, there is some evidence of short term persistence in performance over time, especially by the best and worst performing fund managers. For example, we found that UK equity fund managers in the top quartile of performance in one year had a 37% chance of being in the top quartile the following year, rather than the 25% that would have been expected if relative performance arose purely by chance. Similarly, there was a 32% chance of the fund managers in the bottom quartile for UK equities for one year being in the bottom quartile the following year. There was also evidence of persistence in performance in the top and bottom quartiles for cash/other investments, with probabilities of remaining in these quartiles the following year of 35% in each case. However, there was no evidence of persistence in performance for any other asset category or for the portfolio as a whole. Nor was there any evidence of persistence in performance over longer horizons than one year in any asset category or for the whole portfolio. This suggests that 'hot hands' in performance is a short term phenomenon[16].

Second, 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.

Third, there was evidence of a size effect in performance. Large funds tended to

underperform smaller funds. We found that 32% of the quartile containing the largest funds were also in the quartile containing the worst performing funds, whereas only 15% 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.

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. A key task of pension fund managers is, as we have seen above, to establish and maintain the strategic asset allocation set by the scheme's actuary or investment consultant. This is essentially a passive 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 and market timing (also known as tactical asset allocation). Security selection involves the search for undervalued securities (i.e. involves the reallocation of funds within sectors) and market timing involves the search for undervalued sectors (i.e. involves the reallocation of funds between sectors). We decomposed the total return generated by fund managers into the following components (using the modelling framework of Brinson et. al. (1986, 1991))[17]:

	%
Strategic asset allocation	99.47
Security selection	2.68
Market timing	- 1.64
Other	- 0.51
Total	100

We found that 99.47% of the total return generated by UK fund managers can be explained by the strategic asset allocation, that is, the long-run asset allocation specified by pension scheme sponsors on the advice of their actuaries following an ALM exercise. This is the passive component of pension fund performance. The active components are security selection and market timing (or TAA). The average pension fund was unsuccessful at market timing, generating a negative contribution to the total return of -1.64%. The average pension fund was, however, more successful in security selection, making a positive contribution to the total return of 2.68%. But the overall contribution of active fund management was just over 1% of the total return (or about 13 basis points), 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)[18].

3. Financial System Requirements during the Distribution Stage

There are few if any special financial system requirements during the payout stage of DB schemes. Typically, the assets remain in the fund and the pension is paid from active members' contributions (in the case of a young, immature scheme) or from a combination of active members' contributions and investment income (in the case of a mature scheme). In the case of

an overmature scheme in a declining industry, it may be necessary to sell some assets to provide the pensions (and there could be a requirement for deficiency payments from the sponsor if the stock of assets was insufficient to pay the pensions of the final cohort of pensioners before they died)[19]. The situation is completely different in the case of DC schemes. In most DC schemes, the full value of the assets owing to the scheme member must be liquidated and the proceeds used to purchase an annuity. Generally, some of the proceeds can be taken as a cash lump sum. In some countries such as the US, Germany and Australia there is no formal requirement to take an annuity: the entire proceeds from the DC scheme can be taken as a lump sum. But unless the scheme member uses the lump sum to by an annuity, he or she bears another type of risk, namely mortality risk, i.e., the risk of outliving one's resources.

DC schemes will only be a success if such schemes can deliver adequate pensions in retirement. There are a number of reasons why, as a consequence of factors occurring during the accumulation stage, there might be inadequate pensions during the retirement phase: insufficient contributions into the scheme, high charges, and poor investment performance being the principal ones. But there is major impediment to the provision of decent pensions during the retirement phase itself, namely the annuities 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 relatively thin (i.e. uncompetitive and/or poor value for money). For example, of over 200 authorised life offices in the UK, virtually the entire annuity market is supplied by just 20 firms, with the top five life offices accounting for more than 50% of the market[20].

3.1 The problems with annuity markets.

There are a number of problems facing both annuitants and annuity providers.

First, there is an adverse selection bias associated with mortality 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 histories and their 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 realises 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.

Second, mortality tends to improve over time and there can be severe financial consequences if insurance companies underestimate mortality improvements: some insurance companies in the UK have underestimated the average life expectancy of their pool of annuitants by up to two years[21]. Insurance companies add substantial cost loadings to cover these risks, something of the order of 15%[22].

Third, there is inflation risk, the risk faced by those purchasing level annuities, that unanticipated high inflation rapidly reduces the real value of the pension.

Fourth, 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; and since these yields vary by up to 150% over the cycle[23], annuity rates will vary by the same order of magnitude.

Fifth, there is reinvestment (or mismatch) risk, the risk faced by annuity providers that there are insufficient suitable long-maturing matching assets available to make the annuity payments, with the consequence that the proceeds from maturing assets may have to be reinvested on less favourable terms or in less suitable assets.

Even worse, the market for deferred annuities is often extremely thin, particularly at distant starting dates (where the market is virtually non-existent). Where deferred annuities are available, they are usually offered only on the worst possible terms. Deferred annuities are particularly important in the case where a defined benefit (DB) scheme is wound up, say, as a result of the insolvency of the sponsoring company. The assets of the scheme, which is often in deficit at the time (since the company, recognising its serious financial position, usually ceases making contributions into the scheme some time before the insolvency is formally declared) are insufficient to pay the current and future pension liabilities in full. In the past, the residual assets in the scheme were used to buy non-profit policies for current pensioners and group deferred annuities for deferred pensioners. But fewer and fewer insurance companies are willing to sell deferred annuities because of the uncertainties attached to forecasting mortality improvements.

3.2 How do insurance companies currently deal with these problems?

Insurance companies use the government 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 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 insurance companies would take the risk of selling indexed annuities with expected maturities beyond that of the most distant trading indexed-linked government bond.

But annuitants themselves remain exposed to interest and inflation risk. If a DC scheme member retires during an interest rate trough (as happened in the mid-to-late 1990s in the UK, for example), he or she can end up with a very low pension. Similarly, if a 65-year old male annuitant chooses an indexed annuity, he will receive an initial cash sum that is about 30% lower than a level annuity, and, with inflation at 3% p.a., it would take 11 years for the indexed annuity to exceed the level annuity[24]. Since retired people also tend to underestimate how long they will continue to live after they retire, 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 (see appendix A): it became possible to delay the drawing of an annuity until annuity rates improved 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. The annuitant bears interest rate risk at the date of retirement, and inflation risk after

the retirement date is also borne by the annuitant unless he or she is willing to forego a substantial cash sum at the start of retirement as a consequence of purchasing an indexed annuity. Mortality risk, the risk associated with underestimating improvements in mortality, and reinvestment risk after the annuity is sold appear to be shared between insurance companies and (new) annuitants[25]: despite adding substantial cost loadings of up to 15% to cover these risks, insurance companies (at least in the UK) claim to lose money on their annuity business.

3.3 Potential solutions to the annuities problem

3.3.1 Interest rate risk

Until very recently, the insurance industry (outside the US) has been reluctant to offer products that help annuitants hedge the risks, especially interest rate risk, that they have been forced to assume. Yet a whole range of financial instruments and strategies are available to help them do this.

PHASED ANNUITIES

The simplest strategy is a planned programme of phased annuity purchases, using the principle of cost averaging. This strategy could be used as a cheaper alternative to lifestyle fund management: 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.

ADJUSTABLE ANNUITIES

Another simple strategy would be adjustable annuities which rebases rates periodically (say every three years).

PROTECTED ANNUITY FUNDS

A more sophisticated form of pre-retirement planning is protected annuity funds which employ derivative instruments. One example places a fraction (e.g., 95%) 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.

INVESTMENT-LINKED ANNUITIES

A possible solution for the post-retirement period is provided by investment-linked annuities. The world's first example of these is variable annuities which were introduced in 1952 in the US by the TIAA-CREF[26]. In the UK, they are better known as unit-linked or with-profit annuities,

but only a few insurance companies currently offer them. A lump sum is used to buy units in a diversified fund of assets (mainly equities) and the units are sold on a regular basis to provide the annuity. The size of the annuity depends on the income and growth rate of assets in the fund. The annuity can fall if the value of the assets falls substantially, 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 a variable annuity, based on the return on equities, will generate a higher overall income (assuming that the duration of the annuity is sufficiently great).

INDIVIDUAL RETIREMENT ACCOUNTS WITH LONGEVITY INSURANCE

This suggestion would enable individuals to keep their pension fund fully invested in insured funds or in collective investment schemes (such as unit or investment trusts) without having to purchase an annuity at any particular age. They would separately insure against running out of resources before they die. The greater transparency with this structure might lead to lower charges than with a formal annuity.

3.3.2 Inflation risk

The government could also do more to ameliorate these market failures in the private provision of annuities which arise, in part, from aggregate risks that are beyond the abilities and resources of private insurance companies to hedge. A number of proposals have been suggested recently to help the private sector hedge inflation risk.

DEFERRED INCOME GOVERNMENT SECURITIES

For example, in order to help the private sector hedge against inflation risk more effectively, the Goode Report (1993, sec. 4.4.44)[27] 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.

LIMITED PRICE INDEX BONDS

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

3.3.3 Adverse selection and mortality risk

The main causes of private market failure in annuity provision are the risks associated with adverse selection and mortality.

MANDATORY SECOND PENSIONS

Making second pensions mandatory rather than voluntary would do much to remove the adverse selection bias in the demand for annuities[28].

3.3.4 Underestimating mortality improvements

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 etc.

STATE PROVISION OF ANNUITIES

The state could sell annuities directly to the public. The state 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.

SURVIVOR BONDS

Alternatively, the state could issue 'survivor' bonds, a suggestion made in Blake and Burrows (2001)[29]. These are annuity bonds (i.e., bonds with no return of principal) 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 mortality risk and, as a consequence, cost loadings fall. The insurance company would still retain the specific risk associated with the pool of annuitants that purchase its annuities (e.g., 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.

3.3.5 Inadequate transparency of charges

The only real solution to this problem is a simple charging structure and full disclosure of charges.

3.3.6 Deferred annuities

One of the key reasons for the thinness of the deferred annuities market is the difficulties of forecasting mortality improvements in the distant future. Again the government could help.

DEFERRED SURVIVOR BONDS

The introduction of survivor bonds with delayed starting dates would allow private insurance companies to provide deferred annuities more economically.

3.4 The institutional structure of the annuity market

Annuities are a life assurance product: they involve calculations concerning life expectancies. As such they have to be provided by one or more organisations that are, whether *de facto* or *de jure*, life assurance organisations. But what is the optimal institutional structure of the annuity market?

3.4.1 How many annuity providers should there be?

Possible competitive structures for the annuity market range from the state being the monopoly provider of annuities through a small group of specially licensed providers to a fully competitive private market in annuity provision.

THE STATE AS MONOPOLY PROVIDER

In the light of the problems identified above, some have suggested that the state should be the sole provider. There are a number of potential advantages to this solution. There could be substantial economies of scale in the provision of annuities which would lower the unit costs of providing annuities. The state would be bearing the large aggregate risks relating to mortality and mortality improvements that private insurance companies are either unwilling or do not have the resources to bear. The state would, in effect, be issuing survivor bonds and the purchase of these would help to fund the national debt. These bonds could also be index-linked, and then the state would be assuming another risk (generally regarded as one of its own making) that private sector organisations are unwilling to bear. The state could also assume the interest rate risk by offering 'smoothed' annuities, i.e., annuities that are smoothed across the interest rate cycle.

The main disadvantage of state provision relates to efficiency: there are very few examples anywhere in the world of state organisations run on commercial lines that are efficient. The so-called x-inefficiencies associated with monopoly provision may turn out to be larger than the benefits from economies of scale.

A SMALL GROUP OF COMPETING SPECIALLY LICENSED PROVIDERS

This solution has a number of attractions. It would allow the private sector to offer annuities and also permit each provider to gain sufficient market share to justify entry to the market. Efficiency would result from the competition between the providers.

But the problem is to ensure that the small number of providers genuinely compete against each other rather than collude. There is also a problem concerning the nature of this competition. The licences granted to these providers should be written in such a way that the competition between them is 'efficiency-enhancing' rather than 'wasteful'. An example of

wasteful competition would be costly marketing campaigns to attract new customers which if used by all providers merely become campaigns to preserve market share at the expense of the customer. Efficiency-enhancing competition, on the other hand, keeps providers 'on their toes' at all times and forces them to continuously look at ways of keeping their costs down.

One way of avoiding collusion and of promoting efficiency-enhancing competition would be to artificially segment the market, say, along regional lines, industry lines, professional lines, or even by surnames according to letter of the alphabet or other random means. Each provider would be assigned (or have to bid for) a particular market segment, with the objective of offering better value annuities to its segment than is being provided in other segments. If annuitants are to be allocated to a provider rather than choose one, the bidding process for the licenses would have to ensure that all providers charge the same fee. Full disclosure of charges would help to keep charges low. It is envisaged that a multi-stage bidding process which is insulated from price ring effects would be needed. To further reduce the risk of collusion, the licences could be offered on a fixed term basis and there could be a system of fines if collusion was proved.

The government could also help these companies keep costs down by providing a full range of indexed and survivor bonds with a full range of starting dates.

A FULLY COMPETITIVE INDUSTRY

A fully competitive industry with free entry and exit would clearly help to reduce the risks of collusion, but this may not be suitable for a small country, given the increased risk of insolvency amongst providers, unless there was agreement by the remaining providers to absorb the obligations of any insolvent businesses.

3.4.2 Should the organisations selling annuities be restricted solely to the sale of annuities or should they be permitted to sell other life assurance products as well?

Life assurance businesses generally sell a range of products. The different products can help them offset some of the risks that they face. For example, the mortality risks that life businesses face can be hedged by selling both life assurance and annuities: unanticipated improvements in mortality while increasing the costs of providing annuities reduce the costs of providing life assurance. However, the hedge is effective only if mortality improvements are spread evenly across ages. In practice, life assurance policies provide an imperfect hedge for annuities, since mortality improvements are not spread evenly across ages, but rather are concentrated at greater ages. To illustrate, the percentage improvement in mortality between the PMA80 and PA90M tables (based on mortality experience for UK male annuitants in 1980 and 1990 respectively) was 12% at age 35, 9% at age 55, 23% at age 75 and 20% at age 95. If, as is the case in Poland, the licensed annuity providers are restricted to selling annuities only, they become fully exposed to mortality risk and are unable to offset this risk even partially. This will inevitably raise the cost of providing annuities unless the government helps the annuity providers hedge this risk directly by issuing survivor bonds.

3.4.3 If the domestic annuity market is small and poorly developed, should foreign annuity providers be permitted to enter the market?

Annuities as with all life assurance products is a scale business where the law of large numbers operates and helps to bring down costs. There is now a strong trend in the UK and elsewhere of mergers between insurance companies. This suggests that to enable annuitants in small countries to benefit from scale economies, large international insurance companies should be allowed to enter the annuity market in small countries. Their willingness to do so is another matter, given the difficulties of forecasting mortality accurately.

3.4.4 Should the annuity investments be held in domestic assets only or should international investments be permitted? What about the associated currency risk?

At a very minimum, annuity providers need to invest the premiums in safe (i.e., government) fixed-income bonds denominated in the same (i.e., domestic) currency as the annuities are to be paid and with terms to maturity no less than the maximum life expectancy of their pool of annuitants. More sophisticated investment strategies would involve investments in corporate bonds and equities, again denominated in the domestic currency. This would enable annuity providers both to take advantage of the long-term default and equity risk premiums embedded in the returns on these securities (which can average about 100 and 600 basis points, respectively, in advanced economies[30]) and to benefit from risk diversification.

Even greater risk diversification is available from international investment, but there is also an associated currency risk. But this may be a risk worth paying if the domestic securities markets are small or illiquid, or if the domestic economy lies in the currency zone of a large stable economy (e.g., the US dollar, yen or euro), or if, as a result of an inflationary domestic monetary policy, it is believed that the domestic exchange rate will depreciate on a long term basis. In the latter case, the holding of international assets might be the only way of delivering annuities if inflation indexed bonds are not available in the domestic economy.

However, there are wider macroeconomic implications from investing abroad, especially in the case of countries that have just established organised securities markets, such as the countries of Eastern Europe or South East Asia. For example, the purchase of international assets deprives the domestic economy of investment funds, and capital outflows could depress the exchange rate.

4. Conclusion

The above analysis indicates that the following financial instruments and investment strategies are required to enable the introduction of funded pension systems to be successful in delivering Tj 0.001 4 Tc -0.0612 Tw 12 0 0 12 301.4879 317.25
decent pensions in retirement. It is important to differentiate between the accumulation stage and the distribution stage.
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introducing bonds indexed to the rise in national average earnings. However, this would be virtually equivalent to having a funded state pension system. In addition, it would not be feasible for the government to issue such bonds in sufficient quantities to fully match private pension liabilities, since, in mature pension systems, pension assets greatly exceed the value of the national debt. Private pension schemes therefore have to rely on private sector securities such as equity, corporate bonds and property (both domestic and international) to provide (less than perfect hedges) for real earnings growth.

During the distribution stage, the key requirements are assets that match inflation and assets that allow mortality risk to be hedged. One significant contribution of the government would be to supply instruments such as indexed bonds and survivor bonds that would enable annuity providers to hedge risks (such as inflation and mortality risks) that are beyond the resources and abilities of private sector organisations to hedge effectively and economically. A second important contribution of the government (in the absence of the state being the monopoly provider of annuities) would be to establish an institutional framework for its pension annuity business that offers the appropriate incentives for annuity providers to compete effectively and economically. One aspect of this would be to make second pillar (i.e., supplementary) pensions mandatory, since this would help to reduce the costs associated with adverse selection and the marketing of voluntary arrangements.

In terms of investment strategy during the accumulation stage, it is important to recognise that a DB scheme is in reality a DC scheme that is managed in such a way (using asset-liability management techniques) that it generates a targeted pension benefit. Whether the scheme is DB or DC, the investment performance is critical: it affects the net cost to the sponsor of a DB scheme and the net pension benefit to the member of a DC scheme. We showed that, on average, pension fund managers in the UK and elsewhere have under-performed the market, and there has been a wide dispersion of results by individual fund managers. There is little evidence of persistence in performance or spillover effects in performance; there is, however, evidence that large funds underperform small funds. On top of this, we find that fund managers have not been especially successful at active fund management: virtually the same or better returns could have been generated if pension funds had invested passively in index funds. In addition, fund management costs would have been lower and the wide dispersion in returns across fund managers would have been avoided. If governments wish to promote the efficient investment management of pension assets, they should encourage the introduction of appropriate incentives, such as greater transparency in published performance data and the introduction of performance-related fund management fees. This would encourage the less talented fund managers to invest in index funds, with consequential benefits in terms of lower fund management charges and a lower dispersion of performance.

During the distribution stage, we noted that the insurance industry could be more innovative in using existing financial instruments and established investment management (i.e., immunisation[31]) strategies to help its customers hedge risks such as interest rate risk that it is unwilling to assume itself and so has passed on to annuitants.

I conclude by arguing that appropriate financial instruments and investment strategies are more important than either the structure of financial markets or the nature of the financial institutions involved in the provision of private sector pensions. This is a message that comes from an economy with an advanced financial and pension system. The same message is likely to apply to developing countries in the process of undertaking pension reform.

Table 1 Distribution of Returns Generated by UK Unit Trusts, 1972 - 1995

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 constant contribution stream):

$$\frac{(1+r_T)^T - 1}{r_T} \div \frac{(1+r_B)^T - 1}{r_B}$$

where r_T = 0.160, r_B = 0.119 and T = 40 etc.

Source: Blake and Timmermann (1998) and Lunde, Timmermann and Blake (1999)[32].

Table 2 Fractiles of Total Returns by Asset Class for UK Pension Funds, 1986 - 1994
(Average Annualised Percentages)

	UK Equities	*International equities*	*UK bonds*	*International bonds*	*UK index bonds*	*Cash/other investments*	*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
Maximum	17.39	14.68	17.23	26.34	10.07	19.73	13.53	15.03
Difference between maximum and minimum	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 (2002, Table 1)[33].

Table 3 Performance of UK Pension Funds in Comparison with the Market, 1986 - 1994

	Average portfolio weight (%)	*Average market return (%)*	*Average pension fund return (%)*	*Average outper-formance (%)*	*Percentage of outper-formers*
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

Source: Blake, Lehmann and Timmermann (1999, Table 2; 2002)[34].

Appendix A: Defined Benefit and Defined Contribution Pension Schemes

With a DB scheme, it is the pension benefit that is defined. In the UK, for example, most DB schemes are arranged by companies and are known as occupational final salary schemes, since the pension is some proportion of final salary, where the proportion depends on years of service in the scheme. A typical scheme in the UK has a benefit formula of one-sixtieth of final salary for each year of service up to a maximum of 40 years' service, implying a maximum pension in retirement of two-thirds of final salary, and with the pension indexed to inflation up to a maximum of 2.5% per annum (this is known as limited price indexation). In contrast, with a DC scheme, what is defined is the contribution rate into the fund, e.g. 10% of earnings. The resulting pension depends solely on the size of the fund accumulated at retirement. Such schemes are also known as money purchase schemes and in the UK they are better known as personal pension schemes. The accumulated fund must be used to buy a life annuity from an insurance company (although, in the UK, up to 25% of the fund can be taken as a tax-free lump sum on the retirement date).

Defined benefit and defined contribution schemes have different costs and benefits. Defined benefit schemes offer an assured (and in many cases a relatively high) income replacement ratio in retirement. People in retirement can expect to enjoy a standard of living that is related to their standard of living just prior to retirement. But this is the case only for workers who remain with the same employer for their whole careers. Fewer than 5% of workers in the UK do this: the average worker changes jobs about six times in a lifetime[35]. Every time workers switch jobs they experience a portability loss in respect of their pension entitlement. This is because DB schemes are generally provided by specific employers and when a worker changes jobs they have to move to a new employer's scheme. When they do so, they will take a transfer value equal to the cash equivalent of their accrued pension benefits with them or leave a deferred pension in the scheme that they are leaving. Accrued benefits are valued less favourably if someone leaves a scheme than if they remain active members of the scheme. This is because the accrued benefits of an active member are revalued to the member's retirement age using the forecast increase in the member's earnings, whilst the accrued benefits of an early leaver are revalued to retirement age using the forecast increase in retail prices (which on average grow at 2% p.a. less than prices).

Defined contribution schemes have the advantage of complete portability when changing jobs. However, individual DC schemes (such as personal pension schemes) tend to have much higher operating costs than occupational DB schemes (although occupational DC schemes may have lower operating costs than occupational DB schemes on account of their much simpler structure). Individual DC schemes in the UK take around 2.5% of contributions in administration charges and up to 1.5% of the value of the accumulated assets in fund management charges. The Institute of Actuaries has estimated that all these costs are equivalent to between 10 and 20% of annual contributions; in contrast, the equivalent costs of running an occupational scheme work out to between 5 and 7% of annual contributions[36]. On top of this, most of the charges in individual DC schemes are frontloaded, i.e. they are incurred at the start-up of a scheme rather than spread evenly over the life of the scheme. Much of the first two years of contributions are used to pay commissions to sales staff. This has a dramatic effect in reducing the surrender value of a scheme if contributions cease early in the life of a scheme and it is transformed from an ongoing to a paid-up basis. Over a 25-year investment horizon, the average scheme takes around 20% of the fund value in charges, while the worst scheme provider takes around 30%[37]. Another

problem with DC schemes, in practice, is that total contributions into such schemes tend to be much lower than with DB schemes. In a typical DB scheme in the UK, the employee's contribution is about 5-6% of employee earnings, while the employer's contribution is double this at about 10-12%[38]. The size of the employer's contribution is not widely known amongst employees; and, to an extent, the size of the employer's contribution is irrelevant from the employee's viewpoint, since the pension depends on final salary, not on the level of contributions. This is not the case with DC schemes where the size of the pension depends critically on the size of contributions. It also depends on asset risk which in DC schemes is borne entirely by scheme members. They also bear some other types of risk, such as ill-health, disability and death-in-service. In DB schemes, these risks exist, but are typically carried by the scheme sponsor. In DC schemes, protection against these risks has to be purchased directly by the member as additional insurance products. However, Table A1 shows that so long as individuals join a DC scheme at a sufficiently early age and maintain their contribution record over a sufficiently long investment horizon (and so get the benefits of compounded returns), a decent pension in retirement can be achieved for a modest contribution rate. The table indicates that a 25-year old male can expect a pension of two-thirds of final salary (the maximum available from a DB scheme in the UK) with a total contribution rate of just under 11% of earnings. The required contribution rate rises sharply with age, however. Someone joining at 35 would need a contribution rate of around 17%, and by the age of 40, the required contribution rate is above the maximum permissible under the regulations establishing such schemes.

Table A1 Contributions Needed to Achieve a Pension of Two-Thirds Final Salary

Age at commencement (male)	Required contributions (% of salary)	Maximum contributions (% of salary)
25	10.90	17.5
30	13.41	17.5
35	16.81	17.5
40	21.66	20.0
45	28.92	20.0
50	40.81	25.0
55	64.15	30.0
60	129.83	35.0

Assumptions: Male retiring at age 65; no previous contributions into any other pension scheme; salary increases by 3% p.a.; investment return 6% p.a.

Source: Blake (1997, Table 10.2)[39].

Appendix B: Types of Annuities[40]

Definition of an annuity (from the Pension Management Institute's *Pensions Terminology*):

'A series of payments, which may be subject to increases, made at stated intervals until a particular event occurs. This event is most commonly the end of a specified period or the death of the person receiving the annuity'.

The following range of annuity products is available in developed annuity markets (see Black and Skipper (1994), Blake (2003), March (1996), Vaughan and Vaughan (1996)[41]).

Purchase arrangements:

Single-premium annuity: the cost of the annuity is paid in a single lump sum.

Regular-premium (or *instalment*) *annuity*: the cost of the annuity (which by definition will be a deferred annuity) is paid by regular instalments (either in the form of *fixed premiums* or *flexible premiums*). During the accumulation stage, there is both an accumulation value and a surrender value. The accumulation value equals the premiums paid plus investment returns less expenses. The surrender value is equal to the accumulation value less a surrender charge which typically reduces to zero at the end of the surrender charge period. Should the policy holder die during the accumulation stage, the surrender value of the policy goes to the policy holder's estate; similarly, the policy holder can make a withdrawal up to the surrender value during the accumulation period. A variation on this is the:

Two-tier annuity: the accumulation value will be received only if the policy is subsequently annuitised for a minimum period (e.g., 5 years), and the surrender value is always less than the accumulation value to discourage early withdrawal.

Coverage:

Single-life annuity: payments cease on the death of the annuitant (without refund of the balance of capital).

Joint-life annuity: payments cease when the first of the lives covered dies; the second life receives no further payments after this date.

Joint-and-last-survivor annuity (or simply *joint-survivor annuity*): payments continue until the

death of the second life (usually the surviving spouse). Typically, after the death of the first annuitant, the annuity continues at a lower rate, e.g., one-half or two-thirds. The size of the annuity depends on the age difference between the two lives.

*Survivor (*or *reversionary) annuity*: payments begin on the death of the nominator (the covered life) and continue until the death of the beneficiary of the policy (called the annuitant), unless the beneficiary dies first, in which case the policy expires worthless.

Group annuity: covers a group of individuals, such as the employees of a company, not necessarily by name, rather by characteristics (such as age and sex).

Variations:

Temporary annuity: payments are made for a fixed period or until the annuitant dies, whichever is sooner.

Certain annuity: payments are made for a fixed period, whether or not the annuitant dies.

Whole annuity: payments continue until the annuitant dies.

Annuity *with minimum guarantee* (*period-certain annuity*): payments are made for a minimum period (e.g., 5 or 10 years), however long the annuitant lives.

Annuity *with minimum guarantee and overlap*: the spouse's income and income during the guarantee period are paid simultaneously.

Annuity *with proportion*: on the death of the annuitant, the proportion owing since the last payment is paid (important feature if annuity is paid annually).

Annuity *with capital protection:* the balance of the capital is paid to the annuitant's estate when s/he dies. Variations on this include:

Cash-refund annuity: the balance of the capital is paid as a lump sum.

Instalment-refund annuity: the balance of the capital is paid in instalments.

Other features:

Health: Impaired life annuities: where the prospective annuitant is expected to experience heavier mortality than the average annuitant (say as a result of a fatal illness or, indeed, as a result of lifestyle, such as being a smoker), higher than standard annuity rates apply.

Gender: Uni-sex annuities: the annuity rate is the same for males and females. With conventional annuities, the annuity rates for males exceed those for females on account of the generally heavier mortality experienced by males. Uni-sex annuities therefore involve a cross-subsidy from men to women.

Tax: Compulsory purchase annuities (CPAs): the full amount of the annuity is subject to income tax. In countries, such as the UK, which operate an EET tax system for their pension arrangements (i.e., contributions into the pension scheme are *Exempted* from tax, investment returns are *Exempted* from tax, but the pension in payment is *Taxed*), it is usually mandatory in DC schemes to use the lump sum on the retirement date to purchase a life annuity; because of the tax subsidy involved in generating this lump sum, the full amount of the annuity is taxed as income. In contrast, the voluntary purchase of a life annuity is typically made from post-tax resources. Such annuities are known as *purchased life* annuities (PLAs). Recognising that an annuity payment involves both an income element and a return of capital element, the tax authorities only tax the income element in the case of PLAs.

Timing of payments:

Immediate annuity (*annuity in arrears*): payments commence at the end of the first period.

Annuity-due (*annuity in advance*): payments commence at the beginning of the first perid.

Deferred annuity: first payment is delayed for a number of periods.

Phased annuities (*phased* or *staggered vesting*): a series of annuities are purchased at regular intervals.

Payment frequency: monthly, quarterly, semi-annual, annual.

Currency of denomination: domestic currency or key foreign currencies.

Payment terms:

Level annuity: pays a fixed amount in nominal terms for the duration of the annuity. All other types of annuity pay variable amounts.

Escalating annuity: an example is a *constant-growth annuity*, where the annuity increases annually at a fixed rate of, say, 5%. The starting payment is much lower than with a level annuity costing the same amount.

Index-linked annuity: an example of an escalating annuity where the payments are increased in line with increases in the retail price index.

Limited price indexed (LPI) annuity: this compensates for inflation up to a stated limit (e.g., 5% per annum compound).

With-profit annuity: the capital sum is invested in an insurance company endowment policy and the annuity is based on an assumed or anticipated annual bonus (or crediting) rate (e.g., 8%). The initial payment is lower than with an equivalent level annuity, but is higher the higher the assumed bonus, although, as a consequence, the subsequent rate of increase in the annuity is lower. However, the annuity could fall in value if the assumed bonus rate turns out to exceed the actual declared bonus rate. Some providers offer a two-tier bonus system: an annual reversionary bonus, which, once declared, cannot be removed, and an annual terminal bonus, which applies only for the year in question and can be raised or reduced in subsequent years. See Table B1 for an example.

Unit-linked (or *variable*) *annuity*: the capital sum is invested in unit-linked funds (unit trusts or mutual funds) and each year a fixed number of units are sold to provide the annuity. The initial payment is lower than with an equivalent level annuity. The annuity either fluctuates in line with unit trust (or mutual fund) prices, or is assumed to grow at a constant rate, e.g., 10% p.a.; in the latter case, if investment performance is lower than this, the income from the annuity falls and *vice versa*, in a similar manner to the with-profit annuity.

Market-value-adjusted (MVA) annuity: a hybrid arrangement for a deferred annuity lying between a fixed and variable annuity. The annuity rate is fixed for a specified period, but the surrender value of the policy adjusts in line with the market value of the underlying investments if it is surrendered before the end of this period. At regular intervals (e.g., every 5 years), a window opens enabling a withdrawal to be made without a MVA.

Managed annuity (*managed pension* or *income drawdown* or *income withdrawal* or *deferred annuity purchase*): the capital sum remains invested in a fund and individuals are permitted to draw an income from the fund for a specified period, before purchasing a standard annuity. They were first introduced in the UK as a result of the 1995 Finance Act, following an unprecedented fall in government bond yields and hence annuity rates during the 1990s: individuals retiring during this period were locking themselves into very low level-annuities. In the case of the UK, individuals can delay drawing an annuity until age 75, during which time they can draw an income from the fund that is between 35% and 100% of that available from a single-life level annuity. Tables for doing this are supplied by the Government Actuary, and the arrangements have to be reviewed triennially. If the individual dies before the annuity is purchased: the individual's spouse can continue using the drawdown facility until age 75 and if s/he, in turn, dies before this age, the balance of the fund forms part of his/her estate; or the spouse can purchase a standard annuity; or the balance of the fund can be received as a lump sum, subject to a 35% tax. There are various costs or risks associated with drawdown. First, annuity rates might actually be lower by the time the individual reaches 75. Second, investment performance during the deferral period might be poor with the result that the fund falls in value. Third, by not buying an annuity, individuals forego a 'mortality cross-subsidy' (a cross-subsidy allowed for in annuity rates which arises because some annuitants will die shortly after taking out an annuity thereby releasing a 'mortality profit' which insurance companies share with longer-surviving annuitants): the mortality cross-subsidy is cumulative over time, and by delaying the purchase of an annuity, individuals experience a so-called 'mortality drag' (see appendix C below).

Table B1 Example of with-profit annuity

Year	*Reversionary bonus declared (%)*	*Annuity payments (£)*
1	0	11,449
2	0	10,601
3	0	9,816
4	0	9,089
5	10	9,257
6	10	9,428
7	10	9,603
8	10	9,781
9	10	9,962
10	9	10,054
11	8	10,054
12	8	10,054
13	6	9,868
14	5	9,594
15	7.5	9,594
16	9.5	9,682
17	11	9,951
18	12.5	10,366
19	14	10,941
20	15	11,651

Assumption: Male aged 65 uses £100,000 to purchase a single-life with-profit immediate annuity with an anticipated bonus of 8%: the starting level for the annuity is £11,449.

Note: No bonus is declared in the first four years, so the annuity payments must fall. In years 5-10, the actual bonus exceeds the anticipated bonus, and this allows the annuity payments to rise. In years 11-12, the anticipated and declared bonuses are the same and so the annuity payments remain unchanged. From year 13 on, the bonuses vary year by year and the annuity rises or falls accordingly.

Source: March (1996)[42]

Appendix C: Mortality Drag

The size of an annuity depends on the following factors: the return on the assets purchased with the capital sum (principally government bonds), life company expenses, the degree of escalation, the benefits payable on death and the assumption made about the mortality experience of annuitants, both concerning the average life expectancy of annuitants and the anticipated distribution of life expectancies (i.e., the proportion of annuitants expected to die after one year, after two years, etc.). If the assumptions made about these factors are realised in full, the insurance company will have exactly enough resources to meet every annuity payment due. On the death of an annuitant, the balance of the original capital fund, together with investment returns (collectively called the 'mortality profits'), is used to make payments to surviving annuitants. Each annuity instalment has three components: a proportion of the original purchase price, a proportion of the investment return, and a proportion of the assumed mortality profit released by the early deaths of annuitants.

In contrast, with drawdown, there is no mortality cross-subsidy from those with below-average mortality to those with above-average mortality: every user of a drawdown facility bears his or her own mortality risk. The absence of the mortality cross-subsidy is known as 'mortality drag': it is equal to the proportion of the original cohort of annuitants who die in a given year. For drawdown to be worthwhile, the returns on the invested funds must exceed the annuity yield by a sufficient margin to cover both the mortality drag and the higher charges of drawdown. The mortality drag will be higher for older than for younger people: older people are more likely to die than younger people and also there will be fewer of them, so that the cross-subsidy will be larger and received sooner than for younger people. It will also be higher for men than for women for a similar reason: men tend to die younger than women and relatively there are fewer of them at each given age. However, the benefit of drawdown is its greater flexibility over the timing of the purchase of the annuity and the higher value of the fund if the annuitant dies early. See Table C1 for an example of mortality drag.

Table C1 Example of additional return needed to cover mortality drag and drawdown charges

Age at retirement	*Mortality drag (%)*	*Charges (%)*	*Additional total return required (%)*
60	1.4	1.8	3.2
61	1.5	1.8	3.3
62	1.6	1.8	3.4
63	1.7	1.9	3.6
64	1.9	1.9	3.8
65	2.0	2.0	4.0
66	2.3	2.0	4.3
67	2.5	2.1	4.6
68	2.8	2.2	5.0
69	3.2	2.3	5.5
70	3.5	2.5	6.0
71	3.6	3.0	6.6
72	3.7	3.5	7.2
73	3.9	4.6	8.5
74	4.1	8.4	12.5

Assumption: Male retiring between 60 and 74, assuming an initial drawdown charge of 3%, an annual charge of 0.5%, an annuity yield of 7.5% and an annuity purchased at age 75

Note: If the man retires aged 60, and makes use of the drawdown facility until age 75, when he purchases an annuity, he will require an additional return on his investments of 1.8% p.a. to compensate for the higher charges of drawdown and 1.4% p.a. to compensate for mortality drag. Given that the annuity yield is assumed to be 7.5% p.a., this implies that the total return on investments must exceed an average of 10.7% p.a. between ages 60 and 75 for the benefits of drawdown to exceed those of purchasing the annuity. If this return is not achieved, either the fund will be depleted more rapidly than anticipated or the income withdrawn would have to be lower than that available from the purchase of an annuity at age 60. The additional total return required increases with age of retirement.

Source: National Mutual Life (1996)[43]

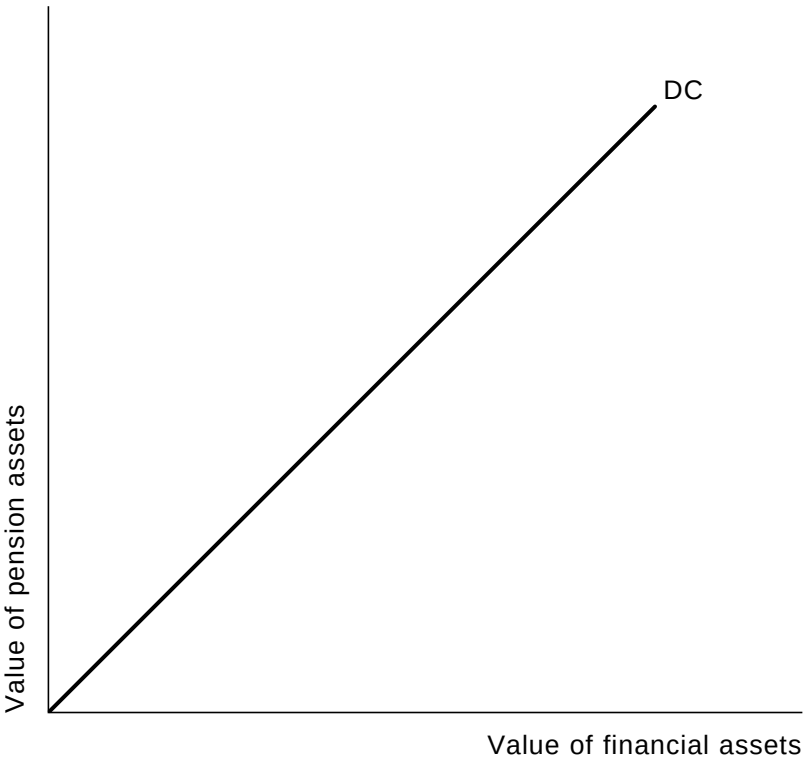

Figure 1: A defined contribution pension scheme

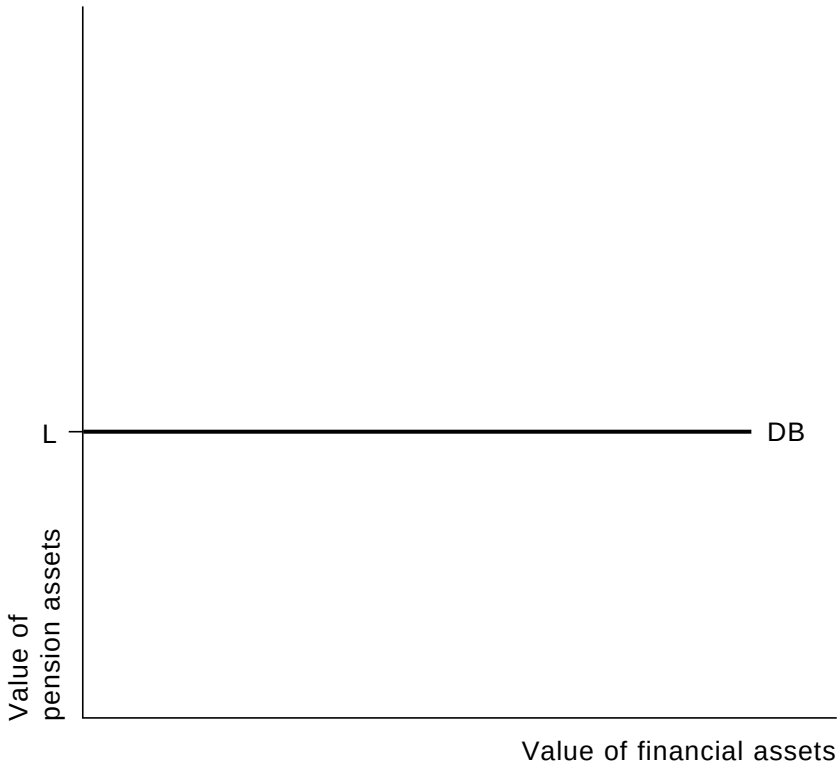

Figure 2: A defined benefit pension scheme

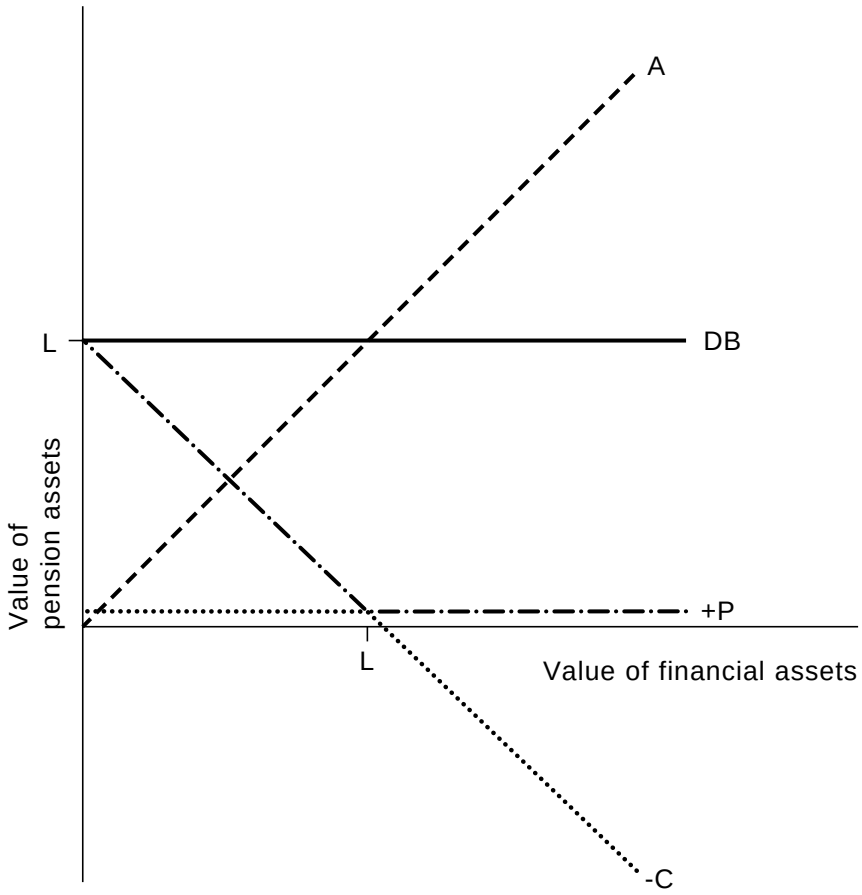

Figure 3: The option composition of a defined benefit scheme

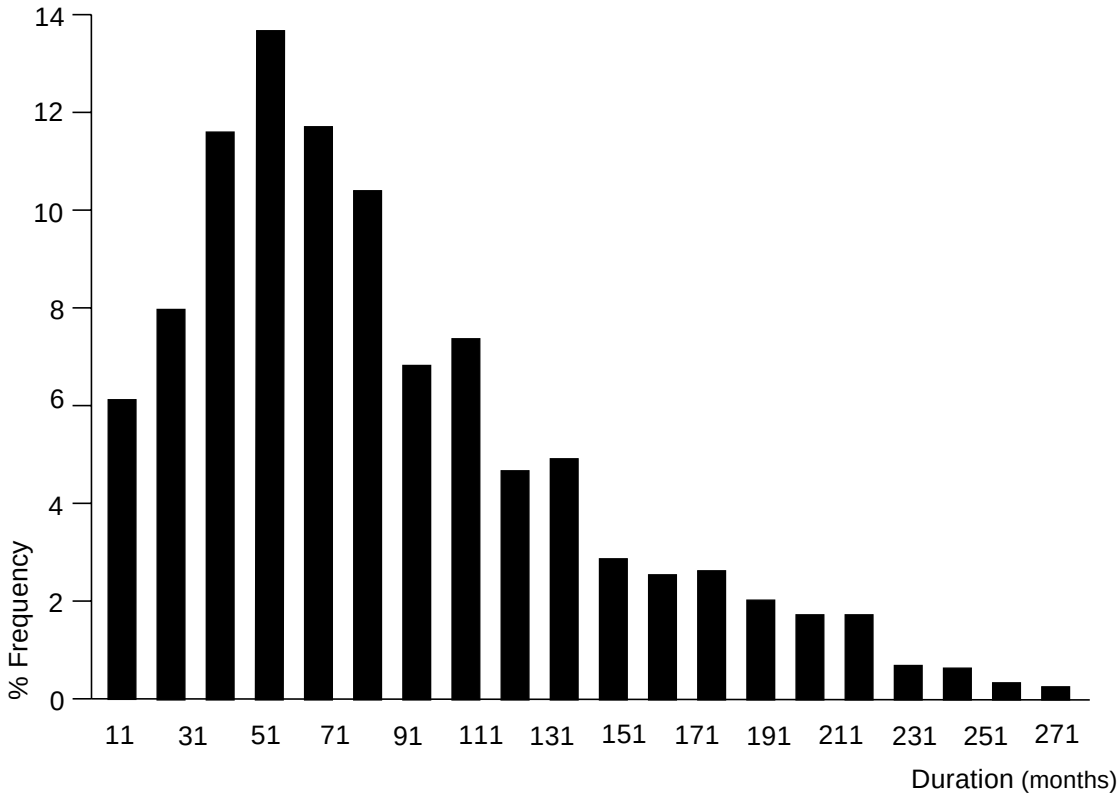

Figure 4: Duration of UK Unit Trusts from Inception (months)

Note: The histogram shows the distribution of lifetimes for the 973 unit trusts that were wound up or merged during the course of the sample (1972-1995)

References

[1] However, there are an increasing number of hybrid schemes being introduced which combine features of both DB and DC schemes. It is also possible to have unfunded DB and DC schemes.

[2] Blake, D. (1998), Pension Schemes as Options on Pension Fund Assets: Implications for Pension Fund Management, *Insurance: Mathematics and Economics*, 23, 263-86.

[3] This is known as the 'prospective benefits obligation' method of calculating pension liabilities.

[4] In the case of equities, this is known as the 'equity risk premium'.

[5] See Blake, D. (2003, Ch. 13), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (second edition) or Blake, D. (2000, Ch. 13), *Financial Market Analysis*, Wiley, Chichester.

[6] See, e.g., Fabozzi, F, and Konishi, A. (eds) (1991), *Asset-Liability Management*, Probus, Chicago or Blake, D. (2003, ch. 13), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (second edition). Formally the fund manager's objective with a DB scheme is to minimise surplus risk each period subject to the condition that the surplus is always zero. The control variables in this dynamic programming exercise are the contribution rate into the fund and the composition of the assets in the funds (i.e., the portfolio weights or the asset allocation). See Blake, D. (1992), *Modelling Pension Fund Investment Behaviour*, Routledge, London. for an analysis of UK pension fund investment behaviour over a period when DB schemes were broadly unconstrained by their liabilities and hence pursued investment strategies more akin to maximising risk-adjusted expected value.

[7] For more details see Blake, D. (1998), Pension Schemes as Options on Pension Fund Assets: Implications for Pension Fund Management, *Insurance: Mathematics and Economics*, 23, 263-86.

[8] To avoid this risk, nearly 70% of companies in the UK had closed their DB schemes to new members by 2003, while 10% of schemes had closed their schemes to additional contributions from existing members (FT.com, 12 June 2003).

[9] Blake, D. and Timmermann, A. (1998), Mutual Fund Performance: Evidence from the UK, *European Finance Review*, 2, 57-77.

[10] This comprises regular contributions plus investment returns on these.

[11] This is despite the fact that, as we have seen above, there are investment management techniques available to reduce the dispersion of realised returns.

[12] Lunde, A., Timmermann, A., and Blake, D. (1999), The Hazards of Mutual Fund Underperformance, *Journal of Empirical Finance*, 6, 121-52.

[13] Blake, D. (2003), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (second edition).

[14] Blake, D., Lehmann, B., and Timmermann, A. (1999), Asset Allocation Dynamics and Pension Fund Performance, *Journal of Business*, 72, 429-62; and Blake, D., Lehmann, B., and Timmermann, A. (2002), Performance Clustering and Incentives in the UK Pension Fund Industry, *Journal of Asset Management*, 3, 173-94. Very similar results have been found for the US , see Lakonishok, J., Shleifer, A., and Vishny, R., (1992), The Structure and Performance of the Money Management Industry, *Brookings Papers: Microeconomics*, 339-91.

[15] Davis, E.P. (1988), *Financial Market Activity of Life Insurance Companies and Pension Funds*, Economic Paper No.21, Bank for International Settlements, Basle, reports a survey of UK and US fund managers in which they acknowledge the existence of a herding effect.

[16] Again very similar results have been found in the US, see: Grinblatt, M., and Titman, S. (1992), The Persistence of Mutual Fund Performance, *Journal of Finance* 47, 1997-84; Hendricks, D., Patel, J., and Zeckhauser, R. (1993), Hot Hands in Mutual Funds: Short-Run Persistence of Relative Performance, *Journal of Finance* 48, 93-130; Brown, S.J., and Goetzmann, W. (1995), Performance Persistence, *Journal of Finance* 50, 679-98; and Carhart, M. (1997), On Persistence in Mutual Fund Performance, *Journal of Finance*, 52, 57-82.

[17] Brinson, G., Hood, L., and Beebower, G. (1986), Determinants of Portfolio Performance, *Financial Analysts Journal*, July-August, 39-48; and Brinson, G., Singer, B., and Beebower, G. (1991), Determinants of Portfolio Performance II: An Update, *Financial Analysts Journal*, May-June, 40-48.

[18] *Pensions Management*, September 1998.

[19] There could, however, be a problem, if many pension schemes are trying to liquidate assets at about the same time, as is predicted to occur in the US, for example, when the 'baby boomers' begin to retire after 2010. This phenomenon has been called the 'wall of money' and it is uncertain whether the growing demand for pension assets in the developing world will be sufficiently great by 2010 for US pension funds to be able to liquidate their asset holdings without substantial losses of capital value.

[20] The Financial Services Authority Statutory Returns of Insurance Companies for 2002.

[21] William Burrows of Prudential Annuities; see also MacDonald, A. (1996), United Kingdom, in A. MacDonald (ed.) *The Second Actuarial Study of Mortality in Europe*, Groupe Consultatif des Associations D'Actuaires des Pays des Communautes Europeennes, Brussels, who finds that errors in forecasting mortality improvements of 20% over periods as short as 10 years are not uncommon.

[22] Mitchell, O.S., Poterba, J.M., Warshawsky, M.J., and Brown, J.R. (1999), New Evidence on the Money's Worth of Individual Annuities, *American Economic Review*, 89, 1299-1318.

[23] CSFB (2003), *Equity-Gilt Study*, Credit Suisse First Boston, London.

[24] Khorasanee, M.Z. (1996), Annuity Choices for Pensioners, *Journal of Actuarial Practice*, 4, 229-55.

[25] Existing annuitants do not bear these risks, since the terms of their contract with the insurance company is set at the time that the annuity is purchased and cannot subsequently be changed.

[26] Teachers Insurance and Annuity Association of America - College Retirement Equity Fund.

[27] Goode, R. (1993), *Pension Law Reform: Report of the Pension Law Review Committee*, CM 2342-I, HMSO, London.

[28] There is a growing body of support for mandatory contributions into second pensions, including: Field, F., and Owen, M. (1993), *Private Pensions for All: Squaring the Circle*, Fabian Society Discussion Paper No. 16, London; Borrie, Sir G. (Chairman) (1994), *Social Justice – Strategies for National Renewal*, Report of the Commission for Social Justice, Vintage, London; World Bank (1994), *Averting the Old-Age Crisis*, Oxford University Press, Oxford; Dahrendorf, Lord R. (Chairman) (1995), *Wealth Creation and Social Cohesion in a FreeSociety*, Report of the Commission on Wealth Creation and Social Cohesion, Xenogamy, London; Anson, Sir J. (Chairman) (1996), *Pensions 2000 and Beyond*, Report of the Retirement

Income Enquiry, London; as well as surveys of customers conducted by NatWest Bank and Coopers & Lybrand (reported in Field, F. (1996, pp. 52-3), *How to Pay for the Future: Building a Stakeholders' Welfare*, Institute of Community Studies, London. (1996, pp. 52-3)). Compulsory contributions are seen as one way of dealing with individual *myopia* and the problem of *moral hazard*. The first issue arises because individuals do not recognise the need to make adequate provision for retirement when they are young. 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.

[29] Blake, D., and Burrows, W. (2001), Survivor Bonds: Helping to Hedge Mortality Risk, *Journal of Risk and Insurance*, 68, 339-48.

[30] CSFB (2003), *Equity-Gilt Study*, Credit Suisse First Boston, London.

[31] See, e.g., Blake, D. (2003, Ch.13), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (second edition).

[32] Blake, D. and Timmermann, A. (1998), Mutual Fund Performance: Evidence from the UK, *European Finance Review*, 2, 57-77; and Lunde, A., Timmermann, A., and Blake, D. (1999), The Hazards of Mutual Fund Underperformance, *Journal of Empirical Finance*, 6, 121-52.

[33] Blake, D., Lehmann, B., and Timmermann, A. (2002), Performance Clustering and Incentives in the UK Pension Fund Industry, *Journal of Asset Management*, 3, 173-94.

[34] Blake, D., Lehmann, B., and Timmermann, A. (1999), Asset Allocation Dynamics and Pension Fund Performance, *Journal of Business*, 72, 429-62; and Blake, D., Lehmann, B., and Timmermann, A. (2002), Performance Clustering and Incentives in the UK Pension Fund Industry, *Journal of Asset Management*, 3, 173-94.

[35] Burgess, S., and Rees, H. (1994), *Lifetime Jobs and Transient Jobs: Job Tenure in Britain 1975-91*, Centre for Economic Policy Research, London; Gregg, P. and Wadsworth, J. (1995), A Short History of Labour Turnover, Job Tenure, and Job Security, 1973-93, *Oxford Review of Economic Policy*, 11, 73-90; Booth, A., Francesconi. M., and Garcia-Serrano, C. (1996), Job Tenure: Does History Matter?, Programme in Labour Dynamics in a Changing Environment, University of Essex, Colchester; Disney, R., and Whitehouse, E. (1996), What are Occupational Pension Plan Entitlements Worth in Britain?, *Economica*, 63, 213-38.

[36] Blake, D. (1995, sec 7.34), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (first edition). Stakeholder pensions, which cap annual charges at 1% of fund value, were introduced to lower the cost of individual DC pension arrangements in the UK.

[37] It is the high costs associated with individual personal pension schemes in the UK that has led many small companies without the resources to run either occupational DB or occupational DC schemes to establish group personal pension schemes (GPPs) which have lower unit costs than personal pension schemes.

[38] Government Actuary's Department (2003), *Occupational Pension Schemes 2003*, Stationery Office, London.

[39] Blake, D. (1997), Pension Choices and Pensions Policy in the United Kingdom, in S. Valdés-Prieto (ed.), *The Economics of Pensions: Principles, Policies and International Experience*, Cambridge University Press, New York, 277-317.

[40] This appendix draws on Blake, D. (1999), Annuity Markets: Problems and Solutions, *Geneva Papers on Risk and Insurance*, 24, 358-75.

[41] Black, K., and Skipper, H. (1994), *Life Assurance*, Prentice Hall, Englewood Cliffs, NJ; Blake, D. (2003), *Pension Schemes and Pension Funds in the United Kingdom*, Oxford University Press, Oxford (second edition); March, H. (1996), The Changing World of Annuities, *Journal of the Society of Fellows*, 12 2-18; and Vaughan, E., and Vaughan, T., (1996), *Fundamentals of Risk and Insurance*, Wiley, New York.

[42] March, H. (1996), The Changing World of Annuities, *Journal of the Society of Fellows*, 12 2-18.

[43] National Mutual Life (1996), *Drawdown: The Technical Manual*, NML Life Assurance Society, Hitchen, Herts.