Annuities and alternative ways of providing retirement income

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Annuities and alternative ways of providing income after retirement

Introduction

Payment of pensions is usually an integral part of defined benefit schemes. The benefit which is defined in the scheme rules is normally a regular income from date of award for the rest of life, commonly with payments continuing to a surviving spouse or partner. In some jurisdictions there may be an entitlement to take part of the benefit as a lump sum on favourable tax terms, but the rest of the benefit usually has to be taken as a pension; the scheme is funded and invested on that assumption. This means that the pension scheme bears the post-retirement longevity risk, and the investment risk; members are protected against those risks, however long they live (subject to the scheme continuing and remaining financially viable). The expected future cash-flows involved in paying out pensions are taken into consideration in deciding on the investment policy for the fund. However, although the investment policy might change gradually over time as the scheme becomes more mature, there is no need to consider selling assets at the point of retirement of individual members. The pay-out phase can be regarded as an integral part of the benefit cash-flow, and, except for a closed scheme in an advanced state of run-off, there will usually be contribution inflows at the same time as pension payment outflows.

Most defined contribution schemes, on the other hand, are segregated into the investment (accumulation) phase and the pay-out (decumulation) phase, often with different entities supplying the respective services. This may have advantages in terms of transparency, enabling the investment and management objectives of the two phases to be clearly articulated and permitting a degree of choice to operate at the moment of retirement. However, complete segregation of the two phases may lead to suboptimal asset allocation over the life-cycle and may introduce new risks for the affiliates from the choices which have to be made at the point of switching from an accumulation vehicle to a pay-out annuity.

Annuities have existed in one form or another for many centuries. James (1947) reported that contracts called *annua* existed even in Roman times, providing for a stream of income for a fixed or variable period of time in return for a payment at the start. Annuities for fixed periods (annuities certain) were used in more recent centuries for the repayment of loans. Immediate life annuities, payable from the date of purchase for as long as the purchaser lives, were offered by some private entities as retirement income for former employees, and were available from some governments as a quasi-commercial product. However, it seems that governments usually undercharged for such products and some of the earliest actuarial calculations were carried out to demonstrate this and to propose a sound basis for calculating the consideration (premium) for such annuities. Witt (1671) and Halley (1693) both studied this problem, as far as we know independently, and arrived at a solution which is still used by actuaries more than three hundred years later, based on the combination of a mortality table and compound interest. De Moivre (1725) also wrote an early treatise on the subject.

Immediate annuities work by pooling the risk of longevity among the cohort of pensioners buying an annuity at a particular age. The mathematics assume that each person buying an annuity at the same age pays the same amount and that payments are

made in return each year to the surviving members of the cohort, with the numbers assumed to reduce over time in accordance with an assumed life table. Those who live longest will receive payments substantially in excess of the consideration for purchasing the annuity. Those who die soonest will receive less than they paid. The pooling of risk means that the surplus funds which remain with the insurer in respect of those who die early are used to finance the extra cost for those who live a long time. The insurer makes a profit on the basis of the profit margin which is priced into the contract, and if the experience of the cohort is such that members on average do not live as long as allowed for in the pricing assumptions. If the members of the cohort live longer on average than allowed for, the insurer is likely to make a loss. Profits or losses can also be made in respect of the investment of funds to back the reserves for future payments under the contract.

Life annuities have obvious attractions from the point of view of the pensioner, since the income continues for as long as he or she lives, substantially reducing the risk of outliving one's financial resources. An annuity for a fixed period is risky, even if payable for the individual's expectation of life. Since hardly anyone dies "on time" in the sense of surviving for exactly the period indicated by their expectation of life at retirement, the payments would almost always stop before the individual's death or continue afterwards. However, notwithstanding the apparent attractions of life annuities, they are generally not very popular with the investing public.

Lump sums at retirement

Since many defined contribution plans are in effect a simple accumulation of savings during the working life, they naturally give rise to an accumulated amount of capital at the date of retirement. Many retirees would be glad to get their hands on their pensions savings at this point, since it would provide them with flexibility to use the savings in whatever way they chose, such as paying off a mortgage on a house or other debts, investing in new or additional property or spending on leisure activities (holidays, cruises, investing in hobbies or buying a car, boat, caravan, etc.). It would also facilitate passing on part of their accumulated savings to children or other family members, particularly with a view to giving children the use of the money earlier than if they had to wait for their inheritance, which in some jurisdictions can also have the beneficial effect of reducing the amount of tax potentially payable on the eventual estate.

Whether the accumulated savings can in practice be taken as a cash lump sum will depend not just on the contractual arrangement but on the tax rules in the particular jurisdiction. Full access to the retirement savings as a lump sum is often not permitted, although in a number of countries it may be possible to take a proportion of the accumulated savings as a lump sum on retirement and in some the permitted lump sum receives favourable tax treatment. Purely from the tax point of view there would seem to be no reason to prevent further immediate withdrawals of cash, provided that they are subject to tax in the hands of the recipient. However, in practice other public policy considerations predominate, namely the concern that pensions savings, which have usually received (or are perceived by the authorities as having received) significant tax advantages, should not be "squandered" but be utilised to provide income in retirement

and, in particular, to prevent the individual eventually falling back onto any form of income support which may be available to supplement the income of the very poor.

Income withdrawal or "draw-down"

Given the public policy concern to ensure that pensioners' savings are not used up too quickly, and the unpopularity of forced annuitisation of the whole of the accumulated investment in a defined contribution plan, many countries permit some form of controlled withdrawal of money from the pension fund. The basic idea is to keep the pension fund invested, with the affiliate still having some control over the investment of the funds, whilst income can be withdrawn on a discretionary basis. Most systems of "draw-down", or "programmed withdrawal", are subject to a variety of constraints. In particular it is common for there to be a ceiling on the amount which can be withdrawn in cash in each period. For example, this might be equivalent to the amount of a level single-life immediate annuity which the remaining fund would be sufficient to purchase at that point of time. Sometimes there is also a minimum amount that can be withdrawn.

In Chile, the maximum amount which can be drawn down each year under what is known as "programmed withdrawal" is calculated by dividing the fund balance at the start of the year by the expectation of life for an individual of that age. At the time of writing, in the United Kingdom both a maximum amount and a minimum amount are specified for the amount of draw-down. The maximum is calculated as the fund balance divided by the level immediate life annuity; the minimum is 35% of that figure. These bounds were set by the Inland Revenue (the UK tax authority) and are implemented using tables provided by the Government Actuary, which seek to approximate the income produced from a single-life level annuity at different ages based on current government bond yields at the time. The maximum and minimum income that an individual can take are reviewed every three years. In the UK pensioners using draw-down must in any case annuitise the remaining balance in their fund by the age of 75. Legislation currently before Parliament is expected to remove the minimum requirement.

Income draw-down is seen as offering more choice to the individual, permitting continued investment of a proportion of the pension assets in equities well into retirement and also permitting greater flexibility in the way in which pension is received. For example, a pensioner may wish to defer taking pension during a period for which some other income from employment is being received, or whilst a partner has still not retired. Many people would also see as an advantage the possibility of not having to hand over the whole of their pension savings to an insurance company, and retaining the capital so that it can be inherited by their spouse or partner or other family members if they die before having had to purchase an annuity.

The principal disadvantage of draw-down arrangements is that individuals have to self-insure the longevity risk; they may well end up on insufficient income in the long term if they survive to a great old age. The risk of running down the money too quickly may be exacerbated by poor investment performance of the balance of the fund, since the pensioner is clearly exposed to investment risk as well as to longevity risk. On the other hand, a cautious pensioner may hold back too much of the fund in order to keep reserves for later, or in case the investments perform less well than expected, with the result that they enjoy a lower income than they ought to have had and leave a large amount of the

fund in their estate when they die. Since noone knows exactly when they will die, it is inevitable that either the drawdown fund will be exhausted before death or that there is money left in at the end.

A more technical (but nevertheless real) point is that, relative to annuitisation, draw-down arrangements suffer from what is known as "mortality drag". Put simply, this means that, because they are self-insuring the mortality/longevity risk, they do not gain any benefit, as they would implicitly if they had purchased an annuity, from the release of funds in respect of those who die relatively young. This means in effect that it becomes increasingly expensive to annuitise what is left of the pension fund balance, necessitating an additional return on the assets (furthermore increasing the longer annuitisation is deferred) just to stand still.

The effect of mortality drag can be seen by a simple illustration of the impact of deferring the purchase of an annuity by one year. The cost of an annuity due (under which the first payment is made immediately and then at yearly intervals as long as the annuitant lives) can be expressed as follows:

$$\ddot{a}_x = 1 + (v\, \ell_{x+1} + v^2\, \ell_{x+2} + \ldots v^{\omega-x}\, \ell_\omega) / \ell_x \quad \text{at rate of interest } i,$$

where ω is the limit of life

$$= 1 + v\, \ell_{x+1}\, \ddot{a}_{x+1} / \ell_x$$

The extra cost of taking a withdrawal of 1 at age x and then buying an annuity at age x+1, instead of buying an annuity at age x is:

$$v\, \ddot{a}_{x+1} - (\ddot{a}_x - 1) = v\, \ddot{a}_{x+1} \left[1 - \ell_{x+1} / \ell_x \right] = v\, q_x\, \ddot{a}_{x+1}$$

The extra cost is effectively the loss of the risk-sharing which would arise under the annuity in respect of those who do not survive from age x to age x+1.

Figure 1 The impact of mortality drag.

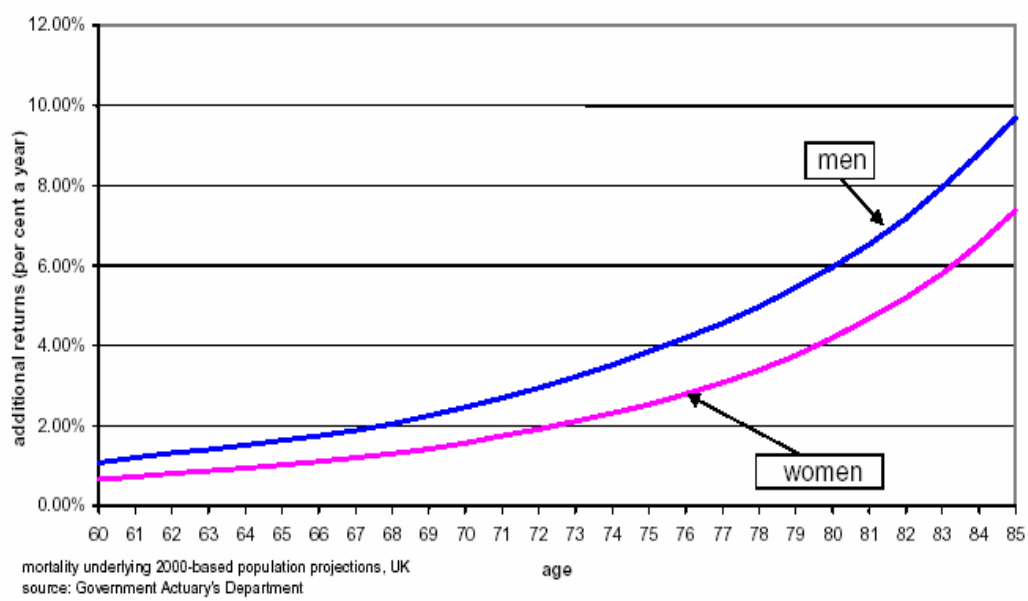


Figure 1 shows the additional return which needs to be earned on the fund in order to compensate for the effect of mortality drag at each age, clearly rising to quite significant levels at older ages.

Apart from having to earn enough return on the balance of the fund to overcome the mortality drag, the individual with a draw-down contract may face the possibility of annuity prices moving against him or her, because of falling interest rates on the bonds which insurance companies use to back their annuity portfolios and because of downward revision of the future mortality rates which are taken into account by insurers in pricing annuities (i.e. assumed improvements in expectation of life).

In addition, many draw-down arrangements incur higher operating expenses than would be implicit in the purchase of an annuity. These arise because of the investment and other advice needed (or required to be offered by the provider or intermediary) and also because draw-down may be a regulated product which is much more complicated for the provider to offer than an immediate annuity would be.

The attraction of draw-down is its greater flexibility and the possibility of keeping the pension fund invested in a wider range of assets than those which back traditional annuities. However, for the various reasons already discussed, together with the likelihood of variability in the value of the fund resulting from the greater choice of assets (for example, continued higher exposure to equities), the chances of achieving a better result than purchasing an annuity at the start may not be high. Thus it is vital that individuals contemplating draw-down should have access to financial advice.

Another approach, adopted in Denmark, is to permit the purchase of a temporary annuity with a proportion of the fund at retirement. The rest of the fund remains invested and the individual may retain investment control. After the first temporary annuity comes to an end, a proportion of the remaining fund is used to purchase a further temporary annuity. This process continues until a specified advanced age is reached, at which a life annuity must be purchased.

Annuitisation

Given the choice, many retirees would choose not to lock their savings into a life annuity and, where annuitisation is compulsory, there is often significant discontent about this requirement. The main reasons for such discontent are:

- concern about the loss of flexibility;
- concern about the fact that, if all their financial resources are used to buy an annuity, there will be nothing left for them to pass on as a bequest when they die;
- concern about effectively having to switch all their investments into bonds;
- exposure to the level of the market for the accumulated pension fund at the specific date at which an annuity has to be taken;
- exposure to the level of interest rates used to price annuities at the specific date at which an annuity has to be taken;
- belief that annuities are expensive, particularly arising because of a lack of appreciation of how many years of life to expect;
- distrust of insurance companies;

- concern about putting all one's eggs in one basket (although diversification between annuity providers is clearly an option);
- a general trend in society towards individual rather than collective approaches.

The real advantage of life annuities is that they offer insurance against longevity. No-one can foresee how long they are going to live, which makes it impossible to plan draw-down efficiently to provide a stable lifetime income. Life annuities ensure that the money will not run out, however long the pensioner lives, with the insurance company taking the risk that pensioners on average will live longer than allowed for in the annuity pricing. It was shown many years ago that immediate life annuities are in fact an income maximising strategy for someone at the point of retirement, in the absence of a bequest motive (Yaari, 1965). They can also offer a highly effective strategy when there is a strong bequest motive, since annuitising to the extent of providing an adequate income to live on in retirement can then free up the remainder of the pensioner's wealth to be handed on to children or others.

However, such theory does not allow for the psychological factors which seem to predominate in many individuals' thought processes, such as the desire to retain control over their assets. Although, as we have seen, this can in principle be achieved though allowing pensioners to retain control of the accumulated pensions savings fund under a draw-down approach, this is likely to lead in practice to the fund being exhausted too early, leaving the individual in poverty, and perhaps falling back onto government welfare support, for the remaining years of their life, or to the individual exercising undue caution in withdrawing income, leaving to a significant balance remaining at the time of death. Perhaps another reason for the lack of enthusiasm about annuitisation is that the accumulated lump sum available does not seem to be sufficient to buy a very large pension. This may be attributed to the high cost of annuities, but a more realistic appraisal may simply be that not enough has been saved.

Much of the economics literature on annuities, over the decades since Yaari's seminal paper, has been devoted to attempts to explain why annuities are not as popular as the theory suggests they should be and why annuity markets in most countries are very poorly developed (Bateman and Piggott, 1999; Palacios and Rofmann, 2001; Cardinale *et al* 2002). Many papers have been written, for example, about the concept of the Money's Worth Ratio (see Murthi *et al*, 1999; Estelle and Vittas, 2000; Brown *et al,* 2001; Finkelstein and Poterba, 2002), which purports to measure the value for money which an individual gets from purchasing an annuity. In fact most of these papers are based on a technical approach which is of debateable validity, with the result that mostly what they are measuring is the effect of the different mortality assumptions adopted by the insurer and the researcher. One would, of course, expect there to be some transaction costs involved in purchasing an annuity, since the insurer has to price to make a profit, to cover sales commission and other expenses, and to finance the cost of capital, which they need both for economic and market reasons and because regulators set down minimum requirements. In practice, in some of the more highly developed annuity markets, it seems likely that consumers may have had very good value from annuities, since many insurers failed to make sufficiently optimistic allowance for the rate at which expectation of life would increase, with the result that many annuities have probably been under- rather than over-priced.

Public policy has two conflicting dimensions with regard to pay-out options. There will usually be a concern that pensioners do not use up their income too quickly, as this may result in them falling back on the state, through qualifying for means-tested income support from the welfare system. However, tax authorities are eager for individuals to draw down their pension assets reasonably speedily, since in most jurisdictions they will have been tax-protected up to this point and it is only pensions in payment which are taxable. This combination of factors may lead legislators to impose conditions on the draw-down of pension fund assets, even if annuitisation as such is not required.

Types of annuity

There are a number of different types of annuity. Mention has already been made of **annuities certain**. These are payable for a fixed period regardless of whether the recipient (or anyone else) survives. They are calculated as a straightforward compound interest function. Thus, an annuity certain of 1 a year for *n* years, with the first payment after one year and then payable annually, would be calculated (ignoring expenses and profit) as:

$$a_{\overline{n}|} = v + v^2 + v^3 + \ldots\ldots + v^n \quad \text{at rate of interest } i$$

$$= (1 - v^n) / i$$

Similar formulae can readily be developed for annuities certain due (with the first payment payable immediately and each year's payment at the start of the relevant year), and annuities certain payable more frequently than annually, including continuous annuities certain, the formula for which is:

$$\bar{a}_{\overline{n}|} = \int_0^n v^t \, dt \quad \text{at rate of interest } i$$

$$= (1 - v^n) / \delta \quad \text{where } \delta \text{ is the force of interest } (\delta = \ell n\,(1 + i))$$

A **single life immediate annuity** is an annuity payable for the rest of the life of an individual (usually the recipient of the income). In North America this would be called a payout annuity. An immediate annuity on the life of a person aged *x* years exactly, with the first payment after one year and then level payments of 1 a year payable annually, would be calculated (ignoring expenses and profit) as:

$$a_x = (v\,\ell_{x+1} + v^2\,\ell_{x+2} + \ldots\ldots + v^n \ell_{x+n} + \ldots.\, v^{\omega-x}\,\ell_\omega) / \ell_x \quad \text{at rate of interest } i$$

$$= \sum_{n=1}^{\omega-x} v^{x+n}\,\ell_{x+n} / v^x\,\ell_x$$

The continuous equivalent would be:

$$\bar{a}_x = \left\{ \int_0^{\omega-x} v^{x+t}\,\ell_{x+t} \, dt \right\} / v^x\,\ell_x \quad \text{at rate of interest } i$$

Immediate annuities may also have payments which vary in amount, for example for a level amount for a number of years and then changing to a different amount. A more

common practical design would be a regularly increasing annuity, for example increasing by $(1 + j)$ each year, for which the formula would be:

$$a_x = \left((1+j)\, v\, \ell_{x+1} + (1+j)^2 v^2 \ell_{x+2} + \ldots + (1+j)^{x+n} v^n \ell_{x+n} + \ldots + (1+j)^{\omega-x} v^n \ell_\omega \right) / \ell_x \quad \text{at rate of interest } i$$

$$= \sum_{n=1}^{\omega-x} v^{x+n} \ell_{x+n} / v^x \ell_x \quad \text{at rate of interest } i', \text{ where } (1+i') = (1+i)/(1+j)$$

Another form of increasing annuity allows for the amount to increase in line with an index, for example the retail price index or the consumer price index:

$$a_x = \sum_{n=1}^{\omega-x} I_{x+n}\, v^{x+n} \ell_{x+n} / I_x\, v^x \ell_x \quad \text{where } I_x \text{ is the relevant index at age } x$$

In practice the future values of the index will usually be estimated using a compound growth assumption and the formula becomes the same as the previous one for an annuity increasing at $(1 + j)$ each year, with i' being the assumed future *real* rate of interest (i.e. the rate of return net of inflation).

One of the reasons that immediate annuities are unpopular is because they use up the capital and do not provide any bequest to surviving heirs when the individual dies. They may also be seen as unfair in that the amount received in annuity payments could be significantly less than the capital invested if the holder dies relatively young. One way of countering this criticism is to guarantee payments for a fixed number of years, whether or not the holder survives. This is known as a guarantee period. The formula for an immediate annuity with a guarantee period of n years is made up of an annuity certain for n years and a deferred annuity subject to survival, payable after n years until the end of life.

$$a_{x:\overline{n}|} = a_{\overline{n}|} + v^{x+n} \ell_{x+n}\, a_{x+n} / v^x \ell_x$$

Another form of immediate annuity which provides some assurance to counter people's concerns about losing their capital is known as the capital protected annuity. Here the immediate annuity is combined with a decreasing temporary assurance payable on death for an amount equal to the difference between the consideration paid for the annuity and the annuity payments received before death.

Immediate annuities can be written on two lives, to be paid whilst both are alive (a joint life annuity):

$$a_{xy} = \sum_{n=1}^{\omega-x} v^{x+n} \ell_{x+n} \ell_{y+n} / v^x \ell_x \ell_y$$

More useful is an immediate annuity payable until the second of the two people dies (a joint life and last survivor annuity), which can be calculated as:

$$a_{\overline{xy}} = a_x + a_y - a_{xy}$$

Manipulating combinations of the single life and joint life annuities permits the calculation of variants on the theme of a joint life and last survivor annuity, for example

to allow for a payment of 1 whilst both are alive and p during the remaining lifetime of the survivor:

$$a'_{xy} = p \cdot a_x + p \cdot a_y - (2p - 1) \cdot a_{xy}$$

Sometimes the annuity payable during the life of the survivor, after the death of the first life, may need to be calculated separately. This is known as a reversionary annuity:

$$a_{y|x} = a_y - a_{xy}$$

Pricing annuities – mortality assumptions

Setting an appropriate price for life annuities depends critically on the assumptions to be made 1) about the future mortality experience of the group of annuitants and 2) for the rate of return which can be obtained on the backing assets. Continuing systematic reductions in mortality at older ages pose a problem for actuaries and demographers in projecting future developments. For pension annuity companies and insurance companies writing a significant book of annuity business, making appropriate assumptions is critical to future profitability and maybe even to the company's long-term survival. Figure 2 illustrates how expectation of life at age 65 has increased for successive cohorts of men and women reaching age 65 in England and Wales. This is based on national statistics for the whole population, rather than for those members of pension plans or those purchasing pension annuities. However, statistics compiled by the Continuous Mortality Investigation Bureau (CMIB) of the UK Actuarial Profession show a similar story for people purchasing annuities or pensions from life insurers. The graphs include a significant element of projected assumptions for the more recent and future years of reaching age 65. Discussion of methodologies for projecting mortality is beyond the scope of this volume, but interested readers are referred to Government Actuary's Department (2001, 2004), Willets (1999, 2004), CMIB (2004), Willets *et al* (2004), etc. for further discussion about these issues.

Figure 2 Expectation of life at 65 according to the mortality rates experienced or projected for cohorts, England & Wales

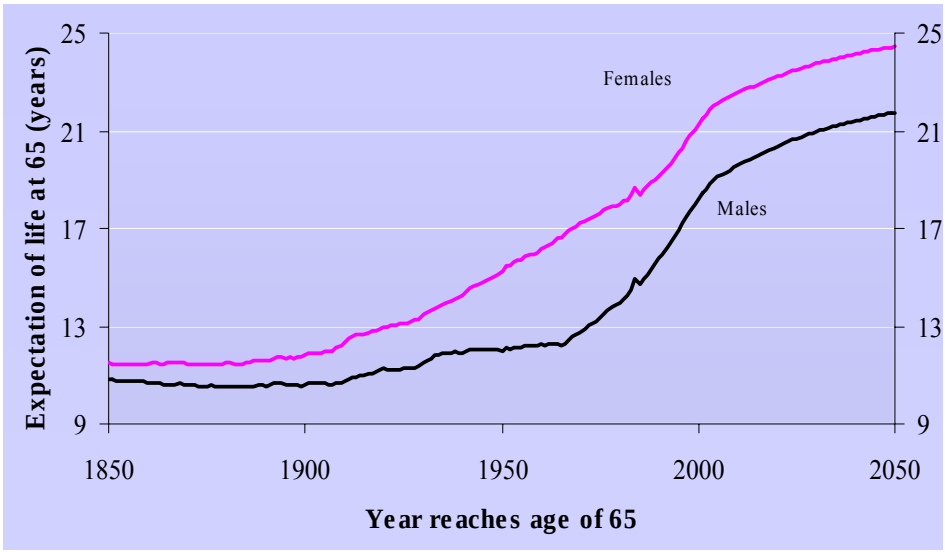
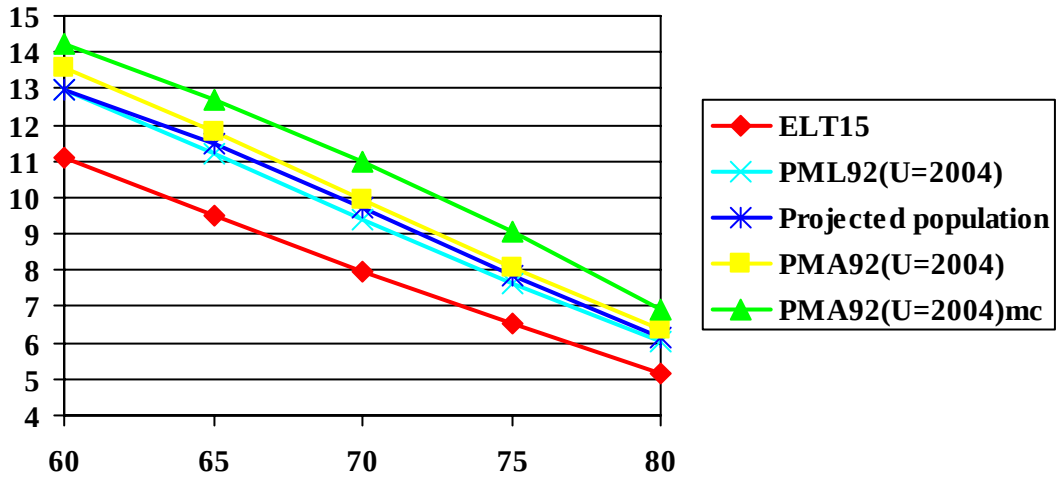


Figure 3 shows the sensitivity of annuity values to different mortality assumptions. These are all mortality tables based on UK experience but they serve to illustrate the differences between population mortality and pensioners' mortality, the impact of allowing for future projected mortality and the effect of weighting mortality rates according to amounts of pensions in payment.

Figure 3 Continuous annuity rates at 5% p.a. on various mortality bases. Males



The mortality tables illustrated are as follows:

- ELT 15: a table derived from the deaths in the population of England and Wales in the years 1990-92, with no allowance for future improvement;
- Projected population: based on the mortality assumptions for the 2002-based official national population projections for England & Wales, allowing for estimated future improvement over each cohort's lifetime;
- PML92(U=2004): standard table issued by the CMI, based on the mortality experience in the years 1991-94 of pensioners with pensions policies issued by UK life offices, allowing for projected future improvement to provide mortality rates appropriate for cohorts purchasing pension annuities at the relevant ages in the year 2004;
- PMA92(U=2004): standard table issued by the CMI, similar to PML92(U=2004) except that it is based on mortality experience weighted by amounts of pension in payment, instead of just on numbers of pensioners;
- PMA92(U=2004)mc: standard table issued by the CMI, similar to PMA92(U=2004), except that the projections of future mortality allow for significantly higher rates of improvement for certain cohorts.

The main lessons to be drawn from Figure 3 are:

- the impact of allowing for a reasonable level of future mortality improvement is very significant (for example the annuity rates on the projected population basis are some 20% higher than those based on ELT15);
- mortality tables based on historic population experience are of little use in pricing annuities;

- the mortality of those receiving pensions from life offices is lighter than general population mortality;
- mortality experience is lighter for those with higher amounts of pension, resulting in annuities on the PMA92 tables being some 5% higher than on the corresponding PML92 tables;
- the methodology for allowing for future mortality improvement is critical, with the additional cohort effect included in the PMA92(U=2004)mc table adding 5% to 10% to the price of annuities.

Figure 4 Continuous annuity rates at 5% p.a. on various mortality bases. Females

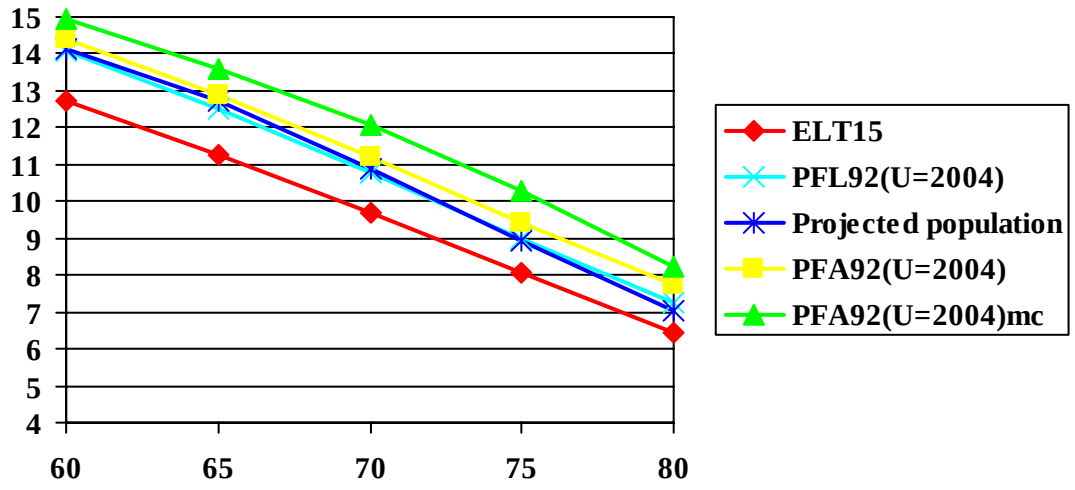


Figure 4 shows a similar comparison for females, with most of the same features as for males, except that the overall spread of results is not quite so great. The allowance for future mortality improvement is somewhat lower for females than for males, the effect of weighting the mortality experience by amounts of pension is smaller, and the cohort improvement effect is not so great.

In selecting mortality assumptions for pricing annuities, therefore, care needs to be taken to ensure that the mortality table used, and the allowance for future mortality improvement, adequately reflect the likely characteristics of the expected population of annuitants. If they are a self-selecting group (if annuitisation is voluntary), the mortality experience can be expected to be lighter (i.e. giving rise to a higher expectation of life) than for a group subject to compulsory annuity purchase. Unless constrained by legislative requirements, insurers will wish to set different prices for males and females and according to the age of the annuitant at the date of purchase. The unit price of an annuity may also vary by amount of annuity, with higher unit prices for larger annuities to reflect the likelihood of greater life expectancy among those with larger pension funds, although this may be offset by the lower expense loadings required on larger annuities.

Pricing annuities – assumptions for the rate of interest

The other critical assumption for pricing annuities is the future rate of return on the investments backing the liabilities. From the perspective of the insurer an optimum low-

risk strategy would generally be to invest in assets which will provide an income stream which closely matches the expected outgoings on the annuity portfolio. For immediate life annuities this may be possible, at least approximately, through investing in a mixture of redeemable bonds. Since bonds frequently have a heavy weighting of cash-flow at the maturity date, it is easier to achieve a match to a portfolio of annuity payments using bond strips, particularly interest strips. The matching exercise would be carried out on the cash-flow which is expected, given the future mortality assumptions underlying the pricing. However, testing would need to be carried out on a range of mortality assumptions to ensure that a sufficient contingency margin is included to avoid exposing the insurer to undue risk in the case that mortality improves faster than on the central assumptions. The rate of interest for pricing is derived from the market yields available on the optimum matching portfolio of assets. In practice this may be a yield curve of interest rates for different durations, rather than a single rate, although it may be approximated, for ease of application, to single rates, possibly differing by age of new annuitant to reflect the different durations of future payment streams.

It may be easiest to construct a matching portfolio using government bonds and bond strips, since these will often be the securities with the deepest, most liquid and lowest risk market and the widest range of possible maturity dates and coupons. However, it may be possible to achieve higher yields (and hence justify a lower annuity price) by investing in higher risk securities, such as corporate bonds, or less marketable securities such as municipal bonds. Relatively poorly marketable securities may be acceptable for matching annuity payments, since the expectation will be that the backing assets will be held to maturity. However, there is always some uncertainty about the payout profile because it is not known how mortality experience will develop.

A serious problem in some markets is the lack of sufficiently long-dated bonds to be able to get anywhere close to matching the liability profile. In this case it is necessary to make an assumption about the likely yields on reinvestment of the asset portfolio as time goes by. Inevitably insurers will need to make a conservative assumption for this, and may be required by regulators to carry out stress-testing or dynamic financial analysis in order to test the adequacy of their provisions to possible future fluctuations in the value of the assets and the yields available on reinvestment. These reserving or capital requirements will also have an impact on the price. This is another factor which may be behind some of the apparent findings of poor value for money from annuities in some markets.

For index-linked annuities, with payments scheduled to rise in line with the retail price index or the consumer price index, the appropriate matching assets will be index-linked bonds instead of fixed interest bonds. The real redemption yields on the matching index-linked bonds will be the guideline for the required real rate of return for the pricing formula.

If the insurer is taxed on investment returns in respect of such business, the yields will need to be reduced to allow for tax.

Pricing annuities – other considerations

In addition to making assumptions about future mortality and the yields on backing assets, the pricing basis will include an allowance for expenses. If there is a rate of

commission payable to agents, the sales force or financial advisers on the sale of annuities, this will need to be factored in. Other expenses to be covered will include the costs of setting up the contract initially and the administrative costs of making regular annuity payments and providing information to the annuitants.

The final pricing of annuities will take into account the need for contingency margins, especially for mortality uncertainty, but also for any mismatch of assets and liabilities, and will be based on a series of profit-tests in order to seek to ensure that the business will yield an adequate profit to the insurer, taking into account regulatory requirements for capital and for setting technical provisions.

Of course, the competitive behaviour of other insurers in the market may also be a relevant factor, depending on how keen the insurer is to write the business. This may in practice depend on a variety of other factors, such as the insurer's overall tax position, the balance between annuity and other business, the importance of pension business generally to the company and investment portfolio management considerations.

Pension increases

Although level immediate life annuities provide protection against longevity risk, they are exposed to the risk of losing value in an inflationary environment. Even at 2% a year retail price inflation, a level annuity of 1000 currency units a year at the start will have purchasing power of only 673 units after 20 years. With inflation at 5% a year the purchasing power after 20 years would be only 377 units. With high rates of inflation a level annuity would rapidly become effectively worthless.

Some protection against inflation can be achieved by purchasing an increasing annuity, but the most effective solution is to have a price-indexed annuity, where the payments are linked to the retail price index or similar. In some countries with mandatory defined contribution pension systems (e.g. Chile and Mexico) there is a legal requirement for the annuities to be price-indexed and these are in practice the only annuities available in the market. Insurers purchase index-linked bonds as the backing assets and the price can be related to the real rate of return available on this type of bond (subject to regulatory constraints, since in some markets the assumptions for annuity pricing are set by the regulatory authority).

In some jurisdictions there is no market in index-linked bonds and this will usually mean that index-linked annuities are not available, although it may be theoretically possible to achieve a suitable matching portfolio by purchasing index-linked bonds in another market (and currency) and using currency swaps to hedge the cash-flows back into the local currency.

Where both index-linked annuities and level annuities are available and annuitants are free to choose between them, few people choose index-linked annuities. This is because the initial amount of annuity available under an index-linked contract can easily be 25% to 30% lower than under a level annuity. Apart from the difference resulting from pricing on a real yield rather than a nominal yield, it seems that insurers may also allow greater margins in price-indexed annuities, partly because of the greater effective exposure to increasing longevity (with much larger payments for those who live longer and therefore also exposure to a greater degree of possible anti-selection, with those

choosing the index-linked annuities likely to have greater life expectancy) and partly because of inefficiencies in the market for index-linked securities and greater difficulty in establishing a suitable matching portfolio. In any case, most people, given the choice, would rather have the higher income initially. It is a common perception that you are unlikely to live long enough to get much beyond the cross-over point at which the payments from the index-linked annuity would exceed those payable from the level annuity.

Unisex annuities

In view of the significant difference between the mortality rates experienced by males and females of similar ages and other characteristics, gender has always been a rating factor for annuity business. The expected cost of providing an annuity to a female can typically be expected to be 10 to 15% higher than for a man of the same age with the same amount of annuity. However, some feel that this is unfair discrimination, as it means that a woman will get a lower amount of pension than a man from a given amount of accumulated pension assets. In 1983 a Supreme Court decision in the United States of America ruled, in the case of State of Arizona *et al* v Norris, that equal contributions required equal pension benefits, i.e. that the same annuity rates must be used for a woman as for a man of the same age. This judgment encouraged the European Commission to include within a proposed Directive on Equal Treatment of Men and Women in Occupational Pension Schemes provisions to require the same actuarial factors to be used for men as for women. In the end this part of the Directive was watered down and, although the final version of the Equal Treatment Directive, approved in 1986, did not impose unisex factors on defined contribution plans, nor did it inhibit the issuance of annuities by insurance companies using gender-specific prices.

A further Equal Treatment Directive has been proposed more recently, Article 4 of which would require unisex factors to be used for all types of insurance business, including annuities. At the time of writing the draft Directive seemed unlikely to be accepted in this form, but there will no doubt continue to be pressure for unisex rating from those who believe that to charge different premiums according to the gender of the applicant is discrimination. Put simply the argument is that it is unfair to charge a different premium to a woman than a man of similar characteristics just because statistical expectations for women as a class differ from the expectations of men as a class. It is argued that an individual woman may live for exactly the same lifespan as a similar man. Of course, it is impossible to know in advance which people will live longest, be they men or women, but the argument that each person must be treated as an individual, without reference to statistics from the group of which they are a member, would effectively destroy the foundation of most types of insurance, which rely on the sharing of risk and the assessment of premiums based on the average characteristics of the risk group.

It is also argued that mortality differentials by gender are no greater than regional differentials in mortality within a country, or differences between the mortality of those in different occupations or different social classes. It is alleged that these differences are often not taken into account by insurance companies and so it is clearly unnecessary to take into account the differences by gender. As a matter of fact, the differences by gender are usually greater than many of these other mortality variations, but they are also

certainly more stable and objective, since people change jobs and move between regions, but gender change is still quite rare! Different mortality assumptions may well be used for different groups of pensioners, where they can be clearly identified. There is also now a growing market in some countries in enhanced annuity rates for smokers and those with medically identified reduced life expectancy.

In practical terms, there is little doubt that insurance companies could operate with unisex annuity rates if they had to. This is in fact already the norm in some countries. It would be relatively straightforward in a system where mandatory annuitisation is required. However, there is more of a problem where annuitisation is voluntary, since, given unisex annuity rates somewhere between the true male rates and the true female rates, annuities would appear relatively cheap to females and relatively expensive to males, so it is likely that a higher proportion of females than males would buy annuities. This would result in the mortality experience of the annuitants being closer to that of females than males, so the insurers would move the pricing basis closer to the female rates to reflect the experience. Then the annuities would be even worse value for money for males, so even fewer would buy annuities. The eventual outcome would be annuity rates close to the female rates and relatively few men buying annuities. Those men who did buy annuities would get much worse value for money than under a system with differential premiums by gender, whereas females would be little better off.

One way to make unisex annuities more stable in a voluntary market is to sell then as joint life and last survivor annuities for a pensioner and a spouse or partner of the opposite sex. This is a requirement for the annuities which have to be purchased with accumulated savings from the required minimum contributions under Appropriate Personal Pensions (which are substitutes for social security) in the United Kingdom. The difference between an annuity rate for a male, with payment continuing at 50% of the pension to a surviving female and the corresponding annuity for a female with a 50% continuing pension to a surviving male, is much smaller than the difference between single life annuity rates to males and females. Unisex rates appear to have operated successfully in this limited market, although the annuitisation requirement (and the type of annuity to be purchased) is mandatory. It could be argued, though, that the requirement to purchase an annuity with a reversion to a survivor is discriminatory against single persons.

Investment-linked annuities

One of the main criticisms of traditional level immediate annuities (and also price-indexed annuities) is that they rely on effectively switching all of one's pension assets into investment in bonds. Those who prefer to maintain exposure to a wider range of investments, including equities and property, may have to choose a draw-down approach, under which they have to carry their own longevity risk. Alternatively, subject to it being permitted under the regulatory structure, they could purchase an annuity to provide a basic level of income and retain the rest of their retirement income in a more flexible vehicle.

It would seem desirable for annuity products to be available where there is sharing of mortality risk but with the possibility of maintaining a wider range of underlying

investments. We will consider three options for such annuity products: with-profits annuities, unit-linked annuities and an annuitised fund.

Under a **with-profits annuity**, a basic level annuity is guaranteed but as time goes on bonuses may be added to increase the amount of the annuity in payment. The bonuses are financed by the insurer achieving investment returns higher than those required to finance the guaranteed level of annuity, and possibly from other experience profits, for example because the mortality rates experienced are higher than those allowed for in the pricing, or because expense levels are lower. Bonuses, once added, usually become part of the guaranteed level of annuity. Investment policy needs to recognize the guaranteed element of the annuities, but can be more flexible over and above securing the guarantees, in order to provide an expectation that investment surplus will arise to finance bonuses. As any particular cohort of annuities ages, the investment policy for that cohort will become more conservative, as an increasing level of annuity becomes guaranteed. Unlike a price-indexed annuity, a with-profits annuity does not guarantee any particular level of future increases, since this will depend on the investment and other experience. However, the initial annuity payment will be significantly lower than under a level immediate annuity. With-profits annuities suffer from a lack of transparency, in common with most other with-profits products. They may be a good way of getting access to a wider range of investments without direct exposure to the investment risk, but it may be difficult for the annuitant to have a good understanding of the underlying processes and there may be concern that, in order to operate the smoothing and to keep on the safe side, the insurance company may hold back the distribution of surpluses unnecessarily.

Under a **unit-linked annuity** the annuitant has direct exposure to the investment risk, but the mortality risk is shared and the insurer carries the risk of systematic improvements in mortality. The premium is invested in a unitised fund (or split between several unitised funds), with a corresponding number of units in each fund being allocated to the annuitant, according to the price of units at the time. The value of the individual's fund varies with the current unit price, just as with a unit-linked pension product in the accumulation phase. Income to the annuitant is provided by the cancellation of units, the amount of income being dependent on the current selling price of the units. The number of units to be cancelled each year is determined at the start of the contract by dividing the total number of units purchased by the annuitant by the expectation of life for a person of that age at the start date. This type of annuity was pioneered in the United States of America by the Teachers Insurance and Annuity Association and they are known there as TIAA-CREF annuities.

To see how the product works, consider a batch of annuities sold to ℓ_x individuals aged x, each purchasing N units. This gives a total number of units in force at age x of $N \cdot \ell_x$.

The unit cancellation rate is defined as: N / e_x , e_x being the expectation of life at age x.

After one year in force, ℓ_{x+1} individuals remain (if mortality is in accordance with the assumed table) and the number of units cancelled at age $x + 1 = \ell_{x+1} \cdot N / \mathrm{e}_x$

Thus the total number of units in force at age x+1 after annuity payments have been made

$$= N \cdot (\ell_x - (\ell_{x+1} / \mathrm{e}_x))$$

$$= N \cdot (\ell_x / \mathrm{e}_x) \cdot (\mathrm{e}_x - (\ell_{x+1} / \ell_x))$$

$$= \frac{N \cdot \ell_{x+1} \cdot e_{x+1}}{e_x}$$

So the number of units runs down with a factor of proportionality $\ell_y \cdot e_y$, which tends to zero as $y \to \omega$, running down in accordance with the number of survivors from the original group according to the assumed mortality table. Everything works out well if the mortality experienced by the cohort corresponds to the mortality table underlying e_x. However, if the cohort experiences lighter mortality, the insurer has to go on providing the survivors with income based on the stipulated unit cancellation rate, even though all the units in force have already been used up.

An **annuitised fund** is a name given to a unitised product where each cohort of participants shares the mortality risk, as well as each individual bearing their own investment risk. The pension fund remains invested in unitised funds, with individuals having a choice of investment options. Income is provided to participants by the cancellation of units, the amount of income depending on the current selling price of the relevant units. As in a typical draw-down contract, the number of units which can be cancelled may be subject to maximum and minimum levels. The maximum might be defined as for a unit-linked annuity. Whenever a participant dies, their units are shared out equally to the survivors in the cohort. The surviving members of the cohort thus benefit from worse mortality than expected and lose out if mortality improves. If the reallocation of units from deceased participants to survivors were permitted to continue indefinitely, the result would be a tontine. However, the process is likely to become rather unstable as the number of survivors declines and a viable commercial product of this sort would probably require the purchase of annuities with the remaining balance of funds standing to the credit of each survivor at a particular advanced age, e.g. 85.

This, and other variants of mortality and investment risk sharing, are discussed in more depth in Wadsworth, Findlater and Boardman (2001) and in Impavido, Thorburn and Wadsworth (2004). There is scope for innovative product development in this area, with different approaches to sharing the risks between the product provider and the participants.

Regulation of annuity business

The profitability, or otherwise, of annuity business to the provider is determined by the price charged and the subsequent experience, of investment returns, mortality and expenses. However, the way in which any profit or loss is recognised will depend on the approach to reserving and any accompanying capital requirements.

Reserving may be carried out for a variety of different purposes. It may be to support the sound and prudent management of the insurer, to determine provisions which give a true and fair view of the liabilities of the insurer for the purpose of the accounts, to permit the identification of profit on which tax might be payable or to meet the requirements of a system of prudential supervision. The level of reserves (and capital) required by the supervisor may have a material effect on the rate at which profit may be released and hence needs to be taken into account in pricing annuities by means of profit-testing procedures.

Prudential reserving requirements are often more stringent than the requirements of accounting principles, which may in turn be more stringent than the provisions permitted by the tax authority. Prudential supervisors will usually seek to have high reserves maintained, since their focus is on the ability of the organisation to meet its future liabilities with a high probability, in virtually every conceivable circumstance.

Whether annuity business is carried on as a separate business through a pension annuity company, as part of the business of a diversified insurance company or as part of the business of a pension fund, there are a number of aspects which need to be considered and incorporated within the regulatory requirements of the supervisory agency:

- prudent provision for the liabilities;
- prudent asset valuation;
- prudent investment strategy, to ensure that there is an appropriate balance of risk and reward;
- prudent provision for future expenses, including the ability to be able to run off the portfolio should the company have to close to new business;
- the relationship between the assets and the liabilities, since the assets are held specifically for the purpose of meeting the liabilities and risk can be reduced by appropriate asset/liability management;
- additional capital requirements, i.e. a margin of assets over liabilities which is required in order to give the entity resilience against possible circumstances that may arise in the future, including the possible consequences of any mismatching of assets and liabilities.

Reserving assumptions

Reserving in accordance with the requirements of prudential supervisors will normally be carried out by means of a prospective assessment of the liabilities under contracts which have been undertaken by the insurer prior to the effective date of the assessment. Most traditional types of annuity do not present any particularly difficult methodological issues, but prudent assumptions are needed for the future mortality experience of the annuitants in question, for a rate (or rates) of discount to be adopted, for future expenses of administering the contracts and possibly certain other assumptions. Special consideration may need to be given to cases where there is a material mismatch between the expected cash flows of the assets and liabilities or where the contracts contain guarantees, or options exercisable by the annuitant.

Mortality

Mortality considerations for annuities have already been discussed under the topic of pricing. When it comes to reserving for the business, particularly once the annuities have been in force for a few years, the mortality rates experienced to date can be analysed and compared with the assumptions. Lower levels of mortality than originally assumed, or clear trends of faster improvement than allowed for, should be taken into account in setting the reserving assumptions. Prudence on the part of the responsible actuary, or requirements of the supervisor, may necessitate additional margins being incorporated in the assumed level of mortality or the rate at which mortality rates may improve in future.

Rate of interest

The second dimension of the reserving basis is the rate of interest. The approach to determining the rate of interest will depend on the asset valuation methodology adopted. One possibility is that the assets are valued at historic cost and the liabilities are valued on the same rate of interest as was used originally in the pricing. However, this type of passive valuation methodology does not provide much useful information about the true state of the business.

The assets and the liabilities may be valued at a consistent cautious rate of interest, with an even more cautious assumption about the yields likely to be obtainable on future reinvestment, on the assumption that the portfolio of assets is likely to be of shorter effective duration than the liabilities (this being most often the case because of the absence of suitable long-dated securities).

Accounting standards, most likely to be followed by regulatory standards, are moving towards fair value methods, with assets shown at market value, or a proxy for market value where there is no liquid market. Liabilities should then also be taken at fair value, although at the time of writing this had not been uniquely defined. The principle is for the value to represent the amount for which the liabilities could be sold in a willing buyer/willing seller transaction. However, liability portfolios are rarely traded in this way and there is certainly no deep and liquid market to determine prices. Proxies for fair value may be assessed using a variety of methods. One would be to create a hypothetical matching portfolio of assets (known as a *replicating portfolio*) and to take the market value of that portfolio of assets as the fair value of the liabilities. Another would be to use the yield curve by duration implicit in current market values of risk-free (or possible low risk) fixed interest bonds or price-indexed bonds and to use this to value the expected cash-flows at each future duration in respect of the liabilities. Since the fair value is intended to be the price at which another agent would take on the liabilities, most definitions of fair value would allow for some risk margins to be incorporated into the valuation, either by adjusting the rate of interest or by adding specific contingency margins into the liabilities, rather than simply taking a best estimate of future cash-flows.

Good practice in managing an annuity portfolio will normally be to invest to provide as good a hedge as possible against the expected liability cash-flows. With level immediate annuities it may be possible to achieve a high level of immunization. In simple terms this can be achieved by designing investment portfolios to generate cash flows equal to the expected outflows under the annuity payments. Immunisation theory demonstrates that a broader range of portfolios will achieve the desired effect, whereby the adequacy of the assets to meet the liabilities will not be adversely affected by changes in market yields on investments. Whatever the valuation methodology, it will usually be necessary to consider the potential impact of changes in market values or future yields. Whilst some margins may be incorporated into technical provisions to allow for this, insurers are also required to hold suitable levels of capital to cover more adverse outcomes and this will include resilience in the face of market movements.

Expenses

For reserving purposes, expenses should be allowed for on the basis of covering the full expected cost of administering the outstanding payments on all the annuity contracts

which have been sold. Many regulatory systems insist on this being done on a "closed fund" basis, i.e. assuming that no further business is written which would provide additional margins to cover some of the expenses. Moreover, in such a scenario, reserves need to be set up to cover the full overheads of the business during a transitional period from operating as a going concern to achieving a slimmed down structure suitable for running off the accrued liabilities as cost-effectively as possible.

In drawing up accounts which are required to give a true and fair view, the traditional assumption is that of a going concern, where one can rely to some extent on new business coming in and helping to finance the company's overheads. In the case of prudential reserving, that may not be allowed, as one should not be able to place any reliance on the future business to support the cost of running off the liabilities. Full provision should be made for the expenses of running off the business (making annuity payments and managing the investments), as well as covering the overheads and allowing for inflation (principally earnings inflation).

Asset/liability mismatching

Problems arise, both for risk management and for reserving, if proper matching of assets and liabilities is not possible, for example because of a limited range of maturity dates on bonds, and particularly if there are no medium to long-dated bonds. In this case prudent allowance needs to be made for the risk that reinvestment of the assets in later years may only be possible at much lower yields. This can be done explicitly through a dynamic cash-flow model, or implicitly by reducing the rate of discount applied to the liabilities. Special mismatching reserves may be required, based on stochastic asset/liability modelling, when the profile of the assets is very different from that of the liabilities (e.g. when some of the assets are in equities).

Mismatch situations arise in many countries because of the absence of very long-dated securities. In the UK there are bonds that have a maturity date 30 years into the future so that it may be possible in principle to immunize, or at least closely match, a portfolio of annuities. However, there are relatively few such long-dated bonds in issue and very few long-dated index-linked bonds. In most parts of South America and Eastern Europe, long-dated bonds usually have at most ten year maturity dates, and full matching of assets to liabilities may not be possible. Reserving must then allow for the fact that on reinvestment of the money in future years it may not be possible to obtain the yields that are available today. In many countries we have seen interest rates coming down dramatically in recent years over the course of a short period of time. It is not appropriate to reserve on the basis of an assumed continuation of current yields unless full matching assets are in place to match the future liabilities on the whole annuity portfolio. Overall one would expect a degree of prudence to be built into the interest rate assumption to reflect the fact that there is future uncertainty.

Other Assumptions

In addition to prudent technical reserves (or provisions) an annuity provider should maintain an appropriate level of capital and surplus (free reserves, sometimes known as solvency margin). This should be sufficient to ensure that the liabilities can be met with high probability in quite adverse scenarios. Although the intention is usually to keep the probability that the liabilities cannot all be met as low as possible, there is clearly a trade-

off between the cost of high capital requirements and the extent to which the insolvency risk can be reduced. Most supervisory régimes acknowledge that 100% security is not in practice achievable.

Risk management

Apart from regulatory requirements to maintain a sound balance sheet, including explicit solvency margins, it is increasingly common for there to be a requirement for robust and effective risk management systems to be in place. This will necessitate regular attention to be paid at Board level to risk management structures and reports and for individual senior managers to be given specific risk management responsibilities and accountability.

The key risk areas which have been developed in banking regulation under the Basel accord are credit risk, liquidity risk, market risk and operational risk. These reflect the short timescales involved in most banking transactions and risks. For insurance companies (and specialised annuity companies) these four risk categories should be supplemented by consideration of underwriting risk, liability risk and asset/liability mismatch risk.

A useful risk management discipline is for the Board of the annuity provider to receive annual dynamic financial analysis reports from their actuary (also known sometimes as dynamic solvency testing, dynamic capital adequacy testing or stress testing). These reports focus on the implications of possible adverse scenarios with respect to all the key assumptions and assist the Board to identify the most significant risks and put in place appropriate strategies for managing the risks.

Wider implications for annuity markets

Setting up adequate technical provisions and maintaining sufficient capital are important for the sound management of the annuity business. The level of provisions and capital should be taken into account in pricing the product, as it will directly affect the price which needs to be charged in order to give a reasonable return on capital. Careful matching of assets and liabilities will enable capital requirements to be reduced. Mismatching may be permitted (depending on the regulatory régime) or may be inevitable, if appropriate assets are not available, but will normally lead to additional capital requirements.

Mismatching may be forced on the industry by virtue of the absence of long-dated securities or the absence of securities that would actually match the required payments on the annuities (e.g. index-linked bonds to hold against the liabilities for index-linked annuities). Governments wishing to see the establishment of a sound annuity market should consider creating assets which match such liabilities e.g. by issuing debt with a wide variety of maturity dates, up to 30 to 40 years ahead, including index-linked debt. There is clearly a need for a wide range of suitable assets, both in terms of maturities, and also in terms of liquidity and marketability.

Another implication is that the annuity business needs to be viable in its own right. It does not need to be carried out in a separate entity but the reserving for annuity business needs to be sufficient on its own and not dependent on other business of the company. There have been occasions where tax rules have created undesirable incentives for

companies to maintain lower provisions on the annuity business, relying on the fact that there is over-provision elsewhere or some hidden reserves, for example in the way that the assets are valued. Unfortunately, some of these margins could slip away or the annuity business could grow rapidly to become a dominant class of business, as it is indeed already becoming in some countries of Latin America, such as Chile and Mexico.

The high volume of annuity business which could arise in the development of a funded pension system, if annuitisation with private insurers is mandatory, may result in an unhealthy concentration of risk in the insurance industry, with a single dominant product. This will be exacerbated if pension annuity business is required to be written by specialist companies. It is sometimes argued that ring-fencing mandatory pension annuity business is desirable in order to avoid possible contagion from poor results in other insurance business. However, the opportunity for wider hedging of longevity and investment risks in a multi-line life insurer seems persuasive from an risk management perspective. Longevity risks cannot be avoided (although reinsurance may sometimes be a possible option) but can be protected against by prudent allowance for future improvement in both pricing and reserving and by designing products which achieve a fairer balance of risks between pensioners and providers.

Conclusions

Annuities are one of the oldest types of insurance product and yet are subject to a great deal of topical discussion. In the design of pension reforms, a mandatory requirement to annuitise accumulated pensions savings in individual accounts seems an obvious way to provide protection against longevity risk and a steady source of income in retirement. Economic theory suggests that annuities provide an optimal route to managing wealth over the personal life cycle, and that, in the absence of a strong bequest motive, individuals should annuitise all their wealth at retirement. However, in practice annuities are not popular and, if they are not mandatory, most people avoid annuitising their wealth as much as possible. Annuity markets worldwide are still mostly quite undeveloped, with only a few exceptions.

Annuities are not popular with the consumer because they are perceived as poor value for money and because they are inflexible regarding the payment streams and limiting regarding investment opportunities. Insurers, on the other hand, are wary about taking on too much annuity business, since it represents a high concentration of systemic longevity risk and usually also exposes the insurer to significant asset/liability mismatch risk. In those countries where annuitisation is mandatory, the annuity business runs the risk of becoming an extremely dominant insurance product, which could in the end put the whole insurance market at risk.

In many environments some form of draw-down of fund is available as an alternative to annuitisation. However, this requires the individual to manage the consequences of their own longevity, without any cross-subsidies from those who die earlier, and is almost certain to result in the money running out too soon, or being run down with unnecessary caution, so that more money is left at death than intended.

The future probably lies in the development of different forms of risk-sharing between pensioners and annuity providers. These could offer both greater flexibility to the

pensioner (at the expense of some greater level of risk) and some moderation of the risks underwritten by the providers. Developing new products and new mechanisms for risk-sharing will be the challenge of the next decade.

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