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Annuity Markets: Problems and Solutions

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Annuity Markets: Problems and Solutions*

by David Blake**

The main problems facing annuity providers relate to adverse selection and mortality risk, the risk associated with mortality improvements, and to interest rate, reinvestment and inflation risk. Annuity providers hedge these risks, wherever possible, by holding suitable matching assets against their annuity liabilities: for example, riskless (government) fixed-income bonds are used to provide the payments on level annuities, and index-linked bonds are needed if index-linked annuities are to be serviced effectively. However, in the absence of suitable matching assets, providers are unable to hedge the risks associated with mortality effectively and compensate for this by imposing substantial cost loadings. They also face reinvestment risk if available assets are of insufficient duration. Annuitants face interest rate risk prior to purchase and, since most of them prefer the higher initial income from a level annuity compared with an indexed annuity, inflation risk after purchase. Some solutions to these problems are considered, including a planned programme of phased annuity purchases to hedge interest rate risk, limited price index bonds to partially hedge inflation risk, and survivor (or indexed life) bonds, with coupons declining in direct proportion to the realized mortality of a selected group of annuitants, to hedge mortality risk. Finally, we examine the advantages and disadvantages of different institutional forms for the annuity market, ranging from monopoly provision through limited licensed provision to a fully competitive provision.

1. Introduction

This paper examines the problems involved in the provision of annuities (financial contracts that provide regular income (in particular, pension income) to those who pay the premium(s) to purchase them). It also examines how insurance companies (the only financial institutions usually permitted to sell annuities) deal currently with some of these problems. The fourth section examines alternative potential solutions to these problems, while the fifth section analyses different forms of institutional structure for the annuity market. Conclusions are drawn in the sixth section and the paper ends with three appendices on the different types of annuities available, on mortality drag, and on procedures for comparing the returns on different types of annuity.

2. The problems facing annuitants and annuity providers

The trend towards private sector defined contribution ("DC") pension 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 a major impediment to the provision of decent pensions during the retirement phase itself, namely the annuity market. The principal vehicle for delivering DC pensions is an annuity purchased from a life assurance company: annuities are necessary to protect against the possibility of outliving one's resources. 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 around 240 authorised life companies in the U.K., only about ten of these at any one time are serious providers of life annuities.[1]

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

Adverse selection and mortality risk

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 realizes that those most likely to purchase annuities will come from the latter group rather than the former group. To hedge this risk, the insurance company will base its annuity rates on the "select group" that is most likely to purchase annuities. Annuities will therefore be poor value for money for members of the first group.

Underestimating mortality improvements

Second, mortality tends to improve over time and there can be severe financial consequences if insurance companies underestimate mortality improvements. Mortality forecast errors of up to 20 per cent over intervals as short as ten years are not uncommon and some insurance companies in the U.K. have underestimated the average life expectancy of their pool of annuitants by up to two years.[2] Insurance companies add substantial cost loadings to cover these risks, something of the order of 12 per cent according to some U.S. studies.[3]

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[1] William Burrows of Prudential Annuities.

[2] MacDonald (1996, Table 18.7) and William Burrows of Prudential Annuities, respectively.

[3] Mitchell *et al.* (forthcoming) and Poterba and Warshawsky (1998). The latter study, for example, found that the deduction from the actuarially fair value of an annuity for a 65-year old U.S. male was 15 per cent if the male was a typical member of the population as a whole (calculated using the mortality tables for the whole U.S. population) and 3 per cent if the male was typical of the population buying annuities voluntarily (calculated using the select mortality tables for male annuity purchasers), implying a 12 per cent deduction for the greater mortality risk.

Inflation risk

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.

Interest rate risk

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 per cent over the cycle,[4] annuity rates will vary by the same order of magnitude.

Reinvestment risk

Fifth, there is reinvestment risk. In some financial markets, especially those of developing countries, long-duration assets are not traded. As a result, insurance companies may not be able to buy assets with sufficiently long maturities to meet the full extent of their annuity payments. As assets mature, the proceeds have to be reinvested, possibly on unfavourable terms.

Inadequate transparency of charges

The charges made by insurance companies to provide annuities are often disguised and unclear. As a consequence, they can be high and uncompetitive, resulting in annuities that can be poor value for money for many people.

Additional problems with deferred annuities

Even worse, the market for deferred annuities is extremely thin, particularly at distant starting dates (where the market is virtually non-existent). Where deferred annuities are available, they are 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, recognizing 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 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.   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

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[4] BGC (1998).

insurance company sells a level annuity, it uses the proceeds raised 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-1990s in the U.K., 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 per cent lower than that from a level annuity, and, with inflation at 3 per cent p.a., it would take 11 years for the indexed annuity to exceed the level annuity and 19 years before the total cash payments were equalized.[5] Since retired people also tend to underestimate how long they will continue to live, most prefer to buy a level annuity and thereby retain the inflation risk. In 1995, as a result of falling interest rates, the U.K. government was pressed into allowing income drawdown (also sometimes called managed annuities or managed pensions; 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. But they face reinvestment risk if only short-term bonds are traded. The interest rate risk up until the date of retirement is borne by the future annuitant, and the inflation risk after the retirement date is also borne by the annuitant unless he or she is willing to forego a substantial cash sum at the start of retirement as a consequence of purchasing an indexed annuity. The mortality risk and the risk associated with under-estimating improvements in mortality appear to be shared between insurance companies and annuitants: despite adding substantial cost loadings of up to 12 per cent to cover these risks, insurance companies (at least in the U.K.) claim to lose money on their annuity business.

4. Potential solutions to the annuities problem

Interest rate risk

Until very recently, the insurance industry (especially in Europe) 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 is available to help them do this.

Phased annuities

The simplest strategy is a planned programme of phased annuity purchases in the period leading up to retirement, using the principle of dollar cost averaging.

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[5] Khorasanee (1996).

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 per cent) of the funds on deposit and the rest in call options on bond futures contracts: if interest rates fall during the life of the option, the profit on the options will compensate for the reduced interest rate. Another example places a fraction of the funds in bonds and the rest in call options on an equity index, thereby gaining from any rise in the stock market over the life of the options.

Unit-linked (variable) or with-profit annuities

A possible solution for the post-retirement period is provided by what in the U.S. are known as variable annuities. These were first issued in 1952 in the U.S. by the TIAA-CREF.[6] In the U.K. they are better known as unit-linked or with-profit annuities, but only a few insurance companies 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).

Reinvestment risk

If there is an insufficient supply of long-duration assets in the domestic economy, insurance companies could buy such assets in foreign markets and hedge the resulting currency risk.

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 most private insurance companies to hedge. A number of proposals have been suggested recently to help the private sector hedge inflation risk.[7]

Deferred income government securities

For example, in order to help the private sector hedge against inflation risk more effectively, the Goode Report (1993, section 4.4.44) in the U.K. 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 U.K. by 1997, although the introduction of the

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[6] Teachers Insurance and Annuity Association of America – College Retirement Equity Fund.
[7] See also Brown *et al.* (1999).

government bond (gilt) strips market in the same year could help U.K. 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 they were to accept that the subsequent uprating of the pension would compensate for inflation only up to a stated limit (e.g. 5 per cent p.a. compound).

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.[8]

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" (or "indexed life" or "mortality") bonds, a suggestion made in Blake and Orszag (1998) and Blake, Burrows and Orszag (1999). These are bonds whose future coupon payments depend on the percentage of the population of retirement age on the issue date of each bond who are still alive on the date of each future coupon payment. For a bond issued in 2000, for instance, the coupon in 2010 will be directly proportional to the amount, on average, that an insurance company has to pay out as an annuity

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[8] There is a growing body of support for mandatory contributions into second pensions, including Field and Owen (1993), Borrie (1994), World Bank (1994), Dahrendorf (1995), and Anson (1996), as well as surveys of customers conducted by NatWest Bank and Coopers & Lybrand (reported in Field, 1996, pp. 52–53). 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 recognize 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.

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.

Inadequate transparency of charges

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

Deferred annuities

One of the key reasons for the thinness of the deferred annuities market is the difficulties in 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.

5.   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 organizations that are, whether *de facto* or *de jure*, life assurance organizations. But what is the optimal institutional structure of the annuity market?

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 organizations 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 organizations 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 by 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 being free to choose one, the bidding process for the licences would have to ensure that all providers charge the same fee (that is, offer the same annuity rates). 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. An international annuity provider might be appointed as a consultant to assess the quotes. 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. In addition, the government could appoint an annuities regulator (similar to the regulator of privatized utility companies in the U.K. and elsewhere) with the power to raise annuity rates if the profits of the annuity providers turned out to be excessive.

The government could also help these companies keep costs down by providing 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 the insolvent businesses.

Should the organizations 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 life assurance products. The different products help them offset some of the risks that they face. For example, the mortality risks that life businesses face can be partially 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. 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. This will inevitably raise the cost of providing annuities unless the government helps the annuity providers hedge this risk directly by issuing survivor bonds.

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 U.K. and elsewhere of mergers between insurance companies. This suggests that to enable annuitants in small, developing countries to benefit from scale economies, large international insurance companies should be allowed to enter the annuity market in these countries. However, given the paucity of accurate mortality data in such countries, international annuity providers might well be reluctant to do so.

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[9]) 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 U.S. dollar or DM/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 organized securities markets, such as those of Eastern Europe. For example, the purchase of international assets deprives the domestic economy of investment funds, and capital outflows could depress the exchange rate.

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[9] BGC (1998).

6. Conclusion

Our analysis indicates that there is much that could be done by both the government and the insurance industry to improve the market for annuities which at the moment are the weak tail in DC pension provision in both advanced and developing economies. One key contribution of the government would be to supply long-term instruments such as indexed bonds and survivor bonds that would enable annuity providers to hedge risks (such as inflation, reinvestment and mortality risks) that are beyond the resources and abilities of private sector organizations to hedge effectively and economically. A second key contribution of the government (in the absence of the state being the monopoly provider of annuities) would be to establish an institutional framework for the 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 pensions mandatory, since this would help to reduce the costs associated with both adverse selection and the marketing of voluntary arrangements. In turn, the insurance industry could be more innovative in using existing financial instruments and established investment management (i.e. immunization[10]) strategies to help its customers hedge risks such as interest rate risk that it is clearly unwilling to assume itself and so has passed directly on to annuitants.

The provision of annuities is therefore a shared responsibility between the public and private sectors. But the relative importance of the public sector in a given country will depend on such factors as the reliability of the mortality data and the inventiveness of the financial system in that country. In small, developing countries with inadequate mortality data and an unsophisticated financial system, it may be the case that either the state has to provide annuities directly or it has to "kick-start" the private annuity market through the issue of indexed and survivor bonds. In larger countries, with more accurate mortality data and more sophisticated financial systems, the optimal size of the state's role is open to debate, but given the present thinness of the annuity market even in countries with long histories of annuity provision, it is highly unlikely that the state has no role to play.

Appendix A: Types of annuities

Definition

"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" (from the Pension Management Institute's *Pensions Terminology*).

The following range of annuity products is available in developed annuity markets (see Black and Skipper (1994), Blake (1995), March (1996), Vaughan and Vaughan (1996)).

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*

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[10] See, e.g., Blake (1995, chapter 13).

or *flexible premiums*). It is rather like an integrated defined contribution pension scheme. 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 policyholder die during the accumulation stage, the surrender value of the policy goes to the policyholder's estate; similarly, the policyholder 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 annuitized for a minimum period (e.g. five 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 a *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. five or ten 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 U.K., which operate an EET tax system for their pension arrangements (i.e., contributions into the pension scheme are e*xempted* 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"). Recognizing 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 per cent. 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 cent per annum compound).

Table 1:
Example of with-profit annuity (from March (1996))
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

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

No bonus is declared in the first four years, so the annuity payments must fall. In years 5 to 10, the actual bonus exceeds the anticipated bonus, and this allows the annuity payments to rise. In years 11 to 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.

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 per cent). 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 1).

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 per cent 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.

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 U.K. as a result of the 1995 Finance Act, following an unprecedented fall in government bond yields and hence annuity rates during the early 1990s: individuals retiring during this period were locking themselves into very low level-annuities. In the case of the U.K., individuals can delay drawing an annuity until age 75, during which time they can draw an income from the fund that is between 35 per cent and 100 per cent 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 per cent 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 B below).

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 five years), a window opens enabling a withdrawal to be made without a MVA.

Appendix B: 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 realized 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

Table 2:

Example of additional return needed to cover mortality drag and draw-down charges (from National Mutual Life (1996)). 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

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

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 the age of retirement.

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".[11] 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 (see Table 2). The mortality drag will be higher for older than for

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[11] The mortality drag in a given year equals the percentage of the original group of annuitants who die during that year.

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.

Appendix C: Comparing the returns on different types of annuity

Black and Skipper (1994, chapter 10) suggest that annuities should be compared on the basis of their internal rates of return. The internal rate of return equates the expected present value of premium payments with the expected present value of annuity and death payments.

We assume the following notation for the most general type of annuity policy, a regular flexible-premium deferred variable annuity:

S = age when policy initiated
T = nominated age for receiving the annuity (e.g., retirement age)
C_x = gross policy premium at age x
A_x = annuity at age x
B_x = benefit payable if policyholder dies at age x
D_x = dummy variable which takes the value 0 if the policy holder's age is less than T and 1 otherwise
P_x = unconditional probability of dying at age x

Table 3:
Example of internal rate of return calculations (from Black and Skipper, 1994, Table 10-9). Fixed premium deferred annuity with an assumed bonus rate of 8.25%

Year	Annual premium (£)	Surrender value (£)	Internal rate of return (%)
1	1,000	866	−13.48
2	1,000	1,717	−9.76
3	1,000	2,647	−6.12
4	1,000	3,750	−2.75
5	1,000	4,988	−0.08
10	1,000	13,796	5.78
15	1,000	26,889	7.00
20	1,000	46,350	7.46
25	1,000	75,278	7.69
30	1,000	118,277	7.82

Because of high surrender charges in the early life of the policy, the internal rate of return is negative in the early years. While the internal rate rises over time, it never reaches the level of the quoted yield (8.25%) because of the policy expenses.

Q_x = conditional probability of dying at age x, having survived to age $x - 1$ (i.e., force of mortality)

R = internal rate of return.

The unconditional probability of dying after t years (conditional on having survived to age S) is:

$$P_{S+t} = Q_{S+t} \prod_{x=S}^{S+t-1} (1 - Q_x).$$

The expected present value of premiums is:

$$EPV(C) = \sum_{t=1}^{T} \frac{C_{S+t}(1 - P_{S+t})}{(1 + R)^t}.$$

The expected present value of annuity and death benefits is:

$$EPV(A + B) = \sum_{t=1}^{\infty} \frac{D_{S+t} A_{S+t}(1 - P_{S+t}) + B_{S+t} P_{S+t}}{(1 + R)^t}.$$

The internal rate of return is the value of R that equates the last two equations. All other annuity policies will be special cases of this. For example, an immediate single premium fixed annuity has $C_{S+t} = 0$ ($t > 0$), $A_{S+t} = A$ (constant), and $B_{S+t} = 0$ (for all t). See Table 3 for an example.

Background: pension reform in Croatia

This paper was prepared for a World Bank Mission to Croatia in November 1998. Croatia is introducing a funded defined contribution second pillar to its national pension arrangements. It is adopting the "Swedish model" for the accumulation phase, namely a centralized administrative structure, with individuals being able to choose from a range of pension investment funds. Croatia has yet to decide on the form of annuity provision for the payout stage, but has prepared draft legislation along the lines of the "Polish model", which involves individuals choosing among competing and specially-licensed annuity companies. The World Bank is concerned that this option will involve high costs and wished to examine alternative solutions.

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