Should Annuities be Guaranteed?

Wadsworth, Mike
Lavecky, John
Chaplin, Mark

Watson Wyatt Limited
Watson House
London Road
Reigate
Surrey
RH2 9PQ

Tel: (+44) 1737 241144
Fax: (+44) 1737 241496

E-mail: mark.chaplin@watsonwyatt.com

Abstract:

The paper investigates the reductions in capital requirements available for insurers issuing annuities if less than full lifetime guarantees are offered

Keywords:

Annuity, guarantee, capital, mortality, reviewable, stochastic

Today's world is not, and cannot be, risk-free and resources are limited. Society must therefore set priorities based upon which risks are most important. The current attitude of society to many forms of risk is totally irrational, scientifically indefensible, and economically damaging – pre-occupation with safety dissipates a significant amount of national resource. If we can get help in quantifying risk, we can make sensible decisions in managing it.

Professor Heinz Wolff, Brunel University
Promotion for a presentation to the Institute of Actuaries, 17 January 2005

1 BACKGROUND

1.1 'In payment' annuities currently play a very large part in pension provision in the United Kingdom. Around 350,000 annuity policies are purchased each year with proceeds from personal and occupational defined contribution pension schemes. Premiums paid for these policies were some £7.5 billion in 2004.

1.2 Most of the policies purchased – over 90% – are for fixed level annual payments for life, and most of these – over 80% – have been written on a single life basis.

1.3 Recent years have seen mortality experience diverge substantially from the projections used to construct published UK life tables for pensioners. There has been increased attention to the uncertainty of mortality projections and the financial consequences of that uncertainty. Such uncertainty is a universal problem and assessing improvement is even more difficult in many developing than developed countries. The structures explored in this paper (and others associated with it) do not solve the problem of future uncertainty but open up the possibility for a more extensive market in annuity guarantees and for more comprehensive market pricing. The consequences could be more scope to choose appropriately priced levels of uncertainty and better mechanisms for managing that uncertainty. Given the hostility towards annuitisation displayed by consumers in the UK as identified through survey responses or in other countries where annuitisation is not compulsory, through buying behaviour, these consequences may well be important for public policy.

1.4 Capital assessment methodology emerging from the Financial Services Authority, the UK regulator for the financial services sector including life insurance companies, requires sufficient capital to be held such that the insurer can survive adverse events over the following 12 month period at a 99.5% confidence level. For annuities such an approach would cover exposures including interest rate, credit and mortality risk. Where it is difficult to quantify correlation between various risks, the Financial Services Authority encourages firms to err on the side of caution when making allowance for any diversification benefits.

1.5 If the insurer's capital requirement is assessed using such an approach – typically by applying stochastic methods – purchasers of annuities will normally bear the cost of the provision of the capital. The scope to make such a charge may be limited by competition but in the UK the annuity market is dominated by proprietary companies seeking to make a return for shareholders. The indications from analysts' reports are that annuities are written with significant positive profit margins (typically 4% to 5% of the purchase price), although these figures must be considered in the context of the uncertainty of the eventual profit from the annuities.

1.6 We may then ask:

- what is the capital provision and associated cost required for the lifetime guarantee provided to the annuitant
- how might annuity rates differ if the guarantee was reduced. For example, we explore how much additional income consumers might be offered initially by allowing a re-rating of their annuity after an initial period of years to reflect a shift in mortality projections from those current when the annuity was purchased.

1.7 In this paper we focus on mortality risk because financial markets increasingly provide the tools to hedge interest rate risk - at a price! We raise the question of whether at least some consumers may prefer to carry greater mortality risk and the market might move away from lifetime guarantees.

2 OBJECTIVES, METHODOLOGY AND MODEL

Overview

2.1 In this paper we:

- apply 'shock' testing to mortality rates to quantify the capital required to support annuities carrying various levels of mortality guarantee
- show adjusted initial levels of income payment from annuities which reflect the cost of supporting capital.

2.2 'Annuity' in our examples means a level stream of income payments made to an annuitant for life, which are fixed either for life or until the next review date.

2.3 The purpose of the model is to estimate the expected cost of tying up capital arising from the need to provide for adverse deviations in mortality experience.

2.4 Projections of mortality rates were required:

- to project the 'realistic' numbers of survivors in each projection step,
- to generate the shock scenarios used to establish the level of reserving capital required.

Description of rate guarantees

2.5 The annuities modelled were based on male lives. A level annuity was assumed. The following versions of rate guarantee were tested:

a. A traditional design with the annuity rate guaranteed throughout life ('lifetime guarantee').

b. Annuity rate guaranteed for an initial period ('initial guarantee'). At the end of the initial period the annuity rate is recalculated using an up to date projection of mortality rates based on recent experience. Such recalculations may occur at frequent intervals thereafter (eg annually) and it is assumed that the reserve for adverse mortality experience is only required to cover the period up to the first rate review.

c. Annuity rate guaranteed for an initial period but at the end of the initial period the annuity rate is recalculated using the same method as in **b.** (continuing to allow for the cost of the guarantee). The rate is then guaranteed for a further period until the next review date ('recurrent guarantee'). The process then repeats itself at the same regular intervals. The overall costs of the guarantee are therefore intermediate between **a.** and **b.**

d. A guarantee similar to **c.** but with a lifetime guarantee commencing at an advanced age ('hybrid guarantee').

Economic assumptions

2.6 The cost of tying up reserving capital (i.e the return required in excess of the risk free rate) was taken as 3% per annum, with the results also shown at 5% per annum to illustrate sensitivity. This represents the difference between the required return on capital and the 'risk free' interest that could be earned on the assets backing the reserves. Differentials of 3% or 5% per annum were chosen as these span the range of typical embedded value assumptions.

2.7 An interest rate of 5% per annum was used as a proxy for a 'risk-free' rate, both:

- within the reserving calculations to discount annuity payments back to the valuation date
- within the pricing calculation to discount the resulting cost of capital back from the valuation date to the annuity start date.

Simulation method

2.8 Starting at the annuity purchase date, and again at each future valuation date, 500 simulations of the future mortality experience were carried out. (This results in fairly significant sampling error at the tail end of the distribution; thus in practical applications, a larger number of simulations would probably be used.) Within each simulation the present value of the future annuity payments was calculated, and the second highest of the annuity values was taken as the adverse scenario, corresponding approximately to the 0.5th percentile. This was compared with the annuity value based on a deterministic scenario. The deterministic mortality rates were established at the annuity start date, based on the same recent experience and central parameters as used in the stochastic projections. At subsequent valuation dates, the deterministic mortality rates depended on information assumed then to be available on the recent experience in the earlier steps of the same simulation, so as to ensure consistency with the future stochastic mortality rates.

2.9 In order to limit the volume of calculations, the model was based on five year projection steps throughout. This also had the advantage that it implicitly assumed a delay between the date of the mortality experience and the availability of the information for pricing purposes. In principle the same method could be used with one year projection steps but the delay would need to be allowed for explicitly.

2.10 For rate guarantee types **c.** and **d.**, for the purpose of recalculating the annuity rate at each review date, revised deterministic mortality rates were used as described in **2.8**.

Mortality rate projections

2.11 The stochastic projection of the mortality rates at each projection step was based on the trend over the previous 10 years, as follows:

2.12 The ${}_5q_{x,y}$ factors (where y represents the calendar year at the start of the 5 year period) were derived as follows:

$${}_5q_{75,y} = {}_5q_{75,y\text{-}5} * [({}_5q_{75,y\text{-}5}/{}_5q_{75,y\text{-}10})\hat{}a\ ] * \exp(bz_1) \quad (2.1)$$

The mortality rates for ages over 75 were then derived by

$$({}_5q_{x,y}/{}_5q_{x\text{-}5,y})/({}_5q_{x,y\text{-}5}/{}_5q_{x\text{-}5,y\text{-}5}) = [({}_5q_{x,y\text{-}5}/{}_5q_{x\text{-}5,y\text{-}5})/({}_5q_{x,y\text{-}10}/{}_5q_{x\text{-}5,y\text{-}10})]\hat{}c * \exp(dz_2) \quad (2.2)$$

and those for ages under 75 were similarly derived by

$$({}_5q_{x,y}/{}_5q_{x+5,y})/({}_5q_{x,y\text{-}5}/{}_5q_{x+5,y\text{-}5}) = [({}_5q_{x,y\text{-}5}/{}_5q_{x+5,y\text{-}5})/({}_5q_{x,y\text{-}10}/{}_5q_{x+5,y\text{-}10})]\hat{}c * \exp(-dz_2) \quad (2.3)$$

where z_1 and z_2 are independent normal random variables with mean 0 and standard deviation 1.

2.13 The 'deterministic' projected mortality rates used a consistent methodology and parameters but with the random components b and d set to zero.

2.14 The parameter values were taken as a=1, b=0.02, c=1, d=0.004, and were selected after consideration of England and Wales population data for the period 1950-1995.

2.15 In formulae (2.1) to (2.3), it would be more correct to use either a force of mortality or q_x/p_x rather than q_x in order to model the variability of mortality rates at advanced ages. In practical applications this modification would be made to the model.

2.16 The historical data for the last 10 years before each valuation date, for input into the projection formulae (2.1) to (2.3), were based on 100% PMA92 with Medium Cohort improvement factors. The same basis was used to project the realistic mortality experience between the start date and the valuation date.

Approximating the value of the annuity

2.17 As the model used five year projection steps, the value of the annuity for the period t to t+5 was taken as:

$$-(1/12)f_{t\text{-}5}+(2/3)f_t+(5/12)f_{t+5} \quad (2.4)$$

where f_t is the product of a discount factor from the start date to time t and the survival probability over the same period, corresponding to D_{x+t}/D_x, where x is the age at the start date. This approach was used consistently for the stochastic and deterministic annuity values.

2.18 Formula (2.4) is an estimate of

$$\int_0^5 f_{t+u}\,du \quad * \;(1/5) \qquad (2.5)$$

which assumes that f_t is a quadratic function of t.

3 RESULTS

3.1 The requirement for capital relating to mortality shocks for a lifetime guarantee is illustrated in Appendix A.

3.2 Appendices B and C show the cost (as a proportion of annuity purchase price) of tying up capital for a set of examples which vary by:

- age
- guarantee period
- guarantee type (initial or recurrent)
- cost of capital (risk free plus 3%/5% per annum)

3.3 The results show that:

- guarantees which apply only for an initial period cost relatively little even where the initial guarantee period is a long one. Some consumers may of course prefer more security later in life, although some economic theories suggest that consumers discount the long term very heavily.
- recurrent guarantees are substantially more expensive than initial guarantees, particularly for longer periods between reviews. (Different consumers may have different preferences for the desired period of income stability.)
- a lifetime guarantee is much more expensive than the reviewable structures. How much more will depend materially on the quantity and cost of capital required by the provider. It may be cheaper for a highly rated company to provide lifetime guarantees and consequently to be more competitive, than for a company with a lower credit rating. This issue is particularly important for the annuity market as the duration of the product is so long.

3.4 The impact of the additional capital cost on the initial annuity that a provider might be willing to offer is illustrated in Appendices D and E for examples corresponding to those shown in Appendices B and C. The initial annuity is increased in proportion to the percentage reduction in cost of capital arising from reduced guarantees. Whether the increased income is sufficiently attractive to draw customers away from lifetime guarantees is a question for the market. However annuity rates have reduced substantially as a result of falling interest rates and lower mortality rates, and we may reach a point at which a significant group of consumers will be willing to accept some reduction in security in return for some increase in yield.

3.5 A developing market in guarantees may identify structures that blend guarantee types listed above to produce structures that are attractive for consumers. For example, a willingness to tolerate some longevity risk in early retirement combined with a desire for security in late retirement might favour a structure with regular reviews up to a threshold age and a fixed rate annuity thereafter (referred to above as a hybrid guarantee). Appendix F compares the cost of capital and the increase in annuity for such a hybrid with the other types of guarantee illustrated earlier.

4 IMPLICATIONS FOR THE ANNUITY MARKET

4.1 Implications include:

- consumers can be given more choice and more income in retirement in exchange for accepting some greater risk. More extensive choice will enable consumers to identify their preferred trade-off between income and security
- there is scope to reduce significantly the size of capital requirements of providers by offering less than full lifetime guarantees
- companies with higher costs of capital would be able to manage down the extent of their disadvantage by operating in market segments where guarantees are reduced
- a variety of patterns of guarantee are possible and it would be possible to design products which align the periods in which maximum security is required by consumers (typically older ages) with periods of maximum guarantee
- the availability of greater choice in product design will increase the opportunities for anti-selection by purchasers, and may result in poorer experience for annuities with a higher level of guarantee.

4.2 More choice increases the scope for misunderstanding and therefore the need for better communication in order to minimise misselling risks.

5 FURTHER QUESTIONS

5.1 The trade-off between guarantees, capital and annuitant income can also usefully be extended to another dimension to take in investment risks (including mismatching and default). A consumer could have more or less income, again depending on the guarantees required. This issue is of particular significance in countries where the supply of long dated bonds and/or associated financial instruments is small or non-existent.

5.2 Development of a multi-dimensional model for annuity risk and identifying the trade-offs of guarantees and income within this space is work for a future paper.

BIBLIOGRAPHY

Association of British Insurers: Long Term Statistics

Findlater and Wadsworth: Reinventing Annuities: paper presented to the International Congress of Actuaries (March 2002)

Gardner and Wadsworth: Who Would Buy an Annuity? An Empirical Investigation: Watson Wyatt (March 2004)

Government Actuary's Department, www.gad.gov.uk: Population projections and life tables

Harrison, Lau and Williams: Estimating Individual Discount Rates in Denmark, a Field Experiment: American Economic Review 92/5, pp 1606-1617 (2002)

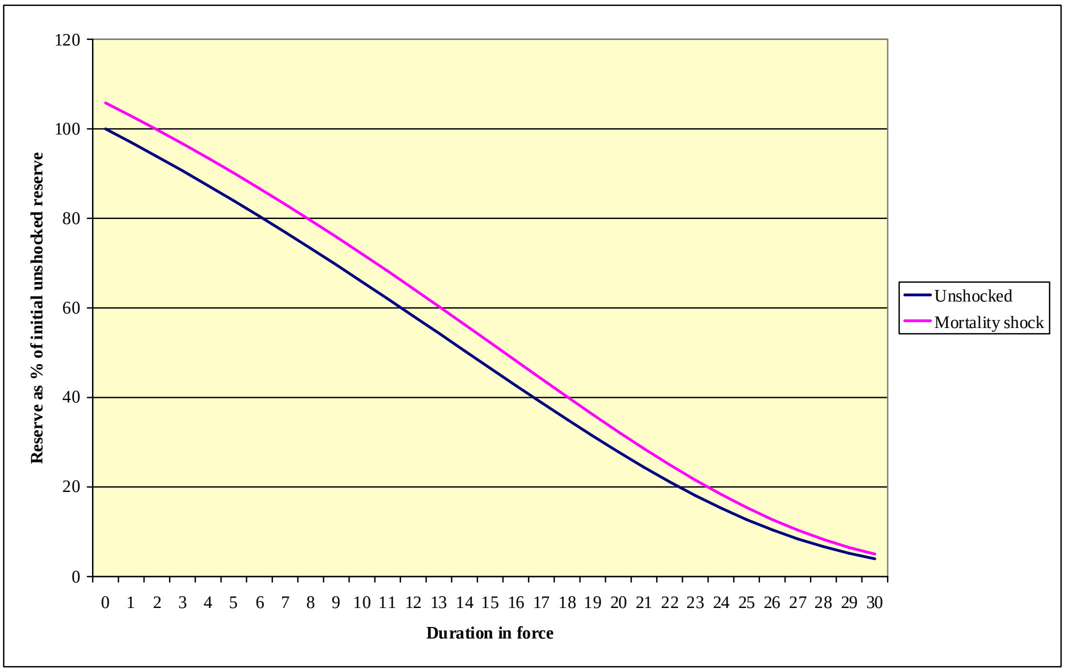
Impavido, Thorburn and Wadsworth: A Conceptual Framework for Retirement Products: Risk Sharing Arrangements Between Providers and Retirees: The World Bank and Watson Wyatt (December 2003)

Olivieri: Uncertainty in mortality projections: an actuarial perspective, Insurance: Mathematics and Economics, vol. 29 no. 2 (2001)

Olshansky and Vaupel: The Uncertain Future of Longevity: Watson Wyatt/Cass Business School Public Lectures (2 February 2005, 23 March 2005)

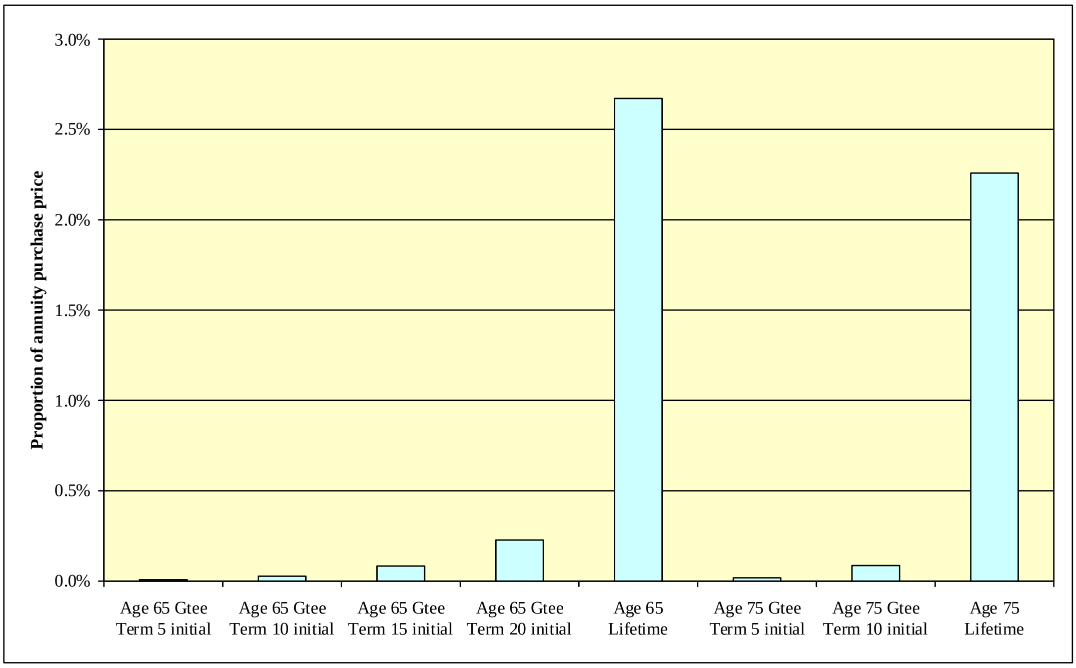
Willets, Gallop, Leandro, Lu, Macdonald, Miller, Richards, Robjohns, Ryan, Waters: Longevity in the 21st Century: British Actuarial Journal, vol. 10 no. 4 (2004)

A EFFECT OF SHOCK SCENARIO FOR AN ANNUITY GUARANTEED THROUGHOUT LIFE, ENTRY AGE 65

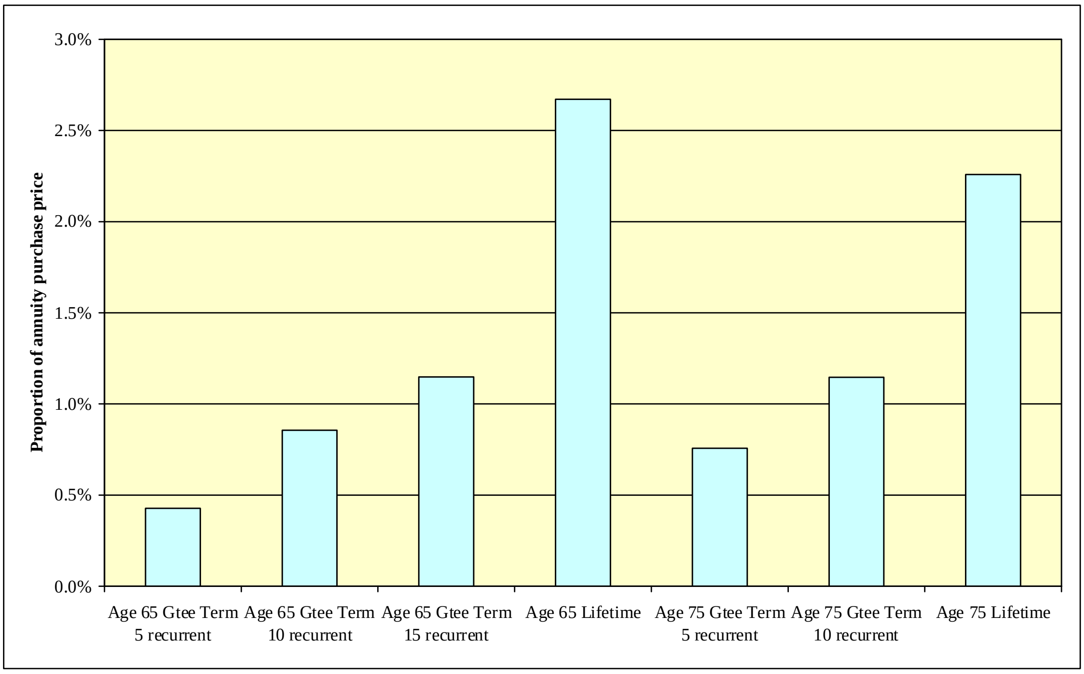


B COST OF TYING UP CAPITAL (SINGLE AND RECURRENT GUARANTEE, RISK FREE INTEREST RATE +3%)

Single guarantee, risk free interest rate + 3%

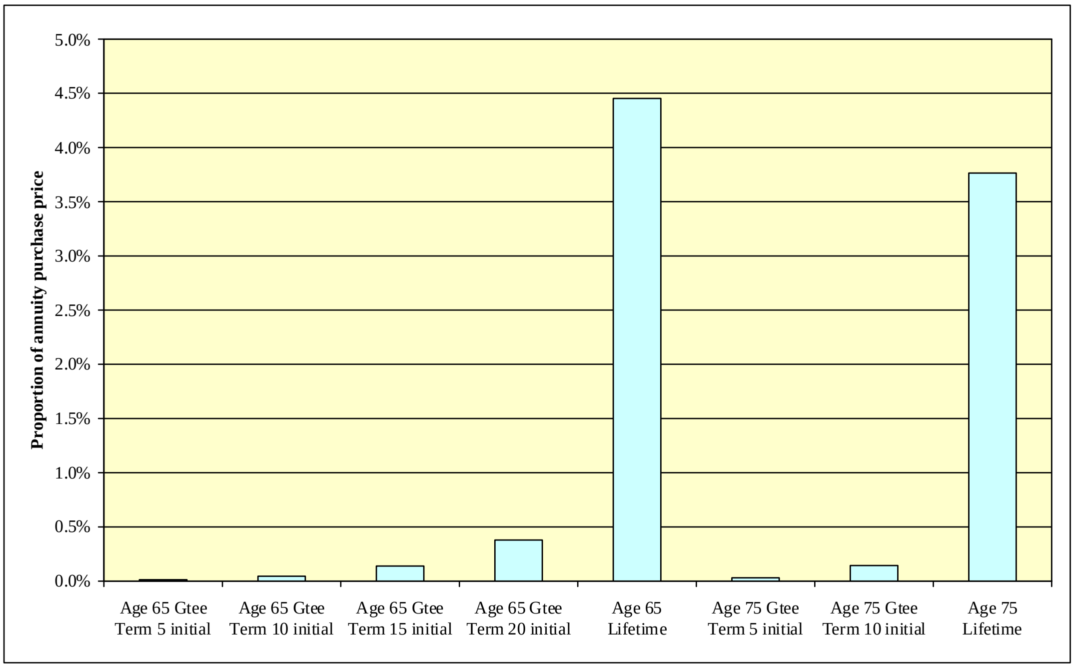


Recurrent guarantee, risk free interest rate + 3%

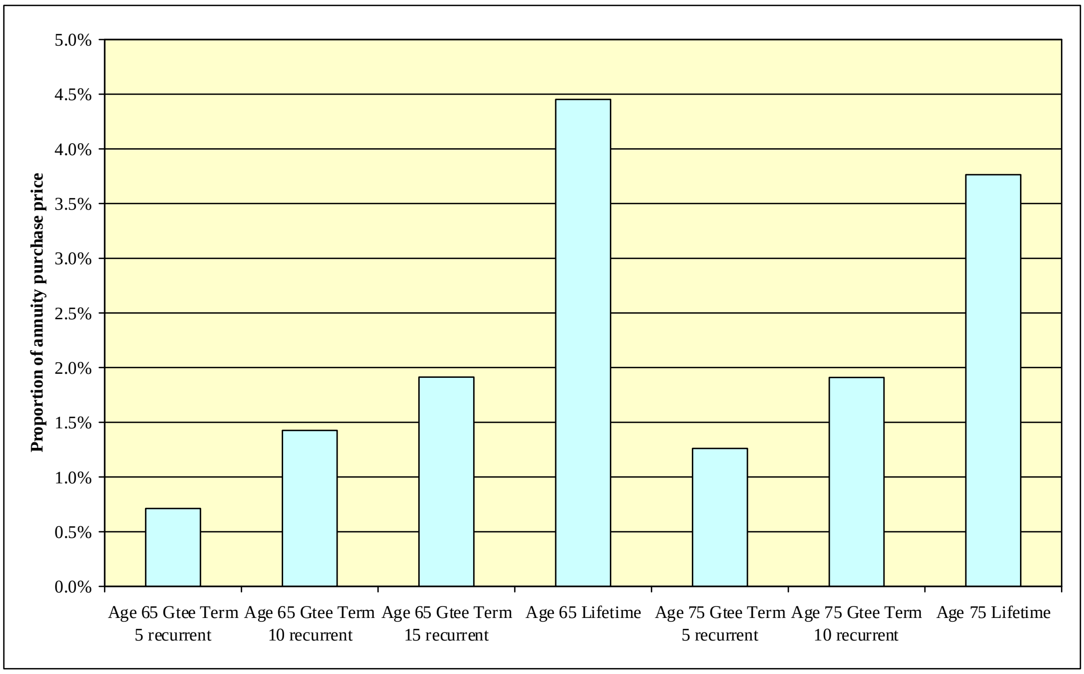


C COST OF TYING UP CAPITAL (SINGLE AND RECURRENT GUARANTEE, RISK FREE INTEREST RATE +5%)

Single guarantee, risk free interest rate + 5%

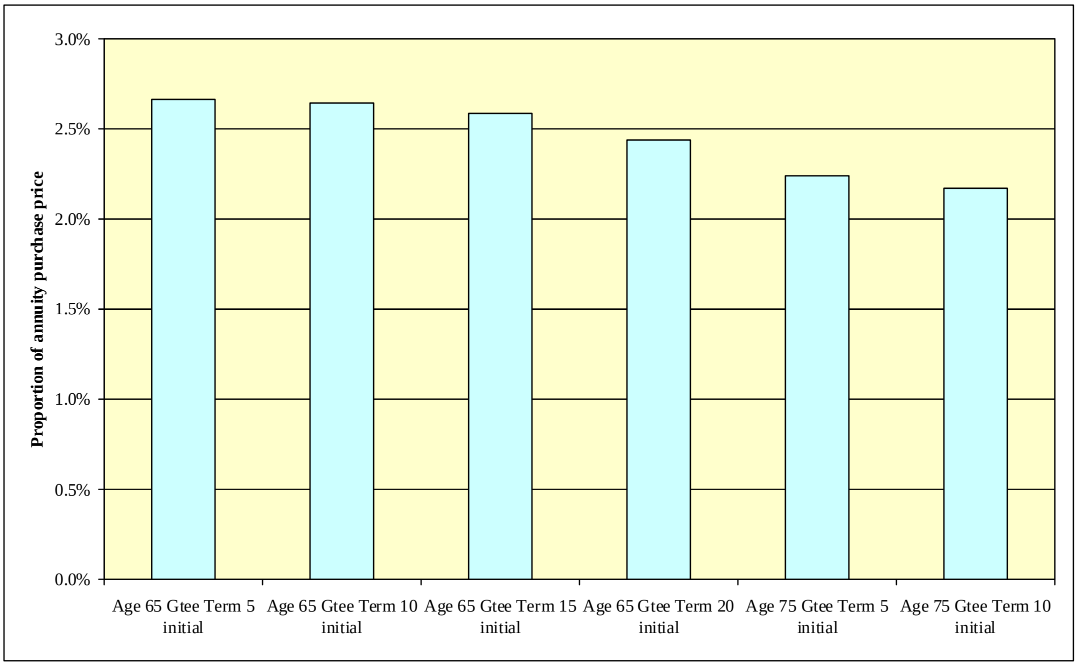


Recurrent guarantee, risk free interest rate + 5%

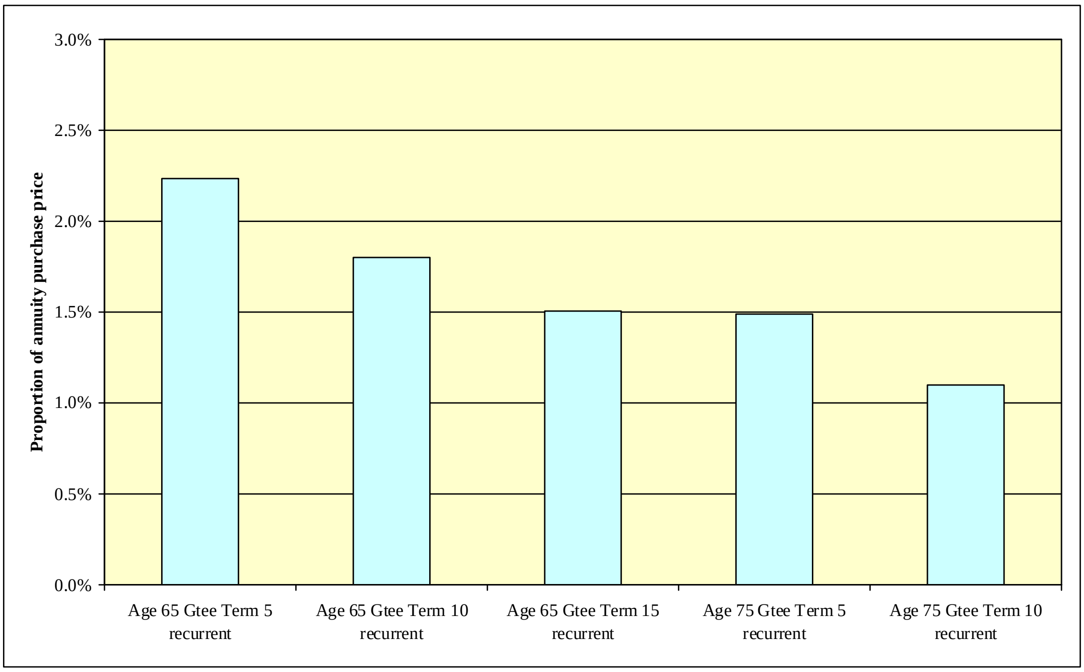


D INCREASE IN ANNUITY FOR REDUCTION IN GUARANTEE (SINGLE AND RECURRENT GUARANTEE, RISK FREE INTEREST RATE +3%)

Single guarantee, risk free interest rate + 3%

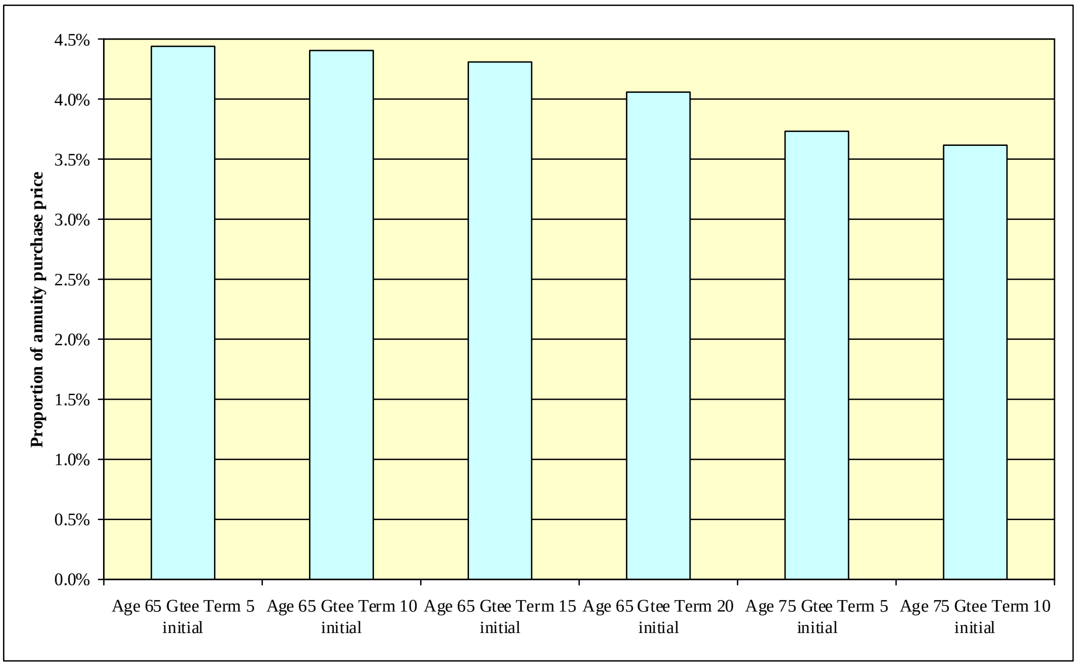


Recurrent guarantee, risk free interest rate + 3%

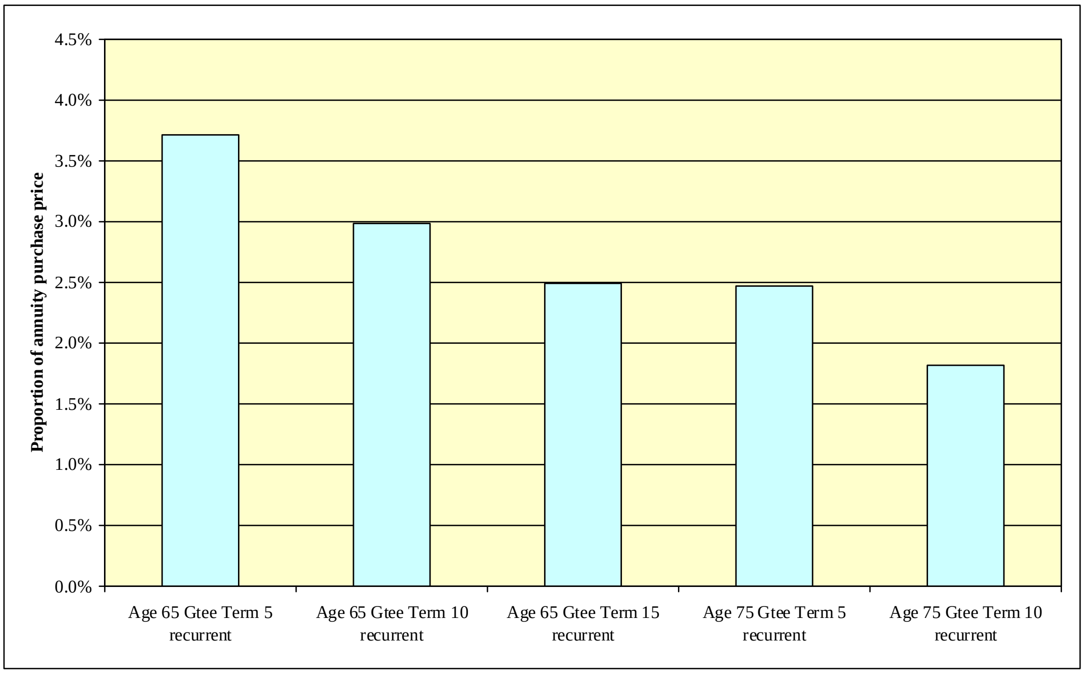


E INCREASE IN ANNUITY FOR REDUCTION IN GUARANTEE (SINGLE AND RECURRENT GUARANTEE, RISK FREE INTEREST RATE +5%)

Single guarantee, risk free interest rate + 5%

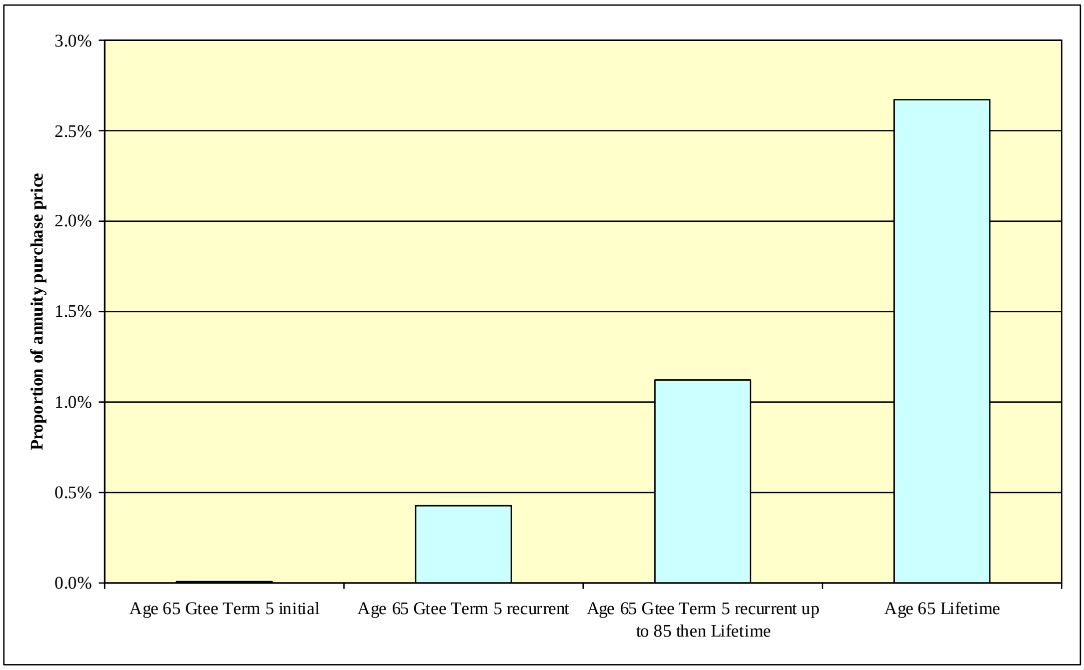


Recurrent guarantee, risk free interest rate + 5%



F COMPARISON WITH HYBRID GUARANTEE

Cost of tying up capital, risk free interest rate + 3%



Increase in annuity for reduction in guarantee, risk free interest rate +3%