The lifetime harvesting plan: smoothed annuities with sharing of mortality, and averaging of investment, risks

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Presented to the Actuaries Institute
Financial Services Forum
30 April – 1 May 2012
Melbourne
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Abstract

This paper considers the design of pooled life annuities for Australian retirees. In particular it considers how mortality can be pooled, and investment returns smoothed, to provide for consumption that is greater and smoother, without the risk of totally exhausting account balances, and without the need for significant shareholder capital. It is also necessary to integrate payments with the age pension and to take regulatory minima into consideration. The results are illustrated for Australian returns since 1956.

Keywords: retirement income streams, smoothing, pooled-, group-, variable- or with-profit life annuities

1 Introduction

This paper is prepared for Australian actuaries concerned with the design of retirement income streams from superannuation.

1.1 Assumptions

In order to focus on annuity design issues, the following assumptions are made:

- Many retirees need products that provide a cash flow that they can use for living expenses, and that allows them to “harvest” some of their accumulated superannuation balances in retirement.
- Bequest motives and any desire for health insurance cover have been satisfied in some other way, and so do not need to be considered in the design of the harvesting plan, which is intended to provide the optimal way of consuming capital.
- While retirees are likely to get to a time of life when their desire to consume will reduce and health care costs rise, and while the two points may not necessarily coincide, the most desirable cash flow is more or less level in real terms.
- Guarantees of investment returns and of future mortality rates are too expensive – in terms of the charges that must be made to cover capital requirements – to be attractive to many Australians who are already guaranteed the age pension.
- All cash flows need to be adjusted for inflation.

Asher (2011) discusses the first three of these assumptions, rehearsing the theoretical and practical arguments why Australian retirees need to be offered life annuities, which are the only way of consuming capital without the risk of it running out. The cost of guarantees is not relevant to the major thrust of the paper, but is discussed briefly in Appendix 1, while the last assumption is taken to be obvious to actuaries.

1.2 Pooled annuities

The term “pooled annuities” is taken from Piggott et al (2005) and used to refer to annuities that can be invested in exactly the same manner as allocated annuities, but where mortality risks are shared between
members of an annuity pool in some fashion. The annual payment is targeted at a level amount (intended to increase with inflation), but will be larger or smaller depending on investment and mortality experience.

For purposes of this paper, pooled annuities are taken to exclude any investment guarantees – although these can – and frequently are added to the benefit design. Smoothing of payouts is, however, included in the discussion using the method described by Asher (2007) This divides the account balance into a risky and a cash component, and uses a smoothing algorithm determine how much to transfer from the risky to the cash component each month, and how much can be withdrawn from the cash account for consumption.

Pooled annuities extend the benefits of allocated pensions by pooling the longevity risk – of outliving one’s capital. They offer better value than guaranteed annuities and guaranteed minimum withdrawal (GMWB) products because they do not need to charge for the guarantees. They can therefore provide a cost-efficient way of drawing down superannuation savings for post retirement spending.

1.3 Structure of the paper

Section two provides a brief survey of pooled annuities in other countries to demonstrate that they can be operated successfully and apparently meet the needs of many retirees.

The following section then considers some design considerations: theoretically looking at the possible shape of retiree utility functions, and also at the more practical considerations of determining the initial instalments, distributing profits and losses, and integrating with the age pension. It develops rules for determining payments, which are expected to guide retirees’ consumption.

Section four illustrates how the impact of different smoothing mechanisms on historical investment returns for both allocated and pooled life annuities, and identifies the important elements of a smoothing mechanism.

2 Pooled annuities internationally

Pooled annuities are normally called with-profit annuities in the Europe and the Commonwealth, but variable life annuities in the North America and Japan. Defined benefit (or “defined ambition”) pensions in some countries like the Netherlands and South Africa also operate as pooled annuities. While they are frequently issued with guarantees, the guarantees are not essential to the design.

2.1 With-profit annuities

With-profit annuities account for most of the annuity market in South Africa, but are also common in the UK, and have recently been introduced into Europe – as new accounting and solvency rules have exposed the risks involved and increased the capital required for issuing guaranteed annuities.

2.1.1 Guarantees

The life insurance companies issuing the contracts normally offer a minimum guaranteed annuity, with an annual bonus that usually increases the minimum guarantee.

- In South Africa, the guarantee is that the pension will not reduce. With higher rates of inflation and long interest rates that have ranged from 8% to 15% and more, it is possible to provide a guarantee of the nominal value of the pension and invest a considerable proportion of the assets in equities in the hope of higher returns. All bonuses therefore compensate for inflation. The amount of the bonus depends on the assumed interest rate (AIR) used to determine the initial annuity: the bonus is then equal to the actual return on the investments less the AIR. The initial amount of the annuity
can be calculated using AIRs from 3.5% to 8% - as shown in the Old Mutual performance tables in Appendix 1.

- In the UK, Germany and Denmark, the guaranteed pension may decline over time (by as much as 5% pa), with the bonus used to maintain as much of the nominal value as possible. The initial value of the annuity is likely to be calculated using an AIR that varies from as little as 1% to perhaps 5%.
- The annuity is not normally guaranteed in North America or in the Swedish PPM system. Vittas (2011, 6) reports an AIR range from 3% to 8% in Canada, 3% to 5% in the USA, with some flexibility to use a higher rate. The Swedish PPM annuities use a rate that has varied from 2.3% to 4%.

2.1.2 Determining bonuses

With profit policies evolved as being administratively tractable and as a source of capital for mutual societies, their only current justification is that they provide smooth payouts – while providing participation in equity returns. \(^1\)

The rationale and method for smoothing however remains opaque. Boulle and Maitland (2006), for instance, set out some of the potentially conflicting considerations:

“Policyholder and market requirements...

- Reflect investment returns and market conditions
- Maintain real bonus rates
- Create a level of smoothing between bonus declarations
- Reach a full distribution of investment income and capital, net of margins, over time

Shareholder and life company demands...

- Maintain solvency and profitability
- Minimise cross subsidies between members
- Reflect the current pricing basis
- Reflect actual mortality and expense experience”

Increasing regulatory oversight over the past two decades have led to increasing pressure not to deviate too much from the underlying experience of the investment pool, which has led to more conservative investments in some cases. The Old Mutual bonus history in Appendix 1, shows that while bonuses dropped from 13.5% in 1998 to 3% in 1999, the drop was from 12% to 7% in the more serious market crash ten years later. It can also be seen that good returns in South African investment markets have allowed annuities to increase at rates higher than inflation – for annuities calculated at 7% or less.

The UK companies are not as forthcoming in publicising their past performance, but investment performance has been lower and the Prudential, for instance, has declared bonuses of only 1% and 1.5% in the past two years. This would mean that annuities that anticipated a 5% bonus to maintain their nominal value would have reduced by 4% and 3.5% respectively in the past two years.

Guillén et al (2006) a mathematical algorithm that can used to smooth returns without the opacity and discretions inherent in the traditional with profit design. This method is being used by some Danish insurers with some success – as reported in Guillén et al (2010). These papers do not however set out how solvency is assured in a long term bear market.
Vittas (2011, 15) suggests smoothing method based on predetermined algorithms, but they still depend on insurer discretion. He reports that “little concrete evidence has been documented with regard to the actual policies pursued by different providers in different countries” although refers to the comparison by Cummins et al (2007) that gives an indication of the type of rule followed. This does not differ much from that described by Boulle and Maitland (2006) outlined above. Clay et al (2001) make a range of suggestions for improving the management and transparency of reporting with profit funds in the UK.

2.1.3 Discretion and opportunists

In practice, smoothing occurs by introducing a delay of a few years in distributing the profits and losses of the underlying pool to annuitants. Losses tend to be passed on faster than profits in order to avoid financial stresses, and because companies are necessarily conservative. This can lead to the development of “orphan estates”. These are surpluses that have not arisen from the current generation of policyholders, and which are open to expropriation by opportunistic stakeholders. These issues – and the potential “dissatisfaction” created – are discussed in some detail in Financial Service Authority (2003).

In my view discretionary smoothing is inherently unfair to policyholders and encourages opportunists to create or expropriate orphan estates. One way of viewing smoothing is to think of them as linked business but where the assets are sold to the next generation at a value that differs from the market price. At first sight, this means that one or other of the parties is being cheated, in that they could have got a better price on the market. Two defences of the practice can be made:

- The first is that the market price may be clearly unreasonable as a consequence of temporary illiquidity and that it would be unfair to the parties to use the market price. This argument is clearly not valid if the market price is higher than the price at which the asset is being transferred. The obvious thing to do in these circumstances is to take advantage of the temporarily higher price – and provide liquidity to buyers as a social benefit. The argument may have validity if the market price is lower than the long term fair value, but smoothing is dangerous in these circumstances: the market can always become more depressed (even if irrationally) and losses are then concentrated in the remaining members. Such a position should therefore not be common.

- A second defence can be made in suggesting that the parties have agreed in advance to transfer the asset at an off market price. Forward contracts of this sort are common, but not where a third and potentially interested party (the directors or trustees) will set the price at which the transfer takes place. The theory of forward and future contract and swap pricing requires the strike or swap price to be predetermined in cash terms, or potentially by reference to an index. Transferring assets at less than market price to shareholders or an amorphous estate (to be later expropriated for some purpose) is clearly reprehensible.

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It is not as if it is necessary to resort to the complexity of with-profit contracts. As the papers by Guillén et al confirm, smoothing can be achieved objectively in a market consistent fashion by effectively moving from risky to lower risk assets in the period before payment is required. Section 3.2.4 below illustrates.

2.2 Variable annuities

2.2.1 Traditional non-guaranteed

TIAA-CREF, a large non-profit US conglomerate largely providing pensions for academic members, has been offering variable annuities for over 50 years. The variable annuity payments reflect the actual experience of the underlying investments and are also adjusted for unexpected changes in mortality. They offer a wide range of underlying investment options.
The historical bonus rates of a sample of TIAA-CREF annuities are shown in Appendix 1. It can be seen that the pensions can be much more variable than with-profit bonuses. The global equities pension reduced by 30% in 2003 and then increased by 40% the next year. Annuities invested in cash portfolios have been much smoother and produced real returns for some years. Current low levels of interest rates mean that this is unlikely to have been the case over the past 2 years, or in the foreseeable future.

The annuities being paid by the Central Provident Fund in Singapore are also variable annuities.

3 Design considerations

3.1 Theoretical

3.1.1 What retirees really need

Clark et al (2008) provide an excellent review of the recent research into the relationship between income, happiness and “utility”. They suggest that the best characterization of the utility of people’s income requires three terms:

- The first is a function of the overall level of income; marginal where utility declines with greater income, consistent with satiation once we have enough and either constant or reducing risk aversion
- The second involves a comparison of current income both with previous income (habituation) and with those we regard as peers; consistent with stronger loss aversion in prospect theory and with our propensity to envy
- The third covers how the income is made, particularly the trade off with leisure

Also required is a way to trade off current and future consumption. This can be incorporated into each of the terms of a lifetime utility function by the introduction of a subjective discount on future spending. The determination of the discount is problematic: seen from the start of retirement, the subjective discount rate might well be greater than the risk free interest rate and indeed of the expected rate of return. Seen from later in retirement however, steeply declining consumption may lead to regrets about earlier overspending. Clark et al quote evidence from small-sample surveys to show that individuals do “express a preference for wage profiles which rise over time, even though these have lower present discounted values than alternative profiles with constant or decreasing wages.” This may also apply to pensions, suggesting that assumptions for the initial instalments discussed in 3.2.1 below should be conservative.

3.1.2 The desire for liquidity

In order to enjoy the full benefit of annuitization, it is necessary to give up some access to investment balances. Asher (2011) considers the arguments for holding cash and for liquidity for medical costs, and comes to the conclusion that liquidity is as likely to be a disadvantage as a benefit, given the high risks of dementia and the risks of making poor financial decisions at advanced ages particularly.

It is however possible to obtain some of the benefits of annuitization and maintain liquidity. Two options suggest themselves:

- Members can retain liquidity and accept that mortality bonuses are going to be based on select rather than ultimate mortality rates. There is limited Australian evidence as to the impact, but the tables in Johansen (2006), looking at US deferred annuitants, suggest that the impact was no more than 50% in the first year. The reduction in value will be less if a period of notice is required before money is withdrawn.
• Members should also be able to obtain liquidity subject to evidence of good health – although obviously not when they are most likely to want money for medical costs. Some companies offer this option in any event, even if it is not advertised.

3.2 Practical

3.2.1 The assumptions for initial instalments

The initial instalments of a pooled annuity are calculated based on a set of assumptions as to the future investment, mortality and expense experience of the pool. The annual payments will retain their real (after inflation) value if future experience is equal to the assumptions. (It is assumed here, and in all that follows, that it is essential for payments will be linked to the CPI – or targeted to match it. 2)

The assumptions are:

• The assumed interest rate (AIR), which will normally be set at a conservative estimate of the real (after inflation) rate of return that is expected to be earned on the underlying assets.
• The expected mortality rates of each annuitant using current life tables, and allowing for improvements in future.
• An allowance for the expenses of administration and distribution.

The same assumptions are required for allocated annuities, although the mortality assumptions are often made implicitly by the use of a life expectancy.

The AIR should significantly exceed the real return on secure indexed linked stock – or it would be better to invest in them. The rate on government indexed bonds therefore provides a lower limit. The dividend yield on shares perhaps provides an upper limit for the relatively conservative assumption that dividends on existing shares will not increase in real terms. Figure 1 shows that these two series were not very different during the nineties, but have deviated since then. An upper limit would perhaps be 5% including franking credits.

Figure 1: Real yield indicators

Assumptions also need to be made about future improvements in mortality. The findings of Willets et al (2004) suggest an annual rate of increase of 2% would be reasonably conservative.
Bateman and Thorp (2008) evaluate alternative payouts for allocated pensions using a utility function that uses the level of income and a bequest motive as inputs. The latter can also function as a measure of aversion to the exhaustion of the fund. They suggest that optimal drawdowns would be greater than the minimum at younger retired ages.

For purposes of illustration later, initial instalments are calculated at 5% with current population mortality reducing at 5% pa.

3.2.2 Adjustments to the payments

The amounts being paid should be adjusted on a regular basis for deviations from experience to utilise profits for higher consumption, or to prevent the balances from being exhausted.

Retirees with allocated annuities who are drawing down a fixed amount regularly face the latter risk particularly – as their drawdown will have to increase anyway as they age because of the unspeakably complex Superannuation Industry (Supervision) Regulations 1994 (SIS Regulations) 1.05 and 1.06 that govern annuities and pensions respectively.³

Schedule 7 requires an increasing proportion of the account balance products to be harvested over time, which means that the payments must ultimately reduce. These percentages are shown in Table 1.

### Table 1: Minimum drawdown required by SIS regulations

<table>
<thead>
<tr>
<th>Age</th>
<th>Minimum drawdown as % account balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 65</td>
<td>4</td>
</tr>
<tr>
<td>65 – 74</td>
<td>5</td>
</tr>
<tr>
<td>75 – 79</td>
<td>6</td>
</tr>
<tr>
<td>80 – 84</td>
<td>7</td>
</tr>
<tr>
<td>85 – 89</td>
<td>9</td>
</tr>
<tr>
<td>90 – 94</td>
<td>11</td>
</tr>
<tr>
<td>Over 95</td>
<td>14</td>
</tr>
</tbody>
</table>

It can be noted that the SIS Regulations do not seem to permit with-profit contracts, which are not offered in Australia, and Stringer (2011) reports that the ATO has raised objections against GMWB contracts.

After allowing for this, investment returns above, or below, the AIR can convert immediately into a permanent increase, or reduction, in the level of the annuity. Both these impacts are, of course, shared by allocated and pooled annuities.

3.2.3 Pooling mortality

Qiao and Sherris (forthcoming) give a detailed description of how deviations from mortality expectations can also be translated into proportional changes in the amount of annuity paid – by sharing risk between cohorts. Their method is to calculate all annuity factors at the rates experienced in the year in question so “capitalising” changes. It is suggested that this creates unnecessary volatility and so initial annuity assumptions (including projected rates of improvement), should not be changed.

Their suggestion can however be adapted to convert mortality profits and losses into equal changes in annuity payments for every member. This however means that the benefit each annuitant receives from the
pool is a different proportion to his or her contribution to the profit or loss that arises. This would not be unfair or subject to anti-selection risks, as long as the expected *ex ante* benefits and contributions are zero.

This could work as follows.

- Contributions to the profit and loss must be in proportion to the expected death release: $q_{x(i)}B_i$, where $B_i$ is the balance in the account that member $i$ would have been contributed to the pool on death. (It may be less than the entire balance if a spouse’s reversionary annuity is payable.). If the weighted actual deaths are $k\%$ lower than expected, then each annuitant will need to contribute $k\% q_{x(i)}B_i$ to the pool and vice versa if the actual deaths exceed expected. This is actuarially fair if expected profits equal expected losses.

- Benefits from the profit or loss can however be allocated in proportional to the balances $B_i$, (adjusted for contributions to the pool) which means that every annuitant will face an equal percentage increase (or reduction) in their annuity payments. If this change is $l\%$, then:

$$\sum_i k\%q_{x(i)}B_i = \sum_i l\%B_i$$

An alternative way of looking at it is to say that each member will receive their expected death release plus a proportion of the profit or less a proportion of the loss, where the proportion is based on their proportion of the total balances at risk.

In the absence of this smoothing method, the pensions of older members face a greater sensitivity to mortality profits or losses. Reducing this sensitivity would seem to be sensible as long as the ratio between younger and older members is not disproportionate.

This will mean that separate records will be required for the original mortality assumptions and current *ex ante* expectations to ensure that the allocation of profits and losses is fair.

### 3.2.4 Smoothing investment volatility

While it is not possible to smooth away long term poor returns, it is possible to smooth shorter term fluctuations. The method is explained in more detail in Asher (2007) and is achieved by averaging the performance of the past few years.

While a longer averaging period achieves greater smoothing, the method can be illustrated using a simple 3 month averaging period. The table below compares a variable annuity based directly on the unit price, and a smoothed annuity where one third of a unit has been disinvested each month for 3 periods – shown as disinvestment months -2, -1 and 0. For simplicity the prices are divisible by 3 and interest is ignored.

E.g. The second column gives the unit price (and the value of a variable annuity entirely dependent on the unit price), the last column the annuity paid. The first smoothed annuity payment of 110 is made in month 3. This is made up of 36 disinvested in month 1 (being one third a unit then priced at 108 as per the arrow), 44 disinvested in month 2 (one third of 132), and 30 disinvested before payment (one third of 90). The payment in month 4 of 114 is thus the sum of one third of 132, 90 and 120 – being 44, 30 and 40.

It can readily be seen that significant smoothing is achieved.
Table 2: Simplified smoothing mechanism

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit price/ Variable annuity</th>
<th>Disinvestment month</th>
<th>Smoothed annuity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>108</td>
<td>36</td>
<td>44</td>
</tr>
<tr>
<td>2</td>
<td>132</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>120</td>
<td>40</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>81</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>90</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>99</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>81</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>9</td>
<td>120</td>
<td>40</td>
<td>37</td>
</tr>
</tbody>
</table>

Smoothing over 3 months, no interest

It should be noted that this is achieved with complete transparency as to the formula used, and that there is no risk to the fund. Each member has a different combination of risky and low risk assets, and can invest more – or disinvest – at any time.

This example also shows that a downturn longer than the averaging period cannot be smoothed out. The illustrations in section four make this clearer. This long term risk can only be avoided by investing in less risky assets.

3.2.5 Capitalization of changes to projections is inappropriate

As with the capitalization of changes to mortality assumptions, a question that commonly arises is whether the AIR should be changed for pensions already being paid. This has been done for the Swedish PPM pensions. The major problem is that it brings forward any gains or losses that would otherwise be felt more gently over a longer period. This increases the volatility of consumption, an effect which is exacerbated when – as in some of the Swedish experience – the change is soon reversed. If changes are made to the AIR or in the expected rate of mortality improvement, it can be made for new pensions (without disruption), but it will be disruptive of existing payments and it is suggested that it should be categorically ruled out.

3.3 Integration with the age pension

Centrelink\(^4\) provides the following information about the age pension.
Table 2: Pension and supplement payable

<table>
<thead>
<tr>
<th>Status</th>
<th>Pension rate per fortnight</th>
<th>With supplement per fortnight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$695.30</td>
<td>$755.50</td>
</tr>
<tr>
<td>Couple</td>
<td>$524.10</td>
<td>$1139.00</td>
</tr>
</tbody>
</table>

The annual rate of pension payable is reduced by 3.9% of the difference between the amount for the full pension and that for a part pension shown in table 3.

Table 3 Assets test for homeowners

<table>
<thead>
<tr>
<th>Family situation</th>
<th>For full pension</th>
<th>For part pension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$186,750</td>
<td>$690,500</td>
</tr>
<tr>
<td>Couple (combined)</td>
<td>$265,000</td>
<td>$1,024,500</td>
</tr>
</tbody>
</table>

Products that are intended to make payments to retirees with a part pension, should ideally be designed to adjust for changes to the age pension. It is recognised that this is complex, but the just as the necessary information is provided every six month to Centrelink, it can obviously be provided to the product providers.

The regular changes to the annuity that are required should be made six monthly, which is when Centrelink will reassess the asset test and make changes to the age pension.

4 Some illustrations

This section develops rules for smoothing payouts that integrate with the age pension and looks at the impact of these rules using some historical Australian returns. It compares different smoothing mechanisms and the pooled annuities designed as above with allocated annuities.

4.1 Allocated pensions

Almost all the proceeds of DC funds that are not withdrawn – often to repay debt – are currently allocated pensions. Very little however appears to be known of the strategies used by pensioners to draw down their income. It is known that many pensioners take the minimum required by the regulations. Figure 2 shows the impact.
Figure 2: Smooth projection; balance starting at $410,000

The graph illustrates how a lump sum of $410,000 would be sufficient (given idealised 5% net returns and current population mortality improving at 2% pa and current asset test regulations) to generate the annual $55,000 determined by ASFA to be sufficient for a comfortable retirement for a retired couple, both aged 65. The guaranteed annuity is determined on the same mortality assumptions at a real interest rate of 2.5%.

It can be seen that the balance on the life annuity reduces faster initially, but then catches up as the allocated annuity is forced to distribute payments, and then is greater at older ages when it is able to continue to provide cover. The “longevity loss” dotted line shows that a 1% increase in rates of mortality improvement can have a significant impact on older lives, but this can be mitigated by the method suggested in section 3.2.3.

An allocated pension with a minimum withdrawal will provide only $44,000 at 65, but pensioners would be required to increase withdrawals to about $55,000 at age 85 and 90. The amounts would drop significantly after 95 – at which time some 25% of the original retirees are projected to still be alive. At least 60% of these will be women – more because they are usually younger than their husbands. It is perhaps moot whether there are many in their nineties who are in sufficiently good health to be able to spend much more than the age pension.

It can also be noted that the faster drawdown of the pooled annuity means a greater age pension.
Figure 3: Smoothing realised returns with an allocated pension

Figure 3 shows the impact of realised returns assuming an allocated pension started in 1956, at the beginning of a bull market run which culminated in 1969. The dip in the middle is a result of very poor returns during the seventies, while the period from 1980 to 1997 also enjoyed good returns – apart from the spike in 1987.

As suggested by Bateman and Thorp (2010), the initial payments are increased and fixed at 10% higher than a guaranteed annuity – as there should be some immediate benefit for not taking advantage of the guarantee.

If not smoothed, payments fluctuate with the proportional line. The payments are a fixed proportion of the balance, and vary every six months when the age pension is reduced.

There are two alternative ways of smoothing. The first is to fix the payment and not change it except for legislative minima until the balance is exhausted – which occurs at age 90 in the illustration here. The second is to smooth payments in line with the method proposed in section 3.2.4. An even smoother payment can be achieved by limiting increases to 1% pa in real terms, and a further adjustment must be made for increases in the age pension when balances decline. The payments are really smooth in the run up to the 1969 crash (before age 80) and there is some smoothing of the crash, but after age 85, the SIS minima make smoothing impossible. The balance is not exhausted as the payments are reduced as the balance declines.

Two conclusions can be drawn:

- Significant smoothing is possible with appropriate algorithms.
- The SIS Regulations make smoothing of allocated pensions almost impossible after age 80.
4.2 Life annuity

Figures 4a to 4d show the results using a pooled annuity. The same patterns are observed except that the higher ratio of payment to benefit means that the SIS minima have a smaller impact and are not noticeable until age 90. They are however likely to create a declining payments after that age.

Figure 4a: Smoothing realised returns with a pooled annuity from 1956
Figure 4b: Smoothing realised returns with a pooled annuity from 1965

Assumptions: All items adjusted and indexed to inflation; real return of a 70% equities fund. Age pension for homeowners with no other assets. ALT2005-07 with 2% pa improvements.

Figure 4c: Smoothing realised returns with a pooled annuity from 1975

Assumptions: All items adjusted and indexed to inflation; real return of a 70% equities fund. Age pension for homeowners with no other assets. ALT2005-07 with 2% pa improvements.
4.3 Long term investment risks

Figure 5: Pooled annuities with Japanese realised returns since 1978
In all the examples shown in Figures 4a to 4d, the pooled annuity would have paid out at least as much as a guaranteed annuity and often more. The major risk with a pooled annuity is, however, of returns as have been experienced in Japan since 1990. Figure 5 starts in 1978 and so provides 12 years of good returns before collapsing.

Investment in equities always exposes investors to the risk of a protracted downturn in prices, but one cannot rely on reasonable real yields in fixed interest stock either. The Japanese experience also shows this over the past 20 years, but investors in high quality government stock are currently at very low rates. Alternative investments that are related to wages, as proposed in Asher (2011) perhaps need more investigation.

5 Conclusion

Pooled annuities are a realistic approach that are used in many countries to meeting retirees’ real needs for greater consumption and smoother payouts, without putting unnecessary strain on investment markets. Successful smoothing mechanisms need to:

- Avoid capitalization of changes to expectations of investment returns and mortality improvement
- Integrate with the age pension
- Average investment returns by switching out of risky assets before payments are due
- Avoid the worst of the SIS minima by annuitization, which increases the payment:balance ratio.

While guaranteed annuities can offer greater security, they are expensive and likely to become more so if they become more popular.

Acknowledgements

I would like to thank Dr Sacha Vidler and the Industry Super Network for their support – financial, moral and intellectual – in preparing significant sections of this paper. Thanks also to Andrew Wakeling for a very helpful review of the first draft. They are in no way responsible for the opinions or errors.
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6 Appendix 1: Guarantees cost too much

Can investment markets to bear longevity risk? Turner (2006), then head of the UK Financial Services Authority, comes to the conclusion:

“in the long run the vast majority of very long-term longevity risk which has been written by defined benefit funds and their sponsoring employers, will simply not be written by anyone—not because there is a meaningfully definable absolute shortage of capacity—but simply because the fair price makes it an unattractive contract for the individual.” (596)

What the market can bear

He comes to this conclusion after calculating that the present value of liabilities to retired peoples in the UK was a little under 100% of GNP, with the private sector responsible for 40%, public servant pensions 15% and state age pension another 40% respectively. A similar order of magnitude is likely to apply in Australia and elsewhere in the developed world.

Capital is required for both investment and mortality guarantees. An idea of the order of magnitude can be taken by looking at the changes of present values.

- An annuity to a pensioner with a life expectancy of 25 has a mean term of over 10 and therefore varies by more than 10% for a 1% change in interest rates at reasonable real rates of interest, although as life expectancy declines, so does the sensitivity. The RBA statistics show that real interest rates on indexed government stocks have ranged from 1.5% to over 5% and have fallen by 1% in the last year. Capital requirements would be at least 10% of present values if matching assets could not be found. The current total issuance of indexed bonds in Australia was reported to be about $20bn in 2009. Total Commonwealth bonds currently stand at over $200 bn of which $15 bn is indexed linked. There would have to be a very significant increase in issuance to meet the need to back even a small proportion of post retirement income streams.

- Sensitivity to mortality changes increases with age. Projecting Australian mortality, Sherris and Njenga (2011) calculate capital requirements for a 99.5% VAR of the order of 5% of present values. These amounts would not be excessive even if the 40% of GNP were invested in guaranteed life annuities, although it would require a doubling of the current capitalization of the Australian life insurance industry.

There is, however, the additional consideration that any deviations from expected mortality would almost certainly be auto-correlated – with losses in any one year being followed by losses subsequently – so that the providers would be faced with the need for regular recapitalization, probably at increasingly less favourable terms. While the current philosophy of regulation permits it, it is not clear that such a situation is really viable.

Willetts et al (2004) show that international experience suggests that rates of improvement can easily vary from 1% to 3% pa. A 1% deviation from expected is therefore quite likely. The IMF (2012) reports on the cumulative cost of 3% pa improvement in mortality to 2050 as 50% of world GNP. If one third of this was born by the private sector, then it would roughly represent the capitalization of the financial services industry. The losses would however be spread over forty years, so it not inconceivable that they be managed – although life insurance would need to be much better capitalized than currently.

The other possibility – of significant profits being made from mortality that does not improve as rapidly as expected – may also be difficult for the industry to sustain politically.
What is clear is that significant changes to the financial services industry is required if guaranteed annuities are to become available, and that profit expectations will need to be high to create such changes. Turner’s view that the premiums will be too high is probably correct.

It can be noted that this view contrasts starkly with claims such as made by Choi et al (2010) that the total trading volume of Korean futures of “about five times Korean GDP ... implies that ... any futures-based hedging programs for VA products will not run into market capacity issues.” Turnover statistics of this magnitude must represent significant multiple counting of the same positions. The real question is how much capital is available at any one time to absorb the losses?

**Guaranteed life annuities**

Even with the current very limited market for guaranteed annuities in Australia, it is clear that the costs of guarantees are already high. The annuity rates from Comminsure and Challenger for a CPI linked annual annuity, for a 65 year old male, were 4.8% and 5.9% of the premium respectively - in early 2011.

The internal real rate of return is probably 2% to 3% - which is relatively generous compared with Commonwealth indexed linked investments, but much less than the over 5% gross dividend yield available on Australian shares. Although dividends can decline (by 30% or so since 2008 and by a perhaps even more in the early nineties), the risk reward ratio appears disproportionate. Many retirees are likely to be persuaded to attempt to live off the dividends and keep their capital.
### Appendix 2: Some historical bonus rates

#### Old Mutual

The Old Mutual performance is reported on their website.\(^9\)

#### Table 1: Old Mutual “Optiplus” bonus rates

<table>
<thead>
<tr>
<th>AIR*</th>
<th>3.50%</th>
<th>4.00%</th>
<th>4.50%</th>
<th>5.00%</th>
<th>5.50%</th>
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<tr>
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</tbody>
</table>

* Assumed investment rate of return

The table shows the increase in pension as a consequence of the declared bonus rate for different after retirement interest rates. Before 1994, it seems that all pensions were at calculated at 3.5%, but more optimistic options were later permitted. The higher the after retirement interest rate, the lower the bonus.

The differences between the columns of the table should be about 0.5% (being the difference in the after retirement interest rate). It varies because the pensions are all guaranteed not to reduce (there are no negative bonus rates) and this guarantee costs more for higher after retirement rates.

The table below shows the real increase in pension each year after adjusting for inflation. It should be noted that the past 17 years were relatively good for investors with inflation averaging 7.5% and the performance underling the investments being some 13.4% for the lower after retirement interest rates.
Table 2: Real increases (reductions) in pensions

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<th>ARI*</th>
<th>3.50%</th>
<th>4.00%</th>
<th>4.50%</th>
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<tr>
<td>2009</td>
<td>2.70%</td>
<td>2.10%</td>
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<tr>
<td>Average</td>
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<td>2.67%</td>
<td>2.09%</td>
<td>1.50%</td>
<td>0.88%</td>
<td>0.37%</td>
<td>-0.16%</td>
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</table>

**TIAA CREF**

The TIAA-CREF Retirement strategies publication\(^10\) provides a review of their wide variety of products, but only shows performance until 2006. Four of the tables from that document are re-produced below to show the impact of some of the different investment strategies on the annual pension. The subsequent development over the financial crisis of the past 5 years would be much lower returns; the effect on pensions can be estimated from the returns on their website.\(^11\)
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<thead>
<tr>
<th>CRE: Global equities fund</th>
<th>CREF: Real estate account</th>
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<table>
<thead>
<tr>
<th>CREF: Inflation-linked bond account</th>
<th>TIAA: Traditional interest rates</th>
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- For the global equities fund, the website reports that the last 5 years have shown a return of approximately zero on average. The annuity can therefore be estimated to have declined to about 15.7, which is still slightly above the initial value of 14.8.
- The real estate fund has produced an average of -1.86% pa, which means that the annuity can be estimated to be about 12.4, which is also above the initial value of 10.1.
- The inflation linked account has performed much better at 6.47% pa, meaning that the pension has continued to increase and would now be estimated to have increased to 14.5.
- The TIAA traditional interest rate products are not shown in the same way, but if they were calculated at the 4% graded rate recommended, then they would have increased by 26% between 1997 and 2005 – and a little more subsequently (although the website is not entirely clear on the appropriate rate to use over the last few years.)
1 See for instance: http://www.telegraph.co.uk/finance/personalfinance/savings/2783961/With-profits-bonds-smooth-out-the-shocks.html

2 Anything less exposes pensioners to an unacceptable loss of purchasing power if inflation rises unexpectedly. Commodity shortages and large government deficits make this a distinct possibility at some point over the next 40 years that make up the potential lifetime of recent retirees.

3 Regulation 1.05 11A (a) defines a flexible account balance annuity that appears to govern most annuity types currently sold – with a similar section in regulation 1.06. It is believed that these regulations would also cover pooled annuities where the benefit is determined with reference to a balance. This paper used the terms pensions and annuities interchangeably as they are for all practical purposes, unless one is unfortunate enough for legal definitions to assume practical significance.


7 From the Australian Office of Financial Management


10 http://www.tiaa-cref.org/ucm/groups/content/@ap_ucm_p_tcp/documents/document/tiaa01007910.pdf