This report is prepared on behalf of
UNSW Global Pty Limited

Longevity Management Issues

for

Australia's Future Tax System, The Treasury

Author:

Professor Michael Sherris &
Associate Professor John Evans
Australian School of Business
The University of New South Wales

24 August 2009

Authorised Contact:

Amber Ahuja

T: +61 2 9385 3175
F: +61 2 9662 6566
E: a.ahuja@unsw.edu.au
W: www.consulting.unsw.edu.au

PO Box 6666
UNSW NSW 1466
AUSTRALIA

Table of Contents

Page

1 Brief

We have been invited to submit a report on various issues relating to the provision of annuity and similar longevity risk management products in Australia.

We have been specifically requested to provide information on:

(i) The role of the government and private sector in meeting risks

a) If the private sector were to provide a guaranteed income for the life of the annuitant, would the private sector be able to hedge the risk associated with longevity, interest and inflation risk?

b) What is the role of government in the production of longevity indices?

c) Would there be significant asset liability mismatching if the government did not support these risks through the offering of inflation and longevity bonds? What is the value of inflation and longevity bonds from the perspectives of both the government and product issuers?

(ii) Pricing of products

To make a decision on an appropriate annuity Treasury seeks modelling on how much income a person would receive from a $100,000 investment under the following options:

a) a private sector product: a guaranteed lifetime income annuity purchased at age 67 for (i) immediate annuity commencing at age 67 (ii) deferred annuity commencing at age 85, (iii) the impact on the income from the product if it was compulsory to purchase such a product (both immediate and deferred), (iv) the impact on the income from the product if it was voluntary to purchase such a product (both immediate and deferred).

b) Private sector deferred guaranteed income pension: what is the effect on income if there was a decreasing return of capital in the event of death (eg, 100 per cent return if the person dies in the first year, then decreasing to age 85)?

c) Private sector pooled non-guaranteed income product: the product would commence from age 85 from which the person would receive an income from the pool based on their contribution. The income would include part of their capital plus a survivor bonus. What are the potential differences in income over retirement between a privately managed deferred guaranteed and pooled non-guaranteed income product? What would be an expected range over time? What effect would a decreasing return of capital on death have on the expected returns from the pool?

d) Public sector guaranteed pension: Does the government provide economies of scale which would make an annuity (either immediate or deferred) cheaper for retirees if it was publicly provided? What is the impact on income if the product is individual rated or community rated?

e) What are the potential future liabilities for government associated with taking on additional longevity, interest and inflation risk by offering an immediate or deferred product (i) if it was voluntary (ii) if mandatory.

2 The Nature of Longevity Risk & the Difficulties of Managing the Risk

Longevity risk refers to the uncertainty of the age of death.

The Australian Institute of Health and Welfare suggests there are several factors, some negative, and some positive that affect longevity, as outlined in their following commentary:

> *"There are both positive and negative influences on mortality and life expectancy, such as improving socioeconomic conditions (positive) or increases in a certain cause of death (negative). In many developing countries, increasing child survival and infectious disease control is leading to increasing life expectancies. However, in some sub-Saharan countries severely affected by the HIV/AIDS pandemic, life expectancy has decreased in the past two decades due to increases in premature death (www.unaids.org).*
>
> *In most developed countries, life expectancy has been increasing steadily since the middle of the 20th Century, due mainly to the near-eradication of infectious disease and high standards of living (which includes diet, sanitation and healthcare). However, even in developed countries these positive influences on life expectancy may change when looking at population sub-groups. For example, life expectancy among African-Americans decreased throughout the late 1980s, due in part to increasing rates of HIV infection and homicide which offset other positive influences (Kochanek, K.D. et al. 1994. Am. J. Pub. Health 84(6): 938-44).*
>
> *Public health campaigns and cultural change may also have a measurable influence on life expectancy. In Australia, the rise in cigarette smoking in the middle of the 20th century resulted in large increases in mortality from lung cancer, cardiovascular disease, respiratory and other conditions. These increases in mortality had a retarding effect on life expectancy, especially in the 1960s (see Australian trends). Public health campaigns and changes in pubic health regulation began to reduce smoking rates. The effect of legislation, rises in tobacco taxes and other health promotion activities is now starting to become evident in the mortality rates and other measures. A sharp decline in the proportion of males who are smoking has been followed by a decline in the incidence of male lung cancer. A rise in smoking prevalence among females in the latter part of the 20th century has been followed by a rise in the incidence of female lung cancer (although female smoking rates are also now in decline).*
>
> *Increasing rates of chronic disease may now have a growing negative influence on life expectancy in both developed and developing countries. This is also the case for chronic disease risk factors, such as obesity and overweight. Indeed, recent research in the United States suggests that high obesity levels may lead to decreasing life expectancy in*

that country during the 21st Century (Olshansky, S. et al. 2005. Obstetrical and Gynecological Survey 60(7): 450-452)." [1]

It is these interacting factors that produce uncertainty in determining expected longevity.

Whilst generally, in Australia there has been a trend to increasing longevity as illustrated by the following table, the rate of change has not been constant as illustrated by the subsequent graph.

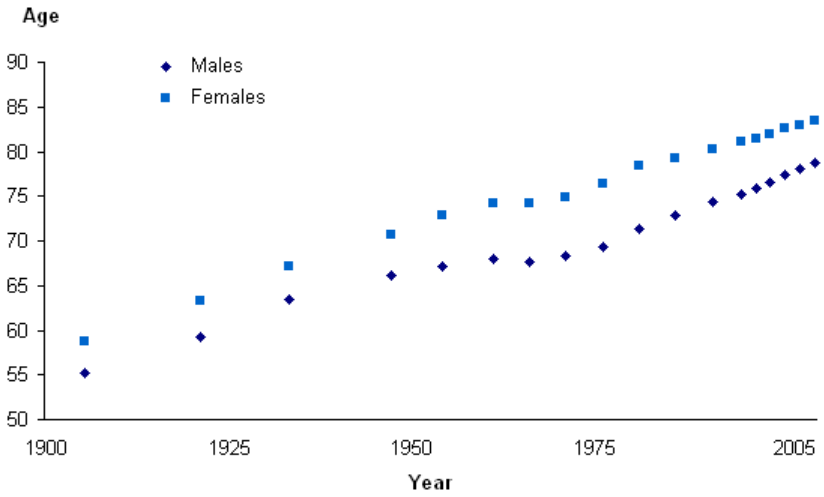
Life expectancy (years) at selected ages, 1901-10 to 2004-06(a)

	At Birth		At age 15		At age 65	
Year	Male	Female	Male	Female	Male	Female
1901-10	55.2	58.8	49.0	51.9	11.3	12.9
1920-22	59.2	63.3	51.4	54.6	12.0	13.6
1946-48	66.1	70.6	54.3	58.3	12.3	14.4
1960-62	67.9	74.2	55.1	61.0	12.5	15.7
1980-82	71.2	78.3	57.4	64.3	13.8	18.0
1990	73.9	80.1	59.8	65.8	15.2	19.0
1991	74.4	80.4	60.2	66.0	15.4	19.1
1992	74.5	80.4	60.3	66.1	15.4	19.2
1993	75.0	80.9	60.8	66.5	15.7	19.5
1994-96	75.2	81.1	60.9	66.7	15.8	19.6
1995-97	75.6	81.3	61.3	66.9	16.1	19.8
1996-98	75.9	81.5	61.5	67.1	16.3	20.0
1998-2000	76.6	82.0	62.2	67.6	16.8	20.4
2000-02	77.4	82.6	63.0	68.1	17.4	20.8
2003-05	78.5	83.3	64.1	68.9	18.1	21.4
2004-06	78.7	83.5	64.3	69.0	18.3	21.5

Sources: ABS Cat. No. 3302.0; ABS Cat. No. 3105.0.65.001.

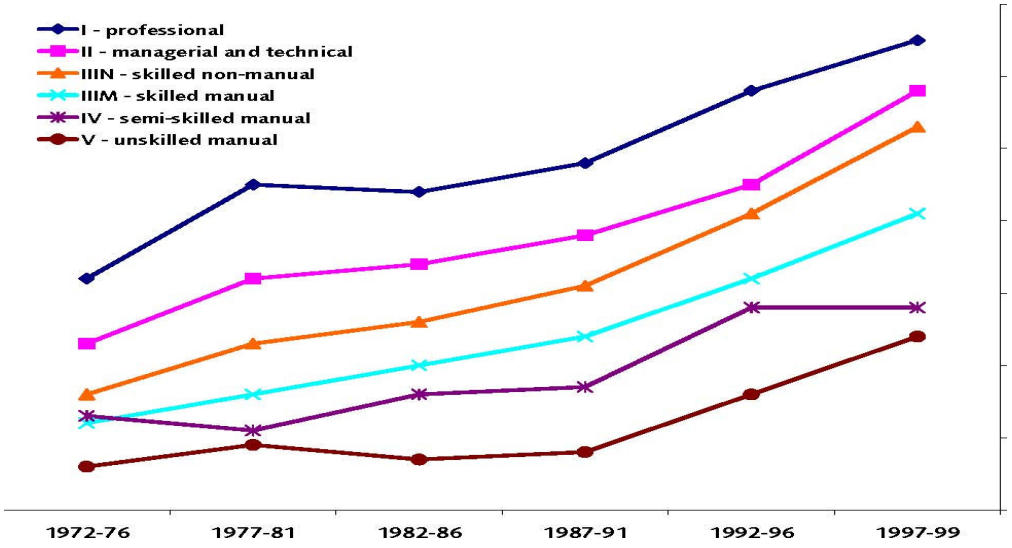
[1] Australian Institute of Health and Welfare web site

Expected length of life at birth, by sex, Australia, 1901-10 to 2004-06



The above table indicates that gender is a major determinate of longevity risk, with females continuing to live longer on average than males.

Longevity risk is also not constant across socio economic groups as illustrated by the following data from the UK[2]:



This differential of improvement in longevity by socio economic group would also affect the pricing of financial products providing lifetime income as it would be reasonable to imply that

[2] Richards s, Jones G (2004) "Financial Aspects of Longevity Risk" presentation to Staple Inn Actuarial Society

compulsory conversion of superannuation benefits to an annuity through a national arrangement for example should have improvements on average lower than would occur if the conversion were voluntary and through private sector products.

Longevity does not appear to vary much by region based on the following UK data:

Life expectancy, 2005-2007

Years

	At birth		At age 65	
	Males	Females	Males	Females
United Kingdom	77.2	81.5	17.2	19.9
England	77.5	81.7	17.3	20.0
Wales	76.7	81.1	16.9	19.6
Scotland	74.8	79.7	16.0	18.7
Northern Ireland	76.2	81.2	16.8	19.7

Source: Office for National Statistics: Interim Life Tables 2005-07

In order therefore to offer any form of financial product that guarantees payments to death, the issuer needs to be able to make estimates of:

- Possible changes in socio economic conditions of the insured population
- Possible changes in the ability to treat diseases
- Possible wars and pandemics

To date, the ability to predict these issues and their interaction has not been very successful. By way of illustration, one of the more common longevity models is known as the Lee Carter[3] model, and in their paper that looked at the error from using this model across various countries, Booth et al[4] found that using data from 1900 to 1989 to determine the Lee Carter model parameters, and then applying the model to deaths from 1986 to 2000, resulted in an average underestimate for expected life in Australia of 1.1 years for males and 0.8 years for females. There was significant variation in the model errors across the 10 countries.

Consideration of the nature of longevity risk suggests an appreciation is best gained though considering the risks broken down into[5]:

- A “known/ known” component, i.e. risks that can be predicted and reasonably modelled

[3] Lee R D, Carter L R. (1992). “Modelling and forecasting U.S. mortality.” Journal of the American Statistical Association, 87: 659–675.

[4] Booth R, Hyndman L, Tickle L and de Jong P (2006) “ Lee Carter Mortality Forecasting: A Multi Country Analysis of Variants and Extensions” Demographic Research Volume 15 Article 9

[5] Ganegoda A, Evans J, “Measuring Operational Risk in Financial Institutions” Finsia Journal of Applied Finance Issue 4 2008

- A “known/ unknown” component, i.e. risks that can be identified, but their modelling is difficult and unreliable
- An “unknown/ unknown” component, i.e. risks that are not known and therefore cannot be modelled.

Using this type of component analysis, longevity risk can be considered as being made up of:

- A general improvement trend from socio economic improvements(i.e. the “known/ known” component)
- Some variation around the longer term improvement trend (i.e. the “known/ unknown” component)
- Sudden changes from wars, pandemics and disease management (i.e. the “unknown/ unknown” component).

Whilst the known/known risk is easily managed as it can be modelled and therefore appropriate allowances made in pricing, the known/unknown risk is more difficult as its modelling is uncertain, and the unknown/unknown risk is impossible to manage as it is not predictable, and therefore appropriate allowances for these possible changes is not feasible.

To date, issuers of lifetime annuities have probably allowed for these risk components through conservative assumptions, which inhibits the development of the market, and reliance on bankruptcy as a means of escaping severe effects of the unknown components.

3 Current Longevity Risk Management Private Sector Products

The extent to which a market has evolved for longevity risk management products would seem to be related to whether superannuation proceeds must be taken in the form of an annuity, and the extent to which the products are seen to be fairly priced.

3.1 Types of Annuities

The major type of longevity risk management product offered is an annuity, with the major variants being:

- **Fixed** or **Variable Income,** with the "fixed income" version providing regular fixed dollar amounts of income defined at the purchase date, and the "variable income" version where the income is either varied according to performance of investments or the change in inflation.
- **Deferred** or **Immediate Income,** with the deferred version offering income from a specified age provided the annuitant has survived to that age.
- **Lifetime** or **Fixed Term Income,** with the former continuing until death, and the later for a set period, regardless of whether the annuitant is alive or not. There is also a hybrid version where the lifetime annuity is paid for minimum period regardless of whether the annuitant is alive or not, and then continues until death.
- **Joint Income** where the income continues until the death of two lives.
- **Enhanced annuities** offered to people with poor health (e.g. Cancer, high blood pressure), and these pay a higher level of income than is the case for healthy annuitants.

3.2 Overview of Annuity Markets

The US and UK have well developed annuity markets, with many large insurers offering many different types of annuities. In the UK, 40 firms offer annuities, with the top 5 having 61% of market[6]. But the market would appear to exhibit stability problems in terms of product offering with several insurers withdrawing their variable annuity products from the market[7]. The reason for the withdrawal seems to be related to income guarantees, which reflects difficulties with the private sector being able to manage the risks involved with these types of products on a sustainable basis.

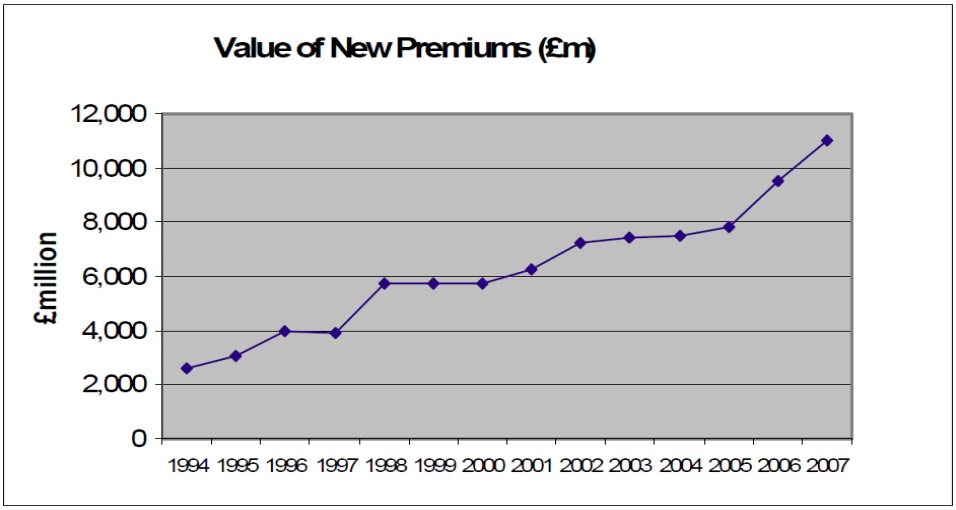
[6] Lewis (2009), HM Treasury "The UK Annuities Market: Structure, Trends & Innovation, International Conference on Annuities Markets" presentation to International Conference on Annuities Markets Tokyo 29-20 January 2009

[7] Financial Times, Wednesday July 8th 2009 "Variable Annuities Dealt New Blow"

Recent annuity sales in the US have been[8]:

Year	Variable Annuity $US Billion	Fixed Term Annuity $US Billion	Total Purchases $US billion
1999	123.0	41.7	164.7
2000	137.3	52.7	190.0
2001	113.3	74.3	187.6
2002	115.0	103.3	218.3
2003	126.4	89.4	215.8
2004	129.7	87.9	217.6
2005	133.1	79.5	212.6
2006	157.3	78.3	235.6
2007	182.2	72.8	255.0

In the UK, the following graphs indicate the market is growing considerably[9]:



Source: ABI (www.abi.org)

[8] Morningstar, Inc. and LIMRA International

[9] Lewis (2009), HM Treasury "The UK Annuities Market: Structure, Trends & Innovation, International Conference on Annuities Markets" presentation to International Conference on Annuities Markets Tokyo 29-20 January 2009

The Australian market is not well developed relative to the UK and US where there is a low and falling demand for life annuities as demonstrated by the annuities issued over the last few years[10]:

	Number of annuities		Total Purchase Price ($m)	
Year	Life	Term	Life	Term
2001	1,927	11,072	166	794
2002	1,750	15,004	154	1,096
2003	1,477	18,606	200	1,357
2004	2,801	37,296	281	2,758
2005	293	7,233	27	548
2006	341	6,565	29	530
2007	374	7,327	36	787

However, fixed term and lifetime annuities are available, and immediate annuities can include a range of features, including inflation indexation. Some insurers are beginning to offer a larger variety of products, with AXA recently offering a variable annuity with investment guarantees.

The consumer view of annuities however remains negative, with the attitude in the UK being summarised as[11]:

> *"Annuities offer the benefits people want from a retirement income: simplicity, security, a guaranteed income level and little or no risk. Yet there remains some opposition to the requirement to annuitise: people argue that annuities are poor value for money or inflexible;*
>
> *or that they should be able to pass on accumulated savings to heirs".*
>
> *and this was despite the view in the same paper that "a sizeable body of independent research – including the most comprehensive ever UK pricing survey published in March 2006 – suggests annuities are priced fairly".*

In summary, it would seem that despite the sales in the US and the UK, consumers perceive the products offered as poor value and Institutions continue to have difficulty offering products on a sustainable basis that consumers are happy to buy.

[10] Plan for Life Research, The Pension and Annuity Market Research Report, Quarterly 1999-2007.

[11] HM Treasury, 2006, "The Annuities Market"

4 Hedging Issues for a Private Sector Lifetime Annuity

The major risks involved in the provision of annuities by the private sector are:

- Investment return, as the return from time to time will be volatile around some assumed average, and whilst exposure to the more volatile assets should produce a longer term greater return than more conservative strategies, (and hence a lower price) the greater exposure to the volatile assets introduces greater variance in the return each year;
- Mortality of annuitants, as the socio economic composition of the insured group will be difficult to manage, and may change over time under a voluntary purchase arrangement, and the incidence of major changes in mortality, both positive and negative are impossible to estimate;
- Expenses of operation as this will be generally relate negatively to inflation and positively to productivity gains, both of which are difficult to estimate over time.

In managing these risks, insurers need to either transfer them to other parties, or remove them entirely, and manage the residual risks through provision of capital to ensure that the insurer's balance sheet remains healthy when adverse events occur.

In assessing the capital required, insurers need to allow for the occurrence of adverse events for all risks at the same time, and they then need a return on this capital to meet shareholders' expectations.

Whilst sharing of risks across the economy does not reduce the risk, what it can do is reduce the capital required, and hence the return required, if members of the economy can be found where some of these risks would be negatively correlated with their existing risks. Diversification of the risks inherent in annuities should therefore reduce costs, and should be encouraged, subject to consideration of the credit risk then introduced.

4.1 Ideal Transfer Products

Considering the lifetime guaranteed annuity, as it involves the longest term and hence the greater uncertainty for the issuer, the ideal financial products that they would need to transfer the appropriate amount of risk would be:

- Investment risk: in order to maximise the investment return over the term of the annuity, and therefore reduce the costs, the issuer would want to hold shares, but shares have a high volatility of return in the short term. It is the volatility that needs to be hedged, and this could involve the use of options to remove the more serious adverse returns, or at the extreme, a "swap" where the insurer could sell their return on their portfolio to another party in return for a fixed return, or a lower volatility of return over the life of the annuity. Options that can provide downside protection are available in the Australian market, through the ASX and are available for individual shares or to cover the broad market, with contracts available for the following March, June, September and December. Longer term options would need to be negotiated individually through investment banks. A

"swap" would then involve the counter party taking on the risk of the return generated by the insurer, as well as the risk of the term of the annuity and would be difficult to price, and hence is not likely to be a viable option unless government were to provide such a product.

- Mortality risk: ideally, an issuer of lifetime annuities would want to hedge the risk that annuitants on average lived longer than expected. The mortality risk is very long term, and assuming the issuer would want to be protected from more favourable mortality as soon as the contract was issued, then the protection would involve the counter party taking on a 30+ year liability. There is also the difficulty that the portfolio taken on by any issuer might have biases relative to the general population, making pricing of protection on an indemnity basis difficult. The credit worthiness of the counter party would also be an issue over such a long period. At the moment, the only protection available to issuers of lifetime annuities against adverse mortality risk is through reinsurance contracts where effectively, part of the annuity is sold to the reinsurer. Attempts to create long term longevity bonds in the alternative risk market that would protect issuers of annuities from adverse mortality have been attempted, but failed to find investors[12]. Apart from being a complex bond structure, it is likely the term of the bond was a deterrent as well, as most "Catastrophe Bonds" that have been sold to the market have been around 3 years duration. As indicated by the OECD[13]:

  > *Viewed in retrospect, the most successful launches of new capital market instruments during the past decade have been undertaken in an environment where initially there was a fair balance between participants with buying and selling interests. If markets are relatively biased towards one side, it may be difficult to launch a product due to lack of interest in and understanding of business characteristics. Consequently, the price will typically be established at a level that is not deemed attractive. In the case of longevity bonds, the most obvious challenge is the lack of natural investors who would benefit from an unexpected rise in life expectancy. Pharmaceutical companies and care providers are often mentioned as examples of investors with a natural interest in assuming this risk. These sectors would be exposed to losses if life expectancy decreases, and thus the companies would be able to hedge their own exposures by issuing longevity bonds. In spite of the theoretical arguments, it is more than doubtful whether the natural investors would actually enter into these transactions, due to corporate governance considerations, among other things. For example,*

[12] EIB Longevity Bond promoted by BNP and Partner Re November 2004

[13] OECD Monetary Review, 4th Quarter 2007

it is debatable whether a company would be able to explain to its shareholders how it can benefit from entering into transactions that may influence profits in a distant future. If this obstacle can be overcome, it is also uncertain whether the potential volume would be more than a drop in the ocean when compared with the overall demand in the pension industry.

Another challenge in relation to establishing a market for longevity bonds is that the underlying characteristics differ significantly from those of other types of financial instrument, such as mortgage-credit

bonds, where the risk premium is determined on the basis of the development

in the credit quality in the mortgage-credit market. The process related to development in life expectancy is characterised by a high duration and low volatility, particularly in recent years, If a comparison is made with the development in credit quality in the mortgage-credit market (illustrated by growth in GDP at factor cost), the duration is lower and the volatility substantially greater. The reason is that the economy has historically gone through complete business cycles in less than 10 years. Consequently, an investor in mortgage-credit

bonds does not have to wait many years to realise whether the investment was profitable. In addition, economic indicators are frequently published, giving an idea of future developments.

It is unlikely that a longevity bond market would develop without government support.

- Expense/ Inflation risk: ideally, an issuer of a lifetime annuity would want to be able to purchase an instrument similar to an option on a stock market, to protect itself against adverse inflation of costs, but this would need to be an instrument of some 30 year's duration. There is no capital market product available that offers protection against inflation of expenses, and given the duration required, this market is not likely to develop without government support.

5 Government Role in Facilitating Hedging Facilities for the Private Sector Annuity Market

The private sector annuity market needs to manage a number of major risks in order to allow it to make most efficient use of risk based capital. In order for individuals to be provided with lowest cost annuities the major risks faced by annuitant providers need to be hedged in financial markets. Without this hedging the risks faced by annuitant providers are often considered to be too large and too uncertain for providers to bear. The major risks for life annuitant providers are the longevity risk as well as the inflation indexation risk for fully indexed life annuities.

For the inflation risk some mitigation is possible by offering only fixed indexation rate life annuities or by using a cap on the maximum level of indexation. If full indexation is considered most desirable then life annuity providers will want to hedge inflation indexed long term cash flows that reflect life annuity cash flows.

By offering both long term CPI linked bonds and longevity bonds the government provides a viable market for hedging the long term risks facing life annuity providers and reducing the costs of the annuities hence making them more attractive to retiring individuals.

Longevity bonds pay future returns based on an index of population mortality. They allow purchasers to receive payments based on future mortality rates for the population as mortality changes according to published mortality tables. They do not directly hedge a particular annuity provider's mortality risk but do so at the population level. Other financial contracts such as mortality swaps and other derivative and reinsurance based contracts can be developed to manage the basis risk between the population mortality and individual provider's experience.

An important issue in hedging risks that is now well understood following the credit crisis, is the credit risk of financial intermediaries including those providing risk management instrument such as derivative and reinsurance contracts. Even in the securitization market, where collateralization has normally been at full coverage, there have been credit impacts especially where these arrangements relied on interest rate swaps or other hedging instruments. Those securitization arrangements that have not been fully collateralized, such as synthetic CDO's, have resulted in substantial losses for major financial players as well as investors of individual savings including retirement savings.

The government has the strongest credit rating and provides the assurance of contract performance that many private sector providers will not have.

The Australian government has previously issued long term inflation indexed securities and has the market experience and knowledge to efficiently provide underlying securities for inflation risk. Providing loans structured as inflation indexed annuity cash flows will provide even more demand for such securities in the event of the development of a more viable life

annuity market in Australia. These securities are also the base for other bespoke inflation hedging derivative instruments that can then be purpose designed for life annuity providers.

Similar comments apply to longevity linked securities. Although the Australian government may not be a natural supplier of such securities because of its exposure to longevity risk through the age pension, providing such instruments and creating a viable life annuity and longevity risk market will reduce the potential future call on government revenues from ageing Australians running out of their retirement savings.

6 Prudential Capital Issues & Role of Inflation and Longevity Bonds

In the absence of viable or affordable hedging instruments for longevity, interest rate and inflation risks private life annuity providers must hold capital to absorb adverse developments in these risks. In the insurance industry risk based capital is determined by life insurance prudential standards and increasingly influenced by Solvency II under development in Europe for insurers. Capital can be costly to hold for insurers. Apart from the competitive return demanded by investors on capital, insurance companies have to price products to cover the risk costs of capital ranging from expected financial distress costs, additional transaction or taxation costs as well as potential agency costs arising from misalignment of interest of policyholders and shareholders. These can lead to inefficiencies in pricing and an unmet demand of potentially valuable risk based products.

Solvency II includes requirements for holding capital to absorb the change in liabilities for a permanent 25% decrease in mortality to cover longevity risk. This may understate the potential risk since it there is a large degree of uncertainty around possible future mortality trends. In the computation of annuity prices in this report this has been the basis used for determining the effect of risk based capital. It would generally be regarded as a significant adverse development in longevity.

Capital is also required for other risks that cannot be hedged. These include inflation risks, where the life annuities are issued on a fully indexed basis, as well as interest rate risk where there is lack of a long dated and actively traded government bond market and also a thinly traded long dated interest rate swaps market.

7 Sample Annuity Prices

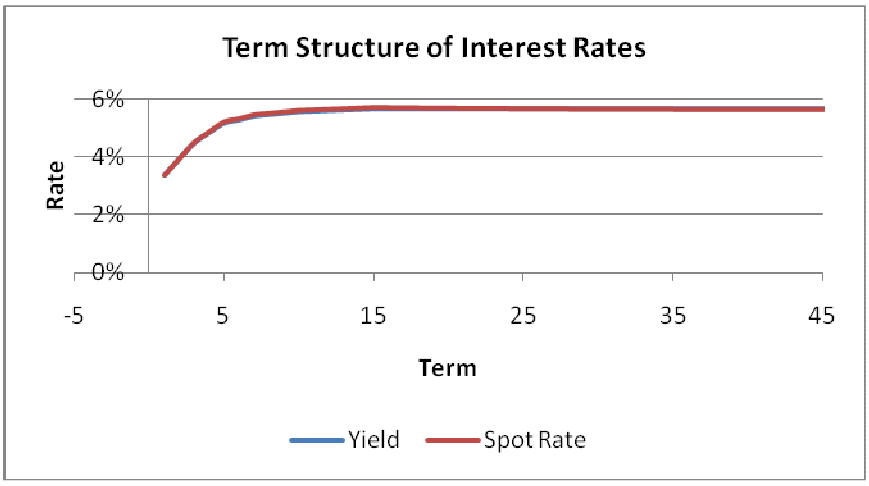
In Tables 1 to 4 sample life annuity values using assumptions for the underlying mortality, interest rates and indexation levels are summarised. The annuities that have been valued are as follows:

Compulsory Immediate (commencing age 67)
Voluntary Immediate (commencing age 67)
Compulsory Immediate (commencing age 67) with Capital Reversion
Voluntary Immediate (commencing age 67) with Capital Reversion
Compulsory Immediate (commencing age 85)
Voluntary Immediate (commencing age 85)
Compulsory Deferred (issue age 67, commencing age 85)
Voluntary Deferred (issue age 67,commencing age 85)
Compulsory Deferred (issue age 67,commencing age 85) with Capital Reversion
Voluntary Deferred (issue age 67, commencing age 85) with Capital Reversion

For all annuities the expected cash flows based on survival probabilities are valued using a current (end June 2009) yield curve from government bonds quoted on Bloomberg to provide a term structure of interest rates. The yield rates used were as follows and the fitted yield curve used for valuation is given in Chart 1:

Chart 1: Term structure used for annuity valuations

Australian Government Bonds			
http://www.bloomberg.com/markets/rates/australia.html			
	COUPON	MATURITY DATE	CURRENT PRICE/YIELD
1-Year	5.25	08/15/2010	102.05 / 3.39
2-Year	5.75	06/15/2011	103.33 / 3.97
3-Year	5.75	04/15/2012	103.24 / 4.51
4-Year	6.5	05/15/2013	105.69 / 4.87
5-Year	6.25	06/15/2014	104.59 / 5.19
6-Year	6.25	04/15/2015	5.3 / 5.30
7-Year	6	02/15/2017	5.43 / 5.43
10-Year	5.25	03/15/2019	97.54 / 5.58
15-Year	5.75	05/15/2021	100.54 / 5.68



For the compulsory annuities the values are based on Australian Population mortality tables using the latest ABS[14] life tables ALT2005-2007 extracted from the Human Mortality Database. Annuity values are also determined without and with mortality improvement. To quantify the possible effects of improvement, the rate of improvement at individual ages was determined based on the last 5 years of life table data and also the last 25 years. A percentage rate of improvement by age was determined and this rate was assumed to continue into the future. All survival probabilities were determined on a cohort table basis to incorporate mortality improvement for both ages 67 for immediate annuity values and age 85 for immediate annuities at this age. Population mortality rates for male and female showing the differences between the survival proportions of those alive at age 67 are shown in Charts 2 and 3. Unisex rates are based on a weighted average of the male and female rates based on the proportion of male and female lives at each of the ages.

Compulsory annuities are determined using population mortality rates so that there is no selection effect included in the mortality rates. Voluntary annuity rates are based on the Australian Actuarial Standards which use 60% of IM80/IF80 as the basis for life annuity valuations to allow for selection of lives. This mortality assumption has been used for determining the voluntary annuity values to reflect the effect of adverse selection. Since in practice it is better to use actual annuitant mortality for these calculations we have also estimated Australian annuitant mortality based on UK annuity data to determine relative annuitant to population mortality for UK lives and to apply these percentage reductions to Australian population mortality. The UK annuitant data was based on the most recent CMIB mortality analysis. These mortality rate calculations are shown in the table under the CMIB column.

[14] Australian Bureau of Statistics

Chart 2: Male Australian Population survival proportions of lives aged 67 showing the effect of mortality improvement assumptions

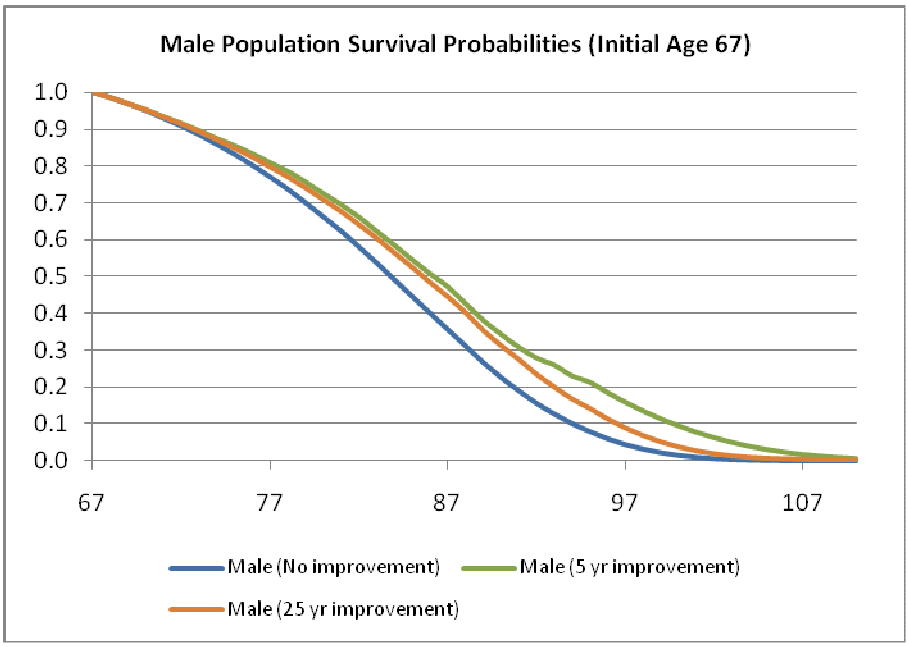


Chart 3: Female Australian Population survival proportions of lives aged 67 showing the effect of mortality improvement assumptions

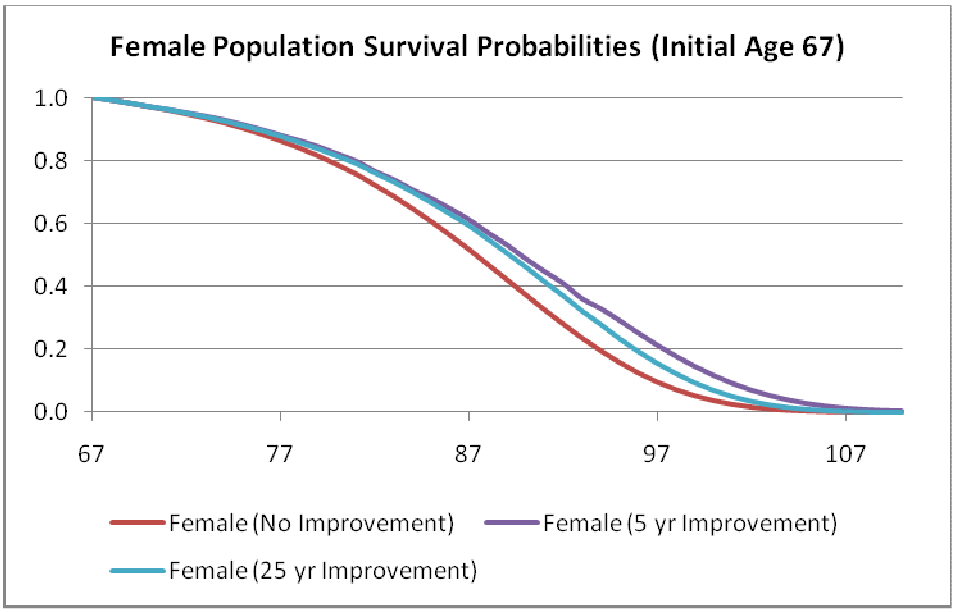


Chart 4: Assumed male annuitant survival curve for life aged 67

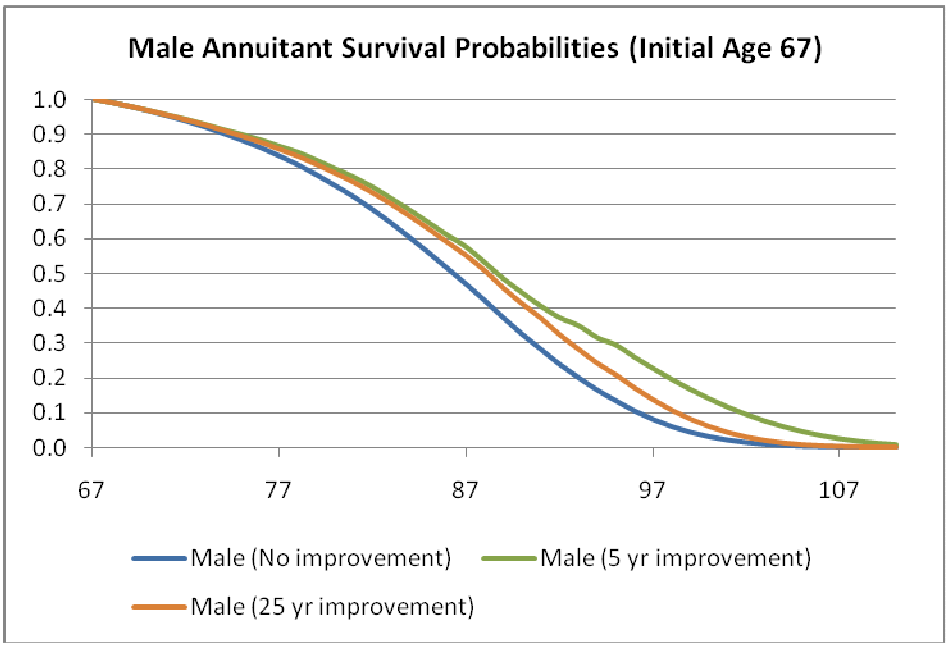
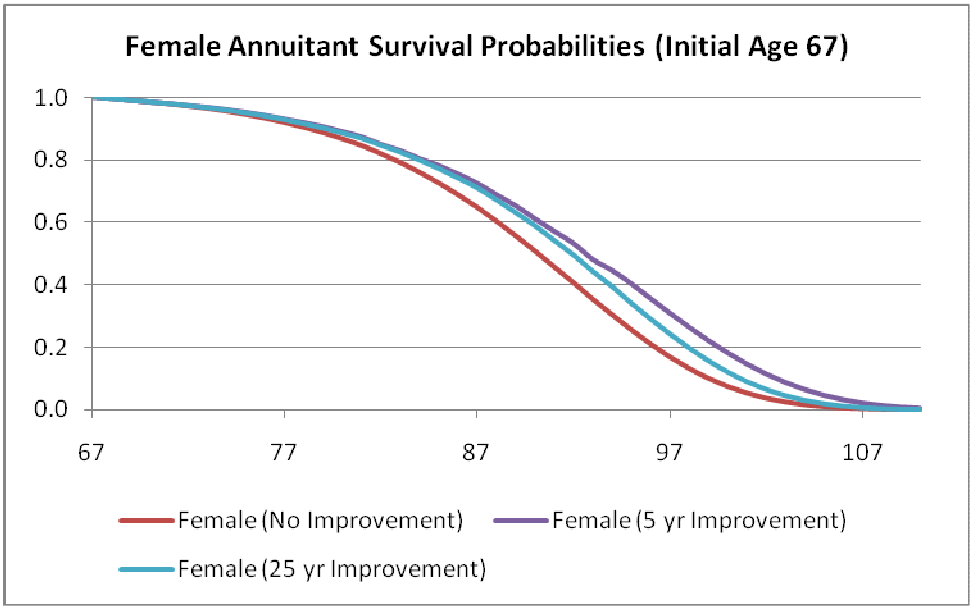


Chart 5: Assumed female annuitant survival curve for life aged 67



In order to provide an indication of the effect of costs of capital for a private insurer to issue a life annuity, allowance has been made only for longevity/mortality risk with no allowance made for interest rate or inflation risk as it has been assumed these can be hedged. The annuities allow for no indexation as well as an assumed fixed rate of indexation equal to the average of 1990-2008 inflation rates. Because the indexation rate is fixed there is no inflation risk as there would be if the rate of indexation was based on an inflation index. The assumption has been made that the interest rate risk of the expected cash flows from the life annuity can be managed using swaps, government bonds and/or a dynamic hedging strategy

and no allowance has been made for costs of interest rate risk in the private market annuity rates. This would have to be allowed for in practice however for the purposes of comparison only mortality risk is included.

The annuity rate for the private case has been determined by allowing for a cost of capital charge based on Solvency II[15] requirements where a cost of capital of the risk free interest rate plus and assumed risk premium of 6% is applied to a capital provision equal to the additional capital required to cover longevity risk arising from an immediate and continuing 25% decrease in mortality rates at all ages. The allowance for capital in the private case is only indicative of possible effects of longevity risk based on current Solvency II requirements and should not be taken as representative of the actual market differences expected. Clearly government or public provided life annuities that do not require capital to support these risks will be better value based on the longevity risk alone and the extent of this is quantified in the Tables 1 to 4.

In order to quantify the impact of community rating it is assumed that the purchase of the life annuities is compulsory for the whole population, that rates differ only by age and annuity values are priced using unisex rates which are weighted averages of male and female annuity rates. The unisex rates are the community rating annuity values.

Table 1 shows the annuity values assuming the current Australian mortality rates and no indexation of annuity payments. Public rates assume no cost of capital for longevity risk and private rates include the cost of capital for longevity risk based on Solvency II. CMIB rates are provided for the voluntary market for comparison with the Australian annuitant mortality solvency assumptions. The capital reversion is allowed for by assuming a decreasing return of capital in the event of death commencing at 100 per cent return if the person dies in the first year and decreasing by even amounts to age 85.

Chart 6 shows the relative male annuity amounts per $100,000 single premium based on current mortality with no indexation highlighting the impact of adverse selection, based on the assumed annuitant mortality, and also of the cost of capital reversion (CR).

Tables 2 and 3 show annuity rates based on no indexation and different levels of mortality improvement. Similar relative results to those in Table 1 are evident. The impact of mortality improvement results in reduced annuity payments for the same single lump sum.

Table 4 shows the annuity values assuming the 25 year trend mortality improvements and a constant 2.7% p.a. indexation. Chart 7 shows the impact of these assumptions on annuity values.

[15] European Proposed Directive for Life, Non Life and Reinsurers, February 2008

Chart 6: No mortality improvement and no indexation – impact of adverse selection and capital reversion

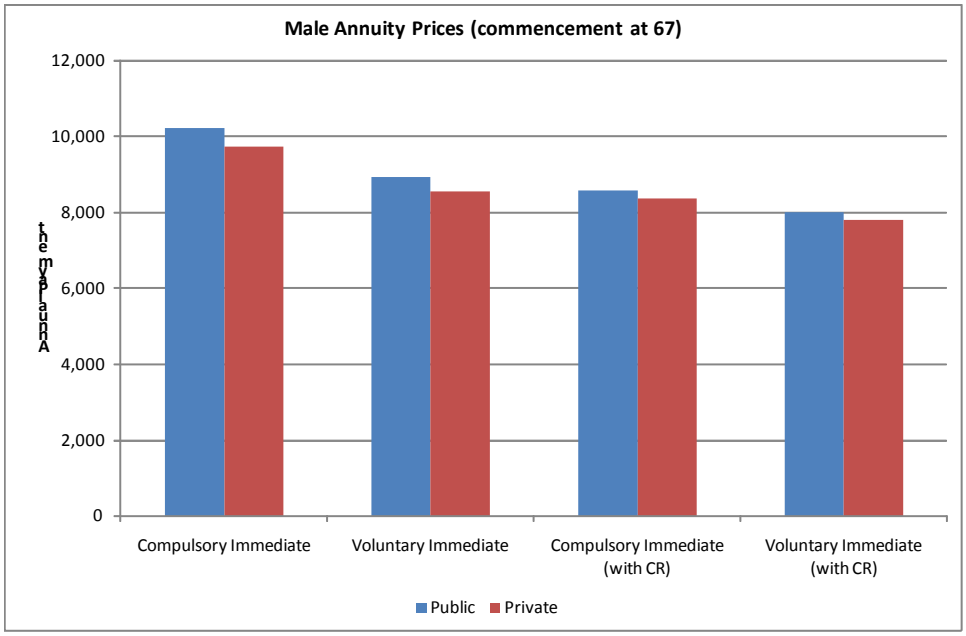


Chart 7: 25 year trend mortality improvement, cohort basis, and constant 2.7% indexation

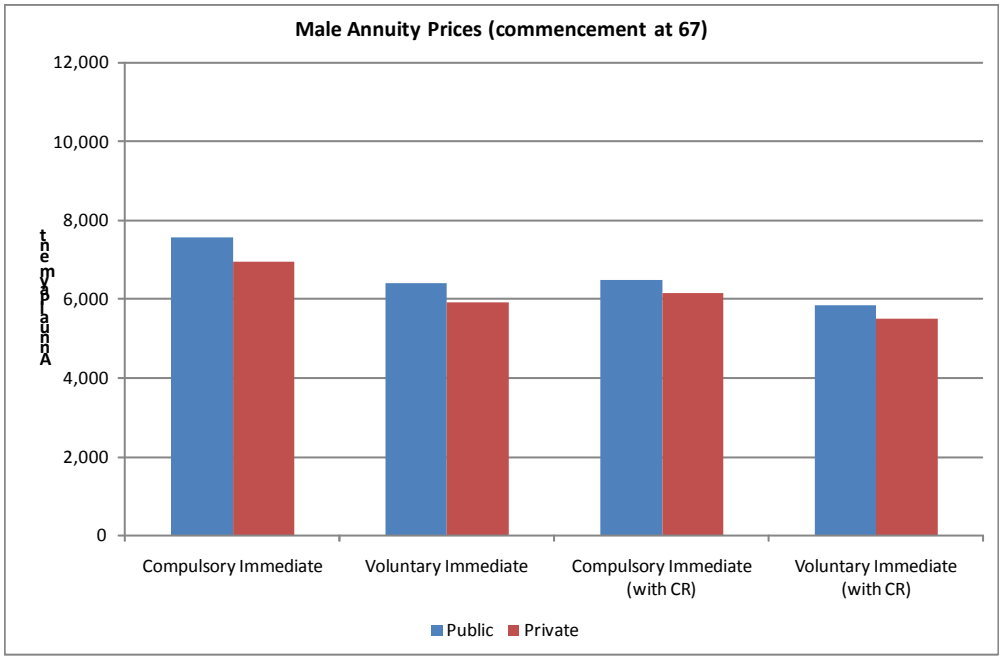


Table 1(a) & 1 (b): Sample estimated annuity rates assuming current mortality rates and no payment indexation

Table 1(a)

1st annual payment of an annuity purchased with $100,000: Public Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 10,225		$ 9,094		$ 9,524	
(ii)	$ 8,937	$ 9,405	$ 8,203	$ 8,382	$ 8,473	$ 8,760
(iii)	$ 8,573		$ 8,172		$ 8,316	
(iv)	$ 8,014	$ 8,291	$ 7,684	$ 7,860	$ 7,796	$ 8,005
(v)	$ 23,134		$ 19,583		$ 20,502	
(vi)	$ 16,895		$ 14,994		$ 15,478	
(vii)	$ 116,023		$ 74,482		$ 86,477	
(viii)	$ 64,114	$ 84,218	$ 48,283	$ 55,579	$ 53,008	$ 63,443
(ix)	$ 97,274		$ 66,937		$ 75,509	
(x)	$ 57,490	$ 74,245	$ 45,228	$ 52,119	$ 48,771	$ 57,980

Table 1(b)

1st annual payment of an annuity purchased with $100,000: Private Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 9,730		$ 8,718		$ 9,096	
(ii)	$ 8,542	$ 8,994	$ 7,902	$ 8,091	$ 8,132	$ 8,414
(iii)	$ 8,371		$ 7,976		$ 8,115	
(iv)	$ 7,803	$ 8,091	$ 7,492	$ 7,676	$ 7,595	$ 7,810
(v)	$ 21,913		$ 18,562		$ 19,422	
(vi)	$ 15,932		$ 14,181		$ 14,622	
(vii)	$ 113,420		$ 72,687		$ 84,407	
(viii)	$ 62,399	$ 82,203	$ 47,041	$ 54,249	$ 51,606	$ 61,876
(ix)	$ 95,305		$ 65,465		$ 73,874	
(x)	$ 56,096	$ 72,631	$ 44,154	$ 50,960	$ 47,594	$ 56,669

Table 2(a) & (b): Sample estimated annuity rates assuming the last 5 year improvements to current mortality rates and no payment indexation

Table 2(a)

1st annual payment of an annuity purchased with $100,000: Public Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 9,441		$ 8,596		$ 8,940	
(ii)	$ 8,304	$ 8,745	$ 7,804	$ 7,983	$ 8,010	$ 8,281
(iii)	$ 8,149		$ 7,843		$ 7,965	
(iv)	$ 7,588	$ 7,879	$ 7,381	$ 7,560	$ 7,466	$ 7,675
(v)	$ 21,729		$ 18,737		$ 19,550	
(vi)	$ 15,791		$ 14,351		$ 14,753	
(vii)	$ 73,447		$ 55,291		$ 61,734	
(viii)	$ 45,487	$ 57,265	$ 38,723	$ 43,814	$ 41,331	$ 48,199
(ix)	$ 63,401		$ 50,453		$ 55,005	
(x)	$ 41,566	$ 51,593	$ 36,623	$ 41,489	$ 38,520	$ 44,672

Table 2(b)

1st annual payment of an annuity purchased with $100,000: Private Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 8,965		$ 8,242		$ 8,535	
(ii)	$ 7,942	$ 8,354	$ 7,531	$ 7,712	$ 7,702	$ 7,959
(iii)	$ 7,925		$ 7,644		$ 7,757	
(iv)	$ 7,379	$ 7,665	$ 7,201	$ 7,379	$ 7,275	$ 7,481
(v)	$ 20,480		$ 17,714		$ 18,463	
(vi)	$ 14,841		$ 13,555		$ 13,914	
(vii)	$ 71,408		$ 53,848		$ 60,078	
(viii)	$ 44,181	$ 55,672	$ 37,737	$ 42,735	$ 40,227	$ 46,938
(ix)	$ 61,826		$ 49,259		$ 53,681	
(x)	$ 40,495	$ 50,296	$ 35,769	$ 40,544	$ 37,588	$ 43,608

Table 3(a) & (b): Sample estimated annuity rates assuming the last 25 year improvements to current mortality rates and no payment indexation

Table 3(a)

1st annual payment of an annuity purchased with $100,000: Public Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 9,715		$ 8,740		$ 9,102	
(ii)	$ 8,561	$ 8,994	$ 7,938	$ 8,111	$ 8,160	$ 8,427
(iii)	$ 8,321		$ 7,952		$ 8,076	
(iv)	$ 7,784	$ 8,057	$ 7,494	$ 7,667	$ 7,585	$ 7,788
(v)	$ 22,592		$ 19,149		$ 20,022	
(vi)	$ 16,524		$ 14,693		$ 15,147	
(vii)	$ 87,089		$ 60,650		$ 68,163	
(viii)	$ 52,779	$ 66,895	$ 41,881	$ 47,517	$ 45,021	$ 52,692
(ix)	$ 74,593		$ 55,182		$ 60,480	
(x)	$ 47,989	$ 59,925	$ 39,538	$ 44,916	$ 41,849	$ 48,699

Table 3(b)

1st annual payment of an annuity purchased with $100,000: Private Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 9,248		$ 8,388		$ 8,700	
(ii)	$ 8,197	$ 8,611	$ 7,661	$ 7,841	$ 7,848	$ 8,107
(iii)	$ 8,115		$ 7,759		$ 7,876	
(iv)	$ 7,581	$ 7,859	$ 7,313	$ 7,491	$ 7,395	$ 7,600
(v)	$ 21,375		$ 18,136		$ 18,949	
(vi)	$ 15,573		$ 13,893		$ 14,305	
(vii)	$ 84,958		$ 59,149		$ 66,451	
(viii)	$ 51,356	$ 65,224	$ 40,833	$ 46,391	$ 43,851	$ 51,383
(ix)	$ 72,961		$ 53,943		$ 59,117	
(x)	$ 46,823	$ 58,573	$ 38,629	$ 43,930	$ 40,862	$ 47,597

Table 4(a) & (b) : Sample estimated annuity rates assuming last 25 year improvements to current mortality rates and payment indexation at current average rate.

Table 4(a)

1st annual payment of an annuity purchased with $100,000: Public Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 7,565		$ 6,648		$ 6,977	
(ii)	$ 6,420	$ 6,886	$ 5,838	$ 6,055	$ 6,037	$ 6,338
(iii)	$ 6,479		$ 6,048		$ 6,190	
(iv)	$ 5,838	$ 6,169	$ 5,511	$ 5,724	$ 5,611	$ 5,858
(v)	$ 19,989		$ 16,739		$ 17,552	
(vi)	$ 14,106		$ 12,410		$ 12,823	
(vii)	$ 77,844		$ 53,550		$ 60,338	
(viii)	$ 45,512	$ 59,249	$ 35,737	$ 41,462	$ 38,493	$ 46,061
(ix)	$ 66,674		$ 48,721		$ 53,537	
(x)	$ 41,382	$ 53,076	$ 33,737	$ 39,193	$ 35,781	$ 42,571

Table 4(b)

1st annual payment of an annuity purchased with $100,000: Private Sector						
Annuity Type	Male	(CMIB)	Female	(CMIB)	Unisex	(CMIB)
(i)	$ 6,960		$ 6,175		$ 6,446	
(ii)	$ 5,921	$ 6,376	$ 5,443	$ 5,676	$ 5,600	$ 5,899
(iii)	$ 6,155		$ 5,745		$ 5,875	
(iv)	$ 5,512	$ 5,857	$ 5,220	$ 5,444	$ 5,306	$ 5,560
(v)	$ 18,629		$ 15,591		$ 16,341	
(vi)	$ 13,008		$ 11,473		$ 11,841	
(vii)	$ 75,550		$ 51,905		$ 58,476	
(viii)	$ 43,934	$ 57,429	$ 34,550	$ 40,205	$ 37,179	$ 44,612
(ix)	$ 64,903		$ 47,351		$ 52,041	
(x)	$ 40,075	$ 51,590	$ 32,698	$ 38,083	$ 34,661	$ 41,339

8 Pooled Arrangements

The variability of the income from pooled arrangements arising from longevity risk reflects the variability of the survivor probabilities[16] . There are two sources of variability that arise from these survivor probabilities. One is the idiosyncratic individual risk that arises from the uncertainty in the survival time of an individual. The other is the systematic risk that arises from the uncertainty of the future survival probabilities from common factors impacting mortality rates at future ages for a group of individuals currently the same age. Over the past 50 years the impact of improvement in mortality has mostly arisen from the systematic improvements arising from improved economic conditions, better health care, and better treatment of diseases, better road safety and other factors that impact on the survival of all individuals to a greater or lesser extent.

The improved longevity has not just been a "chance" outcome with higher than expected numbers of independent individuals surviving to older ages. There has been uncertainty about the future survival probabilities and this has eventuated in common improvement in mortality rates across individuals. This causes dependence between lives so that the benefit of pooling of individuals is much reduced. Common factors affecting mortality improvement account for a significant percentage of total variability of mortality rates over the past 50 years. As an example, if a drug was invented that allowed aged 67 year old lives to live to 120 and then all die, this would result in perfect correlation of the lives if this happened. The chance that this happens lowers the actual correlation. This correlation is difficult to predict into the future and a major study would be required to quantify and analyse the effect for Australia. However it is possible to quantify the impact of this dependence for a range of possible dependence levels. Similarly with the high probability of common improvements in future mortality there is a resulting dependence across lives that needs to be taken into account when analysing the benefits of pooling.

Diversification of longevity risk occurs as the size of the pool of lives that share the longevity risk increases. This is diminished by the stochastic uncertainty of the underlying mortality rates[17]. The relative effects of these two sources of variability are clearly reflected in the Table 7 reproduced below from Olivieri (2001). This example shows the volatility in the survivors of a group of 1000 annuitants initially aged 65 based on Italian mortality tables. The first column shows future time, the second column the variability that arises from pooling of lives assuming no stochastic mortality effects, so that lives are independent, and the third column the variability arising from the stochastic mortality, which is the uncertainty around systematic

[16] The Simple Analytics of a Pooled Annuity Fund by John Piggott, Emiliano Valdez and Bettina Detzel, Journal of Risk and Insurance, 72, 2005, 497-520.

[17] Uncertainty in Mortality Projections: an Actuarial Perspective by Annamaria Olivieri, Insurance: Mathematics and Economics, 29, 2001, 231-245.

mortality changes which induce dependence between lives in the pool. The final column is the total variability. The most striking feature is the high level of variability that arises from the systematic stochastic mortality. Pooling lives into larger pools lowers the variability arising from the current survival probabilities and the resulting uncertain life times assuming lives are independent. It does not however impact as strongly on the variability from systematic stochastic mortality which results in dependence in the survival probabilities of the live in the pool.

Table 7
Number of survivors; stochastic approach

t	$E(N)$	$E_\rho(\mathrm{Var}(N\|\mathcal{S}))$	$\mathrm{Var}_\rho(E(N\|\mathcal{S}))$	$\mathrm{Var}(N)$
0	1000	0	0	0
1	991.507	8.395	25.871	34.266
2	982.104	17.466	109.413	126.879
3	971.703	27.237	259.746	286.983
4	960.207	37.724	486.042	523.766
5	947.514	48.934	797.139	846.073
⋮	⋮	⋮	⋮	⋮
20	542.127	235.854	12371.16	12607.02
21	498.815	237.670	12328.88	12566.55
22	454.217	235.949	11954.46	12190.41
23	408.788	230.434	11246.46	11476.89
24	363.072	221.019	10231.29	10452.31
25	317.701	207.802	8965.249	9173.051
⋮	⋮	⋮	⋮	⋮

In order to illustrate the benefits of pooling on longevity risk and the effect of uncertain systematic improvement in mortality the following analysis is used. These values are illustrative only and a much more substantial study would be warranted to make the analysis more realistic. The analysis follows the assumptions of the Australian Government Actuary in the note "Longevity Risk Pooling – retirement income impact". It aims to illustrate the maximum annual inflation protected drawdown for a 67 year old male through pooling longevity risk compared to self-insurance based on a 95% confidence level. Future life times are assumed to be normally distributed and the mean and variance are estimated from Australian mortality data for males. Different levels of correlation between lives are assessed in the impact of pooling. The table below shows the results. The systematic correlation shows the dependence resulting from systematic improvements. Values from zero to 0.5 are shown. The resulting risk or uncertainty in survival times is given in the systematic variance column and the diversifiable risk is given in the independent variance column. Total variance is the sum of the two components. The resulting age for payment based on 95% confidence of survival of members of the pool is then shown along with the indexed value of an annuity to this age assuming 2% real return. The drawdown column shows the percentage that can be drawn

down to be (approximately) 95% confident of meeting the indexed payments in the pool and finally the increase in drawdown over the base individual life case shown in the final column.

Number in Pool	Systematic Correlation	Systematic Variance	Independent Variance	Total Variance	Survival age 95% confidence	Indexed annuity value to survival age	Drawdown	Drawdown increase
1	0	0	96.70	96.70	103.0	25.48	0.039	Base
10	0	0	9.67	9.67	91.9	19.47	0.051	31%
10	0.1	9.67	8.70	18.37	93.9	20.62	0.048	24%
10	0.2	19.34	7.74	27.08	95.4	21.48	0.047	19%
10	0.5	48.35	4.84	53.19	98.8	23.36	0.043	9%
15	0	0	6.45	6.45	91.0	18.90	0.053	35%
15	0.1	9.67	5.80	15.47	93.3	20.28	0.049	26%
15	0.2	19.34	5.16	24.50	94.9	21.25	0.047	20%
15	0.5	48.35	3.22	51.57	98.6	23.26	0.043	10%
100	0	0	0.97	0.97	88.4	17.28	0.058	47%
100	0.1	9.67	0.87	10.54	92.1	19.61	0.051	30%
100	0.2	19.34	0.77	20.11	94.2	20.81	0.048	22%
100	0.5	48.35	0.48	48.83	98.3	23.10	0.043	10%
1000	0	0	0.10	0.10	87.3	16.56	0.060	54%
1000	0.1	9.67	0.09	9.76	91.9	19.49	0.051	31%
1000	0.2	19.34	0.08	19.42	94.0	20.73	0.048	23%
1000	0.5	48.35	0.05	48.40	98.2	23.07	0.043	10%
10000	0	0	0.01	0.01	87.0	16.33	0.061	56%
10000	0.1	9.67	0.01	9.68	91.9	19.47	0.051	31%
10000	0.2	19.34	0.01	19.35	94.0	20.73	0.048	23%
10000	0.5	48.35	0.00	48.35	98.2	23.06	0.043	10%

The analysis is based on a current age of 67, an average future survival time for an individual life aged 67 of 19.8 years (to age 86.8) and variance of survival time for a 65 year old of 96.7. These are determined from the survival probabilities used in the computation of the sample annuity prices in this report.

Based on the table the benefits from pooling rely significantly on the impact of systematic risk on the survivorship of the pooled lives. If they were independent then pooling at age 67 could increase the drawdown by up to 56% for a large pool of lives. However the historical experience has shown that the major proportion of changes to the survival probabilities of individuals and the distribution of future life times has been from common factors influencing all ages and resulting in strong dependence between lives. The exact level of dependence and its future impact would require a full study in its own right in order to be more confident of the

actual effect of pooling. However with a 50% correlation between lives induced by common factors affecting all lives in the pool the increase in the drawdown could be as little as 10% in this example. This risk from systematic mortality changes is a major risk that cannot be diversified away with pooling of lives.

As a result, pooled arrangements require reinsurance or other longevity risk hedging to manage the uncertainty from systematic changes in longevity. Expected future changes in mortality can be estimated. However the uncertainty around these future trends can not be reduced through pooling. These must be managed through risk transfer using capital market products, such as securitisation, or through reinsurance. Using such risk transfer methods for the systematic risk allows this risk to be diversified with other risks that are relatively independent of mortality risk. In the case of securitisation, hedge funds can pool risk such as capital market risks, insurance catastrophe risks along with mortality/longevity risk and gain diversification of these risks at a portfolio level. Similarly for reinsurers, diversification of relatively uncorrelated life and non-life insurance risks can achieve risk reductions at the portfolio level. This systematic risk will involve a risk premium to the extent that it can not be diversified through these mechanisms and also to cover the costs of capital and expenses of these risk transfer methods. They cannot be diversified in a pool consisting of only mortality/longevity risks.

A much deeper study could be undertaken into this issue and is worthy of consideration and future research. However for the purposes of this report the major implication of the analysis presented here is the continued need for systematic longevity risk insurance even in pooled arrangements since these arrangements do not diversify the systematic mortality risks that have been the most significant risk in the improvement of mortality in developed economies over at least the last 50 years. Risk pooling is required beyond the individual life portfolio level and this requires well developed financial and reinsurance market products to underpin the retail market offering longevity products.

9 Public Sector Annuities

9.1 Economies of Scale effects on pricing

The life insurance industry exhibits economies of scale, as found by Grace and Timme[18] and Cummins et al[19], and it is therefore reasonable to assume that some of the cost reductions could be transferred to people affecting annuities, provided there was a competitive market operating.

If the Australian Government was to provide annuities, then initially, the costs would be at least the same, and possibly higher relative to the private sector until sufficient volume of business was attained. Should however it be made compulsory for some level of annuity to be effected by retirees through a government agency, then the volume of business written would soon be substantial, and cost efficiencies should be achieved.

By way of illustration, based on a study by Pritchard of US life insurers[20], "very large" insurers had on average, almost 18% lower costs than "small" insurers. This would seem to support the argument for a process that ensured the issue of annuities was concentrated to maximise cost efficiencies, but such a process would need to ensure that oligopoly pricing practices did not emerge to remove the advantages for annuitants.

9.2 Effects of Community Rating

Community rating of annuities would mean that the usual rating by age, gender and health would not apply, and all annuitants would receive the same annuity per $1000 purchase price. Community rating is likely to be beneficial only if the purchase of annuities was compulsory at some set age, or very narrow age band, as otherwise, it could lead to pre selection by annuitants with only the very healthy females voluntarily purchasing the annuities. This would particularly occur if there was a private sector market allowed to develop as well, as other groups of annuitants could easily obtain more beneficial arrangements from the private sector.

The introduction of community rating for annuities would have similar problems to its application to the health insurance market, and require government intervention in the market to avoid pre selection problems. It is unlikely the private sector would show any enthusiasm for a community rated annuity unless they were banned from issuing annuities on any other basis, as is done in the health insurance market.

---

[18] Grace M & Timme S (1992), Journal of Risk and Insurance 59, "An Examination of Cost Economies in the US Life Insurance Industry"

[19] Cummins j, Tennyson S, & Weiss M (1998), The Wharton School, University of Pennsylvania, "Efficiency, Scale Economies, and Consolidation in the US Life Insurance Industry

[20] Pritchett S (1971), Journal of Risk and Insurance Volume 38, Number 4, "An intercompany Expense Comparison for Thirty Life Insurers"

Community rating of annuities could be applicable if the Australian Government made it compulsory for retirees to acquire some level of annuity on retirement between narrow age bands.

9.3 Potential liabilities of public sector provided compulsory annuities

If the public sector was to provide lifetime annuities, with retirees being required to acquire some level of annuity, then this would transfer the risks outlined in Section 4, but the risks may well be lower than would occur if a private sector voluntary annuity market were encouraged for the following reasons:

- Mortality risk: compulsory annuitisation of retirement lump sums arising for example from the SGL contributions would ensure that the bias that might arise in voluntary annuitisation from attracting particular socio economic groups would be removed. If a community rating was adopted, then compulsory annuitisation would remove the risk of gender and age bias.
- Investment risk: the larger pools of assets that would arise relative to a voluntary annuitisation process would enable greater diversification, which reduces volatility of returns. There could also be economies of scale through using the existing Future Fund structure.
- Expense risk: the compulsory annuitisation would allow greater economies of scale, particularly if the product offered was simple. It is possible cost savings could be increased by using current public sector systems to pay the annuities.

It is also possible that management of the residual risks may be easier as the volume of longevity bonds that might be issued, together with their regular issue would make it worthwhile to develop the market amongst international investors. As well, pricing may well be lower due to the volume that could be offered to investors.

There remains however a residual risk as it will not be possible to remove all risks, and this would then result in taxpayers having to meet the costs should there be an adverse experience that was not anticipated.

Should this approach be considered seriously, it is recommended further research be undertaken to confirm the above views, and to quantify the gains relative to a voluntary private sector solution. In particular, there needs to be further consideration as to the appropriate risk management for a public sector fund that is effectively backed by the community's tax base.

9.4 Potential liability of public sector provided voluntary annuities

There is little obvious gain for there to be a voluntary public sector solution over that of a voluntary private sector solution.

A voluntary public sector solution would not achieve the economies of scale of the compulsory solution discussed previously, and it could, or most likely would end up with

socio economic group bias. Further, if a community rating approach was adopted, there almost certainly would be a gender and health bias. Removing or reducing these risks would be just as expensive as would occur if the private sector market developed.

9.5 Government Role in the Production of Longevity Indices

Longevity indices are intended to show the number of years that on average a member of the population at a particular age is expected to live. It is therefore important to understand the reason for a particular longevity index when determining its construction, and for example, a longevity index from birth is not of much value in determining annuity costs, as most of these will be acquired around retirement age.

Being averages, longevity indices then can be misleading, and of little value, if there is a significant variation of the age at death amongst the population.

Further, the source of the experience upon which the life expectancy is determined is also critical, as the longevity of people buying annuities is usually higher than the general population.

Very broadly, longevity indices can be of two types: firstly, simply recording historical results, and secondly, based on some assumptions, estimating longevity for current populations. The first type obviously is reasonably factual, but takes a long time to determine. The second type requires estimates as to longevity improvements and is therefore at best a guess, particularly over long periods.

The Australian Government Actuary should be in the best position to produce factual longevity indices for the population through utilisation of government statistical collection, and may well also be the best source of estimated longevity indices, perhaps with some consultation process with relevant experts to ensure maximum acceptance of the resulting longevity indices. The Australian Government would be the best source of population indices.

As well as purely statistical information, longevity indices could be used in the capital markets as benchmarks for creation of derivatives, either exchange traded or over the counter to enable institutions to hedge longevity risk. Similarly, a longevity index could be used as the trigger for a CAT Bond. In this situation, you are most likely dealing with hedging the longevity of annuitants, which would be expected to be different to the general population. The data source is then going to be the insurers operating in the annuity market, but since they are likely to be participant in any emerging derivates market, they would not be credible to create the longevity index upon which payments under the derivatives was payable. Whilst the investment banks could create longevity indices, since they are also likely to be market participants, the credibility of the longevity index could be questioned, or worse, the market ignored by competitors to those creating the indices. It is most likely that the best way to solve this issue would be to have APRA collect the data but outsource the index construction to a consultancy or the ASX if they were to issue a derivative based on the index.

10 Summary & Conclusions

This paper has indicated that there are three major risks associated with the issuing of lifetime annuities and the prediction and management of these risks is not simple, nor is there a readily available or likely to be developed risk transfer mechanism without government support.

To develop a sustainable annuity market for retirees on a cost efficient basis, there are three broad solutions:

- Private Sector: the private sector could develop an annuity market for retirees, but would need government support to provide or organise hedging products for the three major risks involved. If this support is not offered, it is difficult o see how the private sector could develop efficiently priced annuities that would be attractive to retirees.
- Private/ Public Sectors: a public/ private combination would seem feasible with the private sector providing annuities for fixed terms, e.g. until age 85 or earlier death, and the public sector providing a deferred annuity from age 85 until death. This solution would reduce the risks for the private sector and encourage an annuity market to develop, with the longevity risk being taken on by the public sector. This model would work with both voluntary and compulsory annuitisation of retirement funds.
- Public Sector: a public sector solution is likely to be the most efficient, provided the annuitisation is compulsory. In this situation, it would seem feasible to annuitise SGL retirement benefits. Annuitisation of retirement benefits arising from contributions above the SGL would be feasible, but the purchase price would be different to that for the compulsory component.

The estimated premiums clearly show that greatest efficiency is achieved through the compulsory conversion of superannuation benefits to annuities through a public sector arrangement.

Professor Michael Sherris

BA (Hons), MBA, FIA, FIAA, FSA, FFin

Associate Professor John Evans

MBA, FIA, FIAA, ASA

for UNSW Global Pty Limited