The University of New South Wales
Australian School of Business

Australian School of Business Research Paper No. 2010ACTL01

Longevity Risk Management and the Development of a Life Annuity Market in Australia

John Evans & Michael Sherris

7/04/2010
CRICOS Provider: 00098G

Longevity Risk Management and the Development of a Life Annuity Market in Australia

by

John Evans and Michael Sherris
Australian School of Business
University of New South Wales
Sydney, NSW, Australia, 2052

Tel: + 612 9385 2333
Email: m.sherris@unsw.edu.au; john.evans@unsw.edu.au

Abstract
Longevity risk is a major policy issue for governments around the world driven by the increase in the proportion of older aged population resulting from improved mortality and lower fertility. Providing products for individuals to insure longevity risk in conjunction with government pension provision is fundamental to the management of this risk. The annuity market in Australia, as well as in many other developed countries, is practically nonexistent. Retirement savings will need to be converted into income in the future to finance retirement needs for individuals. This paper considers the development of a life annuity market in Australia with an emphasis on longevity risk management. The risks in issuing lifetime guaranteed annuities and their management are discussed. The role of government in the lifetime annuity market and the need for and role of government in hedging markets for the major risks is also considered.

Keywords: longevity risk, ageing, retirement, annuity, regulation

This version: 7 April 2010

Introduction

Longevity risk is the risk that individuals will outlive their retirement savings. In many countries around the world retirement is financed by a mix of both government provided pension and private savings[1]. However, apart from the government provided pension and a small number of countries with mandated annuity markets, a large component of retirement savings is in the form of defined contribution accumulations with no provision for a pension or a guaranteed annuity at retirement. This reduces the longevity risk from the perspective of employers and government, who would otherwise provide a pension or guaranteed annuity, but it does not mitigate the longevity risk of individuals. The traditional product used to manage longevity risk was the life annuity provided by life insurance companies as fixed, indexed, or with limited indexation, annuities. Defined benefit pensions offered by employer and public service pension plans have also been indexed as have government provided pensions. These are designed to hedge longevity risk through risk pooling and hedging of financial risks such as interest rate and inflation rate risks.

Life annuity markets remain limited despite the economic benefits of such products for managing longevity risk producing an "annuity puzzle"[2]. In recent years there has been an increased offering of variable annuities around the world through life insurance companies. These products provide guarantees of various forms that make them attractive to purchasers. They allow flexibility in asset allocation during both accumulation as well as decumulation. Guaranteed death and accumulation benefits are provided to cover the investment risks and guaranteed income and withdrawal benefits are provided for the longevity risk. These guarantees involve costs and present risk management challenges.

In Australia the situation is interesting since there has been a review of Australia's Future Tax System, the Henry Tax Review, and the issue of longevity risk and its management have been a major focus of that review given the fiscal costs of the aging population. Australia is also an interesting case since the second pillar is a mandated private employer contribution into individual defined contribution accounts, the Superannuation Guarantee Levy. The need for retirement income products including life annuities remains unmet.

Issues that require consideration for the development of an annuity market are whether annuities should be provided by government or private providers or a combination, should they be compulsory or voluntary and what features should annuity products have such as guarantees for investment returns, longevity and administrative expenses.

This paper briefly reviews developments in life annuity products in a number of developed countries including Australia. It discusses impediments to the development of a private annuity market related to the risk management and outlines

[1] Whitehouse, E. R., D'Addio, A., Chomik, R. and Reilly, A. (2009)
[2] Sheshinski, E. (2008)

potential solutions. The role of public and private markets is discussed including the reasons to support a role for government provision. Finally options are reviewed and conclusions presented.

Longevity Risk Market Developments

The US and UK have well developed annuity markets, with life insurers offering different types of annuities. Recent annuity sales in the US are given in Table 1. Fixed annuities include a substantial component of deferred annuities that are tax preferred savings products and the immediate life annuities are only a small component of the total. Variable annuities provide more flexibility along with investment and income drawdown guarantees[3]. The impact of the financial crisis on annuity sales can be seen in the significant reduction in variable annuity sales in 2008 and 2009.

Table 1: Individual Annuity sales estimates for the US

Year	Variable Annuity $US Billion	Fixed Annuity $US Billion	Total Purchases $US billion
1999	123	42	165
2000	137	53	190
2001	111	74	185
2002	117	103	220
2003	129	89	218
2004	133	88	221
2005	137	80	217
2006	160	78	238
2007	184	73	257
2008	156	109	265
2009	127	108	235

Source: LIMRA

In the UK, where there is a compulsory annuitisation market, Table 2 indicates the market is growing considerably. Individual and occupational pensions are accumulation products. Retirement income products includes pension annuities and income drawdown products but mostly pension annuities. There are 40 firms offering annuities, with the top 5 having 61% of the market and 66 firms offer income drawdown products, with the top 5 having 66% of the market[4].

Most recently these markets have been impacted by the global financial crisis, particularly the variable annuity market. This extended to the UK where recent offerings of variable annuities were withdrawn from the market[5]. The main reason for

[3] Kalberer and Ravindran (2009) provide extensive coverage on variable annuities

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

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

the withdrawal was related to income guarantees, reflecting challenges for the private sector to manage the product risks on a sustainable basis.

Table 2: Pension and Retirement Income Product New Single Premium sales estimates for the UK

Year	Individual Pensions £ Billion	Occupational Pensions £ Billion	Retirement Income Products £ Billion
2004	10.6	4.5	9.0
2005	12.1	6.5	9.3
2006	18.8	10.8	12.2
2007	22.2	11.0	14.1
2008	18.4	12.1	13.9

Source: Association of British Insurers

Table 3: Australian annuity sales

	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

Source: Plan for Life Research, the Pension and Annuity Market Research Report, Quarterly 1999-2007.

Compared to the US and UK markets, the Australian market is not well developed. There has been a low and falling demand for life annuities as demonstrated in Table 3, which shows annuities issued over recent years including life and fixed term annuities. Immediate annuities offer a range of features, including inflation indexation. A number of insurers are beginning to offer other retirement products, with AXA recently offering a variable annuity with investment guarantees.

The consumer view of annuities has been negative, with the attitude in the UK well captured in the following[6]:

"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

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

for money or inflexible; or that they should be able to pass on accumulated savings to heirs".

and this was despite, as noted 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".

Despite the levels of sales of annuity products in the US and the UK, consumers perceive the products offered as poor value and product providers have difficulty offering products on a sustainable basis that consumers are happy to buy.

Risk Management for Longevity Risk Products

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

- Investment return: with a lack of long term matching assets, investment returns on the assets backing the lifetime annuities will be volatile; whilst exposure to the more volatile asset classes such as equities could produce a higher longer term expected return than more conservative strategies, the greater exposure to volatile assets introduces significant risks in being able to meet obligations and product guarantees, and thus requires capital to support the product.
- Mortality of annuitants: medical advances, possibilities of pandemics and many other factors result in significant uncertainty around future mortality; at the same time the population purchasing annuities in a voluntary market will be heterogeneous with respect to socio economic composition, leading to significant challenges in risk management of longevity.
- Expenses of operation: these are generally influenced by inflation and productivity gains, both of which are uncertain and difficult to hedge.

In order to manage these risks, insurers need to either transfer them to other parties, through hedging, reinsurance or securitization, or remove them through careful product design. Residual risks must then be handled through provision of capital to ensure that the insurer's balance sheet remains healthy when adverse events occur. This requires a high level of risk modelling and quantification of risk. In assessing the capital required, insurers need to allow for the occurrence of adverse events for all risks at the same time through appropriate stress testing scenarios as well as advanced modelling. The capital will only be provided if product margins provide a competitive return on this capital to meet shareholders' expectations.

A significant impediment to an active life annuity market is the inability of product providers to manage the underlying risks. In Australia there is a lack of long term government bonds, especially inflation indexed bonds, as well as limited appetite for longevity risk by reinsurers. Failure of the Australian capital market to provide

hedging instruments suitable for issuers of lifetime annuities is an important contributing factor underlying the lack of a life annuity market.

Investment and interest rate risk

The traditional life annuity transfers all the investment risk to the issuer since payments are guaranteed. For indexed annuities both investment and inflation risk are transferred. This risk can be mitigated through product design as in the variable annuity. However in order to make these products marketable, investment return guarantees are provided for death, withdrawal and maturity benefits[7].

Life annuities are traditionally matched with dedicated bond portfolios or at least the interest rate and inflation rate risks are minimised through hedging. Lack of hedging instruments has resulted in investment in corporate bonds and equity for higher returns. Variable products require complex hedging of equity and other investment classes to ensure guarantees are met.

Hedging equity assets generally requires the use of options or an asset swap where the insurer swaps the 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 to provide downside protection are available to a limited extent in the Australian market through the ASX, and are available for individual equity shares or to cover the broad market.

Longer term options are negotiated individually over-the-counter through investment banks. An asset swap involves a counter party taking on the investment risk of the insurer portfolio, as well as the risk of the average maturity of the annuity cash flows and would need to be hedged by the swap counter party. Lack of long term fixed interest and interest rate swap markets prevent these products from being priced competitively unless the risk can be efficiently hedged.

Longevity risk and pooling

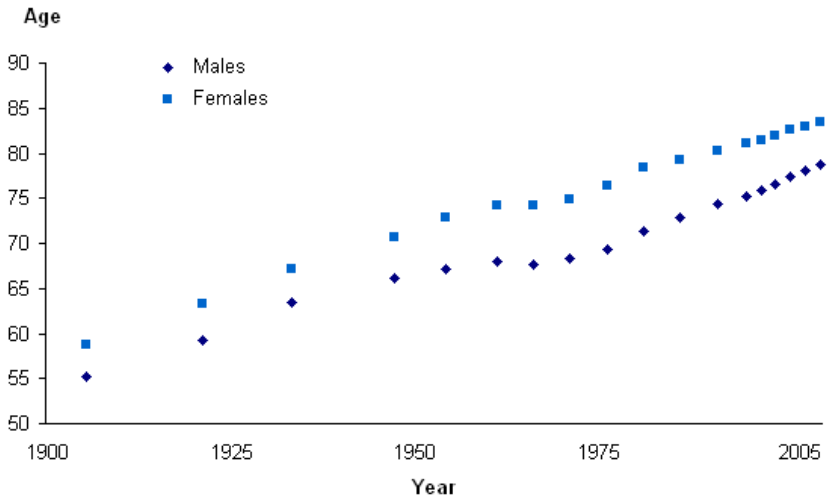
As in most developed countries, longevity has been improving through the last century in Australia and at rates that have been largely unexpected and significantly underestimated. Figure 1 indicates how life expectancies at birth have been increasing over the last century in Australia. Similar trends have occurred in most developed economies. Although gender and current age are clear risk factors in determining survival probabilities, there are any other factors that also influence survival probabilities.

Socio economic group is a significant risk factor as shown in data from the UK in Figure 2[8]. In a voluntary insurance market insurers are faced with the risk of adverse selection. The insurer assumes an average mortality rate for the group of lives purchasing annuities at any age and charges premiums based on this. In a risk pool

[7] Kalberer and Ravindran (2009) provide a full description and analysis of these guarantees.
[8] Richards and Jones (2004)

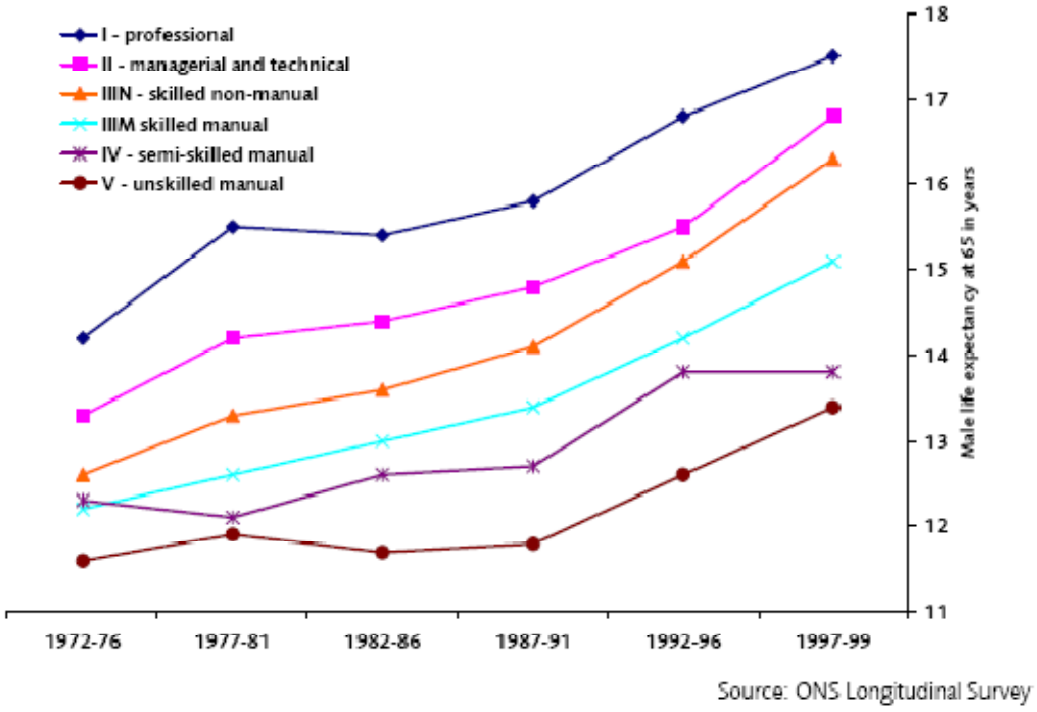
where there is substantial heterogeneity this will result in the lives with higher expected longevity purchasing life annuities and the lives with lower longevity not purchasing. To avoid this, the insurer must adopt risk assessment to differentiate amongst the lives in order to charge fair premiums. This has led to impaired lives annuities and postcode underwriting in the UK for life annuities. Postcode can be regarded as a proxy for socio-economic group.

Figure 1: Expected Age of Death, by Sex, Australia, 1901-10 to 2004-06



Source: Australian Institute of Health and Welfare (ABS Cat No. 3302.0; ABS Cat. No. 3105.0.65.001)

Figure 2: Male Life Expectancy at age 65 by Socio Economic Group



Compulsory purchase of annuities avoids the problem of adverse selection but still leaves open the problem of fair pricing to reflect relative risks in a heterogeneous pool. Compulsory conversion of superannuation accumulation benefits into a life annuity would provide universal coverage and result in lower mortality improvements in the pool of lives on average than would occur if the conversion were voluntary and offered through private sector products by a range of providers.

Mortality is traditionally assumed to be an independent risk that is managed by diversification of lives in large risk pools. The law of large numbers is relied on to reduce mortality variations to manageable levels and capital is then required to be held against the residual risk. Life annuities rely on pooling longevity risks to average the cost. They pool both systematic and non-systematic risks. Systematic risk arises from the uncertainty of the future survival probabilities because of common factors impacting mortality rates at future ages for a group of individuals. Systematic risks are those that impact on all the lives in the pool to a greater or lesser degree resulting in dependence between the lives. Non-systematic risks are independent risks that impact individual lives in an uncorrelated manner as idiosyncratic individual risk.

Variability of the annuity payments from pooling arising from longevity risk reflects the variability of the survivor probabilities[9]. Over the past 50 years the impact of improvement in mortality has mostly resulted from systematic improvements in economic conditions, better health care, and better awareness and treatment of diseases, better road safety and other factors that impact on the survival of all individuals to a greater or lesser extent. Improved longevity has not just been a "chance" outcome with higher than expected numbers of independent individuals surviving to older ages. The uncertainty in the future survival probabilities 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.

Diversification of longevity risk increases as the size of the pool of lives that share the longevity risk increases. This diversification is diminished by systematic changes to the underlying mortality rates. The volatility in the survivors of a group of annuitants initially aged 65 has a high level of variability arising from the systematic stochastic mortality[10]. Pooling lives into larger pools lowers the variability but does not impact as strongly on the variability from systematic stochastic mortality.

The limitations of pooling of longevity risk can be demonstrated by considering the annuity payment that could be paid from a pool so that the pool is 95% confident of meeting its annuity obligations. This example is based on the payment of an indexed life annuity with annual inflation protection for a 67 year old male. The pooling results are compared with the longevity risk for an individual without a purchased life annuity who holds sufficient assets to self-insure based on a 95% confidence level. Different levels of correlation between lives are assessed for the impact of pooling. Table 4 shows, for different levels of assumed systematic

[9] Piggott, Valdez and Detzel (2005)
[10] Olivieri (2001)

correlation with values from zero to 0.5, the average age for payments based on 95% confidence of survival of members in the pool. The indexed value of an annuity to this age is shown and assumes a 2% real return. This is the price to be charged for lives entering the pool. The indexed annuity amount is the percentage that can be paid as annuity income to be (approximately) 95% confident of meeting the indexed payments in the pool. The annuity increase is the benefit from risk pooling compared to the base case of an individual with no longevity insurance and providing their own longevity insurance by limiting the annuity payment drawn from their own capital.

Table 4: Impact of systematic mortality on pooling effectiveness

Number in Pool	Systematic Correlation	Survival age 95% confidence	Indexed annuity value to survival age	Indexed annuity (%)	Annuity increase
1	0	103.0	25.48	0.039	Base
100	0	88.4	17.28	0.058	47%
100	0.1	92.1	19.61	0.051	30%
100	0.2	94.2	20.81	0.048	22%
100	0.5	98.3	23.10	0.043	10%
1000	0	87.3	16.56	0.060	54%
1000	0.1	91.9	19.49	0.051	31%
1000	0.2	94.0	20.73	0.048	23%
1000	0.5	98.2	23.07	0.043	10%
10000	0	87.0	16.33	0.061	56%
10000	0.1	91.9	19.47	0.051	31%
10000	0.2	94.0	20.73	0.048	23%
10000	0.5	98.2	23.06	0.043	10%

Assumptions: Future life times are assumed to be normally distributed and the mean, 19.8 years, and variance, 96.7, are estimated from Australian mortality data for males at age 67.

The benefits from longevity risk pooling are much reduced by the impact of systematic risk on the survivorship of the pooled lives. If lives were independent then pooling at age 67 could increase the annuity payments 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. For example, with a 50% correlation between lives induced by common factors affecting all lives in the pool, the increase in the annuity payment over self insurance could be as little as 10%. This risk from systematic mortality changes is a major risk that cannot be diversified away with pooling of lives and is very difficult to predict.

Pooled arrangements require reinsurance or other longevity risk hedging to manage the uncertainty from these systematic changes in longevity. Expected future changes in mortality can be estimated. However the uncertainty around these future trends cannot be reduced through pooling and can be difficult to estimate. 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 risks 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.

Future mortality of annuitants is difficult to model and forecast since estimates are required of:

- The sectors of the population seeking insurance
- Changes in socio economic conditions of the insured population
- Changes in the ability to manage diseases
- Wars, pandemics and other catastrophes.

To date, the ability to predict these issues and their interaction has not been very successful. For example, one of the more common longevity models is the Lee Carter[11] model. Booth et al[12] found that applying this model across various countries, using data from 1900 to 1989 to estimate 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 can be gained though considering the risks broken down into[13]:

- A “known/known” component: risks that can be predicted and reasonably modelled such as expected improvement trends from socio economic improvements,
- A “known/unknown” component: risks that can be identified, but their modelling is difficult such as uncertainty in the longer term improvement trend,
- An “unknown/unknown” component: risks that are not known and therefore cannot be modelled which would include wars, pandemics and disease management.

Whilst the known/known risk can be managed as it can be modelled and therefore appropriate allowances made in pricing, the known/unknown risk is more difficult to manage and requires appropriate hedging markets, whereas the unknown/unknown risk is effectively impossible to manage as it is not predictable. This has been a major reason for pension funds, insurers and reinsurers to be significantly concerned about longevity risk.

[11] Lee R. D. and Carter L R. (1992)
[12] Booth H., Hyndman R. J., Tickle L. and de Jong P. (2006)
[13] Ganegoda A. and Evans J, (2008)

Issuers of lifetime annuities have generally allowed for these risk components using conservative assumptions and margins, which increases the cost to the consumer and inhibits the development of the market and as a last resort reliance on insolvency to escape the worst case effects of the unknown components.

An issuer of lifetime annuities needs to be able to hedge the risk that annuitants on average live longer than expected. Pooling is not enough. 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 a counterparty taking on a 30+ year liability. There is also the difficulty that the portfolio taken on by any issuer will have biases relative to the general population, making pricing of protection on an indemnity basis difficult.

The credit worthiness of the counterparty 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[14]. 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 noted by the OECD[15] lack of natural investors to take on longevity risk, other than pharmaceutical companies and care providers, results in demand and supply imbalance and lack of market development. The nature of longevity risk is new to financial markets and does not have the cyclical properties of markets such as those for credit risks that developed rapidly over recent years.

Inflation risk

For inflation risk, arising from indexation or partial indexation of annuity payments, mitigation is possible through product design by offering only fixed indexation rate life annuities or by using a cap on the maximum level of indexation. If full indexation is adopted then life annuity providers will need to hedge inflation indexed long term cash flows for the maturity distribution of life annuity cash flows. This requires long term inflation indexed bonds or inflation linked swaps.

Expense risk

For expense risk, ideally, an issuer of a lifetime annuity would need to hedge against adverse inflation of administrative and other costs, and this would need to hedge these costs typically over a 30 year's duration. There is no capital market product available that offers protection against inflation of expenses. Product design for charging

[14] EIB Longevity Bond promoted by BNP and Partner Re November 2004
[15] OECD Monetary Review, 4th Quarter 2007

expense loadings can mitigate the risk, but even variable annuity products have to manage this risk.

Timing risk

Timing risk arises because of the economic conditions facing an individual at the time of electing to receive an annuity stream. Products with guaranteed annuity options that provide annuity conversion at fixed rates avoid this risk but usually provide conservative conditions for conversion. Equity and interest rate volatility increases the risk for individuals at the time of election to convert into a life annuity stream result. Defined benefit pensions and guaranteed annuity conversion at the then current market rates avoid or reduce this risk.

Role of Private Markets

The private market provision of longevity insurance products in Australia has been limited. This is the case in many countries. This reflects the limited demand for life annuity products and the significant costs faced by private markets to supply reliable and efficient longevity risk products. There have been many proposals for private market products[16]. Some of the products developed, such as variable annuities, although attractive to individuals, are complex to risk manage and involve exotic option structures[17].

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 there is a large degree of uncertainty around possible future mortality trends, but holding such capital will increase the pricing of annuities.

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

[16] Ferro, G. (2009)
[17] Milevsky, M. A. (2006)

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.

The private sector annuity market must manage a large number of major risks in order for individuals to be provided with lowest cost annuities. In order to allow the most efficient use of risk based capital, the major risks faced by annuitant providers need to be hedged in financial markets. Without this hedging the risks faced by annuitant providers are significant and highly uncertain. The major risks for life annuitant providers are the longevity risk as well as the inflation indexation risk for fully indexed life annuities. Variable annuities require much more sophisticated hedging and risk management than life annuities. Although the private market would normally have incentives to innovate and provide solutions, in the longevity risk case this is yet to happen in Australia.

The Role of Government: Private Market Support

There are strong arguments for government support for a longevity bond market including the issue by government of survivor or longevity bonds[18.] By offering both long term CPI linked bonds and longevity bonds the government can provide 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 are required 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 instruments such as derivative and reinsurance contracts. Even in the securitization market, 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

[18] Blake and Burrows (2001)

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.

The Role of Government: Longevity Indices

Since longevity risk is a major factor inhibiting the development of a viable annuity market, the government can assist the market through promoting longevity indices that can underlie derivative and other financial structures to hedge this risk. Longevity indices are available in a range of forms including the number of years that on average a member of the population at a particular age is expected to live.

From an individual risk perspective the risk is determined by the survival curve or life table rather than the expectation or average survival age. Longevity risk is also dependent on other factors such as interest rates and inflation (real returns) and the volatility of funding retirement without longevity insurance. For providers of longevity risk products hedging of longevity risk is an important factor. Longevity indices can be a simple recording of historical results, or can, based on specified assumptions, estimate longevity for current populations.

As well as purely statistical information, longevity indices are used in the capital markets as benchmarks for 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 securitised longevity risk linked bond.

Currently there are a number of providers of longevity indices. JP Morgan has developed Lifemetrics[19] which shows mortality rates and expectation of life by age for selected countries and provides projection technology and models, generally with annual updates. They have also developed q forwards and longevity swaps for longevity risk management. The Deutsche Bourse has developed the Xpect indices[20] including Xpect Cohort, showing survivorship proportion for cohorts, and Xpect Age Indices that show the average expectation of life for groups, for Germany and the Netherlands, with some series quarterly updated. There was also the QxX indices developed for the Life Settlements market based on the number of survivors in a reference pool aiming to support index swaps that Goldman Sachs recently discontinued.

Because of the variety of possible applications of a longevity index, it is important to understand the application for a particular longevity index when determining its construction. For example a longevity index based on expectation of life from birth is not of value in determining annuity costs, as most of these are

[19] http://www.jpmorgan.com/pages/jpmorgan/investbk/solutions/lifemetrics
[20] http://deutsche-boerse.com/

determined around retirement age. Expectations of life, being averages, can be misleading, and of little value, if there is a significant variation of the age at death amongst the population. Also the source of the experience upon which the life expectancy is determined is also critical, as the longevity of individuals purchasing annuities is higher than the general population.

The Australian Government Actuary is in the best position to produce factual longevity indices for the Australian population through utilisation of the government statistical collection. They may also be the best source of estimated longevity indices, along with a 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.

For hedging longevity of annuitants, the experience is expected to be different to the general population. The data source for reliable indices for the annuitant population is the insurers operating in the annuity market. An issue with accessing and using this data is that since the insurers are likely to be participant in any emerging derivates market, they would not be independent enough to create the longevity index upon which payments under the derivatives were payable. Whilst investment banks have developed longevity indices, since they are also likely to be market participants, the independence of the longevity index would be questioned, or worse, the market would be ignored by competitors to those creating the indices. To manage this issue, an independent body such as the regulator, APRA, should collect the data and outsource the index construction to a consultancy or the stock exchange, ASX, if they were to issue a derivative based on the index.

The Role of Government: Public Provision

The life annuity market requires a cost efficient long run supplier(s) of longevity risk products on a sustainable basis. The Australian Government currently provides an indexed annuity to a large number of retired Australians through the age pension. If the Australian Government were to offer life annuities more broadly, then with a sufficient volume of business, cost efficiencies would be achieved. If purchase of these life annuities were made compulsory for a specified level of annuity or amount of accumulated savings through a government agency, then the volume of business written would soon be substantial.

The life insurance industry exhibits economies of scale[21] and it is reasonable to assume that cost reductions from size would be transferred to individuals purchasing annuities. The issue of annuities can benefit from economies of scale, 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. A government provided annuity would need to provide the appropriate value for money and have any annuity rates charged reviewed and approved by independent external actuarial expertise.

[21] Cummins and Weiss (1993)

If the government were to issue annuities then it may consider community rating for pricing the annuities in the same way as community rating is required in the private health insurance market in Australia. This would mean that risk 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 a fixed age, or for a very narrow age band, as otherwise, it will lead to adverse selection by annuitants with only the very healthy females voluntarily purchasing the annuities. This would apply in both public and private provision of annuities. This would be even more severe if there was a private sector market allowed to develop as well as a government provided annuity, 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 if not greater problems to its application to the health insurance market, and require government intervention in the market to avoid selection problems. The private market is unlikely to offer annuities under community rating unless they were required to, as is done in the health insurance market. Community rating of annuities should only be considered if the Australian Government made it compulsory for retirees to acquire a specified level of annuity on retirement between narrow age bands.

If lifetime annuities were provided through the public sector, with retirees being required to purchase a specified level of annuity, then the risks facing private providers and limiting the market development would not be a factor. The risks under public provision would be expected to be lower than for a private sector voluntary annuity market for the following reasons:

- Mortality risk: compulsory annuitisation of retirement lump sums, arising for example from the SGL compulsory accumulation contributions, would ensure that the adverse selection that would arise in voluntary annuitisation from attracting particular socio economic groups would not occur. If community rating was adopted, then compulsory annuitisation would remove the risk of gender and age selection but create other issues of equity and fair pricing.
- Investment risk: the larger pools of assets that would arise relative to a voluntary annuitisation process would enable greater diversification, reducing volatility of returns. There would also be investment economies of scale through using existing sovereign fund structures such as the Future Fund[22].
- Expense risk: 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 in a similar way to the aged pension.

The 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

[22] http://www.futurefund.gov.au/

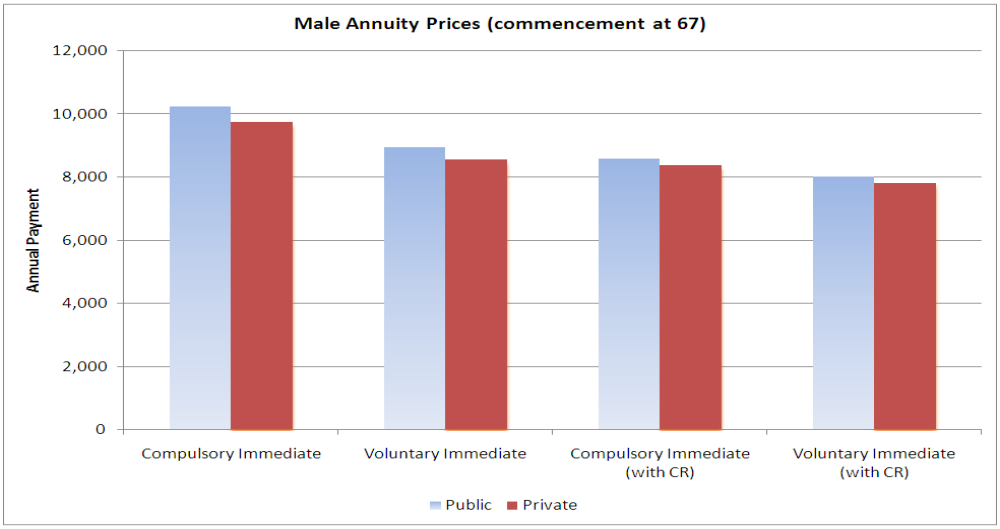
worthwhile to develop the market amongst international investors. As well, pricing may well be lower due to the volume that could be offered to investors. There will remain a residual risk, and this would require taxpayers to meet any costs should there be an adverse experience that was not anticipated.

There is little obvious gain for there to be voluntary public sector provision over that of voluntary private sector provision. Voluntary public sector provision would not achieve the economies of scale of compulsory provision, and this would result in socio economic group adverse selection. If a community rating approach was adopted, there almost certainly would be gender and health adverse selection. The private sector market would have no advantage in managing these risks.

Cost of Capital and Adverse Selection in Annuity Prices

Private providers of life annuities must include in their annuity prices an allowance for the costs of capital and for adverse selection. Longevity risk is a major risk of providing life annuities since interest rate and inflation risks can be managed through product design or reduced through hedging in financial markets. For an annuity where 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. In order to illustrate the impact of these costs, Figure 3 and Figure 4 compare the nominal and indexed annuity payments for life annuities under different assumptions.

Figure 3: Illustrative nominal annuity payments: Australian mortality, males age 67, no mortality improvement



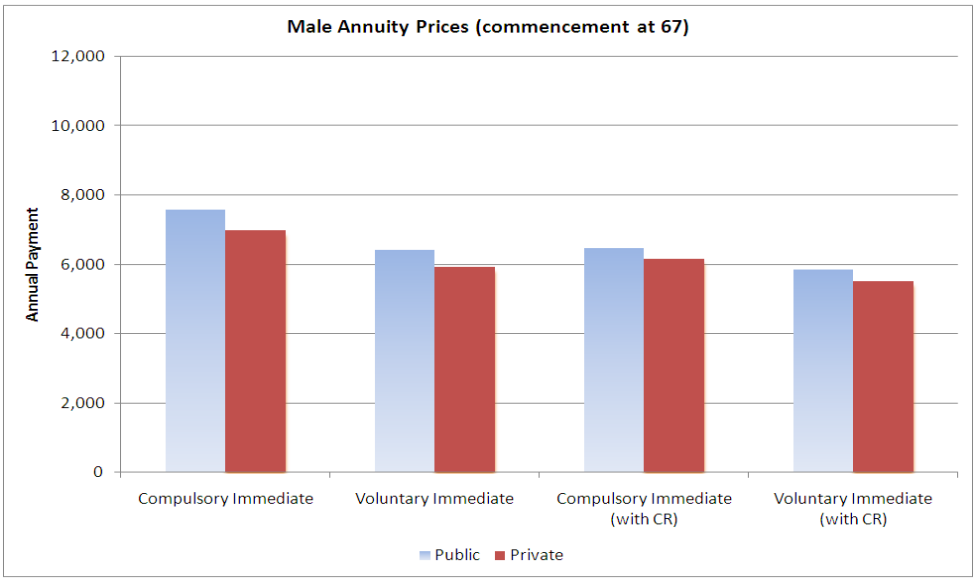
Source: Evans and Sherris (2009)

For the compulsory annuities the values are based on Australian Population mortality tables using the latest ABS life tables ALT2005-2007 extracted from the Human Mortality Database. 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. All survival probabilities were determined

on a cohort table basis to incorporate mortality improvement. Population and annuitant mortality rates for male and female showing the differences between the survival proportions of those alive at age 67 are shown in Figures 5 and 6. Annuitant mortality reflects the cost of adverse selection as would occur in a voluntary purchase annuity market. CR indicates capital reversion where a proportional return of the single premium purchase price is provided on death up to age 85.

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 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.

Figure 4: Illustrative indexed annuity payments: 25 year trend mortality improvement, with constant 2.7% indexation



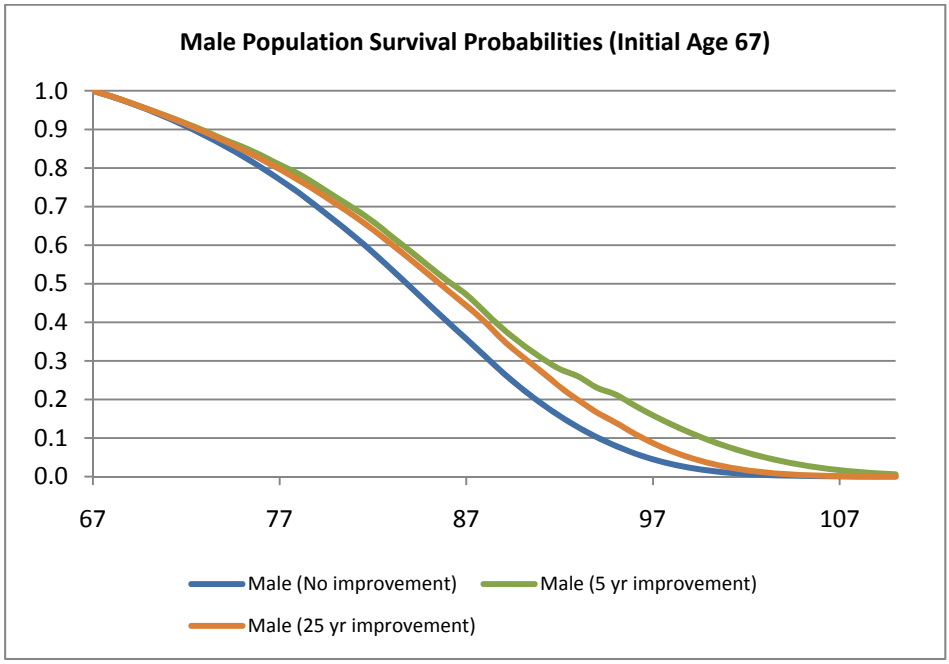
Source: Evans and Sherris (2009)

The annuity rate for the private case has been determined by allowing for a cost of capital charge based on Solvency II[23] requirements where a cost of capital of the risk free interest rate plus an 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 indicative of possible effects of longevity risk based on current Solvency II requirements and as representative of the actual market differences expected. Clearly government or public provided life annuities that

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

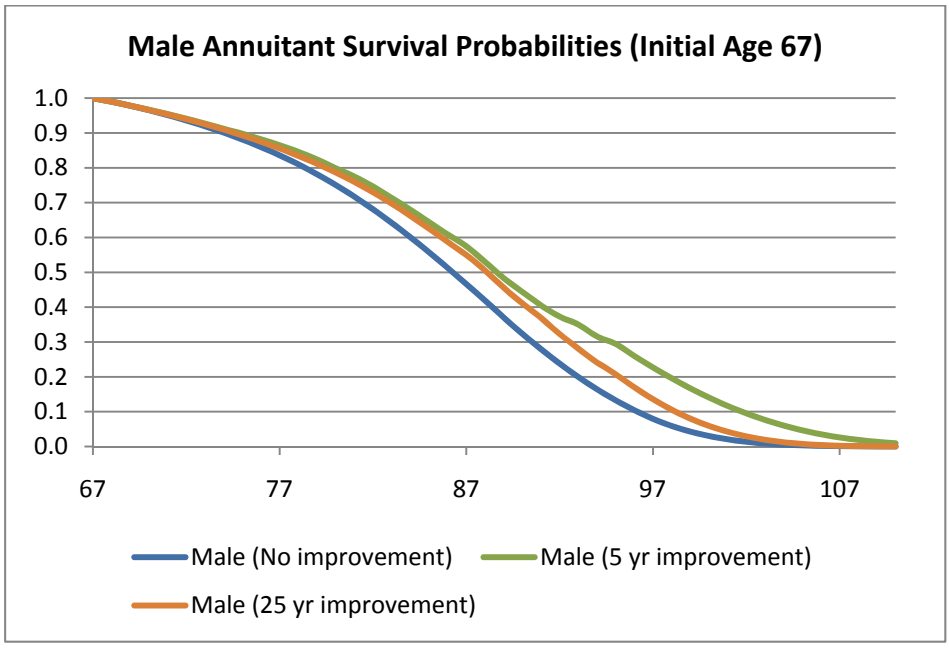
do not require capital to support these risks will be better value based on the longevity risk alone.

Figure 5: Male Australian Population survival proportions of lives aged 67 showing the effect of mortality improvement assumptions



Source: Evans and Sherris (2009)

Figure 6: Male annuitant survival curve for life aged 67



Source: Evans and Sherris (2009)

For all annuities the expected cash flows based on survival probabilities are valued using an end June 2009 yield curve from government bonds quoted on Bloomberg to provide a term structure of interest rates. Annuity values are determined

without and with mortality improvement. To quantify the effects of improvement, the rate of improvement at individual ages was determined based on the last 25 years of life table data. Figure 4 shows indexed payments allowing for mortality improvement. The rate of indexation is equal to the average of 1990-2008 inflation rates.

These annuity payments clearly show the significant costs of capital to hedge longevity risk as well as the significant difference in prices arising from adverse selection. Government provision of compulsory annuities eliminates these additional costs.

Summary and Conclusions

Longevity risk management products have been slow to develop around the world. Australia has been no exception. There are significant impediments to the development of this market. This paper has reviewed those impediments including the major risks associated with the issuing of lifetime annuities and the lack of markets to hedge these risks. The management of these risks is complex and the lack of developed risk transfer mechanisms is a concern that must be addressed

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

- Private Sector: the private sector develops an annuity market for retirees, with government support to provide or organise hedging products for the major risks involved. If government support is not provided, it is difficult to see how the private sector can develop efficiently priced lifetime annuities that would be attractive to retirees.
- Public Sector: a public sector solution would be potentially the most efficient, provided that annuitisation is compulsory. It would be feasible to require compulsory annuitisation of compulsory accumulation SGL retirement benefits. Annuitisation of retirement benefits arising from contributions above the SGL could also be included, but the purchase price would need to differ from that for the compulsory component to reflect differing longevity risks.
- Private/Public Sector partnership: a private/public combination would be feasible with the private sector providing annuities for fixed terms, such as until age 85 or earlier death and the public sector providing a deferred annuity from age 85 until death.

The private/public 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 solution would work with both voluntary and compulsory annuitisation of retirement funds and is likely to be the most viable approach for future policy.

References

Blake, D. and Burrows, W. (2001) *Survivor Bonds: Helping to Hedge Mortality Risk*, Journal of Risk and Insurance, 68: No 2, 339-348.

Booth, H., Hyndman, R. J., 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, 289-310.

Cummins J. David, and Weiss, M. A. (1993) *Measuring cost efficiency in the property-liability insurance industry*, Journal of Banking & Finance, Volume 17, Issues 2-3, April 1993, Pages 463-481. Special Issue on The Efficiency of Financial Institutions.

Evans, J. and Sherris, M. (2009) *Longevity Management Issues for Australia's Future Tax System*, Commissioned Paper Australia's Future Tax System, http://taxreview.treasury.gov.au/content/html/commissioned_work/downloads/Longevity_Management_Issues.pdf (accessed 2 March 2010)

Ferro, G. (2009) *One Possible Life Insurance Market Response to Ageing*, Geneva Papers on Risk and Insurance – Issues and Practice, 34, 119-136.

Ganegoda A. and Evans J. (2008) *Measuring Operational Risk in Financial Institutions*, Finsia Journal of Applied Finance Issue 4 2008, 9-14.

HM Treasury (2006) The Annuities Market, http://www.hm-treasury.gov.uk/d/pbr06_annuities_293.pdf

Kalberer, T. and Ravindran, K. (2009) *Variable Annuities: A Global Perspective*, Risk Books.

Lee R. D. and Carter L. R. (1992) *Modelling and Forecasting U.S. Mortality*, Journal of the American Statistical Association, 87: 659–675.

Lewis, S. (2009) HM Treasury, *The UK Annuities Market: Structure, Trends & Innovation*, International Conference on Annuities Markets, Tokyo 29-20 January 2009.

Milevsky, M. A. (2006) *The Calculus of Retirement Incomes: Financial Models for Pension Annuities and Life Insurance*, Cambridge University Press.

Olivieri, A. (2001) *Uncertainty in Mortality Projections: an Actuarial Perspective*, Insurance: Mathematics and Economics, 29, 2001, 231-245.

Piggott, J., Valdez, E. and Detzel, B. (2005) *The Simple Analytics of a Pooled Annuity Fund*, Journal of Risk and Insurance, 72, 2005, 497-520.

Richards, S. and Jones, G. (2004) *Financial Aspects of Longevity Risk*, paper presented to Staple Inn Actuarial Society, www.sias.org.uk/data/papers/LongevityRisk/DownloadPDF

Sheshinski, E. (2008) *The Economic Theory of Annuities*, Princeton University Press.

Whitehouse, E. R., D'Addio, A., Chomik, R. and Reilly, A. (2009) *Two Decades of Pension Reform: What has been Achieved and What Remains to be Done?*, Geneva Papers on Risk and Insurance – Issues and Practice, 34, 515-535.