

Longevity Insurance: A Missing Market

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Abstract

More than half of the world's old live in Asia, and around 35 per cent in India and China alone. As demographic transition proceeds regionally and globally, the development of a robust and reliable longevity insurance market will become essential. Although the need for such insurance is most pressing in Asia, longevity risk is poorly managed practically everywhere. This paper reviews theory and practice relating to longevity risk and insurance, amid a rapidly changing demographic and policy landscape. It analyses the reasons for the failure of longevity insurance markets, and examines possible innovations in both markets and public policy that may lead to a more vibrant market and a greater variety of longevity insurance products. These include risk sharing between the buyer and seller, 'deductibles', reverse mortgages, and securitisation.

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LONGEVITY INSURANCE: A MISSING MARKET*

“No one can confidently say that he will still be living tomorrow.” – Euripides (485 – 406 BC)

1. Introduction

Apart from the occasional long-lived Greek Tragedian, life expectancy was very short in ancient times. Indeed, for a given child to make forty years would have been highly unusual, and the risk of living too long would not have troubled many. Today, however, with life expectancy over 80 years in many countries, we *can* be reasonably confident that we will still be living tomorrow. Retirements are longer as well: a working-class retirement of thirty years would have seemed fanciful in the late 19th century, yet it is not uncommon now. The risk of outliving one’s resources during retirement has become very real; and as longevity continues to improve, more likely. Meanwhile, governments have been exacerbating this problem by withdrawing or curtailing government-sponsored retirement programs, and transferring longevity risk to individuals.

Life insurance developed on a large scale in response to the precarious lives of yesteryear: the risk of dying too soon; yet longevity insurance, despite its now-obvious utility, remains thin everywhere, especially in Asia. This paper discusses the theory and practice of longevity insurance in the context of both changing demographics and government policy; it explains the factors inhibiting the development of longevity insurance markets, and highlights product and market innovations, involving both the private and public sectors, that can help make such markets dynamic and successful. These latter developments include innovative risk sharing, ‘tailored’ annuities, reverse mortgages and securitisation.

2. Context

Two key and related factors are driving the need for an effective longevity insurance market: demographics and retirement policy.

The benefits of 250 years of industrial and scientific development are most tangible in terms of human life. From less than 30 years in the late 18th century, Frenchwomen, for example, can expect to live to almost 84 years today – more than a 150 per cent increase in what is historically a very short period of time.¹ This long life expectancy is reflected with little variation in all Western countries: even Turkey, the poorest Organisation for Economic Co-operation and Development (OECD) country, has a life expectancy of 72 years. And these life expectancies still incorporate

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¹ http://www.ined.fr/englishversion/publications/pop_et_soc/pesa410.pdf

deaths at or near birth: total life expectancies for those who reach old age are longer again. Australian actuarial tables indicate that retirees over 60 years of age face a 60 per cent chance of living beyond 90 years. Moreover, the current crop of retirees has not had access to today's standards of medical care for their entire lives: a Japanese girl born today may well have a 50 per cent chance of reaching 100.

Yet retirement ages have not increased commensurately with life expectancy. On the contrary, over the last generation people have been retiring earlier. Participation rates for OECD males aged 60-64 have fallen from between 70 and 90 per cent in the 1970s to between 20 and 50 per cent today. In the nation with one of the longest life expectancies, France, the participation rate for males 55-59 is currently around 20 per cent. Although women's participation in the labour market has increased over the last century, they too are retiring earlier. Since 1960, retirement ages for women have fallen by around five years in most OECD countries.

One policy response would be to force people to work longer, so keeping consistent the actual period of retirement and mitigating the probability of outliving one's resources. Aside from the political difficulty, for many types of jobs physical infirmity makes it impossible to work effectively past particular ages, and even many sedentary jobs cannot generally be performed at advanced ages. The Australian national statistical agencies now calculate 'healthy life expectancy' tables, which generally fall around 5 to 10 years earlier than ordinary life expectancy.²

Insert figure 1 here

Because it traditionally exhibits relatively high life expectancies, Europe readily comes to mind when discussing the problems of ageing. Yet Asia is far more significant in absolute terms, and will be increasingly so (Figure 1). In 2000, over half of the world's 605 million people over 60 lived in Asia, and this is forecast to increase to around 63 per cent or two billion such people by 2050. China and India alone are forecast to have almost 40 per cent of the world's population over 60 years by 2050.³ Europe's share of the total will meanwhile decline to 11 per cent, although it will retain the highest *proportion* of old people, especially for those over 80 years.

Insert table 1 here

Asia is also distinguished by the *rate* at which it is ageing. In the quarter-century to 2000 the number of 60-plus people in Asia more than doubled, and will more than double again in the next 25 years (Table 1).⁴ It has taken an average of 75 years for Western countries' elderly populations to expand from 7 to over 21 per cent of their population. Yet for China and India, this transition is

² <http://www.aihw.gov.au/mortality/faqs.cfm#livinglonger>

³ http://www.un.org/esa/population/publications/bulletin42_43/weinbergermirkin.pdf

⁴ <http://www.unescap.org/esid/psis/population/journal/1999/v14n4a4.htm>

forecast to take around 25 years. Finally, except for Japan, Asia's ageing process is occurring at a much lower level of relative per capita wealth. This may retard the development of sophisticated financial products; even in Japan there has been little development of longevity insurance products (Purcal and Piggott 2003).

At least for households, longevity insurance markets are less essential if governments promise to provide for their citizens' retirements, and if defined benefit (DB) pension plans (government or employer-provided) remain the mainstay of retirement provision. But these arrangements are becoming less common.

Declining fertility has exacerbated the difficulty of providing government pensions for a steadily growing and longer-living group of retirees. Fertility in the West has fallen dramatically since the 1970s, and is now 20 per cent below that required to maintain a constant population. This will cause dependency ratios in Western countries to increase significantly over the next 30 years (China will experience similar problems when the effects of its one-child policy are fully realised).⁵ The OECD average aged dependency ratio will increase from around 20 per cent today to almost 40 per cent by 2030. In the developed countries, the proportion of the population over 60 is now around 20 per cent, or 194 million people, and is set to rise to 33 per cent, or 374 million people, by 2050, over one quarter of whom will be over 80 years.⁶

In this context, unfunded Pay As You Go (PAYG) retirement schemes become untenable – unless taxpayers are willing to endure a significant increase in taxation or retirees a reduction in benefits. Consequently, various governments have been, to varying degrees, introducing retirement programmes that shift the responsibility for retirement provision to individuals via defined contribution (DC) schemes. These compel workers to save for their own retirement in special accounts during their working lives, and so break the transfer between those who work and those who are retired.

In theory, governments could make privately funded defined benefit programmes compulsory, to replace their publicly funded schemes, yet DC schemes have significant, additional benefits over defined benefit schemes: potentially higher rates of return, a greater range of investment choices for members, and greater portability for increasingly mobile workforces.

The trend towards defined contribution schemes has been continuing: Table 2 shows that at least twenty countries, representing over 180 million potential contributors, have introduced such plans between 1980 and 2003. Furthermore, the United States has been debating the privatization of part of its social security system for almost a decade; Japan has recently introduced DC plans; China in

⁵ The *dependency ratio* is the ratio of retirees and children to those of working age.

⁶ http://www.un.org/esa/population/publications/bulletin42_43/weinbergermirkin.pdf

2004 has introduced a voluntary Western-style DC framework⁷, and India has been introducing DC elements into its various pension frameworks since at least 2003.⁸ If these countries continue down this path, billions of people will need longevity insurance over the next 100 years. Moreover, the World Bank continues to encourage national retirement systems that include a compulsory defined contribution scheme (Holzmann and Hinz 2005). This policy paradigm is analysed in detail in Bateman et al (2001).

Insert table 2 here

The distinguishing feature of DC systems from a longevity insurance perspective is that they produce accumulated sums of wealth upon retirement that need to be spread over the remainder of retirees' lives. In Australia (having one of the more mature DC systems), over A\$700 billion are saved in such accounts, and every year approximately A\$20 billion are released for retirees' use. In time, as systems mature and more countries adopt DC plans, even larger sums will routinely become available for retirement consumption. Generally, in such systems, retirees are free to use their accumulation as they wish.

3. Dealing with Longevity Risk: theory and practice

With longer retirements, and progressively less government (and corporate) involvement in retirement provision, longevity risk must increasingly be dealt with at the *individual* level. Economists since Yaari (1965), and more recently Davidoff et al (2003), have demonstrated that life annuities provide an optimal income structure for individuals' retirements. A life annuity is a specified and guaranteed series of payments until death purchased for a lump sum today. A geometric treatment of the welfare gains from an efficient life annuity market is provided in Kingston and Piggott (1999). These products remove longevity risk and allow individuals to smooth their consumption patterns, in keeping with the traditional life-cycle hypothesis. Indeed, Panis (2003) shows that individuals with annuitised incomes are more content in retirement than those drawing intermittently upon lump sums.

Longevity risk, however, is only one risk faced by retirees. Investment and inflation risks are also relevant over the course of a long retirement. A life annuity will remove investment and longevity risks, but the real value of a nominal payment can be significantly affected by inflation over an extended period. Inflation-indexed annuities have, therefore, been developed and marketed.

Given some retirement accumulation, the ideal annuity would be calculated in the following manner (Creighton and Piggott (forthcoming 2006)):

⁷ <http://www.mercerhr.com/referencecontent.jhtml?idContent=1181345>

⁸ <http://www.frontlineonnet.com/fl2208/stories/20050422004303300.htm>

$$y_0 = \frac{f \cdot A}{\sum_{t=1}^{\omega} {}_t p_x \left[\frac{(1 + \pi)^{(t-1)}}{(1 + R)^t} \right]} \quad (1)$$

$$y_{t+1} = y_t \times (1 + \pi_t) \quad (2)$$

where A is the accumulation amount, and y_0 is the first yearly income that can be thus derived, assuming a positive annual inflation adjustment factor of π . R is the risk free rate of return, ω is the maximum possible life expectancy, and ${}_t p_x$ is the conditional probability that a particular retiree aged x will live for the next t years. Each individual would only annuitise some fraction, f , of his accumulated balance, given a desire for liquidity or a bequest. Such an arrangement would guarantee both a certain, inflation-adjusted income until death, and accessible precautionary savings. Equation (2) specifies the annual flow of payments.

Yet this type of annuity does have one significant drawback - it is very expensive. It leaves no risk to the annuitant. As a consequence, other forms of annuities have developed that expose the purchaser to some risk, and are therefore able to offer potentially higher payments.

Variable annuities have intuitive appeal in this context, as these guarantee an income for life, but one that fluctuates with the performance of the underlying assets. Annuitants purchase units in an investment fund that pays distributions until death, giving retirees the opportunity to share the potentially higher (expected) returns and to have some control over asset allocation. Of course, at the time of purchase variable annuities are written for a particular, assumed investment return over the life of the annuity (AIR). The actual payout received by the annuitant in any income period, y_t , will be affected by the actual return, R_t^M :

$$y_{t+1} = y_t \times (1 + \pi_t) \times \left(\frac{1 + R_t^M}{1 + AIR} \right) \quad (3)$$

In theory, a huge range of possibilities exists for trading off longevity, inflation, and investment risk to suit the preferences of the retiree. Given sophisticated financial markets, options and derivatives could in practice be incorporated into annuities to quantify exposures to any particular risk for each retiree, including both “co-payments” and deductibles.

But international practice is very different from theory. Only small markets exist for these types of annuities, if at all. Indeed, only a very small fraction of Australian retiree funds under management stem from life annuities (Doyle et al 2004), and mandatory annuitisation has been so disliked in the United Kingdom that its removal has been seriously discussed by policy makers there.

The most common way of dealing with retirement financing in countries with a substantial DC presence has been through ‘phased withdrawals’ or ‘allocated pensions.’ Essentially, these allow retirees intermittent access to their capital within preset maximum and minimum limits, based on life expectancy. Purchasers thus plan to exhaust the resources they have invested by their life expectancy at retirement. However, this strategy will result in little or no resource flexibility as their life expectancy nears; and further, around half of any retiree cohort will continue living for some time after life expectancy.

Yet these products remain a key plank of retirement programmes around the world; and even though annuities remain an option in various countries, they are relatively little used (Table 3). Although phased withdrawals are sometimes referred to as annuities, they are not annuities at all, in the sense of delivering longevity insurance.. For instance, of the over \$900 billion invested in ‘variable annuities’ in the United States, only 2 per cent exhibit genuinely annuitised income until death (Milevsky 2004).

Insert table 3 here

Naturally, retirees deal with longevity risk in other ways. Relying on relatives for financial support is centuries old, even though it may become less relevant as migration continues to increase. Further, there is evidence that risk sharing within and between families is quite limited (Hayashi et al 1996). Most Western governments provide a basic subsistence pension, unrelated to lifetime earnings, which remains for the time being the ultimate safety net for especially long-lived retirees.

4. Annuities: the unwanted and unavailable panacea

So what explains this discrepancy between theory and practice? On the one hand, annuity products are supposedly the best products to hold in retirement; yet on the other, even in the world’s largest annuity market, the United Kingdom, annual life annuity premiums comprise only £200 million of the annual £90 billion in premium income arising from long-tail insurance business.⁹ Life annuities suffer from fundamental demand and supply problems, some of which relate directly to the nature of annuity markets, while others are a result of bounded rationality and industry underdevelopment. None of these is insurmountable, however.

4.1 Demand constraints

Adverse selection has received the most attention from researchers, and is generally considered to be the chief demand impediment (Brown et al 2001). Because of the asymmetric information between prospective annuity purchasers and annuity issuers, annuity prices will be largely

⁹ http://www.abi.org.uk/Display/default.asp?Menu_ID=507&Menu_All=1,506,507

insensitive to personal characteristics, in particular those providing guidance to expected longevity. Those purchasers who do not expect to live very long will find the price too high, and will be driven out of the market. This, in turn, leads to further price increases, a so-called spiralling effect. This process, leading to an adverse selection of risks, is already familiar in health insurance, where, in the absence of policy intervention, healthy people do not find it worthwhile to purchase insurance. Significant adverse selection simply prices people out of the market.

A sample of imminent British retirees has indicated that more than 50 per cent never intend to annuitise, and 45 per cent of these for the reason that annuities are too expensive (Gardner and Wadsworth 2004). That adverse selection in a voluntary annuity market is a problem is not in dispute, although its extent is a subject of empirical investigation. By comparing the ‘money’s worth’ of life annuities in two countries¹⁰, Doyle et al (2004) show that Australia’s annuity market exhibits significantly more marked adverse selection than does Singapore’s, where eligible Central Provident Fund (CPF) accumulations can be better invested in an annuity than in any available alternative. A standardised Australian male annuitant would only reap slightly more than 80 cents per \$1 of annuity purchased, compared to 93 cents in Singapore. However, when *annuitant* mortality tables are used instead, the respective figures are 90 cents and 94 cents. These differences stem from adverse selection. Australia is similar to the United Kingdom and the United States in terms of the extent of adverse selection (Mitchell 2002; Finkelstein and Poterba 2000).

James and Vittas (1999) agree that adverse selection inflates annuity prices, but remind us that other demand factors are also at work. Retirees may be reluctant to annuitise their wealth because it cannot then be bequeathed. Ostensibly, this seems reasonable, but some studies have indicated that bequest motives are not a significant factor in the decision to annuitise: retirees with and without children have shown little difference in their willingness to purchase annuities, and econometric studies have placed little value on it (McCarthy and Neuberger 2003). In any case, although a bequest motive is recognised, it is not necessarily clear that the sizes of bequests are wholly intended. They may be the result of poor planning and lack of reasonable annuity options (Davies 1981). As for the precautionary-saving, or flexibility, motive, retirees may not annuitise because of uncertainty about future expenditures (especially medical bills). This mitigating factor has been strongly evident in surveys in the United States and the United Kingdom (Brown 2000; Gardner and Wadsworth 2004).

Public crowding out is also significant. The availability of publicly provided pensions reduces the need to buy annuities in the private market, especially among the less well off. Indeed, people’s

¹⁰ ‘Money’s Worth’ is the technique used to show how much income is received from \$1 of premium. It compares the expected present discounted value of the annuity benefit stream to its initial cost.

holdings of annuitised wealth can be surprisingly high, especially for those lower down the wealth spectrum who have little independent financial wealth. Moore and Mitchell (1997) calculate that around 60 per cent of the median household's wealth is annuitised (being mainly social security obligations). Other research suggests around two percentage points of estimated adverse selection in fact stems from social security programmes (Walliser 2000). However, as governments continue to withdraw from retirement provision, this factor will recede.

Purcal and Piggott (2003) seek to explore the question of the relative importance of adverse selection, crowding out, and bequests, within a stochastic life-cycle optimizing framework. Their results, in contrast to McCarthy and Neuberger (2003), suggest that bequests are the strongest deterrent to annuity purchase, followed by crowding out through government programs. Loadings simulating adverse selection pricing did not much discourage annuity purchase, even when the loadings were set as high as 30 per cent.

Individual myopia and consumers' lack of understanding further constrain annuity markets. The American Council of Life Insurance has noted that knowledge of the benefits of life annuities is generally low, and that consumers tend to irrationally focus on the risk of dying too soon rather than living too long (Brown 2000). The recent Gardner and Wadsworth (2004) survey shows an increasing tendency to annuitise as education increases. Further, life annuities are inherently difficult to market because they require people to think rationally about retirement, ageing and how best to plan their final years – topics that people often prefer to postpone thinking about (Selnow 2003).

4.2 Supply constraints

Certainly most research examining modest annuity markets has revolved around demand issues, specifically adverse selection and its consequences. Yet recent research is beginning to examine how the insurance industry is also reluctant, and often unable, to provide a significant life annuity market.

The fundamental supply problem relates to the uncertainty surrounding future mortality, which makes pricing life annuities difficult. Two schools of thought have emerged here, proposing either continuous improvement or compression (Lin and Cox 2005). Continuous improvement predicts mortality will decline at all ages; it may decline significantly through progressive scientific breakthroughs. Compression views life expectancy as fundamentally, biologically fixed at some very advanced age, yet believes mortality will continue to decline over a wide range of ages. Although continuous improvement offers more risk for life annuity providers, in either scenario the rates of change in life expectancy will crucially affect profitability and ultimately solvency.

Nevertheless, the reinsurance market offers the possibility of sharing longevity risks. Yet for the above reasons, it also is practically non-existent. The role of reinsurance in standard life insurance contracts is ten times that in annuity contracts; indeed, some reinsurers view longevity risk as “*just too toxic*” and “*dangerous*” (Wadsworth 2005). Reinsurers and direct life annuity providers perceive longevity risks differently; many reinsurers are not even taking on longevity risk at rates consistent with what is being charged in the retail market. Industry commentary suggests that reinsurers will exhibit more interest in underwriting large life annuity pools if it becomes possible to securitise longevity risk externally, if annuity products come to include provision for reviewable payouts contingent on life expectancy developments, and if insurers are made to hold more capital for these products (Wadsworth 2005).

Freely available, creditworthy, long-dated bonds – especially those that are linked to inflation and/or longevity outcomes – are useful for encouraging a life annuity market, as they can shield insurers from interest-rate risk over the course of their life annuity policies. Yet the current stock of government and corporate bonds is both small and ill-suited to such a market. Indeed, the shortage of investment-grade UK long-term bonds has caused their returns to be relatively low: medium term government bonds offer a greater yield than long-term bonds, a potential symptom of excess demand. Furthermore, existing bonds are generally too short to satisfactorily shield annuity providers from interest rate risk over the course of *entire* life annuity policies (which may last for over 40 years in certain cases). Nevertheless, the stock of long-dated *corporate* bond issuance has recently overtaken that of government long-dated bonds in the UK (Wadsworth 2005); other promising developments in the bond market are further discussed in Section 5.

In the following section, we turn to a discussion of some specific products and developments that might encourage the better management of and provision for longevity risk.

5. The Way Forward

The failures of the longevity insurance market can begin to be tackled from two perspectives. First, it may be possible to encourage longevity insurance markets by providing households with more products; second, it may be possible to develop reinsurance markets which facilitate risk spreading by insurers. Current thinking about these possibilities is reviewed in what follows.

5.1 Reverse Mortgages

The discussion thus far has been predicated on retirees’ having enough savings to purchase sufficient, annuitised longevity insurance, using financial assets accumulated through the working years. Yet this is an optimistic scenario for the majority of even the rich world’s retirees. Given that growth in compulsory and voluntary defined contribution retirement systems is a relatively recent

phenomenon, very few retirees have been contributing for their entire working lives. Many will have accumulations that fall far short of that required to finance an adequate retirement. For example, Australia has one of the more mature compulsory DC systems (instituted in 1992), yet the average value of retiree superannuation accounts at retirement is less than \$150,000¹¹, and it is estimated that over 80 per cent of Australians over 65 qualify for (mostly means-tested) government pensions.¹² Moreover, even in mature systems, lower-paid workers may struggle to accumulate enough savings to purchase an acceptable income stream to last for 20 years or more.

Reverse mortgages (RMs) can potentially alleviate some of these problems by allowing retirees to borrow against the value of their existing owner-occupied homes. Yet, unlike an ordinary mortgage, neither interest nor principal is repaid until the house is sold or the borrower dies. The income can be a lump sum, a line-of-credit, or a regular annuity payment. Further, RMs are typically non-recourse loans, meaning the lender cannot claim other assets if the home value is less than total borrowings when the home is sold.

It is worth noting that only an annuity RM offers complete longevity insurance; lump sum and line-of-credit versions are essentially phased withdrawals. Yet interestingly, the annuity RM has proved the least popular; in the United States only around one fifth of reverse mortgages originated have *any* form of annuitisation component, while reverse mortgage providers in Australia rarely offer annuity RMs. Furthermore, it is the reverse annuity mortgage which comes closest to simulating what is intuitively the most likely implicit family annuity contract in this context: the young agrees to support the old if they are long-lived, provided the old bequeath the young remaining assets if they are short-lived. Reverse mortgage annuities have the feature that the reduction in bequest is related not to the initial annuity purchase, but to how long (and how much) the annuity pays.

Reverse mortgages are well suited to the current socio-economic climate in developed countries. The elderly generally have significant wealth tied up in residential housing. Certainly, in the United States, Australia and Japan, housing wealth represents around half of private total assets, and there is a further, positive correlation between age and housing wealth. Moreover, owner-occupation rates are the highest in the over-60 age group (Mitchell and Piggott 2004). These facts, combined with the now well-noted house price appreciation over the past 10 years, underlie the potential efficacy of RMs.

For these reasons, RMs have been estimated to have a very large potential market, potentially 6.7 million households in the United States and as many as 1.3 million in Australia. RMs have not yet approached anywhere near these numbers, but there has been rapid growth in the United States,

¹¹ http://www.asfa.asn.au/guru/rpm.cfm?page=consumers_2_3

¹² <http://www.facs.gov.au/internet/facsinternet.nsf/aboutfacs/programs/seniors-retirement.htm>

which currently has the largest RM market. The American market has been stimulated by a government-sponsored Home Equity Conversion Mortgage (HECM) program initiated in 1989 (which provides participating lenders with mortgage insurance in case the loans come to exceed property values). Although growth started slowly, since 2001 the number of annual RM originations has increased by over 500 per cent, to almost 40 000 in 2004. Similarly, the number of reverse mortgage lenders has roughly tripled to around 200 over the same period.¹³

Outside the United States, there are small RM markets in Australia, Canada and the United Kingdom. Unlike in the United States, however, none has any form of government sponsorship. Australia's relatively new RM market is forecast to expand significantly in the coming years. Over 5 000 RMs were originated in 2003 worth around \$250 million¹⁴; and since 2002 five other Australian lenders have introduced reverse mortgage products.

Despite incipient signs of growth in the United States and Australia, RMs still possess disadvantages that can limit ultimate market size. On the supply side, reverse mortgages entail significant risks for lenders. Longevity risk, of course, is substantial given that loan repayments are often dependent upon the death of the borrower. Moreover, given the potentially long-tail nature of the reverse mortgage contract, lenders must estimate house prices and interest rate dynamics over potentially thirty years or more. Adverse selection and moral hazard issues remain: potential borrowers may better forecast their own longevity, and take less care of the home after the contract is signed. The United States HECM program at least has given potential lenders guaranteed insurance. On the borrowing side, potential borrowers can often have a cultural aversion to re-mortgaging their own home later in life; reducing housing equity can make bequests more difficult; and the desire for precautionary savings, where the housing asset is seen as a last resort, can act as a barrier to growth in the reverse mortgage market.

Recent developments in reverse mortgage markets indicate that some of these constraints are surmountable. In Australia, two favourable developments have arisen to mitigate collateral risk and the bequest motive. Bluestone, an Australian lending company, has introduced a 'protected-equity option' that allows borrowers to protect up to 20 per cent of their home's future value.¹⁵ This allows retirees to determine more accurately the size of the bequest they wish to leave. Another Australian firm, XCapital Health, is offering a reverse mortgage product that incorporates eventual accommodation in a retirement home and long-term health care.¹⁶ Because retirees can live in their home for only eight years before shifting to an XCapital Health retirement village, XCapital is

¹³ <http://www.seniorjournal.com/NEWS/ReverseMortgage/5-02-22HUDreversemortg.htm>

¹⁴ <http://www.theage.com.au/articles/2004/06/29/1088487963311.html?from=storylhs>

¹⁵ <http://www.bluestoneequityrelease.com.au/page.aspx?id=174>

¹⁶ <http://www.smh.com.au/articles/2004/07/12/1089484305051.html?from=storylhs>

better able to forecast the prospective value of the property over that time frame, thereby reducing collateral risk. Finally, securitisation of reverse mortgages can encourage market development by potentially allowing lenders to reduce their exposure to longevity risk and property values. At least two large securitisations have proceeded thus far: Lehman Brothers in 1999 and Citibank in 2001 facilitated securitisations of reverse mortgage portfolios in the United States and Europe, respectively.¹⁷

5.2 GSA (Group Self-Annuitisation)

As we have pointed out above, annuity supply is reluctant. The reasons for this have not been rigorously analysed, but apparently, nervousness over events or medical discoveries that may lead to unanticipated increases in life expectancies is a major inhibitor. That is, insurance companies are concerned about *systematic* longevity risk. Individuals, on the other hand, are most concerned about *idiosyncratic* risk. It follows that an annuity type product which assigns idiosyncratic risk to an insurance company, but leaves systematic risk with the annuitant, may have some appeal to both sides of the market, and may be priced at a level which would encourage purchase.

From a formal point of view, this kind of product, called Group Self-Annuitisation (GSA), a term used in Piggott et al (2005), has a good deal in common with a variable annuity. In the same way that variable annuity payouts are adjusted with market returns, a longevity adjustment annuity has payments which adjust with unanticipated changes in evolving mortality, analogously with equation (3) above, as follows:

$$y_{t+1} = y_t \times (1 + \pi_t) \times \left(\frac{1 + R_t^M}{1 + AIR} \right) \times \left(\frac{{}_1P_{x+t-1}^*}{{}_1P_{x+t-1}} \right) \quad (4)$$

where $\left(\frac{{}_1P_{x+t-1}^*}{{}_1P_{x+t-1}} \right)$ is the mortality experience adjustment; and $\left(\frac{1 + R_t^M}{1 + AIR} \right)$ is the interest rate adjustment for the period from year $t-1$ to t . These adjustments take into account the comparison of the actual $({}_1p_{x+t-1}$ and $R_t^M)$ against the expected $({}_1p_{x+t-1}^*$ and AIR) experience in mortality and interest.

This idea has been around for some time, and is briefly discussed in Wadsworth et al (2001). In fact, the Teachers Insurance and Annuity Association (TIAA) offers this kind of annuity through its companion securitisation College Retirement Equities Fund (CREF). Because TIAA-CREF annuities are participating with regard to both mortality experience and investment performance, there can be similarities between these annuities and those issued by a GSA plan. Payouts from TIAA-CREF life annuities are variable in the sense that ‘dividends’ are periodically paid to

¹⁷ <http://www.reverse.org/Europe.htm> ; <http://www.vinodkothari.com/secnews10.htm>

annuitants to reflect investment performance as well as the mortality experience of the annuitants. However, in practice, most of the adjustments have reflected investment experience and very little from errors resulting from mortality projections, and no *ex ante* formula is applied to the payout change associated with mortality adjustment.

In developing such a product, it is important that new cohorts are admitted into the insurance pool, otherwise over time, a classic ‘small numbers’ problem can arise in each closed cohort, thereby violating the ‘law of large numbers’ that often prevails in the pooling of risks. Equally, the payout formula must guarantee that new entrants face an *ex ante* expectation of an actuarially fair payout. Piggott et al (2005) derive a formal payout formula that provides for a formal analysis of payout adjustments from a longevity risk-pooling fund which meets these requirements. Referring to this as ‘group self annuitisation’, or GSA, they show that under weak requirements a unique solution to payout paths exists when multiple cohorts combine into a single pool. This relies on the harmonic mean of the ratio of realized to expected survivorship rates across cohorts. The case of evolving expectations is also analysed. They demonstrate that the periodic benefit payment in a pooled annuity fund is determined based on the previous payment adjusted for any deviations in mortality and interest from expectations. GSA may have considerable appeal in countries which have adopted national defined contribution schemes and/or in which the life insurance industry is non-competitive or poorly developed. Practical implementation of this product innovation is also a challenge for the future.

5.3 Mortality-based Securities

Relatively little academic research has been directed towards analysing mortality based securities, even though, in one form or another, such instruments potentially provide a means for risk spreading across longevity insurers. As Shiller (2005) points out, the longevity insurance market is growing only slowly, perhaps because major players, at least for now, are following the lead of governments in backing away from longevity insurance. A discussion of a recent conference devoted to this issue is presented in Byrne and Harrison (2005), and material in this section closely follows their report.

In terms of capital market innovations that can be used to hedge mortality and longevity risk, the first significant development has been the Swiss Re mortality bond issued in December 2003. According to published reports, the \$400m bond has a three-year maturity (maturity date is 1 January 2007) and was priced at LIBOR¹⁸ + 1.35 per cent. This instrument was designed to address the risk of catastrophically *increased* mortality, from an extreme event such as an epidemic, war, or

¹⁸ The LIBOR is the most widely used benchmark or reference rate for short term interest rates. LIBOR stands for the London Interbank Offered Rate and is the rate of interest at which banks could borrow funds from other banks, in marketable size, in the London interbank market.

major natural disaster. The catastrophe bond structure arising from this instrument allows for reductions in principal payments, triggered by the mortality reaching a pre-specified level in excess of the normally anticipated experience, to a sliding scale to zero¹⁹. Furthermore, in the event of a mortality catastrophe, the mortality hedge arising from this structure will permit the bond issuer to release the capital that would otherwise need to be held to cover its contingent liabilities. The Swiss Re mortality index has been constructed based on the mortality experience of five major countries: the United States, the United Kingdom, France, Italy and Switzerland.

While of interest as a mortality-based security which has been successfully traded, however, these mortality bonds provide a means of reducing risk of unexpected and substantial jumps in mortality. Our concern is with the opposite risk to which Swiss Re is exposed, faced particularly by pension funds and annuity writers. These organisations require capital market instruments that are linked to longevity experience – in other words instruments that pay more the longer people live.

Companies with longevity risk can either attempt to sell the risk through securitisation, or buy an asset that will hedge the risk (Roberts 2005)²⁰. Survivor bonds (Blake and Burrows 2001) provide the best example of such a security. The 25-year European Investment Bank/BNP (EIB/BNP) Paribas survivor bond, launched in November 2004, specifies coupon payments linked to the proportion of the population who were age 65 in 2003 who are still alive at the coupon date (Azzopardi 2005)²¹. The base coupon is set at £50m per annum and in each year, this is scaled by the percentage of the reference group who are still alive (actually, who were alive two years ago due to the time lag in gathering the data).

These types of bonds should provide for an attractive alternative hedging investment instrument for pension funds, particularly as the EIB/BNP is a supranational institution that is triple-A rated. The longevity risk in this structure is ultimately borne by Partner Re – a Bermuda-based reinsurance company. However, the scale of this bond is still relatively small in comparison with market exposure (£550m of bonds vs. £760bn of DB pension liabilities).

However, the issue has yet to be fully subscribed.²² There appears to be market nervousness about the product, and trustees, fund managers, consultants, and employer sponsors have yet to be confident that this product helps them meet their fiduciary obligations. There are also constraints on the supply side: reinsurance remains reluctant. The reinsurer Partner Re appears to have made it clear that it has little appetite for additional deals (Byrne and Harrison 2005). We summarize the comparison of these two mortality-based securities in Table 4.

¹⁹ <http://www.pensions-management.co.uk/news>

²⁰ Roberts (2005) http://www.pensions-institute.org/conferences/longevity/Roberts_Phil.pdf

²¹ Azzopardi (2005) see also http://www.pensions-institute.org/conferences/longevity/Azzopardi_Mark.pdf

²² <http://www.bfinance.co.uk/inst/article.do?docid=N12130>

Insert table 4 here

Most of these hedges run for a fixed number of years – 25 in the case of the EIB bond – which means there is ‘tail risk’ in that there is currently no way to hedge the cost of pensions to members who survive more than 25 years after retirement. Cash flow swaps might provide an alternative to longevity bonds for DB schemes but trustees’ understanding of these instruments is currently low and this acts as a barrier to usage.

Both the Swiss Re and EIB/Paribas bonds present challenges for actuarial, financial, demographic, and economic research. For these securities to be reliably priced, well-specified and robust stochastic mortality models and reliable well-defined mortality indices are required. Academic research is proving to be crucial to finding market solutions. For the Swiss Re bond, for example, the Lin and Cox (2005)²³ model appears to produce calibrated results that closely approximate the observed pricing. Another approach is to focus on the development of the force of longevity, the longevity analogue of the force of mortality (Jin 2004).²⁴ Ultimately, however, gradually accumulating market experience will prove invaluable, and for this to build, risks will probably have to be shared rather than fully immunized.

Designing appropriate hedges (including partial hedging) is an important first step in producing solutions to longevity risk, but an active market for these hedges requires both buyers and sellers. Identifying buyers can also be problematic, although Shiller (2005) identifies some potential ones – pharmaceutical firms, for example. Governments are possible issuers of longevity bonds, but issuing survivor bonds has much in common with Defined Benefit social security to which many governments wish to reduce their exposure. With some level of longevity reinsurance or some kind of government guarantee, the private sector may be more positive towards designing and issuing longevity insurance products, allowing this risk to be allocated more efficiently in the long run. However, the cost of the guarantee implied by survivor bond issues is unclear – another topic for academic research.

6. Conclusion

In this paper we argue that demographic transition has led to a reduction in longevity insurance around the world, at a time when it is most needed. Governments have backed away from their defined benefit pension promises, and private sector insurance firms, nervous of the implications of medical technology for life expectancy, are reluctant to sell genuine life annuities except on highly unattractive terms. In many countries, annuity markets have declined relative to the number of

²³ Cox and Wang (2004). see also http://www.pensions-institute.org/conferences/longevity/Cox_Samuel.pdf

²⁴ Jin (2004). see also <http://www.actuaries.asn.au/PublicSite/pdf/fsfpaper2004-jin.pdf>

retired households who might be expected to purchase them. Further, government and industry are aligned in their incentives to promote products that offer retirement income for less than the whole of life. This reinforces whatever tendency households have towards a myopic view of retirement financing.

Two kinds of responses might provide some respite going forward – those giving households greater choice in longevity insurance products, and those that allow insurance companies to spread longevity risk through reinsurance.

Looking at household choice first, the accumulation of wealth in residential real estate around the world provides some opportunity for retirement income streams to be built around gradual increases in debt on housing, and these may incorporate a longevity insurance component. These reverse annuity mortgages have the potential to provide alleviation from deteriorating living standards, particular for older retired age groups. Such contracts, in fact, can be seen as the formal analogue for what is frequently an implicit contract between members of the same family of different generations: the younger generation contracts to look after the older generation if they live long, in return for the promise of a bequest if they die early. This bequest-income balance is different from that embodied in a conventional life annuity, in that the debt accrues gradually, and to some limit, depends on the actual life span of the insured individual.

Second, it is possible to design, and may be possible to market, life annuities which separate systematic and idiosyncratic risk. Such products may have a potential market because while insurance companies are nervous about systematic risk, households are more concerned about idiosyncratic risk. By separating these risks, it will be possible to leave households to bear systematic risk, and insurance companies to bear idiosyncratic risk.

Turning to reinsurance, new developments in mortality based securities suggest that there may be some potential for longevity risk to be spread. This may occur either through securitisation of longevity risk business, or through purchase of immunizing securities such as survivor bonds. Experience so far has been limited, and not entirely encouraging. There may be a role for governments, or even supra-national organisations, to issue such bonds. In addition, there may be potential for government to directly provide for systematic longevity risk guarantees to companies prepared to write life annuity business on terms that attract custom.

In general, despite the genuine financial problems being thrown up by our ever-augmenting life expectancies, amid the angst it is heartening to remember that, even if we are still fine-tuning the art of remaining indefinitely comfortable,

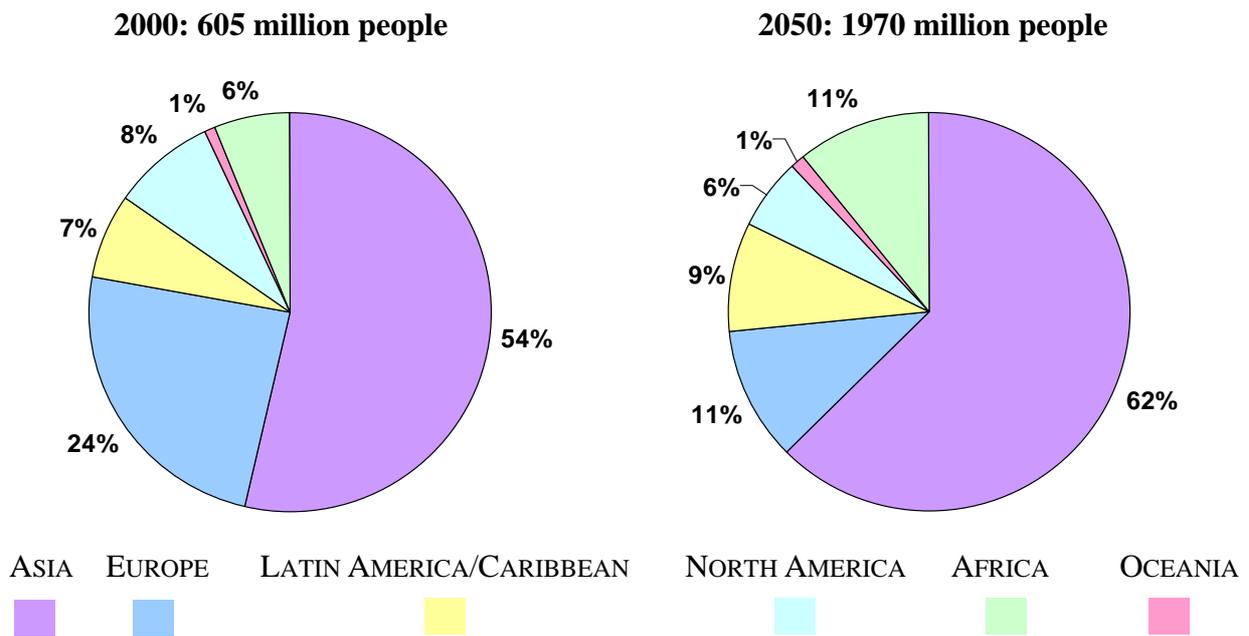
“Old age is not so bad when you consider the alternatives” – Maurice Chevalier (1888 – 1972).

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FIGURE 1: GEOGRAPHIC (ESTIMATED) DISTRIBUTION OF POPULATION AGED 60+



Source: *The Sex and Age Distribution of the World Populations: 1998 Revision, Volume II: Sex and Age* (United Nations publication, Sales No. E.99.XIII.8), medium variant projections

Table 1: World Regions compared - Distribution and Relative Growth of Older Populations

Region	Distribution of populations 60 + and 80 +		
	2000	2025	2050
	Proportion of Aged 60 or Over in percent		
Africa	5	6	12
Asia	9	15	24
Europe	20	28	35
Latin America and the Caribbean	8	14	22
Northern America	16	26	28
Oceania	13	20	24
	Proportion of Aged 80 or Over in percent		
Africa	0.4	1	1
Asia	1	2	4
Europe	3	5	9
Latin America and the Caribbean	1	2	4
Northern America	3	4	8
Oceania	2	3	6
	Percentage increase in 60+ population over previous 25 years		
Asia	104	119	76
Northern America and Europe	36	46	13

Sources: The Sex and Age Distribution of the World Populations: 1998 Revision, Volume II: Sex and Age (United Nations publication, Sales No. E.99.XIII.8), medium variant projections; Knodel (1999)

Table 2: Growth in Countries Operating Privately Managed DC plans, and Potential Contributors: 1981-2003

Year Introduced	Country	Labour Force (millions)	Cumulative Labour Force
1981	Chile	6.2	6.2
1985	Switzerland	3.8	10.0
1988	United Kingdom	29.8	39.8
	Australia	10.4	50.1
1993	Argentina	15.0	65.1
	Denmark	2.9	68.0
	Peru	11.0	79.0
1994	Colombia	20.7	99.7
1996	Uruguay	1.6	101.3
1997	Bolivia	3.8	105.1
	Hungary	4.2	109.2
	Kazakhstan	8.0	117.2
	Mexico	34.7	151.9
1998	El Salvador	2.8	154.7
1999	Sweden	4.5	159.1
	Poland	17.0	176.2
2000	Bulgaria	3.4	179.6
2001	Latvia	1.2	180.7
2003	Dominican Republic	2.5	183.2
	Slovakia	2.2	185.4

Note: Labour Forces as at 2003/2004

Sources: CIA World Factbook 2005 (online); Palacios and Pallares-Miralles (2000)

Table 3: Retirees' Options for Dealing with Longevity Risk – An International Comparison

Country	Generally-Used and Available Benefit Type			Taxation of Retirement Benefits
	<i>Lump Sum</i>	<i>Phased Withdrawal</i>	<i>Life Annuity</i>	
Argentina	Only for Large Sums	Yes	Yes	normal taxation
Australia	Yes	Yes	Yes	annuities and phased withdrawals are favourably taxed
Bolivia	No	No	Yes	generally tax exempt
Chile	Only for Large Sums	Yes	Yes	taxed (but higher threshold)
Colombia	No	Yes	Yes	benefit payments are generally tax exempt
Hungary	Yes	No	Yes	normal taxation
Malaysia	Yes	No	No	generally tax exempt
Mexico	No	Yes	Yes	generally tax exempt
Peru	No	Yes	Yes	normal taxation
Poland	No	No	Yes, mandatory	normal taxation
Singapore	Only for Large Sums	No	Yes, mandatory	generally tax exempt
Sweden	No	No	Yes	normal taxation
Switzerland	Only for Small Sums	No	Yes, generally mandatory	generally tax exempt
United Kingdom	Yes	Yes	Yes	annuity payments are taxed; lump sums tax free
Uruguay	No	No	Yes	normal taxation

Source: Bateman et al (2001)

Table 4: Comparison of Mortality Bond and Longevity Bond

	Swiss Re Mortality Bond	BNP Paribas / EIB Survivor Bond
Issuer	The Swiss Re (Dec 2003)	European Investment Bank (EIB) (Nov 2004)
Cash Flow Structure	3-year Catastrophe Bond Structure	25-year Group Term Life Annuity
Calculation Agency	The Swiss Re	BNP Paribas
Index	weighted average population mortality in US, UK, France, Italy and Switzerland in 2003 to 2006	Based on publicly available ONS data of English and Welsh mortality for a cohort of males aged 65 in 2003
Reinsurer	N.A.	Partner Re
Principal	\$400 million	Nil
Coupon	LIBOR plus 1.35%	£550 million p.a. linked to Cumulative Survival Rate(i.e. proportion of survivors) in the cohort
Risk Type	Extremely high group mortality risk over next 3 years	Cumulative aggregate longevity risk over next 25 years
Risk Transfer	From issuer to bond holder(s)	From bond holder(s) to issuer/reinsurer
Market Yield	LIBOR plus 135 bps initially	LIBOR less 35 bps
Market Response	Over-subscribed; reduced yield	Undersubscribed; No further issues

Source: Swiss Re and BNP Paribas (2004)