Independent Review of Retirement Income

Report

We Need a National Narrative: Building a Consensus around Retirement Income

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Chapter 4: Helping savers to manage longevity risk

A particularly important issue in retirement income provision is longevity risk. There are two components to longevity risk. The first is the uncertainty over how long any particular pension scheme member is going to live after retirement. This is known as idiosyncratic longevity risk. Both individuals and schemes face idiosyncratic longevity risk. The second is uncertainty over how long members of a particular age cohort are going to live after retirement. This is known as systematic longevity risk. Only schemes face systematic longevity risk. Individuals have a poor understanding of idiosyncratic longevity risk. Pension schemes can reduce idiosyncratic longevity risk by pooling the risk amongst a large number of scheme members, i.e., by taking advantage of the law of large numbers. Systematic longevity risk, however, cannot be reduced in this way: it needs to be hedged using a suitable hedging instrument.

4. Helping savers to manage longevity risk

> *'I'm just one hundred and one, five months and a day'.*
>
> *'I can't believe that!', said Alice.*
>
> *'Can't you?', the Queen said in a pitying tone. 'Try again: draw a long breath, and shut your eyes'.*
>
> *Alice laughed. 'There's no use trying', she said: 'one can't believe impossible things'.*
>
> Lewis Carroll (1871) *Through the Looking-Glass, and What Alice Found There*

A particularly important issue in retirement income provision is longevity risk. There are two components to longevity risk. The first is the uncertainty over how long any particular pension scheme member is going to live after retirement. This is known as idiosyncratic longevity risk. Both individuals and schemes face idiosyncratic longevity risk. The second is uncertainty over how long members of a particular age cohort are going to live after retirement. This is known as systematic longevity risk. Only schemes face systematic longevity risk. Individuals have a poor understanding of idiosyncratic longevity risk.[832] Pension schemes can reduce idiosyncratic longevity risk by pooling the risk amongst a large number of scheme members, i.e., by taking advantage of the law of large numbers. Systematic longevity risk, however, cannot be reduced in this way: it needs to be hedged using a suitable hedging instrument.

4.1 Introduction

In order to help savers manage longevity risk, we need to understand both life expectancy and longevity risk and we begin with some observations on these. The main concern is that people who underestimate how long they are going to live face the possibility of running out of money before they die. This, in turn, suggests that idiosyncratic longevity risk is a risk that individual savers are not able – and should not be expected – to manage themselves. To protect themselves from outliving their resources, most savers will need longevity insurance at some stage in retirement.

Systematic longevity risk is a trend risk facing the providers of longevity insurance which can only be hedged with a suitable hedging instrument. The key instrument for hedging

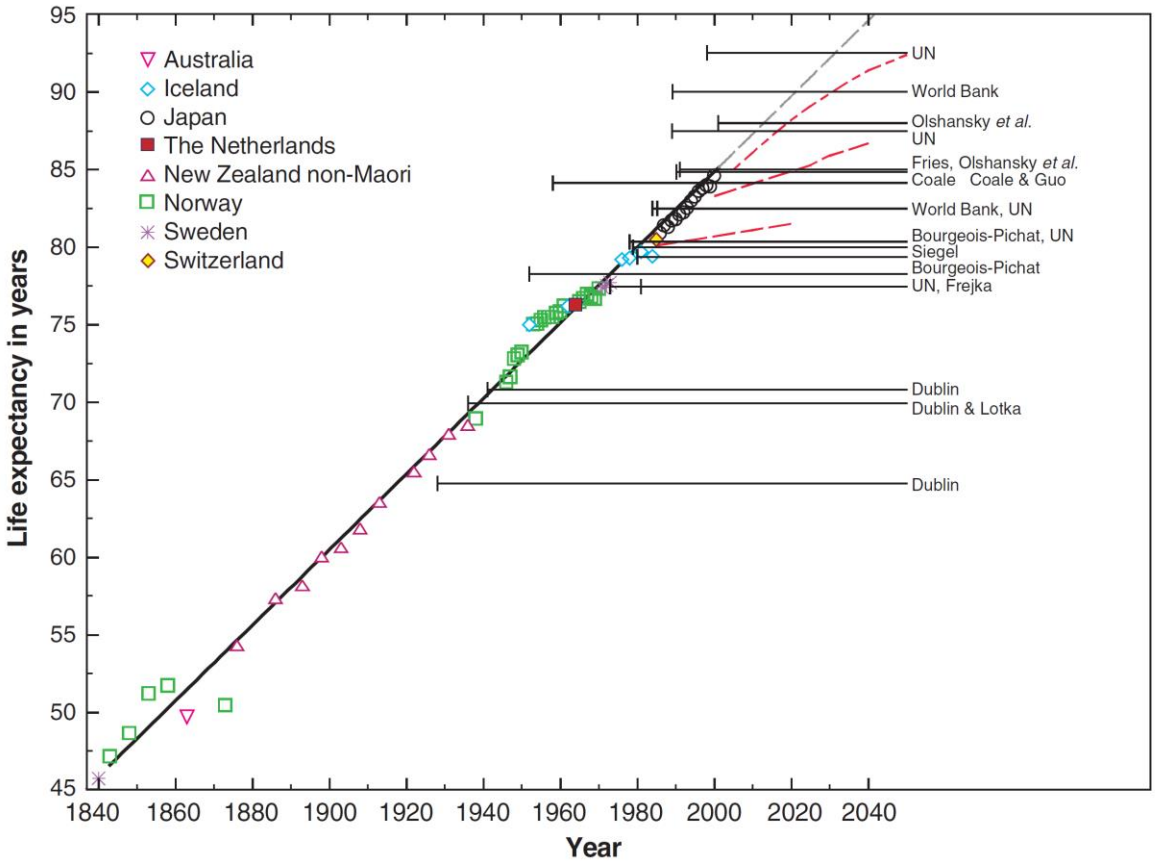
[832] As the American Academy of Actuaries, the UK Institute and Faculty of Actuaries, and the Australian Actuaries Institute say on p.1 of their October 2015 joint report *The Challenge of Longevity Risk: Making Retirement Income Last a Lifetime*: 'Longevity risk is not well understood by many people and this lack of understanding can have significant implications for retirement incomes, particularly as longevity increases'; http://www.actuaries.org.uk/news-and-insights/media-centre/media-releases-and-statements/longevity-risk-ticking-time-bomb.

systematic longevity risk is a longevity bond and we consider the role the Government could play in issuing longevity bonds. We end by examining the arguments that have been put forward by those who support the case for Governments issuing longevity bonds and those who are against the idea.

4.2 Some observations on life expectancy and longevity risk

As we mentioned in Chapter 1, the principal purpose of a pension scheme is to provide an income in retirement for however long the scheme member lives. But how long someone lives cannot be reliably estimated unless they have a terminal condition.

Figure 4.1: Historical increases in life expectancy



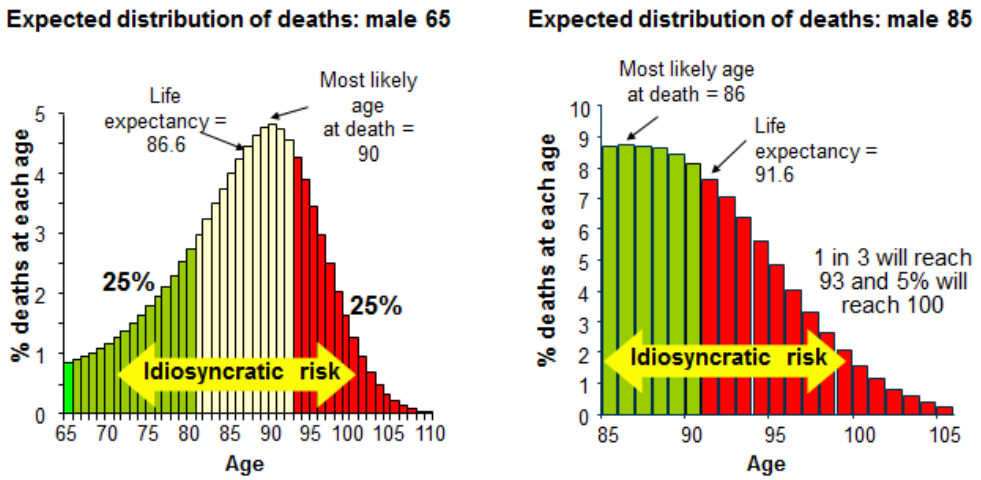
Source: Jim Oeppen and James W. Vaupel (2002), Broken Limits to Life Expectancy, Science, 296(5570): 1029-1031

Figure 4.1 shows that in advanced countries, life expectancy has been increasing at the rate of approximately 2.5 years per decade since 1840.[833] Being told their life expectancy is a

[833] In November 2015, the Office for National Statistics released data which shows that life expectancy continues to improve. For example, a new-born baby boy in England can expect to live to 79.5 years. This is an increase of 5.9 years over two decades. New-born girls in England can expect to live to 83.2 years – an increase of 4.1 years over two decades. Meanwhile, 65-year-old men and women in England can expect to live to 84

completely useless piece of information for someone who has just retired, since there is an approximately 50% chance that a 65-year old man, for example, will live beyond his life expectancy of 86.7 years as the left chart in Figure 4.2 shows. It does not get easier at higher ages. Telling an 85-year old man that his life expectancy is 91.6 years is also of little use, since one-in-three 85-year old men will reach 93 and 5% will reach 100 as the right chart in Figure 4.2 shows. This figure also illustrates the nature of idiosyncratic longevity risk, the uncertainty about how long any particular individual will live.

Figure 4.2: The variability of individual lifetimes



Source: 100% PNMA00 medium cohort 2007

Furthermore, individuals are notoriously bad at estimating their own life expectancy. Figure 4.3 reveals that all age groups – and men more than women – tend to significantly underestimate their own life expectancy. While the extent of the underestimation decreases with age, men in their 60s still underestimate their life expectancy by an average of five years and women by three. So if a retiree plans to draw down their pension fund in line with their own estimate of their life expectancy, a typical male will outlive their pension pot by five years and a typical female by three. A key explanation for the results in Figure 4.3 is that people tend to over-estimate how many people die between 65 and 70, and under-estimate how many live beyond 80 as Table 4.1 shows.[834] To illustrate, the table shows that members of DC schemes aged over 60 believe that 20% of 65-year olds will die before 70, whereas the correct figure is 10%. They also believe that 80% will die before 80, whereas the true figure is only 60%.

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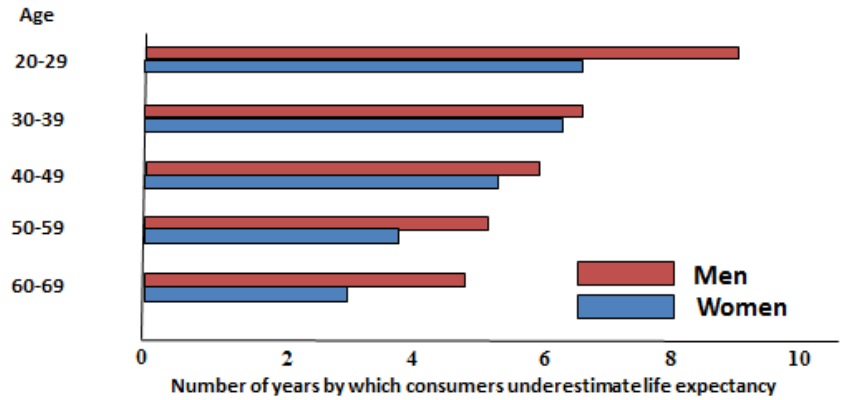
and 86, respectively. In December 2015, the ONS predicted that life expectancy at birth would reach 97.6 for men and 100 for women born in England in 2064.

[834] Reported in Ian Porter (2015) The longevity issue - Mapping the new retirement landscape, Retirement Planner, 14 May.

Figure 4.3: Individual underestimates of life expectancy by age



Source: Christopher O'Brien, Paul Fenn, and Stephen Diacon (2005), How Long do People Expect to Live? Results and Implications, Centre for Risk and Insurance Studies, Nottingham University Business School, CRIS Research report 2005-1, April; the figure shows self-estimated life expectancy compared with the Government Actuary's Department forecast life expectancy.

Table 4.1: Percentage of 65-year old members of a DC pension scheme with a £10,000 pension pot who will die before a specified age

Die before age	Estimate by members of DC pension schemes aged 60+ (%)	Real data (%)
70	20	10
80	50	20
90	80	60
100	90	90

Source: Ignition House

Table 4.2: Difference between self-estimated and actual life expectancy at age 65

Men				Women			
Aviva survey self-estimate	UK average (ONS)	Insured lives	Healthy insured lives	Aviva survey estimate	UK average (ONS)	Insured lives	Healthy insured lives
15	18.3	21.3	23	19	20.8	23.1	23.7
	(3.3)	(6.6)	(8)		(1.8)	(4.1)	(4.7)

Note: Difference compared with Aviva survey self-estimated life expectancy reported in brackets. Source: Aviva (2015, p.6) *Making Your Money Last in Retirement*, January.

A study by Aviva published in 2015 updates the results of Figure 4.3.[835] Table 4.2 shows that 65-year old males underestimate their life expectancy by 3.3 years and 65-year old females by 1.8 years, compared with the UK average population. However, assured lives – people taking out life assurance – and healthy assured lives will live longer than the national average. Healthy assured lives underestimate their life expectancy by 8 years for men and 4.7 years for women. The general pattern is clear and persistent: almost everyone underestimates their life expectancy by a number of years, and men underestimate this more than women.

The Aviva report notes (p4): 'The risk of running out of money is likely to remain a constant threat for many people throughout their retirement, and, through planning, will become increasingly important as people take on more personal responsibility. People choosing to take some or all of their pension savings as cash….can only assess whether this was a wise decision if they have an accurate understanding of their life expectancy. To fail to consider how much money they will need for their retirement years means they may risk a life in poverty if they outlive their savings'.

Table 4.3: Reasons people say they will live a shorter life than average

Reason	Men (%)	Women (%)	All (%)
A serious health condition/illness	64	63	63
A serious health condition/illness in the family (which they currently do not have)	14	10	12
Family does not live long	27	28	28
Lifestyle – drinking and lack of exercise	28	27	28
Smoker	18	22	20
Does not have the money to support themselves should they fall ill	8	11	10

Source: Aviva (2015, p.4) Making Your Money Last in Retirement, January.

[835] Aviva (2015) *Making Your Money Last in Retirement*, January; https://www.aviva.com/media/upload/Making_your_money_last_in_retirement-Aviva__longevity__report.pdf.

The report also gives the reasons why people believe they have a lower life expectancy than the average – see Table 4.3. The most common reasons – which are similar for men and women – are an existing serious health condition/illness, low family life expectancy, and lifestyle – drinking, lack of exercise and smoking.

Table 4.4: Concerns people have about old age

Concern	% most concerned
Living longer than expected and having insufficient money	5
Ill health	56
Dementia	50
Being dependent on other people	36
Going into a care home	30
Dying or people close to them dying	25

Source: Aviva (2015, p.6) Making Your Money Last in Retirement, January.

A particularly worrying finding in the report is that many people do not appear to be too concerned about outliving their savings relative to other concerns they have about old age – see Table 4.4.[836] The main reason for this is that this possibility is 'too far into the future to worry about'. The table does, however, show that people are concerned about going into a care home, but research by Just Retirement indicates that only 10% of people stated that they were prepared for the cost of care.[837] In addition, the table shows that people are concerned about dementia. But we should remember that financial capability declines a long time before dementia sets in – at a rate around 2% a year after age 60 and this is from a base level of financial literacy that is also very low for most people. This suggests that many people will be financially vulnerable well before the onset of full dementia.[838] The

[836] Americans by contrast take a very different attitude. According to a 2010 Allianz survey of 3,257 people, 61% said 'they were more scared of outliving their assets than they were of dying'. This figure increased to 77% for those between the ages of 44 and 49, and to 82% for those in their late 40s with dependants. A 2014 survey conducted by Wells Fargo of 1,001 middle-class Americans (aged 25-75) said they 'would rather "die early" than not have enough money to live comfortably in retirement' (reported in Jessica Rabe (2015) Which profile fits a money manager's ideal customer?, Convergex.com, 12 October).

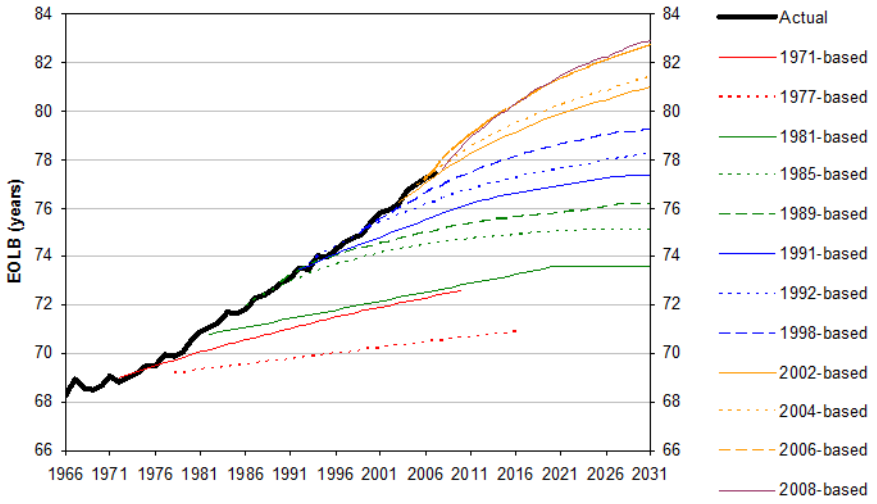
[837] Reported in Ian Porter (2015) The longevity issue - Mapping the new retirement landscape, Retirement Planner, 14 May.

[838] Michael S. Finke, John S. Howe and Sandra J. Huston (2011) *Old Age and the Decline in Financial Literacy*; http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1948627. The 2% rate of decline in financial literacy does not increase with advanced age, nor is the decline related to cohort effects or differences in gender or educational attainment. On the other hand, confidence in financial decision making abilities does not decline with age. Clearly, undiminished confidence when combined with reduced capabilities can lead to very poor investment decisions by older people.

Aviva report concludes (p6): 'Without a focused effort by the Government and the wider industry it may therefore be difficult to get people to really understand the importance of longevity in their retirement planning'.

One might assume that the Government would be better at estimating life expectancy than individuals. Unfortunately this is not the case. The official agency for estimating life expectancy in the UK is the Office for National Statistics. Figure 4.4 indicates that the ONS has systematically and significantly underestimated the increase in life expectancy since 1971. The figure shows one aspect of systematic longevity risk, namely the risk of underestimating the trend improvement in life expectancy. The actual increase in life expectancy is shown by the solid black line – this follows the same straight line increase depicted in Figure 4.1. All the ONS projections assume that there will be a levelling off of life expectancy, but there is little evidence that this is happening.[839] However, it is fair to say that the ONS's more recent projections have been 'more accurate' than its earlier ones, since they involve a lower degree of levelling off.

Figure 4.4: Actual and projected period life expectancy at birth, males, UK, 1966-2031

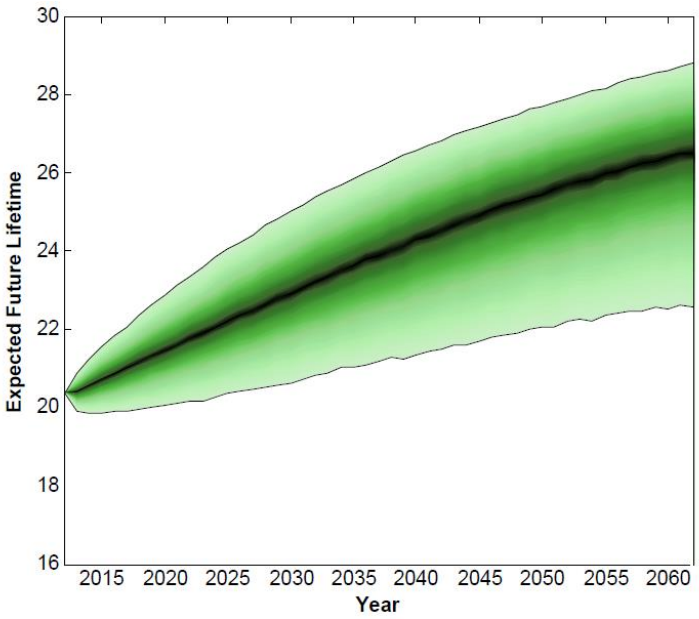


Source: Office for National Statistics

[839] In September 2015, the Institute and Faculty of Actuaries' Continuous Mortality Investigation (CMI) did report a slowdown in increases in life expectancy over the last four years. It found that expected lifespans increased by four months between 2011 and 2015, while life expectancy at 75 showed no improvement at all. Between 2000 and 2011, life expectancy increased by three months a year in line with long-run historical trends. Tim Gordon, CMI chairman, said: 'Insurers and pension funds will need to consider whether this recent experience indicates a fundamental change in mortality improvement trends, or whether it is a short term variation due to influences such as influenza and cold winters - the financial implications are material'. 2015 was an 'exceptionally heavy year for mortality' with 25,000 more deaths than the 300,000 expected in England and Wales over the first seven months, in part because winter flu vaccine had been less effective than usual (reported in Jack Jones (2015) Life expectancy increases slow dramatically, Professional Pensions, 28 September).

Even if everyone – individuals and governments – could improve their forecasts of the trend improvement in life expectancy, there will always be considerable uncertainty around the trend. The longevity fanchart[840] in Figure 4.5 shows that the best estimate of male life expectancy at age 65 in 2060 is 26 years, but it could be anywhere from 22 years to 28 years, a range of 6 years. This uncertainty around the trend improvement in life expectancy is another aspect of systematic longevity risk: how useful is it to tell a 20-year old male that his life expectancy could be anywhere between 87 and 93 years (assuming he survives to 65)?

Figure 4.5: Longevity fanchart for 65-year old males



Source: Kevin Dowd, David Blake, and Andrew Cairns (2010), Facing up to Uncertain Life Expectancy: The Longevity Fan Charts, *Demography*, 47(1): 67-78

[840] This presents projections of male life expectancy at age 65 out to 2060. The dark central line shows the best estimate of the increase in life expectancy to 2016, while the outer lighter shaded area shows the 90% prediction interval: we can be 90% confident that the true life expectancy will lie in this band. The model used to make these projections is the Cairns-Blake-Dowd (CBD) stochastic mortality model (see Andrew Cairns, David Blake, and Kevin Dowd (2006), A Two-Factor Model for Stochastic Mortality with Parameter Uncertainty: Theory and Calibration, *Journal of Risk and Insurance*, 73, 687-718).

4.3 Idiosyncratic longevity risk and its management

4.3.1 Longevity insurance

It should be clear that idiosyncratic longevity risk is a risk that individual savers are not able – and should not be expected – to manage themselves. To protect them from outliving their resources, most savers will need longevity insurance at some stage in retirement – the possible exceptions being those with very significant wealth or those with a serious life-shortening medical condition, but without dependants.

Given the primary purpose of a pension scheme, longevity insurance will be an essential component of a well-designed DC scheme at some point during decumulation, as we have said many times previously.

Longevity insurance can take two principal forms:

- A longevity-insured income, such as a lifetime annuity
- A deferred longevity-insured income, such as a deferred lifetime annuity.

Longevity insurance can be embedded in a range of retirement income products that also invest in growth assets during retirement, such as investment-linked annuities, variable annuities, and guaranteed drawdown products. However, these are retail products, and as such can have high charges, especially if they are sold on a voluntary basis and hence have to be extensively marketed. Furthermore, products with deferral features, such as a deferred lifetime annuity, are expensive to provide from a regulatory capital point of view if sold by insurance companies. This is because under the Solvency II regulatory regime for insurers that came into force in January 2016, the regulator requires significantly higher solvency capital for deferred annuities than for immediate annuities.

To reduce costs, we again need to look for economies of scale within the pensions regulatory regime, since this does not impose solvency capital requirements on pension schemes. The obvious solution for achieving these economies – as we saw in Chapter 3 – is to use ‘scheme drawdown’ combined with ‘longevity insurance’. In other words, the scheme itself provides income drawdown together with the longevity insurance. This would enable flexibility in spending in the early years of retirement, while also allowing for some investment growth, as well as ensuring that retirees do not outlive their assets. This is really no more than what large defined benefit schemes do already, but instead of the pension being pre-determined, it will fluctuate in line with the investment performance of the underlying assets and changing mortality assumptions. The pension only becomes pre-determined once the longevity insurance comes into effect. The pension then becomes fixed in nominal terms if a level annuity is purchased or increases in line with inflation if an index-linked annuity is purchased.

4.3.2 The optimal age to purchase longevity insurance and the optimal age at which the longevity insurance comes into effect

While longevity insurance in the form of a lifetime annuity (LTA) provides a perfect hedge for idiosyncratic longevity risk from the date of purchase, the return is unattractive for many people in the early years of retirement compared with that available on other investments. This is evident in the historically low annuity rates available for those in their late-50s and 60s who are in good health.[841] Low returns also go some way towards explaining why only about 5% of annuitants buy inflation-linking, since it reduces the initial income by around 40%.[842] This means that buying annuities at the point of retirement embeds both low yields and massive inflation risk for the remainder of retirement.

For the purpose of DC decumulation, it is helpful to separate the period prior to longevity insurance coming into effect and the period after. As a rough guide, we classify those who are aged between 55 and 75-80, in good health, with dependants, as being in the pre-longevity insurance stage of their retirement.[843] As we saw in Chapter 2 (Section 2.5), at some point between the ages of 75 and 80, it will become optimal for members of this group to switch between income drawdown and a LTA, since the implied return on a LTA at these ages exceeds any realistic return available on growth assets such as equities.[844] This is because, as the upward-sloping curved line in Figure 4.6 shows, the mortality premium – which is closely related to the corresponding age-specific mortality rate – built into annuity rates increases with age.[845] This means that it is optimal to annuitise around the time that the mortality premium exceeds the equity premium – the horizontal line in the figure.[846] This explains why it might well be sensible for healthy retirees with sufficient resources to

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[841] The low annuity rates are due to both the relentless increase in life expectancy and the historically low long term interest rates that resulted from the programme of quantitative easing introduced by the Bank of England in March 2009 to save the UK banking system from the effects of the Global Financial Crisis which started in 2007-08.

[842] Money Advice Service quotations, 5 January 2015.

[843] As previously mentioned, we do not address the needs of late retirement, when long-term care may be required. This is because, at present, DC pots are too small to accommodate long-term care (LTC) planning. In due course, this will become an important problem to solve in association with the pension problem.

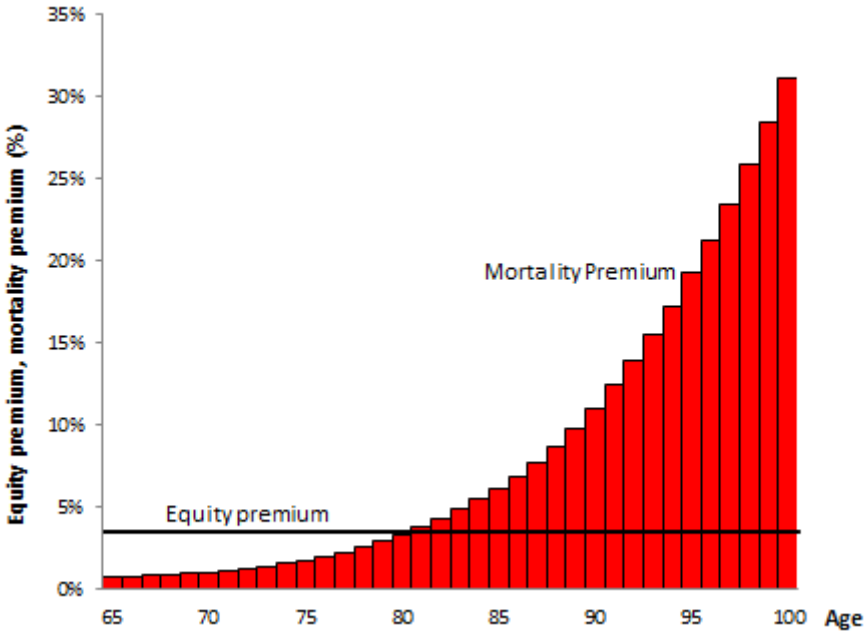
[844] By optimal, we mean that, if people were behaving rationally, they would be better off making this switch than leaving it to chance whether they run out of money before they die (assuming no bequest motive). See Menahem Yaari (1965). Uncertain Lifetime, Life Insurance and the Theory of the Consumer, *Review of Economic Studies*, 32, 137‑50.

[845] Figure 4.6 repeats Figure 2.3 (The Milevsky switching rule) from Chapter 2.

[846] We can think of the return on an annuity as being equal to the return on a risk-free asset such as a government bond plus a mortality premium to those who survive. The mortality premium is related to the mortality rate during the year: those who die during the year no longer receive their annuity and this is then shared out amongst survivors. We can think of the return on growth assets such as equities as equalling the risk-free rate plus the equity premium, the additional return that investors require to hold risky assets rather than risk-free government bonds. The mortality premium = $q_x / (1 - q_x)$, where q_x is the mortality rate at age x.

wait until they are in their late 70s or early 80s before annuitising.[847] People in poor health should, of course, purchase an enhanced annuity.

Figure 4.6: The optimal age to draw longevity-insured income



However, despite being optimal, this does not mean that people will be keen to buy longevity insurance, especially if they are not particularly concerned about living longer than expected and having insufficient money to live on as Table 4.4 appears to indicate. It might therefore be necessary to draw on the lessons of behavioural economics to find ways of nudging pension scheme members into buying longevity insurance when the time is right. One possibility is to use auto-enrolment onto a default decumulation strategy, as we discussed in Chapter 3. We also need to be innovative in annuity design[848] and behavioural economics suggests that capital protected or cash-back annuities might be attractive to scheme members. Similarly, paying for longevity insurance in instalments might be more acceptable than paying for it upfront at the point of retirement. People also need to be

[847] This is strictly true for someone who is risk-neutral and makes investment decisions on the basis of expected returns only: the expected return on annuities will exceed the expected return on equities after this point. For someone who is risk averse, the optimal age will be earlier than this. For someone who is extremely risk averse and does not like any income volatility in retirement, the optimal age to purchase longevity insurance will be at the point of retirement. See David Blake, Andrew Cairns, and Kevin Dowd (2003) PensionMetrics 2: Stochastic Pension Plan Design during the Distribution Phase, *Insurance: Mathematics & Economics*, 33, 29-47.

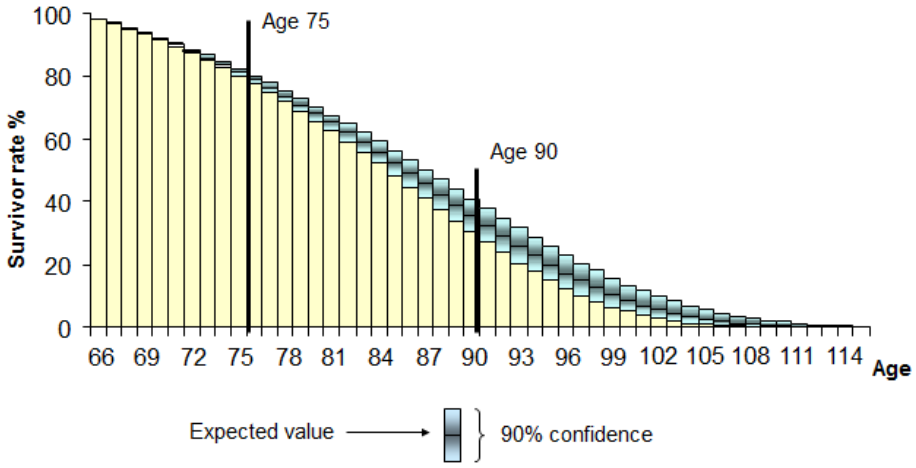
[848] We also need to be innovative in branding, given the current unpopularity of products called 'annuities' and rebrand them as 'guaranteed income for life' products.

continually warned about the very real possibility that they will finding themselves in the upper part of the longevity fanchart in Figure 4.5.

4.4 Systematic longevity risk and its management

Idiosyncratic longevity risk – the uncertainty over how long any particular individual is going to live after retirement – can be reduced by pooling and taking advantage of the law of large numbers. This is what insurance companies do when they sell annuities to a large group of people. Systematic longevity risk – uncertainty over how long members of an entire age cohort are going to live after retirement – cannot be reduced in this way. It is a trend risk and can only be hedged with a suitable hedging instrument. The key instrument for hedging systematic longevity risk is a longevity bond, in precisely the same way that an index-linked bond can be used to hedge inflation risk.[849]

Figure 4.7: Survivor fan chart - Males aged 65



Source: Derived from the Cairns-Blake-Dowd stochastic mortality model, estimated on English and Welsh male mortality data for 65-year olds over the period 1991-2006

In order to see how a longevity bond can hedge systematic longevity risk, we need to both quantify longevity risk and identify where it is concentrated. Figure 4.7 presents a survivor fan chart.[850] This shows the uncertainty surrounding projections of the number of survivors to each age from the cohort of males from the national population of England and Wales who retire aged 65. The grey bars indicate the 90% confidence interval on the projected survivor rate for each age out to 115. The line in the middle of each bar indicates the expected proportion of the cohort to survive to each age. The figure shows that there is

[849] It can also be hedged with a longevity swap in the same way that inflation can be hedged with an inflation swap. In fact, a longevity bond is the combination of an annuity bond and a longevity swap.

[850] See David Blake, Andrew Cairns and Kevin Dowd (2008), Longevity Risk and the Grim Reaper's Toxic Tail: The Survivor Fan Charts, *Insurance: Mathematics & Economics*, 42: 1062-66.

little uncertainty out to age 75: we can be fairly confident that approximately 19% will have died by 75. The uncertainty peaks at age 93: the prediction interval band is widest at this age. The best estimate is that 36% will survive to age 90, but it could be anywhere between 30% and 41%. This is a very large range. The figure also shows the extent of the so-called 'tail risk' after age 90: there is some probability – even if small – that some members of this cohort will live beyond 110.

A survivor fan chart is very useful to a pension scheme or annuity provider since it shows the likely range in the numbers of pensioners or annuitants from a given birth cohort surviving to each age. If more survive to each age than was expected, the pension scheme or annuity provider has to make higher total pension or annuity payments than was anticipated. The opposite holds if fewer survive to each age than was anticipated.

We will now show how a longevity bond with the following characteristics can help to hedge systematic longevity risk:

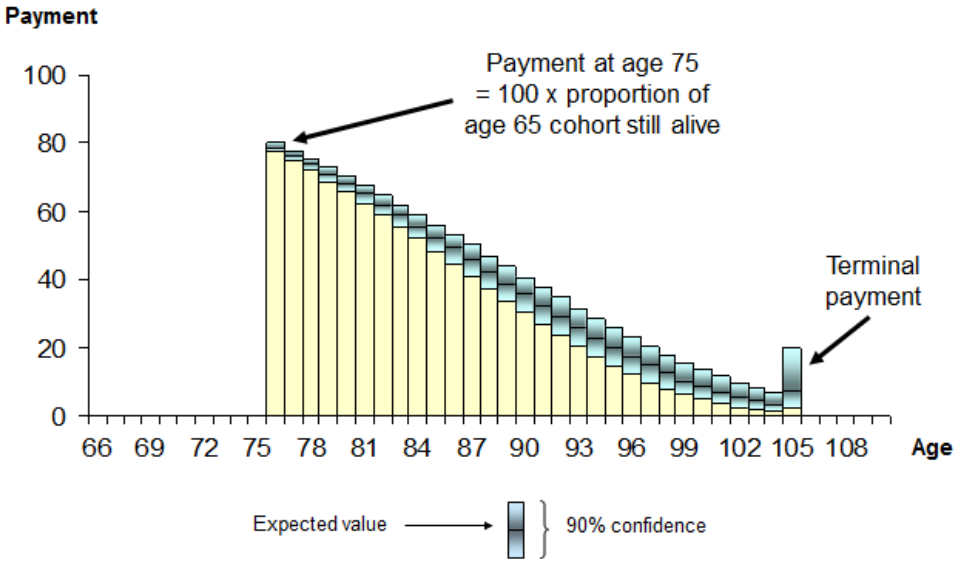
- The bond pays coupons that decline over time in line with the actual mortality experience of a cohort of the population, say 65-year-old males from the national population: so the coupons payable at age 75, for example, will depend on the proportion of 65-year-old males who survive to age 75
- Coupon payments are not made for ages for which longevity risk is low: so, for example, the first coupon might not be paid until the cohort reaches age 75 (such a bond would be a deferred longevity bond)[851]
- The coupon payments continue until the maturity date of the bond which might, for example, be 40 years after the issue date when the cohort of males reaches age 105
- The final coupon incorporates a terminal payment equal to the discounted value of the sum of the post-105 survivor rates to account for those who survive beyond age 105. The terminal payment is calculated on the maturity date of the bond and will depend on the numbers of the cohort still alive at that time and projections of their remaining survivorship. It is intended to avoid the payment of trivial sums at very high ages
- The bond pays coupons only and has no principal repayment (i.e., is an annuity bond).

Figure 4.8 shows the possible range of coupon payments on a deferred longevity bond based on the national population of English and Welsh males who are aged 65. Such a bond would provide a hedge for the systematic longevity risk faced by pension schemes and annuity providers. If population survivorship is higher at each age than was expected, the bond pays out higher coupons. This is what pension schemes and annuity providers need in order to help match the higher than expected pensions and annuity payments they have to

[851] There is no point in paying for insurance when the risk is low.

make. If, on the other hand, survivorship is lower at each age than was expected, the bond pays out lower coupons. But the pension schemes and annuity providers are not likely to mind this, since their pensions and annuity payments are also likely to be lower.

Figure 4.8: Deferred longevity bond for male aged 65 with 10-year deferment



Note: Longevity bond is payable from age 75 with terminal payment at age 105 to cover post-105 longevity risk

However, it is important to recognise that the bond will only provide a perfect hedge for the systematic longevity risk faced by pension schemes and annuity providers if the scheme members and annuitants have exactly the same mortality experience over time as the cohort underlying the bond. If the scheme members and annuitants have a mortality experience that differs from that of the national population, this will introduce basis risk.[852] In practice, there will always be some basis risk. One reason for this is that pension schemes and annuity books have far fewer members than the national population and will therefore experience greater random variation risk than the national population and this is likely to cause the mortality experience of a sub-population to diverge from that of the national population over time, even if they have the same mortality profile at the outset.

Another reason is that most pension schemes and annuity books will not have the same mortality profile as the national population, even to begin with. There can be differences in age, gender and socio-economic composition. Different birth cohorts have different survivor

[852] This is the risk that the 'underlying' – in this case, the survivor rates of the particular population being hedged – does not move in line with the hedging instrument – which, in this case, depends on the survivor rates of the national population.

rates to each age. While survivor rates to each age tend to increase over time, in line with the trend improvement in longevity, they do not do so uniformly: some birth cohorts experience faster improvements than others.[853] Females, on average, live longer than males. Professionals tend to live longer than white-collar workers who, in turn, tend to live longer than blue-collar and manual workers. But it is not simply the differences in life expectancies between these various groups that are important, it is unexpected changes in the trends in their survivorship experience that causes basis risk.

Yet another reason for basis risk involves the difference between 'lives' and 'amounts'. A population longevity index[854] will weight each life equally, but members of the higher socio-economic groups will tend to have higher pensions and annuities than members of the lower socio-economic groups. They are also more likely to have multiple pensions and annuities. The directors of, say, a small engineering company are likely to represent a large share of the company's pension scheme liabilities and are more likely to live longer than the average member. All these factors will increase basis risk and its complexity.

Although basis risk is important, it is a second-order risk compared with systematic longevity risk itself. It can also be hedged by having a small number of suitably designed hedging instruments. In theory, there could be a longevity bond for both males and females, for each age and for each socio-economic group. Such granularity of the longevity bond market would allow a high degree of hedge effectiveness to be achieved. But it would also result in negligible liquidity or pricing transparency: the more bonds there are, the less trading there will be in each bond and the less frequently the bonds will be priced by the market. As is the case in other markets – especially derivatives markets – a small number of suitably designed bonds should provide an appropriate balance between hedge effectiveness, liquidity and pricing transparency. [855]

Not only are longevity bonds useful for hedging systematic longevity risk once retirees are drawing a longevity-insured income, they could be used to hedge systematic longevity risk and long-term investment risk in the period leading up to this point. As we discussed in Chapter 2, DC schemes traditionally used a lifestyle investment strategy involving target-date funds. This involves a high weighting in equities and other growth assets in the 'growth stage' of the accumulation process in order to benefit from the equity premium. There is then a systematic switch to less volatile assets, typically long-dated fixed-income bonds,

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[853] Richard C. Willetts (2004), The Cohort Effect: Insights and Explanations, *British Actuarial Journal*, 10, 833–77.

[854] This is an index based on the mortality experience of the national population.

[855] This is demonstrated in: David Blake, Andrew J. G. Cairns and Kevin Dowd (2006), Living with Mortality: Longevity Bonds and other Mortality-Linked Securities, *British Actuarial Journal*, 12, 153-228; Guy D. Coughlan, Marwa Khalaf-Allah, Yijing Ye, Sumit Kumar, Andrew J. G. Cairns, David Blake, and Kevin Dowd (2011), Longevity Hedging 101: A Framework for Longevity Basis Risk Analysis and Hedge Effectiveness, *North American Actuarial Journal,* 15(2), 150-176.

during the 'consolidation stage'[856] of the accumulation process – the so-called glide path – in order to reduce the volatility of the lifetime retirement income secured at retirement. It used to be the case that most people drew their longevity-insured income at the same time as they retired. The 2014 Budget is likely to lead to some DC scheme members deferring drawing a longevity-insured income from their DC scheme until later in their retirement, while keeping the fund invested in growth assets and using income drawdown in the interim. Nevertheless, it would still be useful to hedge systematic longevity risk during this period by holding some of the fund in longevity bonds.[857]

4.5 Why should the Government issue longevity bonds ?[858]

In principle, longevity bonds could be issued by private-sector organisations. It has been argued that pharmaceutical companies would be natural issuers, since their revenues are positively linked to survivorship: the longer people live, the more they will spend on medicines.[859] While this is true, the scale of the demand for longevity bonds far exceeds conceivable private-sector supply from companies such as pharmaceuticals. Further, there would be significant credit risk associated with the private-sector issuance of an instrument intended to hedge a systematic risk many years into the future. In practice, we would argue that the only realistic issuer of longevity bonds in scale is the Government.[860]

We believe that there are three important reasons why the Government should engage in sharing longevity risk with the private sector. It:

- has an interest in ensuring there is an efficient annuity market
- has an interest in ensuring there is an efficient capital market for longevity risk transfers
- is best placed to engage in intergenerational risk sharing, such as by providing tail risk protection against systematic trend risk.

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[856] This is the name given by NEST to this stage.

[857] If longevity improves at a higher rate than that expected along the glide path, this too will reduce the amount of the annuity that can be paid from a given lump sum. It might also be a better way of providing income security from a DC pension scheme at retirement than the alternative of purchasing deferred annuities, since the annuity provider has to hold significant capital against the deferred annuities it sold (under Solvency II), the cost of which would have to be passed onto the member. Longevity bonds also give more flexibility over when to take a longevity-insured income than deferred annuities.

[858] This section draws David Blake, Tom Boardman and Andrew Cairns (2014), Sharing Longevity Risk: Why Governments Should Issue Longevity Bonds, *North American Actuarial Journal*, 18(1), 258-277.

[859] Kevin Dowd (2003), Survivor Bonds: A Comment on Blake and Burrows, *Journal of Risk and Insurance*, 70, 339-348.

[860] The first suggestion for governments to do this was made in David Blake and William Burrows (2001), Survivor Bonds: Helping to Hedge Mortality Risk, *Journal of Risk and Insurance*, 68: 339-348.

4.5.1 An efficient annuity market for pensioners

The Government has an interest in ensuring there is an efficient annuity market, given its desire to encourage retirement savings in DC pension schemes that need annuities to turn pension savings into guaranteed lifetime retirement income. If the private sector is unable to hedge systematic longevity risk, it increases the likelihood that insurance companies stop selling annuities, especially deferred annuities, or increase annuity prices which would reduce pensioner income in retirement.

A consequence of the above is that Governments might find themselves having to pay additional means-tested benefits to supplement pensioners' incomes, as well as receiving lower income tax and expenditure taxes (such as value added tax) from pensioners due to their lower incomes.[861] This will, ceteris paribus, lead to higher taxes on the working population. This outcome will therefore not be popular with workers or pensioners. Further, workers are likely to reduce savings into DC pension schemes. Those that do continue to save in DC schemes will face even greater uncertainty about their prospective pension income, since an efficient private-sector annuity market might no longer be in existence when they retire.

4.5.2 An efficient capital market for longevity risk transfers

The capital markets have a key role to help ensure there is an efficient annuity market and to help to reduce concentration risk. It can therefore also be argued that the Government has an interest in ensuring there is an efficient capital market for longevity risk transfers. There are two areas where Government support is required.

First, the Government can help with the construction of national longevity indices. It is for reasons of accuracy that longevity indices would most likely have to be based on national mortality data. A key component of the success of the new capital market will be the timely publication of accurate and independently calculated longevity indices. The longevity indices would cover mortality rates, survivor rates and life expectancies for both males and females.

Only the Government has access to the information necessary to produce these indices on account of the legal requirement to report deaths and related information such as dates of death and birth and gender to an official agency, which in the UK is the General Register Office of Births, Marriages and Deaths.[862] Further, only the Government has access to the

[861] Many of the people who traditionally bought annuities in the UK were also on means-tested benefits. Any reduction in annuity payments arising from more onerous capital requirements resulting from insurers being unable to hedge longevity risk will *immediately* increase means-tested benefits.

[862] The government will always have more detailed information than the private sector as a result of data protection legislation. This legislation prevents the release of information that would allow an individual – even one who has died – to be identified. Mortality data will only be published in a sufficiently aggregated form – in terms of date and location of death – that makes it impossible for specific individuals to be identified.

information needed to estimate the size of the exposed population. In the UK, this is currently derived from decadal censuses with annual updates between censuses based on reported deaths and estimated migration flows. However, the resulting estimates are not accurate enough at high ages. It is important to be able to track a cohort over time, particularly at high ages: the Government is in a unique position to do this, since it makes social security pension payments to almost every old person and needs to keep good records to do this. While longevity indices based on social class would be useful, the social class of a deceased person is not recorded at the time of death and while attempts have been made to construct social class indices, based on factors such as post code, these lack the accuracy of national indices. A similar argument would hold for longevity indices based on amounts rather than lives.

Second, the Government can make an important contribution by issuing longevity bonds to facilitate price discovery, thereby encouraging capital market development. Longevity risk is not currently actively traded in the capital markets, so we do not have a good estimate of its market price or premium.[863] But if the Government issued a small number of longevity bonds, this would help to establish and maintain the market-clearing 'price points' for longevity risk at key ages and future dates, and hence establish a market price for longevity risk. In other words, the bonds would help to establish the riskless term structure for survival rates for ages above 65 for future years. There is a clear analogy with the fixed-income and index-linked bond markets. In these markets, the issuance of government bonds helped to establish the riskless term structures for interest rates and inflation rate expectations, respectively, for terms out to 50 years or more. The private sector was then able to issue corporate fixed-income and index-linked bonds with different credit risks (AAA, AA, etc.) and establish credit term structures above the riskless benchmark curves.

The establishment of a market price for longevity risk would be particularly useful for EU insurance companies operating under Solvency II. The maximum longevity risk premium that an annuity provider would be willing to pay to buy a longevity bond would be related to the level of capital that the regulators agree can be released as a result of holding the longevity bond to back annuity liabilities.[864]

The establishment of price points will also help to facilitate the capital market development of longevity swaps and other longevity derivatives similar to the interest-rate and inflation swaps that developed in the fixed-income and index-linked bond markets. Market

[863] The longevity risk premium is paid by the longevity bond's buyer to the bond's issuer to remove systematic longevity risk. It therefore results in a lower coupon that the bond's issuer has to pay the bond's buyer for purchasing the bond, thereby lowering the effective yield on the bond.

[864] It will also be related to the extent of the basis risk that remains unhedged and potentially the size of any illiquidity premium contained in the price of longevity bonds. If longevity bonds are not actively traded, investors will demand an illiquidity premium to hold them and the regulator might be reluctant to accept that the bonds' prices can be used for mark-to-market pricing for capital release purposes.

participants were able to use market interest-rate and inflation expectations rather than projections from models. The same would happen in the longevity swaps market. The longevity swaps market began to develop in the UK in 2007-09 with eight publicly announced swaps involving six annuity providers and two pension funds. A number of global investment banks and reinsurers intermediated the deals – J.P. Morgan, Deutsche Bank, RBS, Credit Suisse, Goldman Sachs, Société Générale, and SwissRe – and the longevity risk was passed through to investors – such as insurance-linked securities (ILS) investors, hedge funds, sovereign wealth funds, family offices and endowments – attracted by a new asset class that is uncorrelated with traditional asset classes, such as equities, bonds and real estate. More than £60bn of longevity swaps have been executed in the UK since 2007.

4.5.3 Intergenerational risk sharing

The Government is the only agency in society that can engage in intergenerational risk sharing on a large scale and enforce intergenerational contracts.[865] This is important, given that longevity risk is a risk that crosses a number of generations.

This is how intergenerational risk sharing operates. The Government would receive a longevity risk premium by issuing longevity bonds. In effect, the current retired population pays future generations an insurance premium to hedge its systematic longevity risk. If, in equilibrium, the risk premium is sufficient to ensure that the generation bearing the risk is adequately compensated, then each generation is treated fairly. The current generation of pensioners derives benefit from annuity companies being able to use government-issued longevity bonds to provide better value annuities. The premium that this generation pays for taking away the longevity risk is effectively the premium required to compensate the younger generations to whom the Government is passing on the risk in the form of possible higher taxes to enable the Government to continue paying state pensions to members of the current generation who live longer than expected.

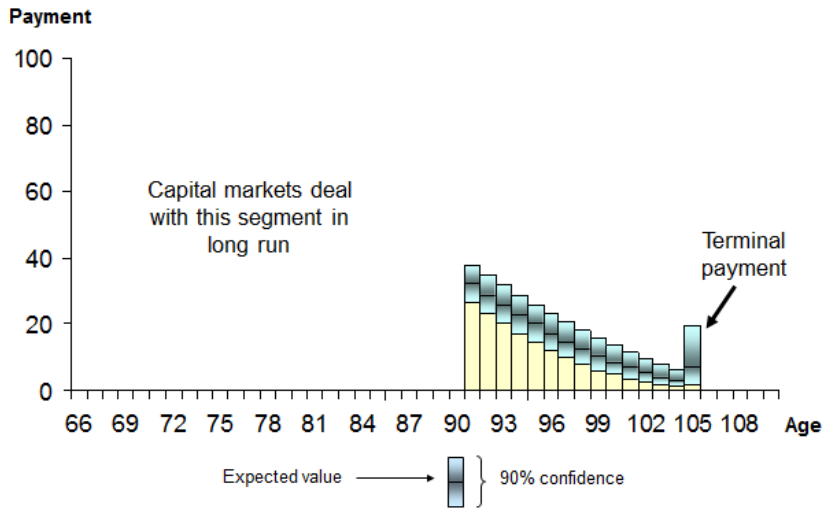
A key role for Government in this context is to provide a hedge for systematic longevity risk by offering tail risk protection against trend risk. Once the market for longevity bonds has matured, in the sense of producing stable and reliable price points in the age range 65-90, the capital markets can take over responsibility for providing the necessary hedging capacity in this age range using longevity securities and derivatives. All that might then be needed would be for the Government to provide a continuous supply of deferred tail longevity bonds with payments starting from age 90 in order to allow pension schemes and insurers to hedge their tail risk.[866] Figure 4.9 illustrates the cash flows on such a bond. These bonds will be necessary on a permanent basis, since the capital that annuity providers would be

[865] In the private sector, long-term contracts can involve significant credit risk as mentioned above and collateralisation can introduce significant frictional costs.

[866] Pension schemes and annuity providers might still be willing to invest in government-issued longevity bonds covering the age range 65-90 if they are competitively priced compared with capital market hedges.

required by the regulator to post in order to cover this risk would be very high in the absence of a close matching asset. The bonds are also necessary because the investors who have recently become interested in taking the other side of the longevity swaps market have no appetite for hedging long-duration tail longevity risk. They would also be needed to help kick start a deferred annuity market.

Figure 4.9: Deferred tail longevity bond for male aged 65



Note: Longevity bond is payable from age 90 with terminal payment at age 105 to cover post-105 longevity risk

4.6 Who benefits from Government issuing longevity bonds?

Who benefits from Governments assisting in encouraging the optimal sharing of longevity risk? The simple answer is everyone. Everyone should benefit from having a market price for longevity risk and the ability to hedge systematic longevity risk. But there are also more specific benefits.

The Government:

- Gains by having both a more secure DC pension savings market and a more efficient annuity market, resulting in less means-tested benefits and a higher tax take
- Should gain access to a new source of long-term funding which, by widening the investor base, lowers the cost of Government issuance
- Is able to issue bonds with a deferred payment structure to help its current funding programme and improve its cash flow
- Earns a market-determined longevity risk premium thereby further reducing the expected cost of the long-term national debt.

Defined benefit (DB) pension schemes:

- Have the opportunity to reduce longevity risks
- Can hedge longevity risk exposure prior to buy out.

Insurers:

- Can potentially establish a mark-to-market mortality rate term structure[867] and hence hold the optimal level of economic capital or at least hold capital closer to the economic level
- Longevity bonds will help insurers to play an aggregating role in providing pension schemes and individuals with longevity insurance, whilst being able to pass on a proportion of their risk to the capital market; this would reduce their longevity concentration risk and facilitate the spread of longevity risk around the capital markets.

The capital markets:

- Get help to kick start market participation through the establishment of reliable longevity indices and key price points on the longevity risk term structure
- Can build on this longevity risk term structure with liquid longevity derivatives.

Investors:

- Get access to a new (longevity-linked) asset class whose returns are uncorrelated with traditional asset classes, such as bonds, equities and real estate.

Regulators:

- A longevity risk term structure should help the insurers' regulator (the Prudential Regulation Authority) validate insurers' economic capital, thereby making regulation more robust
- Longevity bonds should help an orderly transfer of longevity risk from DB schemes to the capital markets, thereby reducing reliance on an uncertain sponsor covenant and reducing concentration risk amongst insurers, and, in turn, giving comfort to the pension schemes' regulator
- A longevity risk term structure should help facilitate the calculation of the risk-based levy to the Pension Protection Fund.[868]

[867] The mortality rate term structure is the two-dimemnsional plot of mortality rates against age and time, and is analogous to the interest rate term structure which is a one-dimemnsional plot of interest rates against time.

[868] The Pensions Regulator is responsible for the regulation of occupational trust-based DB and DC schemes and attempts to limit the number of DB schemes needing support from the Pension Protection Fund.

Pension scheme members:

- DB pension scheme members potentially get better security
- DC pension scheme members get better valued annuities which produce a higher lifetime income when they retire
- Further, individuals with DC pension schemes would have a means of hedging the longevity risk associated with purchasing an annuity at retirement.

The potential demand for longevity bonds is high: of the £1.3trn in DB private-sector pension liabilities, around £600bn relate to pensions in payment; of the approximately £600bn in accumulated DC pension assets, £200bn relate to people over age 55; and insurance companies are committed to making annuity payments valued in excess of £150bn.

4.7 Support for Government issuance of longevity bonds

Support for Governments to issue longevity bonds is growing steadily, not only in the UK, where the situation is most immediate, but also internationally.

The Pensions Commission suggested the Government should consider the use of longevity bonds to absorb tail risk for those over 90 or 95, provided it exits from other forms of longevity risk pre-retirement which it has done by linking state pension age to increases in life expectancy and by raising the future state pension age from 65 to 68 by 2046. 'One possible limited role for Government may, however, be worth consideration: the absorption of the 'extreme tail' of longevity risk post-retirement, i.e., uncertainty about the mortality experience of the minority of people who live to very old ages, say, beyond 90 or beyond 95'.[869]

The Confederation of British Industry, which represents employers, has argued: 'Government should drive development of a market in longevity bonds, a similar instrument to annuities, by which the payments on the bonds depend on the proportion of a reference population that is still surviving at the date of payment of each coupon. This should be done through limited seed capital and supporting policy work on the topic. Government could also consider how best to match government bond issues to pension scheme needs, including the provision of more long-dated bonds and whether Government should issue mortality bonds itself'.[870]

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[869] Pension Commission (2005, p. 229) *A New Pension Settlement for the Twenty-First Century*, TSO, Norwich. An alternative proposal from the Pension Commission was for the state to take over responsibility for providing annuities to people once they had reached 90. The state would then be hedging both the idiosyncratic and the systematic longevity risk of post-90 year olds.

[870] Redressing the Balance - Boosting the Economy and Protecting Pensions, CBI Brief, May 2009.

According to the OECD: 'Governments could improve the market for annuities by issuing longevity indexed bonds and by producing a longevity index'.[871]

The World Economic Forum has argued: 'Given the ongoing shift towards defined contribution pension arrangements, there will be a growing need for annuities to enhance the security of retirement income. Longevity-indexed bonds and markets for hedging longevity risk would therefore play a critical role in ensuring an adequate provision of annuities'.[872]

The IMF states: 'Although the private sector will further develop market-based transfer mechanisms for longevity risk if it recognises the benefits of doing so, the Government has a potential role in supporting this market. Measures could include provision of better longevity data, better regulation and supervision, and education to promote awareness of longevity risk. Those Governments that are able to limit their own longevity risk could consider issuing a limited quantity of longevity bonds to jumpstart the market'. [873]

Finally, Bernhard Brunner, Director of risklab at Allianz, argues: 'An injection of liquidity is therefore imperative. This is where Governments can come in. By issuing standardised longevity bonds index-based on the country's own population, Governments can make prices publicly available. These would then be used as reference points for other transactions and assist the growth of the longevity derivatives market, solving the problem of transparency that is also holding the market back in current over-the-counter deals….Government-issued longevity bonds could also help remove two other obstacles: standardisation and education'. [874]

4.8 Arguments against Government issuance of longevity bonds

A number of arguments have been raised against the issuance of longevity bonds by Governments.

The first is that Governments are not natural issuers of longevity bonds because of their large existing exposure – in excess of £5trn in the case of the UK Government[875] – to longevity risk.

Our response to this is that a Government's exposure to unanticipated longevity improvements through the issuance of longevity bonds is – or at least could be – well

[871] Pablo Antolin and Hans Blommestein (2007), *Governments and the Market for Longevity-Indexed Bonds*, OECD Working Papers on Insurance and Private Pensions, No. 4, OECD Publishing, Paris.

[872] World Economic Forum (2009) *Financing Demographic Shifts Project,* June, Geneva.

[873] International Monetary Fund (2012), *The Financial Impact of Longevity Risk,* Chapter 4 of *Global Financial Stability Report*, April, Washington DC.

[874] Sharing the Load, *Project M #14*, Allianz, April 2013.

[875] David Blake, Tom Boardman and Andrew Cairns (2014, p. 260) Sharing Longevity Risk: Why Governments Should Issue Longevity Bonds, *North American Actuarial Journal*, 18(1), 258-277.

hedged. First, the Government receives a longevity risk premium from issuing the bonds. Second, in the event that the risk premium proves to be insufficient, the Government can reduce its state pension spend and increase its pre-retirement tax take by systematically raising the state pension age in line with increases in life expectancy, as recommended by the Pensions Commission. The next generation might have to work longer, but will, in any case, have ended up being a fitter generation than the previous one and so be able to earn more income which, in turn, will produce more tax. Third, since the issuance of longevity bonds should result in a more efficient annuity market and hence higher incomes in retirement, this should also result in an increase in the tax take and help to reduce the amount of means-tested benefits. In addition, it should be noted that the higher tax take and lower means-tested benefits arising from a more efficient annuity market applies to the lifetimes of all pensioners buying an annuity, whereas the tail risk protection provided by deferred tail longevity bonds applies only to those surviving over 90, some 25 years in the future.

Overall, once a Government is only issuing deferred tail longevity bonds, the risk will be very manageable and consistent with the Government's role of facilitating intergenerational risk sharing. There could be a significant cost-benefit to the Government from the issuance of longevity bonds and therefore a strong case for a Government to issue longevity bonds.

The second argument is that there is no role at all for a Government in issuing longevity bonds as argued by Dowd (2003) and Brown and Orszag (2006).[876]

Dowd (2003) criticised the original argument used by Blake and Burrows (2001)[877] to justify government issuance of longevity bonds (or what Blake and Burrows called survivor bonds), namely the appeal to the Arrow-Lind Theorem on social risk bearing. This theorem states that by dispersing an aggregate risk across the population (of taxpayers) as a whole, the associated risk premium on a longevity bond issued by the Government would be lower than that charged by a private-sector issuer. Dowd countered that many of the assumptions underlying the theorem – such as taxes are costless to collect, each household bears an equal share of the tax burden, and an absence of distributional effects – do not hold in practice. Instead, he argued that capital markets are better suited than any Government to bear and share risks, since they allow risks to be diversified internationally. In short, Dowd argued that Government intervention was unnecessary, since private-sector parties were perfectly capable of creating and trading longevity-linked instruments and derivatives themselves. There was no market failure for the Government to correct, rather the time is not yet ripe: 'The fact that a particular innovation has not yet occurred does not in itself

[876] Kevin Dowd (2003), Survivor Bonds: A Comment on Blake and Burrows, *Journal of Risk and Insurance*, 70, 339-348; Jeffrey Brown and Peter Orszag (2006) The Political Economy of Government-Issued Longevity Bonds, *Journal of Risk and Insurance*, 73, 611-631.

[877] David Blake and William Burrows (2001) Survivor Bonds: Helping to Hedge Mortality Risk, *Journal of Risk and Insurance*, 68, 339-348.

constitute an argument for Government intervention to bring it about. Any good new idea, including that of survivor derivatives, should eventually take off – but we have to give it time.... When the time is ripe, it is therefore entirely possible, and even likely, that markets for survivor derivatives – survivor bonds, forwards, futures, options and swaps, and annuity securitisation – will take off, and eventually become as familiar as comparable instruments such as credit derivatives are today' (pp. 347-8).

Brown and Orszag (2006) also accept that a longevity risk premium would need to be paid in order to hedge aggregate longevity risk, but they argue that it is not sufficiently high to cause a market failure and hence justify Government intervention: 'we suspect that this risk does exert some upward pressure on annuity pricing, possibly in the range of a few percentage points' (p. 622). They also accept that the intergenerational sharing of longevity risk can potentially improve social welfare. Suppose a scientific discovery improves the life expectancy of all current and future generations. Current 80-year olds would be unable to respond to this by re-entering the labour market and hence would experience a lower standard of living as their remaining wealth would have to be spread over a longer period. Younger generations are more able to adjust to this mortality shock. Hence the financial risk from such a shock could be spread over a number of generations and this would improve social welfare. Since only the Government is able to enforce intergenerational contracts, there is a potential role for the Government in efficiently spreading risk across generations. However, Brown and Orszag believe that it is unlikely that the Government will spread risk efficiently: 'to maximise social welfare, it is not sufficient that the Government move any amount of risk from the current generation to some other generation. Rather, the Government needs to move the optimal amount of risk onto the right generations' (p. 625). Instead, they believe that the Government will favour the current generation of voters, and particularly the large number of vocal grey voters, over generations as yet unborn, by transferring 'more than the optimal amount of risk to future generations' (p. 629).[878]

We would argue that there is a role for both Government and the private sector in developing a longevity market. The private sector is best at hedging idiosyncratic longevity risk, once it has hedged systematic longevity risk. The Government is the only agent in society with both the capacity and credibility to provide a long-term hedge for systematic longevity risk through the issuance of longevity bonds. While Dowd, Brown and Orszag highlight some of the difficulties associated with the Government's ability to forecast future mortality improvements, the existence of longevity bonds would provide an incentive for the Government to collect better death records and improve its longevity forecasting techniques, both of which would have wider social benefits. Even if the private sector is better at forecasting than the Government, systematic longevity is a slowly building trend risk and the private-sector issuer of a longevity bond risks insolvency if it gets that trend

[878] Dowd (2003, pp. 346-7) makes the same point: 'The intergenerational argument is open to the objection that governments have an incentive to put the interests of current voters ahead of those of future voters'.

wrong in a way that the Government with its powers of taxation does not. We also need to deal with the possibility that 'more than the optimal amount of risk' is transferred to future generations. However, the total likely issuance of longevity bonds is never going to be sufficient for this to be a serious problem and we should bear in mind that the current generation is getting its longevity risk insurance for free: if longevity bonds were issued, it would have to start paying for it.

The third criticism is that even if longevity bonds are issued by the Government, there is a question mark concerning the potential liquidity of the market trading longevity bonds. Some have argued that liquidity is likely to be thin, since any new information concerning mortality that would be sufficiently significant to motivate trading is likely to arrive very infrequently. While this is true, we believe that there are important lessons from the inflation-linked financial futures market. Early attempts to introduce such a market were initially unsuccessful but they eventually succeeded and inflation indices have similar characteristics to longevity indices, especially in their low frequency of publication.

The first attempt occurred when CPI futures contracts were listed on the US Coffee, Sugar and Cocoa Exchange in June 1985. This contract was delisted in April 1987, with only 10,000 contracts ever having been traded. The key reasons for the failure of this contract were: there was no underlying inflation-linked securities market at the time, the underlying was an infrequently published (i.e., monthly) index, and there was no stable pricing relationship with other instruments to attract the attention of arbitrageurs. The second attempt occurred when Treasury inflation-protected securities (TIPS) futures were listed on the Chicago Board of Trade in June 1997 and subsequently delisted before the end of the year with only 22 contracts ever traded. The key reasons for the failure of this contract were: TIPS had only started trading five months before, there was just a single 10-year TIPS trading, the futures contract competed with the underlying for liquidity, and there was uncertainty over the future of the TIPS program. The final attempt was in February 2004 when the Chicago Mercantile Exchange launched a CPI futures contract which is still trading. The reasons for the success of this contract are: inflation-linked securities have gained acceptance amongst investors, TIPs have evolved into recognised asset class, there is a well-understood pricing relationship allowing for arbitrage opportunities between TIPS, fixed-interest Treasury bonds and CPI futures, the US Treasury is committed to long-term TIPS issuance, CPI futures do not compete directly with but rather complement TIPS and use same the inflation index, and liquidity is enhanced by electronic trading on Globex. This experience therefore suggests that it is possible to create a liquid market in an instrument based on an infrequently published index.

The fourth criticism is that longevity bonds are unnecessary since the load factor built into annuity prices is sufficiently large to (a) absorb the increase in regulatory capital that will be required after the introduction of Solvency II in the absence of longevity bonds, and (b) to absorb the longevity risk in countries not subject to Solvency II (e.g., the US and Australia).

Our response is that there is limited scope for annuity providers to absorb either the costs of the additional capital requirements or the aggregate longevity risk without seriously reducing the money's worth of the annuities they sell.[879]

The life annuity market in the UK has scale[880] and as a consequence is price competitive with a number of life insurers competing for business. It is relatively easy for pensioners to compare the different guaranteed incomes on offer in exchange for their pension savings.

In recent years, the money's worth of the UK annuity market has been assessed and tracked by Edmund Cannon and Ian Tonks. They were commissioned by the Department for Work and Pensions in 2009 to produce a detailed report on the money's worth of annuities in the UK. Their report examines a time series of pension annuity rates in the UK for the period 1994 to 2007. 'The report computes the money's worth of annuities and finds that, on average, the money's worth over the sample period for 65-year old males has been 90 per cent, and for 65-year old females has been a similar but slightly larger 91 per cent. Taking into account load factors associated with annuity contracts and, in comparison with other financial and insurance products, this implies that annuities are fairly priced'.[881]

Cannon and Tonks' analysis shows that there is some evidence that the money's worth has fallen since 2002. They discuss a number of reasons for this, including: changes in insurance regulation, changes in industrial concentration, an insurance cycle, the pricing in of increased mortality uncertainty, and the growth in the impaired lives market. The last of these is becoming an increasingly important factor in the UK and it has resulted in the money's worth for standard annuities (i.e., those for healthy lives) falling as insurance companies have made allowance for the selection effects caused by the introduction of enhanced rates for pensioners with health impairments that reduce their expected life expectancy. Around 30-40% of pensioners qualify for enhanced annuity rates and life insurers have adjusted the rates on standard annuities to reflect the longer life expectancy of the 60-70% buying standard annuities. The other main reason is that UK insurers have increased the loading for the cost of their risk capital to reflect the fact that they expect to have to hold more capital in a Solvency II world. This trend has accelerated since 2009 in anticipation of the introduction of Solvency II in 2016. In short, the load factor in annuities

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[879] The money's worth of an annuity will equal 100% when annuity providers have no administrative costs and are making no profits. In practice, the money's worth will be less than 100% due to the presence of administrative costs, risk charges (in form of cost of capital) and the need for annuity providers to make a 'normal profit'. The sum of the costs and normal profit is called the 'load factor'.

[880] At its peak, the UK annuity market was worth about £12bn a year in new business – around half of the global annuity market – sales have fallen by more than 50% since the 2014 Budget.

[881] Edmund Cannon and Ian Tonks (2009, xiii) Money's Worth of Pension Annuities, Department for Work and Pensions, Research Report No 563. Cannon and Tonks' findings are supported by a more recent study by the FCA: Matteo Aquilina, Robert Baker and Tommaso Majer (2014), The Value for Money of Annuities and Other Retirement Income Strategies in the UK, Financial Conduct Authority, Occasional Paper No. 5, December (http://www.fca.org.uk/static/documents/occasional-papers/occasional-paper-5.pdf)

cannot take much more strain without adversely impacting the size of the annuity payments.

The fifth and final criticism that we consider is that basis risk is sufficiently large that it would negate any gains from holding longevity bonds.

We recognise that basis risk is an important issue. There will be a requirement under Solvency II for annuity companies to hold capital to cover basis risk where they have a hedging instrument that is not perfect. However, given that no longevity bonds have yet been issued,[882] no annuity provider has been in a position to agree the scale of capital required with its regulator. The level of capital will clearly depend on the composition and size of the insurer's annuity population. However, reinsurers who are also caught by Solvency II would be more able to consolidate exposure by pooling portfolios from different providers and therefore experience less basis risk. It is possible that reinsurers could end up using longevity bonds to manage their longevity risk and reduce their Solvency II capital requirement, whilst providing indemnity rather than indexed solutions to insurers with small pools of annuities.

Whilst it is hard to be absolutely sure at this stage in the development of the market, we do not believe that basis risk means that longevity bonds will be ineffective. Basis risk arises in other markets where imperfect hedging instruments are used, such as interest rate and currency futures contracts. Using these contracts leads to both contemporaneous and time basis risk,[883] but this does not prevent them from providing highly effective – if not perfect – hedges.

4.9 Feedback from our interviews and responses to the consultation paper

4.9.1 Feedback from our interviews

We asked the providers and investment managers that we interviewed about their views on longevity bonds. The question gave rise to opposing views, of which the following are typical:

- 'They would be helpful due to long tail of risk and duration of assets. There are not enough long-term bonds. But the return on government bonds is not attractive'

[882] While not a longevity bond of the kind we have discussed above, we should note that Swiss Re issued the world's first 'longevity trend' bond in 2010. This was designed to hedge the difference in the trend increases in life expectancy in the UK and the US. This bond is discussed in detail in Andrew Hunt and David Blake (2015) Modelling Longevity Bonds: Analysing the Swiss Re Kortis Bond, *Insurance: Mathematics & Economics*, 63(C), 12-29.

[883] Contemporaneous basis risk implies that the hedging instrument is not a derivative of the underlying; time basis risk implies that the maturity of the hedging instrument does not coincide with the maturity of the underlying.

- '[Our company – an insurance company] does not see a demand, but we accept the point that there is currently no market price for longevity risk (and everyone's pricing is based on an actuarial model)'.

4.9.2 Responses to the consultation paper

We summarise the responses to Questions 32-40 in the consultation paper here.

32. *What evidence is there of individuals' ability to reliably estimate how long they are going to live?*

33. *How easy is it for individuals to quantify longevity risk? What evidence is available on this question?*

Respondents were unanimous that individuals had problems estimating both life expectancy – with a tendency to under-estimate it – and longevity risk. A minority thought that these problems could be overcome with education or engagement.

34. *Is longevity risk a risk that individual savers are able – and should be expected – to manage themselves?*

The majority of respondents thought that individuals could not manage longevity risk adequately, and pointed to solutions in the form of longevity insurance, annuities and guaranteed drawdown. A minority thought that individuals could manage longevity risk if they received some additional help.

35. *Where people receive tax incentives to save into pensions, should people be required to secure a minimum lifetime income in retirement?*

Respondents were split on whether people who had received tax incentives should secure an income in retirement or not. Just over a quarter said "yes", while just over a third said "no". Others thought that tax relief could be used to encourage people to buy longevity insurance after retirement. Some thought that the use of tax relief in pensions should be reviewed, especially since it did not benefit those on low or modest incomes.

36. *(a) Do you believe that the DC retirement income market could benefit from the introduction of a market in longevity bonds? Explain. (b) Do you believe that a market in longevity bonds is viable (in the sense of having sufficient demand to justify its introduction)? Explain.*

37. *Do you have a preferred design for a longevity bond?*

38. *Is there a case for the Government to issue longevity bonds? Explain.*

There were two interpretations of these questions on longevity bonds. Where longevity bonds were interpreted as products issued by the Government to allow insurance

companies to hedge mortality risk, a majority were in favour of government issuance, although a minority did not believe they would work. Where longevity bonds were intepreted as retail products (i.e., a form of deferred annuity) purchased by individuals (perhaps from the Post Office or National Savings & Investments), many respondents thought that this would be a good idea.

39. *Are there alternatives to longevity bonds to hedge systematic longevity risk? Explain.*

There were only two replies to whether there are alternatives to longevity bonds to hedge systematic longevity risk, one saying "no" and the other saying "yes, but it would probably be expensive."

40. Are *there other ways of helping savers to manage longevity risk?*

Most responses thought that savers could not manage longevity risk without some form of annuity or guaranteed drawdown. A significant minority thought that better education and engagement would improve the chances of individuals dealing with longevity risk.

4.10 Analysis and recommendation

The evidence that we have put forward in this Chapter suggests that longevity risk is a risk that individual savers are not able – and should not be expected – to manage themselves. They need help to manage this risk in a cost-effective way, while retaining flexibility in spending and the investment growth potential of retirement assets in the early years of retirement.

Our analysis provides further support for Recommendation 3.1 in Chapter 3, namely a quasi-default decumulation plan, involving drawdown plus longevity insurance in the form of a deferred annuity (as one option). However, the providers of longevity insurance face systematic longevity risk for which there is currently no suitable hedging instrument, namely a longevity bond, being traded.

We make one recommendation as a result of the analysis in this Chapter:

Recommendation 4.1: Longevity bonds working party

Since longevity bonds have a potentially important role to play in hedging systematic longevity risk, we recommend that the Government sets up a working party to undertake a cost-benefit analysis of government issuance of longevity bonds to help manage the associated longevity risk exposure.

The terms of reference of the working party would cover the benefits that would accrue to all stakeholders, the scale of the longevity risk that Governments would be assuming, the actions Governments can take to mitigate this risk, and the issue of inter-generational

equity. The working party should also work through the practicalities of issuing longevity bonds, including the construction of reference longevity indices, potential demand, pricing, liquidity and taxation.[884]

[884] Since longevity bonds are annuity bonds with the coupon payment involving a return of capital element as well as an interest element, the tax treatment will therefore be more complicated than with a conventional bond.