Pension Corporation Research

Longevity: Trends, uncertainty and the implications for pension systems

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Executive summary

This paper presents historical trends in life expectancy in the United Kingdom and other countries and discusses how these trends might evolve over the coming decades. The paper argues that the expected increases in longevity are likely to have significant implications for the structure of pension systems in the future. Individuals, businesses and governments have already responded to these expected increases – for example by working longer, closing defined-benefit pension schemes or introducing parametric reforms to the state pension system – and are likely to change their behaviours further in the future. The issue is complicated by the fact that future longevity trends are uncertain. This makes it more difficult to allocate longevity risk efficiently and fairly across the different economic agents, while making it also more difficult to guarantee the sustainability of the system overall. The paper shows though that innovative solutions to this challenge are being developed, from businesses moving towards hybrid defined-benefit/defined-contribution pension schemes, to governments introducing mechanisms which automatically split the financial burden arising from future increases in life expectancy between state and individual, to businesses taking advantage of new products being developed to transfer any risk to the capital markets.

i. Introduction

The rapid increase in life expectancy is without doubt one of the great achievements of the human race over the previous two centuries. It has not only transformed individual lives, it has also profoundly transformed societies. These increases have been experienced in most societies, with the most marked changes taking place in the developed world, while more modest gains have been made in the majority of developing countries.

Life expectancy is one of the three so-called vital parameters to generate population projections. The other two are fertility rates and net migration. All three also matter for the provision of pensions. Longevity matters directly because it determines, in combination with the time of entry into retirement, how long someone can expect to receive a pension. The time of entry into retirement generally coincides with an exit from the labour market.

Fertility rates and net migration matter indirectly because they affect the size of the working-age population. For example, with the number of people aged 65 years and over increasing rapidly in most developed countries, the long-term sustainability of so-called state pay-as-you-go (unfunded) pension systems depends crucially on a government's ability to raise taxes, which in turn depends on the size of the economy and hence also the size of the workforce. The future size of the economy also matters for the ability of defined-contribution pension schemes to deliver prosperity for pensioners in the future. This is because the future profitability of businesses will depend on market opportunities. At its most basic, market opportunities depend on the number of people who can purchase products and services.

Setting up an efficient, fair and sustainable pension system is a major challenge and might never fully be achieved. The challenge is made larger still by the fact that longevity trends – and hence one of the key parameters determining the size of the challenge – are not well understood. Actual increases in life expectancy have generally been much more substantial than previously assumed in official population projections, with the result that government, business, the financial markets and individuals had to readjust their behaviours and plans.

It should, therefore, be a priority to improve the understanding of future longevity trends. For individuals, increased longevity is desirable and not surprisingly, there-fore, most developed societies spend a significant percentage of GDP annually on healthcare and medical research to ensure that we all have longer and healthier lives. As the population ages, this share is projected to increase over the coming decades and governments will have to ensure that the public finances will remain sustainable and government policy inter-generationally fair. Equally, increases in longevity can lead to large unanticipated retirement costs for business and governments.

Consequently, this paper focuses on longevity. The following section discusses historical trends in life expectancy, the main drivers of these trends, which have changed over the last century, and what impact these changes had on society more generally. The section also presents the evolution of the official UK population projections over recent decades. Section III discusses the effect of and potential responses by individuals, businesses and governments to increased longevity. As in our earlier paper on the economic landscape of pensions provision, we argue that these responses could be assessed in terms of their impact on the efficiency, equity and affordability of a society's pension system.[1] The identification of desirable responses might also indicate whether existing institutional structures or markets perform optimally. Section IV argues that the uncertainty of future longevity trends adds another layer of complexity over an already complicated issue and that it is therefore useful to improve our understanding of these trends. The paper shows the different

[1] *Pensions Tomorrow A White Paper*, Frank Eich and Amarendra Swarup, 2008 at www.lse.ac.uk/collections/management/PDFs/Pensions_Tomorrow_White_Paper.pdf.

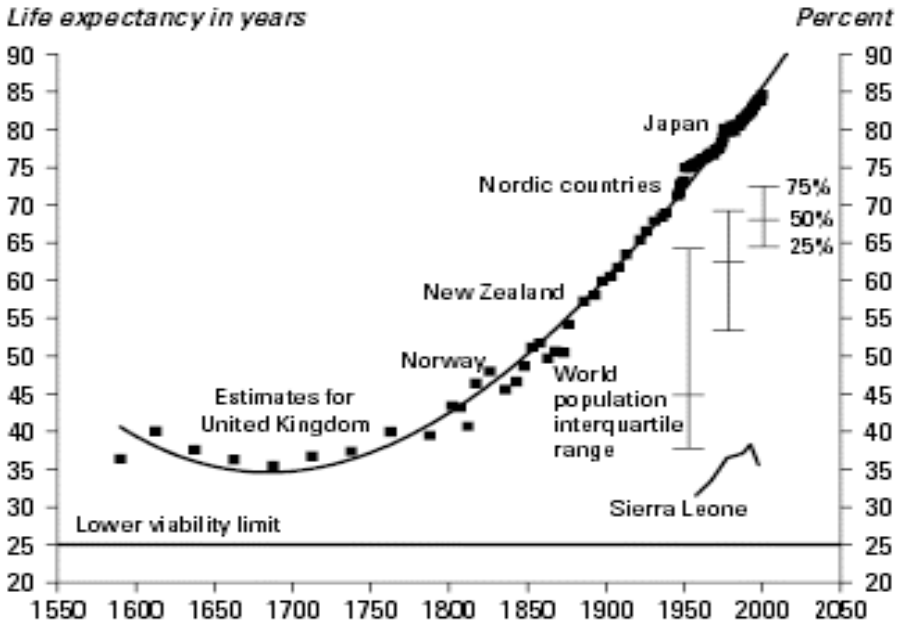
options individuals, businesses and governments have to address the challenges created by this inevitable uncertainty.

ii. Historical developments

Trends in life expectancy

Human life expectancy averaged around 40 years for centuries and only started to increase significantly in the 19th century. It has been on an upward trajectory ever since. At the beginning of the 20th century, (female) life expectancy had risen to around 60 years in New Zealand; by mid century, the strongest performing countries were the Nordics (with an average life expectancy of around 75 years); and towards the end of the previous century, it was Japan (with a life expectancy of around 80 years). While the frontrunners in terms of life expectancy have changed over time, one intriguing feature of the change in life expectancy is that it has more or less followed a linear trend since the beginning of the 20th century (see Chart 1). The picture has been similar for males.

Chart 1: Female life expectancy in years



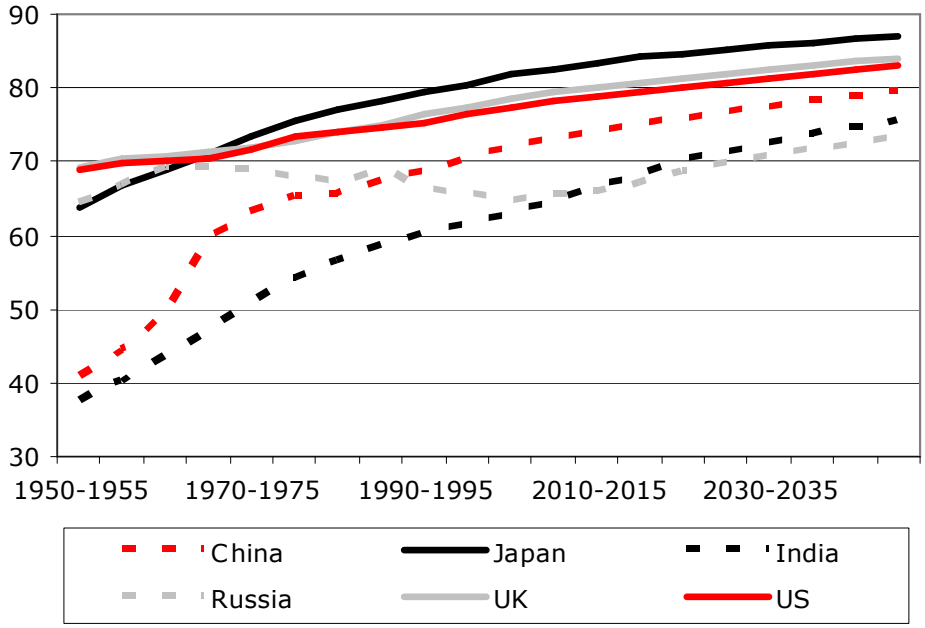
Source: Oeppen 1999.

Reprinted from http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=dcp2.figgrp.100

Chart 2 shows the evolution of life expectancy at birth between 1950 and 2050 (projected) in a number of selected countries. The chart shows that the most marked increases in the second half of the previous century could be found in China and in India, with Japan defining the upper bound internationally since the 1960s. Out of the countries shown, only Russia (or more precisely the former Soviet Union) experienced periods over the last 50 years during which life expectancy at birth actually dropped. However, the United Nations expects that life expectancy at birth will in-crease in all of the selected countries over the coming decades, with India and China gradually catching up with the more advanced nations.[2]

[2] The assumed increases in life expectancy at birth are not limited to the countries shown in the chart. The United Nations expects life expectancy at birth to increase in nearly all countries over the coming decades. See the Appendix for a more detailed list of demographic trends in selected countries.

Chart 2: Life expectancy at birth (selected countries)

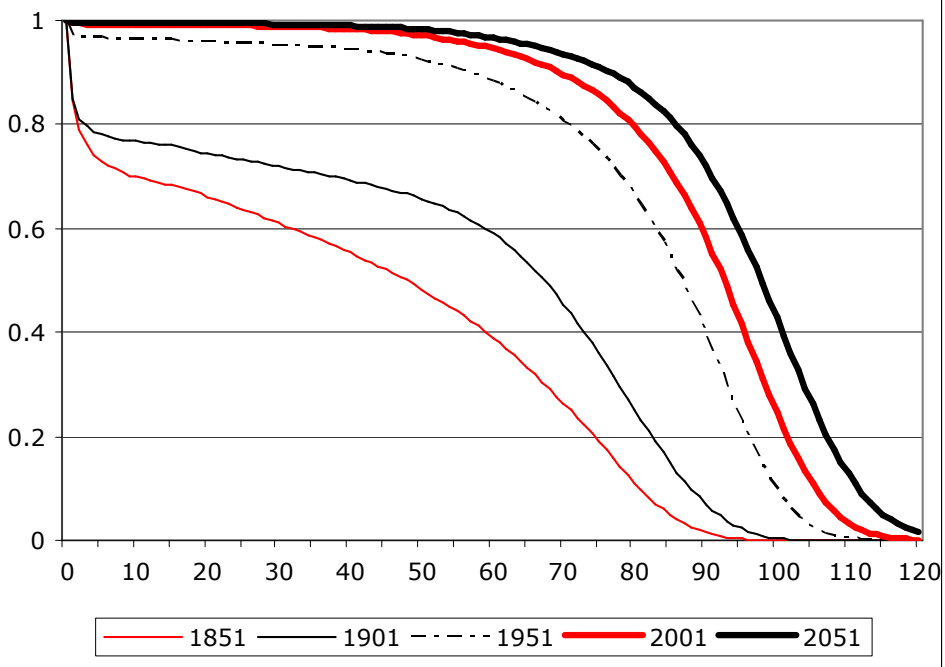


Source: United Nations Population Prospects The 2006 Revision.

However, it is important to understand that these increases were not simply the result of increases in maximum life expectancy. The major increases in life expectancy in the past were mainly the result of reduced infant mortality, which led to the "rectangularisation" of life expectancy as a growing proportion of a cohort reached older age, as can be seen in the example of the British population given in Chart 3. The chart shows that the biggest change took place in the first half of the last century with the dramatic reduction in infant mortality: while a quarter of the population died before the age of 10 years in 1901, within less than two generations that had been pushed out to around 65 years. Similar developments can be found in most other developed countries.

As Chart 3 shows, in 1851 half of the British population survived to around 45 years, by 1901 that had increased to close to 60 years, by 1951 to around 75 years and by 2001, to more than 80 years. However, the "rectangularisation" does not necessarily mean that maximum life expectancy has increased. For example, the "rectangularisation" would be complete once every person reaches the limit of life span, say 100 years.

Chart 3: Proportion surviving to successive ages



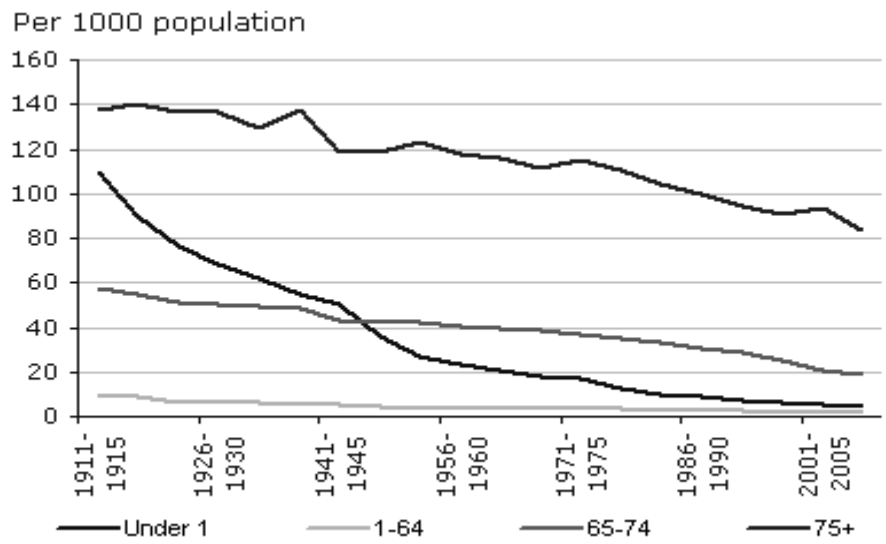
Source: Office for National Statistics.

Mortality developments

Chart 4 shows the underlying mortality trends, which have led to the "rectangularisation" of the population over the last century. Mortality rates have been falling for all age groups but particularly strongly for infants. However, rates for the latter group have converged towards zero and there is not much scope left for further reductions. Mortality rates for those between 1 and 64 years and 65 and 74 years have also fallen gradually but as the chart shows rates for the former age group have been very low throughout the 20th century and as such there is also little scope for further reductions. Mortality rates for those aged 65 to 74 years have fallen very steadily over the last century, reaching around 20 per 1000 population in 2001-05; half of what it was in the 1950s and a third of what it was 90 years earlier.

Despite this decline, there is scope for a further reduction. Finally, the chart shows that the mortality rate – not surprisingly – is highest for those aged 75 years and over, which suggests that the scope for further reductions should be greatest for this age group. The chart also shows that the decline in the mortality rate for this age group appears to have accelerated since the 1970s.

Chart 4: Mortality rates by age (England and Wales)



Source: National Statistics at www.statistics.gov.uk/cci/nugget_print.asp?ID=949

The dramatic decline in infant mortality over the first half of the last century continued a trend, which had already started a few decades earlier. In 1901, for example, infant mortality still stood at around 160 per 1000 births; as Chart 4 shows that had dropped to 110 within ten years.[3] Partly as a result of the sharp decline in infant mortality rates, fertility rates also started to fall rapidly, which in turn had dramatic effects on the role of females in society generally and the labour market in particular.

Longevity and societal change

Increases in life expectancy and the fact that more people reach old age (see Chart 5) have also changed fundamentally how individuals think and feel about age. In the developed world, many people in their 60s, 70s and even 80s nowadays enjoy a health status (and also financial means), which allows them to engage in activities, which only a generation or two ago would have generally been limited to younger adults. The fact that the share of people aged 65 years and over or 85 years and over in total population has increased substantially too over the previous decades also had a profound impact on society.

Females have also postponed child birth to later age. For example, in 1977 the probability for females aged between 25 and 29 years to give birth was twice as high as that for females aged 30 to 34 years. By 2007, the latter group had the highest fertility rate of any age group.[4] As a result, nearly as many females in the UK now give birth in their 30s than in their 20s.[5]

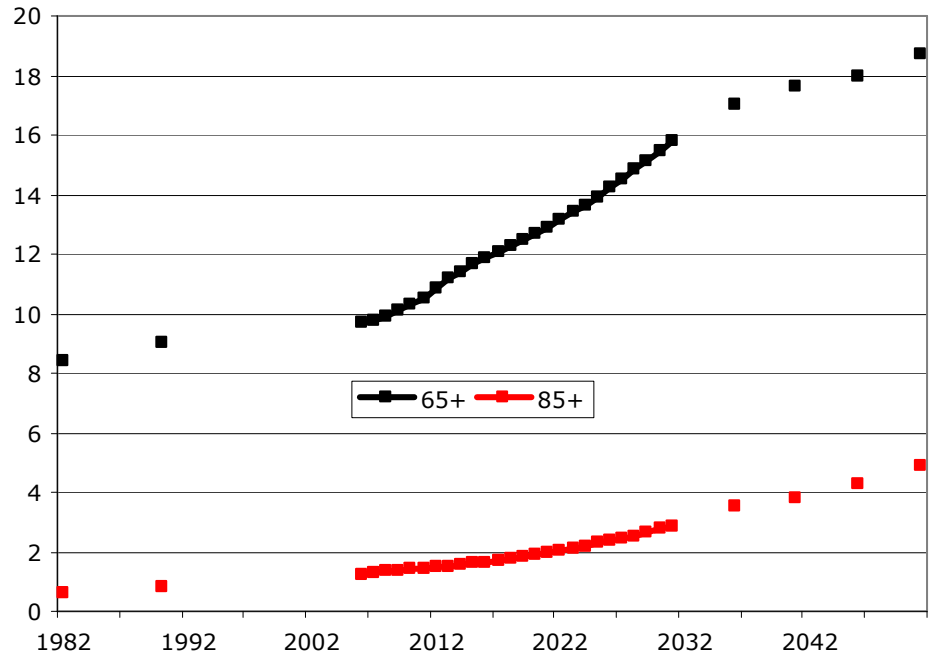
Equally, the average number of years people stay in formal education has also gone up, partly reflecting the trend towards increased tertiary education.

[3] www.healthline.com/galecontent/infant-mortality

[4] www.statistics.gov.uk/cci/nugget.asp?ID=951

[5] www.gad.gov.uk/Demography_Data/Population/2006/uk/wuk06asfr.xls

Chart 5: Number of people aged 65+ and 85+ (millions)



Source: GAD, 2006-based principal population projections and ONS population statistics.

While the notion of what constitutes "old age" has shifted dramatically over the past decades and while the average entry age into the labour market has risen steadily in most developed countries, the effective retirement age of the workforce did not rise in line. In fact, in many developed countries, including the UK, labour market participation rates of older male workers generally trended downwards between the early 1970s and early 1990s, partly as a result of the deep structural changes that were taking place in those economies over that time.[6] By contrast, participation rates of older females have generally trended up as the role of females in society changed. In the UK these developments have meant that subsequent cohorts have spent smaller proportions of their life in work. For example, the cohort born in 1900 spent nearly 70 per cent of their lives in the labour market, that share had dropped to less than 60 per cent for those born in 1935.[7]

The aggregate trends discussed so far conceal substantial variations across social classes, gender or regions. For example, while projected male life expectancy at birth increased from 69.2 years for those born in 1972-76 to 75.4 years for those born in 1997-2001 (+6.2 years or +9 per cent), the absolute and proportional increase is substantially larger for males in Social Class I than for males in Social Class V. For the former the increases are +7½ years (+10.4 per cent), for the latter +4½ years (+6.9 per cent).[8] The trends are different for females: with life expectancy for females in Social Class I projected to increase by less than for females in Social Class V.

In the context of pensions, future trends in life expectancy at age 65 years are if anything more important than at birth. Chart 6 shows that between 1981 and 2001 male (cohort) life expectancy at age 65 years increased by around five years and that for

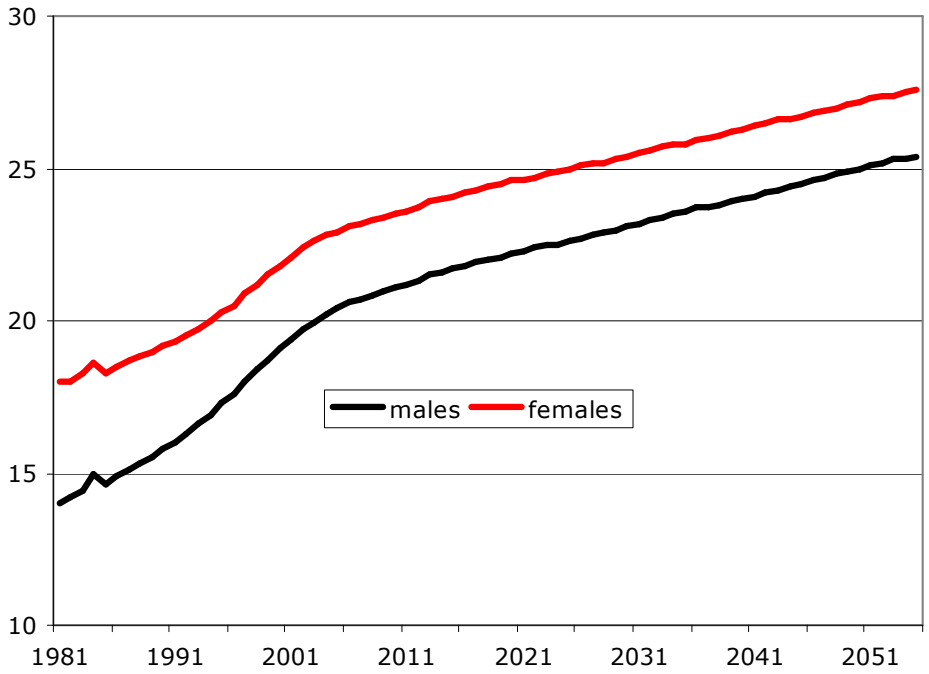
[6] *Retirement in the UK*, James Bank and Sarah Smith, CMPO Working Paper Series No 06/140, 2006. Also see *Social security programs and retirement around the world*, Jonathan Gruber and David Wise, Research in Labor Economics, 1999.

[7] *Retirement in the UK*, James Bank and Sarah Smith, CMPO Working Paper Series No 06/140, 2006, page 3.

[8] *Review of methods for estimating life expectancy by social class using the ONS Longitudinal Study*, Brian Johnson and Louisa Blackwell, Office for National Statistics, Health Statistics Quarterly 2007. The figures shown are for England and Wales only. Social Class I captures "professionals", while Social Class V covers the unskilled.

females by slightly less.[9] In other words cohort life expectancy increased by roughly three months for every year during that period. The latest set of official population projections for the UK assumes that the increase will continue in the future too, albeit at a slower pace. For example, National Statistics projects that male life expectancy at age 65 years will reach 25 years by mid century, around 30 years (and hence one generation) later than females.

Chart 6: Cohort life expectancy at age 65 UK

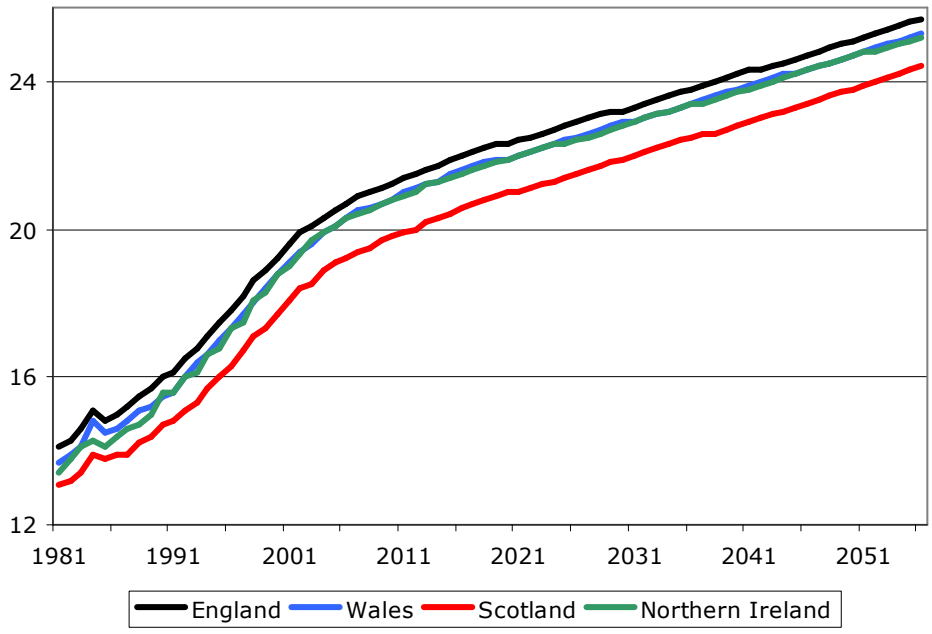


Source: Government Actuary's Department

Chart 7 shows that male cohort life expectancy at age 65 years is projected to increase in all the nations of the UK – England, Scotland, Wales and Northern Ireland – but also that existing differences in levels are if anything expected to remain. For example, cohort life expectancy in 1981 was one year lower in Scotland than in England, by 2056 that gap is projected to widen to 1.3 years.

[9] One can distinguish between the so-called "cohort" and "period" life expectancies. The former includes any potential gains in life expectancy; the latter is based on today's life expectancy for the different ages. As such the former probably gives a more accurate picture of future trends.

Chart 7: Cohort life expectancy at age 65 (Nations of the UK)



Source: Government Actuary's Department.

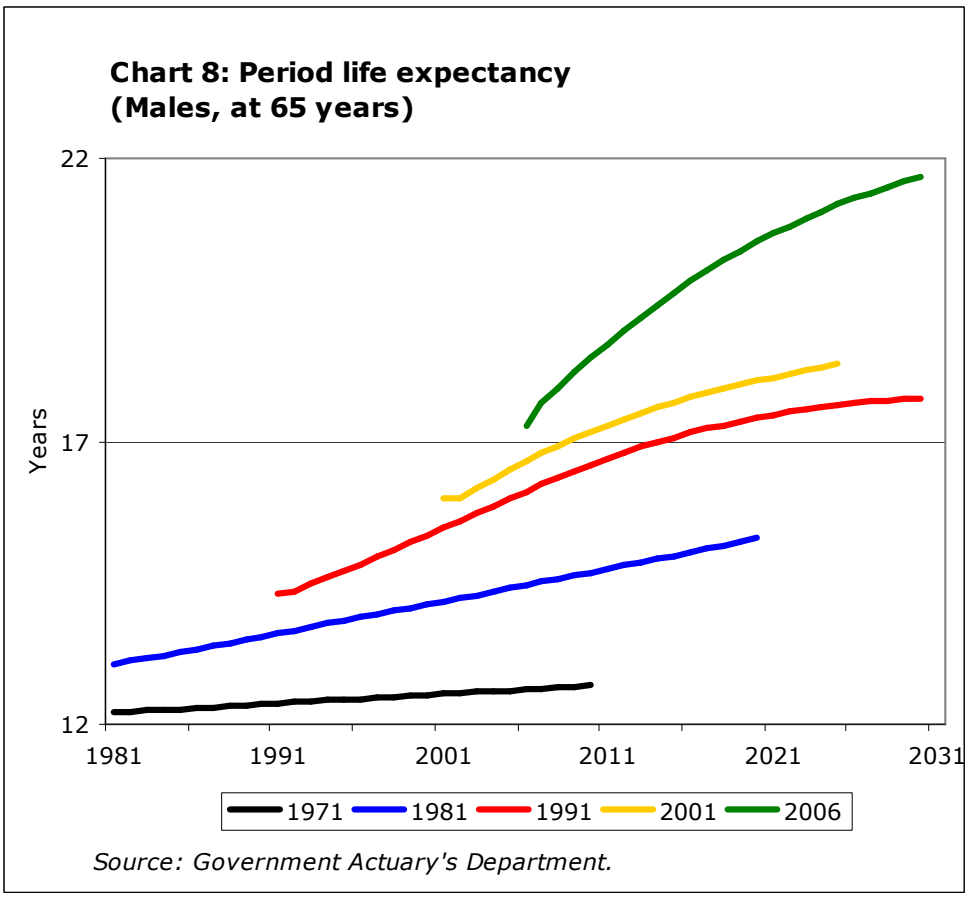
As more people reach old age, the question of what might be the theoretical maximum life span for a human has become more pertinent. Different views have been expressed on this issue. For example, it has been suggested that increases in longevity will not remain linear but will instead gradually become smaller and hence converge towards zero.[10] A still more pessimistic view is that life expectancy has actually peaked and that lifestyle changes in western societies (for example due to in-creased prevalence of obesity) will more than offset the potential positive effects of medial and other progress on life expectancy.[11] On the other extreme of the spectrum, a number of scientists have argued that there should theoretically be no limits to the human life span.[12]

The future path of the life expectancy trend is a crucial unknown in a number of important policy debates, including that on pensions.[13] Governments, businesses and individuals have to prepare for the economic, societal and financial implications of an ageing society. For example, it has been estimated that pension liabilities increase by 3 per cent or more for every added year of life expectancy. Other important policy areas affected include future health and long-term care provision and the built environment. Dealing with pensions is a complex issue as it is, given the different and often conflicting objectives of different stakeholders and constraints involved; the large degree of uncertainty regarding one of the key parameters makes the issue substantially more complex still. Having a thorough understanding of the actual ageing trends would be useful for all agents involved as it could minimise the cost of future adjustments in behaviours as new information emerges.

Chart 8 shows the projected trends in period life expectancy for males as presented in the 1971, 1981, 1991, 2001 and 2006 UK population projections. The chart shows that the latest (2006-based) population projections represent a step change in terms of the

[10] *The Hidden Age Revolution: Emergent Integration of All Ages*, Matilda White Riley, 1998.
[11] See for example www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat4.section.1107 and www.munichre.com/en/ts/biosciences/will_obesity_halt_trend_of_increasing_longevity/default.aspx
[12] *Brave Old World,* Tom Kirkwood, BBC Reith Lecture 1, 2001.
[13] See also *Pensions Tomorrow White Paper*, Frank Eich and Amarendra Swarup, 2008.

(period) life expectancy assumption used. Previous projections assumed that future increases in life expectancy would gradually decline over time (converging to zero eventually), the latest projections assume a sustained increase.[14]



Source: Government Actuary's Department.

iii. Longevity trends and pension systems

The Pensions Tomorrow White Paper introduced three desirable characteristics, against which a pensions system could be judged.[15] These characteristics are:

- Efficiency (static and dynamic)
- Equity (fairness)
- Affordability and sustainability (both financial and social).

As mentioned earlier, setting up an efficient, fair and sustainable pension system is a major challenge and might never fully be achieved. The challenge is made larger still by the fact that longevity trends – and hence one of the key parameters determining the size of the challenge – are not well understood. Actual increases in life expectancy have generally been much more substantial than previously assumed in official population projections, with the result that government, business, the financial markets and individuals had to readjust their behaviours and plans. In hindsight, previous behaviours also turned out to be suboptimal.

Though desirable from an individual and societal perspective, increased longevity can also adversely affect important aspects of the economy, particularly when it comes to pension provision and healthcare. As an example, in the United States Social Security,

[14] A more general discussion of the overall accuracy of national population projections in the UK can be found in *Fifty years of United Kingdom population projections: how accurate have they been?*, Chris Shaw, Office for National Statistics Population Trends 128, www.gad.gov.uk/Documents/Population_Trends_128.pdf

[15] See *Pensions Tomorrow A White Paper*, Frank Eich and Amarendra Swarup, 2008.

Medicare and Medicaid accounted for 8½ per cent of GDP in 2007 but is projected to more than double to 18 per cent by 2050.[16]

Equally, increases in longevity can lead to large unanticipated costs for business and there is substantial evidence that this is adversely affecting the finances of defined benefit pension funds and their sponsors. Over the last decade, new accounting standards have greatly increased transparency with respect to the effects of in-creased longevity on pension fund finances. Many occupational pension funds are also at risk due to the presence of spousal benefits should the main beneficiary die, which can enhance the longevity of the fund.[17]

Sponsors and trustees are increasingly concerned about longevity as the recent trend for life expectancies has been ever upwards and to make things more complicated, the extent of future increases is also highly uncertain. Another fundamental problem is that for most schemes, liabilities are calculated insufficiently frequently, using out of date longevity assumptions and increasing the risk of unexpected future increases in liabilities. In recent times, the area has become all the more important because of increased regulatory scrutiny in the UK and elsewhere, and growing pressure for schemes, for example from The Pensions Regulator, to adopt more realistic mortality assumptions that reflect the latest scientific evidence. In the UK this also presents additional short-term risks for corporate sponsors as they may need to divert potentially vital cash-flow into the scheme to meet these future liabilities.

Dealing with this risk and its consequences has hitherto been far from straightforward and more research is needed to understand the issues better. The role financial markets can play in managing and mitigating this risk is also deserving of further study. The growth of a robust market in catastrophe bonds over the recent past to deal with the risk from natural and man-made disasters is evidence that idiosyncratic but crippling risks can be managed effectively. Recently, steps have been taken with companies launching longevity indices and hedging products. Fundamentally, who should carry the longevity risk and does the allocation of this risk make a difference to the dynamic efficiency of the economy? Can longevity risk be hedged effectively and can firms be actually effectively insured against future longevity increases by the financial markets?

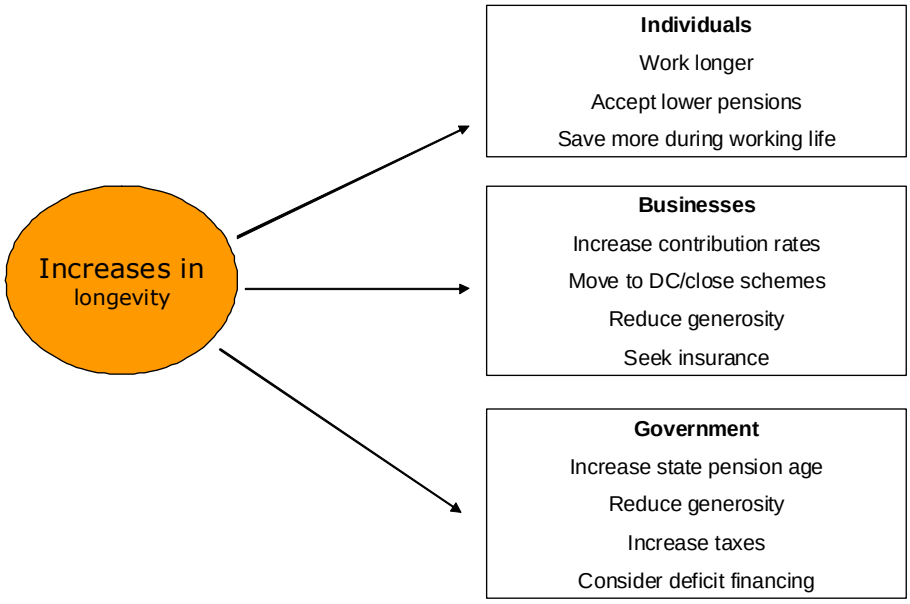
It is likely that having greater information regarding one of the key vital parameters – longevity - should allow one to design ex ante a more efficient and fairer pension system, which would also be financially and socially sustainable.

As Chart 9 shows individuals, businesses and governments can respond in a number of ways to expected increases in longevity (note that the chart provides a non-exhaustive list of responses).

[16] *The long-term budget outlook and options for slowing the growth of health care costs*, Congressional Budget Office, June 2008.

[17] For example, the American Civil War Veterans Pension Fund made its last payment in 2001, nearly 140 years after it was first set up in 1862.

Chart 9: Possible responses to increased longevity



Individuals

Individuals, for example, could in theory accept a lower annual pension as the accumulated assets (savings) will have to be spread over a longer period of time in old age. Alternatively, individuals could decide to extend their working lives in response to an increase in longevity or save more during their working lives, as would be suggested by the so-called life cycle model.[18] The life-cycle model is one of the key tools with which economists analyse individual life-time consumption and saving behaviours. According to the model, people save when young to build up financial assets, which can then be disinvested again in old age to finance consumption. In a world of certainty, individuals can optimise their savings/consumption and labour market behaviour (e.g. timing of retirement) to maximise life-time welfare.

Businesses

Businesses have dealt with the expected increases in longevity in numerous ways, including by increasing contribution rates or by reducing the generosity of future pension promises. More fundamentally, businesses in the UK and elsewhere have also started to close defined benefit (DB) pension schemes to new entrants and by shifting pension provision on to a defined contribution basis. Up to the 1990s, defined benefit pension schemes were the prevalent type of pension scheme offered in the UK private sector. In other words, many businesses have dealt with the challenges arising from future longevity trends by shifting the burden away from themselves to their employees. It has been argued that individuals are in fact relatively badly placed to deal with these challenges on their own so that the shift might not have raised societal welfare. There is also the important issue of future pensioner poverty to be considered.

However, defined benefit pension funds remain an important issue for many companies and pension fund trustees. Corporate managers are faced with the problem of maintaining a set of financial commitments made in the past, when assumptions for example regarding future longevity trends were very different. Meeting these commitments will depend on the financial well-being of the corporate sponsor, which is nowadays legally required to underwrite any deficit.[19] At the same time, pension fund

[18] The government can influence these decisions by changing financial incentives (e.g. in-come tax rates) or by changing legislation (e.g. anti age-discrimination legislation).

[19] This is not necessarily the case in all countries though.

trustees try to pursue the appropriate investment strategies, taking account of increasing longevity exposure and the financial robustness of their corporate sponsor. Not surprisingly, trustees and beneficiaries of defined benefit pension funds feel secure when the sponsor of their fund is making good profits, and rather insecure when it is not.

There is also the issue of growing tensions between shareholders and pension scheme members. Management teams, with their primary responsibility to share-holders – typically including other pension schemes as well – make necessary and in some cases risky decisions that affect the direction of their companies. The result is that the shape of the sponsor of a pension fund today may be markedly different to that of the company that initiated it. Pension funds, and the beneficiaries who rely upon them, are often at the mercy of these changes. This can create unhealthy tension and lead to trustees treating the sponsor as little more than the prime debtor to the pension fund. Such an attitude is harmful for all concerned: sponsors may be distracted from their core business and restricted in terms of their corporate goals, ultimately impacting the funding position of the pension fund.

There is an additional complication. The horizon of success in which most companies operate is at most five or ten years distant. Yet, as their pension funds need a much longer perspective, these corporate sponsors are also charged with maintaining open-ended commitments for a very long period ahead. Some will still be paying out benefits in 50 or 60 years' time, depending on the longevity of their members, even if they closed their schemes to new entrants now. Corporate sponsors that initiated de-fined benefit pension funds in an earlier generation also may now suddenly find their balance sheets at the mercy of volatile markets. This can have dramatic effects on their share price, their room for corporate manoeuvre and, in the end, on the security of the commitments they are pledged to maintain.

Governments

Increases in longevity, the ageing of the baby boom cohorts and declining workforces due to low fertility rates will lead to a marked increase in the so-called old-age dependency ratio in most developed countries over the coming decades.[20] Faced with these demographic developments and their potential adverse effects on the long-term sustainability of the public finances; many governments implemented policies over recent years with the objective of reducing the generosity of state pensions in the future. These policies have come in many different shapes. For example, governments have shifted the indexation of future pension increases from earnings to prices or moved the earnings-related pension formula from final salary to career-average. Many governments also announced to increase the official retirement age over the coming decades from which on future pensioners can claim a state pension. These policies were complemented by measures aimed at strengthening occupational and private pensions (the so-called second and third pillars of pension provision) to ensure the adequacy of retirement incomes in the future.[21]

Faced with a rapidly rising number of older people in the future (partly but not only due to increases in longevity), governments have also opted to consolidate the public finances over recent years. Denmark, Sweden and Finland, for example, reduced their gross debt to GDP ratios and accumulated financial assets (mainly in pension funds) in an effort to create some "fiscal space" in the years ahead. Australia, New Zealand and Canada pursued similar policies over recent years.[22] This fiscal consolidation can at least help to deal with the financial implications of the ageing baby boom cohorts.

[20] The demographic old-age dependency ratio is generally defined as the number of people aged 65 years and over relative to the number of people aged between 16 and 64 years. The economic old-age dependency ratio replaces the arbitrary age of 65 years with the state pension age. See Eurostat for the latest population projections for EU Member States.

[21] As part of its 2003 reforms, for example, the German government introduced the so-called Riester Rente, which offers financial incentives to encourage individuals to save for their own retirement. Similar policies were implemented in a number of other countries.

[22] See, for example, the country studies conducted by the International Monetary Fund.

While all the above responses (besides others) are feasible, what effect might they have on their own or in combination on the efficiency, equity and affordability (sustainability) of a country's pension system or economy more generally? A related question is whether existing institutions and market structures, among other things, are in the position to enable society to achieve an efficient, equitable and affordable outcome. For example, are existing labour market structures and pension age legislation flexible enough to allow individuals to make optimal choices given the diversity in individual circumstances and preferences?

iv. Understanding and dealing with the uncertainty of longevity trends

Stochastic projections

The previous section illustrated the choices available to society to achieve an efficient, fair and affordable pension system in the light of certain increases in longevity. In reality though the future increases in longevity are far from certain.

In an effort to develop a better understanding of the uncertainties surrounding future longevity trends, actuaries and other population forecasters have started to complement their more traditional "deterministic" approach to projecting future population trends with stochastic projections. In these projections the key parameters – longevity, fertility and migration flows – are shocked at random to generate projections. While this approach allows for the explicit quantification of the uncertainties involved, the parameters will still be centred on pre-determined baseline assumptions.

Potential drivers of future longevity trends

Over the last few years there have also been major efforts to improve the scientific foundation underlying the assumptions. For example, in 2008 the Mortality Research Steering Group of the Institute of Actuaries commissioned a scoping note on mortality research across the professions.[23] This and similar initiatives could help to establish the links between, for example, medical progress and future life expectancy trends. More generally, what could be the impact of *past, current and future*:

- medical progress
- new health and safety regulation
- lifestyle changes (e.g. obesity)
- technological progress
- socio-economic changes such as migration and economic growth
- pandemics
- climate change
- labour market developments (e.g. sectoral changes)

on life expectancy and healthy life expectancy?

Assessing the potential implications of these developments for longevity will inevitably involve a high degree of uncertainty, which will increase the further the projection horizon. For example, the exact medical progress over the coming decades is unknown but current developments might yield insights into what might be achieved over the coming years. In a number of areas there might be an emerging consensus that a number of important breakthroughs will be made soon, including potentially in the treatment of Alzheimer's. Past patterns of medical progress and the speed of rollout of, *inter alia*, new types of treatment across the general population might also give an indication how medical provision might evolve in the foreseeable future. For decades

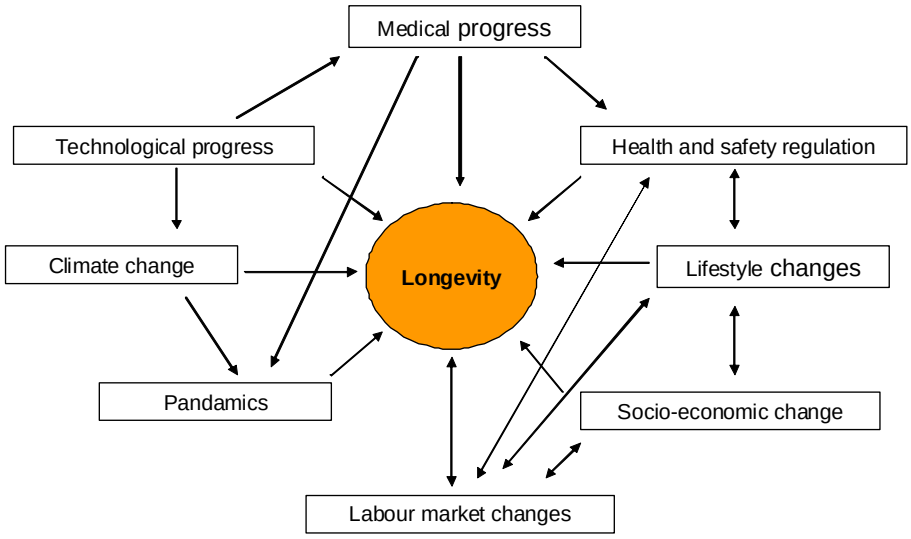
[23] *Scoping Mortality Research (Report of the Mortality Research Steering Group)*, presented by Catriona MacDonald to the Institute of Actuaries, 22 September 2008.

further into the future the nature of such assessment will inevitably have to become more speculative.

The above-mentioned trends are likely to affect mortality rates at different age groups. For example, new health and safety regulation might address health risks at the workplace and as such would affect mortality rates of the working-age population. By contrast, advances in the treatment of Alzheimer's will most likely reduce mortality rates of the oldest old, in other words those above 85 years of age.

The issue is complicated by the interdependencies of the different factors that might affect longevity. This is shown in Chart 10. As an illustration consider technological progress and climate change: technological progress and climate change might impact separately on future longevity trends but technological progress will also impact on climate change developments. Similarly, health and safety regulation might affect longevity trends and could affect lifestyles, but the latter will also be a driving force for new health and safety regulation in the first place - and impact on longevity on its own.

Chart 10: Longevity and its drivers



A better understanding of future life expectancy trends would allow society to make better decisions in many areas. For example, assuming that increasing life expectancy is one of the most desirable outcomes in a society, what is the most cost-effective way to achieve these increases? A better understanding of longevity trends would also likely yield important insights into trends in healthy life expectancy, which could have many other policy implications.[24] People might be living longer, but will they be living longer healthier lives too so that working longer is a feasible option? Being able to work for longer will be fundamental to making the announced increases in retirement ages, which have been announced in many countries, work. There is an additional – indirect – link between longevity trends and the labour market: the largest group providing informal long-term care services to the very elderly are people – and predominantly females - in their late 50s and increasingly early 60s who look after their parents or spouse's parents. Can these different demands be reconciled if the elderly live for longer?

[24] See for example *Securing good care for older people: Taking a long-term view,* Derek Wanless, 2002 and *Mental Capital and Wellbeing: Making the most of ourselves in the 21st century*, Government Office for Science (Foresight), 2008 at http://dius.ecgroup.net/files/116-08-FO_b.pdf.

Dealing with uncertainty: a challenge for individuals, businesses and governments

The fact that future trends in longevity are uncertain (including for the current working-age population) adds a layer of complexity to the longevity issue and poses many additional challenges for economic agents – individuals, businesses or governments – with which they have to deal with. One of the key challenges is to decide ex ante who – individuals, businesses or governments (and hence society at large) - should carry the longevity risk. The optimal allocation of this risk should depend on an agent's ability to deal with this risk.

There is a substantial literature on optimisation under uncertainty. For example, it has been suggested that faced with uncertain life expectancy and other developments (e.g. healthy life expectancy, which affects the ability to work in older age, and the future policy environment), risk-averse **individuals** are likely to conduct precautionary savings to prepare for old age.[25] These in turn could lead to sub-optimally high levels of inheritance. However, given the time horizons involved, myopia is likely to at least partially offset this, with many individuals ultimately saving too little for their own retirement. The situation is complicated further by the fact that most individuals make decisions based on an incomplete set of information, with individuals often believing life expectancy to be shorter than it is in reality. The fact that individuals generally underestimate longevity trends will probably accentuate this bias towards under-saving (efficiency and affordability).

An individual's ability to cope with longevity risk (alongside other types of risk, including the risks from uncertain investment returns) must be limited though. Unlike groups of individuals (either in the form of businesses or governments), individuals have no scope to pool risk and would have to deal with any implications on their own. Their choice set is also more limited than that for larger groups. For example, individuals will generally find it difficult to return to work in old age should they find that the pension income they receive (from the state or as an annuity) is inadequate. Pre-cautionary saving then appears the only way for individuals to prepare for this eventuality.

As mentioned above, **businesses** can and have responded to increases in life expectancy and the resultant increase in the value of the pension entitlements by closing defined pension schemes to new entrants and promoting defined contribution schemes instead. By moving from DB to DC pension schemes, many businesses have been able to shift the entire longevity risk to individuals.

Intermittent solutions can also be found though and have often taken the form of hybrid DB/DC schemes. For example, Allied Irish Bank in Ireland announced in 2007 to launch a hybrid DB/DC pension scheme for new entrants; which would cap the DB benefit at a certain amount; above that amount scheme members would be on a DC scheme.[26,27] Similar hybrid schemes have also been launched in the Netherlands, where there has also been a shift away from final salary to career average DB schemes. In these schemes the annual accrual of future pension entitlements is pre-determined (as in a DB plan) but the indexation of pension entitlements in retirement will depend on the investment return of the underlying fund (as in a DC plan).[28]

[25] See for example *Saving*, Laurence J. Kotlikoff at www.econlib.org/library/Enc/Saving.html. Also see *Precautionary saving and old-age provisions: Do subjective saving motive measures work?*, Lothar Essig, University of Mannheim, August 2004 and *Disentangling the Importance of the Precautionary Saving Motive*, Arthur Kennickell and Annamaria Lusardi, November 2005.
[26] www.independent.ie/business/irish/boi-and--unions--strike--hybrid-pension--deal-1206142.html
[27] *DWP publishes new research reports on hybrid pension schemes*, Department for Work and Pensions, 2005, www.dwp.gov.uk/mediacentre/pressreleases/2005/aug/iad300805-hybpens.pdf
[28] *Sharing risks: the Netherlands' new approach to pensions*, Eduard Ponds and Bart van Riel, www.law.harvard.edu/programs/lwp/PDF_pres/PONDS%20VRIEL.pdf

In the UK, corporate sponsors of defined-benefit pension schemes have recently benefited from innovations in the financial markets, which have opened new opportunities for passing on longevity risk. For example, there is a growing market in pension risk transfer solutions, where companies can pass on all their risks, including longevity risk, and the responsibility of meeting them to a specialist third party pension solutions provider. This appears to provide a compromise for both sides, where members gain improved security through a bespoke and regulated insurance contract, while the sponsor company removes future pension uncertainties from its balance sheet and commercial consideration.

However, though increasingly popular, the solutions have yet to show that they can help companies with creating a viable pension system for the future. Currently, the UK pension insurance market has been focussed on helping sponsors and trustees manage those liabilities that are already well constrained due to the scheme being closed to new members. Nevertheless, some of the recent innovations such as partial buyouts may help schemes create an ongoing defined benefit scheme system where the risk is transferred away in tranches over time, though this still leaves open the question of whether sponsors feel able to hold the longevity risk for the rest.

The question is whether a greater understanding of future longevity trends would allow for more efficient, equitable and affordable arrangements. An interesting area of recent activity in the financial markets has been the attempt to separate out longevity risk on its own and see if that can be individually managed or hedged away. This could have far-reaching implications for corporate pension funds as they could theoretically continue to pay pensions while facing reduced financial risk from longevity increases should such a market develop. This could be an important step if a sustainable pension system for the future is to be created.[29]

The principal vehicle for longevity risk transfer proposed by the capital markets is a longevity swap. This allows the scheme to lock into an agreed level of future longevity, or to hedge against general trends in longevity experienced by the population as a whole through either offering limited downside protection or based on a "longevity index" as seen in JP Morgan's LifeMetrics index.[30] Others have also developed be-spoke longevity swap products, including through insurance structures for added security. These initiatives are all designed to parcel up mortality, allowing it to be traded and giving pension schemes the opportunity to hedge their longevity risk outside of a buyout. All these developments help to price longevity risk, which should make it easier in the future to allocate the risk to the most appropriate agent.

For pension schemes, the benefits are potentially attractive: it eliminates their most significant long-term risk, that of pensioners living longer; and mitigates the cost of more conservative longevity assumptions that may be required in the future, relieving pressure on the sponsor's covenant.

As part of the aforementioned reform efforts, **governments** have tried to deal with the issue of uncertainty by making their policies flexible and adapt automatically to future changes in longevity or other demographic developments. Sweden and Germany are widely recognised as having implemented innovative reforms to deal with this challenge. In 1998 the then Swedish government implemented a substantial pension reform, which included the introduction of a so-called annuity divisor and the so-called automatic balance mechanism. The former is updated for every new cohort of retirees to take into account the latest estimates of life expectancy. Everything else equal, as life expectancy rises; the divisor will reduce monthly annuity payments. This in turn should help to dampen future increases in state pension spending. The automatic balance mechanism is meant to guarantee the solvency of the Swedish pension system more generally by making automatic adjustments to inter alia the contribution rates. Over recent years Finland, Norway and other countries have introduced mechanisms

[29] The market has antecedents. The first bonds issued with a mortality element were issued in the Netherlands in 1670. In 1693, the British Government issued its own mortality bonds, the "Tontines" to help fund a war with France.

[30] www.jpmorgan.com/pages/jpmorgan/investbk/solutions/lifemetrics

similar to the Swedish annuity divisor in their own effort to keep future state pension spending under control.[31]

As part of a wider reform package the then German government in 2003 introduced a so-called sustainability factor in its pension calculation formula with the aim of dampening future state pension increases. This factor ensures that future state pension adjustments will take into account future trends in the number of contributors to the state scheme and pensioners (which in turn also depends on longevity trends). As a result the pension adjustment might turn out to be significantly smaller than the increase in average earnings (which remains the baseline) and could even reach zero without any further legislative changes.[32]

As a result of the reforms at least some part of the longevity risk will be shared automatically between the government and individuals. While this might help to ensure the sustainability of the public finances over the longer term, are these individuals, and in particular those who are already retired and therefore no longer in the labour market, well placed to deal with this risk sharing? Would a greater understanding of future longevity trends allow governments to design more efficient, equitable and affordable pension systems?[33] See Box 1 on the allocation of longevity risk.

[31] *Finnish and Norwegian Pension Reform Implications for Preparing Aged Society*, Ismo Risku and Mika Vidlund, Finnish Centre for Pensions, Working Paper 4, 2008 (www.etk.fi/Binary.aspx?Section=41096&Item=62970). Other countries include Canada and Japan. See *Automatic balance mechanisms in pay-as-you-go pension systems*, Carlos Vidal-Meliá, María del Carmen Boado-Penas and Ole Settergren, 2008 (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1132686).

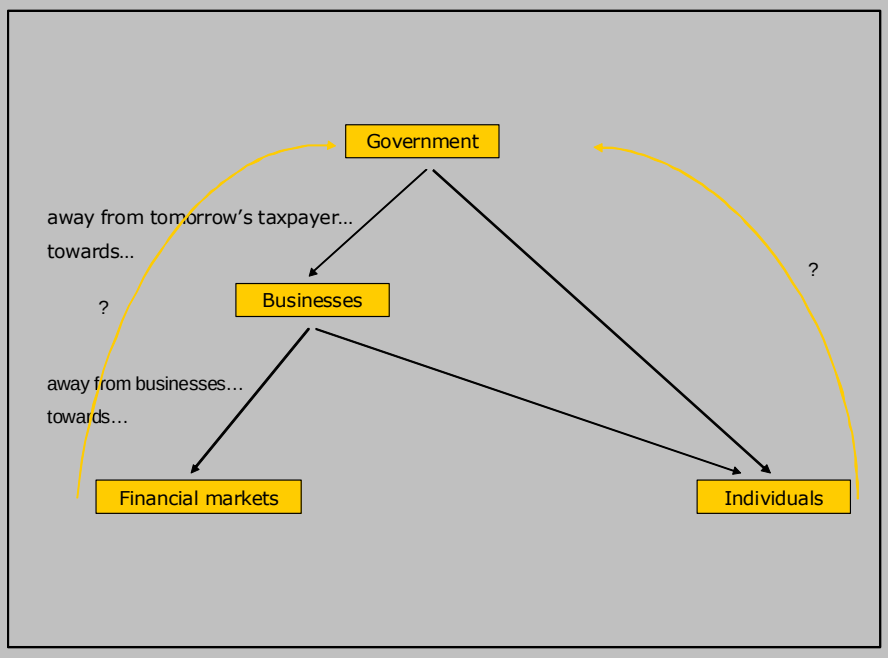
[32] More information on the automatic stabilisers in the Swedish and German pension systems can be found in *Building Automatic Solvency into U.S. Social Security: Insights from Sweden and Germany*, James C. Capretta, The Brookings Institution, Policy Brief 151, March 2006. Further information on the pension systems more generally can found in *Pension Schemes and Projection Models in the EU-25 Member States*, Economic Policy Committee, November 2007 (http://ec.europa.eu/economy_finance/epc/documents/2007/pensions_en.pdf). In 2007 the German government implemented further reforms, including an increase in the official pension age from 65 years now to 67 years by 2029.

[33] See also *Uncertain Demographics and Fiscal Sustainability*, edited by Juha M. Alho, 2008.

Box 1: Allocating longevity risk

In most countries the (re)allocation of longevity risk has been a gradual process. Starting in the mid 1990s governments in many developed countries concluded that without reforms their often generous state pension systems would become fiscally unaffordable in the decades ahead. Governments responded to this challenge by announcing future increases in the pension age and by reducing the generosity of their future pension promises. To ensure the adequacy of future pensioner incomes, governments also promoted occupational and personal pensions. As argued in the main text, several governments also introduced mechanisms, which would automatically share the financial burden arising from unexpected increases in longevity between the state and the individual. These policies have led to an explicit and implicit reallocation of the longevity risk.

In a number of countries – including the UK – the private sector has traditionally played a crucial part in the provision of pensions. Faced with rising longevity (and the uncertainty of future longevity increases), businesses have inter alia tried to shift the longevity risk to their employees (shift from DB to DC, closure of schemes). More recently, pension fund trustees and their corporate sponsors have looked at the financial sector to provide solutions to dealing with longevity risk. It needs to be seen whether the emerging allocation of longevity risk will be perceived to be efficient, equitable and sustainable in the longer term. If not, it is possible that the electorate will give future governments the mandate to initiate further adjustments.



Unlike the previous Swedish and German pension reforms, the 2007 reforms in the UK do not contain any automatic mechanisms, which could help to dampen future increases in state pension spending.[34] While the centre piece of the reform is the introduction of the so-called personal accounts in 2012, the reform also includes an increase in the state pension age from 65 years in 2020 to 68 years by the mid 2040s (in line with assumed longevity increases). Furthermore, state pension increases will be indexed to earnings rather than prices from 2012 onwards. At the time of the re-form, the British government argued that the policy measures would be fiscally sustainable over the long term. However, will they also be fiscally sustainable should the actual increases in life expectancy exceed those assumed at the time of the reforms?

[34] www.dwp.gov.uk/pensionsreform/.

Conversely, what will the British government do should future improvements in life expectancy in fact turn out to be more modest than assumed? The lack of in-built flexibility means that any potential future policy changes will require future governments to re-open the pensions debate, which would likely be time consuming and politically costly.

Appendix

Table 1 summarises some of the main demographic trends in selected countries over the coming decades.

Table 1	**Fertility rate**			**Life expectancy[1]**			**Old-age dependency ratio[2]**		
Selected countries	2005[3]	2030[4]	2050[5]	2005	2030	2050	2005	2030	2050
Australia	1.79	1.85	1.85	78.9	82	84.1	19	35	41
Brazil	2.25	1.92	1.85	68.8	73.1	76	9	19	31
China	1.73	1.85	1.85	71.3	74.8	77.4	11	24	39
Germany	1.36	1.54	1.74	76.5	79.1	81.4	28	46	54
France	1.89	1.85	1.85	77.1	79.6	81.8	25	38	45
India	2.81	1.97	1.85	63.2	69.3	73.4	8	13	21
Italy	1.38	1.54	1.74	77.5	79.9	82.1	30	44	60
Japan	1.27	1.4	1.6	79	81.5	83.3	30	52	74
Mexico	2.21	1.85	1.85	73.7	77.2	78.9	9	18	34
Russia	1.34	1.51	1.71	59	64	68.5	19	28	39
South Africa	2.64	2.13	1.85	48.8	55.3	61.2	7	12	14
UAE	2.31	1.95	1.85	77.2	79.6	81.9	1	6	27
UK	1.82	1.85	1.85	77.2	79.6	81.9	24	35	40
USA	2.02	1.85	1.85	75.6	77.9	80.4	18	31	34

[1] Life expectancy at birth, males. The overall trend is similar for females. [2] This is defined as the number of people aged 65 years and over as a share of those people aged 15 to 64 years. [3] 2005-2010. [4] 2025-2030. [5] 2045-2050.

Source: United Nations World Population Prospects 2007.

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Data sources

Department for Work and Pensions
Government Actuary's Department
Office for National Statistics
United Nations

Disclaimer

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