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Managing financial risk of longevity

Abstract. The financial implications of people living longer than expected (so-called longevity risk) are very large. There are different implications for individuals, for households, for insurers, for local and central governments.

Longevity is public goods for local and central government. Longevity is merit goods for insurers. Longevity is club goods for households. Longevity is private goods for individuals.

Addressing longevity risk requires a multi-pronged policy approach. First, governments, local and central, should acknowledge the significance of longevity risk. Second, this risk should be appropriately shared between individuals, households, insurers and the government. Third, financial risk of longevity should be transferred to those that are better able to manage it. Moreover, longevity risk is a long-tailed risk. However, there is a limit to the number of capital market participants that are willing to provide long-term risk transfer solutions.

In the paper there are highlighted a number of instruments for management financial risk of longevity. All participants in management financial risk of longevity need to:

- acknowledge their exposure to longevity risk,
- put in place methods for better risk sharing between governments, insurers, households and individuals,
- promote financial innovations for the transfer of longevity risk,
- provide better information on longevity and better education on old age finance.

In sum, better recognition and mitigation of longevity risk should be undertaken now, including thorough risk sharing between individuals, households, insurers and government through the development of a liquid longevity risk transfer market. Longevity risk is already on the doorstep and effectively addressing it will be the more difficult, the longer remedial action is delayed.

Keywords: risk management, longevity, household finance

Introduction

Life expectancy at birth rose rapidly during the last century due to a number of factors, including reductions in infant mortality, rising living standards, improved lifestyles and better education, as well as advances in healthcare and medicine.

The main source of longevity risk is the discrepancy between expected and actual life spans, which has been large and one-sided. Forecasters, regardless of the techniques they use, have consistently underestimated how long people will live. These forecast errors have been systematic over time and across population.

Longevity began increasing around 1400 and again around 1650 among European nobles. Declines in violence contributed to some of this increase, but the majority must reflect other changes in individual behavior (Cummins, 2014).

From a life of 24 years expected at birth in the year 1000 in Western Europe, the Western Offshoots and Japan, a figure of 36 years is estimated for the year 1820, reaching 46 in 1900, 66 in 1950 and 78 at the turn of the century.

G-20 countries are confronted with a variety of challenges associated with population ageing, reflecting in part two long-term demographic trends: increasing longevity, reflected in rising life expectancy at age 65, and low and declining fertility rates. Two broad consequences follow from these trends in population ageing. First, as individuals spend a longer period of time in old age living on retirement, their retirement consumption needs will be greater, in large part because the period of time spent in retirement is increasing, but also because of rising health care expenditures, given the relatively strong correlation between age and spending on health care. Consequently, individuals' replacement income needs relative to lifetime income will grow, unless individuals extend their working age. Thus individuals may need to increase their savings to maintain their retirement incomes at adequate levels. Second, ageing and related pressures also highlight the importance of improving the quality of retirement savings, especially in order to better manage risks associated with longevity, investment and biflation, as well as the high and rapidly escalating health care costs in Poland.

As outlined above, the economic and financial challenges associated with population ageing have continued to grow. The dynamics of mortality over the last fifty years shows a consistent pattern across all high-income economies. In particular, data show:

- an increase in life expectancy at old ages (65 years and older),

- an increase in the mode of the age of death distribution,
- a decrease in mortality rates at old ages (Visco, 2006).

Human longevity is determined by:

- genes,
- nutrition,
- lifestyle,
- environment,
- socioeconomic status.

Genes account for about 25% of what determines human longevity. Historical mortality tables imply a 12% increase in age 65 male life expectancy over 9 years in the UK.

Table 1. Life expectancy at 65 in the UK

Period	Male	Female
2005	19.3	22.3
2008	20.8	23.0
2011	21.2	23.0
2014	21.6	23.5

Source: National Statistical Office, London, 2016.

Variations across different sub-populations are small.

Table 2. Unisex life expectations in some sub-population

Unisex life expectancy	Life expectancy at 65	Life expectancy at 80
Total	21.0	9.1
Females only	22.2	10.0
Souses only	22.6	10.3
Ill health retirees	16.2	7.2

Source: National Statistical Office, London, 2016.

In Poland the average life expectancy was 66 years for men and 74.4 years for women in 1980, and 73.8 for men and 81.6 for women in 2014. Life expectancy's increase is a result of falling infant mortality rate and improving quality of life (Bojar, 2015).

To achieve the necessary progress in management of financial risk of longevity we need to overcome the following barriers:

- fatalism,
- explicit and implicit prejudice,
- reluctance to address complexity,
- narrowness of vision,
- short-termism,
- funding constraints (Kirkwood, 2015).

The issues related to ageing are relevant for all countries, and are not going to fade away. On the contrary, these tend to be cumulating risk, and with time may well exacerbate a number of related social, economic and financial challenges (Groome et al., 2006).

The paper is briefly outlined as follows. Section 1 is an analysis of life expectancy at birth as public goods. Section 2 shows how longevity risk transforms into public programs of merit goods distribution. Section 3 demonstrates the arguments to see longevity risk as club goods. Section 4 describes recent trends in life expectancy at older ages. This is private goods. Conclusions points complexity and dynamism of longevity financial risk management.

1. Financial longevity risk management as public goods

While the need to manage investment risk has been a focal point, there is now a growing awareness of the need to manage longevity risk. This growing awareness is predicated on employers' and individuals' increase in exposure and it is rooted in changing demographics, a shift in who bears the responsibility of sufficient retirement income, uncertainty of government benefits and economic volatility. Insurers' experience with underwriting products to longevity risk makes them a natural fit to fill the growing demand for longevity protection. However, this new growth opportunity also exposes them to additional risk and challenges that will need to be appropriately controlled.

A key driver in the growing need to address longevity risk is the increasing percentage of people that are approaching or entering retirement. The most commonly used indicator for analyzing mortality is life expectancy at birth: the mean number of years that a person can expect to live at birth if subjected to current mortality conditions throughout the rest of his or her life.

Table 3. Life expectancy at birth in Poland (1990–2013)

M 1990	M 2000	M 2010	M 2011	M 2012	M 2013	F 1990	F 2000	F 2010	F 2011	F 2012	F 2013
66.3	69.6	72.2	72.5	72.6	73.0	75.3	78.0	80.7	81.1	81.1	81.2

Source: Eurostat, Brussels, 2015.

There are several philosophies to model and forecast the age distribution of death. Booth and Tickle (2008) distinguish extrapolation, expectation, and explanation approaches.

Extrapolation covers all attempts that project future rates based on extrapolation on historical data. Expectation involves either the forecaster or consulted experts making assumption about future levels or trajectories of mortality, often based on biomedical considerations. The practice of building scenarios, assuming upper limits of life expectancy, convergence to low-mortality groups, or including theoretical knowledge on human aging are examples of the expectation approach. Explanation also relies on external knowledge, by including determinants of mortality such as smoking and obesity in the projection model.

Caution is needed when applying these models:

1. Expectation is not generally a good basis for mortality forecasting as expectations are invariably conservative.
2. Explanation, these are structural or epidemiological models of mortality derived from certain causes of death with known determinants. Decomposition by cause of death poses problems and is subject to data difficulties. However it can give a better understanding of the factors behind overall changes in mortality.
3. Extrapolation is the most advanced in mortality forecasting. The extrapolative models can be either deterministic or stochastic. Since longevity has become uncertain, it is better to use the stochastic approach to calculate probability distributions rather than point estimates.

This aggregate risk of longevity cannot be diversified. The International Monetary Fund (*Global...*, 2012) calculated that if everyone in 2050 lived just three years longer than is now expected – three years being the average underestimation of longevity in the past – society would need extra resources equal to 1–2% of GDP per year.

A three-pronged approach should be taken to address longevity risk. Measures to be taken include: 1) acknowledging government exposure to longevity

risk and implementing measures to ensure that it does not threaten medium- and long-term fiscal sustainability; 2) risk sharing between governments, private pension providers and individuals, partly through increased individual financial buffers for retirement, pension system reform and sustainable old-age safety nets; 3) transferring longevity risk in capital markets to those that can better bear it.

2. Financial longevity risk management as merit goods

Longevity risk is the risk that future outcomes in mortality and life expectancy will turn out different to expectations. Longevity risk manifests as either an idiosyncratic or specific risk unique to each individual or aggregate risk which is merit goods.

Broadly, there are three sources of such merit goods: social security, employer-sponsored plans and actual annuity contracts. However, the annuity market remains small relative to the magnitude of risk that individuals are exposed to. Several impediments have led to this under-annuitization. First, for annuity providers, the pricing of such products can be an onerous task. They are exposed to substantial mispricing risk which is mostly due to asymmetric information, as those exposed to higher risk will be more willing to seek annuities, but insurers will not be able to distinguish between high-risk and low-risk types. The extent of adverse selection adds to the cost of annuities, making them unattractive to low-risk individuals. Third, the demand for annuities is further tamed by retirees' bequest motives, the reluctance to lose discretionary control, etc. (Roy, 2012).

Over the last couple of decades there have been unprecedented, and to some extent unexpected, increases in life expectancy which have raised important concerns for retirement savings and for the affordability of defined-benefit pension plans. The response of governments has been to decrease the benefits of state pensions, and to give tax and other incentives for individuals to save privately, through defined contribution pension schemes.

There are several ways in which the agents react to shocks to life-expectancy. First, since longevity risk is realized slowly over the life-cycle, agents optimally save more throughout the life-cycle in response to an improvement in longevity. Second, when faced with large improvements in life-expectancy individuals decide to retire later, even though this entails a utility cost. The individuals who

expect to live longer and who have higher lifetime earnings, save more (Cocco, Gomes, 2011).

Table 4. Life expectancy at age 65 in years 1990–2013 in Poland

M 1990	M 2000	M 2010	M 2011	M 2012	M 2013	F 1990	F 2000	F 2010	F 2011	F 2012	F 2013
12.4	13.5	15.1	15.4	15.4	15.5	16.2	17.5	19.5	19.9	19.8	19.9

Source: Eurostat, Brussels, 2015.

Life expectancy at 60 for 195 countries shows that Poland with its 21 years is between leaders such as: Japan (26 years), Italy, Spain, France, Canada (25), and Chad (15), Mongolia (16), Afghanistan (16), Nigeria (16). So we are challenged by longevity risk as the risk that the individual will outlive the total income that can be received from their retirement assets (*Better...*, 2015).

In general, pension plans de-risk their portfolios by transferring longevity risk through a buy-out, buy-in or longevity insurance transaction with a counterparty. In this case, the pension plan would be a buyer of longevity risk protection and the counterparty (insurer or bank) would be a seller of longevity risk protection. Insurers also enter agreements with reinsurers to assume part of their longevity risk. In this case, the insurer would be the buyer and the reinsurer would be the seller. Longevity swap participants usually include (re)insurers and banks as either buyers or sellers.

A buy-out involves the sale and transfer of all of a pension plan's assets and liabilities in return for a single premium payment. Insurers usually issue a group annuity contract as part of a buy-out. This transaction provides the insurer with complete ability to control and manage the underlying assets. However, it also leaves the insurer exposed to all asset related risks, such as investment, credit and inflation risk, as well as longevity risk.

A buy-in transaction allows for more flexibility so that the underlying assets remain with the pension plan manager, who pays a single premium in exchange for periodic payments that match those of its pension obligations. The insurance company issues an annuity that kept on the pension plan's financial books and provides the retirement income benefit. A buy-in provides for partial risk transfer, with the buyer retaining liability for ultimate payment to annuitants.

Longevity insurance (longevity swap) replaces the unknown cost of the future obligations with the purchase of a known liability. The buyer of longevity

risk protection pays a fixed periodic premium based on mortality assumption to the swap counterparty. The swap counterparty in turn pays a floating premium to the buyer of longevity risk protection based on the difference between actual and expected mortality experience. An index swap is an emerging type of longevity swap in which mortality rates are based on the experience of an index rather than the portfolio (Obersteadt, 2013).

3. Financial longevity risk management as club goods

Longevity risk and related capital market solution have grown increasingly important in recent years, both in academic research and in the markets. These included:

- design and pricing of longevity bonds and other longevity-linked products,
- design and pricing of longevity-linked derivatives,
- pricing longevity risk,
- the pricing of longevity-related guarantees,
- the pricing of life settlements,
- longevity and mortality indices,
- securitization of longevity risk,
- management and hedging of longevity risk,
- mortality modeling, mortality rates at different ages for different future years,
- multi-population mortality modeling,
- longevity risk and financial innovation,
- reverse mortgages,
- longevity risk in investment portfolios,
- longevity risk in pension plans and pension systems (Tan et al., 2015).

All this research focuses attention on the role of longevity risk aversion in determining optimal consumption and spending rates during a retirement period of stochastic length. By longevity risk aversion one can mean that different people might have different attitudes toward the “fear” of living longer than anticipated and possibly depleting their financial resources. Some might respond to this economic risk by spending less early on in retirement, whereas others might

be willing to take their chances and enjoy a higher standard of living while they are still able to do so.

Staying healthy comes up with three reasons. First, more than ever, older people can drive or have access to transportation, and their homes are more friendly to aging. There are fewer stairs and bathrooms can be modified for easier use, for example. That makes getting around and being able to take care of yourself easier.

To a financial economist, the optimal retirement consumption rate, asset allocation (investment) and product allocation (insurance) are complicated functions of mortality expectations, economic forecasts, and the trade-off between the preference for retirement sustainability and the desire to leave a financial legacy (bequest motive) (Milevsky, Huang, 2011).

The key variable to any pension reform is effective government, which is a prerequisite for well-run pensions, however they are organized. It is not possible to get government out of the pension business. The state pension should be optimized, not minimized. From economic point of view there is no one and only solution. That being the case, the right choice for a country is that which accords best with the political economy of effective reform. This, in turn, will depend on prerequisites for pension reform.

Table 5. Prerequisites for pension reform

Prerequisites	State	Private
Public		
Fiscal sustainability of state scheme	V	
Political sustainability of pension reform package	V	V
Administrative capacity to enforce taxes/contributions	V	V
Capacity to maintain macroeconomic stability	V	V
Effective regulatory capacity		V
Private		
Sufficiently well-informed population		V
Financial assets		V
Financial markets		V
Adequate private-sector capacity		V

Source: Barr (2002), p. 27.

4. Financial longevity risk management as private goods

In this paper, the author focuses on aggregate longevity risk, the risk that people on average live longer than expected. Individuals face an individual or “idiosyncratic” longevity risk that may cause them to outlive their financial resources, sometimes referred to as “retirement ruin”.

Individual longevity risk management needs transparency of data. Data transparency can be thought as the availability of comprehensive, comparable, reliable, timely and relevant data to public. The advantages of transparent and disaggregated demographic data are many fold. Such data would: 1) contribute to the smooth functioning of economies via evidence-based policy-making predicated on reliable data, which objectively depict demographic conditions; 2) reduce data uncertainties for analysis and thereby improve the assessment of economic and financial risk of longevity; 3) promote credibility of policy makers and encourage informed public-policy debate and 4) provide an objective basis to other social actors accountable (Kostroch, Ugazio, 2016).

The results of a survey of over 3,500 individuals in Great Britain questioned in 2005 on how long they expected to live are presented in Table 6.

Table 6. Overall averages of age to which people will live

	Population estimate	Self-estimate	GAD current	GAD forecast
Males	77.07	78.52	79.64	83.17
Females	79.45	80.30	82.76	86.35
Total	78.37	79.48	81.34	84.90

Source: O’Brien, Fenn, Diacon (2005), p. 19.

The first column is the overall averages of the age to which people expect those of the same age and sex to live. The second column is their answer for themselves. The third and the fourth columns are GAD current and GAD forecast data.

On average (O’Brien et al., 2005, p. 21), people under-estimate how long they are likely to live, for males it is 4.62 years, for females 5.95 years. The under-estimation is still significant in their 60s: the under-estimation is 2.83 years for males and 4.62 for females.

Individual people are optimistic: they will live longer, on average, than people of their own age and sex: by 1.19 years (males), 0.76 years (females).

Private longevity risk sharing is limited to current savers. No insurance against risks realized at start of adulthood - e.g. changes in longevity (Bohn, 2009). If you are currently 65 years of age, there is a 10% chance you will live into your 90s. Planning for a “typical” 25 years retirement might mean you will outlive your savings.

Table 7. Chances for women aged 65 in the UK to live longer

If you are currently	50% chance past	25% chance past	10% chance past
65	85	91	96
75	88	92	96
85	92	94	98

Source: Williams (2015), p. 5.

Table 8. Chances for men aged 65 in the UK to live longer

If you are currently	50% chance past	25% chance past	10% chance past
65	82	89	93
75	86	90	94
85	91	93	96

Source: Williams (2015), p. 5.

Table 9. Average annual growth rates in life expectancy at ages 65, 75, 85 and 95 in the UK from 1981 to 2013 (%)

Life expectancy at age	Males	Females
65	1.2	0.7
75	1.2	0.8
85	1.0	0.7
95	0.3	0.2

Source : *Recent...* (2015), p. 7.

In order to fully understand trends in life expectancy it is necessary to understand trends in age-specific and cause-specific mortality as well. Life expectancy at older ages has been upwards. Period expectation of life at a given age for an area in a given time period is an estimate of the average number of years

a person of that age would survive if he or she experienced the particular area's age-specific mortality rates for that time period throughout the rest of his or her life. The figure reflects mortality among those living in the area in each time period, rather than mortality among those born in each area. It is not therefore the number of years a person in the area in each period could actually expect to live, both because the death rates of the area are likely to change in the future and because many of those in the area may live elsewhere for at least some part of their lives.

People under-estimate how long they might live for by between 5 to 8 years. In the next 10 years life expectancy is likely to increase by 19% for people aged over 65 and by 40% for people over 85.

Life expectancy today is significantly impacted by our health, wealth and lifestyle. While male and female life expectancy had increased over the past two decades, it had increased less for those in the lowest social classes than for those in the highest social classes. Life expectancy at 65 was around 4 years higher on average for those in the highest social class than it was for those in the lowest social class.

Older people will die of different things to previous generations, as health education and medical advances lead to fewer cases of circulatory diseases and a growth in age related non-communicable diseases such as dementia (*Tomorrow's...*, 2016).

If we are healthy, at the wealthy end (of the spectrum) we need to add four years to the average (life expectancy), if we are unhealthy, at the less wealthy end of the spectrum, subtract six years.

In an environment of lower and more stable inflation, lower nominal investment returns and lower real and nominal interest rates, actuaries' attention is increasingly focused on mortality rates. This is not just because the relative importance of mortality assumptions increases against a backdrop of lower interest rates, but also because those mortality rates have changed very radically.

One could regard these sea changes as actuaries and insurers returning to their proper historical and economic role – the transfer of risk, as opposed to the management of savings. If actuaries want to keep their position in this new era of financial services, they must re-learn some neglected skills for handling mortality rates and longevity risk (Richards, Jones, 2004).

Conclusion

Longevity risk is already on the doorstep and effectively addressing it will be the more difficult, the longer remedial action is delayed. People living longer is now very desirable and has improved individual welfare. However, there is a need in culture of longevity risk professional management.

Life expectancy at 60 is the average number of years that a person at that age can be expected to live, assuming that age-specific mortality levels remain constant. This is a better estimate of survival within the adult life course than life expectancy at birth. Life expectancy at birth is hugely influenced by high levels of infant mortality and therefore tell us little about the survival of adults.

It is recommended to:

- base important decisions not on a single projection model but using complementary projections, based on different approaches, including a stochastic two-three-factor time-series model,
- present uncertainty estimates and communicate about uncertainty, including uncertainty of the choice of approach, and
- carefully monitor current developments in mortality, healthcare and other important determinants so that change can be quickly recognized (Peters et al., 2012).

Demographic ageing is certainly a major challenge for societies today. While demographics may not be inverted nor corrected (with reasonable costs), labor markets and pension system need to be flexible in order to adapt to the changing demographics. Certainly, the “static trichotomy in human life” – education until 20 to 25, employment until 60 to 65, and ever increasing time as retirees thereafter – needs to be reconsidered. However, it takes a lot of effort to convince people today that the almost unnoticeable, but ongoing, irreversible changes in demographics need action today.

The individual longevity risk management is likely to become more important. More responsibility is being shifted to individuals:

- employers continue substituting defined contributions for defined benefits pensions, shifting decisions about securing retirement income to individuals,
- public pension benefit levels are declining relatively, shifting more of the retirement income burden to individuals,

- the partial “privatization” of public pension system is a further likely shift of retirement income decisions to individuals (Steinmann, Scotti, 2007).

People with good genes who have lived in beneficial surroundings – good nature and nurture – are overrepresented in older populations. The main reason is that the three biggest killers of older people – heart disease, cancer, and stroke – are being treated more successfully.

The mega-trend of global aging opens up important new investment opportunities for investors. Aging populations are now a phenomenon across both developed and emerging markets, and the trend is accelerating. Investors should consider capitalizing on the opportunities arising from this unprecedented global demographic shift.

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Zarządzanie ryzykiem długowieczności

Streszczenie. Finansowe następstwa braku profesjonalnego zarządzania ryzykiem długowieczności są znaczne. Fakt, że ludzie masowo myślą się o 3–5 lat we własnych ocenach długości swego życia, ma duże znaczenie dla bliskich, gospodarstwa domowego, dla ubezpieczycieli, lokalnych i centralnych władz. Długowieczność rozpatrywana jako dobro publiczne, dobro użyteczności publicznej, dobro klubowe oraz dobro prywatne pokazuje nową twarz tego złożonego zjawiska demograficznego. Redukcja negatywnych następstw urzeczywistniania się ryzyka długowieczności będzie tym trudniejsza, im dłużej będziemy zwlekać z uznaniem istnienia tego typu ryzyka.

Słowa kluczowe: zarządzanie ryzykiem, długowieczność, ryzyko finansowe codzienności