Mortality Assumptions and Longevity Risk
Implications for Pension Funds and Annuity Providers

Chapter 6

Policy options for managing longevity risk

This chapter discusses how pension funds and annuity providers can manage longevity risk and how the regulatory framework can support this effort. Regulators should enable and encourage the management of longevity risk as they have an interest to ensure that pension funds and annuity providers will be able to meet future payment obligations to retirees.

The first step in managing longevity risk is to ensure that pension funds use appropriate and up to date mortality tables that incorporate expected future improvements in mortality and life expectancy and are based on the relevant populations. For the unexpected future improvements in mortality and life expectancy, regulators may want to facilitate capital market solutions to hedge or mitigate this risk using standardised index based longevity hedges that would promote transparent and liquid secondary markets. Governments could also provide a reliable longevity index and mortality projections. Finally governments could assist by establishing capital and funding requirements as well as accounting standards that ensure appropriate valuations and reflect the risks faced.

This chapter discusses how pension funds and annuity providers can manage longevity risk and how the regulatory framework can support this effort.[1] Previous chapters showed that if the assumptions on mortality improvements embedded in the mortality tables commonly used for the valuation of pension and annuity liabilities are not adequate, pension funds and annuity providers face an increased likelihood that they will not be able to meet future payment obligations.

Therefore, the first consideration in managing longevity risk is to ensure that mortality assumptions used account for the expected improvements in mortality and life expectancy. Moreover, mortality tables should also be based on relevant mortality experience and be regularly updated based on this experience.

Secondly, once pension funds and annuity providers have ensured the adequacy of their mortality assumptions and have aligned them with current expectations about future mortality improvements, they then need to address the potential financial impact of unexpected increases in longevity beyond the current expectations and determine if and how to mitigate this risk.[2] The financial impact of these unexpected improvements in mortality can also be quite significant, and pension funds and annuity providers must then decide how much of this risk they are willing or able to bear. The risk beyond their capacity must be transferred or mitigated in some manner. The regulatory framework should encourage the recognition of this risk as well as enable the effectiveness and availability of mechanisms for reducing longevity risk exposure in order to encourage the management of longevity risk and ensure the sustainability of pension funds and annuity providers.

Therefore, the regulation needs to ensure that longevity risk is recognised and provide a framework that encourages and facilitates the active management of the risk. This should be done based around two main objectives. The first objective is to ensure that pension plans and annuity providers have addressed the costs of aligning with the current expectations of life expectancy by using mortality assumptions which are based on relevant and recent mortality data and account for the future expected trend in mortality. Secondly, incentives for the management of this risk also need to be put in place, with regulation encouraging and facilitating the measurement and mitigation of longevity risk coming from the uncertainty around these assumptions. The latter objective, however, is not possible unless the first objective is met. Longevity risk will not be able to be accurately measured or appropriately managed unless the mortality assumptions are in line with reasonable expectations. The mortality assumptions used must therefore be the first focus of policymakers.

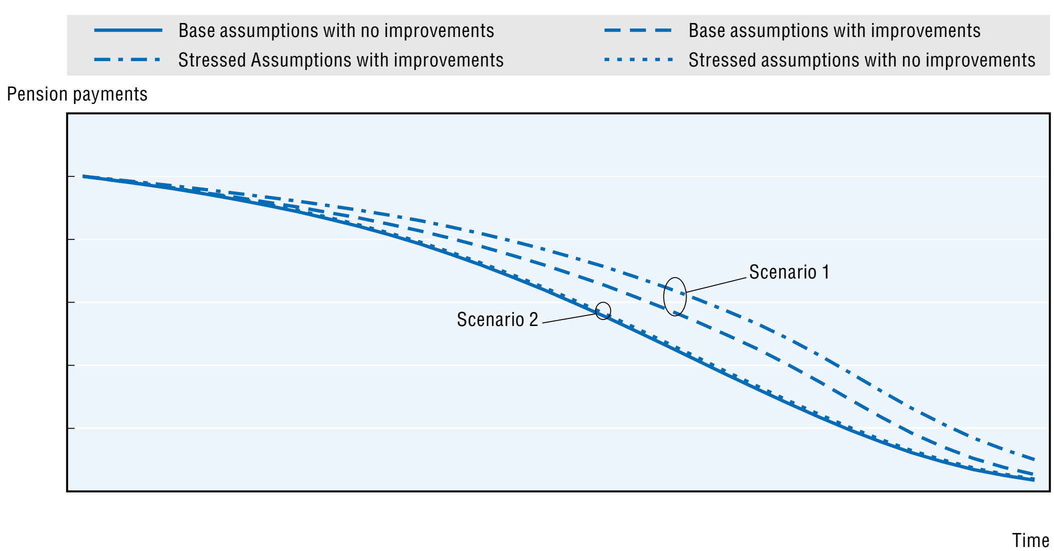
Establish mortality tables which adequately reflect current and future expectations of mortality

Mortality tables used for the valuation of pension and annuity liabilities should reflect reasonable expectations with respect to current and future mortality. The importance of starting with reasonable mortality assumptions can be illustrated with a simple example. Imagine a pension fund that has up-to-date mortality assumptions that account for the expected improvement in mortality wants to assess the financial impact of overestimating its mortality assumptions by 25%. This overestimation would mean a realised life expectancy higher than provisioned for and an increase in the amount of future pension payments to be made. The expected pension payments and the increase in these payments due to an overestimation in mortality are shown for Scenario 1 in the figure below, which clearly demonstrates the significant financial impact this longevity risk could have.

Now imagine that the pension fund's starting mortality assumptions fail to include mortality improvements. As demonstrated in the previous section of the document, not accounting for future improvements has a significant impact on the present value of expected payments and can result in an underestimation of these liabilities by over 10%. However, Scenario 2 shows that not only are the expected future pension payments underestimated, but the estimated financial impact of overestimating these assumptions by 25% is unrealistic compared to the actual financial impact shown by the difference between the two lines in Scenario 1.

The use of unreasonable mortality assumptions therefore not only increases the probability that future payments are not properly reserved for, but also that the fund is underestimating its exposure to longevity risk and will not take appropriate actions to manage this risk. The fund in Scenario 2 is not likely to deem its exposure to longevity risk significant enough to consider mitigation, when in reality its actual exposure to longevity

Figure 6.1. **Illustration of expected pension payments using different mortality assumptions**



risk is much greater than the fund in Scenario 1. Furthermore, even if it did want to hedge its risk, any solution to do so with a third party is likely to be more expensive than the pension fund is willing or able to pay, as the price to hedge the longevity would be based on the assumptions accounting for mortality improvements in Scenario 1.

This example illustrates the importance of setting reasonable mortality assumptions in order to avoid a significant shortfall in provisions for future pension payments as well as to have the ability to make appropriate decisions regarding the management of the risk. The regulatory framework therefore needs to set the standards for assumption setting in order to subsequently further the goal of the recognition and the active management of longevity risk.

In order to accomplish this goal, there should be clear guidelines regarding the data used as the basis for mortality assumptions. Moreover, assumptions in mortality tables should include expected mortality improvements.

As a starting point, assumptions should be based on mortality data of the country in which they are used. Figures 3.1 and 3.2 in Chapter 3 demonstrated that life expectancy and the evolution of mortality can vary significantly from one country to the next. Mortality assumptions for pensioners and annuitants based on one country's population cannot be assumed to accurately reflect the mortality in another country. This difference stems not only from the social and economic environment in a given country, but also the structure of the pension system itself, which would be reflected in the magnitude of the differences in mortality for the subpopulations of pensioners and annuitants compared to the general population. This is because the proportion of the population covered by private pensions and whether or not the system is mandatory is related to the level of anti-selection experienced, in other words the extent to which individuals with lower mortality and higher life expectancy choose to insure their own longevity. This anti-selection will be larger where private pensions represent a small proportion of retirement income and where this type of longevity protection is voluntary, as the individuals most likely to elect this type of coverage tend to be of a higher socio-economic status than the general population. Income and socio-economic status are correlated with having a higher life expectancy, resulting in a gap between the mortality of the general population and that of the pensioners and annuitants.

With that said, ideally the initial mortality assumptions should be based not only on the mortality experience of the country in question, but also of the subpopulation of pensioners and annuitants themselves, where available, or adjusted to reflect the characteristics of the particular population for which the tables are being used. These adjustments could reflect, for example, the expected mortality of the specific industry in which the pensioners are employed or the socio-economic characteristics of the individuals insured.

Expected improvements in mortality must also be taken into account. The highest assessed shortfall in provisions is for tables which do not account for these improvements. Figures 3.1 and 3.2 in Chapter 3 showed that future mortality improvements are expected to add at least two years to life expectancy on average, with each additional year of life expectancy not provisioned for translating to an expected shortfall in reserves of 3-5%.[3]

Finally, mortality tables should also be regularly updated and based on the most recent experience to ensure that assumptions accurately represent the current mortality level and monitor whether or not experience has been in line with expectations. Encouraging frequent review will also help to avoid significant one-off increases in reserves driven by the update of assumptions as these changes in expectations could be implemented more gradually.

To facilitate the assessment of mortality assumptions, policymakers should also ensure that accurate and timely mortality data are publically available. National statistical institutes should regularly publish population estimations and death statistics so that the mortality of the general population may be assessed. This data should be as granular as possible – by individual age and gender at a minimum – in order to provide a benchmark or basis for mortality assumptions. Data including socio-economic indicators could also be quite useful to assess the general differences in mortality within the same country. Having readily available data allows for academic studies regarding mortality patterns and trends which could lead to a better understanding overall of the potential future evolution of mortality and its drivers. The data and studies can furthermore be used to inform the setting of mortality assumptions by providing a credible basis for model inputs and measuring mortality improvements. The data should be released in a timely manner, as a significant time-lag results in more uncertainty around the current assumptions.

To go even further, cooperation with industry bodies to organise the collection of mortality data from pension plans and insurance companies could allow for the assessment of the mortality for these specific populations. This could lead to the development of more appropriate mortality assumptions for these sub-populations, particularly for smaller plans or portfolios which do not have sufficient experience of their own on which to base assumptions. However this initiative can be costly to organise in the private sector, and as there is a clear benefit that this type of data is made available, the organization of the data collection in the public sector may be more efficient.

Assess the potential impact of unexpected improvements in life expectancy

The risk of having insufficiently provisioned for future improvements in mortality and life expectancy stems from having unreasonable starting mortality assumptions and from the uncertainty surrounding future improvements. The discussion above highlighted the importance of establishing reasonable mortality assumptions for the valuation of and provisioning for future pension and annuity payments.

Once adequate mortality assumptions have been established which reasonably reflect recent mortality experience and the expectations regarding its future improvement, the remaining longevity risk coming from the unexpected increases in life expectancy can be assessed. While the central mortality assumptions can reasonably be estimated using deterministic models, stochastic models are typically more useful for the assessment of the unexpected longevity risk as they are capable of providing probability distributions around the expected value of future mortality rates. Such distributions allow pension funds and annuity providers to quantify the likelihood that their current provisions could be insufficient and what the financial impact of that shortfall could be.

Two stochastic models, the Lee-Carter (LC) model and the Cairn-Blake-Dowd (CBD) model, were implemented in this study for the quantification of the potential shortfall in provisions due inadequate mortality assumptions. These two models can also be used here to demonstrate the potential impact of the additional longevity risk to which pension funds and annuity providers are exposed coming from unexpected improvements in future mortality.

Table 6.1 below shows the financial impact of unexpected improvements in life expectancy at the 95% confidence level as a percentage of liabilities for each age and gender for several countries based on these two stochastic models. This level of confidence means that there should be only a 5% chance that future mortality experience will result in a financial loss greater than the figures given in the table. Therefore, if a pension fund or annuity provider wants to be 95% sure to be able to meet its future payment obligations, it should have this additional amount of funds, or capital, available to cover the excess longevity risk. These figures are based on the population mortality for each country as an illustration of the potential impact. Adjusting the figures to be based on a lower level of mortality, for example to the mortality of a specific insured population, would slightly reduce the magnitude of the results.

The results of this risk assessment are quite dependent on the model being used. We can observe that the Cairns-Blake-Dowd model generally results in a larger estimation of

Table 6.1. **Financial impact of unexpected improvements in life expectancy at the 95% level of confidence as a percentage of pension liabilities[1]**

		Male		Female	
Country	Age	LC	CBD	LC	CBD
Canada	55	2.3%	3.4%	2.3%	2.7%
	65	1.4%	2.2%	1.6%	2.0%
	75	1.4%	2.6%	1.9%	2.5%
Chile	55	6.8%	8.2%	5.4%	6.3%
	65	4.7%	5.2%	4.1%	4.7%
	75	6.1%	5.5%	5.0%	6.2%
France	55	5.3%	6.9%	4.0%	4.9%
	65	3.3%	4.3%	3.1%	3.7%
	75	3.4%	4.8%	3.7%	4.7%
Germany	55	4.3%	6.0%	3.4%	4.3%
	65	2.6%	3.6%	2.4%	3.0%
	75	2.3%	3.8%	2.5%	3.5%
Israel	55	4.7%	5.6%	3.4%	4.5%
	65	3.1%	3.9%	2.5%	3.4%
	75	3.2%	4.6%	2.8%	4.5%
Japan	55	5.1%	6.6%	3.2%	4.0%
	65	3.6%	4.6%	2.7%	3.3%
	75	4.2%	5.5%	3.6%	4.4%
Netherlands	55	4.1%	6.9%	3.9%	4.5%
	65	2.4%	4.4%	2.9%	3.2%
	75	2.0%	5.1%	3.4%	4.1%
Spain	55	7.2%	8.7%	3.7%	5.1%
	65	4.8%	5.7%	2.8%	4.0%
	75	5.2%	6.7%	3.4%	5.3%
Switzerland	55	3.7%	5.5%	3.3%	4.6%
	65	2.3%	3.6%	2.4%	3.4%
	75	2.2%	4.0%	2.7%	4.2%
UK	55	4.6%	6.9%	4.6%	5.4%
	65	3.0%	4.7%	3.3%	3.9%
	75	3.1%	5.5%	3.8%	4.9%
US	55	3.0%	4.0%	3.3%	3.5%
	65	1.7%	2.4%	2.1%	2.4%
	75	1.5%	2.6%	2.4%	2.7%

Source: OECD Calculations

Notes: 1. The table shows the percentage increase in liabilities that can be expected at the 95% confidence level. These calculations are based on 1 000 simulations of future mortality using the two stochastic mortality projection models (Lee-Carter and Cairns-Blake-Dowd), and assuming a discount rate of 4.5% to calculate the annuity value. The calculation for age 55 is based on a deferred annuity commencing payments age 65; calculations for ages 65 and 75 are calculated as commencing immediately.

StatLink http://dx.doi.org/10.1787/888933153712

longevity risk than the Lee-Carter model. This is driven by the tendency of the Lee-Carter model to produce narrower confidence intervals, and has been mentioned as a disadvantage for the use of this model for risk assessment in Chapter 4. Nevertheless, considering the results of the two models here provides a reference for the potential magnitude of the longevity risk coming from unexpected improvements in life expectancy.

Assessing longevity risk using probability distributions from stochastic models provides a way to quantify the risk at a given confidence level. The results from this type of analysis can provide a basis for the pension fund or annuity provider to make a decision regarding its ability to retain the risk or the need to mitigate the risk. This will ultimately be affected by capital constraints – i.e. are there sufficient assets to meet future payment obligations if longevity experience turns out to be at the 95th percentile of what we expect today – or internal risk appetite limits, for example the decision of management to limit the possible losses from changes in longevity experience to a certain amount.

The potential role that regulation can play in encouraging the management of longevity risk

Policymakers can ensure that the regulatory framework encourages the pension or annuity provider not only to assess and evaluate longevity risk, but also facilitates the availability and effectiveness of methods to hedge the excess risk if necessary. Incentives for the management of longevity risk can be addressed through capital and funding requirements as well as through accounting standards. Unless these regulatory standards consistently recognise the existence of longevity risk, pension funds and annuity providers will have little incentive to recognise and manage the risk to which they are exposed.

As such, capital and funding requirements should be reflective of and reactive to the risk profile of the liabilities in order to account for the specific exposure to longevity risk.

Risk-based requirements aim to reflect the underlying risk profile of the concerned entity and would therefore compel it to measure the longevity risk to which it is exposed. Changes to this exposure should have a direct impact on the capital required to support the pension or annuity liabilities. This would provide an incentive to assess how much risk can be retained given any protection mechanisms in place and whether to mitigate excess risk in order to achieve a target level of capitalization or funding, or at least not fall below any minimum limits imposed.

Any measure taken to reduce the exposure to longevity risk should therefore be reflected in the capital requirements. For example, any reduction in risk from business diversification or from directly hedging longevity risk should result in a reduction of the capital requirements. Otherwise the entity will not realise any benefit from the reduction of its risk, even if internal risk measures consider the risk reduction prudent or necessary.

Interactions between risks, and in particular the diversification between risks, should be recognised if such diversification of exposures can reduce the overall risk profile of the pension fund or annuity provider. For example mortality-contingent insurance business which provides payments upon death could offset some of the longevity risk from annuity liabilities, since if longevity increases significantly it could also be expected that mortality claims would decrease. While this offset is only partial due to differences in the age groups and populations covered by the two lines of business, diversification of business mix should be taken into account in assessing the risk profile and therefore the capital or funding requirements of an entity.

Capital requirements should also account for instruments purchased explicitly to hedge longevity risk such as reinsurance or a longevity swap. For example, consider the calculation of capital requirements which is based on a simple formula of a percentage of reserves. As the purchase of a longevity swap would not necessarily impact the value of reserves, it would also not impact the capital requirement. The reduction in risk achieved will therefore not be recognised by regulation and the entity will not be able to use the instrument to manage their longevity risk. Indeed, the entity would be penalised for purchasing such an instrument in the short-term compared to another entity which has not hedged its longevity risk.

Capital and funding requirements need to reflect the full potential impact of longevity risk so that these requirements are reactive to risk mitigating measures which decrease the risk of insolvency. Risk-based requirements for which an explicit charge is imposed for longevity risk and which account for risk diversification would force pension sponsors and annuity providers to address the risk and actively assess their exposure to it.

In addition to capital and funding requirements, however, accounting standards should ensure the appropriate valuation of longevity hedging instruments. If longevity hedges are not appropriately reflected in the balance sheet, pension funds and annuity providers will not be able to use these instruments to hedge their longevity risk.

For example, in some countries insurance companies are not allowed to value longevity instruments at a higher value than the purchase price. Thus, if mortality improves at a higher rate than expected and the pension fund can expect a positive return from a longevity swap, they would not be allowed to recognise this increase in the value of their assets to offset the resulting increase in liabilities. Moreover, for participating policies where annuitants are entitled to a certain part of the annuity provider's unrealised gains, the increase in fair value of the longevity swap could only be partly used to offset the increase in liabilities as a portion of the gains would be paid to the policyholders.

If instruments to hedge longevity cannot be used to offset the increase in liabilities due to decreasing mortality rates, no benefit from the reduction of risk from the hedge will be realised.

External solutions for mitigating longevity risk

The measurement of longevity risk discussed above is the key to determining whether or not the mitigation of the risk is necessary. Once the financial impact of an unexpected increase in longevity has been determined and assessed given the business mix and risk diversifications, the pension fund or annuity provider can then take an informed decision regarding its capacity to retain the longevity risk of its liabilities and its ability to continue managing it internally given the protection mechanisms in place, such as a capital buffer. If the entity is not capable or willing to fully bear this longevity risk, external solutions to mitigate the risk need to be available as an alternative solution.

There are several financial arrangements that allow pension funds and annuity providers to either transfer or hedge longevity risk. For those looking to reduce their exposure to longevity risk, the traditional solution has been to transfer the risk to insurance or reinsurance entities. Several different types of structures for this arrangement are possible. The first type is referred to as a bulk annuity, where both investment and longevity risk are transferred to the third party, and can be done either as a buy-out or buy-in structure. The second type is via a longevity swap, a hedge which transfers only the longevity risk to the third party.

Pension buy-outs and buy-ins

The most common arrangements for transferring longevity risk from pension funds in the private sector have up to now been pension buy-outs and buy-ins. Both of these solutions remove the longevity risk as well as investment risk from the pension fund or plan, transferring these risks to an insurer or reinsurer. These hedges usually cover only the current pensioners and are especially attractive for defined benefit pension plans in termination.

In a pension buy-out, the pension fund and/or plan sponsor hands over all the assets and liabilities of the fund to an external provider. After the conclusion of the contract, the responsibility for making payments to members passes to the provider (typically an insurer or reinsurer) and removes the pension liabilities from the sponsor's balance sheet. While the plan sponsor offloads all risk, this arrangement exposes plan members to counterparty risk, or the risk that the insurer becomes insolvent, as the structure no longer has the same benefit protection mechanisms in place as the pension plan.

In a pension buy-in, the pension fund or plan sponsor retains the liabilities and assets and remains responsible for the payment of pension benefits to members, but effectively insures these payments with an external provider. In exchange for a premium, the provider fully or partially insures the pension plan's liabilities. Thus, in effect, the pension fund buys an annuity contract with an insurance company so that annuity payments coincide with some or all the benefit payments of the pension plan.

While these types of arrangements maximise the risk transfer for the sponsor, both types of contracts tend to require significant upfront premiums, making them a less feasible solution for underfunded plans.

Longevity derivatives

As an alternative to buy-ins and buy-outs, pension funds and annuity providers can retain the investment risk and pass only the longevity risk to a third party through the use of longevity hedges. These instruments can be structured as perfect hedges in bespoke transactions, or they can be based on an objective longevity index. Insurance and reinsurance companies are the usual counterparty in the case of bespoke longevity hedges, which are the most common form of transaction, but capital market solutions using index-based arrangements are also beginning to emerge in practice.

Compared to bulk annuities, longevity derivatives can be a more economical solution to hedging longevity risk as they typically do not require large upfront premiums.

A forward contract is the simplest form of a longevity derivative, and is defined as an agreement to exchange a fixed sum defined at the inception of the contract with a floating amount to be determined based on future mortality experience. These floating amounts can be based on a realised mortality rate ($q_{x,t}$) or survival rate ($_tp_x$) and are referred to as q-forwards and s-forwards, respectively. The fixed amounts are typically based on the expected mortality or survival plus a risk premium. These contracts require no upfront funding and there is no exchange of payments until the maturity of the contract, at which time the payment is the net amount of the fixed and floating payments. With a q-forward, the party agreeing to pay the floating payment benefits if mortality is lower than expected, whereas the party with the fixed payment gains with an s-forward if longevity is higher than expected. Longevity forward contracts can be used as building blocks to construct a more complete hedge of longevity risk by combining them with different ages and durations.

As s-forwards are based on cumulative survival probabilities over *n* years, they are likely to be a better match to hedge pension and annuity liabilities compared to q-forward contracts which are based on one year probabilities of death (i.e. mortality rates) and therefore are subject to significantly more volatility.

Box 6.1. **Hypothetical examples of q-forward and s-forward contracts**

q-forward contract

Consider a 5-year q-forward contract on a population aged between 58 and 60 years at January 1 2010. The cash flows at maturity depend on the average mortality rates of the three ages in 2015, i.e. the average mortality rate of the ages between 63 and 65. The maturity date is January 1 2015 and the notional amount is 1 million. Let q(x,t) be the one-year death probability of an x-year old person in the year t. The relevant one-year death probabilities in 2010 are given in the table below:

Age	q(x,2010)
63	1.80%
64	2.00%
65	2.20%
Average	2.00%

Thus, the average one-year death probability for the given population is 2.00%. Assume that an expected decrease of the mortality rate in the population in question of 1.50% per year, i.e. the best estimate of the one-year death probability is 98.5% of the rate in the previous year. Consequently, the best estimate of q(63,2011), the one-year death probability of a person aged 63 in the year 2011, is 1.773% = 1.80% • 0.985. Therefore, the best estimate of the mortality rate of our group in 2015 is 1.85% = 2.00% • $(0.985\%)^5$.

To determine the fixed payment the forward mortality rate is needed. Assume that the risk premium is equivalent to a decrease of the mortality rate of 1.00% in addition to the expected decrease of 1.50%, equating to an overall improvement in mortality of 2.5% per year to be used for calculating the fixed rate. Therefore, the forward mortality rate of the group in 2015 is 1.76% = 2.00 • $(0.975\%)^5$. Thus, the fixed rate is 1.76% in our q-forward and the risk premium is equal to 0.09% because 1.85% – 1.76% = 0.09%.

The price of the q-forward at any time is the net value of the present values of the two expected payments, in other words the difference between the present value of the fixed payment and floating payment. At inception, the present value of both payments is the same (ignoring any bid-offer spread) and the present value of the fixed payment is calculated by:

PV = 1 000 000 • 1.76% / $(1 + 3\%)^5$ = 15 182, where we have assumed a risk-free interest rate of 3%.

The cash flows (or settlements) at each year of the contract are shown in the table below and are calculated as the difference between the realised and fixed mortality rates multiplied by the notional amount. The final payments depend on the outcome of the realised mortality rate. The pension fund or annuity provider receives payments if the realised mortality rate is below the fixed rate and makes payments otherwise.

Realised mortality rate	Fixed mortality rate	Notional	Settlement
1.56%	1.76%	1 000 000	200 000
1.66%	1.76%	1 000 000	100 000
1.76%	1.76%	1 000 000	0
1.86%	1.76%	1 000 000	- 100 000
1.96%	1.76%	1 000 000	- 200 000

Box 6.1. **Hypothetical examples of q-forward and s-forward contracts** *(cont.)*

s-forward contract

Consider next an s-forward contract with a term of three years and a notional amount of 1 million, based on males aged 65 years at inception of the contract (1 January 2011). Thus, the underlying survival rate is the three-year survival probability of a person aged 65 at inception; i.e. the probability that a person aged 65 survives three more years. Let q(x,t) be the one-year death probability of a person aged x in the year t, i.e. the probability that an x-year old person dies in the year t, and let p(x,t) be the corresponding one-year survival probability such that p(x,t) = 1 – q(x,t).

Assume an expected mortality improvement of 2% for each year and age. Thus, if the one-year death probability of a person aged 65 in the year 2010 is 1.80%, the best estimate of the one-year death probability of a person aged 65 for the year 2011 is 1.76% = 0.98 • 1.80%. The table below shows the best estimate of the one-year death probabilities. The one-year death probabilities relevant for the s-forward are in bold.

Age x	q(x,2010)	q(x,2011)	q(x,2012)	q(x,2013)
65	1.80%	**1.76%**	1.73%	1.69%
66	1.90%	1.86%	**1.82%**	1.79%
67	2.00%	1.96%	1.92%	**1.88%**

The corresponding one-year survival probabilities can be found in the next table. The three-year survival probability can be calculated as the product of these one-year survival probabilities, such that: 0.9664= 0.9824 • 0.9818 • 0.9812. Therefore, the best estimate of the three-year survival probability is 96.64%. This means that 96.64% of the given population (males aged 65 years) is expected to survive to the end of the year 2013.

Age x	p(x,2010)	p(x,2011)	p(x,2012)	p(x,2013)
65		**98.24%**		
66			**98.18%**	
67				**98.12%**

Ignoring the risk premium for simplicity, the fixed payment is based on a survival rate of 96.64%. The table below shows the net settlement of this s-forward, where the exact cash flow depends on the realised survival rate. If the realised survival rate is above the fixed one, the pension fund or annuity provider will receive the net payment.

Realised survival rate	Fixed survival rate	Notional	Settlement
96.44%	96.64%	1 000 000	- 200 000
96.64%	96.64%	1 000 000	0
96.84%	96.64%	1 000 000	200 000

Source: LLMA 2010a, 2010b

One of the more commonly used longevity derivatives is a longevity swap, which is essentially a series of forward contracts combined. In a longevity swap, the party seeking to hedge their longevity risk pays a series of fixed amounts for the duration of the contract ('fixed leg') based on pre-specified survival rates in exchange for receiving a series of variable payments ('floating leg') which are linked to actual mortality experienced. The net payments are settled at regular intervals, and the fixed plus variable payments should track closely with the actual pension or annuity payments being made, thereby providing a hedge for the longevity risk of the pension fund or group of annuitants. Box 6.2 provides an example of the structure and payments for a bespoke longevity swap based on survival rates.

Box 6.2. **Hypothetical example of a longevity swap**

Consider a hypothetical example of a homogeneous pension plan with 100 000 members aged 65 years as of January 1st. Each month, the pension plan has to pay €10 to each member of the plan. The pension plan wants to hedge its exposure to longevity risk and enters the fixed side of the longevity swap based on survival rates with starting date of January 1st. The table below shows the cash flows for the first four months.

Assume that after one month, every pension plan member is still alive. Therefore, the pension plan has to pay €1 000 000 to the plan members, whereas the predefined cash flow is € 950 000 as 5 000 pensioners were expected to die. Therefore, the pension plan has to pay more money to the members than expected, but it receives this extra money from the hedge provider. The amount received from the hedge provider is €50 000.

Assume that after the second month, 5 000 pension members have passed away and so the pension plan has to pay € 950 000 to the surviving pensioners. However as only 93 000 pensioners were still expected to be alive, the pension plan receives € 20 000 from the hedge provider, which is the difference between the actual payments made and the expected payments.

Assume that between the second and the third month, another 5 000 people pass away making the actual pension payment € 900 000 compared to an expected € 910 000 leading to fewer payments to the pensioners than planned for. Therefore, the pension plan has to pay € 10 000 to the hedge provider.

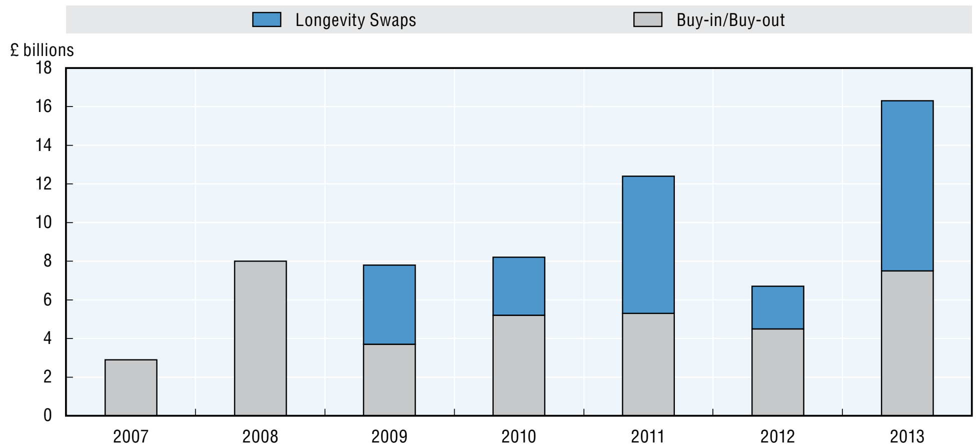
Date	Actual Pension Payment	Predefined cash flow	Payment to the pension plan
Feb. 1st	1 000 000	950 000	50 000
March 1st	950 000	930 000	20 000
April 1st	900 000	910 000	-10 000
May 1st	900 000	890 000	10 000

Longevity swaps have been increasing dramatically in popularity compared to bulk annuity structures since 2009, as shown Figure 6.2 below for the United Kingdom. The year 2013 saw swaps transactions surpassing buy-ins and buy-outs in the United Kingdom.

Longevity swap deals totalled over GBP 70 billion at the end of the third quarter of 2014, with the transactions listed in the Table 6.2 below. The vast majority have been bespoke transactions based on the actual mortality of the pensioners, though two notably large index-based transactions (Aegon with Deutche Bank and Delta Lloyd with RGA Re) have been based on Dutch population indices.

Insurers and reinsurers are capable of taking on longevity risk for bespoke transactions because this type of risk forms a core part of their business and expertise. However, they may be limited in their capacity to absorb longevity risk. While exposure to longevity risk can be partially offset by the exposure to mortality risk coming from life insurance products sold by insurers, the life insurance and annuity portfolios often cover different population

Figure 6.2. **Volume of longevity transactions in the United Kingdom**



Source: Hymans Robertson (2014)

StatLink http://dx.doi.org/10.1787/888933153532

Table 6.2. **Longevity Swap Transactions as at Q3 2014**

Organization	Date	Provider	Value (GBP bn)
Delta Lloyd	Q3 2014	RGA Re	12
Pheonix Group	Q3 2014	Pheonix Life	0.9
AXA France	Q3 2014	Hannover Re	EUR 0.75 bn
BT Pension Scheme	Q3 2014	Prudential	16
Aviva	Q1 2014	Swiss Re/Munich Re/SCOR	5
BAE Systems	Q4 2013	Legal & General	1.7
AstraZeneca	Q4 2013	Deutsche Bank/Abbey Life	2.5
Carillion	Q4 2013	Deutsche Bank/Abbey Life	1
Aegon	Q4 2013	Societe General CIB/SCOR	1.4
Bentley	Q2 2013	Deutsche Bank/Abbey Life	0.4
BAE Systems	Q1 2013	Legal & General	3.2
LV	Q4 2012	Swiss Re	0.8
Azko Nobel	Q2 2012	Swiss Re	1.4
Aegon	Q1 2012	Deutsche Bank	12
Pilkington	Q4 2011	Legal & General	1
British Airways	Q4 2011	Goldman Sachs/Rothesay Life	1.3
Rolls Royce	Q4 2011	Deutsche Bank/Abbey Life	3
ITV	Q3 2011	Credit Suisse	1.7
Pall	Q1 2011	JP Morgan	0.1
BMW	Q1 2010	Deutsche Bank/Abbey Life	3
Berkshire	Q4 2009	Swiss Re	1
RSA Insurance	Q3 2009	Goldman Sachs/Rothesay Life	1.9
Babcock	Q3 2009	Credit Suisse	1.2
Canada Life	Q3 2008	JP Morgan	0.5
Lucida	Q1 2008	JP Morgan	0.1

Source: Artemis

StatLink http://dx.doi.org/10.1787/888933155985

groups so this arrangement is not a perfect hedge and there is residual longevity exposure. Furthermore, with the trend towards risk based requirements and the increased emphasis on enterprise risk management, the capacity for the (re)insurance industry to absorb the increasing demand for longevity protection is limited. These capacity constraints therefore need to be addressed in order to ensure a supply of longevity protection sufficient to meet the demand. Given the potentially limited capacity of the insurance market to absorb longevity risk, another solution may have to be found.

Capital markets have the potential to provide the additional capacity for longevity risk and offer some relief from the concentration in the supply of longevity protection. One of the main incentives for capital markets investors to invest in longevity risk is that longevity seems to be largely uncorrelated with typical market risks, and therefore could offer a diversifying investment opportunity.

However, bespoke transactions pose several problems for the capital markets investor. First of all is the lack of transparency of such a transaction, where the insurer or pension fund possesses asymmetrical information regarding the mortality experience of the population being hedged. Secondly, a bespoke transaction can be extremely time-consuming to implement as the investor must assess the specific longevity characteristics of the portfolio or fund in order to price the transaction. Finally the long-term nature of longevity risk would expose the investor to a very long-tailed investment with a duration upwards of fifty years. These characteristics are not conducive to the creation of an attractive investment vehicle, for which cash flows would need to be based on an easily understood and independent measure, be transacted in a timely manner and reflect a duration more in line with the preferred investment strategy of the investor.

Index-based longevity hedges could address the above shortcomings and provide a potentially attractive investment for capital markets investors. Rather than payments being based on the actual underlying mortality of the plan or portfolio being hedged as in a bespoke transaction, an index-based transaction is based on the mortality of an independent mortality index, such as the mortality of the general population of the country. This structure would address the concerns of capital markets investors as cash flows would be based on an independent longevity index with clearly defined indicators, providing full transparency for the investor with respect to the calculation of payments. As cash flows would not be based on the mortality of the portfolio itself, the counterparty does not need to have any information about the portfolio and a transaction could be executed more quickly. Finally there can be more flexibility around the design of the structure of the transaction so the duration of the instrument could be defined for a shorter time horizon and the tail risk limited.

Nevertheless, as opposed to a bespoke transaction, with an index-based hedge the pension fund or annuity provider would have to accept to be exposed to some remaining residual and tail risk, primarily that coming from basis risk. Basis risk exists as the mortality on which the index is based is not guaranteed to evolve in the same way as the mortality of the portfolio or fund being hedged, so there can be some discrepancy between the cash flows the hedger receives from the investors and the payments to be made to the pensioners.

The main sources of basis risk stem from the structural risk coming from the structure of the instrument itself, sampling risk due to the natural volatility in mortality experience, and the demographic risk reflecting the inherent underlying differences in dynamics of mortality of the index and hedged populations (LLMA, 2012). This latter risk is typically driven primarily by geographic and socio-economic differences, which were previously demonstrated to have a significant impact on life expectancy.

Pension funds or annuity providers can reasonably manage many aspects of basis risk. Structural risk can be reduced with careful analysis and matching of the age and gender profile of the portfolio with the one the hedge references. More granular hedge references enable a better match to be achieved. This risk would further be reduced with the emergence of a more liquid market as the hedge could be adapted to the evolving demographic profile over time.

The risk stemming from underlying volatility, also referred to as idiosyncratic risk, can be mitigated by pooling underlying portfolios. This implies that basis risk in general is likely to be much larger for small pension schemes or portfolios as the mortality experience is subject to more volatility than large ones, making indexed based solutions less effective for a small group of lives where this idiosyncratic risk, or individual differences, are not sufficiently diversified as with a large pool of lives. Index-based transactions may therefore be more effective in transferring the systemic longevity risk, which comes from the overall shifts in longevity trends and cannot be diversified away by pooling risks. One solution to the challenge smaller plans and portfolios face in mitigating their longevity risk would be for an insurer or reinsurer act as an intermediary to the capital markets by providing bespoke hedges with these small plans to acquire and pool the risks, subsequently transferring the systemic longevity risk of this pool to the capital markets.

Demographic basis risk remains the most challenging component to mitigate and quantify, however, primarily due to the lack of data with which to assess such differences. As discussed previously, there is some evidence that insurers and pensioners not only experience lower mortality than the general population but also experience higher improvements, with these differences driven primarily by differences in socio-economic profiles. Thus if a longevity swap is indexed to the evolution in the mortality of the general population, the floating payments received may not be sufficient to cover the higher increase in longevity for the pensioners or annuitants being hedged. This component presents one of the largest obstacles to the demand for index-based longevity protection.

The development of capital market solutions for hedging longevity risk does seem to be a promising way forward in order to ensure the continued capacity for pension funds and annuity providers to mitigate the risk. However, this misalignment of incentives between those needing to hedge longevity risk and the capital markets investors who can provide additional capacity will need to be overcome. This will involve addressing the risk constraints of the capital markets investors through the use of index-based instruments, as well as facilitating the recognition and assessment of the residual basis risk for those using these instruments to hedge their risk.

Index-based instruments offer a solution to the constraints of capital markets investors in supplying longevity protection, and the further development of these instruments could be facilitated by additional standardization and transparency in the market. However, on the demand side, the measurement of the residual basis risk from using index-based longevity instruments to hedge their risk remains a challenge for pension funds and annuity providers, particularly for the risk relating to socio-economic differences. This poses a problem not only for assessing the residual longevity exposure which is retained, but also in determining the appropriate level of risk reduction which should be reflected through the capital and funding requirements. This measurement then needs to be facilitated through the increased availability of data, particularly by socio-economic groups, and clear rules communicated as to the level of capital or funding relief which can be realised from index-based longevity hedges.

As policymakers have an interest in the continued availability of longevity risk protection and alternative solutions to mitigate the risk, the additional capacity that the capital markets can offer should be acknowledged and the development of this market facilitated. This involves addressing this misalignment of incentives on both sides of the market. On the supply side, the transparency and standardization of longevity hedge instruments could be facilitated to address the constraints of capital markets investors. For pension funds and annuity providers seeking to mitigate their longevity risk, the measurement of the residual basis risk retained could also be facilitated and the recognition of it clear and consistent for capital and funding requirements.

More transparency and standardization in the pricing of longevity instruments would aid potential investors in becoming comfortable with investing in longevity risk and allow for the further development of index-based instruments. The issuance of index-based longevity bonds has often been discussed as a solution to kick-start the purchase of longevity risk by the capital markets by providing this standardization and transparency (Blake et al., 2010). A longevity bond is an index-based longevity hedging instrument where the third party issuing the bond assumes longevity risk. These bonds have no principle re-payment, but pay regular coupons which are linked to a longevity index which would typically be based on the mortality experience of the general population. The coupon payments are proportional to the survival rate of the specified reference population. For example, if a longevity bond is based on the survival of a cohort of males aged 65 at the time of issuing the bond, the coupons payable in 10 years will depend on the proportion of 65-year-old males who survive to age 75. Purchasers of the bond will thus receive a higher coupon in the case that mortality improvements have been higher than expected.

A longevity bond would allow prices to become publicly available as a reference point for other transactions, establishing a term structure which the private sector could use as a basis to issue index-based longevity derivatives. This term structure could also be used by regulators as a check for the appropriateness of the level of capital which the (re)insurers are holding to cover longevity risk.

There are several arguments for the government issuance of a longevity bond. Compared to solutions offered by the private sector, such a bond would provide a longevity hedge with little to no counterparty risk which could increase the capital relief (re)insurance companies could potentially receive from such a hedge. The government would also be better positioned to offer a hedge in line with the long duration of longevity risk, which capital markets investors have been so far reluctant to do. The government is also arguably in a better position to support the systemic longevity risk. Benefits for the government itself could include the reduction of its cost of borrowing compared to traditional government bonds since it would be receiving a risk premium for taking on the longevity risk. However, the longevity bond market is likely to remain fairly illiquid and the coupons would have to include a certain level of illiquidity premium, therefore it is not certain that the cost of borrowing could be reduced in reality (Brown and Orszag, 2006).

Nevertheless this solution would have to be very carefully assessed as many governments already hold significant longevity risk on their balance sheet from public pensions and health programs. While some argue that the government could hedge some of its exposure to increases in systemic longevity through adjustments to the state pension (Blake et al, 2010), governments are currently proving that these types of adjustments – such as increasing retirement age or decreasing pension levels – are very slow and unpopular to implement. However if insurance companies are not able to insure the longevity risk of

Box 6.3. **Hypothetical example of a longevity bond**

The EIB/BNP bond attempt in 2004 had a 25-year maturity and coupons were linked to a cohort of English and Welsh males aged 65 in 2003. The initial coupon payment was £50 million. Let q(x,t) be the mortality rate of a person aged x in the year t. The survivor index S(t) was constructed as follows:

$$S(0) = 1$$

$$S(1) = S(0) * (1 – q(65,2003))$$

$$S(2) = S(1) * (1 – q(66,2004))$$

$$S(t) = S(t-1)* (1 – q(64+t,2002+t))$$

Therefore, the following coupon payments would have been £50 million. S(t) with t=1,2,…,25 and the issue price of £540 million determined by the projected coupons based on survival rates, calculated by the UK Government Actuary Department, which were discounted at LIBOR minus 35 basis points.

Here a hypothetical scenario describes the coupon payment in the first three years. The table below shows a possible development of the mortality rates, where the ones for the cohort aged 65 in 2003 are in bold as they are needed for the calculation of the survivor index.

Age x \ Year t	2003	2004	2005
65	**2.05%**	2.00%	1.95%
66	2.15%	**2.10%**	2.05%
67	2.25%	2.20%	**2.15%**

Thus, the coupon payment at time t = 1 is 48 975 000 = 0.9795 • 50 000 000.

All hypothetical coupon payments in the first three years can be found in the table below:

Time	Mortality rate q(64+t,2002+t)	Survivor index S(t)	Coupon payment
t = 1	2.05%	97.95%	48 975 000
t = 2	2.10%	95.89%	47 945 000
t = 3	2.15%	93.83%	46 915 000

individuals, it is possible that more elderly would fall into poverty and their longevity risk would have to be covered by the government anyway through the safety nets which are in place.

The current lack of demand for these bonds and the extent to which these instruments are effective in hedging longevity risk must also be considered, as attempts thus far to issue a longevity bond have not succeeded. Reasons for the lack of interest by pension funds and annuity providers include the significant upfront capital required and the basis risk involved, the latter of which seems to be one of the main reasons for the failure (Biffis and Blake, 2014). The bond structure is capable of providing longevity risk protection to several entities seeking to hedge their pension funds and annuity portfolios, therefore the reference index on which the coupons is based is typically more generic than the reference population which could be used for an index-based swap. As such, a longevity hedge using longevity bonds would expose the pension fund or annuity provider to arguably more structural basis risk than a longevity swap, where the reference index can be tailored more specifically to the population being hedged. Overall, a longevity swap based on survival rates can provide a better hedge for the longevity risk of pension and annuity portfolios at a much lower upfront cost.

There is some evidence that the private markets are beginning to develop products and structures to hedge longevity risk, with a handful of index-based longevity swaps having already succeeded in being transacted. Progressively innovative structures have aimed to resolve the tension between the interests of the hedging party and the investor and create standardised instruments which can be easily customised to provide attractive investments which offer effective longevity hedges which minimise basis risk for the subscriber.

The Pall Pension Fund longevity swap with J.P. Morgan in 2011 was the first public index-based swap, and the first transaction to cover the longevity risk for future pensioners, whose younger ages mean more uncertainty around future longevity experience. This was clearly a big step in demonstrating the possibility to hedge the longevity risk for a larger portion of the exposure for pension funds or insurance companies.

The index-based longevity swap transacted between Aegon and Deutche Bank in 2012 provided an excellent example of how an innovative structure can help to bridge the conflicting interests of the two counterparties, and was the first transaction directly targeting capital market investors. To limit the duration of risk exposure for the investors, payments will only be exchanged for twenty years. However a lump sum will be paid at the end of the contract reflecting the evolution in mortality up to that point, effectively covering the risk of deviations from the current expected mortality beyond that point. This structure allows Aegon to partially hedge the long tail of their liabilities while restricting the time horizon on which the investor is exposed to the risk. Furthermore payments to cover the longevity risk would only be triggered when longevity would exceed a pre-specified reduction in mortality set beyond current expectations. This reduced the cost of the swap for Aegon as it was not priced ‘at the money’ and provided an effective source of capital relief for the tail longevity risk.

The year 2013 saw an additional push towards the standardization and transparency of these types of transactions with the development of products meant to be highly customisable. Deutche Bank launched its Longevity Experience Option, a product with specified attachment and detachment points for specified cohorts over a ten year duration for which pricing is publically available. Aegon completed a second index-based longevity transaction, this time with Société Générale, with the longevity risk being passed on to reinsurers. More recently, Delta Lloyd conducted a large six-year longevity swap with RGA Re based on a Dutch population index, allowing the insurer to manage its economic capital position (Artemis, 2014).

This evolution in the structures being used to hedge longevity risk indicate a strong potential for index-based instruments to be used more widely to achieve an effective reduction in longevity risk for pension funds and annuity providers while attracting a wide investor base in the capital markets. Perhaps, then, all that is needed is an additional nudge towards the more rapid development of the market by taking smaller steps to facilitate the standardization and transparency of these instruments.

A regular and reliable publication of a longevity index could further this standardisation and transparency. This index could provide a basis for the calculation of future swap payments as well as provide a price reference from which market participants could decide how much they are willing to pay for a given transaction. Such an index should include both metrics relating to current mortality as well as mortality projections which reflect the most up-to-date expectations of future mortality improvement and life expectancy. The methodology and data used to develop the index should be clear and transparent so that the market understands the basis of the calculations and will be confident in the reliability of the index going forward. As governments have access to all necessary data needed to publish such indices on an ongoing basis, perhaps national statistical institutes could be in charge of publishing annual indices for their respective countries.

Finally, to further the aim of transparency, regulation could consider bringing in standardised swaps traded on the capital markets into exchanges or electronic trading platforms, where appropriate, to be centrally cleared (consistent with the FSB's OTC derivative reform agenda) so as to limit the opaqueness of these over-the-counter (OTC) transactions and keep tabs on the accumulation of longevity risk in the capital markets.

Concluding remarks

Mortality assumptions have a significant influence on the liability value for pension funds and annuities and realistic assumptions are necessary in order to sufficiently provision for future payment obligations in both cases. The improvement in mortality and life expectancy is a phenomenon globally observed and cannot be ignored when setting mortality assumptions for the future. Pension funds and annuity providers must actively assess and monitor mortality experience, keeping assumptions up-to-date and recognizing the risk to which they are exposed.

The analysis included in this publication has shown that failure to account for future improvements in mortality can result in an expected shortfall of provisions of well over 10% of the pension and annuity liabilities. Likewise, the use of assumptions which are not reflective of recent improvements in mortality can expose the pension plan or annuity provider to the need for a significant increase in reserves.

Beyond ensuring that mortality assumptions used for the valuation of pension and annuity liabilities reflect reasonable expectations, regulatory frameworks should also encourage pension funds and annuity providers to recognise and assess the risk to which they are exposed through capital and funding rules. Funding and capital requirements along with accounting standards should reflect any actions taken to mitigate longevity risk, which would provide incentives for the active management of this risk.

Effective options for pension funds and insurers to mitigate longevity risk, when necessary, should also be available. With the potentially limited capacity for insurers and reinsurers to accept this risk, capital market solutions seem to be a promising alternative option for hedging the risk that pension plans and annuity providers are not willing or able to retain via a capital buffer. However several issues need to be addressed to facilitate both the supply and demand of index based longevity hedging instruments which could be traded on the capital markets. Investors have a need for standardisation and transparency with respect to the pricing of the instruments, and additional benchmarks may be necessary to facilitate this.

Demand for protection against longevity risk will only increase as individuals are expected to live longer, and the sustainability of pension funds and annuities providing this protection for individuals has to be ensured. Sufficient provisioning for longevity is essential to guarantee that future payments will be met, and the ability for providers to manage the risk and mitigate it if needed will allow continued protection to be offered in the future.

To summarise, the main policy options discussed are[4]:

- The regulatory framework should ensure that pension funds and annuity providers use appropriate mortality tables to account and provision for expected future improvements by establishing clear guidelines for the development of mortality tables used for reserving for annuity and pension liabilities.
  - Mortality tables should include the expected future improvements in mortality.
  - Mortality tables should be regularly updated to accurately reflect the most recent experience and avoid significant increases in reserves.
  - Mortality tables should be based on the mortality experience of the relevant population.
- Governments should facilitate the measurement of mortality for the purposes of assumption setting and the evaluation of basis risk of index-based hedging instruments.
  - Accurate and timely mortality data should be publicly available.
  - Mortality data by a socio-economic indicator should be made publically available.
- The regulatory framework should provide incentives for the active management of longevity risk.
  - Capital and funding requirements should be reflective of the risks faced in order to account for the specific exposure to longevity risk and allow institutions mitigating their longevity risk to adjust their requirements accordingly. These requirements could be based on results from stochastic models which provide probability distributions.
  - Accounting standards should ensure the appropriate valuation of longevity hedging instruments.
- Governments could encourage the development of a market for alternative instruments to hedge longevity in order to ensure a complementary solution for pension funds and annuity providers to mitigate the risk they are not able or willing to retain. This could be accomplished by facilitating transparency and standardization of index-based longevity hedges.
  - A reliable longevity index could be developed to provide price reference and encourage liquidity and standardization.
  - Over-the-counter standardised transactions could be brought into exchanges or electronic trading platforms and centrally cleared.
  - The issuance of longevity indexed bond could be considered, though with care, as it would also increase the exposure of the government to longevity risk which many governments already have significant exposure to.

Notes

1. There are different approaches to address the management of longevity risk that may be country specific. Consequently, discussions about managing longevity risk should keep different country contexts in mind. One example could be the existence of pension protection funds which can be used to offset the financial impact of longevity risk in the event that it materialises in the future. The approach presented in this section is preventative as the focus is on addressing the management of longevity risk directly in order to avoid excessive adverse financial impacts from materialising.

2. Mitigating or hedging a risk is the act or method of reducing the risk of financial loss of an investment. In what follows, the text refers to hedging longevity risk as reducing the longevity risk to which pension funds and annuity providers are exposed.
3. Based on the analysis in Chapter 3.
4. These policy options elaborate in more detail existing recommendations relating to managing longevity risk, such as those of the Joint Forum Paper. For example, the option suggesting specifically that future improvements should be accounted for, that tables are regularly updated, and that the relevant experience be used as a basis for setting assumptions develops in more detail the Joint Forum's Recommendation 4 to "Review longevity risk rules and regulations … pertaining to the measurement, management and disclosure of longevity risk". Additionally, the policy option saying that policymakers should facilitate the measurement of mortality for the purposes of assumption setting by ensuring that accurate and granular mortality data is publically available – a recommendation completely in line with Recommendation 8 of the Joint Forum to "Collect adequate data" goes further than the recommendation 2 of the Joint Forum to "Understand longevity risk exposures…to ensure that holders of longevity risk…have the appropriate knowledge, skills, expertise and information to manage it". Moreover, the final policy option in this paper that policy makers could encourage the development of the longevity transfer market goes hand and hand with Recommendation 3 of the Joint Forum to "Assess relevant policies…with regard to where longevity risk should reside" and simply takes a position that longevity risk should be more broadly shared across society in order to ensure the continued capacity of pension funds and annuity providers to manage and insure longevity risk.

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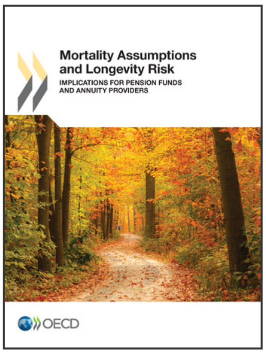

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