



PENSION NOTES
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LONGEVITY RISK AND MECHANISMS FOR ITS MITIGATION¹

Introduction

As the population ages, this issue will consume a growing percentage of resources, exerting pressure on the solvency of the public and private sectors. Governments and private pension providers have been preparing for the financial consequences of aging. However, this preparation is based on demographic projections, which have always underestimated the life expectancy of people in the past (IMF, 2012). Unexpected longevity beyond these projections, although good news for people and society as a whole, is a financial risk for governments and life insurance companies (in the case of pensions paid in the form of life annuities) which will have to pay more than they had expected in social security benefits and pensions. It also constitutes a financial risk for individuals, who may survive their retirement resources (as occurs, for example, in pensions in the "Programmed Withdrawal" mode in the individually-funded systems).

These financial risks will increase slowly over time, but if they are not addressed soon they could have profound negative effects on the balance sheets of the public and private sectors, increasing their vulnerability to other impacts, thus affecting their financial stability. According to estimates of the International Monetary Fund (IMF), if average life expectancy were to increase by three years more than expected by 2050, (in line with past underestimations), the costs of ageing could increase by 50%. Studies in the United States have shown that private pensions face a longevity risk that could increase their total pension liabilities by about 3% for each additional year that pensioners live beyond the age of 63, implying an overall increase of 9% in liabilities resulting from a 3-year increase in longevity. Since the total number of pension liabilities is voluminous, companies that manage private pension plans would have to provide several times their normal annual contributions to meet these additional liabilities.

This brief article summarizes part of the existing literature on the risk of longevity, its growing importance, and the mechanisms that should be explored for mitigating its financial costs.

What is the risk of longevity?

For individuals, Longevity Risk (LR) is the risk of exhausting one's own resources for financing retirement and falling into poverty (as occurs in Programmed Withdrawal (PW)). On the other hand, for pension funds with a pension promise and the providers of Life Annuities (LA), such as life insurance companies (LICs), LR is the risk that future pension payments could be greater than expected or estimated (OECD, 2013).

¹ Document drawn up by FIAP.

What are the underlying factors of longevity risk?

There are three factors driving LR (Mastrangelo, 2013):

- (i) Modeling risk: The risk that life expectancy probability distribution is modeled incorrectly due to faulty data. From the regulator's standpoint, this risk can be minimized by improving the information with which mortality tables are drawn up, regularly reviewing their sufficiency and incorporating new enhancing factors.
- (ii) Idiosyncratic (non-systematic) risk: The specific risk of life annuity liabilities (non-financial). This originates in the variability of life expectancy with respect to the expected value (an individual can live more or less than the average life expectancy of the population). This risk is diversifiable and can be managed by the LICs, although it would require a significant mass of insured individuals and relatively homogeneous LA modes from the longevity standpoint.
- (iii) Trend Risk (Systematic): The risk of significant unexpected increases in life expectancy due to socio-economic factors or improvements in the effectiveness of medical treatment affecting the entire population. This risk is not locally diversifiable since, by definition, it would affect all pensioners and the relative sizes of exposure to mortality and longevity are not suitable for diversification.

Why is longevity risk important?

The pension funds and the LICs use mortality assumptions (death or survival probabilities specific to a certain age) to determine how much must be paid to pensioners or individuals purchasing LA, given their contributions and/or accumulated assets. These mortality assumptions deal with the future probabilities of death, odds which are by definition unknown or uncertain. The deviation between these assumptions and the future realization of these mortality rates could lead the pension funds and the LICs to incur in liabilities greater than those they have provisioned for (OECD, 2013). Put another way, unexpected increases in longevity cause a downward revision of PR and losses to the LICs, an ex-post phenomenon (Vial, 2009).

How important is Longevity Risk?

Table No. 1
Longevity Risk and Fiscal Challenges in Selected Countries
(% of nominal GDP in 2010)

Country	(1) Total Household Financial Assets (2010) (1)	(2) Discounted Present Value of the Income Required in Retirement	(3) Gross Public Debt of the Government (2010)	(4) Gap: (1) - (2)	(5) Increase in the Present Discounted Value resulting from increasing longevity by 3 years
United States	339	272 to 363	94	67 to -24	40 to 53
Japan	309	499 to 365	220	-190 to - 356	65 to 87
United Kingdom	296	293 to 391	76	3 to -95	44 to 59
Canada	268	295 to 393	84	-27 to - 125	42 to 56
Italy	234	242 to 322	119	-8 to - 88	34 to 45
France	197	295 to 393	82	-97 to - 196	40 to 54
Australia	190	263 to 350	21	-73 to - 161	36 to 49
Germany	189	375 to 500	84	-186 to - 311	55 to 74
Korea	186	267 to 357	33	-81 to - 170	39 to 52
China	178	197 to 263	34	-19 to - 85	34 to 45
Spain	165	277 to 370	60	-112 to - 205	39 to 52
Hungary	108	190 to 254	80	-82 to - 146	34 to 45
Czech Republic	89	216 to 289	39	-127 to - 200	36 to 48
Poland	88	160 to 213	55	-72 to - 125	27 to 35
Lithuania	80	189 to 252	39	-109 to - 172	34 to 45

Source: IMF (2012).

(1) In the case of China, it is 2009.

Notes:

- The ranges of values for columns (2), (4) and (5) cover a replacement rate of 60% of income prior to retirement at the lower end, and at the upper end, a replacement rate of 80% for pensioners of 65 or more for maintaining the pre-retirement standard of living between 2010 and 2050.
- Column (1) (total financial assets of households), includes assets in defined-benefit pension plans, defined-contribution pension plans, insurance reserves, and other financial assets.

In many countries, the private sector would appear to be lacking sufficient financial assets for dealing with the costs of population aging and LR. In most countries, the estimated discounted present value of the income required in retirement, under the current longevity assumptions of the United Nations for 2010 - 2050 (Table No. 1, Column 2) exceeds the total financial assets of households. In Japan, for example, the difference between financial assets and potential liabilities is between 2 and 3.5 times it's GDP for 2010, assuming a replacement rate of between 60% and 80% of the average wage.

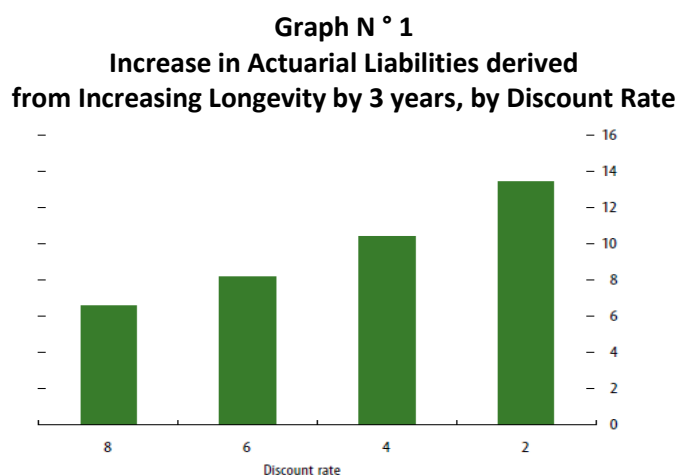
In the United Kingdom, for example, in order to be able to finance a replacement rate of between 60% and 80%, taking into account the expected increase in longevity in the United Nations assumptions, it would be necessary to finance a gap that could reach 95% of GDP in 2010. However, if there is an unexpected increase of 3 years in longevity, column 5 of Table No. 1 tells us that the present value of the required retirement income increases by up to 59 percentage points, which means that it increases from 391% of GDP to 450% of GDP, and therefore the gap that needs to be financed increases to 150% of GDP in 2010 (= 296% -450% = - 150%).

Even though a portion of the differences observed in Table No. 1 is covered by Social Security benefits, real estate assets of households and other financial assets² in many countries, it is unlikely that existing household wealth is sufficient for providing a sufficient level of income for retirement.

The potential effects of LR on government liabilities are substantial in many countries. With a private sector that is not well prepared for the expected effects of aging, it is not unreasonable to suppose that the financial burden of an unexpected increase in longevity will fall ultimately on the public sector. Increases in potential public debt resulting from an increase of 3 years in average life expectancy, are between one third and half of the GDP in 2010, with the greatest impact in Germany (two-thirds of GDP in 2010) and Japan (three quarters of the GDP in 2010) [Table No. 1, column (5)].

Contingent debts arising from LR could further increase the debt/GDP ratios of a large number of countries. For example, if the risk of 3 additional years of longevity were to affect countries, the debt-to-GDP ratios could increase to about 150% in Germany and the United States and to about 300% in Japan [Table No. 1, sum of Columns (3) and (5)].

The pension plans, the LICs, and other retirement income providers have had to face large increases in their liabilities, since the current low levels of interest rates increase the financial impact of LR. LR is a future event, due to which its financial consequences should be discounted. The lower the discount rate, the greater the discounted present value of the cost derived from LR³. Graph No. 1 illustrates this situation. With a discount rate of 6%, a 3-year increase in life expectancy generates an 8% increase in actuarial liabilities, whereas, with a discount rate of 2%, the same life expectancy shock generates an increase of nearly 14% in liabilities.



Source: IMF (2012).

² We are referring to other financial assets not included in Column 1 of Table No. 2.

³ For accounting purposes, the discount rate used in the calculation of the pension debt is typically the long-term return of high quality domestic corporate bonds; for the purposes of prudential regulation, the long-term return of a government bond, which is currently at historic lows, is often used

Who bears the longevity risk in the pension system?

Table No. 2 shows the parties that must bear the longevity risk, depending on the pillar of the pension system concerned. In the case of the non-contributory pillar (solidarity pensions) and the first Public PAYGO Pillar, LR must be assumed by the government since it finances pensions or lifetime complementary pensions (for example, minimum guaranteed pensions, basic solidarity pensions or solidarity pension contributions⁴).

In the case of the second pillar (Mandatory Individually-Funded Accounts) and the third pillar (Voluntary Pension Savings) of the pension system, the usual mechanism is that the accumulated fund is annuitized (purchase of a LA in a LIC), in which case the LIC assumes the LR. The other option is that on retirement, workers maintain the accumulated balance in their individually funded accounts and withdraw monthly amounts whose value is calculated by dividing the accumulated balance by the capital necessary for paying a pension unit to the member, recalculating the pension each year⁵. In the latter case, the LR is assumed by the individual. Finally, in defined benefit corporate pension programs, if the company does not take out LA insurance for its workers with the pension fund, it assumes the LR (and workers assume the risk of bankruptcy of the company).

Table No. 2
Retirement Phase and Longevity Risk: Who bears the risk?

Non-contributory pillar	Gives rise to tax obligations and the government assumes the LR.
First pillar (public, mandatory)	
Second pillar (private): Mandatory Individually Funded Accounts	They give rise to accumulation of funds that finance pensions: <ul style="list-style-type: none">• <u>Normal Mechanism</u>: The fund is used for buying a stream of annual income (LA or annuity) in a LIC. The LR is assumed by the LIC.• <u>Programmed Withdrawal Option</u>: The life annuity is recalculated annually. It is common in Latin American reformed systems. The LR is assumed by the individual.• In pension funds for workers (occupational pension programs), if the company does not contract LA insurance for its workers with the Pension Fund, it assumes the LR (and workers assume the risk of bankruptcy of the company. Example: United Airlines).
Third pillar (private): Voluntary Pension Savings	

Source: Vial (2009).

⁴ This is the case in Chile, for example.

⁵ The "capital necessary for a pension unit" depends on a type of technical interest that is defined in the respective regulations, and the life expectancy of the worker and his family group, according to the mortality tables.

What options exist for mitigating the longevity risk?

Like any other risks faced by economic agents (such as the interest rate risk, foreign exchange risk), the LR must be acknowledge and mitigated. On a global scale, reducing the LR would require reversing the current bias towards underestimating longevity. Nonetheless, given the uncertainties inherent in the estimation and projection process, the LR will probably remain.

In order to effectively mitigate the LR, basically three types of measures (IMF, 2012) are required:

(i) Recognize and take action with regard to the significant LR governments are exposed to.

Addressing the substantial public sector LR requires, in the first instance, measuring the degree of the government's exposure to risk, with the same techniques used in the private sector⁶. The LR can be partially quantified with a variety of longevity scenarios, possibly derived from a set of assumptions that are typically used in population projections. This analysis could effectively conduct a stress test of public finances with respect to their exposure to LR and its resilience to various shocks.

Mitigating the identified LR would require a combination of different policies, which could include:

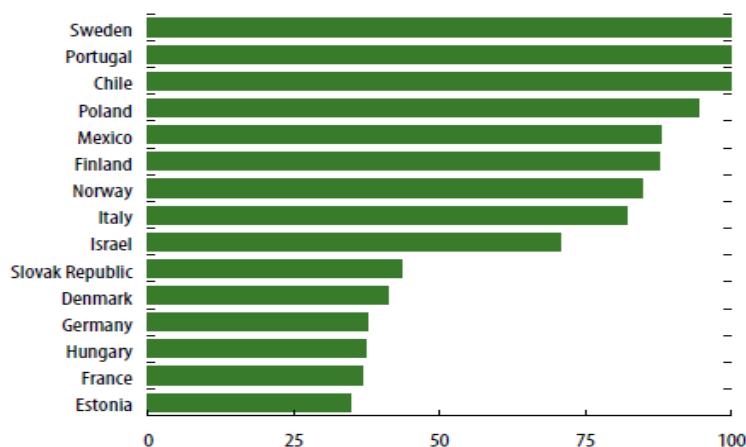
- a. Share the risk with individuals [see section (ii)], adjusting the terms of the retirement plans and social security schemes (including parametric reforms such as a reduction in benefits, increasing contribution rates, and increasing the legal retirement age).
- b. Reducing public debt, anticipating the potential pressures arising from the LR.
- c. Selling the risk in the capital market [see (iii)].

Only a few governments have taken steps to limit their exposure to LR (see Graph No. 2). Some countries have adjusted the pension calculation formula for linking improvements in life expectancy to benefits (e.g., Germany, Finland, Japan and Portugal) or the retirement age (e.g., Denmark, France and Italy), transferring part of the LR to individuals. Other Governments have established defined contribution programs (for example, Chile and Sweden). Governments could also consider increasing contribution rates to social security schemes⁷. Although such transfers could be an effective way of sharing the burden of aging and RL, any measure must be carefully designed to avoid the exhaustion of sources of income for the retirement of individuals, in which case the LR would again fall on the government (last resort option).

⁶ Stochastic approximations must generally be incorporated into the valuation of the LR, using projective actuarial calculation and simulations of scenarios, stress-testing, and other common internal risk management processes. Financial techniques such as Asset Liability Management (ALM) or Liability Driven Investment (LDI), which attempt to adjust the strategic allocation of assets to obligations, so that the returns on investments will suffice, at least, to cover obligations (Valero, 2013), can also be used.

⁷ Option available for those countries that still have space for increasing contribution rates on the payroll. In countries where taxes on income and payroll as a percentage of the earnings are already about 50% of total labor costs, increasing contribution rates could have adverse effects on the labor market. Another option would be to equalize taxation of pensions and other forms of income.

Graph No. 2
Index of share of pension entitlements linked to life expectancy
in selected countries



Source: Pensions at a Glance 2011, OECD.

Note: This index includes links to life expectancy through defined contribution plans.

- (ii) **Distribute the LR adequately among individuals, the managers of the pension plans and the government, together with improving the ability of individuals to self-insure against their individual LR.**

The LR is too large to be managed by a single sector of society. The solution therefore demands a better distribution of this risk between the private sector, the public sector, households and individuals. A better distribution of such risk could be achieved by:

- a. Having pension schemes that share the burden of longevity with retirees through increases in the retirement age and contributions, or a reduction in pension amounts.**

Greater flexibility in the design of retirement income systems would enable a better distribution of the LR among providers of pensions and pensioners, improving the resilience of the system to longevity shocks.

- b. Increasing financial shock absorbers so that individuals can "self-insure" against LR.**

To the extent that pension providers reduce the aggregate LR, individuals are increasingly exposed to their own individual LR. To deal with this situation, individuals must delay their retirement and increase their financial shock absorbers (for example, by means of mandatory additional retirement savings, or encouraging saving through tax advantages). For these shock absorbers to be available in retirement, both financial stability and prudent investment strategies (with an appropriate percentage of "safe" assets) are essential for avoiding a situation where financial crises can deplete these sources of additional retirement income (as occurred recently in some countries where many of the retirement income sources depended on defined-contribution plans, including the United States).

These "shock absorbers" could then be used for the self-insurance of households against longevity shocks, without having to resort to governments, resulting in a better distribution of the LR between households and the public sector. For example, in order to avoid the exhaustion of resources prior to death, individuals could be obligated to use a portion of their accumulated pension savings to purchase a LA that guarantees the payment of an annuity until death. However, this "mandatory annuitization" must be very well designed and regulated to ensure that the individuals purchasing such LAs fully understand the contracts, thus avoiding undue concentration of this risk among the sellers of LAs (i.e. in the LICs).

In this regard, Edwards (2013) shows that a person very averse to LR will immediately opt for a LA with all his funds, whereas a person who is not very averse to this risk will take a high proportion in the Programmed Withdrawal mode if the expected return on his funds is far above the "sale rate" of the LA. The recommendation is therefore that part of the funds must be annuitized for achieving a reasonable minimum level of income in the last years of life. Some questions still open in this regard are that if annuitization is mandatory: from what age would it be mandatory? At what point would the annuity be taken out? What part of the funds would it be mandatory to annuitize?

In practice, few people buy LAs. Researchers who have studied this issue, concluding that LAs are not "actuarially fair"; i.e., for a person with an average life expectancy, for every dollar in premium payments, the LA only provides between 74 to 85 cents (the precise degree of "actuarial justice" depends on the interest rate used to discount the income stream, and to a lesser extent, the type of LA) (Center for Retirement Research, 2006).

The not very attractive price of the LA is partly explained by administrative costs and profit margins. Furthermore, those who expect to live longer than average are more likely to buy LAs, which constitutes a form of "adverse selection." The LICs take this selection bias into account when putting a price on the LA, which makes these products not very attractive to the public in general. In order to resolve this problem, **some governments have made annuitization mandatory** (for example, the United Kingdom and Singapore). As an alternative, it is also proposed in the literature that groups of retirees should get together and self-annuitize in order to reduce the costs of adverse selection. Another option for elderly homeowners is to increase their retirement income by consuming their own equity through what is known as "reverse or inverse mortgage"⁸.

In order for individuals to be able to increase their financial shock absorbers in retirement and self-insure against LR, better financial and pension education and education regarding the concept of LR is essential, a task that should be part of the plans of all governments. Most households are probably not really aware of the magnitude of the individual LR (idiosyncratic) they are exposed to, which makes them less likely to want to be able to self-insure against this risk.

⁸ An operation that consists in selling the house or property in advance and receiving a monthly pension in the form of a LA in exchange, but without handing over the physical ownership of the house or the property until the death of the family group. This is basically a credit with a real estate guarantee, i.e. a business whereby a person who owns a property receives a monthly income, determined by several factors, and on the death of the owner the heirs pay off the loan or the agency will proceed to execute the warranty."

(iii) Recur to the capital market for transferring the LR of pension schemes to parties that are more capable of handling it.

There are basically two instruments in the capital market through which the LR can be transferred to parties that are more capable of handling it:

a. Bilateral Contracts.

In the case of defined benefit pension plans, the LR can also be transferred through buy-outs (transferring the scheme to an insurer), or buy-ins (an operation in which the liabilities of the pension plan are secured through an insurer⁹) (Valero, 2013).

b. Derivatives for hedging against longevity.

There is ample scope for the development of instruments for hedging against longevity. These instruments take the form of swaps in which the party purchasing the hedge (the pension fund or the insurer that provides the income) pays fixed quantities while the contract is valid, based on specified mortality tables, in exchange for coverage of the variable payments linked to real mortality. In the United Kingdom, for example, this method implies that insurance companies pay a mixed set of cash flows to an investment bank – based on the best estimate of future pensions together with a longevity risk prize - and receive a set of fluctuating cash flows based on experience regarding the mortality of pensioners.

The first longevity swap in a capital market took place in July, 2008, between Canada Life and a group of investors (Sarto, 2011).

Swaps based on ratings enable a partial transfer of the risk, because they protect against unexpected increases in aggregate longevity (the pension fund or the insurer keeps the individual longevity risk), and are relatively easy to standardize, with all that that entails in terms of better transferability, liquidity and price (Valero, 2013).

The problem with these swaps is that they are not transparent and use private longevity indices not known by the public, and furthermore, their duration may not be sufficient for the period that needs to be covered, and large groups are necessary for making this risk transfer possible. Public and credible longevity indices must be available for the adequate use of swaps, a task that governments should assume through their statistics departments (OECD, 2012).

c. Longevity Bonds

A pioneer study on the subject (Blake, 2001) proposed the creation of a bond indexed to the mortality rate of senior citizens issued by the government. Work is currently underway on a series of similar financial instruments, the so-called "**longevity bonds**", which are bonds indexed to the life expectancy of one population in particular. In other words, in these types of bonds, coupons are linked to a longevity index.

⁹ In this operation, the sponsor of the pension plan pays a premium to the insurer, and the latter makes regular payments to the sponsor, which are identical in amount to those that the sponsor pays the workers. The "insurance policy" is maintained as an asset by the pension plan; the premium is the cost of the insurance policy that guarantees regular payments, even in a situation in which retirees live more than expected (IMF, 2012).

The main argument in favor of a possible takeoff of this market is the low correlation between the risks of longevity with the yields of other financial instruments, which would transform them into an interesting asset (BBVA, 2009).

As highlighted in an OECD study (OECD, 2007), a key challenge for developing the market for this type of bonds is to find the counterpart, i.e. investors benefiting from a greater survival of the population. Industries focused on senior citizens, such as the pharmaceutical industry, meet this requirement. However, this offer would not be sufficient to meet the demand for coverage against LR. It is therefore argued that the government could be the driver for this market, by being the issuer of such instruments. The issuing of longevity bonds by governments would help the LICs to cover the "systematic" or "aggregate" longevity risk they face. By covering this risk, the LICs would be able to sell better valued LAs and, at the same time, reduce the risk of becoming insolvent due to a significant rise in unanticipated life expectancy (Pulso 2013). If the LICs do not hold longevity bonds for facing the systematic risk of longevity they are exposed to, they would then face extra capital requirements¹⁰.

The market for bonds linked to life expectancy is still emerging. BNP Paribas was the first to try it, although the bond was never issued, since among other reasons, the pension industry consider the price to be very high (BBVA, 2009). The only bond of this type issued so far was issued by the SwissRe reinsurance company and was called the Kortis Bond. (Pulso, 2013).

No Government has yet issued a longevity bond. In 2004, the United Kingdom decided not to issue longevity bonds in the short term, although it did state its interest, declaring that it will continue to assess the possibility of doing so in future (BBVA, 2009). There was an attempt by the Chilean Government to issue longevity bonds between 2006 and 2009, but it was also unsuccessful (Pulso, 2013).

Some countries recently announced the issuance of long-term bonds. For example, Sweden has announced bonds at 20 years, and the United Kingdom is debating the issuing of 100 year bonds, or perpetual debt (OECD, 2012).

¹⁰ This is what is happening in Europe with the new standards of regulation called Solvency II.

Conclusions

Predictive failure generates risks that can be mitigated financially. There is a financial risk associated to living less or more than expected.

In earlier centuries, the most common risk was untimely death, and in response the financial industry developed the life insurance market. Survival is now becoming the common risk. The current challenge therefore consists in developing means whereby the impact of this risk can be cushioned, at a systemic level.

For the insurance industry, the challenge of the longevity risk involves developing a sustainable and profitable annuities market.

In order to address the risk of longevity, it is necessary to act on several fronts. First of all, governments must recognize the significant risk of longevity that the defined benefit plans of their own employees and social security systems for the elderly expose them to. Secondly, the risk must be properly distributed among individuals, the managers of the pension plans and the government. Thirdly, one can resort to the capital markets to transfer the risk of longevity of pension schemes to parties that are more capable of handling it. There are a number of instruments in this growing market and different possibilities for improving their functioning (for example, longevity swaps, longevity bonds).

Allowing the retirement age to increase on a par with expected longevity is an essential reform. It could be an obligation imposed by the Government, but incentives could also be offered to individuals to delay retirement, which helps in two ways: (i) it extends the period of accumulation of retirement resources; and (ii) it shortens the period of use of those resources. The disclosure of detailed information on longevity and its financial impact would contribute to better clarifying its consequences. It is also important to allow agencies that offer pensions to be able to act flexibly: if it is not possible to increase contributions or raise the retirement age, pension amounts will probably have to be cut.

Recognizing and better mitigating the risk of longevity is a process that must be implemented now, since the measures take years to give fruit and it will be more difficult to properly deal with this issue if corrective action is postponed.

Paying attention to the ageing of the population and the risk of additional longevity is part of the set of reforms that governments should get underway worldwide.

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