



PGIM

LONGEVITY AND LIABILITIES


Bridging the Gap

For Professional Investor use only. Not for use with the public. Your capital is at risk and the value of investments can go down as well as up.



INTRODUCTION

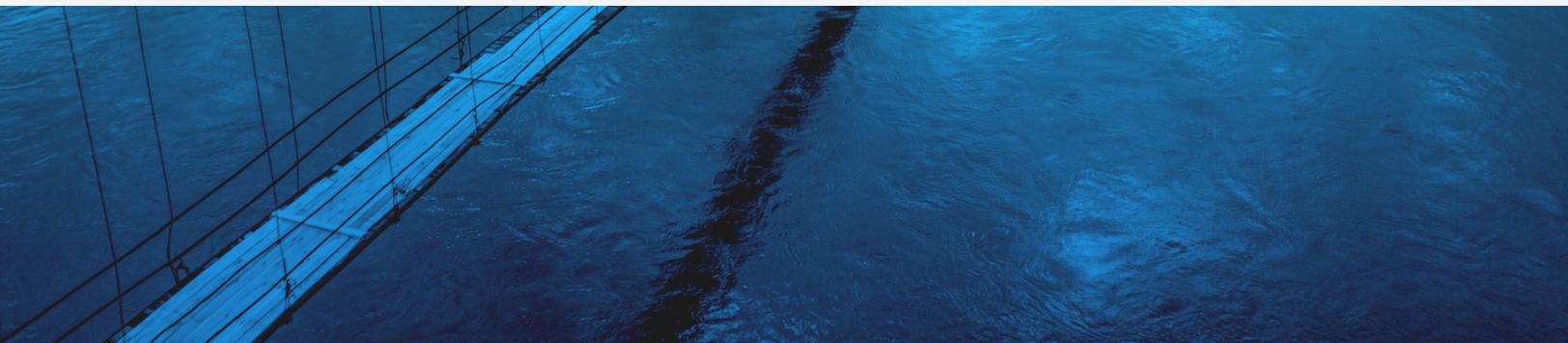
Major improvements in human health and well-being have led to a drastic rise in global life expectancy — from approximately 48 years in 1950 to over 71 years in 2015.¹ But with progress in extending life spans come new challenges for governments, private pension plans, and individuals trying to generate sufficient retirement income in an aging world.

The most discussed challenge is the cost of belatedly catching up to the increased social security, pension, and individual retirement income requirements resulting from the currently *expected* increases in life spans. Less well appreciated, but of similar magnitude and importance, are the costs of longevity risk — *unexpected* increases in human life spans beyond what actuaries and demographers have currently forecast.² The IMF estimates that if everyone lives three years longer than expected — the average underestimation of longevity in the past — the present value of additional retirement expenses during these additional years of life could amount to 25-50% of global GDP.³

For pension plan sponsors, especially in the US, longevity risk has often taken a backseat to investment and interest rate risks. And for good reason: the financial crisis decimated portfolios, and persistently low interest rates have made underfunding problems

worse. But given ongoing improvements in life expectancy, plan sponsors will increasingly have to focus on the risk posed by unexpected longevity improvements to the funded status of pensions, especially as a persistently low rate environment only exacerbates the present financial impact of longevity risk. Even sponsors with completely frozen, fully funded plans will be confronted with future liability growth due to longevity improvements. Understanding and quantifying the magnitude of longevity risk can help plan sponsors establish a framework for taking the appropriate actions today to ensure the ongoing health of their pension plans.

In this paper, PGIM builds upon the insights from our recent report, *A Silver Lining: The Investment Implications of an Aging World*, to discuss the challenges posed to pension plan sponsors by longevity risk and the options available for managing it.⁴



PART 1: THE CHALLENGES OF PREDICTING LONGEVITY RISK

Longevity risk impacts pension plans in three distinct but interrelated ways. First, forecasters often misjudge and undershoot actual increases in human life spans, and these small annual forecasting errors compound over time to become significant.⁵ Second, demographic forecasts do not include the sharp, unanticipated increases in longevity that may result from significant medical breakthroughs. Third, pension plans may not always apply the most conservative set of assumptions when analyzing funded status.

A century of undershooting actual longevity experience

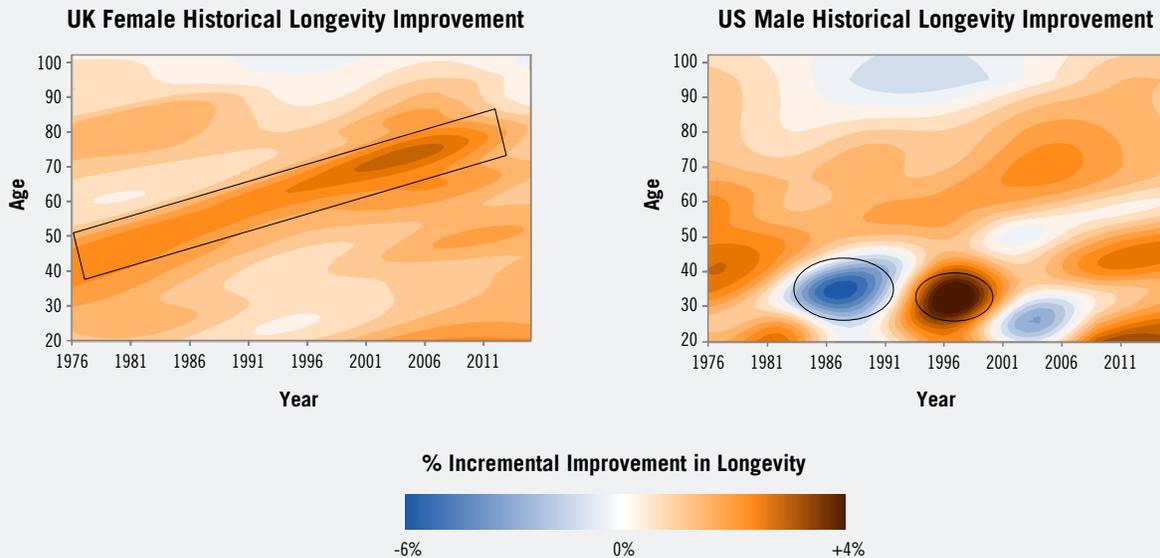
If the last century of experience is any guide, people will likely live longer than currently anticipated by demographers. In the US, each update in longevity estimates from 1930 to 1990 undershot the actual increase in longevity. For the Baby Boomer

generation, the underestimation of longevity continues right up to today. For instance, an American born in 1940 was expected to live on average until 63; current life expectancy for that 1940 cohort is now known to be well over 75.

Indeed, forecasts of longevity can often be off-target, with the discrepancy between expected and actual life spans largely

EXHIBIT 1

Longevity improvements have typically been underestimated in both the UK and US over the last 40 years



Note: US longevity improvements are based on Society of Actuaries' table RP-2014 with improvement scale MP-2015. UK longevity improvements are based on the Institute and Faculty of Actuaries' Continuous Mortality Investigation mortality and morbidity tables.
Source: Society of Actuaries, Institute and Faculty of Actuaries

being a one-sided affair. Regardless of the methodology used, forecasters — over time and across populations — have typically underestimated how long people will actually live.⁶ Much of this underestimation has no doubt been driven by the rapid and unforeseen advances in medicine, health care delivery, and poverty alleviation experienced in many parts of the world.

The past half century in the UK and the US provides an example of longevity underestimation (Exhibit 1). In the UK, for example, the so-called “golden cohort” (shown by the rectangle in the exhibit) — a generation that experienced food rationing during World War II — has continuously beaten forecaster longevity expectations, likely due to the impact of a healthy fruit- and vegetable-based diet and lower consumption of saturated fats at a young age.⁷

The orange areas in the US and UK heat maps indicate the consistent underestimation of longevity improvements. However, there have also been a few periods when forecasters have erred in the opposite direction. For instance, the AIDS epidemic increased mortality rates for US males in their 20s

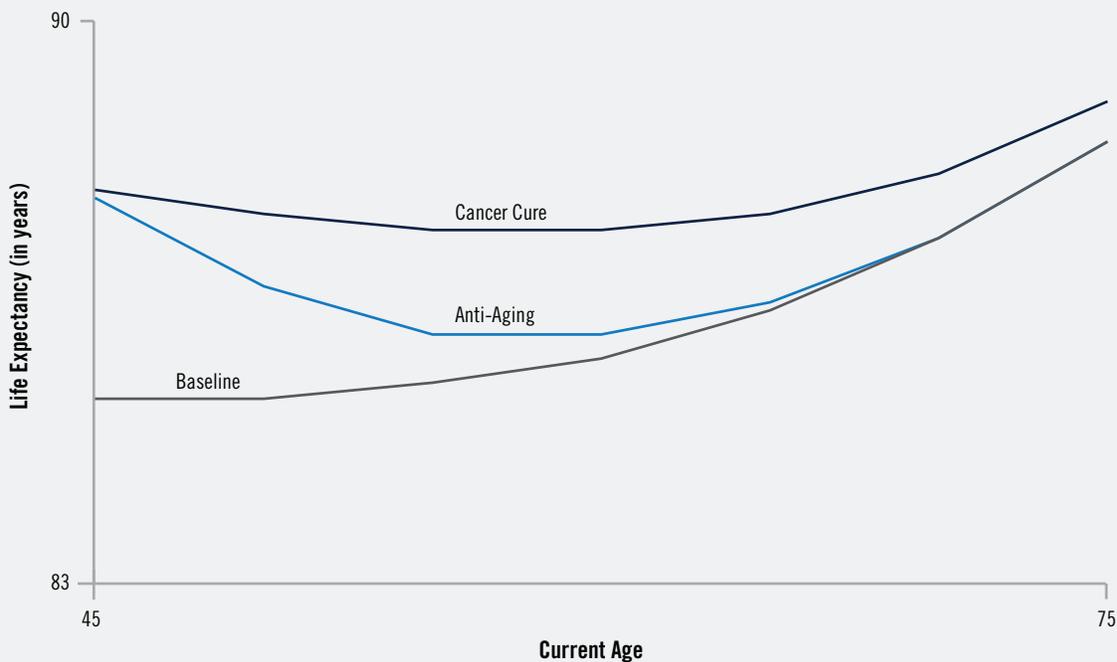
and 30s significantly during the 1980s, but as soon as the use of antiretroviral drugs became widespread, longevity improvement picked up again (as shown by the circles in the exhibit).⁸

The impact of medical breakthroughs

Proprietary actuarial analysis conducted by Prudential Financial, Inc. (PFI)* shows that significant future longevity improvements could potentially result from breakthrough medical advances, which would further exacerbate the underestimation of longevity (Exhibit 2). The impact of such breakthrough discoveries might vary significantly with age. For instance, a cure for all forms of cancer — however theoretical — would likely bring about the greatest longevity improvement for middle-aged individuals but have less of an impact on people in their later years, since they are more susceptible to other ailments. Similarly, for anti-aging genetic treatments, those who are younger are likely to benefit the most since it will take many years for the most promising anti-aging research to move from pre-clinical research to successful clinical trials and ultimately to successful application on humans.

EXHIBIT 2

Potential medical advances could significantly impact life expectancy



From *A Silver Lining: The Investment Implications of an Aging World*

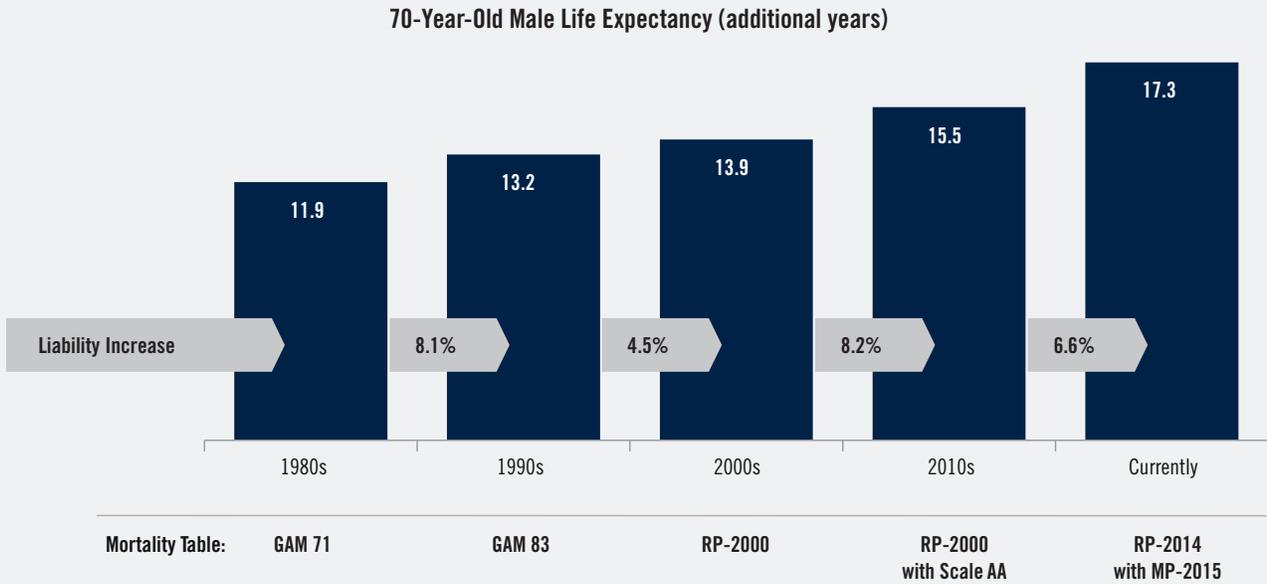
Note: Analysis based on the US population. “Baseline” assumes mortality improvement follows historical trends. “Cancer cure” assumes, theoretically, a mortality improvement equivalent to a cure for all forms of cancer that becomes quickly and widely used. “Anti-aging” assumes anti-aging technology becomes reality in 25 years.

Source: PFI

*PFI, a company incorporated and with its principal place of business in the United States of America, is not affiliated in any manner with Prudential plc, a company headquartered in the United Kingdom.

EXHIBIT 3

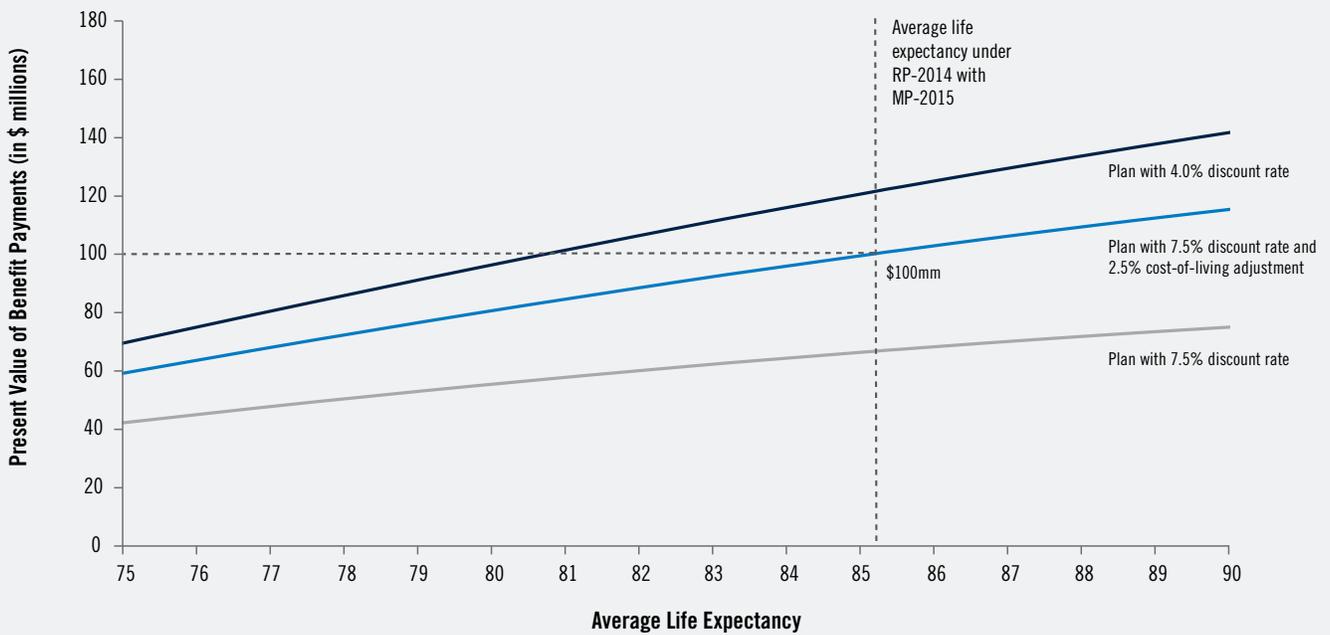
US pension plan sponsors have recognized increasing liabilities as new mortality tables are released



Source: PFI's Retirement Division

EXHIBIT 4

The discount rate utilized will affect the calculation of a plan's liabilities



Note: Line represents Society of Actuaries' table RP-2014 with improvement scale MP-2015. Based on illustrative representative plan.
Source: PGIM Institutional Advisory & Solutions

The impact of accounting on US defined benefit plans

US accounting rules do not prescribe the longevity and discount rate assumptions that must be used for pension cost accounting. This leads to variation in the longevity risk across different plans.

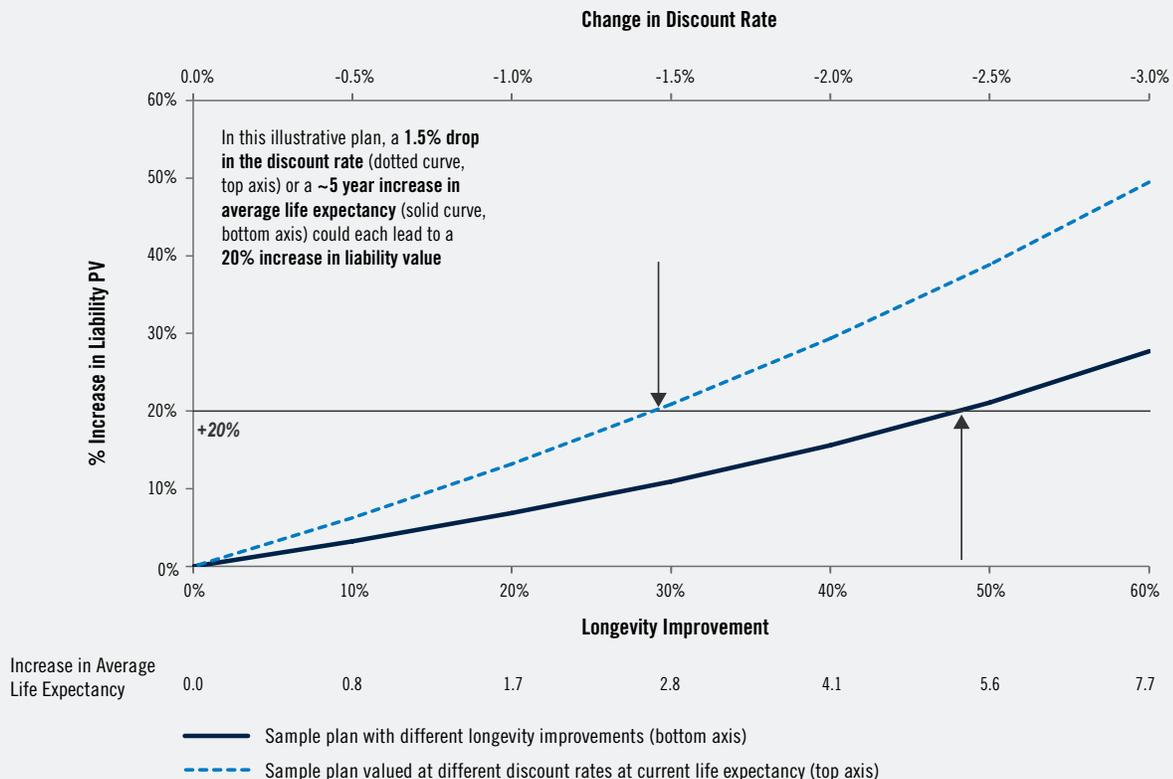
Actuarial tables released in 2014 by the Society of Actuaries (SOA), which US corporations must account for in their financial statements, quantified what many suspected — that pensions underestimated liabilities by an average of 5% to 8%. The tables previously had been updated every 10 years or so, but the SOA recently pledged to provide updates more frequently going forward so that plan sponsors can more accurately project the impact of longevity improvements on their liabilities. In fact, the 2015 update and the recently announced 2016 update led to a downward adjustment in plan liabilities due to a decrease in life expectancy. However, over the long-term, when the SOA's tables are used, projected pension liabilities increase significantly (Exhibit 3).

While changes in longevity can materially impact the pension liabilities of all sponsors, the effect is magnified for pension plans with cost-of-living adjustments or inflation indexation, including many US public pensions and UK public and corporate plans, resulting in even more exposure to longevity risk. Some of these same plans, particularly US public pensions, also tend to use higher-than-market discount rates. Because the impact of increasing longevity on the overall liability value is more readily seen when using a lower discount rate, this means that the very plans that could be most affected by longevity improvements may also be the ones that are least likely to have an accurate measure of its potential impact (Exhibit 4).

In fact, the SOA released a draft paper discussing the accounting practices of state-sponsored pension plans in the US, including questioning the use of higher discount rates and a suggestion to instead use default free rates to develop a more accurate picture of funded status.⁹ Several US public plans have begun reviewing the discount rates they are using, and some are even beginning to decrease them in this low-yield environment.

EXHIBIT 5

Depending on a plan's characteristics, longevity risk may be significant compared to other risks affecting funded status



Note: Sample plan shown for illustrative purposes only with assumed 50% active participants and 50% retirees. The sample plan shown has a duration of 12 years when discounted at 5%.
 Source: PGIM Institutional Advisory & Solutions

On the whole, it does appear plan sponsors are increasingly beginning to tackle the underestimation of longevity in their accounting assumptions. In the recent joint CFO Research/PFI survey, more than 60% of pension sponsors said they have either reviewed participant mortality experience within the past year (46%) or are planning on doing so within the next 12 months (15%).¹⁰

Prioritizing longevity risk

What could additional improvements in longevity mean for pensions going forward? Clearly, the liability values based on an existing set of promised benefits will be larger, but the net impact of increasing longevity depends greatly on the plan itself.

In order to characterize some of the general dynamics, we modeled the potential impact of longevity risk on an illustrative plan with 50% active participants (duration of 16 years when discounted at 5%) and 50% retirees (duration of 8 years when discounted at 5%).¹¹ If the average life expectancy at birth over the next few decades were to unexpectedly increase by 4 or 5 years, then we might expect an increase in the range of 15%-20% in the liability value of our sample plan (Exhibit 5).¹² It is worth noting, however, that this increase would arise over an extended period rather than all at once.

Just how significant is this relative to other risks? The answer depends on a range of plan characteristics, including demographics, duration, and funded status. For our sample

plan, we find that an increase in liability value of this magnitude would be comparable to the impact of a 150-basis-point drop in the discount rate. Of course, the higher the equity allocation in a plan, the more likely that investment risk associated with changes in market values will dominate longevity risk.

Regardless, if the liability increases, there will be an increase in required return (or contributions) over time, just to maintain the original funded ratio. For a fully funded plan, a liability increase of 20% (as highlighted in Exhibit 5) could cause a 15% drop in funded ratio (from 100% to 85%). The magnitude of this effect on funded ratio is comparable to a 30% decline in equities (for a fully funded plan that is 50% invested in equities) — a significant risk event to any plan.

In the UK, where many public and corporate plans also have embedded cost-of-living adjustments and inflation indexation, longevity uncertainty rises up the hierarchy of plan sponsor risk. A recent Willis Towers Watson briefing note demonstrated that as many UK plan sponsors have reduced the volatility of their funding positions, their longevity risk has risen to become a fairly dominant unhedged risk to their funding levels.¹³

Understanding and quantifying the true magnitude of the longevity risk they face is an important first step for plan sponsors. The next section outlines the strategies available to sponsors as they tackle the important issue of longevity and liabilities and seek to ensure the ongoing health of their pension plans for beneficiaries.

PART 2: MANAGING LONGEVITY RISK: AN AGENDA FOR PLAN SPONSORS

Longevity risk is an increasingly critical item on the agenda of all institutions aiming to fulfill their pension obligations against a backdrop of aging populations and rising life expectancies. Unmanaged longevity risk can fundamentally worsen a plan's risk profile, reduce funded status, and lead to unforeseen costs. We believe plan sponsors should consider a three-pronged approach to better address longevity risk into their portfolio decisions:

1. Implement a robust framework to accurately measure and analyze the implications of longevity risk on plan outcomes.
2. Assess the toolbox of investment and protection actions that can mitigate the impact of longevity risk on the plan.
3. Evaluate the desirability, potential timing, and likely costs of risk transfer actions given the impact of longevity risk on plan liabilities and corporate balance sheet volatility.

Below, we lay out a program of actions that can support plan sponsors as they consider the portfolio implications of longevity risk from each of these three angles.

1. Implement a robust framework to measure and analyze the impact of longevity risk

Generate accurate, up-to-date, and customized measures of mortality rates

A foundational starting point for managing longevity risk is to accurately and regularly measure baseline mortality rates and expected longevity improvements.

Best-in-class plans measure baseline mortality rates by taking into account the unique demographic profile of their plan participants, including age, gender, location, socio-economic background, and health characteristics. For plans that are too small to set baseline longevity assumptions solely by looking at in-plan mortality experience, external data sources can be used

to benchmark life expectancies based on the socio-economic characteristics of their plan.¹⁴ Larger plans may carry out plan-specific analysis based on the actual mortality experience of plan participants that can further fine-tune the longevity analysis.¹⁵

Given the historic underestimation of longevity improvements, a robust framework for measuring future mortality rates should incorporate future longevity improvements, relative to the baseline mortality table. Standard longevity improvement assumptions provide a useful starting point, but, if history is any guide, plans may need to account for faster improvements in longevity than standard assumptions and may want to consider updating their forecasts more frequently based on the most robust information.

Adjust plan liabilities based on updated longevity expectations, including the interactions with other investment risks

Interest rate, inflation, and longevity risk all compound each other. When rates fall, the measured impact of longevity on the liability value increases.¹⁶ Similarly, when life expectancy increases, interest rate risk (duration) increases. This compounding of changes in rates and longevity means the combined effect is greater than the sum of the parts and is magnified for cost-of-living-adjusted or inflation-linked plans, which are common amongst US public pensions and UK public and corporate plans.¹⁷ It is therefore critical that plan sponsors measure and manage longevity risk, inflation risk, and interest rate risk in an integrated framework.

Stress test portfolios based on different longevity improvement scenarios

Given the uncertainty around the timing and magnitude of future longevity changes, a thorough liability analysis should incorporate a variety of life expectancy improvement scenarios. One approach would be to begin with the actuarial longevity improvement assumptions as a base case and then test a variety of more aggressive life expectancy improvement scenarios, for example akin to the impact of the medical breakthrough scenarios illustrated in Exhibit 2. Such an analysis would

effectively “stress test” the sensitivity of plan objectives to different longevity outcomes and provides valuable insight on the plan’s resilience and vulnerability to different longevity outcomes.

2. Assess the toolbox of investment actions to mitigate the impact of longevity

Reevaluate the portfolio’s allocation to growth assets

At its core, the investment challenge presented by longevity is that liabilities may continue to grow even larger than had been projected. Many plans are already poorly funded, and this means that assets, already straining to keep up with liabilities, must work even harder. Highly efficient deployment of a plan’s risk budget is essential in order to help contain these widening funding gaps.

One strategy to address the risk of longevity is to consider re-risking the plan and to target sufficient exposure to growth-oriented assets, which are generally expected to carry greater long-term returns. Many plans have been cutting down on growth assets in an effort to de-risk. However, in this low-rate environment, some may wish to re-evaluate and possibly maintain, or even increase, their planned allocations to higher-growth, diversified equity and alternative strategies. For some

plans, sustained allocations to longer-term and less liquid assets such as real estate, infrastructure, and private equity might prove to be particularly suitable in light of larger, and more extended, obligations. The “right” level, of course, depends on the plan’s circumstances, demographics, liquidity needs, and risk tolerance. For example, sponsors looking to realize a funded buy-out in the future may want to consider the cost of offloading less liquid assets in secondary markets in advance of a buy-out. Nevertheless, some sponsors may find that the extended time horizon associated with longer liabilities produces the conditions in which to capitalize on such longer-term investments.

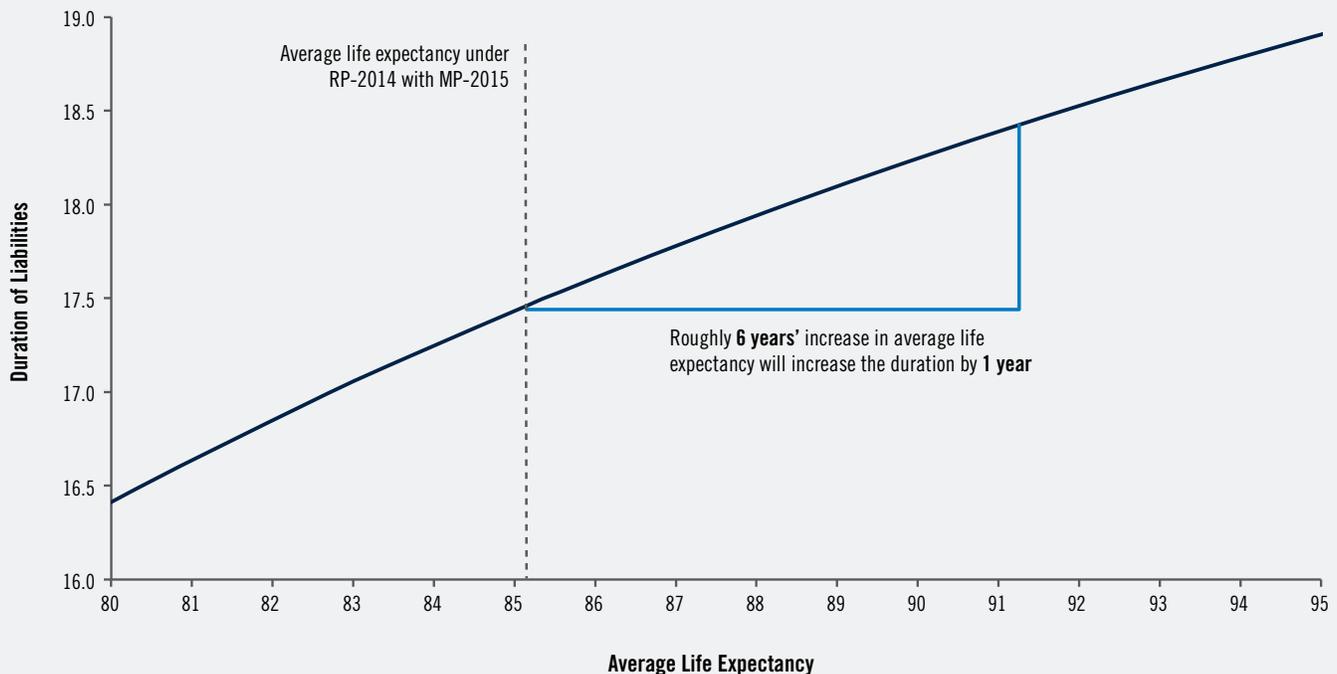
Sponsors should also evaluate the opportunities available in fixed income spread instruments and, when appropriate, incorporate higher-yielding fixed income (e.g., leveraged loans, high yield corporates, or emerging markets debt) or structured fixed income products (e.g., asset-backed securities, mortgage-backed securities, or collateralized loan obligations) to enhance returns via spread, as well as the potential for appreciation.

Address the elevated duration risks associated with longevity

Many plans have been adopting a liability-driven investing approach, which typically involves some matching of bond portfolios or interest rate sensitivity to pension liabilities. Liability-driven investing better aligns the asset side with the

EXHIBIT 6

As retiree pension payments stretch further into the future, the duration of the liabilities increases



Note: Line represents Society of Actuaries’ table RP-2014 with improvement scale MP-2015. Based on illustrative representative plan.
Source: PGIM Institutional Advisory & Solutions

assurances made to participants, specifically managing the exposure to duration, liquidity, and inflation risks. Technically, the recognition that retiree pension payments will stretch further into the future increases the duration of the liabilities, heightening the interest rate sensitivity of the plan (Exhibit 6). This trend would naturally call for longer-duration investments.

Plans that have earmarked a pool of bonds for a given segment’s benefit payments may wish to consider adding to, and lengthening, the bond portfolio. Still, some market participants may be hesitant to lengthen duration or increase their capital allocation to bonds in a low-rate environment.

Another approach for hedging interest rate uncertainty that accompanies longer-duration liabilities is to consider the use of interest rate swaps and futures instead of, or in combination with, cash bonds. These instruments can be useful in the design of more-tailored interest rate exposures and have the benefit of enabling the plan to target a desired hedge ratio without necessarily allocating the equivalent notional to bonds.

Plans that have a specific range around their interest rate risk tolerance, or those with a view on rates, might consider interest rate swap options, or “swaptions.” For instance, a plan could generate income by selling a payer swaption, which would obligate the plan to enter into a contract in which they would receive fixed rates (and pay floating), should rates rise above a

certain level.

This might be appealing to a plan that does not want to commit to longer duration now but would be willing to extend duration if rates were to rise past a certain level. The premium gained could also be used to purchase a receiver swaption, which would allow the plan to receive a fixed interest rate, and pay a floating rate, should rates fall below a certain level. While the value of the collar strategy would fall if interest rates rise (as the value of a bond would), the resulting decrease in pension liabilities would help offset losses.

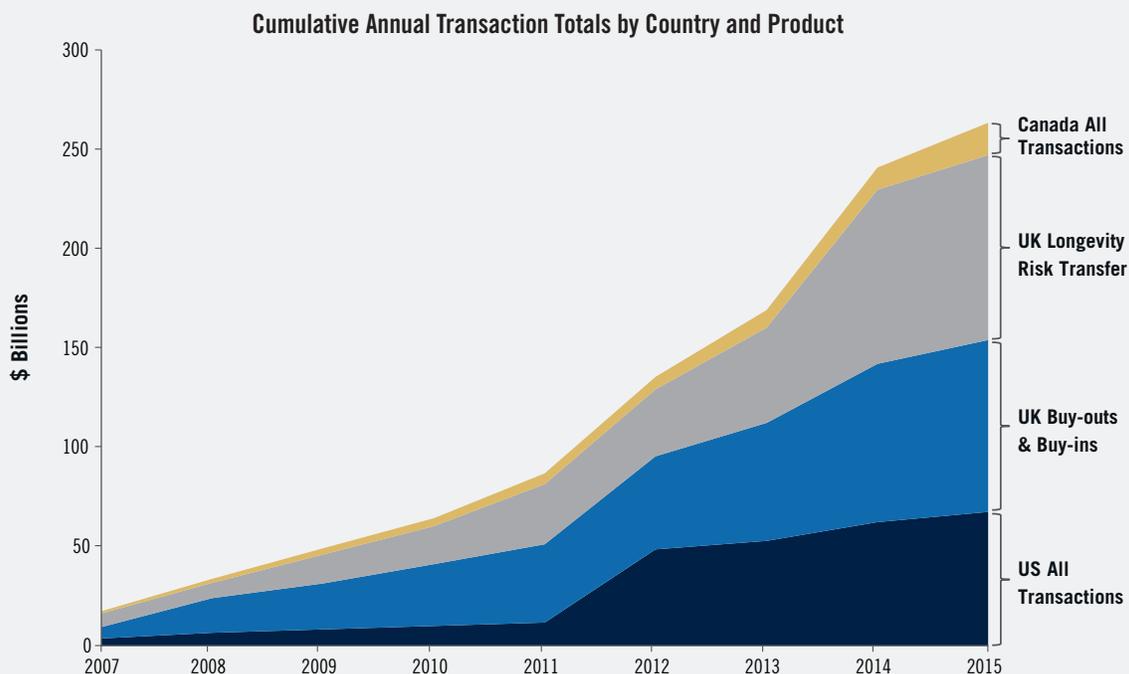
It is important to note that depending on the hedge structure and the level of duration protection already employed, the additional duration produced by any of these interest rate hedging strategies might appear to “overshoot” the liability’s duration unless the liability’s extended longevity is actually recognized.

3. Evaluate the desirability, timing, and financial impact of risk transfer actions

While investment and risk management strategies can provide some flexibility for managing plan outcomes, no investment strategy can completely insulate a pension plan against future unexpected increases in participant life expectancies. To fully hedge against this longevity-driven uncertainty, an increasing

EXHIBIT 7

Risk transfer transactions have been growing rapidly



Source: LCP, LIMRA, Hymans Robertson, and PFI analysis

number of sponsors are engaging in longevity insurance or pension risk transfers (Exhibit 7).

Engage in longevity insurance

With longevity insurance, the pension sponsor transfers the risk of further longevity increases to an insurance company, while the plan retains the assets and liabilities. In other words, the plan retains the interest rate, investment risk, and, in most cases, the inflation risk.

It is especially popular in the UK, where public and corporate pension benefits often include cost-of-living adjustments or inflation indexation, which compound the risk of longevity. To date, most longevity insurance transactions have been for retirees, rather than active participants, given the greater visibility into future longevity paths versus a younger, actively working population.

Purchasing longevity insurance has been part of the risk transfer options in the UK, in addition to pension risk transfer (described below), as the market has needed to keep up with the demand for corporate pension plans seeking reductions to risks surrounding their plan liability growth. Additionally, UK plans have historically been fairly sophisticated in their approach to liability-driven investing, and use of hedging techniques, including hedging longevity risk through longevity insurance.

In the US market, pension risk transfer remains the dominant option (the first longevity insurance transaction in all of North America was just completed in Canada in 2015). However, as more plans look to insurers to transfer their liabilities, longevity insurance may become a compelling option for some sponsors in the US to consider as well.

Evaluate a pension risk transfer

Pension risk transfers can be conducted through a buy-in or a buy-out. While largely similar, there are important differences for plans to consider.

Buy-ins are insurance contracts that enable sponsors to transfer interest rate, investment, and longevity risk to an insurer for a portion of a plan's participants. A buy-in contract is retained as a plan asset, leaving the plan ultimately responsible for

providing pension benefits. These distinguishing features enable buy-ins to fulfill unique objectives such as maintaining funding ratio, avoiding settlement accounting, and providing a phased approach to transferring risk.

A buy-out involves transferring the assets and liabilities of a pension plan to an insurance company, which guarantees payments to participants for life. This effectively settles the liability for the transacted population and shifts all associated uncertainty — including longevity-driven uncertainty — to the insurer. Administrative expenses associated with the pension plan are also reduced, including the elimination of Pension Benefit Guaranty Corporation premiums for covered participants in the US. A buy-out triggers settlement accounting because the sponsor is fully transferring the liability of certain covered participants to an insurer, accelerating recognition of any deferred losses or gains within its defined benefit plan.

A decrease in pension risk could also potentially lower a company's weighted average cost of capital and create value for shareholders.¹⁸ Of course, plan sponsors should carefully evaluate whether a risk reduction strategy makes sense for them, given the particular circumstances of their plan and their risk tolerance.

Mitigating longevity risk

When choosing among the risk mitigation options available to them, plan sponsors will need to consider factors like funded status, plan size, pricing, risk tolerance, and contractual obligations. An appreciation of the full range of potential longevity scenarios will allow sophisticated plan sponsors to use the complete array of asset management and risk mitigation tools at their disposal.

There's no question that a range of views on future longevity improvements exist, with a fairly high degree of subjectivity and uncertainty around various estimates. Nevertheless, the challenge of managing significant future improvements in longevity is one that plan sponsors would do well to closely evaluate. Understanding and quantifying the magnitude of longevity risk can help plan sponsors establish a framework for taking the appropriate actions today to ensure the ongoing health of their pension plans.

Acknowledgments

PGIM gratefully acknowledges the contributions by the following individuals at PGIM and across PFI to our ongoing research on the implications of longevity for investors:

Contributors

Edmund Bellord

Emer Casey

Tully Cheng

Robert Haack

David Hunt

Taimur Hyat

Nan Jiang

Amy Kessler

Gary Knapp

Austin Krompasky

Li Liu

Rohit Mathur

Tom McCartan

Peggy McDonald

Karen McQuiston

Harsh Parikh

Sylvia Pozezanac

Keshav Rajagopalan

George Silos

Michael Straus

Martin Tarlie

Phil Waldeck

Endnotes

- ¹ United Nations Population Division, *World Population Prospects – 2015 Revision*; World Health Organization, “Annex B: Tables of Health Statistics By Country, WHO Region and Globally”
- ² International Monetary Fund – Global Financial Stability Report, *The Financial Impact of Longevity Risk*, April 2012
- ³ Ibid
- ⁴ PGIM, *A Silver Lining: The Investment Implications of an Aging World*, <http://www.pgim.com/silverlining>
- ⁵ International Monetary Fund – Global Financial Stability Report, *The Financial Impact of Longevity Risk*, April 2012
- ⁶ Ibid
- ⁷ Shayla Goldring, Nigel Henretty, Julie Mills, Kate Johnson, and Steve Smallwood, UK Office for National Statistics, “Mortality of the ‘Golden Generation’: What can the ONS Longitudinal Study tell us?”
- ⁸ <https://www.aids.gov/hiv-aids-basics/hiv-aids-101/aids-timeline/>
- ⁹ Joint AAA/SOA Pension Finance Task Force, *Financial Economics Principles Applied to Public Pension Plans*, Working Draft, November 2015
- ¹⁰ CFO Research and PFI, “Closing the Gap in DB Plans,” http://research.prudential.com/documents/rp/CFO_Prudential_ADA_Report_030416.pdf
- ¹¹ Initial values were developed using the RP-2014 mortality table (with MP-2015 improvements) and discounted at 5%. To measure the impact of potential longevity increases, we applied a uniform, proportional improvement in longevity (decrease in mortality) to every age in each sample population. For example, to test a 10% decrease in mortality, we reduced the probability of predicted mortality at each age by 10%; we tested mortality decreases of up to 50% in this manner (corresponding to increases in average life expectancy of up to 7 years). Changes in liability values were measured relative to the beginning liability value of the sample plan.
- ¹² <https://www.imf.org/External/Pubs/FT/GFSR/2012/01/pdf/c4.pdf>, (Table 4.1.1, *Longevity Trends, 1970-2050*)
- ¹³ Willis Towers Watson, Corporate and Trustee Briefing, “Building momentum in the longevity hedging market,” August 2015
- ¹⁴ Gordon Fletcher, *Institutional Investor Journals*, “A New Age of Models and Management for Longevity Risk,” Fall 2012, Vol. 2012, No. 1: pp. 12-17
- ¹⁵ Ibid
- ¹⁶ For a scenario analysis, see Guy Coughlan, Pension Research Council – The Wharton School, *Longevity Risk Management, Corporate Finance, and Sustainable Pensions*
- ¹⁷ Ibid
- ¹⁸ Scott Kaplan and Rohit Mathur, Prudential Retirement, “Reducing Pension Risk: The Five Myths Holding Back Plan Sponsors,” 2016

Important Information

The information contained herein is provided by PGIM, Inc., the principal asset management business of Prudential Financial, Inc. (PFI), and an investment adviser registered with the US Securities and Exchange Commission. PFI is not affiliated in any manner with Prudential plc, a company incorporated in the United Kingdom.

PGIM Limited registered office: Grand Buildings, 1-3 Strand, Trafalgar Square, London, WC2N 5HR is authorised and regulated by the Financial Conduct Authority of the United Kingdom (registration number 193418) and duly passported in various jurisdictions in the EEA. These materials are issued to persons who are professional clients or eligible counterparties for the purposes of the Financial Conduct Authority's Conduct of Business Sourcebook. In certain countries in Asia, information is presented by PGIM Singapore, a Singapore investment manager registered with and licensed by the Monetary Authority of Singapore. In Japan, information is presented by PIMJ, registered investment adviser with the Japanese Financial Services Agency. In South Korea, information is presented by PGIM, Inc., which is licensed to provide discretionary investment management services directly to South Korean investors. In Hong Kong, information is presented by representatives of PGIM (Hong Kong) Limited, a regulated entity with the Securities and Futures Commission in Hong Kong to professional investors as defined in Part 1 of Schedule 1 of the Securities and Futures Ordinance.

These materials are for informational or educational purposes only. The information is not intended as investment advice and is not a recommendation about managing or investing assets. In providing these materials, PGIM is not acting as your fiduciary as defined by the Department of Labor.

These materials represent the views, opinions and recommendations of the author(s) regarding the economic conditions, asset classes, securities, issuers or financial instruments referenced herein. Distribution of this information to any person other than the person to whom it was originally delivered and to such person's advisers is unauthorized, and any reproduction of these materials, in whole or in part, or the divulgence of any of the contents hereof, without prior consent of PGIM is prohibited. Certain information contained herein has been obtained from sources that PGIM believes to be reliable as of the date presented; however, PGIM cannot guarantee the accuracy of such information, assure its completeness, or warrant such information will not be changed. The information contained herein is current as of the date of issuance (or such earlier date as referenced herein) and is subject to change without notice. PGIM has no obligation to update any or all of such information; nor do we make any express or implied warranties or representations as to the completeness or accuracy or accept responsibility for errors. These materials are not intended as an offer or solicitation with respect to the purchase or sale of any security or other financial instrument or any investment management services and should not be used as the basis for any investment decision. No risk management technique can guarantee the mitigation or elimination of risk in any market environment. Past performance is not a guarantee or a reliable indicator of future results and an investment could lose value. No liability whatsoever is accepted for any loss (whether direct, indirect, or consequential) that may arise from any use of the information contained in or derived from this report. PGIM and its affiliates may make investment decisions that are inconsistent with the recommendations or views expressed herein, including for proprietary accounts of PGIM or its affiliates. Any projections or forecasts presented herein are as of the date of this presentation and are subject to change without notice. Actual data will vary and may not be reflected here. Projections and forecasts are subject to high levels of uncertainty. Accordingly, any projections or forecasts should be viewed as merely representative of a broad range of possible outcomes. Projections or forecasts are estimated, based on assumptions, and are subject to significant revision and may change materially as economic and market conditions change. PGIM has no obligation to provide updates or changes to any projections or forecasts.

The opinions and recommendations herein do not take into account individual client circumstances, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies to particular clients or prospects. No determination has been made regarding the suitability of any securities, financial instruments or strategies for particular clients or prospects. For any securities or financial instruments mentioned herein, the recipient(s) of this report must make its own independent decisions.

Conflicts of Interest: PGIM and its affiliates may have investment advisory or other business relationships with the issuers of securities referenced herein. PGIM and its affiliates, officers, directors and employees may from time to time have long or short positions in and buy or sell securities or financial instruments referenced herein. PGIM and its affiliates may develop and publish research that is independent of, and different than, the recommendations contained herein. PGIM's personnel other than the author(s), such as sales, marketing and trading personnel, may provide oral or written market commentary or ideas to PGIM's clients or prospects or proprietary investment ideas that differ from the views expressed herein.

© 2017 PFI and its related entities.

PGIM 1017-1400

About PGIM

PGIM is a top 10 global investment manager offering a range of investment solutions for retail and institutional investors around the world across a broad range of asset classes, including fundamental equity, quantitative equity, public fixed income, private fixed income, real estate and commercial mortgages. Its businesses have offices in 16 countries across five continents and had over \$1 trillion in assets under management as of September 30, 2016. PGIM is the global investment management businesses of PFI. (NYSE: PRU). For more information, please visit us at www.pgim.com.



PGIM, Inc.

Prudential Tower
655 Broad Street
Newark, NJ 07102
+1 973 367 9213

For inquiries, please contact
thought.leadership@pgim.com

Visit us online at www.pgim.com