Recreating Sustainable Retirement

Resilience, Solvency, and Tail Risk

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Longevity Risk Management, Corporate Finance, and Sustainable Pensions

Guy Coughlan

Longevity risk poses a significant threat to the provision of retirement income. With life expectancy having steadily risen in most of the world's countries, so too has the cost of providing adequate income in retirement. Moreover, the fact that actuaries and demographers have consistently underestimated these increases in life expectancy is a cause for concern and calls into question the sustainability of defined benefit (DB) pension plans and the adequacy of individual retirement savings.[1]

Until recently, longevity risk was an unacknowledged risk in DB pension plans, despite being an obvious risk for individuals who financed their retirement directly from savings. Just how big longevity risk actually is depends on the details of each pension plan: in particular, the precise nature of its benefits and the demographic profile of its members (or beneficiaries). For most DB pension plans, longevity risk has generally been smaller than both the investment risk associated with the pension assets and the interest rate risk associated with the pension liability. Yet for pension plans that have substantially de-risked and/or have a low funded status, longevity risk can emerge as much more significant.

The development of new tools to measure and manage longevity risk means that DB pension plans now have at their disposal a complete toolkit for ensuring the plan is managed in a sustainable fashion. But simply having the tools available is not enough. To make sustainability a real possibility requires not only appropriate implementation, but also, for many plan sponsors, a change in mindset. In particular, it means taking a perspective which has a greater focus on the financial economics of the plan and a reduced focus on the accounting. For corporate pension plans, this means also taking account of the principles of corporate finance and the interrelationships between the pension plan and the sponsor.

This chapter emphasizes the importance of addressing longevity risk in DB pension plans and presents a framework for the sustainable management of these plans based on these observations. Our framework provides a basis for long-term management of the plan, in a way that minimizes the likelihood that the sponsor will be required to make an excessively large unplanned contribution at some future date, and also maximizes the likelihood that plan members will receive their full pension benefits.

In what follows, we address the notion of sustainability for DB pension plans and what it means for pension management. We then discuss the size of longevity risk and its significance for DB plans. Subsequently we review the development of the longevity market and the new instruments for managing longevity risk that make sustainability a realistic goal. The corporate finance context of pensions is then presented as the appropriate stage for addressing longevity risk management decisions. Our discussion emphasizes the importance of understanding the differing, but interrelated, perspectives of the sponsor and the plan. Finally, we present a framework for sustainable management of DB pension plans, which incorporates decisions related to management of longevity risk.

Long-term Alternatives for DB Plans

Over the long term, there are only two possible strategic alternatives for the sponsor of a DB pension plan: transfer it or keep it. The decision to transfer it, now or at some time in the future, means executing a pension buyout, or termination, with an insurance company. This is the traditional approach to managing longevity risk and it involves selling the longevity risk along with all other risks and transferring pension obligations to the insurer, thereby removing the pension from the sponsor's balance sheet. In contrast, a decision to keep the pension plan entails a commitment to maintain it for the long term. This involves managing the longevity risk (along with all other risks) over the life of the plan.

In both cases, the management of the pension assets against the pension liability requires a focus on the underlying economics of the plan, rather than the accounting. When the objective is a buyout/termination, the insurer will certainly take this long-term economic perspective. So moving from an accounting focus to an economic focus soon becomes prudent. When the objective is to keep the plan over the long term, this necessitates a long-term perspective on performance and risk, along with a long-term commitment to manage the plan sustainably. Since it is the economics that matters over the long term, an economic perspective is also vital in this case.

Managing DB Pension Plans Sustainably

Insurance companies in the business of providing life annuities and pension buyouts are practical examples of the kind of sustainable management relevant to DB pension plans. These insurers, in fact, make a profitable business out of managing what are effectively (at least in economic terms) DB pension plans. They do so by fully (or indeed over-) funding the liability, hedging unrewarded and unwanted risks, and managing a carefully designed, diversified investment strategy. Moreover, they do so within the tightly controlled regime of insurance regulation, which effectively places limits on the minimal level of funding, the risk profile, and the

investment strategy. It is partly because of these restrictions that the annuity business has remained profitable and sustainable.

Clearly DB pension plans are different from annuity portfolios and cannot be managed in exactly the same way. In particular, unlike annuity portfolios, they may be underfunded and are associated with a sponsor for whom managing pensions is not the main business line. Nevertheless, the insurance example provides practical pointers as to what pension plans and their sponsors can do to make them more sustainable.

Sustainability for DB pension plans means being able to manage the plans for the long term, without (a) exposing the sponsors to the potential requirement of making excessively large contributions at some future date and (b) exposing plan members to increased risk that the sponsors are unable to pay pension benefits in full. In practice, sustainability can only be achieved by ensuring two things. The first is that a credible and sustainable strategy is in place for funding the pension plan through contributions. The second is that the risks facing the plan are appropriately sized and diversified, relative to the plan's funded status and relative to the size, risk profile, and financial strength of the sponsor. These require a thorough understanding of both the perspective of the pension plan and the perspective of the sponsor, which reflects the interdependencies between them in the context of corporate finance. This is a point on which we elaborate further on in the chapter.

How Significant is Longevity Risk for DB Pension Plans?

As mentioned, the significance of longevity risk for a DB pension plan depends on the details of the plan:: specifically, the nature of its benefits and the demographic profile of its members. Some key factors determining the size of this risk are listed

Table 6.1 Factors that impact the longevity risk in a DB pension plan

Category	Factor
Demographic	Number of members
	Age profile
	Gender profile
	Socioeconomic profile
	Aggregate health profile
	Profile of spouses and dependents
	Willingness of members to take lump sums (if available)
	Utilization of other optional benefits
Benefit structure	Fixed benefits vs. inflation- or COLA-linked benefits
	Nature of lump sum options
	Nature of spouse and dependent benefits
	Nature of other optional benefits and payment adjustments

Source: Author's tabulation.

in Table 6.1. The principal demographic factors relate to the age and socioeconomic profiles of the members, whereas the factors relating to benefit structure include whether the benefit payments are fixed or rise in line with inflation, or some other cost of living adjustment (COLA). If a plan has an inflation- or COLA-linked benefit structure, the longevity risk is significantly magnified. Another benefit structure-related factor is the nature of lump sum options. If a plan permits members to take a lump sum payment in lieu of a pension at an attractive conversion price, then longevity risk will be diminished by an amount that depends on the take-up rate.

Relative to the financial risks faced by most DB pension plans, longevity risk is usually smaller. For most U.S. and U.K. plans, their traditional high allocation to growth assets (principally equities) has meant that longevity risk has generally been smaller than investment risk. Additionally, longevity risk has been typically smaller than the interest rate risk associated with the pension liability. Despite this, longevity risk can emerge as much more significant in relative terms if the plan has low funded status, has substantially de-risked by reducing its equity allocation, and/or has hedged a significant amount of its liability interest rate risk.

Unfortunately, the significance of longevity risk must be measured in detail for each pension plan. This involves a two-stage process, where the first stage involves evaluating the likelihood and size of potential increases in life expectancy for the plan members/beneficiaries. The second stage involves evaluating how these potential future increases in life expectancy impact the pension liability. The resulting longevity risk depends on the factors related to the demographics and benefit structure, as listed in Table 6.1.

Stage 1: Projecting Future Mortality

Life expectancy is estimated by measuring current mortality rates and forecasting future rates, taking account of how the observed historical trend of falling mortality rates—referred to as mortality 'improvements'—is likely to evolve in the future. So the first stage in evaluating longevity risk requires quantifying the potential range of outcomes for the trend of future mortality improvements, relative to the initial (or base) mortality table.

Typically, actuaries develop longevity forecasts based on extrapolative methods that project future mortality from historical trends (Lee and Carter 1992; Currie et al. 2004; Cairns et al. 2006).[2] These are complex models that are widely used for valuation and risk assessment of pension plans and insurers' annuity portfolios.

So historical mortality improvements provide a useful input into how mortality rates might evolve in the future. Figure 6.1 shows average annualized mortality improvements for U.S. males in five-year age groups over the 41-year period 1968–2008.[3] These average improvements range from 0.96 percent *per annum* (p.a.) for ages 25–29 to 1.92 percent p.a. for ages 60–64. Note that a mortality improvement of 0.96 percent p.a. means that next year's mortality rate will be 99.04 percent of

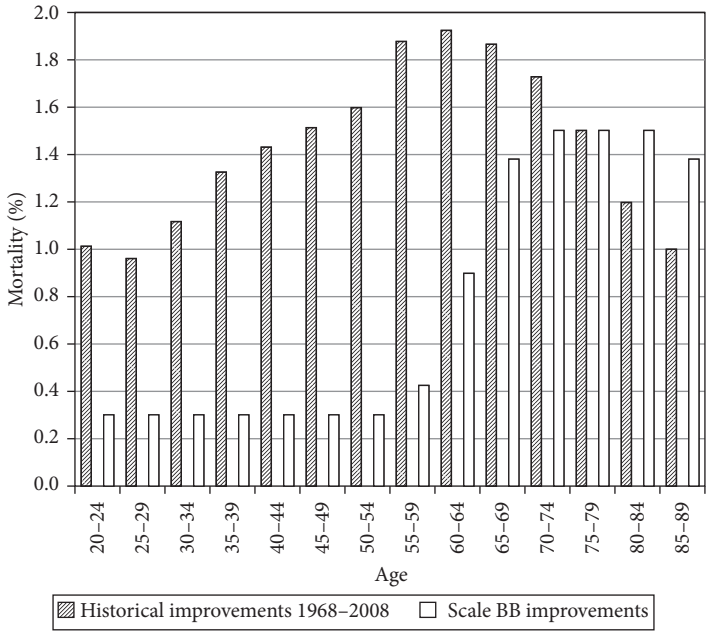

Figure 6.1. Average mortality improvements for U.S. males in different age groups over the period 1968–2008 compared with Scale BB.

Source: LifeMetrics data for the U.S. national population and Society of Actuaries (2012).

this year's mortality rate, then the following year's mortality rate will be 99.04 percent of the next year's rate, etc.

It is important to note that the average improvements in Figure 6.1 obscure considerable variation over time. This is illustrated in Figure 6.2, which shows annualized five-year mortality improvements for ages 70–74.[4] The average mortality improvement for this age group is 1.74 percent p.a., but over the period it shows an upward trend rising from 0.70 percent p.a. to 2.44 percent p.a. with significant volatility.

For comparison, Figure 6.1 also shows the Scale BB forecast improvements published by the Society of Actuaries (2012) for use in pension valuations. The Scale BB improvements are generally below the historical averages, except for ages 75 and over, but even for these higher ages the Scale BB improvements are significantly below the most recent five-year improvements.

If we take an aggregate view of five-year mortality improvements across all age groups and all years collectively, then the average improvement comes to 1.43 percent p.a. with a standard deviation of 1.51 percent and a 95 percent confidence 'worst case' improvement of 3.38 percent p.a. Figure 6.3 shows a histogram of all these mortality improvements, which illustrates the degree of volatility in the

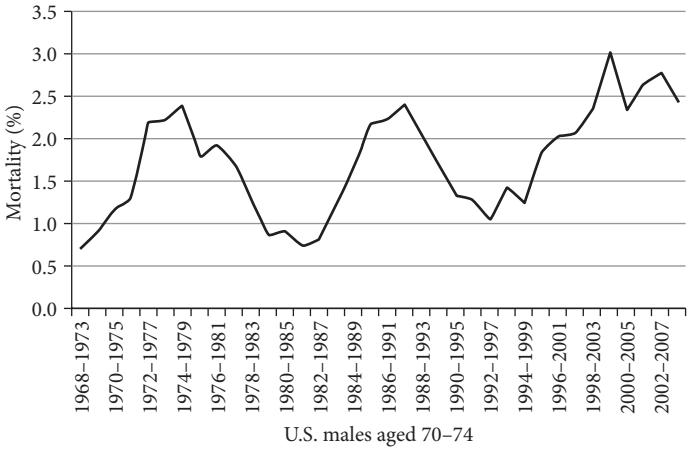

Figure 6.2. Annualized five-year mortality improvements for U.S. males aged 70–74 over 1968–2008.

Source: LifeMetrics data for the U.S. national population and author's calculations.

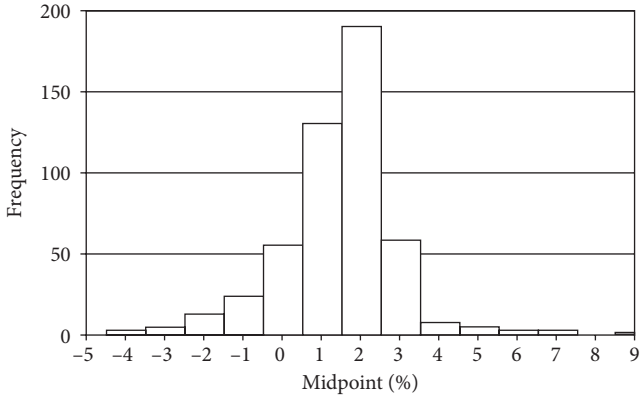

Figure 6.3. Histogram of mortality improvements 1968–2008. Annualized five-year mortality improvements for U.S. males in five-year age groups from 20–24 to 85–89.

Source: LifeMetrics data for the U.S. national population and author's calculations.

historical observations. Note the absolute worst case is an improvement of 8.55 percent p.a., which occurred for ages 30–34 over the period 1995–2000.

Stage 2: Impact on the Pension Liability

The second stage in the evaluation of longevity risk involves measuring the impact of projected mortality improvements on the pension liability. This can be evaluated

TABLE 6.2 Mortality *q*-duration and interest rate duration for generic U.S. pension benefits without a lump-sum option

	45-year-old pre-retirement	65-year-old retiree (pensioner)
Initial life expectancy	37.1 years	19.2 years
Impact on life expectancy of an unexpected mortality improvement of 1% p.a.	+3.9 years	+1.4 years
q-duration for a fixed pension*	16	5
q-duration for an inflation- or COLA-linked pension*	22	8
Interest rate duration for a fixed pension**	36	11
Interest rate duration for an inflation- or COLA-linked pension**	39	13

Notes:

* % increase in pension value due to a 1% p.a. unexpected improvement in mortality rates

** % increase in pension value due to a 1% fall in interest rates

Source: Author's calculations.

either in terms of a stochastic value-at-risk (VaR) metric or in terms of a sensitivity metric similar to interest rate duration called mortality duration, or '*q*-duration' (Coughlan et al. 2007a).

Mortality *q*-duration is defined as the percentage increase in the value of a pension liability if mortality improvements are higher (and mortality rates correspondingly lower) than expected by 1 percent per year compounded (Coughlan et al. 2008a). Table 6.2 compares the mortality *q*-duration and interest rate duration for generic U.S. pension benefits without lump sums for 45-year-old and 65-year-old U.S. males. Note that *q*-duration, although much smaller than interest rate duration, is still significant. This is partly due to the mortality improvement expectations for these individuals and partly due to the current interest rate environment, in which nominal interest rates are very low and real rates are negative at all but the longest maturities.[5] Table 6.2 shows that if mortality improvements are underestimated by 1 percent p.a. then a fixed pension liability (with no inflation or COLA linkage) increases by 15 percent for 45-year-olds and by 5 percent for 65-year-olds. For an inflation- or COLA-linked liability the increases are 22 percent and 8 percent respectively. Note that the longevity risk and interest rate risk are both higher for younger plan members than for older members, reflecting the longer duration (*q*-duration and interest rate duration) of pensions for the former.

Longevity, Interest Rate, and Inflation Risks

Longevity risk, interest rate risk, and inflation risk are the key risks to which DB pension liabilities are subject,[6] but the relationship between them is often overlooked. For example, despite the fact that mortality rates and interest rates appear to be uncorrelated, longevity risk and interest rate risk are actually interdependent. When interest rates fall, longevity risk increases, and when life expectancy increases, interest rate risk increases. Moreover, the impact of a combined change

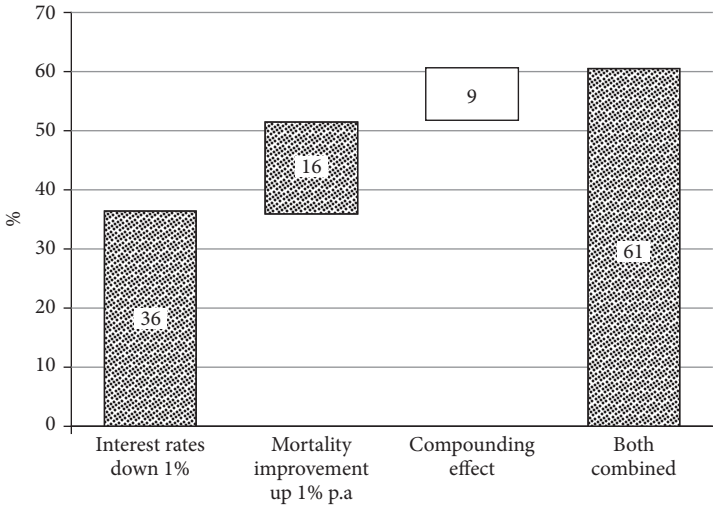

Figure 6.4 Impact of an interest rate stress and mortality improvement stress on the value of the pension liability (fixed benefit payments) for 45-year-olds.

Source: Author's calculations.

in interest rates and longevity is greater than the sum of the parts. In other words, the impact of a combined fall in interest rates and an increase in mortality improvements is actually greater than the sum of the impacts of these changes separately. This compounding effect can be seen clearly in Figure 6.4. The same is true of the combination of longevity risk and inflation risk.

The obvious implication of this interrelationship is that longevity risk and interest rate risk (and inflation risk where appropriate) should be measured and managed together in a coordinated fashion. Moreover, the advent of longevity swaps now makes it practical to coordinate the hedging of longevity risk and interest rate risk of pension liabilities. This brings a new dimension to so-called liability-driven investing (LDI) strategies and to other strategies that are liability 'aware.'

The Significance of Longevity Risk

Such analysis shows that longevity risk can be very significant for many DB pension plans, depending on their benefit structure and demographics. It can lead to higher benefit payments than expected over a longer period of time than expected, thereby increasing the value of the pension liability. This can have a devastating impact on the funded status of the plan over the medium term—even if the investment and risk management strategies are best in class.

Ignoring longevity risk means that pension plans cannot be credibly managed for the long term. It also means that pension buyouts/terminations will appear relatively more expensive. For these reasons, longevity risk needs to be incorporated into both the process of measuring risk and the strategy for managing risk.

Evolution of Longevity Risk Management

The development of new tools such as longevity swaps has made longevity risk management viable for DB pension plans. Before the development of such tools, the management of longevity risk was rigidly tied to both funding and the management of other pension-related risks. In particular, instruments for removing longevity risk also removed other risks and, moreover, required that the pension be funded at least to the level of the risk mitigation. In this section, we briefly review the evolution of longevity risk management from traditional annuities to the flexible, new capital markets solutions. The different types of longevity risk management solutions are summarized in Table 6.3.

Longevity risk management essentially began as an insurance activity. This involves individuals and DB pension plans buying annuities from insurers, in order to provide certainty of retirement income regardless of how long people live. The annuity insurers then invest the proceeds from selling annuities and manage the

Table 6.3 Summary of longevity risk management solutions that have been transacted

Solution	Type of contract	Risks transferred or hedged	Comments
Buyout or termination	Insurance	Longevity risk and all other financial and demographic risks	Removes pension plan from the sponsor's balance sheet
Buy-in	Insurance	Longevity risk and all other financial and demographic risks	Annuities become pension plan assets and the plan remains on the sponsor's balance sheet
Lump sum offer	Agreement between sponsor and beneficiaries	Longevity risk and all other risks	Removes pension plan from the sponsor's balance sheet
Longevity swap	Capital markets or insurance	Longevity risk only	Exchanges actual pension benefit payments (based on realized longevity) for a fixed set of payments
q-forward	Capital markets	Longevity risk only	Exchanges a payment based on a realized mortality rate for a fixed payment
Synthetic buy-in	Capital markets or insurance	Longevity risk and selected other financial risks	Combines longevity swaps with hedges of financial risks (e.g. interest rate swaps) in a flexible way. May also include asset swaps
Out-of-the-money longevity swap	Capital markets or insurance	A portion of the longevity risk. Specifically just that associated with large increases in life expectancy	Does not hedge increases in life expectancy that are below a certain level

Source: Author's tabulation.

assets (i.e. investments) against these liabilities (i.e. annuities). Since annuities are of very long duration, insurers manage these portfolios using a carefully constructed long-term investment and risk management program.

Pension Buyouts, Buy-ins, and Terminations

The traditional solution for managing the longevity risk in a DB pension plan is to transfer the liability, along with all its risks, to an insurer via a contract of insurance. This type of transaction is called a pension buyout, or pension termination. A buyout is one endgame for a DB pension plan, in that it removes the pension liability from the plan sponsor's balance sheet. This process involves transferring the pension assets and liabilities to an insurer, together with a top-up payment. This payment is required to bring the assets up to the level of the so-called 'buy-out liability,' which is typically larger than the size of the liability recorded in the accounts. This liability is larger because it generally reflects more realistic longevity assumptions, market-based risk-free discount rates, expenses, and a risk premium.

A related type of solution is a pension buy-in, which, in contrast to a buyout, does not remove the pension liability from the sponsor's balance sheet. It involves the bulk purchase of annuities by the pension plan to match the obligations and risks associated with a subset of the plan's liabilities, typically associated with retired members. In a buy-in, the annuities become assets of the plan and reflect the exact mortality and demographic characteristics of the plan's beneficiaries. Buy-ins are often used as stepping stones to a buyout. They effectively reduce the size of the pension plan in economic terms, but not necessarily in accounting or regulatory terms. Their utility lies in their ability to enable the plan to move towards a buyout gradually over time, allowing the sponsor to avoid the large upfront payment that is required in a buyout (at least for plans that are underfunded on this basis) and also allowing the sponsor to take advantage of periods in which annuity pricing is favorable.

Note that as a result of innovation, actual transactions have recently become more complex and in many cases cannot be accurately characterized as a simple buyout or buy-in.

The modern longevity market, of which buyouts and buy-ins are a part, effectively began in 2006 in the U.K. with the launch of several new monoline insurers set up specifically to acquire DB pension plans.[7] Prior to this time, the buyout market in the U.K., like that in the U.S. and elsewhere, comprised pension plans that were being wound up, often due to the insolvency of the sponsor. This proto-market was characterized by a large number of small buyout transactions typically totaling £1.5–2 billion a year in the U.K., and similar levels in the U.S. and Canada.

Crucially for the development of the market, the new specialist insurers were backed by investment banks and private equity, which brought a new mindset and helped crystallize innovation within the market. This has led to the creation of new capital market-based solutions, as well as new insurance-based solutions.

New Solutions for Longevity Risk

Shortly after the birth of the longevity market, capital markets-based solutions for managing longevity risk began to emerge. These solutions were motivated by a perceived need for additional capacity for bearing longevity risk; greater diversity of counterparties; liquidity and flexibility; fungibility; and better management of counterparty credit risk.

Longevity Bonds

One of the earliest proposals for a capital markets-based longevity hedging instrument was the so-called longevity bond (Blake and Burrows 2001; Blake et al. 2006), which predated the birth of the longevity market. A longevity bond (or survivor bond) is essentially a life annuity bond with no return of principal, whose payments decline in line with the survivorship profile of a population of individuals. If the individuals in the population live longer than expected, then the bond makes correspondingly larger payments than expected.

The first attempt to issue a longevity bond to manage the longevity risk of DB pension plans took place in 2004, when the European Investment Bank (EIB) sought to launch a 25-year, £540 million longevity bond with an initial coupon of £50 million (Azzopardi 2005). The reference population for calculating survivorship was all 65-year-old males from the national population of England and Wales as reflected in mortality statistics produced by the U.K. Government Actuary's Department. The structurer and lead manager for the bond was the French bank BNP Paribas, which intended to assume the longevity risk and then reinsure it through PartnerRe. Unfortunately, the bond was unsuccessful for several reasons connected with its structure and the lack of education of its target market (Blake et al. 2006).

Then in 2006, the World Bank, with the help of the Chilean insurance regulator, the Superintendencia de Valores y Seguros (SVS), made another attempt to issue a longevity bond, but this time in Chile (Zelenko 2011). The bond was targeted at insurers who provide retirement annuities and the SVS agreed to provide explicit regulatory capital relief to insurers who hedged the risk. A feasibility project was conducted with BNP Paribas, but the effort foundered due to the high cost of what was envisaged to be a World Bank-issued longevity bond. Following this, the World Bank turned to J.P. Morgan to develop a more cost-effective 25-year maturity bond structure that was designed to provide an effective hedge, with minimal basis risk. The longevity bond was to be issued out of a collateralized special purpose entity, with Munich Re taking the longevity risk and J.P. Morgan managing the cash flow mismatch between the various payment streams (Coughlan 2009; Life & Pension Risk 2010). This bond, like others before it, was not successful for reasons related to its novelty and what was perceived to be little need to hedge.

The First Successful Capital Markets Solutions

In 2007, a very different capital markets instrument for transferring longevity risk, called a '*q*-forward,' was proposed (Coughlan et al. 2007b). This instrument was a mortality forward-rate contract, a financial derivative that locks in a fixed mortality rate at a future time. Its name comes from the actuarial symbol for a mortality rate, '*q*.'

A *q*-forward is an agreement in which two parties agree to exchange an amount proportional to the actual, realized mortality rate of a given population, in return for an amount proportional to a fixed mortality rate at a future date (the maturity of the contract). The importance of *q*-forwards derives from the fact that they are building-blocks from which other, more complex, instruments can be constructed. When appropriately designed, a portfolio of *q*-forwards can be used to hedge the longevity exposure of an annuity or a pension liability with a high degree of effectiveness.

The first successful capital markets transaction to hedge longevity risk was in fact a *q*-forward contract. It was executed by Lucida PLC, a pension buyout insurer, in January 2008 (Lucida 2008; Symmons 2008). The instrument was a *q*-forward linked to a longevity index based on England and Wales national male mortality for a range of different ages.[8] The hedge was provided by J.P. Morgan, and was novel not just because it involved a longevity index and a new kind of product, but also because it was designed as a hedge of liability value rather than a hedge of liability cash flow. In other words, it hedged the value of the annuity, not the actual annuity payments.

Soon afterwards, in July 2008, J.P. Morgan completed another capital market-based longevity hedge, this time with Canada Life in the U.K. (Trading Risk 2008; Life and Pension Risk 2008). But in this case, the hedging instrument was different from that used by Lucida. It was a 40-year maturity £500 million longevity swap linked not to an index, but to the actual mortality experience of the 125,000-plus annuitants in Canada Life's annuity portfolio. It also differed in being a cash flow hedge of longevity risk by hedging the variability in pension benefit cash flows rather than just the variability in the value of the liability. And most significantly, this transaction brought capital markets investors into the longevity market for the very first time, as the longevity risk was passed from Canada Life to J.P. Morgan and then directly on to investors. The Canada Life–J.P. Morgan longevity swap has become a standard instrument for transferring longevity risk. Such a longevity swap involves the exchange on a regular basis of the actual realized annuity, or pension benefit, payments for a fixed set of payments based on fixed life expectancy.

The third capital markets longevity swap to be completed was a hybrid of the first two, involving a hedge of both cash flow and value provided by RBS to U.K. insurer Aviva in March 2009. It was a £475 million hedge based on the actual mortality experience of Aviva's annuitants. The longevity risk in this transaction was also placed with a group of capital markets investors (Towers Perrin 2009; Trading Risk 2010).

June 2009 saw the execution of the first longevity swap implemented by a pension plan. Babcock International implemented a series of customized longevity swaps totaling £1.2 billion to hedge the longevity risk in its three U.K. pension plans. These were capital markets swaps transacted with Credit Suisse. Although the structure of the swap was not new, being essentially the same as that of the Canada Life–J.P. Morgan swap, it was significant in that it demonstrated the practical relevance of longevity swaps for managing longevity risk in DB pension plans.

New Insurance Solutions

At the same time, product innovation was also occurring in insurance-based solutions. An example of this was the 'synthetic pension buy-in,' the first of which was transacted in July 2009 by the pension plan of RSA Insurance Group. This was essentially an asset-swap-funded longevity swap executed in insurance format with Rothesay Life, which also incorporated hedges of inflation risk and interest rate risk. An important component in this £1.9 billion transaction was a total return swap—of U.K. government securities (gilts) for higher-yielding government-backed bonds—whose cash flows were used to fund the longevity swap. The key to this synthetic buy-in was the effective combination of insurance and capital markets capabilities across Rothesay Life and its parent, Goldman Sachs (Tsentas 2011). Also in 2009, the first public sector pension plan transacted a longevity swap in the U.K. The Royal County of Berkshire Pension Fund entered a £750 million insurance-based longevity swap with Swiss Re to hedge a portion of its longevity risk.

Initiatives to Facilitate Market Development

In addition to the developments described which were designed to facilitate individual transactions, there were also a number of initiatives broadly aimed at facilitating the development of the longevity market as a whole. Here we mention the most significant.

The first of these was LifeMetrics (Coughlan et al. 2007a, 2007c, 2008b), launched by J.P. Morgan in association with the Pensions Institute and Towers Watson in 2007, with the aim of promoting standardization and education. LifeMetrics was from its launch a publicly available set of resources for measuring and managing longevity risk that included a risk management framework, longevity indices (for the U.S., England and Wales, Germany, and the Netherlands), analytics, and software. The framework blended actuarial and financial perspectives on longevity, in order to educate and establish a common basis for longevity risk management across the insurance, pension, banking, and investment management industries.

Then in November 2008, Hymans Robertson, a pension consultant, launched an organization to enable U.K. pension plans to pool mortality data in return for

regular analysis and reporting on longevity (Hymans Robertson 2008). Called Club Vita, it aimed to provide pension plans with better and timelier information on longevity trends. By 2011, Club Vita had amassed a huge longevity database with more than 130 large pension plans contributing data, including the U.K.'s Pension Protection Fund (PPF).[9]

Another facilitating initiative was the formation in 2010 of a not-for-profit, cross-industry trade association called the Life & Longevity Markets Association (LLMA). The LLMA aims to 'promote a liquid, traded market in longevity and mortality-related risk' by supporting the development of 'consistent standards, methodologies and benchmarks.'[10] In April 2011, the LLMA acquired the LifeMetrics Longevity Index from J.P. Morgan.

Developments in the U.S. Market

The U.K. initiated the development of the longevity market, but progress has also been made recently in other countries, notably the U.S., Canada, and the Netherlands. The U.S., in particular, has seen several important transactions since 2011. For example, in May 2011, U.S. insurer Prudential announced a high-profile $75 million buy-in for the pension plan of Hickory Springs Manufacturing Company. Then 2012 saw several significant transactions, including very large deals by General Motors and Verizon. We return to these in the next section.

Pension Risk Management and Corporate Finance

Next we describe the corporate finance context of DB pension plans, which provides the backdrop for the management of longevity risk and also has important implications for the sustainable management of these plans.

In 2012, four major U.S. corporations announced significant initiatives to address the challenges associated with their U.S. pension plans. Each of these was very different from the other. The first took place in April, when Ford announced it was offering lump sum payments to some 90,000 retirees (pensioners) and terminated vested (i.e. deferred) plan members as part of a long-term de-risking strategy. This offering effectively transferred the longevity risk, investment risk, and all other pension-related risks to the individual members. This was followed by General Motors' (GM) announcement in June of its intention to remove $29 billion of pension liability from its balance sheet, with a combination of (a) retiree lump sums, (b) a spin-off of active and terminated vested members into a new GM pension plan, and (c) the termination of the residual retiree plan. This combination transferred the longevity risk to external parties, including retirees and an insurance company (Prudential). Then in October, Verizon announced the buyout

(with accounting settlement) of $7.5 billion of pension liabilities. The same month, AT&T announced a plan to contribute $9.5 billion of preferred stock in its wireless business into its pension plans. This last transaction was a pension funding transaction without an annuity purchase or a lump sum offering.

The diversity of these transactions is striking, reflecting as it does the varied circumstances and objectives of the sponsors and their associated pension plans. This diversity also emphasizes the importance of understanding the situations and perspectives of both the sponsor and the pension plan when evaluating risk management and funding. It is particularly important to note the interrelationships between them. For corporate pension plans, these interrelationships need to be understood in the context of corporate finance.

The literature addressing DB pensions in the context of corporate finance goes back several decades (e.g. Tepper and Afflect 1974; Sharpe 1976; Treynor 1977; Black 1980; Tepper 1981). However, those papers involved simple models used to illustrate the principles. It was not until the 2000s that these ideas began to be widely promoted, and researchers and investment banks began to develop practical methods to incorporate them into decision-making (Coughlan and Ong 2003; Bodie 2004; Jurin and Margrabe 2005; Frieman et al. 2005; Jin et al. 2006).

Impact of the Pension Plan on the Sponsor

The relevant corporate finance implications of DB pension plans relate to their impact on the firm's (a) capital structure, (b) risk profile, and (c) enterprise value. In particular, we note the following.

A DB pension liability is a form of debt, which is held by the plan members and collateralized by pension assets (Feldstein and Morck 1983; Bodie 2004). In fact, investors view pension deficits, or underfunding, as being like debt, but riskier (Long et al. 2010). As a result, an underfunded pension has an impact on the credit rating of the firm as it is effectively a claim against the future operating cash flows of the business, which reduces the security of other debtholders. Carroll and Niehaus (1998) established empirically that debt market valuations actually do reflect the funded status of the plan.

The funded status of a DB pension plan is also reflected in equity market valuations of the sponsor, as established by a number of empirical studies (Feldstein and Seligman 1981; Feldstein and Morck 1983; Bodie et al. 1987; Bulow et al. 1987; Bodie and Papke 1992; Long et al. 2010).

Pension risk adds volatility to the sponsor's stock price, increases the equity beta of the firm, and raises the weighted average cost of capital or WACC. Moreover, a pension plan typically decreases the firm's optimal leverage ratio and reduces debt capacity (Frieman et al. 2005; Jin et al. 2006; Gold 2008; Long et al. 2010).

Pension risk adds to the overall risk profile of the corporation, consuming risk budget and displacing business opportunities that might have otherwise been pursued. If the risk of the pension is too great, then it can impact liquidity and/or

financial strength, leading to reduced access to the capital markets and threatening the execution of business plans (Coughlan and Ong 2003; Frieman et al. 2005; Gold 2008).

These points demonstrate that a DB pension plan can have a significant impact on the value of a firm's debt and equity through both the plan's funding level and its risk profile. In particular, Long et al. (2010) present an empirical analysis that suggests that the sponsor's stock price is inversely related to the size of the pension liability and directly related to its funded status. Moreover, it appears that the impact of funded status on debt and equity prices is asymmetric. Jurin and Margrabe (2005) developed a theoretical model for this based on the option-like profile created by the U.S. excise tax on the reversion of pension surpluses. See also Coronado et al. (2008).

Impact of the Sponsor on the Pension Plan

Conversely, a firm's capital structure decisions, corporate risk profile, and financial strength have an impact on the fair value of the claims of pension plan members. The members of an underfunded plan rely on the sponsor to make contributions to eliminate the deficit and ensure all pensions are paid in full at some future time. The sponsor's ability to do so depends on these factors and is summarized in its credit rating. Note that even if plan members' claims are collateralized by a fully funded asset portfolio, this may only be temporary because of a risky asset allocation or a liability that is growing faster than asset returns. In other words, the plan members hold a contingent call on the firm's future cash flows even if the plan is currently fully funded. As a result, the capital structure, corporate risk profile, and financial strength of the sponsor should be of great interest to plan members and fiduciaries.

Both Perspectives Matter: Sponsor and Plan

While a DB pension plan must always be managed in the best interest of its members, the previous discussion suggests that the management of any such plan should take into account the perspectives of both the sponsor and the plan itself. Furthermore, despite the existence of some conflicts, we argue that the relationship between the two is in many ways symbiotic: what is good for the plan is often good for the sponsor, and vice versa. In considering these two perspectives, the interrelationships between sponsor and plan necessitate a holistic approach to evaluating pension decisions. This has a long history, and it involves consolidating the pension plan and the sponsor into each other's economic balance sheet (see Treynor et al. 1978). It was originally referred to as the 'augmented balance sheet,' but we shall use the term 'holistic balance sheet.'

From the sponsor's perspective, the pension plan should be consolidated into the corporate balance sheet and evaluated using the principles of corporate finance, with the aim of maximizing shareholder, or firm, value. We call this consolidation

the *holistic corporate balance sheet*. Pensions need to be economically consolidated along with the rest of the corporation despite the fact that the company is not the legal owner of the assets in the pension fund, because it does effectively own the risks and rewards associated with those assets. In particular, if the assets outperform, the company's contributions into the pension fund will fall. On the other hand, if the assets underperform, then contributions will need to rise. For this reason, pensions must be economically consolidated for the purposes of risk management and the management of capital structure.

Conversely, from the plan's perspective, the sponsor should be consolidated into the pension balance sheet using the principles of financial economics, with the aim of maximizing the probability that pension plan members (beneficiaries) receive the full benefits they have been promised. We call this consolidation the *holistic pension balance sheet*. An important component on the asset side of this holistic balance sheet is the so-called 'sponsor covenant,' which reflects the ability and willingness of the sponsor to fund the plan and ensure that pensions are paid in full. All underfunded plans rely on the sponsor covenant, the value of which reflects the credit rating of the sponsor, the level and timing of planned contributions, and the associated risks. Also included on the asset side are other contingent assets such as benefit guarantees from bodies such as the Pension Benefit Guaranty Corporation (PBGC) in the U.S. and the PPF in the U.K. These organizations make payments in the event that the assets fall short of what is needed for a specified guaranteed benefit level. Recently, the European Insurance and Occupational Pension Authority (EIOPA) has been discussing the notion of a holistic balance sheet for pension plans as the basis of future European pension regulation. This version of the holistic balance sheet also includes contingent assets, such as benefit guarantees and the sponsor covenant (European Commission 2012).

The holistic balance sheet concept, as applied to both the sponsor and the pension plan, neatly summarizes the interdependencies between these two entities and provides an objective basis for evaluating strategies for sustainable management of the plan. This concept is fundamentally based on a purely economic view of pensions, rather than the more traditional accounting view.

Managing Longevity Risk in Pension Plans

With the advent of longevity swaps and the other new solutions for longevity risk management described earlier in the chapter, pension longevity risk can now be managed in a flexible and customized way, similar to the way in which other pension risks are managed. This is an important element of ensuring the sustainability of a DB pension plan over the long term. Prior to the development of these new instruments, longevity risk could only be fully hedged with annuities in the form of a buyout or a buy-in, which required all risks to be hedged at the same time and was not possible unless the plan was adequately funded.

As we have argued, corporate finance provides the appropriate context for managing longevity risk and developing sustainable DB pension strategies. As such, it provides important insights into the economics of pension decisions from the perspectives of the key stakeholders: the plan beneficiaries and the corporate sponsor.

Framework for Sustainability

Now that all the tools are available to manage pension plans sustainably, what is required is a framework for evaluating the key decisions such as whether to transfer or keep the pension plan; how much longevity risk to hedge (this is relevant if the plan is being kept, or if a buyout is planned at a distant time in the future); and the degree to which funding and the management of other risks should be pursued in conjunction with longevity risk management.

The framework we propose acknowledges the interrelationships between the pension plan and the sponsor, and the connections with corporate finance discussed earlier. In particular, from the sponsor's perspective, the relevant decision metrics are linked to valuation in terms of shareholder value and/or enterprise value. This will be driven by the impact of the pension plan on the corporate cost of capital, corporate risk profile, and competing uses of cash flow. On the other hand, from the pension plan's perspective the relevant decision metrics are linked to the valuation of the sponsor covenant. This will be driven by the impact of the pension plan on corporate credit quality, corporate risk profile, and cash flow.

Several tools are important in implementing this framework. Foremost among these are the holistic balance sheets of both the sponsor and the pension plan, as illustrated in Figure 6.5. These capture the economic impact of contingent assets and liabilities, a realistic measurement of the pension liability, and the interdependencies between the sponsor and the plan. Note the contingent liability on the sponsor's balance sheet, which incorporates additional claims on the sponsor, including the additional liability that would result if the funded status falls below its current level, as well as the excise tax that would accrue should the plan become significantly overfunded.

Also important are the risk profiles, or risk decompositions, of both the sponsor and the pension plan. Table 6.4 summarizes the main financial and demographic risks in the risk profile of a typical DB pension plan.

The framework can be summarized as follows. First, evaluate the pension liability in economic terms. This includes the use of market interest rates for discounting liability cash flows, up-to-date mortality base tables, and realistic projections for future mortality improvements. Second, model the interdependencies between the pension plan and the sponsor, and their differing perspectives. This includes taking account of the optionality in the holistic balance sheet of each. Important metrics include materiality of the plan as measured by the ratio of economic pension liability to equity market capitalization (or enterprise value) and the ratio of economic pension deficit to the market value of corporate debt. Third, evaluate

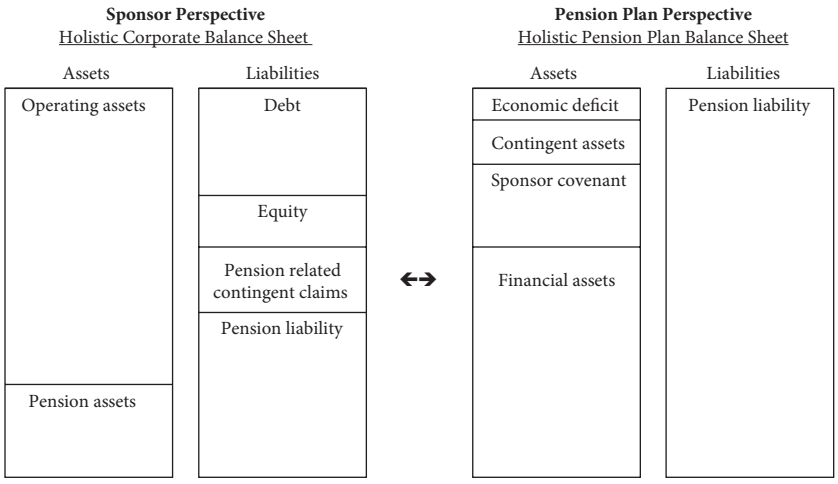

Figure 6.5. The holistic balance sheets for the sponsor and the pension plan reflect the economic interdependencies between them.

Note: Illustrative only, not to scale.

Source: Pacific Global Advisors.

TABLE 6.4 Major financial and demographic risks impacting DB pension plans

Risk origin	Risk type
Asset-related risk	Equity risk
	Interest rate risk
	Nominal interest rate risk
	Real interest rate risk
	Includes inflation risk
	Credit risk
	Alternatives risk
Contingent asset-related risk	Sponsor covenant risk
	Benefit guarantee risk
	Credit risk
	Regulatory risk
Liability-related risk	Interest rate risk
	Nominal interest rate risk
	Real interest rate risk
	Includes inflation risk
	Demographic risk
	Longevity risk
	Other

Source: Author's tabulation.

the risk profile for the plan and the sponsor. This refers to the size and composition of risks. For the sponsor, it includes the scale of pension risk in relation to the sponsor's operating and financing risks. For the plan, this includes the impact of the sponsor covenant. Fourth, evaluate the key valuation metrics for the plan and the sponsor. This includes the actual and contingent impact of the pension plan on cost of capital, risk profile, credit rating, debt capacity, and cash flow. From these the implications can be assessed for shareholder value, enterprise value, and the value of the sponsor covenant. Finally, select the preferred strategy on the basis of how it impacts the pension plan and the sponsor in terms of higher valuation metrics, sustainable risk levels, and diversification.

This framework provides a basis for managing the pension plan for the long term, which minimizes the likelihood that the sponsor will be required to make an excessively large unplanned contribution and maximizes the likelihood that plan members receive their full pension benefits. In particular, it facilitates a consistent approach to evaluating decisions connected with the hedging and management of longevity risk, along with liability-related interest rate risk and investment risks.

Conclusion

Longevity risk can be a significant risk for many DB pension plans and should, at the very least, be measured along with the other risks facing these plans. With the development of longevity swaps and other solutions, this risk can now be hedged in a flexible and customized way. As a result, DB pension plans now have at their disposal a complete toolkit for ensuring they are managed in a sustainable fashion. In fact, because of the compounding effects between longevity and interest rate risks, it is highly desirable to manage these two liability risks in concert.

We have argued that longevity risk management should be addressed in a framework for managing DB plans based on corporate finance and financial economics. Our proposed framework acknowledges the different, but interrelated, perspectives of the sponsor and the plan, and it argues that both must be taken into account for optimal decision-making. Even fiduciaries acting in the interest of the plan members/beneficiaries must take account of the sponsor's perspective in order to maximize the probability that pensions will be paid in full. This framework provides the basis for addressing key pension risk management decisions, including whether to consider a buyout/termination or pursue the hedging of longevity risk as part of the long-term management of the plan.

Disclaimer

estimates constitute the judgment of the authors and are subject to change without notice. Past performance is not indicative of future results. This material is provided for informational purposes only and is not intended as a recommendation or an offer or solicitation for the purchase or sale of any security or financial instrument and should not serve as a primary basis for investment decisions.

Notes

1. See IMF (2012). The authors point out that mortality tables used by U.S. pension actuaries in particular have been consistently out of date.
2. Recently new models have emerged based on modelling the causes of mortality improvement that provide greater insight into forecasting future mortality rates (Coburn and Nakada 2012).
3. These mortality improvements are derived from LifeMetrics data for U.S. males, which are available at www.lifemetrics.com.
4. The data in Figures 6.2 and 6.3 reflect rolling five-year mortality improvements that are annualized.
5. The mortality assumptions for this example include expected mortality improvements averaging 1 percent per year. At the time of writing, nominal swap rates are close to 2 percent at the ten-year point and 3 percent at the 30-year point, and with inflation expectations of 2.5 percent, real rates are negative to slightly positive across the yield curve.
6. Inflation risk can be considered an interest rate risk.
7. These specialist pension insurers included Paternoster, Synesis, Lucida, Pension Insurance Corporation and Rothesay Life.
8. The mortality rates used in this first *q*-forward transaction were based on the LifeMetrics Index for the mortality of the population of males in England and Wales (Coughlan et al. 2007*a*).
9. The PPF plays a similar role to the PBGC in the U.S. It was established by the U.K. Pensions Act 2004 to provide compensation to DB plan members, when the employer suffers an insolvency event and there are insufficient assets in the plan to cover the PPF level of benefits.
10. Taken from the LLMA website, <www.llma.org>.

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