The case for longevity bonds

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By David Blake, Tom Boardman, and Andrew Cairns*

Introduction

Insurance companies and defined benefit pension plans face the risk that retirees might live longer than expected. This risk might adversely affect both the willingness and ability of financial institutions to supply retired households with financial products to manage their wealth decumulation. Longevity bonds are instruments that would allow financial institutions to hedge aggregate longevity risk.

Longevity bonds, which involve no repayment of principal, would pay a coupon that is linked to the survivorship of a cohort, say, 65-year-old males born in 1945. If a higher-than-expected proportion of this cohort survived to age 75 – a development that would cost the insurance company or pension plan more than expected – the coupon rate would increase, offsetting some of the provider's cost.

This *brief* highlights the benefits that could flow from a transparent and liquid capital market in longevity risk, and argues that the government could play an important role in helping this market grow. The line of reasoning comes from the United Kingdom, but has validity for all countries with mature funded pension systems.

The first section explains the problems longevity risk poses. The second section looks at how longevity bonds can help hedge aggregate longevity risk. The third section considers who should issue longevity bonds, while the fourth section highlights pricing considerations. The final section concludes with a discussion of the merits of government-issued longevity bonds.

Why Worry About Longevity Risk?

Longevity risk is borne by every institution making payments that depend on how long individuals are going to live. These institutions include sponsors of defined benefit plans in the private sector, insurance companies selling life annuities, and governments, through the social security systems and defined benefit plans they sponsor for public-sector employees.

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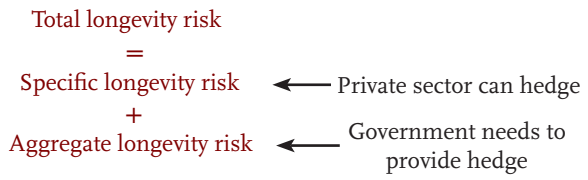
Longevity risk consists of specific longevity risk and aggregate longevity risk (see Figure 1). Specific longevity risk exists because some people will die before their life expectancy and some will die after. Aggregate longevity risk involves the possibility that unanticipated changes in lifestyle or medical advances significantly improve average longevity.[1]

Figure 1. Decomposition of Longevity Risk



Source: Authors' illustration.

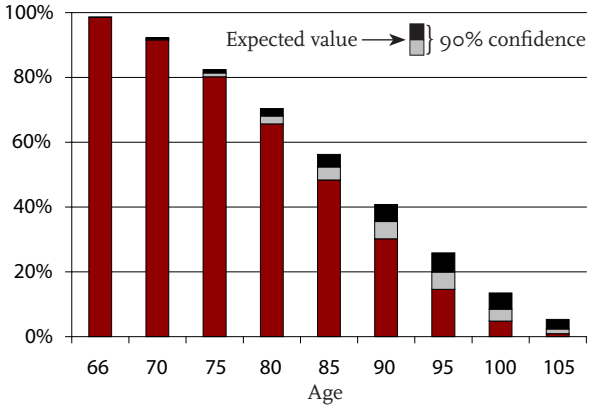
Private-sector institutions can reduce specific longevity risk by pooling and relying on the law of large numbers – that is, those with longer-than-average life spans will be balanced out by those with shorter life spans. Aggregate longevity risk, on the other hand, is an "aggregate risk" that cannot be diversified away by pooling. The private sector is unable to hedge this risk effectively without a suitable hedging instrument.

The presence of such a non-hedgeable risk in the face of an increasing demand for annuities creates two problems. First, a big growth in annuities could result in an unhealthy concentration of risk among a small number of insurance companies, leading to insolvency should mortality rates decline faster than forecast. Second, a non-hedgeable risk will raise costs and reduce the income from annuities. European Union (EU) regulators have proposed requiring additional capital for liabilities with non-hedgeable risks.[2] The cost of the extra capital would have to be passed on to customers, resulting in a reduction of up to 10 percent in the income annuities can provide. Longevity bonds address both of these problems.

How Longevity Bonds Work

To see how a longevity bond can hedge aggregate longevity risk requires both quantifying longevity risk and identifying where it is concentrated. Figure 2 shows the uncertainty surrounding projections of the number of survivors to each age from the cohort of males from England and Wales who are age 65 at the end of 2006.[3] The areas at the top of each bar indicate the 90-percent confidence interval, and the line in the middle of each area indicates the proportion of the cohort expected to survive to each age. Uncertainty is low at younger ages; one can be fairly confident that about 80 percent of 65-year-olds will survive to 75. Uncertainty increases thereafter and peaks at age 93. The best estimate is that 36 percent will survive to age 90, but it could be anywhere between 30 percent and 41 percent, a very large range. The figure also shows the so-called "tail risk" – that is, the probability that some members of this cohort will live beyond 100.

Figure 2. Percent of Males Age 65 Surviving to a Given Age[4]



Source: Authors' calculations from Cairns, Blake, and Dowd (2006).

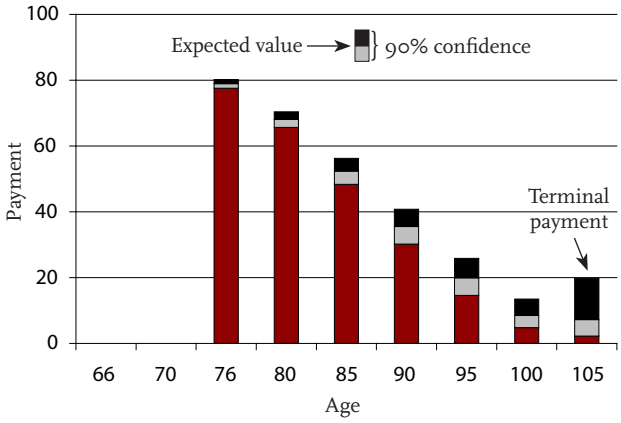
Consider how a longevity bond with the following characteristics can help to hedge aggregate longevity risk:

- The bond coupons payable each year depend on the proportion of a given cohort that is alive in that year – for example, the percent of men born in 1945, and who were age 65 in 2010, that survives to 2011, 2012, and so on.
- Coupon payments are not made for ages for which longevity risk is low – for example, the first coupon might not be paid until the cohort reaches age 75 (such a bond would be called a deferred longevity bond).
- The coupon payments continue until the maturity date of the bond, which might be, for example, 40 years after the issue date, when the cohort of males reaches age 105.

- The bond pays coupons only and has no principal repayment.[5]

Figure 3 shows the possible range of coupon payments on such a deferred longevity bond based on the population of English and Welsh males age 65 at the end of 2006. If population survivorship is higher than expected at each age, the bond pays out higher coupons. This pattern helps pension plans and annuity providers meet the higher-than-expected pensions and annuity payments they need to make. On the other hand, if survivorship is lower at each age than expected, the bond pays out lower coupons. But the pension plans and annuity providers are not likely to mind, since their pensions and annuity payments are also likely to be lower.

Figure 3. Payment on Longevity Bond with 10-Year Deferment for Male Age 65,* with Terminal Payment to Cover Post-105 Longevity Risk



* See Endnote 4.
Note: This example assumes a bond coupon of $100. The actual payment equals the bond coupon amount multiplied by the proportion of individuals in the age-65 birth cohort who are still alive at a given age.
Source: Cairns, Blake, and Dowd (2006).

The bond will provide a *perfect* hedge only for pension plans and annuity providers with plan members/annuitants who have exactly the same mortality experience over time as the cohort underlying the bond. If the plan members/annuitants have a mortality experience that differs from that of the national population, it will introduce basis risk. In practice, some basis risk will remain.[6]

In theory, longevity bonds could be issued for both males and females, for each age and for each socio-economic group. Such granularity of the longevity bond market would allow a high degree of hedge effectiveness. But it would also result in negligible liquidity or pricing transparency: the more bonds, the less trading in each bond and the less frequently the bonds will be priced. As with other markets – especially derivatives markets – a small number of suitably designed bonds should provide an appropriate balance between hedge effectiveness, liquidity, and pricing transparency.[7]

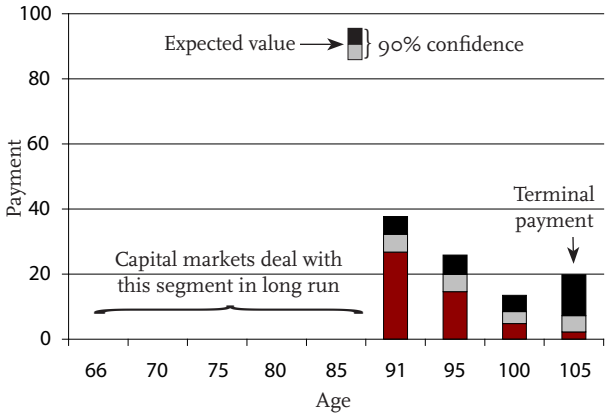
Who Could Issue Longevity Bonds?

In principle, longevity bonds could be issued by private-sector organizations. Some argue that pharmaceutical companies would be natural issuers, since the longer people live, the more they will spend on medicines.[8] While the theory may be correct, the scale of the demand for longevity bonds far exceeds conceivable supply from such companies.

Instead, the government may be better able to issue such bonds in the required volume. The government also has an interest in promoting an efficient and well-functioning annuity market, safeguarding the solvency of insurance companies and facilitating the efficient spreading of longevity risk.[9] Researchers at both the International Monetary Fund and the Organization for Economic Cooperation and Development have recognized government involvement in a longevity bond market as potentially useful, as has the World Economic Forum.[10]

Once the market for longevity bonds has matured, in the sense of producing stable and reliable price points in the age range 65-90, the capital markets could take over responsibility for providing the necessary hedging capacity in this age range. All that might then be needed would be for the government to provide a continuous supply of deferred tail longevity bonds with payments starting at, say, age 90.[11] Figure 4 on the next page illustrates the cash flows on such a bond. These bonds would allow for full hedging of longevity risk and allow investors who have recently become interested in taking the other side of the longevity swaps market to avoid assuming long-duration tail longevity risk, a risk for which they have no appetite.

Figure 4. Payment on Longevity Bond with Deferred Tail for Male Age 65,* with Terminal Payment to Cover Post-105 Longevity Risk



* See Endnote 4.
Note: See Figure 4.
Source: Cairns, Blake, and Dowd (2006).

Some contend that the government is not a natural issuer of longevity bonds because of its large existing exposure to longevity risk through the social security system and pensions for public employees. Here, several considerations may be relevant. First, the government would receive a longevity risk premium from issuing the bonds – that is, the issuance would generate revenue. Second, the government could control the ultimate cost of the pensions by increasing the official retirement age should longevity increase dramatically.[12] Third, the issuance of longevity bonds should result in a more efficient annuity market and hence higher incomes in retirement, perhaps reducing the need for means-tested retirement benefits. Fourth, the total issuance is likely to be small in relation to the overall size of the government bond market. Finally, one could argue that the risk is consistent with the government's role of facilitating intergenerational risk sharing.

Pricing Considerations

Ultimately, the demand for longevity bonds will depend on their price. The government would likely be able to charge a risk premium – that is, the price at which the government will be able to sell the bond would exceed the expected present value of the coupons payable on the bond, discounted by the interest rate on government securities of comparable maturities. The reason for this is that insurance companies holding longevity bonds would need to hold less capital against the risk of mortality improvements being more rapid than expected. But it is unlikely that the desired market for longevity bonds will develop if the government just focuses on insurers. The bonds would need to be priced to also attract sponsors of defined benefit plans, which do not currently face solvency capital requirements. Other investors, including investment banks, would also be discouraged from buying such bonds if they believe the longevity risk premium is excessive, because they would fear that the bonds would eventually fall in value.

Conclusion

Many parties would gain from having a market price for longevity risk and the ability to hedge aggregate longevity risk. The expected cost of government borrowing would decline because investors seeking protection against longevity risk would be willing to accept a lower return than on comparable government securities. The government as regulator would also benefit. A longevity risk term structure should help the regulators calculate any risk-based levy to government-operated pension insurance funds such as those administered by the U.S. Pension Benefit Guaranty Corporation and the U.K. Pension Protection Fund.

In the private sector, sponsors of defined benefit plans would have the opportunity to reduce longevity risks. Insurers could quantify the market value of their longevity risk. The ability to hedge longevity risk would reduce insurers' capital requirements, a potentially important consideration should the demand for annuities increase. Longevity bonds would also reduce the concentration of longevity risk among insurers by facilitating the spread of longevity risk around the capital markets. In addition, investors would gain access to a new asset class whose returns are uncorrelated with traditional asset classes, such as bonds, equities, and real estate.

Endnotes

1 It is also possible that average longevity could decline due to factors such as obesity and environmental degradation.

2 The situation is particularly acute for insurance companies operating in the European Union, where a new regulatory regime, Solvency II, is due to be introduced in 2012. The current Solvency II proposals, if adopted, will require insurers to hold significant additional capital to back their annuity liabilities if longevity risk cannot be hedged effectively or marked to market.

3 The model was estimated from an application of the Cairns, Blake, and Dowd (2006) mortality model to data for the period 1991-2006.

4 These data were derived from the Cairns, Blake, and Dowd (2006) stochastic model, estimated on English and Welsh male mortality data for 65-year-olds over the period 1991-2006.

5 The final coupon incorporates a terminal payment equal to the discounted value of the sum of the post-105 survivor rates to account for those who survive beyond age 105. The terminal payment is calculated on the maturity date of the bond and will depend on the numbers of the cohort still alive at that time and projections of their remaining survivorship. It is intended to avoid the payment of trivial sums at very high ages.

6 One reason for this is that pension plans and annuity books have far fewer members than the national population. They will experience random variation in their mortality rates, even though they had the same mortality profile at the outset. Another reason is that most pension plans and annuity books will not have the same mortality profile as the national population. Mortality rates vary by socioeconomic status, and there have also been persistent socioeconomic variations in the rate of decline.

7 See Blake, Cairns, and Dowd (2006).

8 Dowd (2003).

9 The first suggestion that governments issue longevity bonds was made in 2001 (Blake and Burrows, 2001).

10 International Monetary Fund (2006); Antolin and Blommestein (2007); and the World Economic Forum (2009).

11 Pension plans and annuity providers might still be willing to invest in government-issued longevity bonds covering the 65-90 age range if they are competitively priced compared with capital market hedges.

12 Governments throughout the world are beginning to do this in any case and will have to continue doing so if longevity continues to improve.

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