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THE MARKET FOR MORTALITY

by Paul Sweeting

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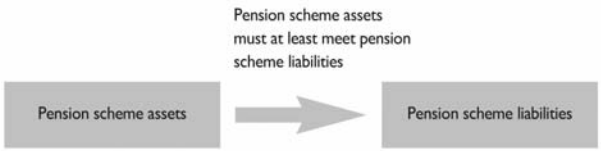
Mortality risk is the risk that a portfolio will suffer from mortality being heavier than expected. Longevity risk is the risk that a portfolio will suffer from mortality being lighter than expected. Both types of risk are significant factors for pension schemes and life insurance companies. The International Actuarial Association defines four types of mortality or longevity risk: level, trend, volatility, and catastrophe. However, for practical purposes these risks can be classified into two types: the risk of getting the average wrong (systematic risk), and the risk of getting the average right, but being unlucky (specific risk). The latter of these risks reduces as the number of lives increases but this does nothing to reduce the former risk.

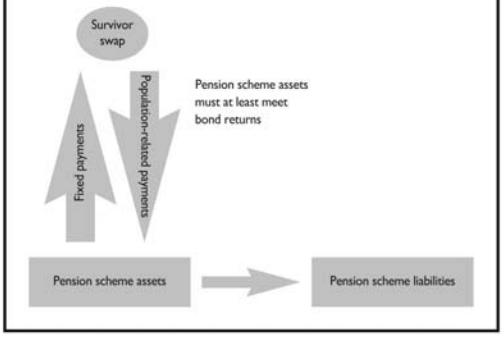
Figure 1 Pension scheme investment without survivor swaps



Risk Transfer

Reinsurance is a method of risk transfer that is used by insurance companies to reduce systematic risk. This is usually proportional (thus allowing an insurer to improve the mix of business written) or excess of loss (thus protecting an insurer from extreme events). Pension schemes use an approach similar to proportional reinsurance when they buy annuities, either as a matter of course for retiring members or as part of a bulk buyout of part or all of the membership. More recently, specialists have started to offer an increasing range of opportunities for the buyout of deferred benefits.

Figure 2 Pension scheme investment with survivor swaps



However, capital market solutions for these issues have only been explored relatively recently. Blake and Burrows (2001) were among the first to look at market solutions, discussing the idea of survivor bonds. The bonds in their paper are amortizing securities, the payments of which depend on the proportion of a reference population that is still surviving at the date of payment of each coupon. This makes them similar to annuities, but unlike annuities the payments from survivor bonds are based on the survival of a reference population, not the mortality of the institution purchasing the bond.

Blake and Burrows assume that the group of lives is based on an initial cohort retiring at age 65 and assume that the reference population is the population at large. However, they also point out two key risks:

- pensioner annuitants are likely to live longer than the general population (basis risk); and
- an individual insurance company's pool of annuitants might experience markedly different mortality to that of the overall population of pensioner annuitants (specific risk).

Mortality Bonds

Blake and Burrows suggest that such bonds might be issued by the government. This could also avoid any risk premium being charged in respect of the uncertainty surrounding mortality forecasts.

Although Swiss Re launched a successful mortality bond in 2003 – so successful that it launched a second in 2005 – this bond was simply a form of catastrophe bond which paid out in full except in cases of exceptionally bad mortality experience, and not a

bond in the format described by Blake and Burrows (2001). In fact, when BNP Paribas looked at launching a Blake and Burrows-style longevity bond with the European Investment Bank (EIB), the reception could be described as lukewarm at best, and the bond was withdrawn without being launched.

Blake et al (2006) give a number of reasons for the bond's lack of success. In particular:

- the bond was unable to reflect the wide range of demographic characteristics between schemes;
- investing in the form of a bond meant that to reduce risk meant to reduce expected return;
- a high degree of model and parameter risk existed;
- a high degree of basis risk existed between a pension scheme's mortality and the mortality of the reference population.

They also look at alternatives to the structure of the BNP Paribas bond in order to address some of the issues. For example:

- zero-coupon longevity bonds, which make a single, mortality-based payment, thus increasing flexibility;
- geared longevity bonds, where every £1 of capital buys more than £1 of exposure, thus reducing the amount of capital needed; and
- deferred longevity bonds, where the payments start at some point in the future, so no capital payments are required upfront.

Futures and Options

Futures and options on bonds are also investigated by Blake et al, providing increased exposure for decreased capital and also offering the opportunity for an asymmetric payoff pattern. With options, a pension scheme could protect against longevity increasing faster than predicted, but could benefit from slower than expected improvement. However, without a quoted price for an underlying security, agreeing a price for such derivatives would be a challenge.

Survivor Swaps

It is possible that a better solution is to avoid using a bond at all, and instead to use some other instrument altogether. In particular, survivor swaps offer a potential solution.

Dowd (2003) is one of the first authors to describe survivor swaps. He describes a swap based on the mortality experience of a reference population, where the population-dependent payments form the floating leg of the swap, with the fixed or preset leg being the expected amount of those payments assessed at the time of the swap. Such an instrument could be of particular interest to a pension scheme. The main aim of a pension scheme is to invest such that the investment returns are sufficient to meet the liabilities, as shown in figure 1.

A pension scheme could use survivor swaps to produce a series of payments that broadly reflect changes to the longevity of its members – all that would be required would be that the pension scheme assets produced sufficient returns to meet the series of fixed payments making up the preset leg of the swap, as shown in figure 2.

If the pension scheme wanted to take as little risk as possible, then it could invest in bonds to produce these fixed payments – but this would mean that the pension scheme might as well have purchased a mortality bond. Instead, a pension scheme could hold assets that it thought would be able to produce higher returns than those required to meet the fixed payments.

Since the fixed leg of a swap can be thought of as a fixed-interest bond, this would mean investing in assets that were expected to beat bonds.

However, there is a more elegant solution. If as well as a survivor swap, a pay-fixed interest swap is held, then the fixed payments from the interest rate swap can be used to meet the fixed leg of the survivor swap. This means that the assets now need to beat cash, a more conventional investment objective, as shown in figure 3 (see page 12).

Blake et al (2006) describe two different types of survivor swap. The first is a vanilla survivor swap (VSS). This is where periodic floating payments are based on the survivorship of a reference population over the term of a swap. So, for example, a ten-year swap where the initial reference population was for 65-year-old men in

continued on page 12

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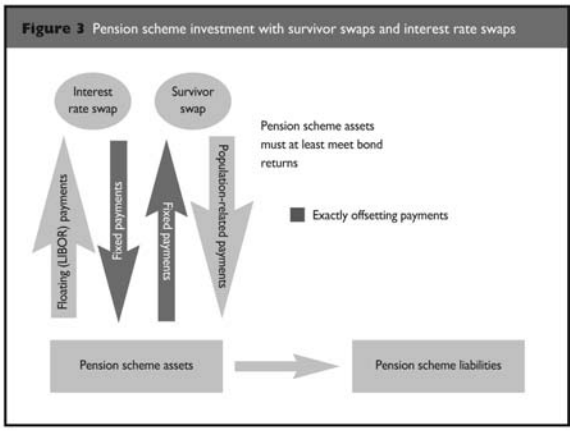
The prospects for a market … from page 11

England and Wales might make annual payments in proportion to the number of people surviving to age 66, 67, and so on until age 75, who were aged 65 at the swap's inception. The fixed payments would represent the proportion of people who, at the swaps inception, were expected to survive to these ages.

Figure 3 Pension scheme investment with survivor swaps and interest rate swaps



Such a structure has clear attractions for a pension scheme, where the benefits are annuities. However, the structure might still be too inflexible for some. An alternative is to use a single-payment swap, where the floating payment represents the proportion of a particular reference population alive at some time in the future, and the fixed payment represents the expected proportion.

Natural Hedging

In this article, I have concentrated on the use of survivor swaps by pension schemes. However, while longevity is an issue for pension schemes, for life assurance companies mortality is often more of an issue. This suggests that pension schemes and life assurance companies might find themselves on opposite ends of survivor swaps, although a number of practical issues exist. Cox and Lin (2005) found that a degree of what they call 'natural hedging' appears to take place within insurance companies between their life assurance and annuity portfolios.

These practical issues are for a large part responsible for the slow development of a liquid market for survivor swaps, and merit an article in themselves. However, research into these and other mortality-related instruments is ongoing and hopefully before too long market-based solutions for longevity and mortality will find their way into the mainstream. ✹

Editor's Note: A follow up to this article was published in the August 2007 issue of "The Actuary" and can be found online at: www.the-actuary.org.uk/pdfs/07_08_09.pdf

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