

## ABSTRACT OF THE DISCUSSION

## HELD BY THE INSTITUTE OF ACTUARIES

**Professor D. Blake** (a visitor; introducing the paper): Longevity risk is the risk that aggregate survival rates are higher than anticipated. This is now a risk which is regarded as a key factor for life insurers, pension funds and, indeed, the state providing state pension plans, and it is a problem looking for a solution. We are questioning and wondering whether the capital markets can provide such a solution.

Table D.1 is from the recent report of the Pensions Commission, the Turner Report, which shows you his estimates of the extent of longevity risk in the United Kingdom economy and where it lies, and also how little of it lies in the hands of those who are supposed to be experts in managing it; namely the insurance companies. Already in payment: something like £70 billion lies in the hands of insurers; £400 billion in the hands of occupational pension plans; £190 billion in unfunded public employee pension plans; the state earnings related pension system or the second state pension, over £100 billion; and the basic state pension system, £390 billion. A total of £1.2 trillion already in payment and another £1.4 trillion coming up; and most of this is exposed to longevity risk to some degree. Someone is either going to have to assume that risk or manage it in one way or another.

So, what are the possible responses? Those who carry the risk can assume it as a legitimate business risk; they can try to reinsure it; they can try to securitise it; or they can try to share it out among the existing policyholders in the form of, say, participating annuities with survival credits or (which is what we are interested in) they can consider whether the risk can be managed with mortality-linked securities.

The possible stakeholders in this exercise are: those which wish to hedge; general investors who might be seeking low beta securities for diversified portfolios; speculators (who are essential for creating and providing liquidity to any financial market); arbitrageurs who might arbitrage between related instruments if there is a well-defined pricing relationship between those instruments; and, naturally, the Government, which is the insurer of last resort, and is also interested in providing stability to the economy and to the marketplace as a whole.

There have been a couple of examples of instruments which have been offered to the markets. The Swiss Re mortality catastrophe bond, in 2003, was a short-term three-year bond, which reduces exposure to catastrophic mortality events in Swiss Re's own book. This was very successful. It was oversubscribed and, indeed, a second tranche was issued to investors in 2005 on less favourable terms than the first tranche. Then we had the EIB/BNP bond offered to the

Table D.1. Longevity risk in U.K. pension provision; £bn of total liabilities; end 2003

	Pre-retirement (still in employment)	Post-retirement (already in payment)
Insurance companies	10	70
Pension funds	400	400
Unfunded public employee pensions	260	190
State pensions — earnings related	190	100
Total earnings related	860	760
State pensions — basic	510	390
Total	1,370	1,150

Source: Pensions Commission (2005) *A New Pensions Settlement for the Twenty-First Century*, The Stationery Office, Norwich: Table 5.17 (p181)

markets in 2004, which was a long-term 25-year bond, based on the population mortality of 65-year-old males from England and Wales. Unfortunately, there was insufficient investor interest and it was withdrawn, but we can learn important lessons from the experiences of these two instruments.

In the paper we discuss a whole range of new mortality-linked securities. Some of the ideas come from the existing financial markets. Some of them are specific to mortality products. Within the cash market, the spot market, we can think of various types of longevity bond, for example classical longevity bonds, or what we called originally, survivor bonds. These are bonds without a fixed length of life; they have stochastic maturity, and the payments continue while a particular reference population is still alive. Then there are geared longevity bonds to reduce capital outlay, in which the actual payments lie within a particular range. We can consider deferred longevity bonds, which focus on the more distant cash flows or the more distant liabilities, which are riskier in terms of longevity risk. There are principal-at-risk bonds, where the principal is reduced if survivorship is above a threshold. This was the type of bond issued by Swiss Re, and was a success.

In terms of derivatives, we can think of mortality swaps. A classic example would be a fixed-for-floating swap based on a survivor index. This is flexible and tailor-made, and it was an example of the swap embedded in the EIB bond. We can think of a mortality futures market in which the underlying is either a cash market instrument, like a bond, or an index.

The Association of French Pension Funds (AFPEN) is considering launching an annuities futures market, based on U.K. mortality rates. As we all know, the U.K. sells more than half of the world's life annuities at the present time.

We can think of option products, survivor caps, survivor floors, and we can think of options on annuity futures.

In the paper we considered reasons why futures markets survive and why futures contracts fail. Futures markets depend on having a liquid spot market, and there are very few examples of futures markets which have survived historically without having an underlying liquid spot market. One of the few examples is weather futures, in which there is no natural underlying.

Spot prices must be sufficiently volatile to create both hedging needs and speculative interest, and the underlying must be homogeneous or be able to be assigned to a well-defined grading system. The market, for its success, also requires active participation by both hedgers and speculators, and possibly by arbitrageurs as well.

An extremely important feature which has been emphasised to us by practitioners is the type of mortality index upon which a mortality-linked instrument would be based. The choice of any reference population is critical, and that is because of the issue of basis risk, the difference between the realised mortality experience of the reference population and the hedging population of interest to a hedger.

There are issues about the integrity of the index, its construction, and various moral hazard aspects. Swiss Re, for example, while wanting to hedge its own book, decided to use independent population mortality indices, but it chose the weights attached to those indices to be as close as possible to its own exposure.

So, the choice depends on whether we go for population tables or for the specific populations which hedgers, such as insurance companies, might wish to hedge. In the U.K., for example, these might be based on CMI tables or, indeed, the hedger's own mortality experience.

There is also an issue of credit risk, since the payments go out for many years. We have looked at the classic solutions to this: credit enhancement; credit derivatives; and possibly securitisation via a special purpose vehicle.

We were particularly concerned about barriers to the development of this market. The EIB bond did not generate sufficient demand to be launched, and it is instructive to look at some of the reasons for this. There were design issues, pricing issues, and institutional issues.

#### *Design issues*

The capital outlay on the bond was considered too high relative to the bond's hedging capacity, and there was no capital left over for hedging other particular risks, such as inflation.

There was concern that the basis risk might be too high; that there might be too wide a gap between the reference population and the mortality experience of the hedger. The instrument was based on the lives of 65-year-old males, but pension funds and insurers have people of different ages within their policyholders, and there is basis risk as a result of the age factor. The instrument hedged male lives, but there are females in the pensioner and annuitant population as well.

*Pricing issues*

Embedded in the price of the bond was a longevity risk premium of 20 basis points. Because this was the first type of bond ever offered, we had no idea whether this was a fair calculation of this premium. There were demand versus supply issues. We might believe that the demand for these instruments is high, but, unless the market believes that there will be an adequate and continuous supply of similar instruments into the future, why should anybody go into a bond which might be the only such bond ever issued? There is, therefore, a need for more research and for more education on these issues. There is also the question of how the basis risk will affect the issue price and the subsequent market price.

*Institutional issues*

The issue size was considered to be too small to create a liquid market. Consultants were reluctant to recommend it to trustees; no one was willing to be the first to leap. Fund managers at the time did not have a mandate to manage longevity risk, so there was no particular need for fund managers to look to this bond.

Of particular importance at the time was the inadequacy of reinsurance capacity. The EIB/BNP could not find a U.K./European Union reinsurer, and the Bermuda-based Partner Re (the bond's mortality swap counter party) would not cover for more than the issue amount of £540 million.

Those were the problems in terms of getting the spot market going. We also looked at why futures and options markets have survived or failed. As I mentioned earlier, it seems to be critical that a liquid spot market is normally a prerequisite to active derivatives markets operating. The underlying mortality index must be regarded as fair and trustworthy. The underlying indices must be few in number and also appropriately graded. A small number of contracts helps to increase liquidity, but leads to greater basis risk. However, basis risk can be reduced with suitably graded contracts.

Thus, mortality-linked securities are potentially very useful tools for managing longevity risk. We believe that, once the teething problems are overcome, the way will be clear for markets in these securities to develop and to mature. We would then be on the cusp of a completely new global financial market in mortality-linked securities.

**Mr D. C. E. Wilson, F.I.A.** (opening the discussion): This very interesting paper is also timely, given recent market events. I agree with the authors that everyone should welcome the successful development of this market. It would not only allow the efficient transfer of risk, but also make the whole concept of market consistent reserving and pricing for annuity business that much more coherent.

The paper discusses the structure of existing mortality-linked and longevity-linked securities, and a wide variety of possible forms which future deals could take. Although the authors do not explicitly distinguish between shorter-term mortality-linked securities and longer-term longevity-linked securities, I believe that it is worth so doing, as the markets seem to be developing at different rates. Catastrophe bonds, like the Swiss Re examples described in Section 4.2, are now an accepted alternative to reinsurance, and with Scottish Re launching a similar bond in February 2006, the market can be said to be relatively well established. Conversely, the failure of the proposed EIB longevity bond, described in Section 4.3, shows that there is further to go here.

The main focus of the paper is on what I have termed longevity-linked securities. The authors demonstrate that there is a wide array of possible instrument types, including bonds, swaps, futures, forwards, options, caps, floors, swaptions, etc. They also discuss the choice of underlying

for new derivative contracts and a number of practical implementation issues. Perhaps most interestingly, they consider typical conditions which need to apply for derivative contracts to succeed, and the extent to which these conditions are met by mortality derivatives.

However, before covering these issues, the paper discusses the possible motivation for the development of these markets. Section 2 lists a number of ways in which companies might respond to longevity risk. The authors then make the assumption, in ¶2.2, that the main parties concerned will wish to hedge this risk. It seems to me that this is a major assumption, and I would like to have seen more discussion of it. After all, hedging in the form discussed in this paper does not eliminate any risks, it simply transfers them between market participants. So, it seems natural to ask the question which the authors touch on in Section 3, as to who are the natural holders of longevity risk.

Of course, insurers prefer less risk to more, but insurance shareholders should (and will) ask the questions: “What price am I paid to bear this risk?” “What is the cost of removing the risk?” “Is *my* balance sheet a more natural place for the risk to reside than, say, a hedge fund?” Remember that longevity risk is largely diversifiable, and so, at least theoretically, should not be expected to carry a large risk premium.

Another possible outcome mentioned in Section 2 involves the pooling of longevity risk amongst annuitants or pensioners. As the authors point out, some insurance companies have already developed non-profit annuity products which do this, and, of course, with-profits annuities have always done so. It is also very much in tune with the Pensions Commission’s thinking on basing state pension age on current life expectancy, and similar proposals in France. Also, it is not as if annuitants do not already accept significant levels of risk — many choose to take a level annuity rather than an index-linked annuity, and even with an index-linked annuity the annuitant must accept what is probably a significant basis risk between the RPI index, on which annuity increases are based, and the rate of price inflation, which affects the costs of what they spend their money on. So, perhaps we should think about financial risks arising from longevity in two parts: those which already exist because corresponding promises have been made to individuals; and those where the option to leave the risks with the individuals concerned still exists. Of course, the development of an active market in longevity-linked securities would help in the pricing of alternative annuity products, as well as in the management of existing longevity risks.

The related questions of the choice of underlying mortality index and basis risk are discussed in the paper in a number of places, most notably in Section 10. These are clearly very important issues, affecting, on the one hand, the likely saleability and liquidity of the security, and, on the other hand, the value of the security in enabling the issuer to hedge its risks. The focus, at present, seems to be on the first aspect of this, with standardisation of underlying seen as important in developing the market. Hence, for example, there is CSFB’s launch, in January 2006, of a longevity index for the United States of America, based on standardised measures of life expectancy of the general population (plus gender and age specific sub-indices), specifically designed to help price and structure financial instruments related to longevity risk. In this context, it would be helpful to see some figures for the correlation between changes in life expectancy in the U.S.A. and, for example, the U.K. However, evidence from within the U.K., showing different patterns of mortality and patterns of mortality improvements between different socio-economic groups, suggests that basis risk is a real issue, and not just an excuse for inaction.

A further factor which may affect the development of this market is the attitude of the Government. The paper discusses the possible role of the Government in Section 3.5. Incidentally, I am not convinced by the description of the U.K. Government as ‘insurer of last resort’ — after all, the Government went out of its way not to stand behind the Pension Protection Fund — but this does not affect the fact that the Government has significant exposure to longevity risk, as well as, presumably, an interest in helping pension funds and insurance companies to manage their longevity risks.

Section 8.2 reviews factors contributing to the success or failure of new futures contracts based on past experience. The most important criterion for success listed is the existence of a

large, liquid spot market in the underlying. This and the other factors given would seem to pose considerable barriers to the development of a mortality futures contract. However, this does not preclude the successful trading of over-the-counter forward contracts. Some encouragement can be found here if we extend the authors' example of property futures in Section 8.3, as, after several attempts, there does appear to be an active market developing now in property forwards.

Overall, the paper provides a useful codification of the types of mortality derivative, and can only help the process of developing the market by providing a new focus. However, we should not underestimate the considerable practical barriers to the implementation of longevity-linked securities. There has been significant effort from a number of investment banks over several years, but little to show for it all so far. Nevertheless, I agree with the authors that, eventually, capital markets will find a way to make this work, and some genuine opportunities for risk management in this area will emerge.

**Mr C. D. O'Brien, F.I.A.:** Insurance companies take on the risks which others do not want, so, it is good that this paper shows how insurance companies and pension funds can manage the mortality risks which they have.

I once worked for a life insurance company, and attended a conference which covered both life and general insurance, although it was not an actuarial conference. At it there was a paper on catastrophe bonds, which were used by general reinsurers. It is an exciting concept, of capital markets being used to hedge insurance risks, and so it is good to see it applied now to mortality risks.

One of the first stages in managing risk is risk identification. We know that individual mortality risk is diversifiable, but it is clear that we have not given enough thought in the past to identify the systematic mortality risk which can affect us.

I would like to think that pension funds give more thought to mortality hedging controls and securities. After all, firms often outsource the operations which are not their core skills, so that they are not left bearing those risks. I suggest that pension funds need to consider longevity risk in a similar way. Indeed, if we see a new development of arrangements to manage closed pension funds, I think that they would be reluctant to be fully exposed to longevity risk, and should be particularly interested in these securities.

I also suspect that regulators will have a particular interest in it. The Financial Services Authority (FSA) has set stress tests for large with-profits life insurers which lead to a capital requirement, depending on market, credit and persistency risk. If it sets a stress test for non-profit life insurers, I think that it would be logical for there to be a mortality stress test. Of course, designing this test needs considerable thought, recognising that lower mortality rates have different effects on assurances and annuities.

Logically, this would lead to the capital requirement being reduced if the insurer had appropriate mortality hedging in place to control those risks. However, regulators also need to ensure that they give appropriate credit for both reinsurance and mortality-hedging securities as methods of risk control.

The same could follow for pension funds, and I would certainly expect the Pensions Regulator and the Pension Protection Fund to be interested to see which funds buy mortality risk protection. I suspect that fund members might be more comfortable with that protection in place.

I suspect that the accounting standard setters would not be too far behind either. Should life insurers and pension funds with mortality-related liabilities value these at a price at which liabilities can be transferred on the capital markets? There are pros and cons to this, and, to some extent, it depends on how the market emerges.

There are several examples, in recent years, where we have seen the investment choices and some of the management actions of insurers and pension funds being influenced by the regulators and the accounting standards, although I would not wish to suggest that those influences have always been wrong.

When it comes to mortality-linked securities, let us hope that the market can come to an early conclusion on what product designs are suitable. This involves overcoming quite a lot of

obstacles, and may well take some time, as, indeed, the market for hedging general insurance risks has shown. However, we should then see insurers and pension funds giving proper consideration as to whether to hedge or not, and disclosing to stakeholders the residual mortality risks which they are taking.

Regulators may have a role in this by requiring disclosure of mortality risks, and that would be a stimulus to improving what may have been inadequate mortality risk identification in the past.

**Mr P. J. Sweeting, F.I.A.:** This is an interesting paper, dealing with practical answers to a topical issue. However, it is important not to spend too long thinking about bonds at the expense of some of the derivatives, such as swaps. Although the authors have done some work on the use of longevity or survivor swaps, it is worth spending some time discussing them in more detail.

The authors highlight the problems associated with the EIB/BNP bond, and suggest solutions to many of them; but, in a number of cases, a simpler solution is just to use a more suitable longevity instrument, and, in many cases, that is going to be a swap. The authors point out some of the advantages of swaps over bonds in this context. However, they only allude to the key advantage which swaps have; namely, the ability to separate the decision to reduce unrewarded risk from the decision on how to spend the risk budget.

There is also a more pragmatic reason to consider the swap market in more detail. Innovative instruments, such as those relating to longevity, are always more likely to be used by larger institutions, at least initially, and such institutions are more likely to use, and to be able to use, over-the-counter instruments such as swaps. A good recent example is that of inflation swaps, and the subsequent introduction of liability driven investment funds. Swaps do provide, at least potentially, a more practical and flexible way for larger pension schemes to manage their mortality and longevity risks, and if swaps are ultimately traded in a standardised framework, then a liquid market might be a possibility. Also, a liquid survivor swap market would provide instruments which could be used to create bonds or funds, which would allow smaller investors to hedge risk as they saw fit.

So, whilst longevity bonds offer an intuitively simple approach, I believe that, at present, their flaws are such that their practical use is limited to extreme event versions, such as the Swiss Re catastrophe bond, and that survivor swaps offer a more practical and saleable way forward.

**Mr P. W. Wright, F.I.A.:** I do not share the authors' bullish view of the prospects for longevity, as opposed to mortality, securities. In my conversations with investment banks concerning embedded value securitisation, I have gained the impression that they view anything associated with longevity risk as being akin to toxic waste. There are fashions in this business, and it is quite possible that the time will come for these securities, but I think that we are some way off this at the present time.

Section 3 gives some possible interested parties in the securities. General investors probably already have as much, if not more, of this risk than they really want, through investment in companies with large defined benefit pension schemes. As for the Government, the paper does refer to its liabilities under the old age pensions and SERPS, but fails to refer to the vast liability for public sector pensions, where it is probably true to say that it is genuinely the insurer of last resort.

The principal issue which I shall raise, however, is not one which concerns the main subject matter of the paper. Rather, the paper drew my attention to a longstanding practice in the insurance industry in a way which I had not seen quantified or analysed before — namely that of companies moving in and out of the annuity market.

For genuine new business, companies clearly have a right to set whatever terms they like for annuities. However, if they make similar drastic changes to the rates offered on their vesting personal pension contracts and group money purchase plans, then I wonder whether this is consistent with the concept of treating customers fairly. The existence of the open market option is some argument to support this practice within the concept of treating customers fairly, but

the exercise of this option may not be practical in all circumstances — particularly where the accumulated fund is relatively small. The ability from A-day to commute fund values of up to £15,000 could make the issue less of a problem, but with treating customers fairly so prominent at present within the thinking of the FSA, I thought that the matter should be aired in this discussion.

In ¶8.4.4.(4) the authors point to an apparent steep drop in annuity rates in 2002, beyond what would be explained by interest rate movements alone. I wonder whether, in addition to mortality expectations, this could have been influenced by a change, around that time, in the perception of the appropriate allowance to make in pricing for anticipated rates of return in excess of the risk free rate.

**Mr I. J. Kenna, A.I.A.:** Although much hard work has been put into this paper, it amounts to little more than a discussion of how to arrange the lifeboats on the Titanic, with some of the lifeboats being hypothetical. An optimum arrangement of the lifeboats is desirable, which will ensure an orderly evacuation, but it will not prevent the Titanic from hitting the iceberg.

Pension schemes are in crisis because of low real yields and improving longevity. It is elementary actuarial science that, as far as pensions are concerned, an increase in the force of interest counterbalances a decrease in the force of mortality.

After much research on increased longevity, nowhere have I been able to discover what increase in yields would counterbalance the likely decrease in mortality rates. Accordingly, I have worked on the following assumptions: males retiring at age 65; current assumed expectation of life 16 years; future likely expectation of life 20 years; pensions linked to inflation, currently 3%; and current interest rates and yields 6%. My calculations show that an increase of 2% in interest rates would be required to offset the effect of improved mortality. The question is how to obtain the extra 2%.

Official interest rates are political. Intense lobbying is going on all the time to keep interest rates down. Our manufacturing industry, we are told, will perish if the official rate of interest is increased. In fact, U.K. manufacturing way well perish, but not because of increases in interest rates. Funded pension schemes are already perishing. The Actuarial Profession needs to put the case for higher official interest rates.

What is the case?

- (1) It has been noted that: "If we had to choose a single, ordinal measure of general well-being, life expectancy at birth would seem to be the best." Improved longevity is something of which the U.K. can be proud.
- (2) The Preston curve shows that life expectancy goes up as GDP per capita increases. GDP per capita goes up much more quickly than life expectancy. The increase in GDP per capita provides the wealth to pay for the improved longevity.
- (3) Part of the increase in GDP has to be channelled into extra money for pensions. As regards state benefits, this needs to be from increased taxes and national insurance contributions. As regards funded pensions, increases in interest rates are more appropriate.

In 2006 we celebrate the centenary of the birth of Frank Redington, an actuary who was not afraid to face the authorities with the facts. I wonder if there is anyone like Redington in the Actuarial Profession today?

**Mr R. A. Humble, F.I.A.:** I shall concentrate my remarks on the issues relating to bonds suitable for hedging pension longevity risk.

In ¶4.3.11 the authors discuss various reasons for the slow take up of the EIB/BNP bond. One of the matters which they mention is that it was effectively restricted to male lives. I think that this is a most important point which needs further consideration. Not allowing for females was not merely a feature of the EIB bond, the female longevity trends have received much less attention in actuarial work generally, most noticeably in the work on the cohort effect.

It is interesting and important to explore this. I suspect that part of the reason is that there are simply less insured data available to the CMI, and such data as there are for females tend to

show some rather peculiar trends, as the most recent results indicated. However, this is not a good reason for the profession not to try to understand female longevity trends, given the huge potential importance of this subject.

If one moves away from insured data and looks at population data, the trends are rather more credible. As the paper points out, there are other advantages in using population data as a basis for an index in a longevity bond. The significant differences which are observed between the insured pensioner experience and the population experience are, in my view, a result of socio-economic factors to a very significant extent. I think that, as a first approximation, it would be possible to allow for this by an addition to population increases in longevity.

If one were to consider these issues together with the authors' comments about the relative cost of the bond, in terms of tying up capital in order to make payments in the short term where the level of uncertainty was not particularly onerous, then, maybe, we could look at a bond which would: be based on deferred annuities rather than on immediate annuities; be based on a weighted mix of male and female lives; and be based on population mortality as an index, possibly with an additional improvement factor for socio-economic issues. That would obviously depend on the particular block of pensions business which one was considering.

I think that, if one were to adopt that sort of approach, one might have a longevity bond which came a lot closer to mirroring the reality of the profile of the insured pension fund liabilities which it was designed to hedge.

**Mr M. G. White, F.I.A.:** When I consider my own position, I will need to live off my savings. At some stage I may need to buy an annuity. If, by that time, mortality has generally improved, I will get a lower annuity rate, but if I have already exposed part of my capital to other people's longevity, I will suffer a 'double whammy'.

The capital markets and the financial markets are really the savings and investments of individuals. Just imagine the potential mis-selling scandal if bonds, heavily exposed to improving mortality, were marketed to people saving for their retirement. However, is that not the underlying purpose of most savings? So, which financial market participants will feel comfortable exposing their clients' savings to this risk?

Longevity risk is rather like the nastiest form of long tail or latent claims experienced by the non-life insurance industry. It has the ability to wipe out exposed risk capital many years after the contract is entered into, with no recourse to the policyholder. We cannot safely say that the insurance or reinsurance industry will step in. I like to think of all companies as stewards of the wealth of long-term savers, and insurers and reinsurers are more likely to want to offload this risk than to accept more.

I would not make the same comments about the risk of rising mortality, and the experience of Swiss Re in successfully issuing its mortality bond bears this out.

**Mr N. Knowles, F.F.A.:** The subject matter of this interesting paper is an issue with which Credit Suisse and others have been grappling, and have taken a number of steps to try to source longevity protection from the capital markets. Possibly one of the most important things which, maybe, has not been brought out in as great detail in the paper as might have been is pricing. I like to think of it as the 'Crayola School of Underwriting'. Any of us can get a piece of paper and a crayon and draw a curve as to where we think future longevity is going to be. My guess is as good as yours, and therein lies the fundamental problem. Whereas there are many people who have a view about which way interest rates are going to go, it is much harder to get enough people in a room together who actually have a consensus about where the longevity curve should be. Pick two people and the curves could be anywhere. If you find enough people, then it is to be hoped that you will get some of the curves crossing each other. We and others have been looking for places where the curves cross.

So far as the form of the contract is concerned, I agree strongly with a previous comment that separating the funding decision from the risk transfer decision is helpful. If I am an insurance company, I like to buy credit or I like to buy other assets because I like the return on those assets. Embedding a hedging instrument in an asset which I would not normally buy may



not be very attractive to me. That is equally applicable if I am a pension fund. I buy an asset because I like it, not because it happens to have some unusual feature. That is not to say that we should not tag mortality and longevity risk transfer into assets — far from it. If that is the way to get capital into the market, that is good news, but the key thing is to make it an asset which somebody wants to buy in the first place. If people do not buy gilts, then they are not going to buy gilts, even if we put a mortality coupon on them. If we make it an interesting credit-related payout or something like that, then they are more likely to want to buy it.

My other comment comes back to the nature of the contract. I think that this is the same point as before, in terms of finding it difficult to get two parties to agree. A swap fundamentally requires two people to take two views, and then agree, it is to be hoped, where the middle of the curve is. I have already said that it is difficult, at the moment, to find people who have a common view as to where the fair value, the best estimate, lies. That naturally pushes us more towards the catastrophe or the option type of payout. The difficulty there is that it comes back to where the sources of capital might be. Catastrophe bonds have been successful, mainly because you can buy a short-dated exposure to risk. I have a view as to whether I think that there is going to be an outbreak of avian influenza, another typhoon, or something else. So, I can get a handle on that, and I will see what happens over the course of three or four years. Longevity, necessarily, is much longer term. We need structures which capital providers are wanting to tie into for ten, 15 or 20 years, potentially, because it is only by that time when we find out that we have our latest set of mortality projections wrong. Of course, it is hoped that many of us here will be beneficiaries of the improving longevity rather than people rubbing their hands and worrying about it.

**Mr A. J. Wells, F.I.A.:** As the authors and other speakers have commented, many parties are exposed to longevity risk. These can include: companies with defined benefit pension schemes and all the stakeholders in them; long-term insurance companies and their stakeholders, whether they be shareholders, policyholders of a mutual company, or their representatives, the directors; and the Government, with its exposure to the state pension, SERPS or the state second pension, and as an insurer of last resort (if, indeed, that is what the Government is).

However, I venture the comment that many of the stakeholders do not fully understand the longevity risks to which they are exposed. I think that this might be true even of some of those more directly connected with risks, such as pension fund trustees, directors of sponsoring companies and of insurance companies, and those in decision making positions in Government. I think that the same is true, to a much greater extent, of the ordinary shareholders and stakeholders in such parties.

There could be a sort of virtuous circle here. The setting up of a proper market for suitable securities could greatly enhance the true understanding of the price — the value — of the longevity risks which have been taken on, and, conversely, a greater understanding of those risks and their price (or value) could help in setting up a fuller market for these securities.

**Mr M. D. Autier** (a visitor; Head of Global Risk Solutions, BNP Paribas): My firm is the origin of this attempt to move the market a little (as described in Section 4.3). Unfortunately, it has been a failure so far. Sometimes you have to try, and we believe that this market will evolve. This paper will definitely contribute to that.

I now give you some information about the background of the product which is described in Section 4.3, which may complete the paper. First, the positioning of this product is a means to bring something more into the market. Today, if you want to manage longevity, if you are a pension fund, it is either buyout, and that is only limited to pension funds which can have a successful buyout, or it is nothing. There is nothing in between. The big advantage of this product is that anybody can buy the product, and it offers longevity protection. That, we believe, is a massive advantage.

The issue is that longevity is not a key priority for pension funds. They have much bigger problems to address before longevity. These are: their assets/liabilities; their deficits; and then comes longevity. Longevity is a slow moving evolution. If you have markets like those of 2000,

going the wrong way: you are hit on the asset; you are hit on the liability; that is a far bigger issue. So, longevity comes well after that.

This product was an important derivative form. It is very easy, from a financial engineering point of view, to reverse the structure of this product in a two-way swap. This would not make it easier for most pension funds. They are not used to manage liabilities. They focus completely on the return on assets. At the time when we launched the product there were very few swaps which were implemented by pension funds. They already had a big reason to enter into swaps, at least to manage their interest rate risk position. If they do not manage their interest rate risk position they will not manage their longevity, because it starts on the same principle.

My view is that longevity risk is a very expensive risk. At the moment there is probably not enough remuneration for transferring the risk. Today, if you look at who takes the longevity risk, insurance companies are taking this longevity risk, but are they taking it *for* the longevity risk? I am not sure. I think that they are taking it, also, to get the assets, and to consider that they will overperform a certain return of the assets to pay for the longevity risk. However, so far I do not know many companies which offer longevity risk on its own. Managing longevity risk is really the business of insurance companies, which should be able to offer purely protection on longevity. However, that is not the case. It is a case of the business insuring the risk, but having the assets, and the bulk of the profitability is probably in the assets. This is already a sign.

I believe that the longevity bond attempts to move the market in the right direction. This will start to pay off, because it is a massive structural risk which a pension fund or society itself will have to carry. However, only part of this will probably be covered. I believe that, in the long run, a risk at 40 years or at 50 years is very difficult to manage. The Turner Report recommended that the age of retirement has to change and become a floating retirement age, evolving with longevity improvement. If longevity improves, the retirement age will be later. This will eliminate the risk, at least for part of the active population.

**Mr C. G. Lewin, F.I.A.:** Ice cream sellers want sun; umbrella sellers want rain; hence you get a weather market. So, might it be possible to get a similar balance in the case of longevity? Who does not want excessive longevity? Obviously, the state in respect of state pensions, and trustees in respect of occupational pensions, to name just two parties.

Who does want more longevity? Some people may well want it for themselves. Insurers who issue non-profit whole-life policies would want it. The state will want it for healthcare.

Much of the cost of healthcare is in the last years of life. At the moment that cost falls largely on the state, although, to some extent, wealthier individuals might bear it through having to sell their houses. If longevity improves, the cost of the final years' healthcare for the population as a whole is deferred. That benefits the state and offsets, to a significant extent, the cost of the extra state pensions. Does it more than offset it? One would need to do the appropriate sums to see. If it did more than offset it, then this would enable the state to meet an extra liability on a state issued longevity bond without extra risk.

It seems to me that further study of the total real costs to the community of long-term care, in all its guises, is needed to see whether it is an effective counterweight to the extra cost of pensions if longevity improves.

**Professor A. J. G. Cairns, F.F.A.:** Some in the discussion have asked whether there is a need for this type of market. One of the reasons why we became involved in this research, at least from speaking to some people, is that there is a perceived need coming from pension funds, for example, that they would like to see some types of products of this type to help them to hedge their liabilities. Does anyone here reinforce this view?

**Mr Wilson:** I try to answer that question. I think that most people who are asked a question like that will say 'yes'. However, it depends, ultimately, on what the price is. Until that is known, I do not think that you can believe the answer. There is already a market, in a sense, in the bulk purchase annuity market, to which reference has already been made.

Many pension funds do not like the price, so what they are saying is that they would like something cheaper.

**Mr M. H. D. Kemp, F.I.A.** (closing the discussion): In the discussion a number of issues have been raised. Probably the most important theme was whether there were people who actually wanted to buy these instruments, in particular the long-dated types epitomised by the proposed EIB/BNP issue. The Swiss Re product seems to have done quite well. The EIB/BNP product has been less successful.

I found it very interesting, within the presentation by Professor Blake, how little longevity risk is actually held by insurance companies, as shown in Table D.1. This observation suggests to me that, not only do many in the audience have question marks about whether they would want to buy more exposure to longevity risk, but even insurance companies are showing a reluctance to hold more longevity risk than they really have to.

Mr Wright and others made interesting comments that investors, typically, already have rather a lot of this risk through shareholdings in companies with defined benefit pension fund exposures.

The opener noted that most people would like to be able to protect these risks, but only at what they considered was a 'reasonable' price. Therefore, it would be intrinsically helpful if a market did develop, as it would then be more practical to put a (market) price on such risk.

Other themes which were picked up in the discussion included whether some of these risks could actually be shared with the pensioners/annuitants, and were there offsets which we should be bearing in mind, for instance, were some longevity costs being implicitly offset by healthcare costs as far as the Government is concerned.

There was scepticism aired about how rapid it might be possible to get people to agree, even broadly, on what was the right price for longevity risk. Mr Knowles suggested that there might be a tendency for a Crayola School of Underwriting. I hope that this is not true so far as most reinsurance companies are concerned! Scepticism was also expressed regarding whether there really would be the level of understanding to make this market develop rapidly.

I was interested to note how the authors had used the term 'security' in the paper's title when they then went on to talk about derivatives. Typically, securities are used in the context of a tangible physical instrument, such as a bond or an equity. The authors may have deliberately chosen to use a wider definition, because the 'D-word' is sometimes a turn off for investors. I hope that that is not going to be the attitude with these instruments. As was pointed out by Mr Autier, these instruments can be converted into or out of funded physical forms relatively straightforwardly by capital market participants.

Also, I should like to note that, a decade or so ago, when I was an investment consultant, I tried to get LIFFE to launch a futures contract on index-linked gilts. This was not successful. Perhaps the timing was not right. Note that this was when the underlying market was pretty sizeable, had acquired widespread actuarial credibility, and had many investor participants, even if the stocks concerned were somewhat tightly held. So, I would agree with the opener that the rapid creation of a listed mortality derivatives market is likely to be a tall order.

Conversely, I would note that there has been a huge explosion in the use of credit derivatives (in over-the-counter form) over the last, say, five years. This growth is only partly because there is a natural role which credit derivatives play in the interbank market (enabling one bank to lend more to a corporate than its credit officers would otherwise allow, because the excess credit exposures can then be passed to others).

An even bigger source of growth recently for the credit derivatives market has been the issuance of collateralised debt obligations and their purchase by insurance companies. This has led to market participants moving away from the old idea of bundling together credit risk and interest rate risk in the same instrument, via a bond, and, instead, trading the credit element (via credit default swaps) separately from the interest rate element (via interest rate swaps, etc.).

The credit derivatives market does show that things can change, in the context of the long term, which is typically the actuarial perspective, almost overnight. Whether I would actually bet

the bank on this happening in the case of mortality instruments is moot point, but at least we can say, on the basis of this paper, that, if such a quantum leap does occur, we, the Actuarial Profession, should be positioned at the leading edge rather than behind the curve.

**Professor Cairns** (replying): I have a general remark which, perhaps, follows on from the closer's comment, which is that, for me, this has been a fascinating general area in which to work. It pulls together many very diverse areas of expertise. On the one hand you have traditional actuarial mortality; on the other hand you have the financial markets and financial mathematics stochastic modelling and statistics all in this one big pot, all of which are dear to my heart. It is good to have a single project where these come together.

Concerning some of the points made by various speakers, one or two questioned the need for this type of asset. I passed that question back to the audience, and we are getting varied responses.

If you take one step back and think about a more pure financial world, if you try to put into existence an asset, the worst that can happen is that nobody invests in that asset. On the other hand, the introduction of a new asset, for example a longevity bond or some other asset of that type, does allow for greater efficiency in the marketplace. The worst that might happen is that nobody invests in it, but, more likely, there may well be a price at which some people will go long in that particular asset, such as pension funds, while other investors will go short. In aggregate, the fact that these individual groups invest in those assets at that particular price should mean that, somehow, the general welfare of all parties, however you measure that, is improved.

The opener made some remarks about alternative annuity products. I think that that is a good approach as part of the overall package of how we might decide, in the longer term, to address the overall problem of longevity risk. However, at the current time we still have a big problem with the longevity risk which is currently held by defined benefit pension plans and also, to a smaller extent, by the annuity providers. This problem is not going to go away in the short or medium term, and, in effect, it is this with which we aim to deal in our paper.

Some comments were made about the different improvements in longevity among the different socio-economic groups. That is a very important observation. In a typical pension fund, a large part of the liability will most likely be associated with people who are in the higher socio-economic groups. Therefore, just using a national index of mortality may somehow underestimate the longevity risk. If we are developing new mortality indices, perhaps some way to try to separate out those different groups might be a very useful way forward.

Mr O'Brien mentioned the regulators as a possible way of encouraging people or hitting people with a stick, in order to get them to use these types of contracts; for example, if regulations change in a way which require the pension funds or life insurers to measure properly their longevity risks and more general mortality risks. That is one aspect of encouraging greater use of these types of product, but which is a slightly unsatisfactory way of getting people interested in this sort of market. What you really want are people going out willingly to buy these types of products to manage their risks.

As a related, but separate and important, point, my view is very much that this type of contract should not be used in isolation, but needs to be part of a much bigger package of risk management, be it within a pension fund, a life insurance company or whatever.

One example of where this type of approach was taken was the Swiss Re mortality catastrophe bond. One of the reasons why they introduced that contract was to demonstrate that they were doing good risk management. There was then a beneficial effect that, when they go to the capital markets to raise further capital, they get a better credit rating by virtue of the fact that they are using these types of contracts as part of a bigger package of good risk management.

Mr Sweeting made some good comments about how the over-the-counter swaps market is perhaps where things might go first of all. I agree with that. The limited knowledge which I have in terms of what contracts have been transacted in the past is that most of these are over-the-counter swap contracts. There is certainly much which we can learn from that. The other observation, which was made by Mr Autier, was that over-the-counter swaps are perhaps good

for the big life insurers and the pension funds, but when it comes to the smaller players in the market, a swap contract may be prohibitively expensive or just not possible to negotiate. So, the traded instruments are ones which might help to allow smaller pension funds, and so on, to hedge this risk themselves rather than just to leave it to the larger pension funds.

Mr Humble made another interesting suggestion about how contracts might develop. He suggested a more complex form of longevity bond which has a weighted mix of ages, and also by sex, in order to provide a better match for pension funds. That is something which is worth following up as a means of reducing basis risk. If you think about the related example, the Swiss Re catastrophe bond, it was designed using national mortality indices, but Swiss Re chose weights which allowed them to match as closely as possible their own exposure to catastrophic mortality risk. So, it seems equally plausible that a longevity bond or some mortality swap could be developed where there are some standard weightings which are attached to the different ages and different sexes.

Mr White made an important point that, if you have these contracts, who will take the other side of the deal? He said that it should not be pension savers. I agree with that. It is very important that individuals and their advisers understand what risks they are taking. If, for example, you are looking at somebody who has a personal pensions contract as part of their portfolio, they may want to have a long position in a longevity bond rather than a short position, in order to hedge that future risk of when they come to retire and they have to buy an annuity. By holding longevity bonds, they could partially hedge the longevity risk which is associated with the annuity purchase at retirement.

So, Mr White is quite right that pension savers are not the sort of people who you should be advising to take that sort of position. In the paper we do not give the full answers as to who these counter-parties might be. However, if these contracts exist, then the individual investors have the chance to look properly at their risks, and assess whether they want to go long or short in this particular type of asset.

The existence of these assets is all part of having an efficient and transparent market. This is in contrast to the current situation, where longevity risk is, as some have pointed out, embedded in individual investments in large companies which have big defined benefit pension plans. The existence of mortality contracts does make things more transparent, and easier for people to assess the risks and, perhaps, to reduce that particular risk if they want to do so.

Mr Knowles mentioned the issue of having too many diverse projections. In a way, I see that as helpful to the development of a market. If you have people with diverse projections of the market, then, if you set a particular price: some people are going to think that this is a good deal to buy that contract; other people will think that that particular price makes it a good deal to go short. I think that a diversity of opinion is a good thing to some extent, because people will perceive that they can get a good risk premium out of that sort of investment. I am sure that that sort of diversity and opinion exists in other assets in which organisations invest.

**The President (Mr M. A. Pomery, F.I.A.):** I thank Professor Cairns for his reply. If I may add a couple of comments of my own, I would observe that longevity is a much more complex subject than many people appreciate. As actuaries, we have been used to splitting populations into male and female, and looking at different mortality tables for those two groups; and, more recently, smoker and non-smoker, and other breakdowns, but it seems clear from the work which we have been doing recently on investigating the mortality of pensioners from large self-administered pension schemes, that the socio-economic factors are going to have a major impact on future mortality. This, to me, just underlines the problem of trying to develop suitable mortality indices which can underlie these longevity bonds.

This is a very timely paper. The existence of so many closed legacy final salary pension schemes will, I think, inevitably lead to innovative solutions. There are already rumours regarding possible new ventures in this area.

On behalf of us all, I should like to thank the authors for this paper, and to join with that our thanks to the opener and the closer for their contributions. I also thank all those who participated in the discussion, too.

## WRITTEN CONTRIBUTION

**The authors subsequently wrote:** We thank all of the speakers at the meeting for their interesting contributions. We had the opportunity to respond to many of the remarks made at the end of the discussion. There are a few additional points which we wish to add in this written response.

A number of contributors touched on the issue of who the natural receivers of longevity risk are. Some took the view that there are natural receivers, albeit with significant basis risk, while others took the opposite view. However, even where there are no natural receivers, we feel that there should be willing investors; specifically investors looking for low beta investments. Better still, if there are no natural receivers of longevity risk, then the hedgers should be prepared to pay a premium to offload their longevity risk, creating an investment with positive alpha. Perhaps we are already seeing investors of this type entering the market. For example, the opener commented on the recent creations of insurance companies which specialise in bulk buyouts of pools of annuitants. We cannot claim to have a detailed knowledge of how such companies work internally, but such specialised companies would not exist unless their core business was offering satisfactory expected returns to their investors.

A different response to this question is to regard individuals, themselves, as the natural receivers of longevity risk. On the one hand, pension funds and annuity providers lose financially if longevity improves by more than anticipated. On the other hand, everything else being equal, individuals will gain, not just financially (if they purchased an annuity on *ex post* favourable terms), but also in terms of expected utility. This would suggest that passing longevity back to the policyholders through the use of increasing retirement ages (as suggested by the Pensions Commission) and through the use of participating policies might be possible without risk premia being necessary.

We replied at the meeting to Mr O'Brien's comments on the role of regulators in encouraging the use of mortality-linked securities. We would add to this a more positive suggestion which builds on our comments on the Swiss Re issue. Specifically, a company which can demonstrate that it is practising good risk management can raise money in the financial markets at lower rates of interest. In financial economic terms, the current value of a company includes, not just the value of any debt and equity, but also the future probability and expected costs of bankruptcy. Good risk management reduces the risk and expected costs of bankruptcy, and therefore results in this part taking a smaller slice of the Modigliani-Miller 'cake'.

Mr Sweeting and a number of other speakers stressed the importance of swaps in the development of a derivatives market. This is an important observation to make; in that it allows, to a large degree, separation of the decision to manage (all) risks from the decisions on how to invest the assets. As a swaps market develops, things might become more standardised, making the market more efficient and more liquid. However, we would also echo Mr Autier's remarks that, at least at the current time, longevity swaps might be prohibitively expensive for smaller enterprises. Access to suitable instruments for hedging longevity will only come when the swaps market becomes sufficiently liquid or if a market in traded securities develops. The additional transparency of traded securities, noted by the closer, will also allow potential hedgers to gauge the value of their liabilities and provide information on the right prices at which they might be able to hedge.

Finally, the closer remarked on the development of the credit derivatives market. We would echo his thoughts on this, and suggest that further work ought to be done to see what ideas can be transferred from the field of credit derivatives into mortality-linked derivatives.