Longevity Risk and Retirement Savings

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1 Introduction

Over the last few decades there has been an unprecedented increase in life expectancy. For example, in 1970 a 65-year-old United States male individual had a life expectancy of 13.04 years. Three and a half decades later, in 2005, a 65-year-old male had a life expectancy of 17.2 years. This represents an increase of 1.16 years per decade. To understand what such an increase implies in terms of the savings needed to finance retirement consumption, consider a fairly-priced annuity that pays $1 real per year, and assume that the real interest rate is 2 percent. The price of such annuity for a 65 year old male would have increased from $10.52 in 1970, to $13.53 by 2005. This is an increase of roughly 29 percent. Or in other words, to finance a given stream of real consumption during retirement, a 65-year-old male would have needed 29 percent more wealth in 2005 than in 1970.

These large increases in life expectancy were, to a large extent, unexpected and as a result they have often been underestimated by actuaries and insurers. This is hardly surprising given the historical evidence on life expectancy. From 1970 to 2005 the average increase in the life expectancy of a 65 year old male was 1.12 years/decade, but, from 1933 to 1970, the corresponding increase had only been 0.2 years/decade. This pattern of increases in life-expectancy has not been confined to the US. In the United Kingdom, a country for which a longer-time series of data on mortality is available, the average increase in the life expectancy of a 65 year old male was 1.35 years/decade from 1970 to 2005, but only 0.17 years/decade from 1870 to 1970. These unprecedented longevity increases are to a large extent responsible for the underfunding of pay as you go state pensions, and of defined-benefit company sponsored pension plans. For individuals who are not covered by such defined-benefit schemes, and who have failed to anticipate the observed increases in life expectancy, a longer live span implies a lower average level of retirement consumption.

The response of governments has been to decrease the benefits of state pensions, and to give tax and other incentives for individuals to save privately, through defined contribution pension schemes. Likewise, many companies have closed company sponsored defined benefit plans to new members, and have instead chosen to contribute towards personal pensions that tend to be defined contribution in nature. This means a transfer of longevity risk from pension providers to the individuals themselves.

3The decrease in birth rates that has occurred over this period has also contributed to the underfunding.
It is true that longevity risk, or the risk that the individual might live longer than average, may be reduced by the purchase of annuities at retirement age. However, a young individual saving for retirement faces substantial uncertainty as to the level of aggregate life expectancy, and consequently the annuity prices, that she will face when she retires. Furthermore, markets may be incomplete in the sense that individuals may lack the financial assets that would allow them to insure against this risk. This paper studies the extent to which individuals are affected by longevity risk, and the role that different instruments, including financial assets, play in hedging it.

We first document the existing empirical evidence on longevity, focusing both on its historical evolution, and in forward-looking estimates of mortality rates and of the uncertainty surrounding these estimates. For this purpose we use current long-term projections made by the US Social Security Administration and by the UK Government Actuaries Department (GAD). We use this evidence to parameterize a life-cycle model of consumption and saving choices. The main distinctive feature of the model is that the survival probabilities are stochastic and evolve according to the Lee-Carter model, which is the leading statistical model of mortality in the demographic literature.

In our model, and in each period, the individual receives a stochastic labor income stream, and must decide how much to consume and save. She knows the current survival probabilities, but she does not know the future survival probabilities, since they are stochastic. Naturally the individual forms an expectation of such probabilities when making her decisions. In addition to being able to adjust her savings in response to changes in life expectancy, we allow for endogenous retirement, i.e. we allow the individual to choose the age at which to retire.

Traditionally markets were incomplete in that agents did not have at their disposal the financial assets that would allow them to hedge longevity risk. We say traditionally since there have been recent attempts to address this market incompleteness. In December 2003, Swiss Re. issued a $400m three-year life catastrophe bond. This was a direct attempt by Swiss Re. to insure itself against a catastrophic mortality deterioration (e.g. a pandemic). This bond offered an opposite hedge to pension funds and other annuity providers. It was well received and fully subscribed, and followed by a second bond placement in April 2005, which was also fully subscribed.

In spite of these bond issues currently there is not an active and liquid market for longevity bonds. In addition, there have been in the past unsuccessful attempts to issue longevity bonds.
In November 2004, the European Investment Bank (EIB) announced the issuance of a 25-year £540m longevity bond. Despite receiving substantial public attention, the issue was not well perceived by market participants, and was eventually withdrawn. The main challenge is that in the market place there is no natural counterparty, willing to take on longevity risk. In addition, for a liquid market to develop the product must be standardized, but those that are exposed to longevity risk want a customised product tailored to their specific situation.

It is with this process of financial innovation in mind that we allow the individual in our model to invest in longevity bonds, or financial assets whose returns are correlated with the shocks to the survival probabilities. We study the household portfolio allocation between these two assets, and how it changes over the life-cycle. Therefore, our model allows us to study, in a micro setting, who are the individuals who benefit most from longevity bonds, and those who benefit less who might be the counterparty for such bonds. We also draw implications for security design.

We find that agents respond to longevity improvements by increasing their savings, and in this way they are able to at least partially self insure against longevity shocks. We say partially because when agents guide their decisions using official period life tables, which do not take into account future improvements in longevity, the effects of longevity risk on welfare can be substantial, particularly as of retirement age. More generally, we show that longevity risk can have significant welfare implications when agents underestimate the probability of future mortality improvements. These welfare losses are substantially higher when the payouts of defined benefit pension plans are negatively correlated with aggregate survival rates. This scenario is motivated by recent events, which suggest that as survival rates increase retirement benefits are progressively decreased. In this case, when longevity increases and households need more wealth to finance their retirement consumption, they are also more likely to receive a lower pension.

We also find that, if households know the exact parameters of the stochastic process for mortality rates, then the benefits of being able to trade longevity bonds are quite small. However, small misperceptions about future improvements in mortality rates are enough to induce very large welfare gains from investing in longevity bonds. This difference is extremely important because it suggests that investors might not buy these bonds even if they actually stand to gain significantly from investing in them.