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Richard McMinn, Jennifer Wang and David Blake

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The Pensions Institute
Cass Business School
City University
106 Bunhill Row London
EC1Y 8TZ
UNITED KINGDOM

<http://www.pensions-institute.org/>

Longevity Risk and Capital Markets: The 2007-2008 Update

Richard MacMinn⁺
Jennifer Wang⁺
David Blake⁺

Longevity Three: The Third International Longevity Risk and Capital Markets Solutions Conference was held in Taipei, Taiwan on 20-21 July 2007. It was hosted by National Chengchi University.

Mortality improvements around the world are putting more pressure on governments, pension funds, life insurance companies as well as individuals to deal with the increasing longevity risk they face. Financial markets, on the other hand, can in principle provide vehicles to hedge longevity risk effectively. Many new investment products have been created both by the insurance/reinsurance industry and by the capital markets. Mortality catastrophe bonds are an example of a successful insurance-linked security. Some new innovative capital market solutions for transferring longevity risk include survivor bonds, reverse mortgages, longevity-linked swaps and forward contracts. The aim of the *International Longevity Risk and Capital Markets Solutions Conferences* is to bring together academics and practitioners from all over the world to discuss and analyze these exciting new developments.

The first conference was held at Cass Business School in London in February 2005. This conference was prompted by the announcement of the Swiss Re mortality catastrophe bond in December 2003 and the EIB/BNP/PartnerRe longevity bond in November 2004.

The second conference was held in April 2006 in Chicago and hosted by the Katie School at Illinois State University.¹ In the intervening period, there were further issues of mortality catastrophe bonds, as well as the release of the Credit Suisse Longevity Index. Life settlement securitizations were also beginning to take place in the US. In the UK, new life companies backed by global investment banks and private equity firms were setting up for the express purpose of buying out the defined benefit pension liabilities of UK corporations. Goldman Sachs announced it was setting up such a buy-out company itself because the issue of pension liabilities was beginning to impede its mergers and acquisitions activities. So there was now clear evidence that a new global capital market in longevity risk transference was beginning to emerge. However, as with many other economic activities, not all progress follows a smooth path. The EIB/BNP/PartnerRe longevity bond did not attract sufficient investor interest and was withdrawn in late 2005. But a great deal was learned from this about the conditions and requirements needed to launch a successful capital market.

⁺ Richard MacMinn [richard.macminn@ilstu.edu] is Edmondson-Miller Chair in Insurance and Financial Services at Katie School, Illinois State University, US. Jennifer Wang [jenwang@nccu.edu.tw] is Professor of Insurance at the National Cheng-chi University, Taipei, Taiwan. David Blake [D.Blake@city.ac.uk] is Professor and Director of the Pensions Institute, Cass Business School, City University London.

¹ The conference proceedings for *Longevity Two* were published in the December 2006 issue of the *Journal of Risk and Insurance*.

We decided to hold the third conference in the Far East, not only to reflect the growing importance of the Far East in the global economy, but also in recognition of the fact that population ageing and longevity risk are problems that affect all parts of the world and that what we need is a global approach to solving these problems.² Since the Chicago conference, there have been many new developments, including: the release of the LifeMetrics Index in March 2007 by JPMorgan, the Pensions Institute and Watson Wyatt; the world's first publicly announced longevity swap between Swiss Re and the UK life office Friends' Provident in April 2007; the launch of the Institutional Life Markets Association also in April 2007; and the world's first derivative transaction, i.e., a q-forward contract between JPMorgan and the UK pension fund buy-out company Lucida in February 2008.

We are grateful to the *Asia-Pacific Journal of Risk and Insurance* for agreeing to publish a special issue of the Longevity Three conference proceedings.

In "The Birth of the Life Market," David Blake, Andrew Cairns and Kevin Dowd present a general overview of the Life Market, the new global capital market that is developing to trade longevity-linked securities and derivatives. Traditionally, longevity risk has been transferred through insurance and reinsurance contracts. But the sheer size of global longevity risk exposure – \$23 trillion in global defined benefit pension funds alone, according to Watson Wyatt's *Global Pension Assets Study 2007* – means that the insurance industry is severely capacity constrained, leaving the capital markets to provide an effective solution to a problem of this scale. The paper considers what capital markets need to both start and evolve. It then looks at the first generation of bond-based capital market solutions that have been tried so far and examines their success or failure. The paper explains how the lessons learned here have informed the design of the second generation of derivatives-based capital market solutions.

Modeling and quantifying longevity risk is an important prerequisite to the development of a successful capital market. Shripad Tuljapurkar in "Mortality Declines, Longevity Risk and Aging" shows that there is an ongoing, longstanding trend to higher average ages at death for both sexes in most countries. Accompanying this trend has been a decrease in the dispersion of the age of adult death which has slowed in most countries in the past five decades. He shows that the Lee-Carter model can be used to provide stochastic projections of average longevity. The dispersion in the forecasted averages can be thought of as a form of systematic risk that is important in pricing longevity risk. The dispersion around the average age at death is a form of individual or idiosyncratic risk. This individual risk certainly does matter to individuals making decisions about consumption, savings, bequests and so on. In particular, it matters to economic aggregates such as population wealth, health, and savings, and to the fiscal flows in private and public pensions. Realistic models of annuity valuation are likely to be nonlinear and so annuity values are also likely to depend on the individual component of longevity risk.

Michael Sherris and Samuel Wills in "Financial Innovation and the Hedging of Longevity Risk" argue that longevity risk is one of the remaining frontiers challenging modern financial markets and financial engineering. Financial innovation has yet to successfully master this very significant risk facing many countries internationally. The aging population around the world drives the need for new products for managing longevity risk and new markets for hedging this risk. The authors consider how financial markets and financial product innovations can ideally be used to hedge longevity risk and also consider lessons from the insurance-linked securities (ILS) market that could be used to successfully fund this risk in financial markets.

² In fact, Asia has the world's largest and fastest growing aging population (United Nations, 2007).

In "Hedging Pension Longevity Risk: Practical Capital Markets Solutions," Guy D. Coughlan, David Epstein, Chris S. Watts and Marwa Khalaf-Allah show that longevity risk transfer via the capital markets is now a reality. Pension plans and annuity providers can hedge longevity risk with capital markets instruments. The key players in the new Life Market are hedgers (pension plans and annuity providers), intermediaries (investment banks and broker-dealers) and end investors (ILS funds, hedge funds, endowments, etc.). The authors argue that the development of liquidity in this market depends on the acceptance of longevity indices, such as the LifeMetrics index, and the development of standardized instruments to transfer this risk. Until now, hedgers of longevity risk have almost exclusively approached the subject from the perspective of indemnification, i.e., that is, 100 percent risk transfer. The authors propose an alternative approach based on a risk management paradigm that does not require 100 percent risk transfer and is consistent with the way in which other pension-related risks are managed. To this end, they present a framework for longevity hedging centered on standardized index-based hedges. This framework uses a building-block approach in which standardized hedge building blocks are combined to provide a longevity hedge tailored to the specific demographics, benefit structure and mortality table of any pension plan. The effectiveness of this hedge is maximized by careful calibration of the mix of building blocks and then verified in hedge effectiveness tests. The authors also discuss customized longevity hedges that will be preferred by some hedgers, who are unconcerned by the lower liquidity and onerous requirements for data disclosure associated with these hedges, and are prepared to pay the additional premium above the cost of a standardized hedge.

In "Assessing Investment and Longevity Risks within Immediate Annuities," Daniel Bauer and Frederik Weber argue that since life annuities provide a guaranteed income for the remainder of the recipient's lifetime, annuitization represents an important option when choosing an adequate investment strategy for the retirement period. While there are numerous scientific articles studying annuities from the pensioner's point of view, there have been few contributions considering annuities from the provider's perspective. In particular, there are no surveys on the general risks within annuity books. The authors aim to fill this void. Using a simulation framework, this paper provides a long-term analysis of the risks within annuity books. In particular, the respective impacts of systematic mortality risk and investment risk on the insurer's financial situation are studied. The key finding is that under the model specifications and using annuity data from the United Kingdom, the risk premium charged for assuming longevity risk seems to be very high relative to other systematic risks. Possible explanations as well as economic implications are provided, and potential caveats are discussed.

Wei Sun, Robert K. Triest and Anthony Webb in "Optimal Retirement Asset Decumulation Strategies: The Impact of Housing Wealth," extend the literature examining the optimal decumulation of financial wealth in retirement to incorporate housing, an asset which comprises the majority of most households' non-pension wealth. They estimate the relationship between the returns on housing, stocks, and bonds, and simulate a variety of decumulation strategies incorporating reverse mortgages. The authors show that a homeowner's reversionary interest, the amount that can be borrowed through a reverse mortgage, is a surprisingly risky asset. Under their baseline assumptions, they find that the average household would be as much as 24 percent better off taking a reverse mortgage as a lifetime income relative to what appears to be the most common strategy, namely delaying tapping housing wealth until financial wealth is exhausted and then taking a line of credit. In addition, they show that housing wealth displaces bonds in optimal portfolios, making the low rate of participation in the stock market even more of a puzzle.

Hong-Chih Huang, Jack C. Yue and Sharon S. Yang in "An Empirical Study of Mortality Models in Taiwan," show that there has been a significant increase in the life expectancy of the Taiwanese population after the end of the Second World War. This, when combined with lower fertility rates, has created an aging population which has now become a major policy

concern in Taiwan. This has, in turn, prompted a search for feasible methods for modeling future mortality changes in Taiwan. The Lee-Carter (LC) model, the reduction factor (RF) model, and the age-period-cohort (APC) model are the three most frequently used methods for modeling future mortality dynamics. The authors carry out an empirical study for these models based on Taiwan mortality experience. In addition, they make a comparison analysis of different models, including the Cairns-Blake-Dowd model, (Cairns et al., 2006) with different mortality experience in Japan, England & Wales, and the US.³

In "Pricing and Implementation of Longevity Bonds in Taiwan", Jennifer L. Wang and Sharon S. Yang argue that as the population ages and the deterioration of pension funds continue, hedging longevity risk is becoming increasingly important in Taiwan. This article analyzes the potential market for issuing longevity bonds to hedge against the longevity risk in Taiwan. The authors illustrate the pricing of longevity bonds using the Lee-Carter model on the basis of mortality experience in Taiwan. Their results show that the risk premium for issuing a longevity bond in Taiwan is lower than that in the United States. However, in order to measure longevity risk more precisely and to overcome the potential problems of issuing longevity bonds in Taiwan, the authors recommend that the quality of mortality data be improved and the regulatory framework be amended.

Finally, in "The Volatility of Mortality", Daniel Bauer, Matthias Börger, Jochen Ruß and Hans-Joachim Zwiesler use forward models to project mortality. The contribution of the paper is to specify adequate volatility structures for such models. They derive a Heath-Jarrow-Morton drift condition under different measures. Based on demographic and epidemiological insights, they then propose two different models with a Gaussian and a non-Gaussian volatility structure, respectively. They present a Maximum Likelihood approach for the calibration of the Gaussian model and develop a Monte Carlo Pseudo Maximum Likelihood approach that can be used in the non-Gaussian case. Finally, they calibrate these models to historic mortality data and analyze and value certain longevity-dependent payoffs using the models.

We have come a long way since the publication of the original theoretical paper on survivor bonds in 2001 that helped to kick-start the Life Market (Blake and Burrows, 2001). A lot of theoretical work has been done on designing and pricing longevity-linked securities and derivatives and on designing longevity-risk hedging strategies. But a lot more work needs to be done. On a theoretical level, more work needs to be done on pinning down a fair price for longevity risk. There are currently widely differing estimates in the theoretical literature. On a practical level, a big education program is needed to inform companies with pension plans about the size of the longevity risk exposure they face. In many countries, pension plans are putting in place liability-driven investment strategies. While these can hedge inflation and interest rate risks, they leave longevity risk unhedged. The sponsors of pension plans therefore face an unhedged exposure to cures for cancer and other terminal diseases. Also, on a practical level, there needs to be greater transparency by the participants in the Life Market, such as the investment banks, concerning the pricing of the longevity-risk hedging strategies they are implementing. One of the important benefits of a capital market is pricing transparency. This is currently lacking in the Life Market. In the absence of a clear market price for longevity risk, the investors that investment banks are trying to persuade to be the ultimate holders of longevity risk are demanding a much higher longevity-risk premium (between 75 and 550 basis points per annum, according to some conversations we have had with pension plans) than pension plans are willing to pay to lay off this risk. Continued growth in the Life Market requires this gap to be closed as soon as possible.

³ This model was first presented at the Longevity Two conference in Chicago.

The fourth longevity risk and capital markets solutions conference, *Longevity Four*, will be held in Amsterdam on 25-26 September 2008. It will be hosted by Netspar at Tilburg University and the Pensions Institute. *Longevity Five* is being planned for the US in 2009.

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