Institution: City, University of London

Unit of Assessment: UoA 17 – Business & Management

Title of case study: The development of the Life Market, a global capital market for transferring longevity risk.

Period when the underpinning research was undertaken: 2001 - 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Professor David Blake	Professor of Finance & Director of Pensions Institute	2004 – ongoing

Period when the claimed impact occurred: 2001 – ongoing

Is this case study continued from a case study submitted in 2014? Y

1. Summary of the impact

The Life Market (LM) is a major new global capital market for transferring longevity risk from corporate pension schemes and annuity providers to reinsurers and capital-market investors. Mortality forecasting models together with longevity bonds and swaps, designed as longevity risk hedges by Professor Blake of the Pensions Institute at City, University of London, have been integral to the operation and further development of the LM. To date, one $50mn longevity bond, 61 UK longevity swaps (worth £105bn) and seven Dutch longevity swaps have been executed. The research has contributed to a reduction in the prices reinsurers charge clients by 1%. Since UK pension funds have so far transferred approximately £100bn in liabilities, the estimated industry savings is £1bn. This reduction in risk transfer pricing directly benefits the pension schemes transferring the risk as they will have paid less to have their members' pensions reinsured. It also benefits pension scheme members who now have greater confidence that their pensions will be paid in full.

2. Underpinning research

The reason for the development of the LM can be found in the fact that people are living much longer than anticipated (a phenomenon known as longevity risk) and, as a result, companies are having to address future, unanticipated increases in pension liabilities which will compromise their economic health and viability. The insurance industry is not large enough to insure all the longevity risk on a global basis. Blake and co-researchers have been actively researching a solution to the problem and his research introduced the idea of longevity (or survivor) bonds (LBs) to hedge systematic or aggregate longevity risk. His research further focused on developing and designing the LBs using a new stochastic mortality model, the CBD (Cairns-Blake-Dowd) model. **[3.1]** Following the initial failure to bring a LB to market, further research was undertaken, led by the Pensions Institute with support from global institutions such as JP Morgan and Prudential Financial. As a result, a number of successful initiatives were launched to initially establish and then support the LM to grow.

The **first** of these initiatives was to examine alternatives to longevity bonds as a hedging instrument. A key alternative was longevity swaps which are less capital-intensive in terms of the level of shareholders' funds that regulators require to support this line of business. **[3.2]**

The **second** research initiative was based on theoretical academic work designed to support the practical development of the LM. The key outcomes were the recognition of the role a national population mortality index could play (a) in the pricing and securitisation of longevity risk **[3.3]** and (b) in index-based longevity hedges that minimise basis risk (in this context, the difference in mortality experience between the population underlying the index and the population of lives in a particular pension scheme being hedged) **[3.4]**. Previous experience shows that an important prerequisite for traded derivatives markets to succeed is a well-defined, homogeneous "underlying" asset or index. This problem complicates the LM, where the "underlying" consists of the lives of different pension scheme members and annuitants from different life companies, regions and socio-economic groups (i.e. it is neither well defined nor homogenous). Professor

Blake and Pensions Institute co-researchers suggested that the only effective way of creating a liquid traded LM was to build it around national population mortality rate indices that were calculated by an independent agent.

The **third** initiative was the creation of the LifeMetrics Indices, designed to facilitate the LM's development. These were jointly designed between 2007 and 2009 by Blake and JP Morgan and are national population mortality rate indices constructed using official mortality data based on the populations for England & Wales, the US, Holland and Germany, with Towers Watson appointed as the independent calculation agent.

The **fourth** research stream initiated a debate on the (potential) role for government and particularly government-issued LBs. This would directly support the development of the LM as it would be instrumental in establishing a market price for longevity risk in the same way that governments help create a market price for inflation risk by issuing inflation-index-linked bonds. Detailed arguments were more formally laid out in Blake et al (2014) **[3.5]**.

The **fifth** initiative was to recognise, that due to informational asymmetries, new investors in longevity risk needed the assurance that they were not being "sold a lemon", i.e., a product where the true risk is hidden from the customer. The classic way of dealing with this is to co-share the risk between the "informed" cedents wishing to lay off the risk and the new "uninformed" investors taking it on. How to do this is explained in Biffis and Blake (2014) **[3.6]**.

3. References to the research

3.1 Cairns, A., D. **Blake**, and K. Dowd (2006a) A Two-Factor Model for Stochastic Mortality with Parameter Uncertainty: Theory and Calibration, *Journal of Risk and Insurance,* 73, p. 687-718 [Winner of the *2016 Robert I. Mehr Award* for the paper published in the *JRI* ten years ago that has best stood the test of time]; http://journalofriskandinsurance.smeal.psu.edu/mehr-awards/2016-robert-i-mehr-award

3.2 Dowd, K., D. **Blake**, A. Cairns and P.Dawson (2006) "Survivor Swaps*", Journal of Risk and Insurance*, 73, p. 1-17.

3.3 Cairns, A., D. **Blake**, and K. Dowd (2006b) "Pricing Death: Frameworks for the Valuation and Securitisation of Mortality Risk", *ASTIN Bulletin*, 36, p. 79-120 [Winner of a) the Bob Alting Von Geusau Prize for the best paper on financial risk published in *ASTIN Bulletin* in 2005 and 2006, b) the 2008 David Garrick Halmstad Prize of the Actuarial Foundation]

3.4 Coughlan, G., M. Khalaf-Allah, Y. Ye, S. Kumar, A. Cairns, D. **Blake** and K. Dowd (2011) "Longevity Hedging 101: A Framework for Longevity Basis Risk Analysis and Hedge Effectiveness", *North American Actuarial Journal*, 15 (2), p. 150-176.

3.5 **Blake**, D., T. Boardman and A. Cairns (2014) "Sharing Longevity Risk: Why Governments Should Issue Longevity Bonds", *North American Actuarial Journal*, 18 (1), p. 258-277.

3.6 Biffis, E., and D. **Blake** (2014) "Keeping Some Skin in the Game: How to Start a Capital Market in Longevity Risk Transfers", *North American Actuarial Journal*, 18(1), p. 14–21

Research was published in journals that apply a stringent peer-review process prior to accepting articles for publication and have been consistently rated highly by the Charted Association of Business Schools.

4. Details of the impact

Professor Blake's research and its adoption by market practitioners demonstrates how academic ideas can translate into sustainable market applications by creating new products, models and vehicles for improving the effectiveness of the Life Market. This is being achieved through (a) "spreading the word" about the new market via publications, such as Blake, D. (2018) "Longevity: A New Asset Class", *Journal of Asset Management*, 19, p. 278-300, and (b) the International Longevity Risk and Capital Markets Solutions Conference series, which was launched by Blake at City, University of London in 2005, with its 16th annual iteration due in August 2021 **[5.1].** These are held annually, at different venues around the world, to bring together academics, industry practitioners and policy makers, providing an environment conducive to research collaboration and learning; disseminating Professor Blake's work to the people mostly likely to benefit from it.

New products

The failure of the first attempt to issue a longevity bond, marketed unsuccessfully by the European Investment Bank and BNP Paribas, in November 2004, prompted Swiss Re, the world's

second-largest reinsurer, to design a "longevity trend bond" which successfully launched as the $50mn "Kortis" bond in 2010 **[5.2]** and matured in 2017**.** Blake's research (in particular, Blake *et al.* (2006) "Living with Mortality: Longevity Bonds and Other Mortality-Linked Securities", *British Actuarial Journal*, 12(1), p. 153-228 (sections 4.3 and 10)) was instrumental as it (a) provided explanations for the failure of the original LB and hence influenced the design of the Kortis bond and (b) had also provided the incentive, research and tools (such as LifeMetrics) to further explore and develop LBs successfully.

Blake's work has contributed to significant success in the use of longevity swaps to hedge longevity risk, with index-based swaps which minimise basis risk increasing in use. There have been a total of 61 swaps worth £105bn in the UK [to December 2020] **[5.3**]. There have been 7 index-based swaps in the Netherlands since 2012, the most recent being between NN Life, part of the Nationale-Nederlanden Group, and Canada Life, Munich Re and Swiss Re, in May 2020, valued at €13.5bn **[5.3]** These, in turn, prompted the Dutch Central Bank, which is also the Dutch financial regulator, to undertake a formal study of macro-longevity risk sharing. **[5.4]**

New models

The "Longevity Risk Transfer, Investment & Pension Solutions for Prudential Retirement" division of US insurer Prudential Financial uses one of the CBD models to provide more accurate pricing for longevity swaps and reports that: "*The reduction in model risk from using the CBD5 model has contributed to a reduction in the price that Prudential charges its clients by nearly 1%. Since 2016, total transactions concluded by our team amount to £33bn in liabilities reinsured so the total cost saving to the pension funds and insurers involved in these transactions is approximately £330mn. We believe that most of the other companies engaged in the longevity risk transfer business also use the [CBD models]. Since UK pension funds have transferred approximately £100bn in liabilities over the same time period [by means of swaps, buy-ins and buy-outs], the estimated industry savings is nearing £1bn. This reduction in risk transfer pricing inures directly to the benefit of the pension schemes transferring the risk as they will have paid less to have their benefit obligations insured and reinsured*." **[5.5]**

To illustrate the widespread use of the CBD model, the European Insurance and Occupational Pensions Authority (EIOPA) recommend it as one of two that insurance companies should use for Solvency II calculations of their regulatory capital requirements **[5.6].** The UK Prudential Regulation Authority lists the CBD model as one of its quantitative indicators ('QIs') for longevity risk **[5.7].**

Vehicles for improving the effectiveness of the Life Market

The research continues to be disseminated by various means and with ever increasing reach. Chief among the tools of dissemination is the annual Longevity Conference. An important, recent example of the success of the annual conference and the influence exerted on the development of the market was the following presentation at Longevity 12: The Twelfth International Longevity Risk and Capital Markets Solutions Conference held in Chicago in September 2016. The CEO of Athene Life Re along with the Senior Vice-President of Prudential Retirement and partners from the Corporate & Financial Services Department of Willkie Farr & Gallagher gave a presentation on "Sidecars: Alternative Capital or Reinsurance?" signaling their imminent adoption **[5.8].** This presentation was invited following discussions at the Longevity 11 conference about how to increase the interest of investors who were not familiar with longevity risk, illustrating the ongoing impact and influence of Blake's work and contacts and of the mechanisms established to promote it, in particular the conference. Traditionally, "sidecars" were set up by reinsurers looking to either partner with another source of capital or an entity to enable reinsurers to accept capital from third-party investors. This is a way of gradually bringing in third-party investors who do not have a full understanding of the risks, but as long as the original reinsurer stays engaged and co-shares the downside risk (by "keeping some skin in the game"), then there is some assurance to these new types of investors that they are not being "sold a lemon". A key benefit of sidecars is that they are not subject to a requirement to hold a regulatory solvency capital buffer, thereby enabling sponsoring reinsurers to offer keener pricing to cedants.

Shortly after the Longevity 12 presentation, a number of sidecar agreements were executed, including one led by Athene Life Re:

- In December 2017, Athene Life Re entered into a reinsurance agreement with Voya

Financial, covering $19bn of fixed, indexed and variable annuity liabilities. The matching assets will be managed by Athene Asset Management. By using an "enhanced asset management" strategy and positioning itself for "incremental value creation in a more favorable credit spread environment", the company hopes to generate "mid-teens returns". The capital is supplied mainly by private equity investors, including Apollo, Athene's parent company, Crestview Partners and Reverence Capital Partners. **[5.9]**

- In January 2018, RGA Re and RenaissanceRe, announced a new start-up named Langhorne Re, which will target in-force life and annuity business. The new company has secured $780m of equity capital from RGA, RenaissanceRe and third-party sidecar investors, including pension funds and other life companies. **[5.9]**
- In February 2018, the $400m Leo Re Ltd. 2018-1 collateralised reinsurance sidecar was executed between Dutch pension fund manager PGGM and Munich Re as a private ILS (insurance linked securities) deal. The agreement allows PGGM, which manages the pension assets of the Dutch healthcare workers' scheme, PFZW, to gain access to a share of Munich Re's portfolio. PGGM will enter into direct ILS trades with counterparties, via quota share arrangements with a reinsurer, for a proportion of the counterparties' underwriting book, thereby sharing in the cedents' risks and underwriting returns. **[5.9]**

The impact of Blake's research and of the annual Conference series has received numerous endorsements from market participants. One example comes from the Chief Risk Officer of Universities Superannuation Scheme, with whom Blake collaborated on a number of research projects when he was at JP Morgan: "It is no exaggeration to say that these projects collectively changed the industry. They helped to set the direction in which the longevity risk transfer industry has moved over the past 14 years. The mortality models have become the benchmark models for the industry and are widely used. The basis risk work formed the foundation of additional work carried out by the actuarial profession and the LLMA (Life and Longevity Markets Association)". **[5.10].** Another example is the Founder of Club Vita – a UK-based longevity data analytics business which supports furthering the understanding of longevity risk management, including the trading of longevity risk between pension schemes and insurers – whose participation in the Longevity 13 conference and exposure to Blake's research was key to setting up a branch of Club Vita in the US. This happened two years later when collaborations with RiskFirst and JTL were publicly announced **[5.11].**

Conclusion

In the context of a world where longevity is not only increasing, but is increasingly uncertain, the long-term benefits of the Life Market are clear. In addition to the economic value to the insurance and pensions industries, more companies can unwind (and do so more cheaply) their legacy defined benefit pension liabilities which are now a dragging anchor on their performance, if not their very survival. As a result, pension scheme members get better security and the risk that the government will have to pick up the pension liabilities of failed companies (through, for example, the Pension Protection Fund in the UK) is significantly reduced.

5. Sources to corroborate the impact

5.1 Sixteenth International Longevity Risk and Capital Markets Solutions Conference https://www.cass.city.ac.uk/faculties-and-research/centres/pensions-institute/events/longevity-16

5.2http://www.swissre.com/media/news_releases/Swiss_Re_completes_first_longevity_trend_bond_transferring_USD_50_million_of_longevity_trend_risk_to_the_capital_markets.html. Also Hunt, A., and Blake, D. (2015) "Modelling Longevity Bonds: Analysing the Swiss Re Kortis Bond", *Insurance: Mathematics and Economics*, 63, p. 12-29.

5.3 List of longevity swaps and longevity risk transfer transactions: www.artemis.bm/longevity-swaps-and-longevity-risk-transfers (as of December 2020). Accompanied by: https://www.artemis.bm/news/nn-life-transfers-eur-13-5bn-of-pension-longevity-risk-to-reinsurers/

5.4 Dirk Broeders, Roel Mehlkopf and Annick van Ool (2018) "The Economics of Sharing Macro-longevity Risk", De Nederlandsche Bank Working Paper No. 618, December. See references to Blake's work. (Now forthcoming in *Insurance: Mathematics & Economics*)

5.5 Support statement from Senior Vice-President & Head of Longevity Risk Transfer, Investments & Pension Solutions Prudential Retirement

5.6 EIOPA's second set of *Advice to the European Commission on Specific Items in the Solvency II Delegated Regulation*, February 2018; https://www.eiopa.europa.eu/content/eiopas-second-set-advice-european-commission-specific-items-solvency-ii-delegated-regulation_en

5.7 Sam Woods, Executive Director Insurance, Prudential Regulation Authority (2016) *Reflections on the 2015 Solvency II Internal Model Approval Process*, 15 January; https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/letter/2016/sam-woods-reflections-2015-solvency-ii-internal-model-approval-process-jan-2016.pdf?la=en&hash=102860654E89EE80954F9394381863172AE3CBDB

5.8 Sidecars: Alternative Capital or Reinsurance? (Presented by representatives from Prudential, Wilkie Farr & Gallagher, Athene Life Re at Longevity 12: The Twelfth International Longevity Risk and Capital Markets Solutions Conference; 2016). Accompanied by Bugler et al. (2020) "Re-insurance Side-cars: The Next Stage in the Development of the Longevity Risk Transfer Market", *North American Actuarial Journal*, forthcoming.

5.9 List of Sidecar agreements following Longevity 12:
- Athene & Apollo get long-term capital in $19bn annuity reinsurance deal, by Artemis on December 21, 2017; http://www.artemis.bm/blog/2017/12/21/athene-apollo-get-long-term-capital-in-19bn-annuity-reinsurance-deal/

- Steve Evans (2018) Langhorne Re launched by RGA and RenRe as in-force life and annuity reinsurer, *Reinsurance News*, 11 January,

- PGGM's $400m Leo Re is a private sidecar deal with Munich Re, by Artemis on February 5, 2018; http://www.artemis.bm/blog/2018/01/02/pggm-secures-140m-leo-re-sidecar-tranche-takes-2018-issue-to-400m/

5.10 Support statement from Chief Risk Officer of Universities Superannuation Scheme

5.11 Support statement from Founder of Club Vita. Accompanied by Club Vita Milestone Timeline; https://www.clubvita.us/why-club-vita-10-reasons-why/why-club-vita-timeline