Institute and Faculty of Actuaries

Life & Longevity Markets Association

7 October 2015

Call for research project proposals

Project to develop a method of assessing basis risk for longevity transactions – Phase 2

Closing date for proposals Monday 23 November 2015, 5PM GMT

1. Summary

This document is an invitation to tender for Phase 2 of a research project for the Longevity Basis Risk Working Group (LBRWG).

The aim of the overall project is:

to develop a readily-applicable methodology for quantifying the basis risk arising from the use of population-based mortality indices for managing the longevity risk inherent in specific blocks of pension benefits or annuitant liabilities.

We believe this project will offer the successful party an opportunity to use statistical knowledge and/or original research to produce a solution to a real industry problem. If the project were successful and facilitated the transfer of longevity risk between market participants, the work would be ground-breaking and very high-profile. We would expect that the methodology would use the indices published by the LLMA but be applicable in any territory world-wide subject to the availability of appropriate data.

The first phase of this project was successfully completed at the end of 2014. This phase focused on research into longevity basis risk and consequent development of a methodology that can be used to measure longevity basis risk.

The results from Phase 1 were presented at a sessional event at the Institute and Faculty of Actuaries (IFoA) on 8 December 2014. The research report on Phase 1 can be downloaded at:

http://www.actuaries.org.uk/events/one-day/sessional-research-event-longevity-basis-risk-methodology

Phase 2 of the project will focus on putting the work carried out in Phase 1 into practice.

The LBRWG has received a commitment to fund Phase 2 of the project from the IFoA and the Life and Longevity Markets Association (LLMA), subject to receipt of a satisfactory proposal and to achievement of interim project targets.

We expect Phase 2 of the project to last approximately 6 months from the time the project is awarded; further details of the timeline are set down below. However, credible proposals that could be completed in a shorter time frame would be considered.

We are seeking proposals from actuarial consultancies and academic institutions. Responses to the tender should be received by **5pm (GMT) on Monday 23 November 2015**. We anticipate that shortlisted candidates will be invited to present and discuss their responses during the week beginning 30 November 2015.

2. Background to the project

The LLMA began publishing indices linked to population mortality statistics in March 2012 with the goal of facilitating the hedging of longevity risk for pension funds and annuity books. The launch of the LLMA indices was an important milestone towards a longevity market where risk management can be carried out through transactions that are linked to

standardised population-level data. Index-based hedges have considerable potential to provide effective risk and capital management for all holders of longevity risk.

In addition to the mortality indices, the LLMA has also produced a significant body of work around possible derivative transactions that could reference mortality indices and offer 'standardised' longevity risk management tools (see http://www.llma.org/publications.html).

However the building blocks described above have not proved sufficient to develop a 'liquid market' in longevity and have not led to transactions based on these standardized measures. Indeed, both are underutilised relative to more traditional longevity transactions that occur in the market. Some institutions currently use risk management tools linked to indices – the concept is proven. Even so, we believe that a major obstacle to widespread use of longevity risk management tools that reference population-based mortality indices is the difficulty in quantifying, and hence managing, **longevity basis risk.**

There are two major considerations for longevity basis risk:

- The need to understand the nature of the risk and its impact in different circumstances, and
- The need to account for the basis risk underlying the transaction in reported results.

In December 2011 the LLMA and IFoA formed the LBRWG (see Appendix A for current membership). Its remit is straightforward: to investigate how to provide a market-friendly means of analysing longevity basis risk.

Having carefully considered the matter, we concluded that the task is beyond the scope of the working group by itself. The challenge is technically complex and time-consuming. Further research, or considerable work to synthesise existing research, is required before a solution can be developed. So we require the assistance of either a consultancy firm or an academic/research institution to perform that research.

Phase 1 was undertaken by a joint team from Hymans Robertson and Cass Business School, and we are now looking for a partner for Phase 2 of the project.

3. A description of Longevity Basis Risk

Longevity basis risk is the potential mismatch between the behaviour of a longevity hedge and the portfolio of pensioners or annuitants being hedged, in cases where the hedging transaction's cash flows are determined by reference to a mortality index and not directly linked to the actual pool of lives.

There are three major sources of basis risk between the pension fund/annuity book risk to be hedged and the value of the hedging tools employed to reduce that risk. These are:

- **Demographic risk:** the difference between $\mu 1$ and $\mu 2$, the underlying forces of mortality for the reference portfolio and the pension fund/annuity book, respectively, due to demographic or socio-economic differences. This difference may comprise two elements: the initial (current) level of mortality and the rates of future improvement.

- **Sampling risk:** the difference in the population sizes (exposures) and varying levels of annuity amounts, because any sub-population is a random sample of the large population, so the observed mortality rates in the two populations will not be the same, except by chance.
- **Structural risk** due to the payoff structure of the hedge. We could for example use a portfolio of S-Forward derivatives and compare how the value of that portfolio behaves versus the original liabilities being hedged (see the LLMA website for a description of S-Forward hedges). The pay out of the hedge is unlikely to exactly match the liabilities being hedged.

These three sources of basis risk all contribute to a longevity hedge being a less-than-perfect match to the portfolio being hedged. We believe that demographic risk and sampling risk are most usefully analysed through stochastic projections of mortality rates. Structural risk can be analysed relatively simply after the other two, because structural risk can be quantified in a straightforward fashion once scenarios of mortality rates have been projected for the different populations under consideration. Such quantification involves calculating the value of the hedge instrument under every scenario of mortality and then looking at the expected value of the result, either in isolation or relative to the pension or annuity portfolio value using a relevant metric. Therefore defining and optimising a hedge portfolio is a separate exercise from trying to estimate the relationship between the progression of mortality behaviours between $\mu 1$ and $\mu 2$.

4. The proposal

Throughout the project, the goal will be an outcome that is practically applicable to analysing basis risk arising from standard information available to a regular market participant. Original academic research may be required, but only in so far as it leads towards that goal.

Our proposal is for an overall project delivered in two phases:

Phase 1 focused on the demonstration of the feasibility of a methodology for determining the relationship between $\mu 1$ and $\mu 2$ in the future.

Phase 2 will be the practical application of the Phase 1 work to demonstrate the use of the initial research in practice.

The scope of Phase 2 would be:

1. Consideration and definition of the most relevant **metrics** for the measurement of basis risk for practitioners, and a demonstration of how the outputs from Phase 1 can be used to assess hedge effectiveness under the chosen metric(s);

2. The application of the approach from Phase 1 to **realistic worked examples**, based on the most appropriate available data. Where a suitable history of data is available, this should include examples where the predicted hedge effectiveness is back-tested against actual outcomes over a suitable timeframe. The majority of the worked examples should be able to be reproduced by practitioners using publicly available data;

3. Demonstration of how the outputs from Phase 1 might be used to **present a robust quantification of basis risk to third parties** such as regulators;

4. Investigate **potential limitations of the choice of time series** used in the Phase 1 approach, and suggest ways in which practitioners may be able to manage these limitations (including worked examples). There is a potential risk that the level of mean reversion inherent in the choice of time series under Phase 1 would result in an understatement of the potential divergence between the mortality rates of the two populations, and would like to investigate whether there are practical ways of addressing this potential limitation.

5. Project management

The successful party will be accountable to the LBRWG, who will closely monitor the progress of the research to ensure that it continues to lead to the desired outcome.

Throughout the work, the principal research team will be expected to regularly meet and discuss progress and planning with members of the LBRWG.

We expect that documentation and supporting work to describe progress, results, and limitations of results, would be provided from time to time as part of the project management. Ultimately, this documentation (to the extent that it is relevant to the final outcome) would be placed into the public domain via the LLMA website and the IFoA website. We expect the sponsoring organisations to hold intellectual property rights in the research, but it is our intention that all of the work produced will be open source once completed.

In addition to the milestones and deliverables for the project, the LBRWG would like the successful party to commit to wider dissemination of the results of Phase 2, through presentations at relevant industry conferences and presentations to the LLMA, potentially in conjunction with member(s) of the LBRWG, as well as wider publicity activity.

6. Submission guidelines

Please provide a response to the following items. Submission should be in the format of an A4 document in no more than 12 pages in length and 11 point Times New Roman font.

a. Relevant Experience

Candidates will preferably have prior experience in two-population modelling of longevity risk and a thorough understanding of the different improvements seen amongst different annuitant/pensioner groups. We expect institutions to provide details of relevant experience and we would welcome demonstration of previous advances made in this topic.

b. Project Plan

We believe that the project will have maximum chance of success if all parties clearly understand how the project will be run. We have outlined above our current intention but we would be open to alternative approaches.

Please provide your thoughts on how the project might be delivered to achieve its goals most efficiently. We would welcome any initial ideas regarding potential lines of research and a demonstration of how they would support the project aims.

Please provide sufficient detail to enable us to be confident in the management and control of the project.

c. Resources and timing

Please describe the proposed resourcing for the project including named individuals, the level of seniority of the persons involved, and the suggested time each person would dedicate to the two phases of the project.

Please provide a work plan that demonstrates delivery within the broad time frame specified above, for both phases.

d. Dissemination and Knowledge Exchange

Please provide a draft plan for disseminating and exploiting the project's results.

e. Communication

The LBRWG will require regular updates on progress to ensure that the project is progressing as desired. You may wish to suggest an optimal structure for the involvement of the LBRWG in the project (e.g. frequency and format of meetings).

f. Costs

The target cost for the project is £60,000 (excluding VAT), but higher quotes will be considered where they can be justified. Please provide a detailed estimate of your costs including a breakdown of the time and cost of each resource you expect to employ on the project. Please include all expected expenses.

The successful party will be required to commit to a binding quote following more detailed discussion of the work plan.

All rights and title to Joint Intellectual Property shall be jointly owned by LLMA and IFoA.

7. Key considerations for selection

We will assess submissions on a range of criteria, including:

- Evidence that the candidate will produce work that:
    - is theoretically and statistically robust,
    - can be applied easily and consistently by practitioners;
    - is clearly explained and well documented.
- Existing relevant skills and experience in the individuals working on the project;
- Evidence of a track record on similar projects;
- Confidence that the aims of the project can be met within the timescales specified;

- Willingness to promote and support the work post project completion;
- Ability to communicate results;
- Value for money.

Other considerations of the LBRWG in candidate selection will be evidence of innovative thinking in relevant areas, quality of vision and enthusiasm for the project.

8. Next steps

Please make your submission to the Executive of the IFoA by no later than **5pm (GMT) on 23 November 2015.** Please address your response to research@actuaries.org.uk

We anticipate that shortlisted candidates will be invited to present and discuss their responses during the week beginning 30 November 2015.

APPENDIX A: Membership of the Working Group

The LBRWG consists of members from consultancies, insurance companies and banks:

Name	Affiliation	LLMA or IFoA representative
Robert Bugg (Chair)	Milliman	IFoA
Pretty Sagoo	Deutsche Bank	LLMA
Rodger Lovel	Aviva	LLMA
Jon Palin	Barnett Waddingham	IFoA
Rémi Martin	AXA	LLMA
Rob Kairis	Lloyds Banking Group	IFoA