Longevity Risk and Hedge Effects in a Portfolio of Life Insurance Products with Investment Risk

Discussion

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Content and Results

- The authors analyze
  - interactions between longevity risk and financial risk
  - capital requirements for different insurance portfolios
  - hedge effects of various product mixes and asset allocations
  - the hedge effect of longevity swaps

- Main result
  - Significant financial risk can arise from longevity risk
  - This financial risk cannot be hedged
  - In the traditional setting (financial risk is assumed to be completely hedged), the true risk might be significantly underestimated

- Related observations
  - The size of the buffer portfolio strongly depends on the asset allocation in the buffer portfolio
  - The inclusion of survivor annuities and death benefits can reduce the buffer size significantly
  - The asset allocation in the buffer portfolio affects the hedge potential of product mixes
  - In general, a buffer portfolio consisting of bonds and stocks is optimal (in terms of buffer size)
  - The hedge potential of survivor swaps with basis risk can be rather small
Comments on Setup and Modeling

- The liabilities are decomposed into components for best estimate liabilities, pure financial risk, pure longevity risk, and interactions between those risks
  - The interactions component is separated from the other components in a distinct way
  - The significance of financial risk due to longevity risk is highlighted very well
- Mortality model risk is allowed for by simultaneously applying different models

- Independence between mortality evolution and financial market evolution is assumed
  - Amongst others, Hanewald et al. (2009) show that there seems to be correlation
  - Taking this correlation into account might significantly affect results here
- The solvency criterion for computing the buffer size $c$ only takes into account the terminal asset value
  - $P(A_T < 0 | A_0 = (1 + c) \cdot \text{BEL}) \leq \varepsilon$
  - Even if the asset value $A_T$ is positive, $A_t < \text{BEL}$ could have occurred
  - The criterion should allow for the insurer’s solvency during the whole run-off
  - Alternative criterion: $P(A_1 - \text{BEL}_1 < 0 \lor A_2 - \text{BEL}_2 < 0 \lor \ldots \lor A_T - \text{BEL}_T < 0 | A_0 = (1 + c) \cdot \text{BEL}) \leq \varepsilon$
- No reasoning for accepted default probability of 2.5% is provided
  - 0.5% (= accepted level under Solvency II) seems more intuitive
Possible Extensions or New Projects

- **Implications of interactions between longevity risk and financial risk for Solvency II**
  - In the standard model, risks are treated separately and such interactions are disregarded

- **Optimal asset allocation in the buffer portfolio**
  - 100% equity always requires largest buffer but also offers largest expected returns
  - What is the optimal asset allocation if the insurer wants to
    - minimize the initial buffer size?
    - optimize his returns?
    - reduce the buffer size as soon and as much as possible in the portfolio run-off?

- **Best estimate portfolio with limited cash flow matching**
  - Bonds with extreme maturities do not always exist
  - More realistic scenario of portfolio with bonds of maturities up to 10 or 15 only

- **Portfolios of contracts with different ages instead of single age portfolios**

- **For portfolios with survivor annuities, sometimes more swaps than contracts are optimal**
  - There seems to be a partial hedge of survivor annuities by swaps for other sex
  - Can this hedge be specified and how effective is it?
Minor Comments

- In main text, parameter risk is said to be considered in mortality models
  - According to the appendix, this is done only for the Lee-Carter class of models

- In proof of Proposition 2, the BEL are $1/r$
  - The proposition is nevertheless correct

- The interpretation of $d$ in Figure 2 is not obvious
  - Are the numbers on the horizontal axis percentages?
  - Or is it possible to include more than one death benefit into a single life annuity contract?

- Left panels of Figures 3, 5, and 6: Printing buffers for $s>1$ may be confusing
  - $s=1$ offers the best possible hedge
  - Purchase of additional swaps is not reasonable