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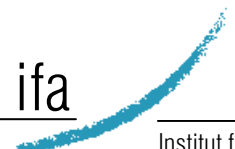# in a Portfolio of Life Insurance Products with Investment Risk

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

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- **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**
  - $P\big(A_T < 0 \big| A_0 = (1+c)\cdot BEL\big) \le \varepsilon$
  - Even if the asset value A_T is positive, $A_t < BEL$ could have occured
  - The criterion should allow for the insurer's solvency during the whole run-off
  - Alternative criterion: $P\big(A_1 - BEL_1 < 0 \vee A_2 - BEL_2 < 0 \vee ... \vee A_T - BEL_T < 0 \big| A_0 = (1+c)\cdot BEL\big) \le \varepsilon$
- **No reasoning for accepted default probability of 2.5% is provided**
  - 0.5% (= accepted level under Solvency II) seems more intuitive

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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?

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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

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