Individual post-retirement longevity risk management under systematic mortality risk

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Topic Coverage

Background

Optimal longevity insurance: two-period model

Longevity insurance: multi-period scenario and portfolio analysis

Results

Summary and conclusions

Topic Coverage

Motivation

- Increasingly complex post-retirement financing decision
- Recent product innovations:
  - Deferred annuities (Post, 2010; Stevens, 2010; Horneff *et al.*, 2010a)
  - Variable annuities (Doyle and Piggott, 2003; Milevsky and Kyrychenko, 2008; Horneff *et al.*, 2010b)
  - Inflation-indexed annuities (Brown *et al.*, 2002; Mitchell, 2002; Doyle and Piggott, 2003)
  - Group self-annuitization plans (Valdez *et al.*, 2006; Stamos, 2008; Qiao and Sherris, 2011)
- Varying product costs and guarantees
- Significant systematic component of longevity risk reducing effectiveness of traditional mortality pooling

Summary

- We assess post-retirement strategies for an individual facing idiosyncratic and systematic longevity risk and inflation risk
- Concepts of optimal insurance (Borch, 1960; Arrow, 1971, 1973; Raviv, 1979) are applied to construct portfolios with differing levels of systematic and idiosyncratic longevity risk
  1. Theoretical framework based on state-contingent consumption and complete markets: Optimal longevity risk management strategy
  2. Multi-period simulation based on stochastic economic variables and stochastic mortality with systematic and idiosyncratic risk: Assess a broader range of retirement strategies

Key Results

- Systematic longevity risk matters
- Optimal insurance concepts are useful

- No loadings, no bequest: annuitization strategies including GSA plans are optimal
- With loadings on life annuities: mutual, non-guaranteed GSA products replace annuitization, even inflation-linked annuities
- With bequest: coinsurance portfolio strategies with self-annuitization and GSA's

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A two-period expected utility model

- Idiosyncratic and systematic longevity risk
- Four products: risk-free investment, a life annuity, a longevity bond, and a GSA fund

State	Risk-free bond	Annuity	Longevity bond	GSA
(h, a)	1	1	1	0
(l, a)	1	1	0	1
(h, d)	1	0	1	0
(l, d)	1	0	0	0

- Product prices derived using a state-contingent claims approach, product risk premiums

Results of the two-period model

- Complete market, no bequest motive:
  - Full annuitization is the dominant strategy as in Yaari (1965)
- Complete market, bequest motive:
  - Life annuity demand reduced; risk-free bond provides bequest
  - Systematic longevity risk hedged with GSA and longevity bond
- Loading on the price of the life annuity:
  - Life annuity demand reduced, substituted with longevity bond and GSA
- Life annuity provider faces insolvency risk:
  - Similar to complete market case with bequest; small increase in annuity demand
- The optimal portfolio depends on the price for transferring systematic and idiosyncratic longevity risk

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Multi-period numerical analysis

- Multi-period simulation model used to assess a range of alternative strategies based on optimal insurance concepts (coinsurance, deductible)
- Allow for inflation and real consumption with discounted expected utility with and without bequest
- Extended products and portfolios: fixed life annuities, deferred annuities, inflation-indexed annuities, group self- annuitization (GSA), and self-annuitization
- Simulate stochastic economic variables and stochastic mortality with systematic and idiosyncratic risk

Stochastic building blocks

- Mortality model: based on Wills and Sherris (2010)
- Market model: cointegrating vector error correction model with regime switching (RS-VECM) (Ngai and Sherris, 2011)

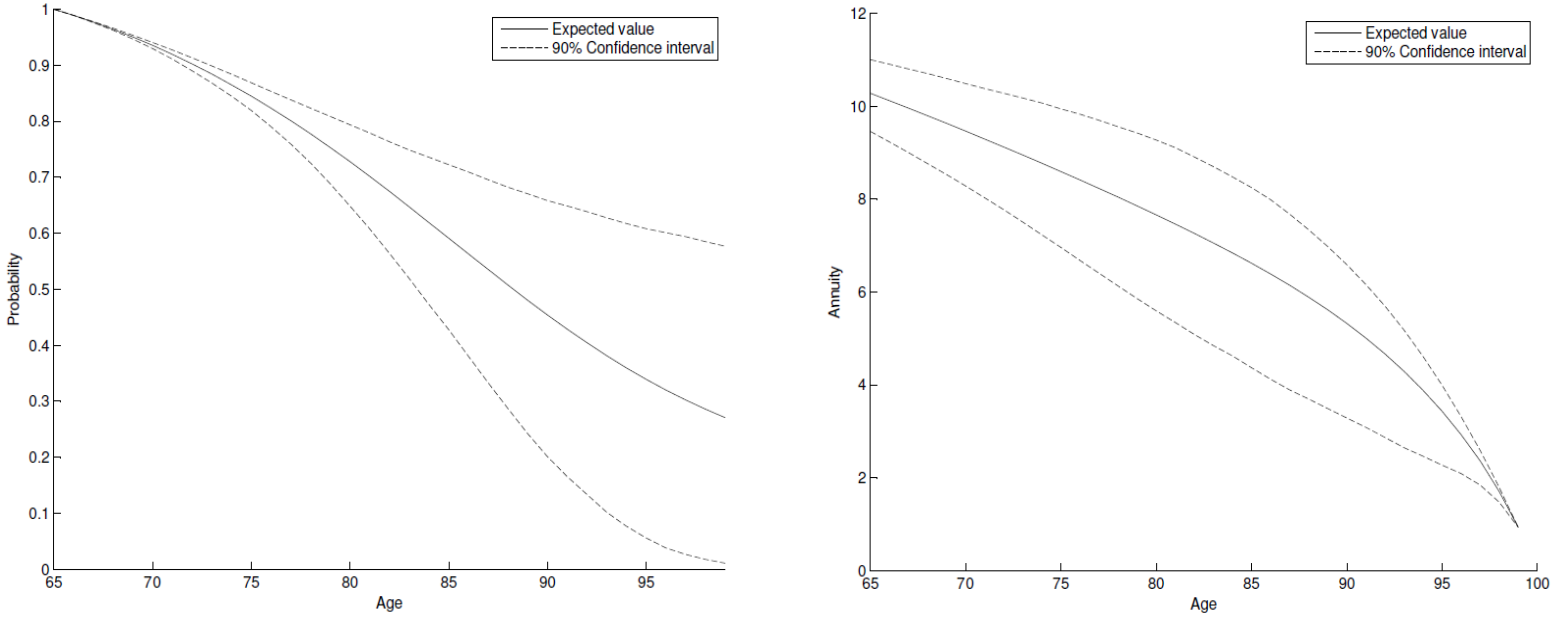

Figure: Survival curve and annuity values, 65-year-old male with confidence intervals.

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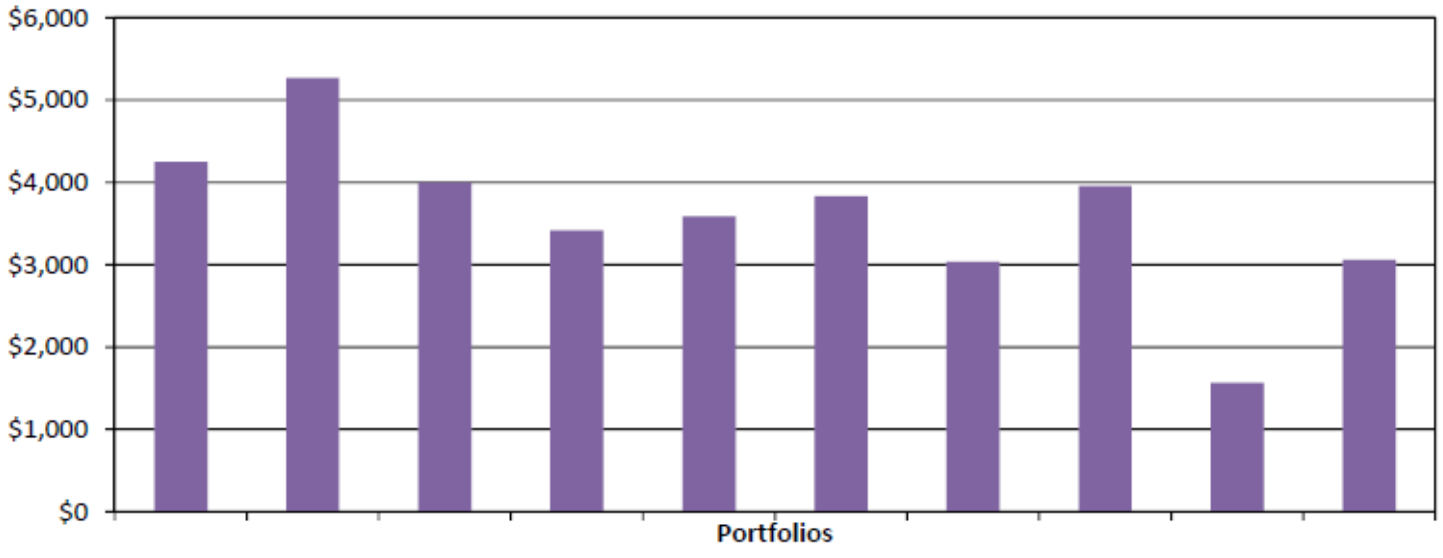
Certainty equivalent cash flow: portfolios

- Age = 65, $\beta = 0.98$, $\delta = 2$, wealth = \$75,000, no bequest, no loadings



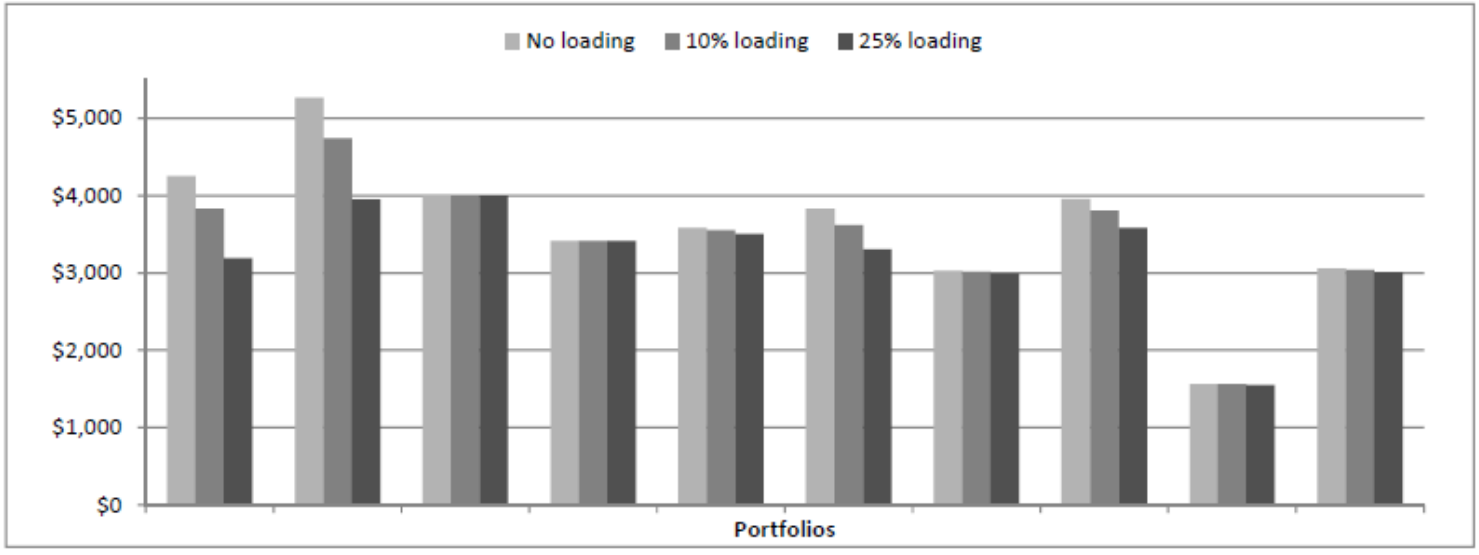
	1	2	3	4	5	6	7	8	9	10
Life annuity	100					50		35		
Deferred Annuity					25		50		75	50
Indexed life annuity		100								
Group self-annuitization			100				50	35	25	
Self-anunitization				100	75	50		30		50

Results: no bequest, no loadings

- Results for the base case (age = 65, $\beta = 0.98$, $\delta = 2$, wealth = \$75,000, no bequest, no loadings):
  1. 100% inflation-indexed annuity
  2. 100% life annuity
  3. 100% GSA
- Full annuitization, inflation-indexed annuities preferred, GSA because of systematic longevity risk
- Similar results for different wealth levels and different ages

Certainty equivalent cash flow: loadings

- Age = 65, $\beta = 0.98$, $\delta = 2$, wealth = \$75,000, no bequest



	1	2	3	4	5	6	7	8	9	10
Life annuity	100					50		35		
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Indexed life annuity		100								
Group self-annuitization			100				50	35	25	
Self-anunitization				100	75	50		30		50

Results: guarantee product loadings, no bequest

- Age = 65, $\beta = 0.98$, $\delta = 2$, wealth = \$75,000, no bequest
- 10% loading:
  1. 100% inflation-indexed annuity
  2. 100% GSA
  3. 100% life annuity
- 25% loading:
  1. 100% GSA
  2. 100% inflation-indexed annuity
  3. 35% life annuity, 35% GSA, 30% self-annuitization
- Increased role for mutual GSA and co-insurance

Results: bequest motive

- Age = 65, $\beta = 0.98$, $\delta = 2$, no loadings
- With bequest motive:
  1. 35% life annuity, 35% GSA, 30% self-annuitization
  2. 50% life annuity, 50% self-annuitization
  3. 25% deferred annuity, 75% self-annuitization
- Increased role for self-annuitization through phased withdrawal products

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Conclusions

- For individuals with no bequest motive, and assuming no product loadings, annuitization strategies with small holdings of GSA plans are optimal under systematic longevity risk.
- With loadings on guaranteed life annuity products, GSA plans which are mutual and non-guaranteed, are included in an optimal strategy for individuals to manage their post-retirement longevity risk, replacing even annuitization products with inflation guarantees.
- For individuals with a bequest motive, portfolio strategies including self-annuitization and GSA's dominate full annuitization.

Thank you very much!

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