All Things Considered: An Integrated Framework for Multidimensional Longevity Risk Concerns

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Agenda

- Background and motivations
- Our model
- Simulation exercise
- Empirical efforts
- Discussions

Background

- Retirement planning is important and multivariate in nature
- Longevity improvement is real
  - Hedging is important but only for insurers and pension funds
  - Risk transfer from individuals does not necessarily occur
- If and how individuals incorporate longevity improvement in retirement decision making
  - Unique characteristics: low probability event; minimum knowledge and/or experience (non-repeatable); cannot be individually hedged and managed, etc.
- At the intersection of a few different literatures
  - Retirement planning/personal finance, health economics, mortality/longevity modeling and risk management, behavioral economics

Motivations I

- Retirement planning taking into account health related issues
  - Retirement wealth allocation and the impact of health risk (Scholez, Seshadri and Khitatrakun 2006; De Nardi, French and Jones 2010; Ameriks, Caplin and Laufer 2011; Pashchenko 2013)
  - Annuity purchase and the impact of health risk (Davidoff, Brown and Diamond 2005; MacMinn and Weber 2011)

Motivations II

- Extensive literature for modeling longevity/mortality improvement and risk management
- This paper tries to combine these considerations from an individual consumer's perspective
- As a first pass, we consider a rational, full information model but eventually hope to incorporate the relevant and inevitable behavioral biases
- Insights
  - Product design and risk management strategies for insurance companies
  - Public policy implications

Our Model I

- Basic model assumptions
  - Health dynamics and health costs (Ameriks et al. 2011)
    - Four health states: good health ($s=1$); incurring medical problems but requiring no long-term care($s=2$); long-term care($s=3$); and death ($s=4$)
    - The health status follows a Markov chain with an age-varying one-period state transition matrix
    - The health cost (H): \$1000 in state 1; \$10,000 in state 2; \$50,000 in state 3; and 0 in state 4 (ignore costs associated with death)

Our Model II

- Basic model assumptions (Cont'd)
  - One-period health status transition Matrix at stage 65+a given by $P(a) =$

$$\begin{bmatrix} p_{11} & p_{12} & p_{13} & 1-p_{11}-p_{12}-p_{13} \\ p_{21} & p_{22} & p_{23} & 1-p_{21}-p_{22}-p_{23} \\ p_{21} & p_{21} & p_{21} & 1-p_{21}-p_{22}-p_{23} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\times \begin{bmatrix} 1-c_1(a) & \frac{c_2c_3 \times c_1(a)}{1+c_2+c_2c_3} & \frac{c_2 \times c_1(a)}{1+c_2+c_2c_3} & \frac{c_1(a)}{1+c_2+c_2c_3} \\ 0 & 1-c_1(a) & \frac{c_2 \times c_1(a)}{1+c_2} & \frac{c_1(a)}{1+c_2} \\ 0 & 0 & 1-c_1(a) & c_1(a) \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Our Model III

- Basic model assumptions (Cont'd)
  - Mortality projection: Lee-Carter model
  - Annuity: actuarially fair immediate annuity at retirement (say, at age 65), providing income Y_n in period n
  - Investment: risk-free bond with return R_f and risky asset with return $\widetilde{R}$ (~ Lognormal)
  - Consumption floor and public long-term care (Ameriks et al. 2011): in health states 1 and 2, provided with consumption floor C^f; while in state 3, provided with minimal level of consumption C^{PC}, $C^f \geq C^{PC}$

Our Model IV

- Basic model assumptions (Cont'd)
  - CRRA utility over consumption

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}$$

  - Bequest utility

$$V(B) = \frac{\omega}{1-\gamma}(\varphi + \frac{B}{\omega})^{1-\gamma}$$

Our Model V

- Optimization Problem

$$U_n(s_n, W_n) = \begin{cases} \max_{C_n}[u(C_n) + \beta E_n U_{n+1}(s_{n+1}, W_{n+1})] & \text{if } s_n < 4; \\ v(B_n) & \text{if } s_n = 4. \end{cases}$$

s.t. budget constraint

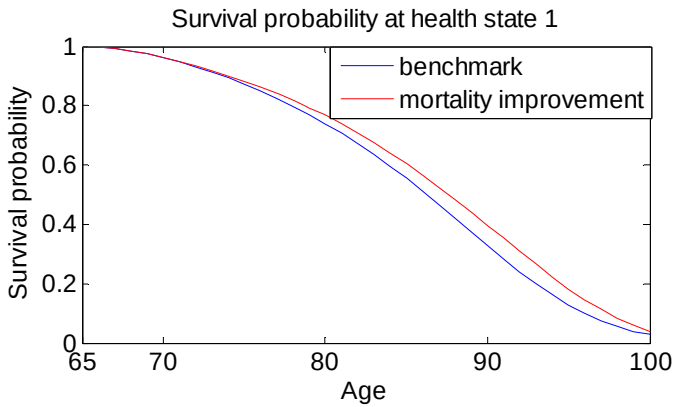
$$W_{n+1} = \begin{cases} (W_n + Y_n - H(s_n) - C_n)(R_n^f + (\tilde{R}_{n+1} - R_n^f)w_n) & \text{if } I_n^G = 0; \\ 0 & \text{if } I_n^G = 1. \end{cases}$$

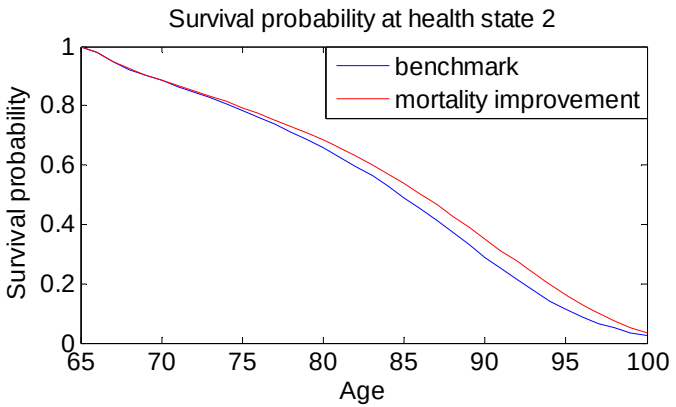
$I_n^G = 1$ if $C_n < C^f$ in states 1 and 2, or $C_n < C^{PC}$ in state 3

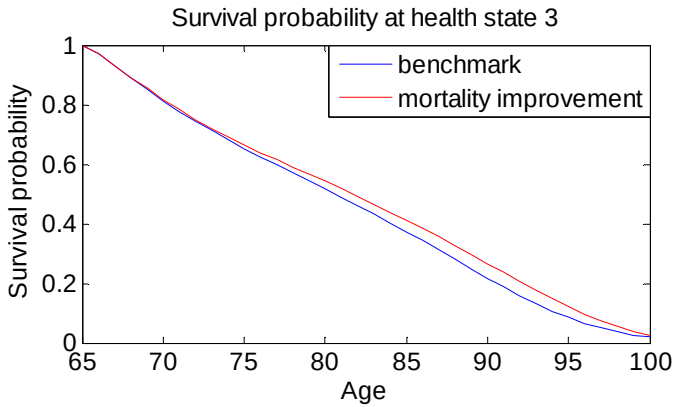
Parameterization

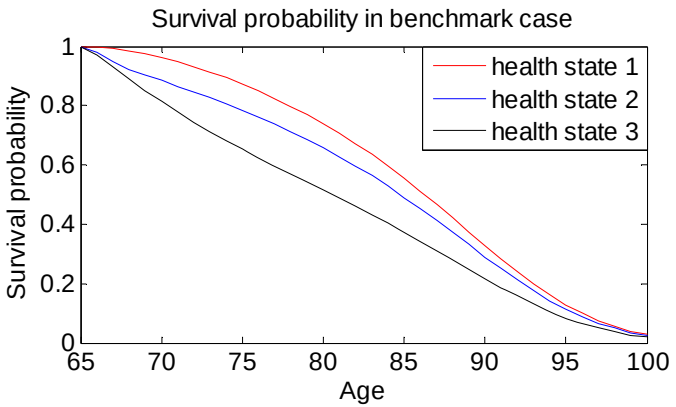
Parameter	Notation	Benchmark Value	Note
Mortality	q_n	Age-death rate in 2006	
Mortality improvement	q_n	Age-death rate forecasted by Lee-carter model	
Health dynamics			Ameriks et al. 2011
Risk aversion	gamma	3	Ameriks et al. 2011
Discount factor	beta	0.97	Ameriks et al. 2011
Bequest utility	phi	12.06	Ameriks et al. 2011
	omega	93.7	Ameriks et al. 2011
Consumption floor	C_f in health states 1 and 2	5750	Ameriks et al. 2011
	C_pc in health state 3	2200	Ameriks et al. 2011
Risk-free interest	R_f	1.02	CoCoo, RFS 2005
Risky asset	mean	0.04	CoCoo, RFS 2005
	standard Deviation	0.157	CoCoo, RFS 2005
Annuity Type	Immediate annuity at retirement		

Mortality improvement for different health states

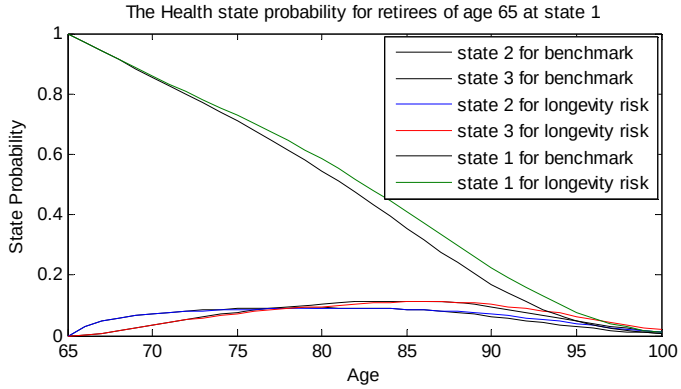


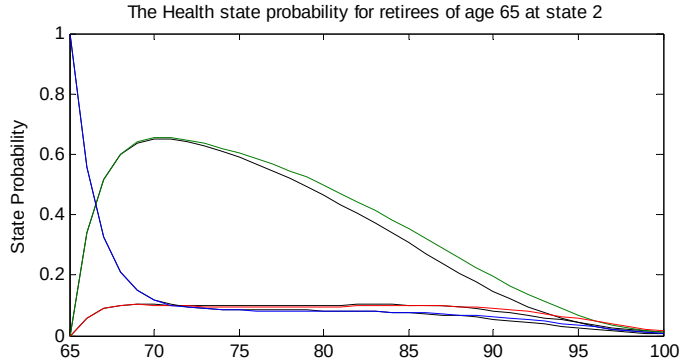


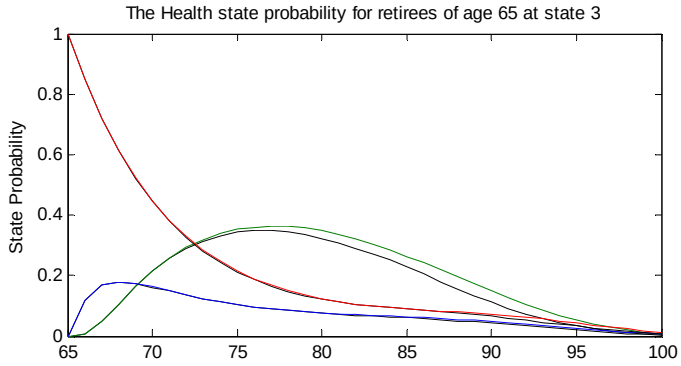




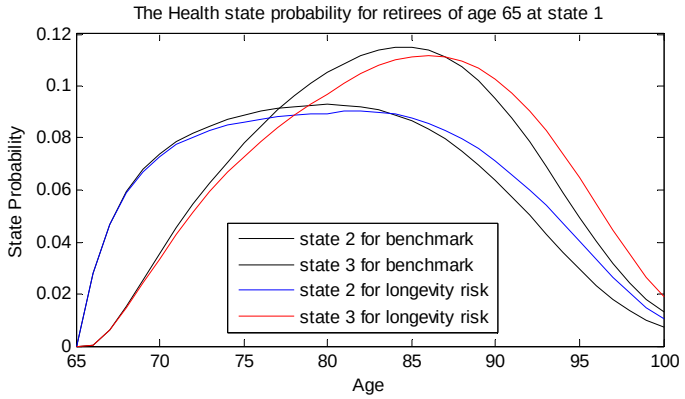
Health State Dynamics I

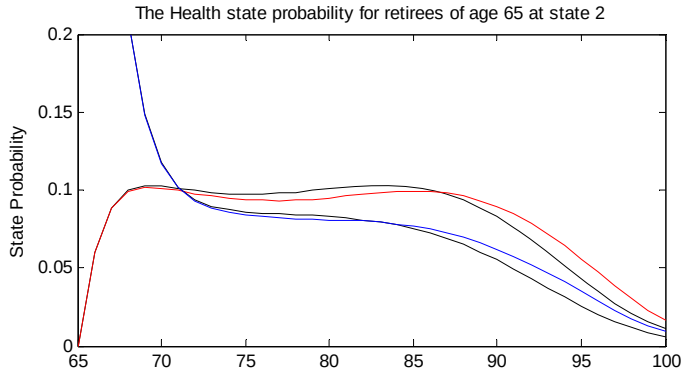


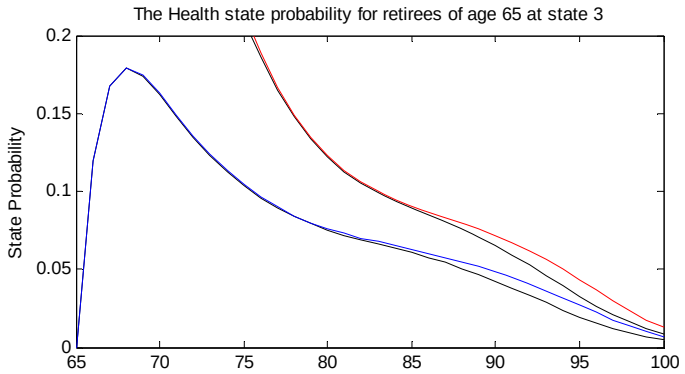




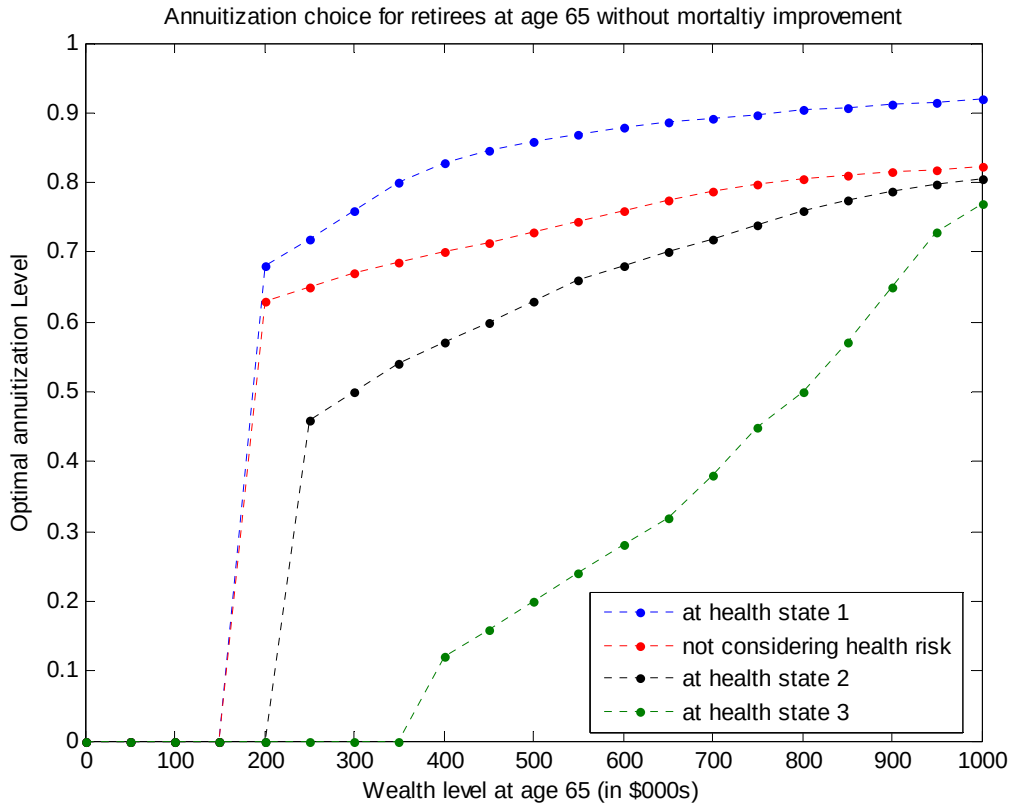
Health State Dynamics II





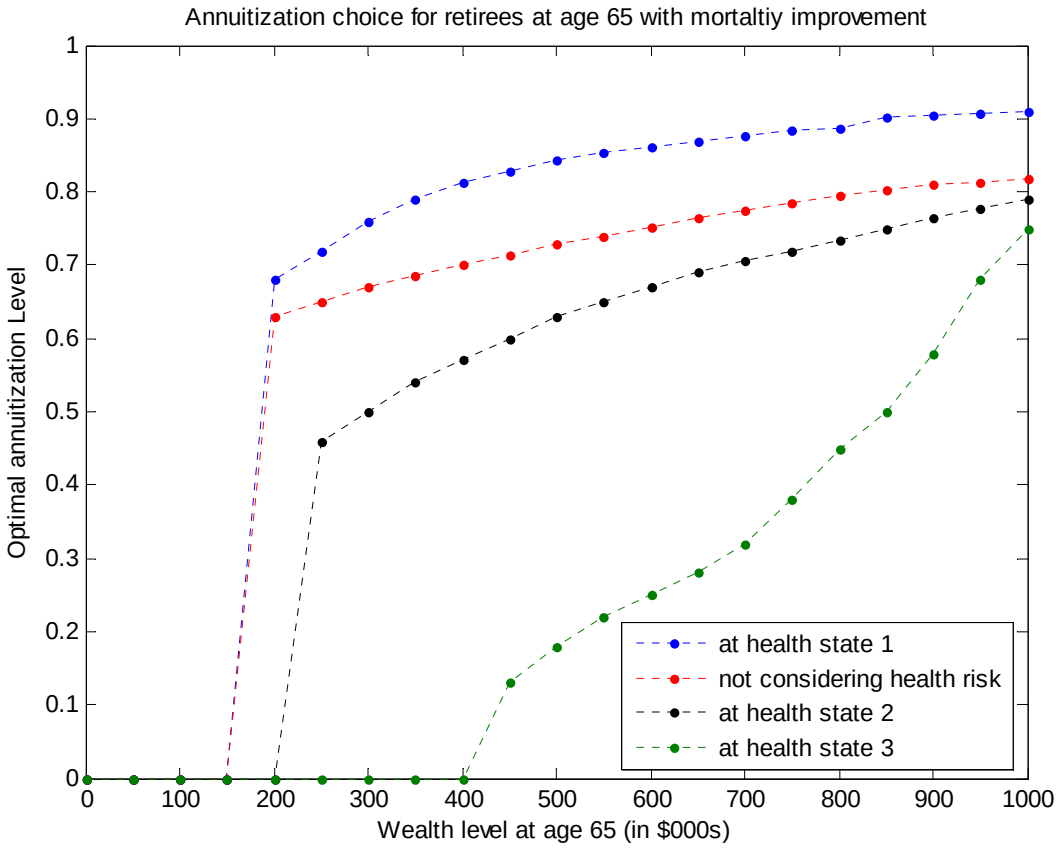


Basic Results I

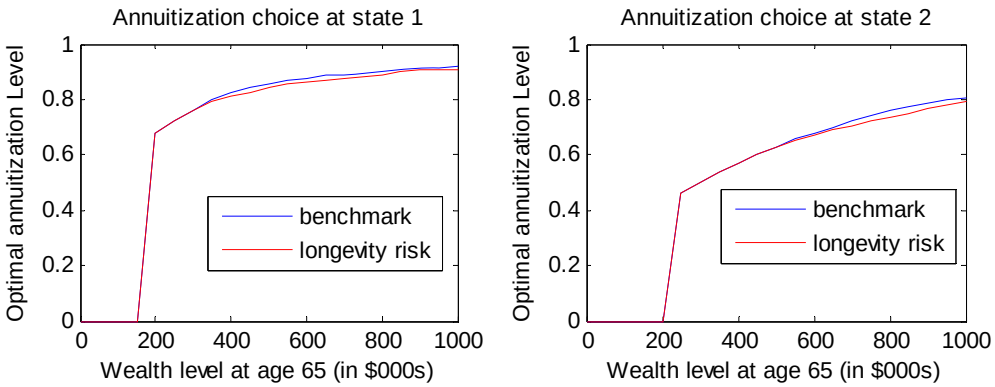


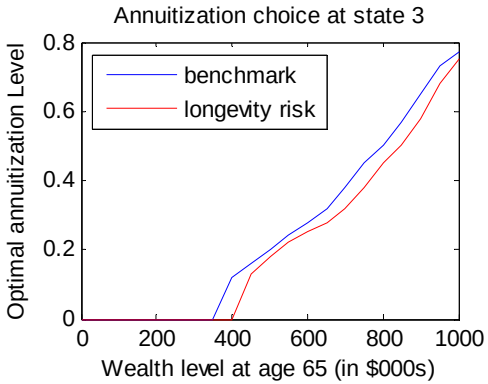
- Adverse selection
  - More annuitization with lower health risk
- Consumption floor and public healthcare
  - Low-wealth people prefer not to purchase annuity. The worth the health, the more so.
- The impact of bequest motive
  - Optimal annuitization level is less than 1 in the case not considering health risk

Basic Results II



Basic Results III





- Prefer to purchase less annuity as longevity risk is taken into account. The higher the health risk is, the more so.

Empirical Efforts I

- Focus group study to look into the decision making process
  - Provide motivations and rationales
  - Potentially shed light on the behavior aspects and future model frameworks
- Develop survey based empirical analysis
  - Self conducted?
  - Existing NIA funded HRS survey
  - Support model and simulation assumptions
  - Verify model and simulation results

Empirical Efforts II

- We begin the process of conducting two focus groups with people 55-70 years of age
  - 12 persons to discuss a topic with an impartial moderator
  - To investigate the role that annuities play in their retirement planning
- Based on a know technique to other business literature, the results will help us investigate our model in the "real world" and will also help us in developing further empirical research
  - E.g., why consumers buy or do not buy annuities and, if they buy, what factors are considered in deciding how much they buy?

Discussions and Conclusions

- We suggest a first step forward to incorporate longevity risk consideration in a (rational) multivariate retirement decision making framework
- Robustness of model assumptions (life insurance? long-term care product? Pre-annuitization wealth? health status transition matrix?)
- Limitations of a rational framework
- Institutional changes and its impact
- Fine tunes needed based on empirical results

Thank you!

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