LIFE ANNUITIES: BEYOND THE TRADITIONAL SINGLE PREMIUM IMMEDIATE ANNUITY

Annamaria Olivieri

University of Parma (Italy), Department of Economics and Management

annamaria.olivieri@unipr.it

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Background

In many markets

- Individual wealth is increasingly exposed to *financial risk* (prior and after retirement) and *(individual) longevity risk* (after retirement)

Single Premium Immediate Annuity (SPIA)

- Traditional (optimal?) solution to get protection, post-retirement
- However: Annuity markets remain little
- *What alternative products can be designed?*

Standard annuities

Lifelong payment (fixed or minimum annual amount)

- Independent of: Individual's lifetime *&* Average lifetime of the population *&* Returns on investments
- Relying on guaranteed levels of mortality credits

Provider

- Long term exposure to risks: Financial, longevity (idiosyncratic & aggregate), inflationary
- Adverse-selection
- Pricing assumptions, and the overall annuity design, chosen at issue, without following updates
  - Conservative assumptions $\Rightarrow$ (*High?*) Loadings
  - Inflexible benefits (apart from participation to extra-returns)

Individual

- Lifelong protection
- No bequest ($\Leftarrow$ Mortality credits)
- Irreversible decision
- Illiquid asset
  - No revision of the sequence of benefits
  - Asset line chosen by the provider
  - No (partial) surrender
- Perceived to be expensive
- Further downside: Possible mortality shocks
- Overall, myopic view (contrasting with the long term features of an annuity)

What does a life annuity represent for an individual ?

- An investment?
  - Focus on return and flexibility
- A non-refundable asset, interesting thanks to tax incentives, but subject to (too) many constraints?
  - Cultural issues (financial & insurance literacy)
- A protection against the risk of outliving his/her own assets?
  - Possible innovations in respect of benefit duration, additional benefits, structure of the guarantee

In what follows:

Some remarks related to the third view

Introducing innovations in annuities: Relaxing the guarantees

Restrict the number of payments

- Postpone the start of the benefit payment
  - Old age annuities (or Longevity insurance)
  - Deferred (old age) annuities
- Maximum number of payments
  - Temporary annuities (Extendable annuities)
  - Guaranteed Minimum Withdrawal benefits

Old-age annuities (or Longevity insurance) *&* Extendable annuities ➔ North American market

Link the benefit amount to a given mortality/longevity experience

- Mortality/longevity-linked annuity benefits (pooling products)

See Australian experience on GSA

But also

Extend and diversify the guarantees

- Adding additional benefits (in particular, death and health benefits)

Money-back annuities (or Capital protection), LTC uplift (Enhanced pension) common in many markets

Customize the pricing of the lifetime guarantee, adopting risk classification

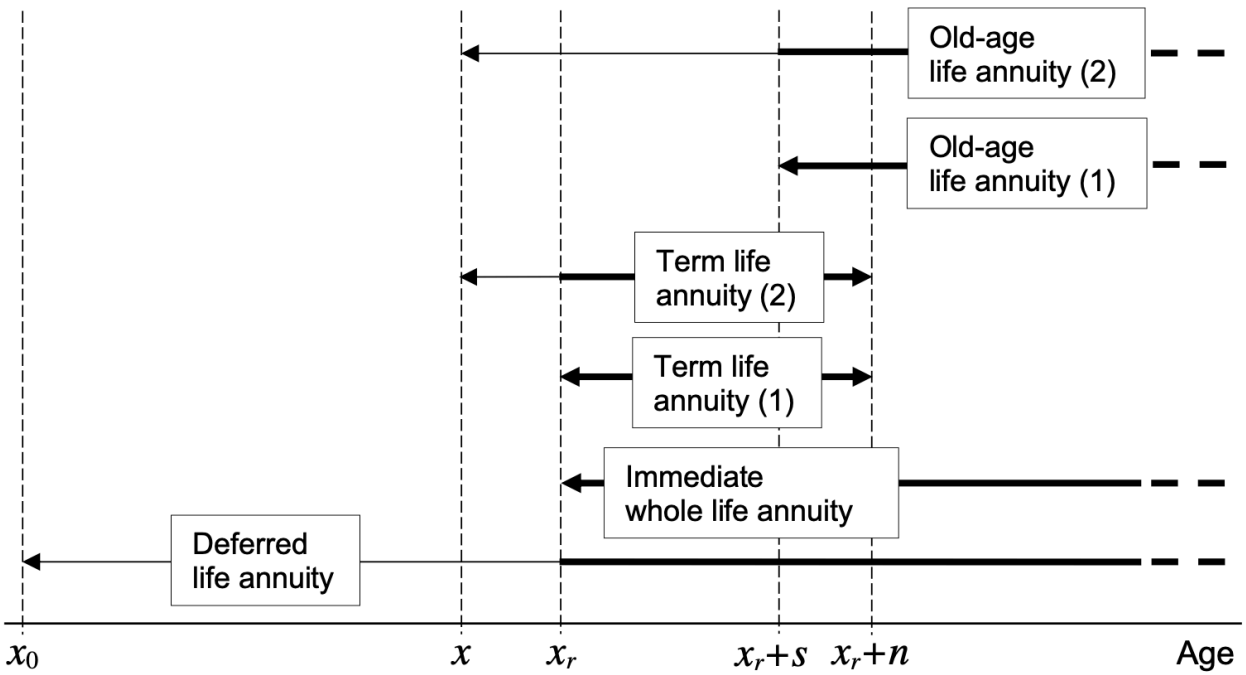
- Special-rate annuities
  - Health-related: Enhanced, Impaired-life, Care annuities
  - Lifestyle: Annuities for smokers, Unmarried lives annuities
  - Postcode

Significant market experience in UK

In the following:

Some issues about time restrictions, mortality/longevity-linking, risk classification

Time restrictions: Alternative annuity structures with respect to time-frames

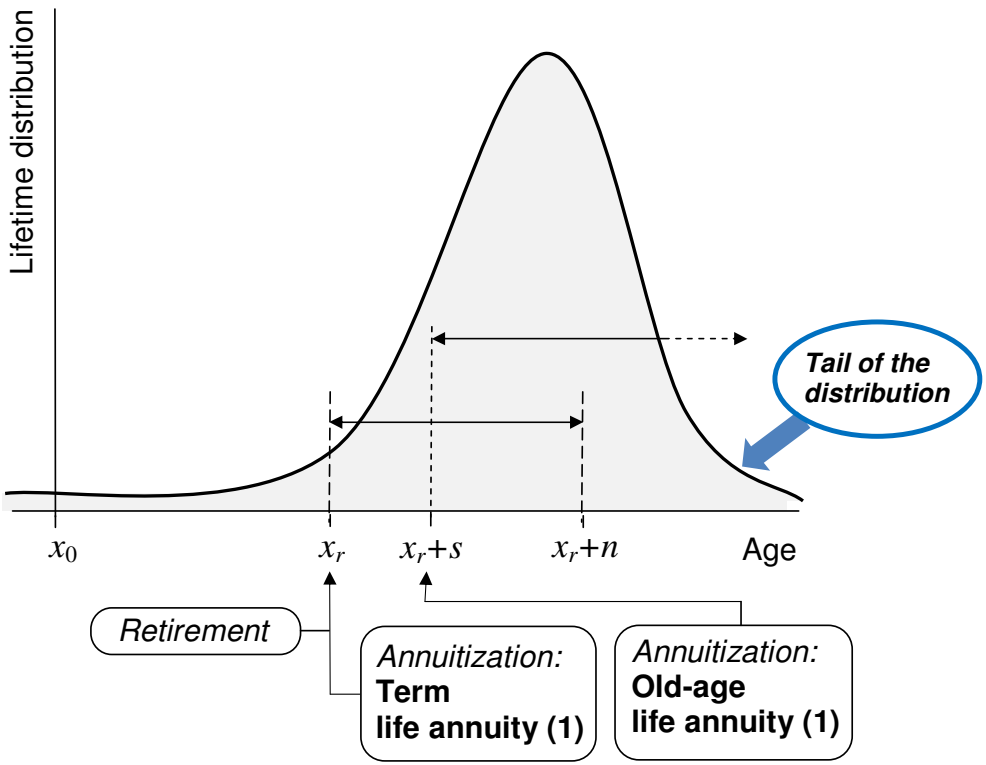


Time restrictions

- Lower expected value of payments
- Lower equivalence premium
- Lower cost perceived

Time restrictions and longevity risk

Longevity risk varies with age



- Time restrictions imply different levels of longevity risk for the provider
- In particular: The total size of longevity risk reduces

BUT: In relative terms, longevity risk could be higher, in particular if only older ages are involved

➔ *Possible need of higher loadings or capital (per unit of expected value)*

Some results

Arrangements

Annuity Type	Year of Birth	Entry Age	Deferment	Maximum Duration	Annuity Age Frames	Benefit Payment Age Frames
Immediate whole life annuity	1957	65	0	∞	(65,121]	(65,121]
Deferred life annuity	1972	50	15	∞	(50,121]	(65,121]
Term life annuity (1) - Immediate	1957	65	0	25	(65,90]	(65,90]
Term life annuity (2) - Deferred	1972	50	15	25	(50,90]	(65,90]
Old-age life annuity (1) - Immediate	1942	80	0	∞	(80,121]	(80,121]
Old-age life annuity (2) - Deferred	1957	65	15	∞	(65,121]	(80,121]

Best-estimate values and quantiles (% of the best-estimate value) at time 0

Scenario with longevity risk only: Risk-free return (0%), stochastic mortality

Annuity Type	BE	Moderate Deviations in Mortality $\varepsilon = 0.9$	Moderate Deviations in Mortality $\varepsilon = 0.995$	Major Deviations in Mortality $\varepsilon = 0.9$	Major Deviations in Mortality $\varepsilon = 0.995$
Immediate whole life annuity	21.20	101.60%	103.24%	105.28%	110.71%
Deferred life annuity	21.54	101.76%	103.55%	105.77%	111.85%
Term life annuity (1) - Immediate	19.23	100.96%	101.92%	103.07%	105.89%
Term life annuity (2) - Deferred	18.95	101.06%	102.10%	103.34%	106.51%
Old-age life annuity (1) - Immediate	9.47	102.65%	105.40%	108.69%	118.22%
Old-age life annuity (2) - Deferred	7.72	103.65%	107.42%	112.17%	124.98%

Findings: Summary

Scenario with longevity risk only

- In relative terms: Higher longevity risk for old-age annuities

Scenario with financial and longevity risk

- Financial risk is not affected by age, but by the extension of the time-interval
- Old-age annuities: Trade-off between longevity risk and financial risk, depending on the respective volatility
- Deferred annuities: Significantly exposed to financial risk, due to the extension of the time-interval

Mortality/Longevity-linking – I

Benefit structure

$$b_t = b_{t-1} \cdot \underbrace{\frac{1+g_t}{1+i(\tau)}}_{\text{Return on investments}} \cdot \underbrace{\frac{p_{x+t-1}(\tau)}{\tilde{p}_{x+t-1}}}_{\text{Survival rate}} \cdot \underbrace{\frac{1+a_{x+t}(\tau)}{1+a_{x+t}(\tau')}}_{\text{Actuarial value of the annuity}}$$

- A life annuity immediate. One cohort. Entry time: 0. Entry age: x
- Technical basis (benchmark) chosen/revised at time τ, $0 \leq \tau \leq t-1$
- g_t: Realized financial return in year $(t-1, t)$
- $i(\tau)$: Interest rate based on best-estimate assumptions at time τ

  ➔ *Benchmark interest rate*

- $p_{x+t-1}(\tau)$: Survival rate based on the best-estimate assumptions at time τ

  ➔ *Benchmark survival rate*

- $\tilde{p}_{x+t-1}$: Realised survival rate in year $(t-1, t)$, in a *given population*
- $a_{x+t}(\tau), a_{x+t}(\tau')$: Actuarial value at time t of a unitary annuity, based on the best-estimate assumptions at time τ (τ'), $0 \leq \tau \leq t-1$, $0 \leq \tau' \leq t$)

  ➔ *$a_{x+t}(\tau)$: Benchmark actuarial value*
  $a_{x+t}(\tau')$: Updated ("Realized") act. value

Mortality/Longevity-linking – II

Particular choices

Fixed benefit	$b_t = b_0$
Linking to Survival rate Benchmark: BE k years before	$b_t = b_{t-k} \cdot \frac{p_{x+t-1}(t-k)}{\underbrace{\tilde{p}_{x+t-1}}}$ From a "reference" population (*Index-based*)
Linking to Actuarial value Benchmark: BE k years before	$b_t = b_{t-k} \cdot \frac{1+a_{x+t}(t-k)}{1+a_{x+t}(t)}$
Group Self-Annuitization	$b_t = b_{t-1} \cdot \frac{p_{x+t-1}(t-1)}{\underbrace{\tilde{p}_{x+t-1}}} \cdot \frac{1+a_{x+t}(t-1)}{1+a_{x+t}(t)}$ From the pool (*Indemnity-based*)

- Embedded guarantees depending on the linking rule and parameters
- Additionally: Explicit guarantees (e.g: floor and cap to the benefit amount, the adjustment coefficient, adjustment up to a maximum age, . . .)

Some results

Benefit type		Premium loading (% of the BE annuity value at time 0)
Fixed benefit		1.731%
Linking to Survival rate	$s = k = 1$	1.654%
Benchmark: BE k years before	$s = k = 3$	1.572%
Adjustment every s years	$s = k = 5$	1.481%
Linking to Actuarial value	$s = k = 1$	0.092%
Benchmark: BE k years before	$s = k = 3$	0.185%
Adjustment every s years	$s = k = 5$	0.293%
Linking to Survival rate	$s = 1$	0.052%
Benchmark: BE at time 0	$s = 3$	0.227%
Adjustment every s years	$s = 5$	0.384%
Linking to Actuarial value	$s = 1$	-0.034%
Benchmark: BE at time 0	$s = 3$	0.017%
Adjustment every s years	$s = 5$	0.144%
Group Self-Annuitization		0.000%

Main assumptions:

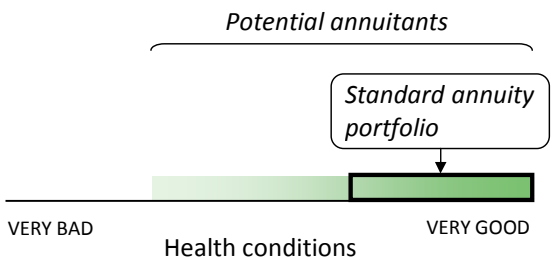
- Annuity immediate. Entry age 65. Maximum attainable age 100
- Deterministic financial setting
- Stochastic mortality setting, predicting a moderate level of aggregate deviations
- 10% loss probability admitted for the provider
- Benefit amount at time t: $0.75 \cdot b_0 \leq b_t \leq b_0$
- Adjustment up to age 95

➔ Size of the premium loading as a measure of the guarantee level

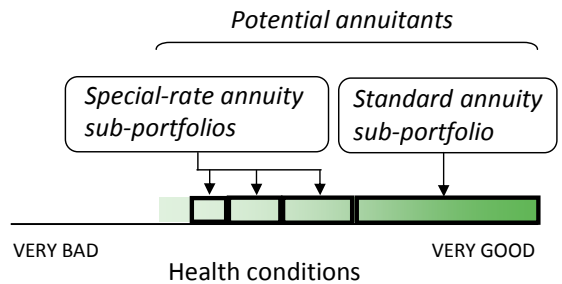
Risk classification: Customizing the annuity rate

Standard life annuities are priced considering healthy individuals

- ➔ Annuity rates perceived too low by individuals in poor or critical health conditions
- ➔ A large proportion of potential annuitants are out of reach of insurers



Risk classification can make the product convenient also to these individuals



Issues:

- What are the risk factors? (Apart from age)
- How many classes?
- "Cannibalization" effects?
- Classification errors?
- Portfolio heterogeneity vs pooling effects

This presentation is based on:

Olivieri, A. (2021). Designing annuities with flexibility opportunities in an uncertain mortality scenario. *Risks*, 9:189.

Olivieri, A. and Pitacco, E. (2020a). Linking annuity benefits to the longevity experience: Alternative solutions. *Annals of Actuarial Science*,14(2):316–337.

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Just some suggestions (The list is not exhaustive)

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Thank you! 

Contacts:

Annamaria Olivieri

University of Parma (Italy)

Email: annamaria.olivieri@unipr.it