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Key insights into decumulation strategies

Thomas Bernhardt & Catherine Donnelly
Risk Insight Lab, Heriot-Watt University

www.risk-insight-lab.com

The '**Minimising Longevity and Investment Risk while Optimising Future Pension Plans**' research programme is being funded by the Actuarial Research Centre.

22 November 2018

www.actuaries.org.uk/arc

Overview

- Introduction to the research programme
- Optimal decumulation strategies
- Our recent research
- Questions and comments

Introduction

Research programme: “Minimising Longevity and Investment Risk while Optimising Future Pension Plans”:

- Customers’ needs at the forefront.
- Provide customers with a real income in retirement that has the desired balance between stability and performance.
- Minimize costs for the customer.

Research topics

- Investment strategies throughout the customer's lifetime
- Investment return smoothing and/or risk sharing
- Longevity risk sharing (modern tontines)
- Performance measurement: investment risk vs income stability
- Market timing
- Guarantees: only when needed
- Robustness to assumptions

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Research coalition

- Joint project led by Heriot-Watt and Cass Business School.
- Funded by the Actuarial Research Centre (ARC).
- Research network extends to Australia, Austria, Germany and Spain with tenured academics.
- IFoA ARC project website: https://www.actuaries.org.uk/learn-and-develop/research-and-knowledge/actuarial-research-centre-arc/research-programmes/minimising-longevity-and-investment-risk-while-optimising-future-pension-plans

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Research outputs - selection

- Papers
  - Self-selection and risk sharing in a modern world of life-long annuities, *by R. Gerrard, M. Hiabu, I. Kyriakou, J. P. Nielsen.*
  - Choice of Benchmark When Forecasting Long-term Stock Returns, *by I. Kyriakou, P. Mousavi, J . P. Nielsen, M. Scholz.*
  - Product options for enhanced retirement income, *by C. Donnelly and J. Young.*
  - Implementing individual savings' decisions for retirement with bounds on wealth, *by C. Donnelly, M. Guillen, J.P. Nielsen, A.-M. Perez-Marin*.
  - State-of-the-Art Report on Investment Risk-Sharing, *by R. Chehab and C. Donnelly.*

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Research outputs relevant to this talk

- State-of-the-Art Report on Pension Decumulation Strategies, *by T.Bernhardt and C. Donnelly* (download from www.risk-sight-lab.com/outputs).

- Webinar on modern tontines (Actuarial Research Centre website, under this Research Programme).

- How much to invest in a tontine, *by T.Bernhardt and C. Donnelly* [submitted paper].

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Optimal investment strategies

- State-of-the-Art Report on Pension Decumulation Strategies, *by T.Bernhardt and C. Donnelly* (download from www.risk-sight-lab.com/outputs).
  - Review of the literature on pension decumulation, mostly academic
- Covers investment and income withdrawal strategies, e.g.
  - how much to invest in equities vs bonds at each time.
  - how much to withdraw as an income every year.
- Investment in the financial markets is essential (Battocchio et al, 2017).

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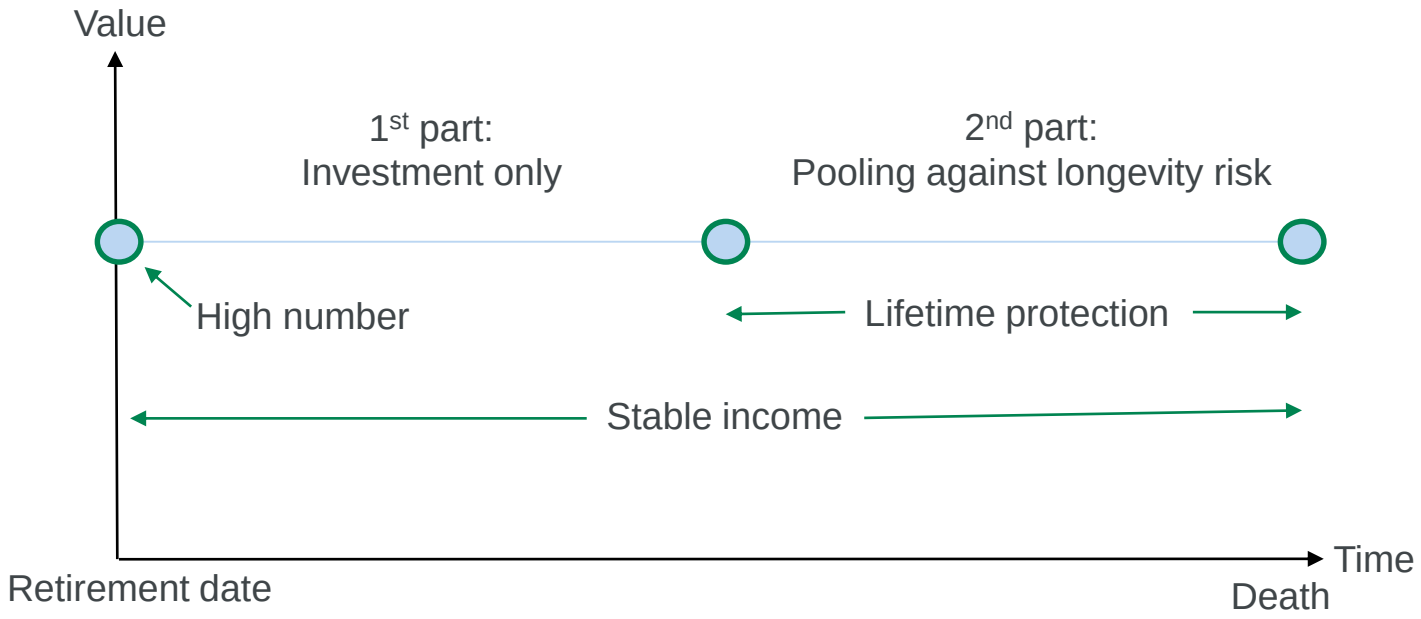
Optimal investment strategies

A good retirement product looks like…



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Optimal investment strategies

Variety of **objective functions** studied…

(1) Max lifetime income $\mathbb{E}[\int_0^T U(t,c)dt + V(T,X)]$.

(1) Min probability of wealth falling to zero.

(2) Max above level $\mathbb{E}[\int_0^T U(t,c-h)dt + V(T,X-H)]$.

(2) Max mean-variance $\mathbb{E}[X] - \gamma\, Var[X]$.

(2) Min distance from a target

$$\mathbb{E}[\int_0^T a \times (c-f)^2 dt + b \times (X-F)^2].$$

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From maximizing/minimizing objective functions (1)

"Max lifetime income" or "Min probability of wealth falling to zero":

- Mutual fund separation, ✓Presenting equity as one thing.
- Constant mix strategy, ✓How insurance companies invest.
- Equity ↓ then Longevity risk ↑, ✓~50% in equity for lowest lifetime ruin.
- Changing consumption, ✗Unstable income.
- Deplete savings, ✓Bequest is second order.
- Savings don't last forever, ✓Annuity.

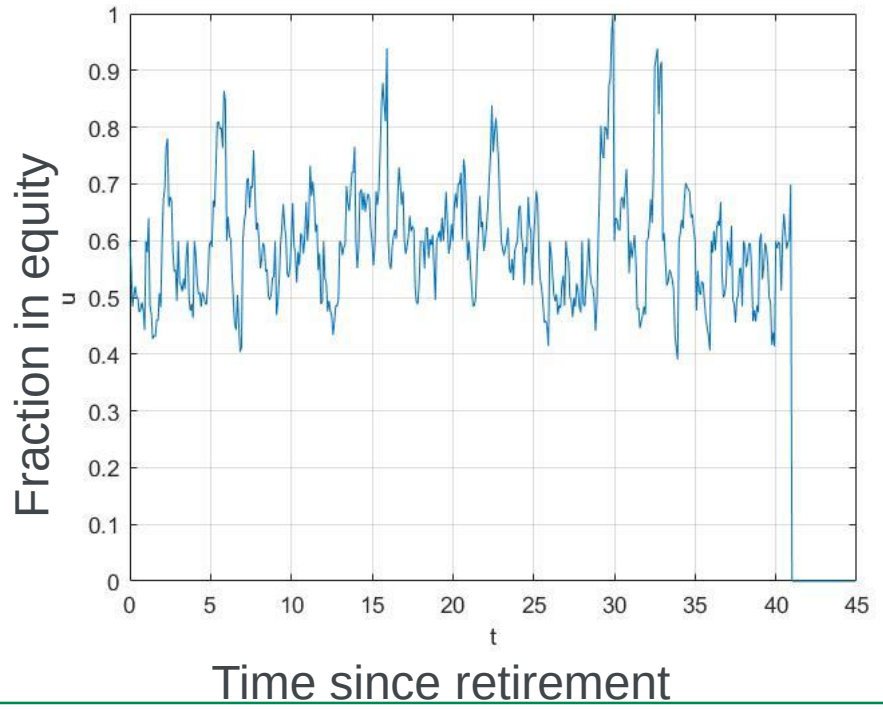
- "4% rule" for a stable income
  - How long? How much left?

	Initial annual withdrawal rate						
Years	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
15	100%	100%	100%	100%	99%	97%	91%
20	100%	100%	98%	95%	85%	66%	41%
25	100%	97%	92%	77%	51%	28%	12%
30	97%	92%	75%	49%	27%	12%	5%
35	94%	81%	57%	33%	14%	6%	3%

From maximizing/minimizing objective functions (2)

Optimizing remaining objective functions:

- Similar to “Max lifetime income”, i.e. robust optimal solutions.
- Variance increases over time,
  - Needs control.
- Varying equity proportion,
  - How investment firms invest.
- Stable profit,
  - Predictable outcome.



“4% rule”, i.e. income drawdown

- e.g. 50% in equity.
- Withdraw *x*% from initial savings, then increase with inflation.
- Probability savings last for at least…

	Initial annual withdrawal rate						
Years	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
15	99.98%	99.83%	99.20%	97.30%	93.14%	87.00%	77.50%
20	98.53%	95.00%	87.70%	76.47%	63.24%	49.28%	36.48%
25	91.05%	79.27%	65.48%	48.87%	34.60%	23.52%	14.92%
30	77.37%	60.04%	43.44%	29.39%	18.63%	11.13%	6.33%
35	62.14%	44.17%	28.23%	18.16%	10.53%	5.65%	2.98%

Mean-variance objective function

- Annual optimization problem.
- Inflation adjusted percentage from initial savings.
- Probability savings last for at least…

	Initial annual withdrawal rate						
Years	**3.0%**	**3.5%**	**4.0%**	**4.5%**	**5.0%**	**5.5%**	**6.0%**
15	98.95%	96.63%	94.17% -5.03	91.10%	89.60%	85.48%	77.82%
20	96.03%	90.07%	85.34% -2.36	80.35%	74.84%	63.14%	49.02%
25	91.99%	82.90%	75.49% +10.01	66.26%	46.09%	23.35%	12.63%
30	87.19% +9.82	75.03% +14.99	61.94% +18.50	37.28% +7.89	7.67% -10.96	1.48% -9.65	0.48% -5.85
35	78.75%	59.83%	30.65% +2.42	3.93%	0.15%	0%	0%

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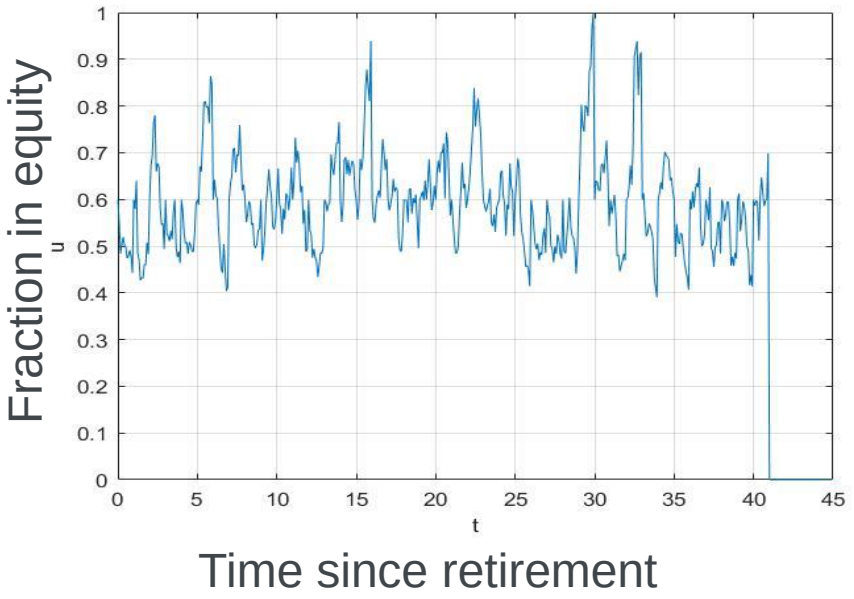
Mean-variance objective function

- Annual optimization problem.
- Inflation adjusted percentage from initial savings.
- Probability savings last for at least…

	Initial annual withdrawal rate		
Years	3.0%	3.5%	4.0%
15	98.95%	96.63%	94.17% -5.03
20	96.03%	90.07%	85.34% -2.36
25	91.99%	82.90%	75.49% +10.01
30	87.19% +9.82	75.03% +14.99	61.94% +18.50
35	78.75%	59.83%	30.65% +2.42



Undesirable features of optimal strategies

Undesirable feature		Implication
Difficult to communicate	…	Car mechanic analogy
Sensitive to parameters	…	Indication for wrong set-up
Non-explicit indication for outcome	…	Explicit in idealistic situation
No constraints	…	Numerical solutions

Life annuities - features

Feature	Consequence
Guaranteed lifetime income	Premium reflects actuarially fair value + fees/solvency margin/other costs
Underlying low risk/low return investment strategy	Low annuity income
Longevity gains eventually out-pace investment gains	Happens around age 80
Not favourable to buy life annuity all the time	Optimal stopping problem

Life annuities - features

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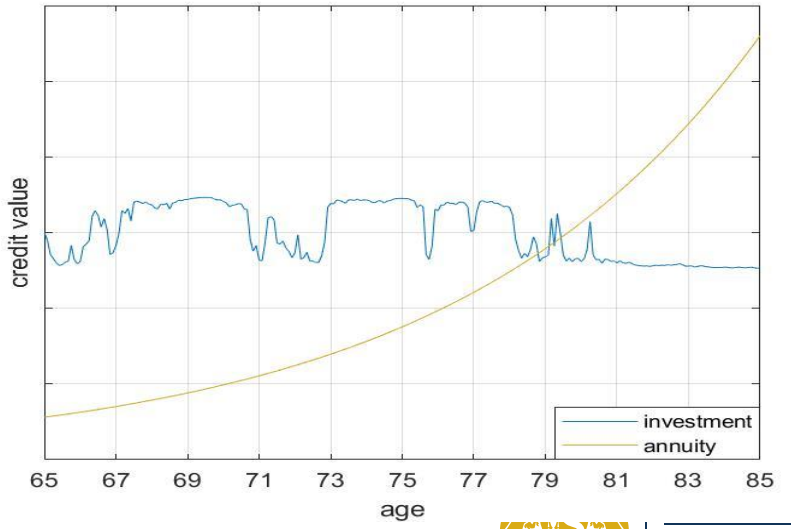
Guaranteed lifetime income	Premium reflects actuarially fair value + fees/solvency margin/other costs
Underlying low risk/low return investment strategy	Low annuity income
Longevity gains eventually out-pace investment gains	
Not favourable to buy life annuity all the time	



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State of the art involving life annuities

- Annuity best option at high ages.
- Don’t fully annuitization at the retirement date,
  - phase transition (stagger purchase).
  - deferred annuities.

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Our innovations in pension decumulation

Catherine Donnelly
Risk Insight Lab, Heriot-Watt University

www.risk-insight-lab.com

The '**Minimising Longevity and Investment Risk while Optimising Future Pension Plans**' research programme is being funded by the Actuarial Research Centre.

What is a tontine?

- A tontine is a structure to pool longevity risk.
- A pure tontine has no guarantees – the pool of people bear the longevity risk.
- The purpose of modern tontines is to pay an income for life.

Imagine yourself

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Seeking advice…

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Age 70 with £100K pot

	Pure modern tontine			
Annual income	£7,100			
Age at which out-live savings	120 years			
Money left to heirs	Nothing			
Basis				
(Mortality, Investment returns), [allocation to tontine],[income if use unadjusted table]	*(S1PMA-2, 2% p.a.), [100% allocation], [£7,700 on S1PMA]*			

Age 70 with £100K pot

	Pure modern tontine	Modern tontine with bequest		
Annual income	£7,100	£6,600		
Age at which out-live savings	120 years	120 years		
Money left to heirs	Nothing	20% of pot at death		
Basis				
(Mortality, Investment returns), [allocation to tontine],[income if use unadjusted table]	*(S1PMA-2, 2% p.a.), [100% allocation], [£7,700 on S1PMA]*	*(S1PMA-2, 2% p.a.), [80% allocation], [£7,100 on S1PMA]*		

Age 70 with £100K pot

	Pure modern tontine	Modern tontine with bequest	Life annuity	
Annual income	£7,100	£6,600	£6,000	
Age at which out-live savings	120 years	120 years	Never	
Money left to heirs	Nothing	20% of pot at death	Nothing	
Basis				
(Mortality, Investment returns), [allocation to tontine],[income if use unadjusted table]	*(S1PMA-2, 2% p.a.), [100% allocation], [£7,700 on S1PMA]*	*(S1PMA-2, 2% p.a.), [80% allocation], [£7,100 on S1PMA]*	*(S1PMA-4, UK yield curve), equivalently (S1PMA-2, -0.3% p.a.)*	

Age 70 with £100K pot

	Pure modern tontine	Modern tontine with bequest	Life annuity	Income drawdown
Annual income	£7,100	£6,600	£6,000	£6,600
Age at which out-live savings	120 years	120 years	Never	87 years
Money left to heirs	Nothing	20% of pot at death	Nothing	Whatever left in pot at death
Basis				
(Mortality, Investment returns), [allocation to tontine],[income if use unadjusted table]	*(S1PMA-2, 2% p.a.), [100% allocation], [£7,700 on S1PMA]*	*(S1PMA-2, 2% p.a.), [80% allocation], [£7,100 on S1PMA]*	*(S1PMA-4, UK yield curve), equivalently (S1PMA-2, -0.3% p.a.)*	*(S1PMA, 2% p.a.)*

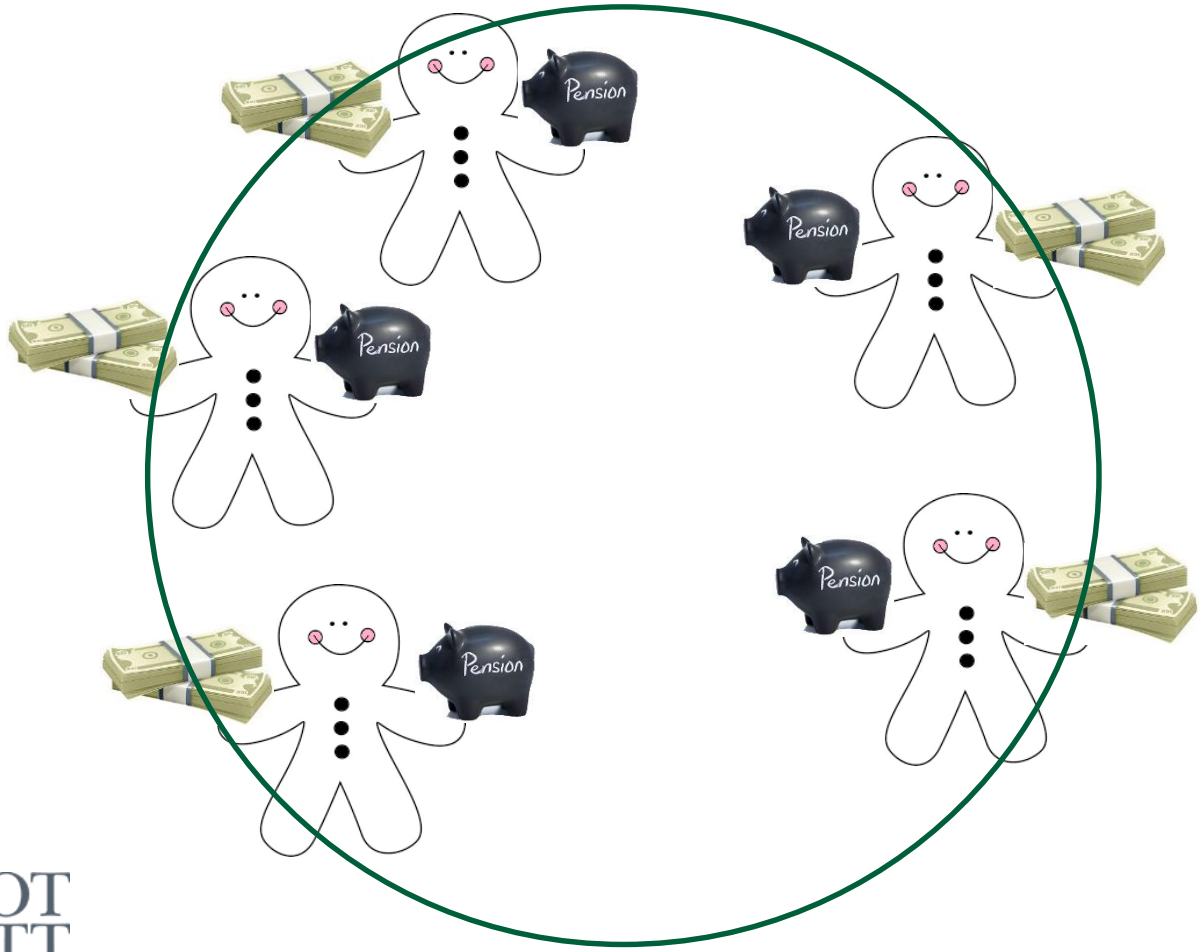
Life annuity feature

- Despite the previous table…
- Life annuity gives higher income than income drawdown,
  - if follow same investment strategy, and
  - ignore fees, costs, taxes, etc.

(Different investment strategy in previous table)

- Why? Pool longevity risk.
- We can pool longevity risk without buying life annuities.

Tontine



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Modern tontines

- Aim: retirement income, not a life-death gamble.
- Various tontines structures have been proposed.
- For a brief introduction to how to calculate longevity credits, see our October 2018 webinar (on IFoA ARC website)

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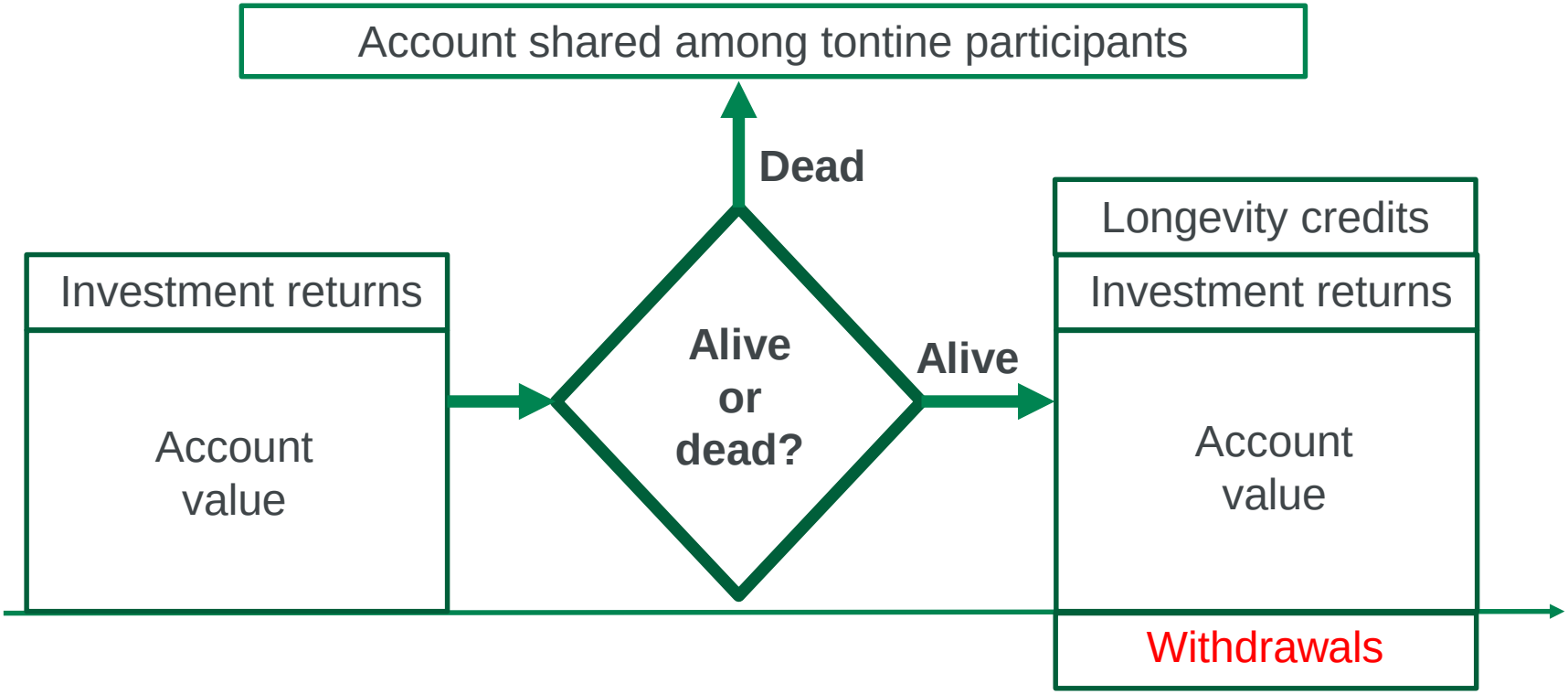
Pure modern tontine – individual account structure

Pure modern tontine



Minimising Longevity and Investment Risk while Optimising Future Pension Plans

Recent project presentations

- Sessional Research Event in May 2018:

  Self-selection and Risk Sharing in a Modern World of Life-Long Annuities, presented by J.P. Nielsen.

- Here, present work with Thomas Bernhardt, Risk Insight Lab, Heriot-Watt University

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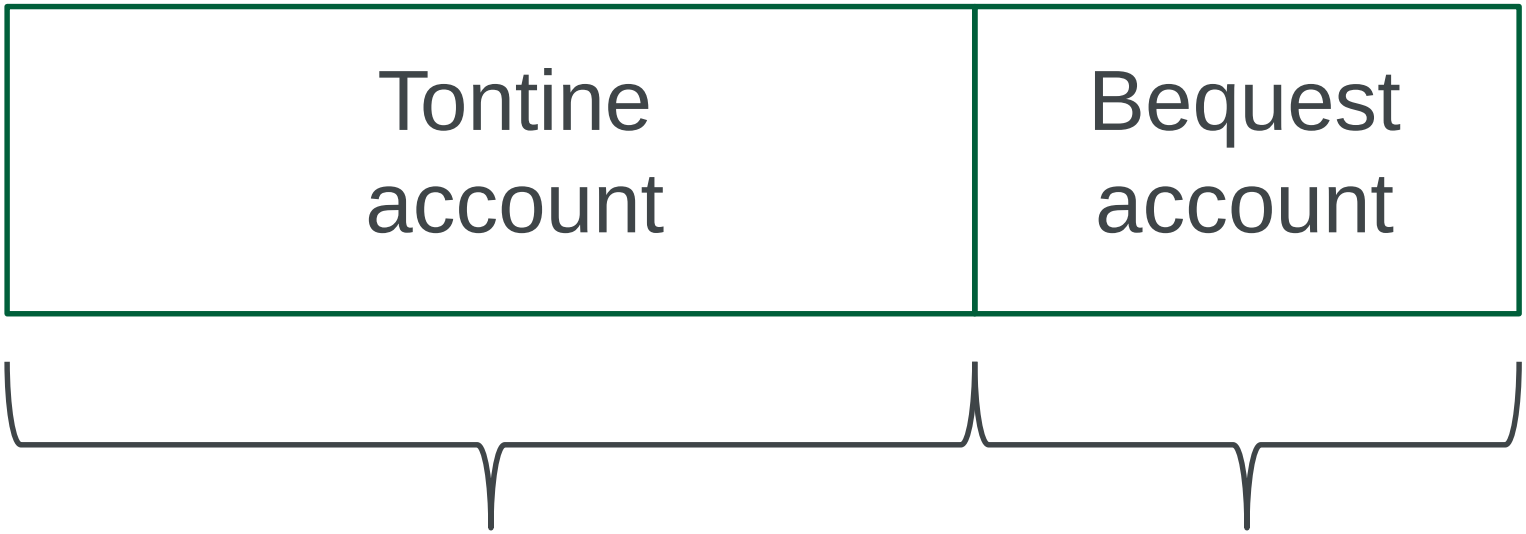
Modern tontine with bequest

Split pension savings into two accounts, 80% in tontine account



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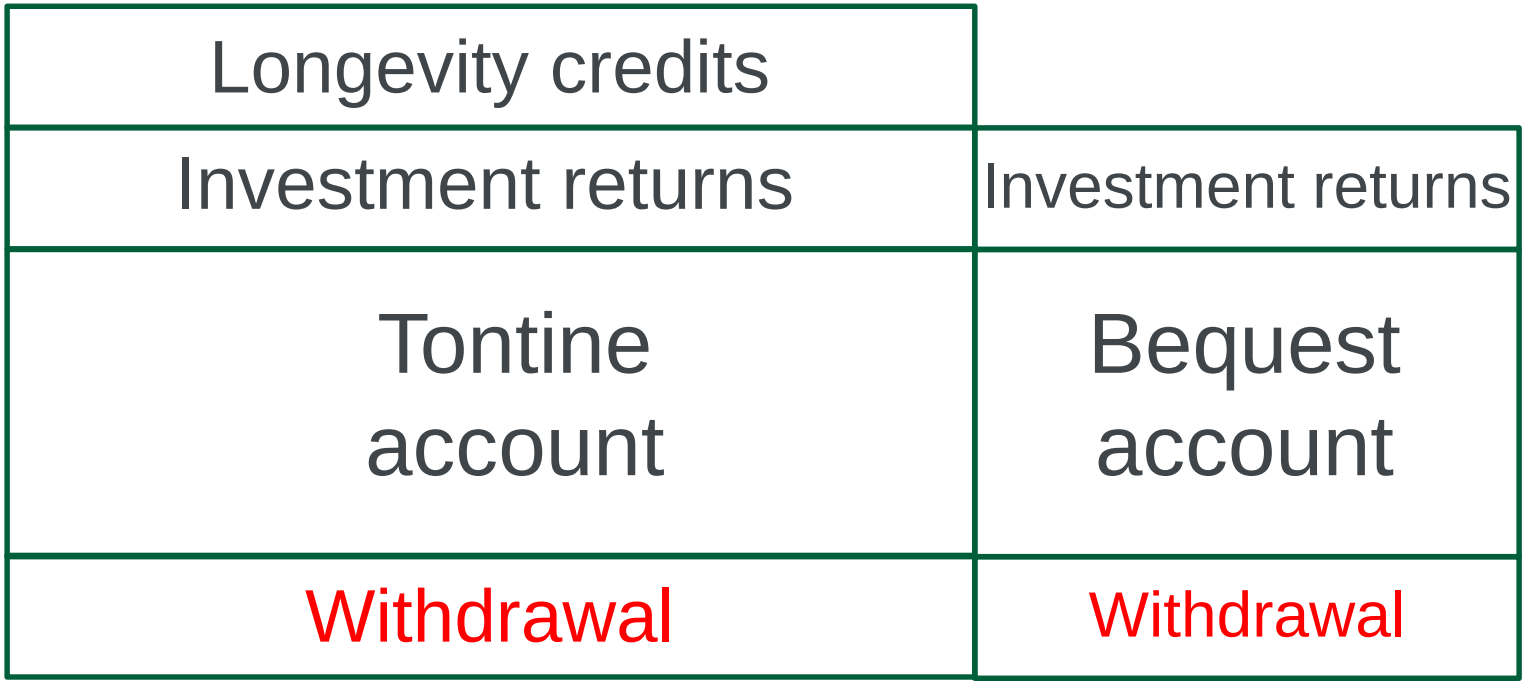
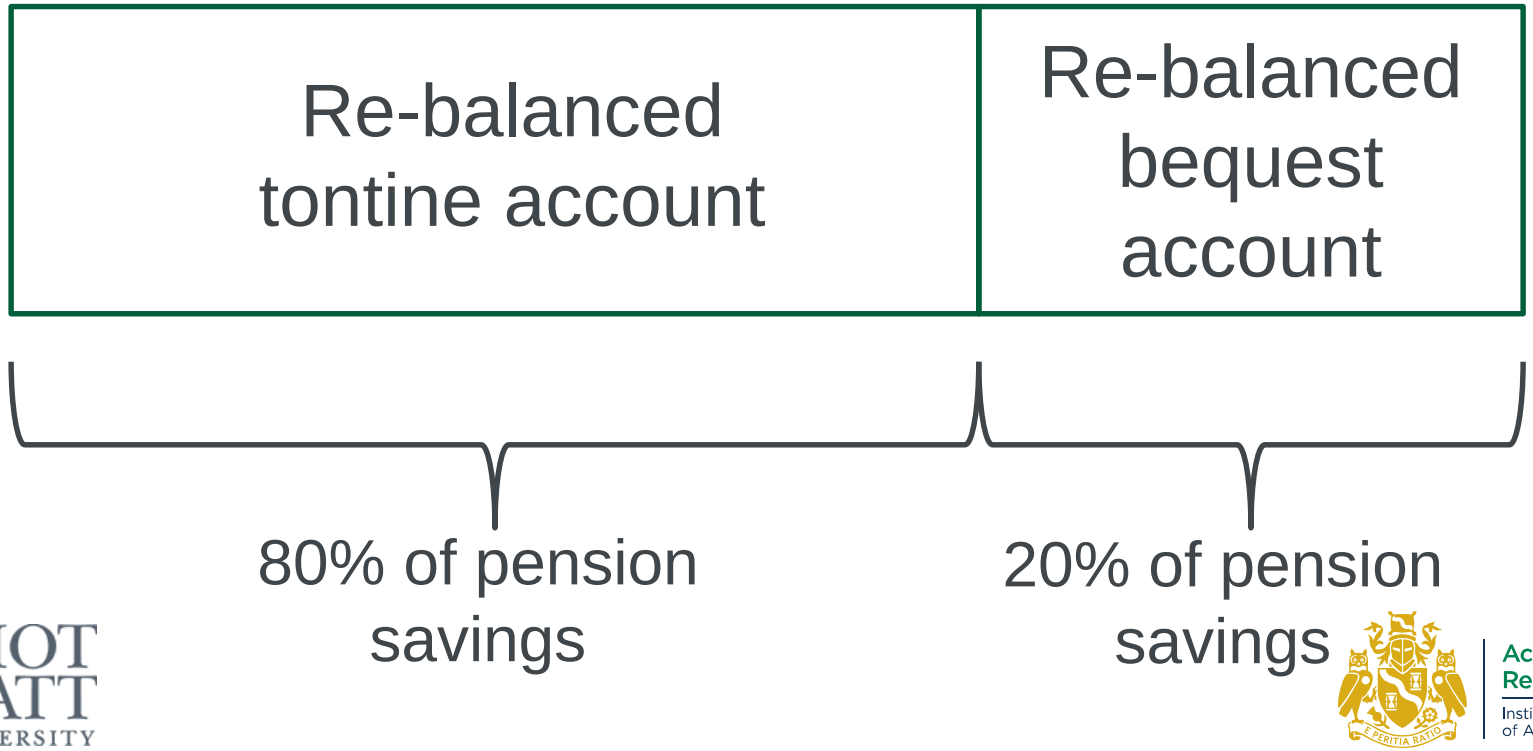
Modern tontine with bequest



Modern tontine with bequest

Rebalance accounts (re-distribute longevity credits)



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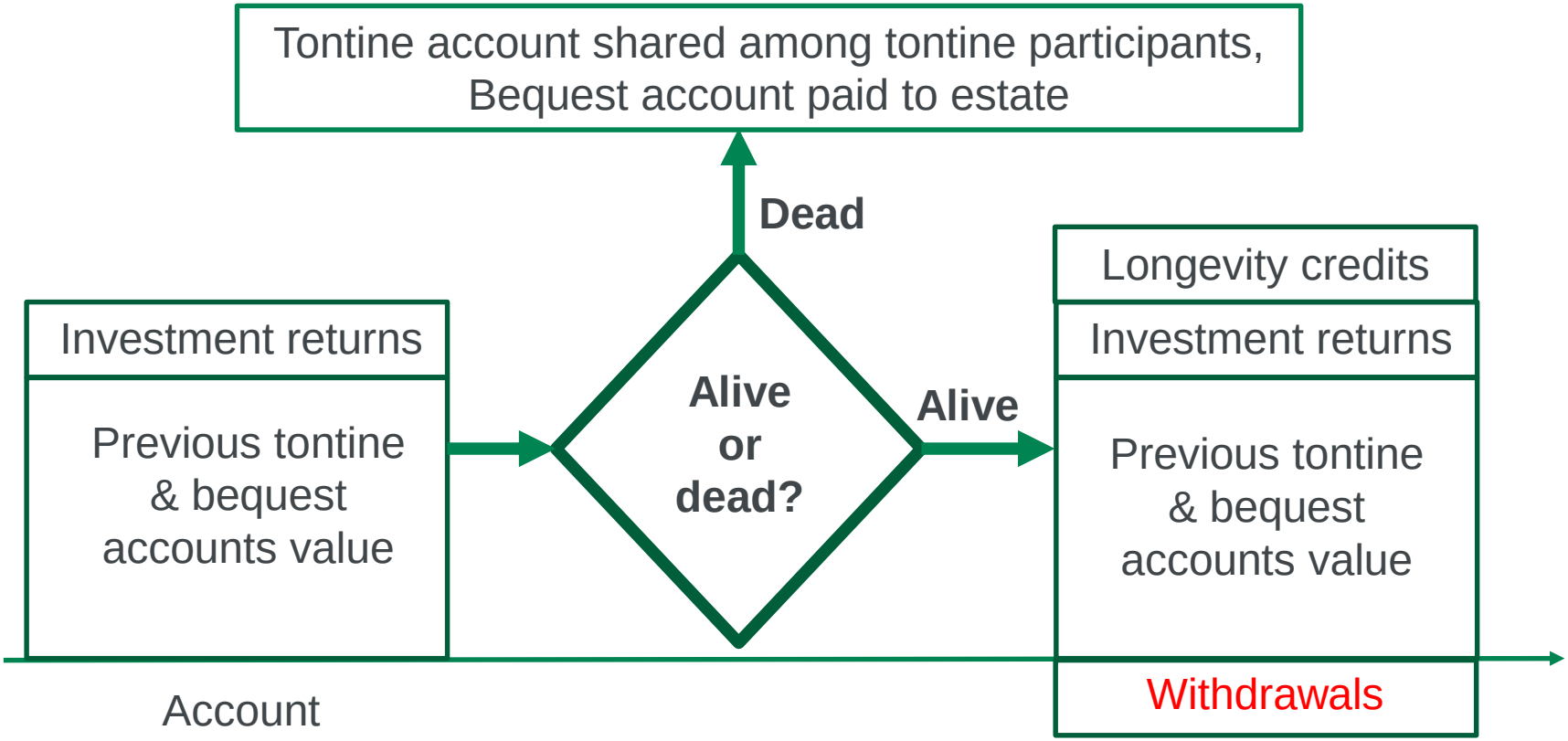
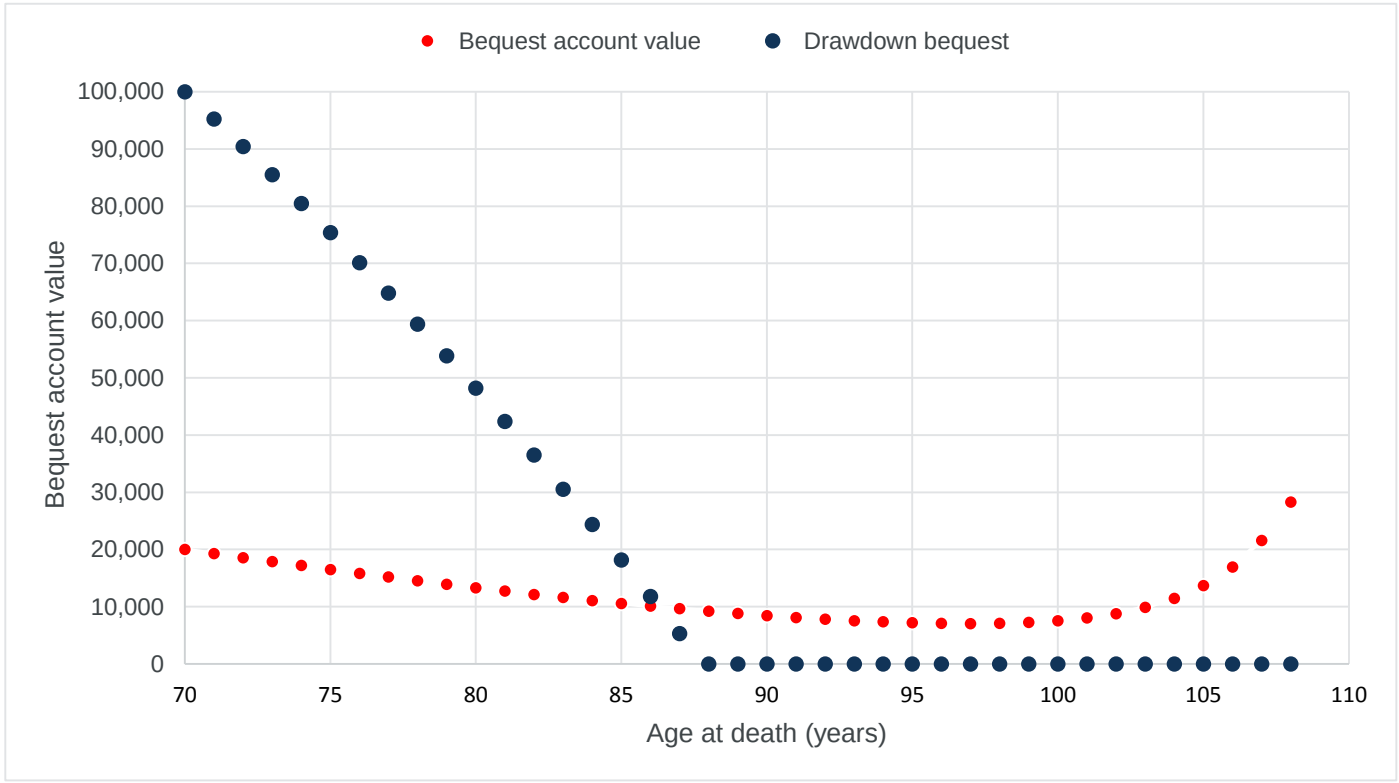
Modern tontine with bequest



Age 70 with £100K pot

		Modern tontine with bequest		Income drawdown
Annual income		£6,600		£6,600
Age at which out-live savings		120 years		87 years
Money left to heirs		20% of pot at death		Whatever left in pot at death
Basis				
(Mortality, Investment returns), [allocation to tontine],[income if use unadjusted table]		*(S1PMA-2, 2% p.a.), [80% allocation], [£7,100 on S1PMA]*		*(S1PMA, 2% p.a.)*

Bequest account vs Drawdown bequest



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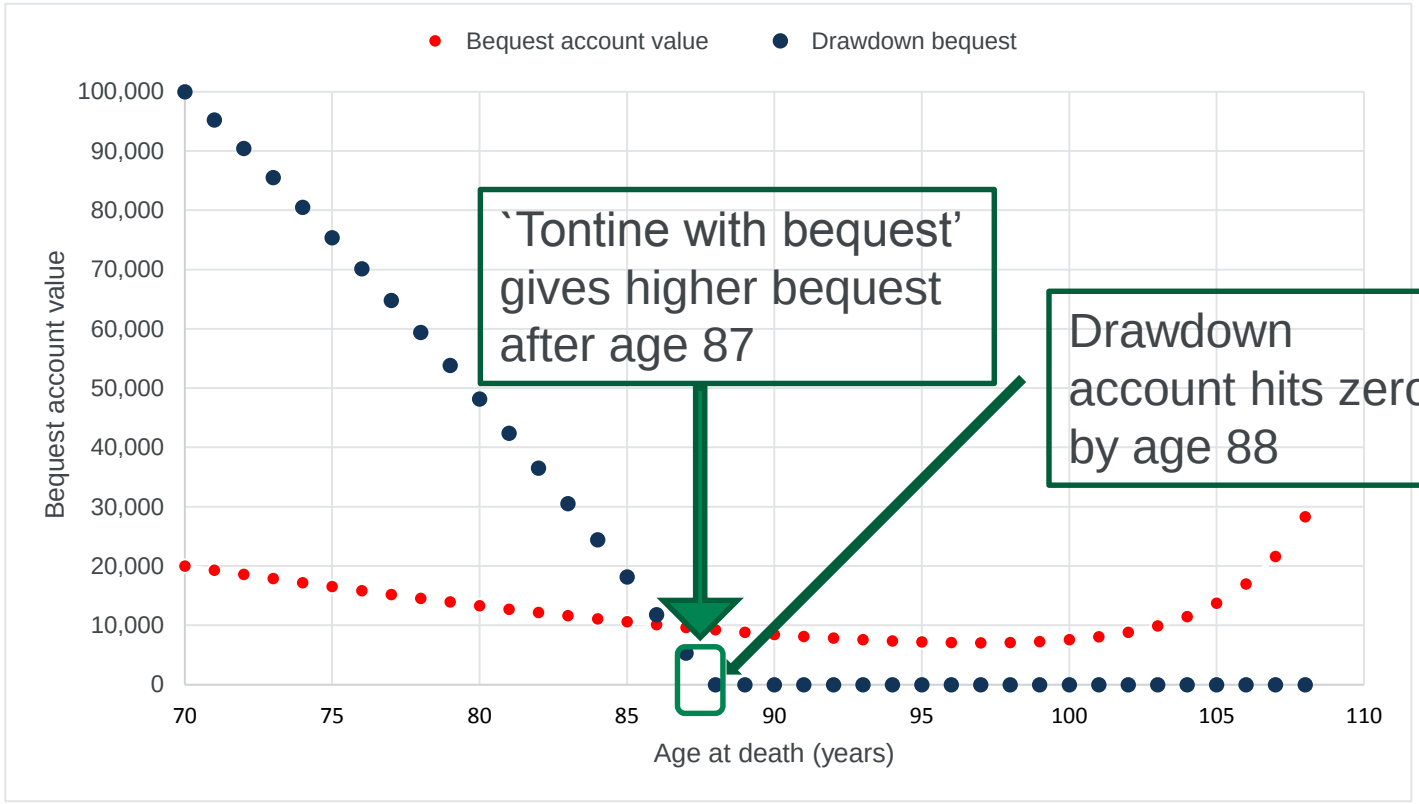
Bequest account vs Drawdown bequest



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Research question

What percentage of pension savings should you put in the tontine account?

- Allow for desire for income, bequest motive and risk aversion.
- Found that, for (normal) risk aversion, percentage is fairly stable and high.
- Harder to say for risk-seekers.
- Results are in theoretical model.
- Next step is to look at more realistic model.

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Modern tontines - summary

- Reduce risk of running out of money in retirement.
- Should be structured to provide a stable, fairly constant income (**not** increasing exponentially with the longevity credit!).
- Provide a higher income than living off investment returns alone.
- Can seek higher investment returns than life annuity.
- Can incorporate bequests.

Modern tontines - applications

- Innovation in retirement products
  - e.g. allow for bequest: ‘modern tontine with bequest’.
  - e.g. provide downside protection that too few deaths occur (minimum income) – see Donnelly & Young (2017).
  - e.g. allow less liquid assets such as pensioner’s house.
- Foundation for collective DC plans
  - Provides income without buying life annuities.
  - Could be integrated into DC plans as post-retirement option.

Questions

Comments

The views expressed in this presentation are those of the presenter.

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A gateway to global actuarial research

The Actuarial Research Centre (ARC) is the Institute and Faculty of Actuaries' (IFoA) network of actuarial researchers around the world.

The ARC seeks to deliver cutting-edge research programmes that address some of the significant, global challenges in actuarial science, through a partnership of the actuarial profession, the academic community and practitioners.

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