NDC Schemes and Heterogeneity in Longevity: Proposals for Re-design

Robert Holzmann, Jennifer Alonso-García, Héloïse Labit-Hardy, Andrés Villegas

CEPAR, UNSW Business School, Australia

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Overview of pensions

Funding methodologies

- Pay as you go (PAYG): current contributors pay current pensioners (Unfunded schemes)
- Funding: contributions are accumulated in a fund which earns a market return (Funded schemes)

Benefit formula

- Defined Benefit (DB): Pension is calculated according to a fixed formula which usually depends on the members salary and the number of contribution years.
- Defined Contributions (DC): Pension is dependent on the amount of money contributed each year and their return.

Overview of pensions

- The financing choice is present for both DB and DC pension schemes.
  - *In PAYG*: increasing fiscal burden of wage-based pension schemes
  - *In Funding*: defined contribution shift return risk to the individuals
  - Global shift from DB to DC
- Mixing possibilities:

	Pay-as-you-go	Funding
DB	Classical social security	Classical Employee DB Plan
DC	Nonfinancial (NDC)	Pension savings accounts

Advantages of PAYG DC (NDC)

- It's *more or less* actuarially fair (takes into account life expectancy and contributions)
- Portability of pension rights between jobs, occupations and sectors is permitted.
- It promises to deal with the effects of population ageing more or less automatically.
- Arbitrariness in benefit indexation rules and adjustment factors is avoided.

Mortality heterogeneity

- Everybody talks about heterogeneity in longevity but few to no solutions have been proposed.
- There is increasing evidence that heterogeneity in longevity is high, increasing for many dimensions, in particular for income, with expected further rise
- This heterogeneity acts like a tax/subsidy mechanism, reducing the link between lifetime contributions and pensions typically found in defined contribution pension schemes
- Data points for OECD countries suggest that tax rates can reach 30 percent for low income, and subsidy rates of over 20 percent for high income earners.

Our contribution

- We explore five mechanisms to compensate for mortality heterogeneity in NDC scheme:
  - Individualized annuities
  - Individualized contribution rates
  - Two-tier contribution structured (social+individual contribution rate)
  - Two additional schemes to deal with the tails

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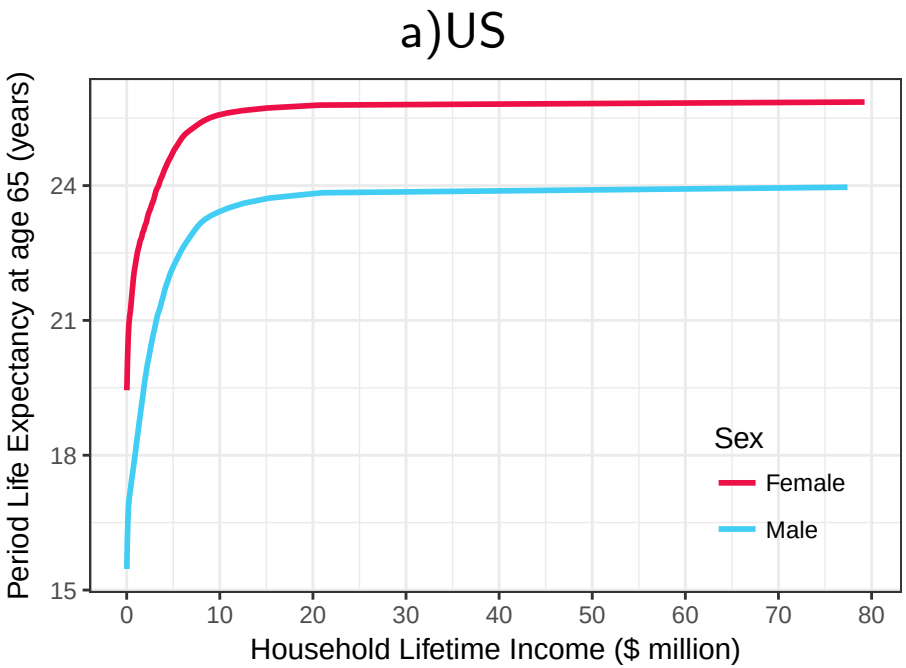
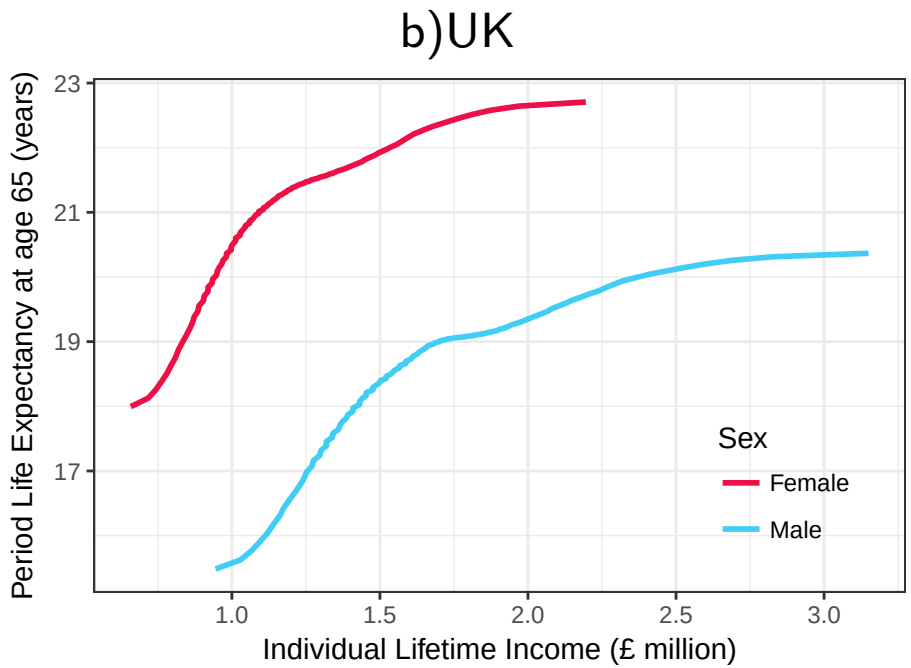
Challenge to the distribution of heterogeneity

- Linking life expectancy to a measure from life-time income requires the crossing of various sources of data (e.g. tax declaration and death certificate)
- Most available datasets provide data points for income terciles, quartiles and quintiles, or link mortality to educational attainment
- However, the tails of the income matter and full distributions are preferable.
- We use two datasets:
  - United States: Chetty et al. (2016) use federal income tax and social security records
  - England and Wales: income and mortality data for statistical geographies used by the Office of National Statistics (ONS)

Life expectancy vs Lifetime income in 2014 at age 65





Heterogeneity in longevity as tax-subsidy mechanism

- The pension at retirement is commonly calculated as the lifetime accumulated wealth $AK^k(tc)$ and the average life expectancy LE^a (with a contribution rate tc).
- We measure the pension wealth $PW^k_{x_r}$ for an individual k at retirement age x_r and assess the effect of individual life expectancy LE^k:

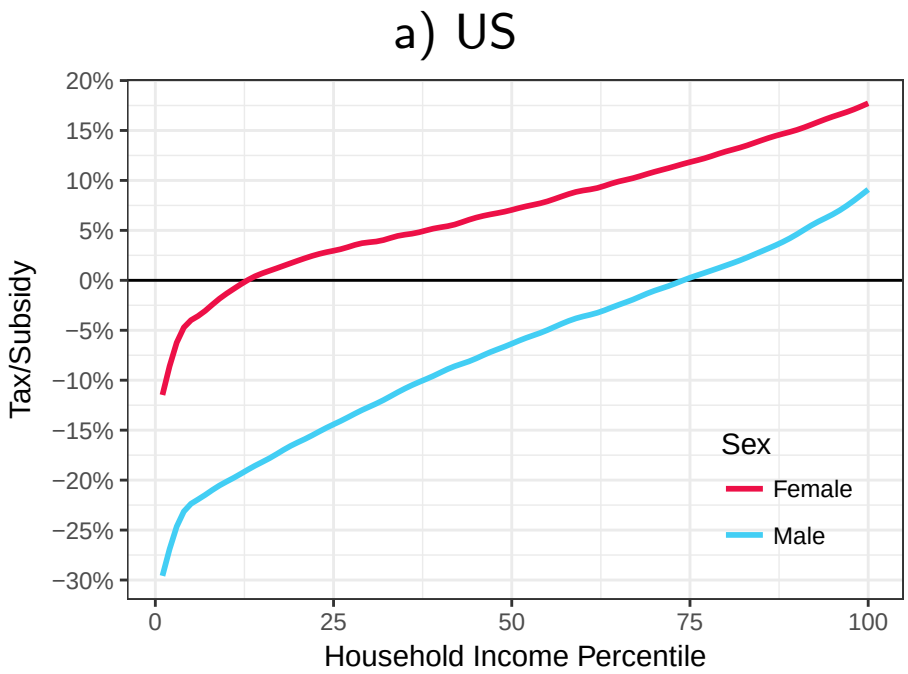
$$PW^k_{x_r} = P_{x_r} LE^k = \frac{AK^k(tc)}{LE^a} LE^k = AK^k(tc)(1 + t^k)$$

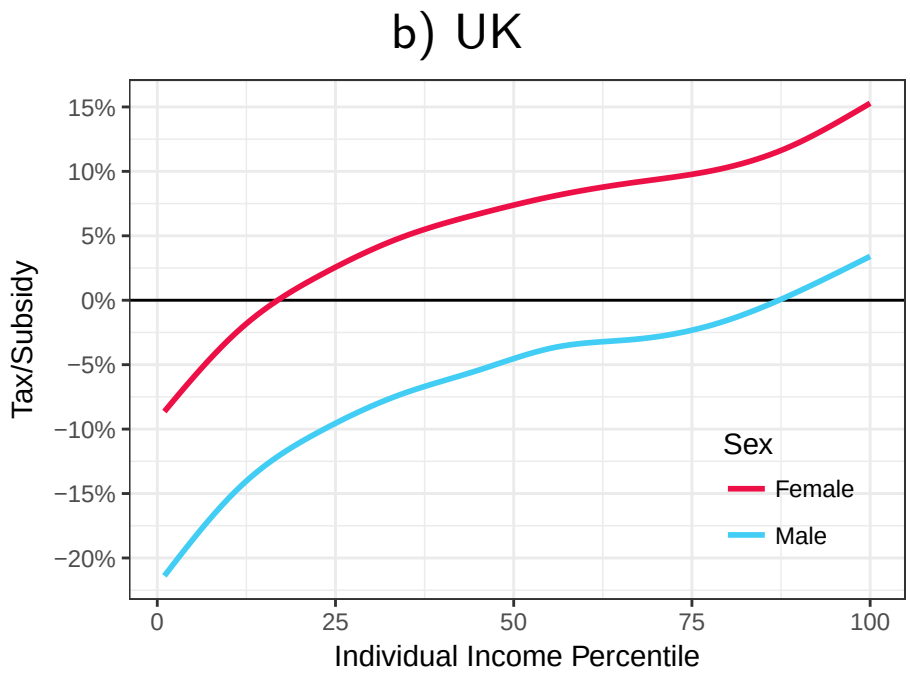
$\Rightarrow$ If the individual's life expectancy differs from the average mortality experience a tax or subsidy will arise:

$$t^k = \frac{\text{Actual liability}}{\text{Accumulated notional capital}} - 1 = \frac{PW^k_{x_r}}{AK^k(tc)} - 1$$

$$= \frac{LE^k}{LE^a} - 1$$

Tax and subsidy for US and England & Wales: t^k





Implications for scheme design and pension reform

If left un-addressed, heterogeneity in longevity will diminish much of the rationale for approach

- It eliminates the *direct link* between contributions and benefits and thus claimed fairness
- It **eliminates** the linear intertemporal budget constrains for individuals earning further away from average income and thus the neutrality of retirement decisions
- It introduces again implicit **redistributive** features and hence eliminates the neutrality of NDC where redistribution needs to be introduced explicitly
  - Taxes to deprived and subsidies to higher income households is (jointly) undesired.

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Explored design alternatives

- **0: Benchmark**: status-quo (non-individualized rates or annuities)
- **1: Individualized annuities**
- 2: Individual contribution rates (2 versions)
- **3: Two-tier contribution schemes with flat and individualized contribution rates**
- 4: Two-tier contribution scheme with caps on the contributions
- 5: Two-tier contribution scheme with individualized contribution rates to deal with lower tail

Starting Position and Benchmark (Design 0)

- We assess the redistribution of the system by defining a measure of aggregate tax/subsidy effects:

  Total Absolut Tax Subsidy Indicator (TATSI)
  = average of absolute values of tax and subsidy rates

- We assess the effect of gender by studying a joint and gender-specific pools:
  $\rightarrow$ To explore how much of TATSI for a country can be reduced by simply separating the risk pools

- Benchmark (Design 0): non-individualized rates or annuities

Individualized annuities (Design 1)

- Life expectancy as a function of income
  - To reduce the tax/subsidy distortion, we seek to model life expectancy using a simple function that policymakers can use
  - Depending on the data availability, the function links individual life expectancy to lifetime income, education, geographical location, etc.
  - Among the simple specifications we have:

$$\text{quadratic: } LE_i = a + b \cdot Y_i + c \cdot Y_i^2$$

$$\text{logarithmic: } LE_i = a + b \cdot \log(Y_i)$$

Calculation of the two-tier arrangement (Design 3)

Proposal: divide the total contribution *tc* into

- social contribution that yields average pension rights: *sc*
- contribution that yields individualized pension rights: *nc*

We calculate the split by minimising the squared differences between the individualized annuities (zero-subsidy) and the two-tier pension:

$$sc^* = tc \cdot \frac{\sum_{k \in I} \frac{Y^k}{LE^k} \left(LE^k - LE^a\right)\left(Y^k - Y^a\right)}{\sum_{k \in I} \left(Y^k - Y^a\right)^2}$$

Comparison between re-designs

England and Wales	Design 0: Status quo				Design 1: Individualized annuities				Design 3: Two-tier contributions			
	Joint pool		Separate pool		Joint pool		Separate pool		Joint pool		Separate pool	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Nominal tax/subsidy rate	6,0%	-6,0%	0,0%	0,0%	6,5%	-6,5%	0,0%	0,0%	3,4%	-2,5%	2,7%	-2,7%
Absolute tax/subsidy rate	7,3%	6,5%	4,3%	5,0%	7,4%	6,6%	0,9%	1,0%	3,5%	2,7%	3,2%	2,7%
	Total		Total		Total		Total		Total		Total	
Nominal tax/subsidy rate	0,0%		0,0%		0,0%		0,0%		0,9%		0,1%	
TATSI	**6,9%**		**4,6%**		**7,0%**		**0,9%**		**3,1%**		**3,0%**	

United States	Design 0: Status quo				Design 1: Individualized annuities				Design 3: Two-tier contributions			
	Joint pool		Separate pool		Joint pool		Separate pool		Joint pool		Separate pool	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Nominal tax/subsidy rate	7,1%	-7,1%	0,0%	0,0%	7,3%	-7,3%	0,0%	0,0%	27,1%	30,3%	20,0%	36,6%
Absolute tax/subsidy rate	8,0%	9,2%	4,7%	8,3%	7,4%	7,3%	2,1%	3,7%	28,1%	30,3%	20,0%	36,6%
	Total		Total		Total		Total		Total		Total	
Nominal tax/subsidy rate	0,0%		0,0%		0,0%		0,0%		57,5%		56,6%	
TATSI	**8,6%**		**6,5%**		**7,3%**		**2,9%**		**29,2%**		**28,3%**	

Conclusion

- Heterogeneity in longevity is multi-dimensional and with regard to life-time income likely to continue increasing
- Without addressing heterogeneity, DC type reforms may not move forward and cannot convincingly be argued (such as reducing the hard to measure tax wedge of NDB schemes)
- There are promising and operational policy options to reduce the tax/subsidy effects of heterogeneity
  - Risk pooling by gender would help but alone is not sufficient
  - Individualized annuities by individual life expectancy estimations promise to be effective without being too complex
  - A two-tier contribution scheme (for NDC) may go a long way, with some gender differentiation
  - Other elements can be added to the two-tier design, dealing in particular with the tails of the distribution

Next step for this research

- Explore empirically the full set of policy alternatives developed and presented, and develop new ones.
  In particular, deeper investigation of the tails of the distribution is required.
- Access or construct similar life expectancy/lifetime income data for other countries and improve on lifetime estimates, and the link to other heterogeneity characteristics, particularly education.
  This would improve the estimates and make them even more policy relevant.
- Empirically compare results across countries to better understand what may simply be a statistical issue or artifact, or whether issues exist that require policy interventions beyond heterogeneity.

Reference

Chetty, R., Stepner, M., Abraham, S., Lin, S., Scuderi, B., Turner, N., Bergeron, A., and Cutler, D. (2016), "The association between income and life expectancy in the United States, 2001-2014," *Jama*, 315, 1750–1766.

Mail: h.labithardy@unsw.edu.au

thank you!