MORTALITY ASSUMPTIONS LONGEVITY RISK

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Purpose: Policy questions

- How important longevity risk (LR) is or could be?
- What can be done: How to manage LR?
- OECD work there tries to assess longevity risk on pension funds and annuity providers in several OECD and non-OECD countries

Why LR is important?

- Many ways of defining longevity risk
  - For individuals LR is the risk of exhausting their own resources to finance retirement and fall into poverty
  - For pension funds, with a pension promise, and annuity providers (e.g. insurance companies) is the risk that future payments turn out higher than expected
- Focus on impact of LR on pension funds and annuity providers.
- LR can bankrupt them or lead them to insolvency: payment commitments can turn out to be much higher than what they planned and reserved for.

Why LR is important?

- Pension funds and annuity providers use mortality assumptions (age-specific probabilities of dying or surviving) to determine how much they can pay to pensioners or annuitants given their contributions and/or assets accumulated.
- Those mortality assumptions are about future probabilities of dying, which by definition are unknown or uncertain
- The deviation between those assumptions and the future realisations of those mortality rates could lead pension funds and annuity providers to bigger liabilities that provisioned for.

Structure of the project

1. Assess how important LR is

- Look at the mortality assumptions used by pension funds and annuity providers.
  - Mortality tables required by the pension and insurance regulators (regulatory tables)
  - The most common tables used by the industry, which can be different (more conservative) than those required by the regulatory framework
- Project future improvements in mortality and life expectancy using standard mortality projections models

Structure of the project

- Measuring the potential amount of LR by comparing the life expectancy and annuity premiums resulting from
  - using the mortality rates in the regulatory and market mortality tables
  - And the mortality rates of the mortality projection models as a proxy for the future
- Proxy for longevity risk: the difference between what is accounted or provision for and what it may turn out to be.

Structure of the presentation

2. Policy discussion on how to manage LR
   - Internal management
   - Policy options to develop capital market solutions
   - What are the market failures requiring government interventions
   - Reasons why governments should issue LIB (David Blake)

Regulatory and market practice mortality tables

- The regulatory framework requires in some countries that pension funds and/or annuity providers use specific mortality tables.
- These tables may or may not include future improvements in mortality
- In some countries (e.g. Canada, Netherlands and UK) there are not specific mortality tables required by the regulator. Yet, the regulatory framework establishes that the tables to be used should include improvements in mortality.

- The analysis shows that pension funds and annuity providers provision inadequately for future improvements in mortality.
- Mortality tables used by insurance companies account for future improvements in more countries than those used by pension funds.

Regulatory minimum mortality tables

- 8 out of 16 countries require minimum regulatory mortality tables with no difference btw annuity providers and pension funds, except for Japan and Mexico

Country	Annuity providers		Pension plans
Brazil	Yes		Yes
Canada	No		No
Chile	Yes		Yes
China	Yes		Yes
France	Yes		Yes
Germany	No		No
Israel	Yes		Yes
Japan	No		Yes
Korea	No		No
Mexico	Yes		No
Netherlands	No		No
Peru	Yes		Yes
Spain	No		No
Switzerland	No		No
United Kingdom	No		No
United States	Yes		Yes

Mortality improvements required by the regulatory framework

- Most countries do not require that pension funds and annuity providers account for future improvements in mortality. Half of the sixteen countries have no requirements, two additional countries have no requirement for one or the other. Six countries have requirements to account for improvements for both.

Country	Annuity providers		Pension plans
Brazil	No		No
Canada	Yes		Yes
Chile	Yes		Yes
China	No		No
France	Yes		Yes
Germany	No		No
Israel	Yes		Yes
Japan	No		No
Korea	No		No
Mexico	Yes		No
Netherlands	Yes		Yes
Peru	No		No
Spain	No		No
Switzerland	No		No
United Kingdom	Yes		Yes
United States	No		Yes

Market practice mortality tables

- The majority of countries provision in practice for improvements in mortality.
- Annuity providers (13 out of 16) do so more often than pension funds (10 out of 16).

Country	Annuity providers		Pension plans
Brazil	No		No
Canada	Yes		Yes
Chile	Yes		Yes
China	No		No
France	Yes		Yes
Germany	Yes		Yes
Israel	Yes		Yes
Japan	Yes		No
Korea	No		No
Mexico	Yes		No
Netherlands	Yes		Yes
Peru	Some		Some
Spain	Yes		Yes
Switzerland	Yes		Some
United Kingdom	Yes		Yes
United States	Yes		Yes

Are pension funds and annuity providers exposed to longevity risk?

- In practice, annuity providers and, to lesser extend, pension funds provision for future improvements in mortality (future improvements are taken into account when calculating liabilities and/or determining contributions, premiums and payments)
- Are they therefore free from longevity risk? Those who do not provision are not. Those who provision depend on whether their provisioning is enough.
- Do those that provision for future improvements provision or account fully for future improvements? Next step is to assess whether it is enough.

How do we go about assessing whether they are exposed to longevity risk?

- Regulatory and market practice tables entail a certain life expectancy and/or certain annuity premiums that are implicit therefore in the actuarial calculations of pension funds and annuity providers
- That life expectancy and annuity premiums may not be sufficient if future improvements may turn out higher than those provisioned for
- Using mortality projections models as a proxy of how future mortality may turn out, one could compare the life expectancy and annuity premiums that would result from using mortality projections models instead of the regulatory or market practice mortality tables.
- Any deviation is a proxy for the amount of longevity risk they may be exposed, which may increase their liabilities and even bankrupt them.

Projecting future improvements in mortality

- The projection methods implemented are:
  - The Lee-Carter (demographers, gov.)
  - The Cairns-Blake-Dowd (actuaries, LR managers
  - The P-Splines model
  - The Continuous Mortality Investigation (CMI) model (UK actuarial profession)
- Implemented using the R programming language via an Excel user interface (prepared for the OECD by A. Hunt, Cass Business School, D. Blake)

Projecting future improvements in mortality

- Data comes from HMD (Brazil and Mexico National Statistical Offices)
- There is not “best” or “correct” model to use. Every model has advantages (e.g. stochastic projections: LC, CBD; fit all ages) and limitations (e.g. deterministic projections, one time trend, “edge effects”)
- Use all of them to have a broader perspective of potential future improvement and control for model bias.

Summary

Model	Lee-Carter	Cairns-Blake-Dowd	P-Splines	CMI
Stochastic projections	Yes	Yes	No	No
Complex correlations	No	Yes	N/A	N/A
Good fit at all ages	Yes	No	Yes	Yes
Robust to changes in data range	Yes	Yes	No	Yes
Objective inputs	Yes	Yes	Yes	No

ASSESSING LONGEVITY RISK

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Assessing LR: Approach

- Measure LR by comparing life expectancy and annuity premiums resulting from using the mortality rates in the regulatory and commonly used mortality tables
- With life expectancy and annuity premiums resulting from stochastic modelling of future improvements in mortality and life expectancy (BCD, LC, Splines, CMI): proxy for the future.

Assessing LR: Problems

- Mortality rates from the mortality projections models are obtained by using the overall population.
- Mortality rates included in the regulatory and market practice mortality tables are generally for different population subgroups (e.g. lives, annuitants), generally high income groups with lower mortality rates.

Assessing LR: Solutions (?)

- Compare results with different populations. If regulatory and market mortality tables that use subpopulations with lower mortality still show lower future improvements in life expectancy and annuity premiums ➔LR, but cannot measure it.
- Apply mortality improvements obtained from mortality projections models to the base population used in the regulatory and market practice mortality tables.
- Implicit assumption: differences bwt those sub-populations groups and the overall population to remain constant.
- Advantage: possible to measure the amount of LR

Assessing LR: 1st approach

- Same base populations (Japan and Spain).
- Different base populations (annuitants and lives instead of overall population) but adjustments
  - France (professions)
  - UK (CMI lives)
  - USA
- Different base populations (Brazil, Canada, Chile, Germany, Switzerland)

Assessing LR: 1st approach

- Regulatory and market practice mortality tables fail to account fully for longevity risk.
- In several countries (Canada, Chile, Germany, Japan, Switzerland and the United States), the life expectancy at age 65 and the annuity factor seem to be lower when using the mortality rates embedded in the regulatory and market practice mortality tables than when using the mortality rates stemming from the mortality projection models.
- In a few countries (France, UK) the regulatory and market practice tables no LR

Importance longevity risk: 2nd approach

Classification	Definition	Pension Plans	Annuity Providers
Serious	>10%	**Brazil** (US 1983IAM), **China** (CL2000-2003), **Mexico** (EMSSA 1997), **Switzerland** (EVK2005)	**Brazil** (US Annuity 2000) , **China** (CL2000-2003)
Significant	5-10%	**Chile** (RV2009), **Japan** (EPI2005), **US** (RP2000-ScaleAA)	**Chile** (RV2009)
Moderate	2-5%	**Canada** (UP94-ScaleAA), **Spain** (PERM/F C 2000)	**Spain** (PERM/F C 2000) **US** (GAM94-ScaleAA)
Monitor	<2%; specific issues to address	**France** (TGH/F 2005), **Israel, Spain** (PERM/F P 2000) **Switzerland** (BVG 2010), **US** (RP2000-ScaleBB)	**Canada** (GAM94-CIA), **France** (TGH/F 2005), **Israel, Mexico** (EMSSA 2009), **Japan** (SMT 2007), **Spain** (PERM/F P 2000)
OK	little to no longevity risk as assessed here	**Netherlands** (AG-Prognosetael 2010), **UK** (PCMA/PCFA 2000-CMI)	**Germany** (DAV 2004 R), **Netherlands** (AG-Prognosetael 2010), **UK** (SAPS1-CMI)

POLICY OPTIONS TO ADDRESS LONGEVITY RISK

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Policy analysis: How to manage LR?

How to manage longevity risk?

- In house: actuarial valuation process
- Asset liability management
- Transfer LR to a third party: capital market solutions for LR

Potential role of government

- Reasons why governments should issue longevity-indexed bonds
- What are the market failures requiring government interventions?

Managing LR in house

- In house as part of internal risk management systems: retain risk and hold enough capital to withstand fluctuations. Actuarial valuation process. Hence
  - 1st step recognise its existence,
  - incorporate it in the actuarial valuation process,
  - use stochastic modelling,
  - update tables regularly and
  - allow for long enough periods.

Asset liability management (LDI)

- Asset liability management (LDI): link asset allocation strategies to liabilities so that returns can at least match liability streams.
- Bond-heavy allocation?
- Risk sharing via innovative products that link payments to changes in life expectancy so all stake holders share LR.

Capital market solutions for LR

- Existing arrangements to manage LR focus almost exclusively on transferring longevity risk from one party to another.
- It is reasonable to ask whether support should be given instead for instruments to hedge longevity risk.
- Distinction btw transferring all the LR or hedging (partially covering) the LR

Financial instruments to hedge LR

- Buy-outs (passing the entire scheme to a specialist insurer) and buy-outs (insuring the liabilities): Only for closed DB plans, not a general solution
- Longevity hedges
  - Forwards contracts (payments at maturity, no up-front disbursements): Q- and S-forwards
  - Longevity bonds (regular payments, coupons, up-front disbursement)
  - Longevity swaps (regular payments, no up-front disbursements)

Ranking of instruments for hedging LR

- Forward contracts & longevity swaps relatively more attractive than longevity bonds because they do not require upfront funding
- Longevity swaps more useful than forward contracts in managing LR as they provide for regular payments, compared with only a single payment at maturity for forward contracts; and

Ranking of instruments for hedging LR

- Longevity swaps based on survival rates are more attractive than similar contracts based on mortality rates because the former are more closely linked to the actual longevity experience of pension funds and insurers

Misalignment of incentives

- Longevity hedges can be:
  - Individualised (bespoke longevity hedges)
  - Standardised (indexed-based hedges)
- Misalignment of incentives between pension funds and annuity providers on the one side and private investors on the other.

Requirements development capital market solutions for managing LR

- Legislation and regulation
- Market capacity and structure
- Standardisation, liquidity and transparency

Legislation and regulation

- In some countries, legislation may (dis)-encourage the use of longevity hedges by affecting the requirements for capital reserving
- Accounting rules and standards in different countries may (not) allow for adequate valuation of longevity hedging instruments

Market capacity and structure

- There are big questions about how to increase the capacity of the market for longevity hedging products: there are not natural hedgers
- It is suggested that insurance companies and reinsurers could act as intermediaries between pension funds and private investors by bundling individualised hedges and selling standardised hedges to private investors and thus taking on board the basis risk

Questions on standardisation …

- How standardisation, liquidity and transparency could be achieved in the market for longevity hedging instruments?
- Are there other viable alternatives to the issuance of longevity indexed bonds by governments for the purpose of providing publicly available reference points for pricing longevity risk?

Role governments in encouraging …

- Regulate mortality and life tables to include stochastic forecasts of future improvements in mortality and life expectancy.
- Government could encourage the development of a market for longevity hedging products by developing a reliable longevity index.
- Countries small liabilities from PAYG, gov. should consider issuing longevity-indexed bonds.

Other policy issues to address

- What are the market failures requiring government interventions?
  - No price to clear markets
  - Misalignment of incentives
  - Maturity mismatch
- Why governments should issue longevity-indexed bonds?
  - Systematic (cohort, aggregate) LR

Conclusions

- Longevity risk is important for pension funds and annuity providers because inappropriate provisioning for future improvements in mortality can lead them to insolvency and bankruptcy
- Despite of the use of mortality tables that incorporate improvements, LR is still a serious and large problem for pension funds and annuity providers in most countries.
- There are valuable approaches to manage LR. The best is a combination: internal, hedges, and LIBs

THANK YOU VERY MUCH

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