MORTALITY ASSUMPTIONS AND LONGEVITY RISK

Challenges in assessing expected longevity risk

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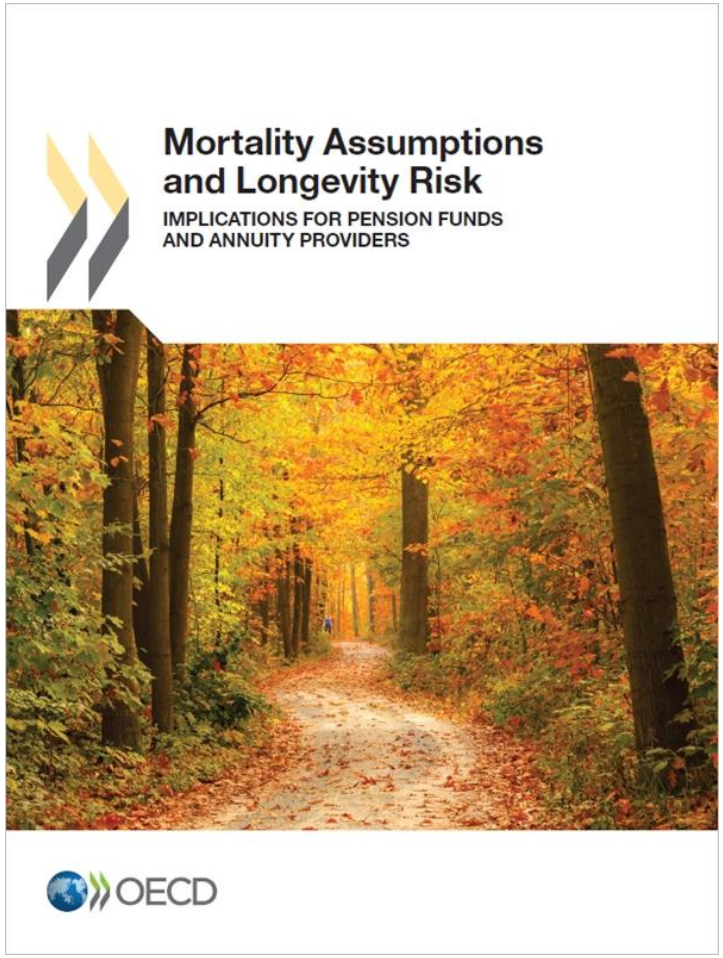

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Today's plan

- Assumptions and challenges in assessing the adequacy of mortality tables
- Chile's case – the update of the 2009 mortality tables
- Policy implications to address expected longevity risk

Key Distinctions in Definitions

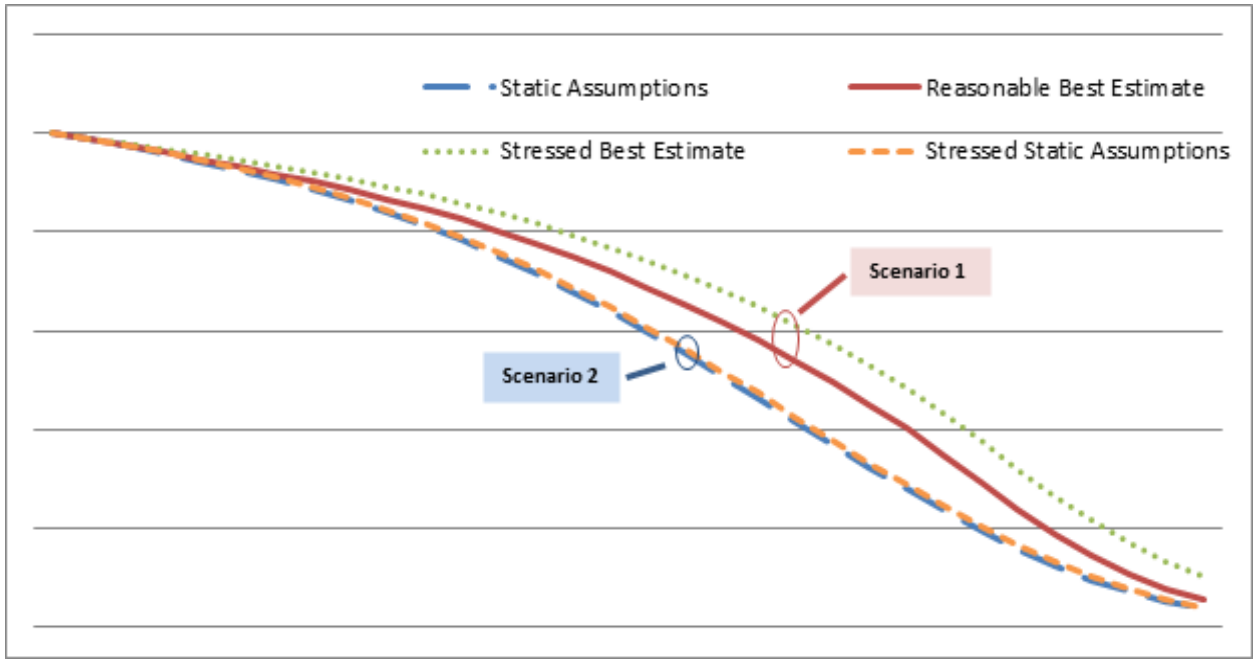
- Mortality Assumptions
  - The ***level*** of mortality today
  - The ***improvement*** in mortality tomorrow

- Longevity Risk
  - Expected risk
    - The extent to which **mortality assumptions are in line with expectations** to address expected improvements in life expectancy
  - Unexpected risk
    - The **impact of additional unexpected increases** in life expectancy

Longevity risk

- Must first have a reasonable estimation of expected pension/annuity liabilities to be able to assess the impact of unexpected increases in longevity to decide how much risk to retain or mitigate
  - The financial impact of a 25% decrease in mortality will not be the same if assumptions include no improvements (Scenario 2)

Future pension payments using different mortality assumptions



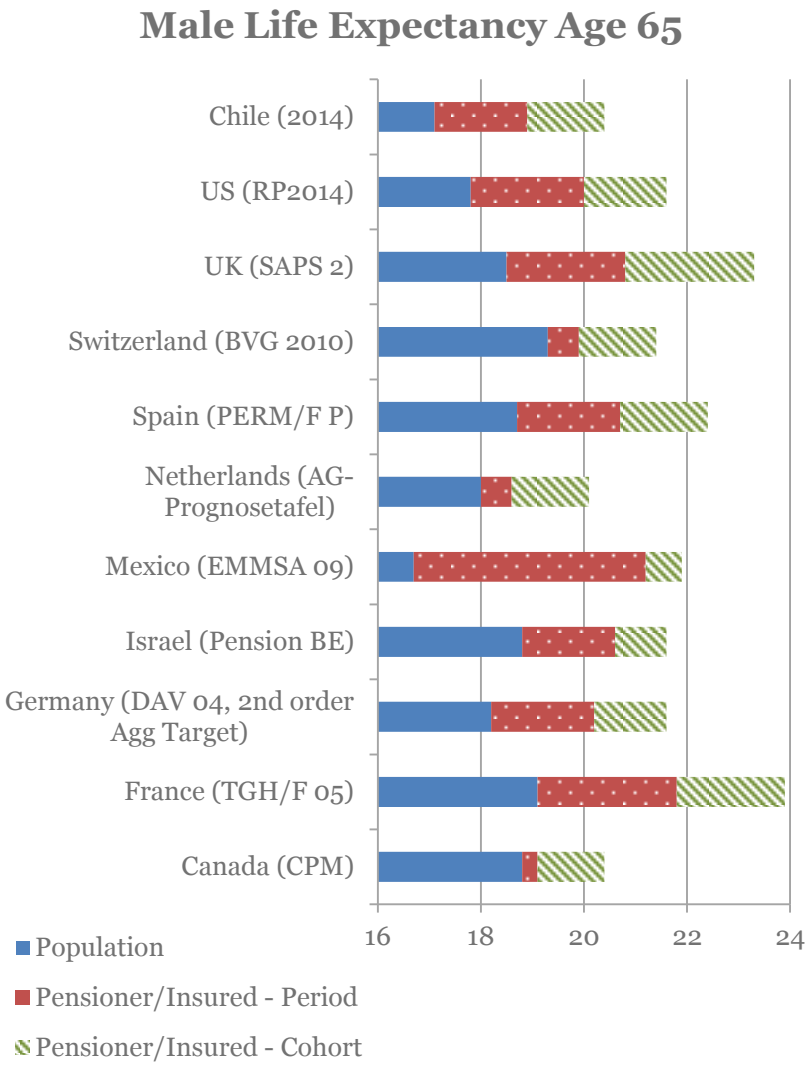
Expected longevity risk of standard mortality tables

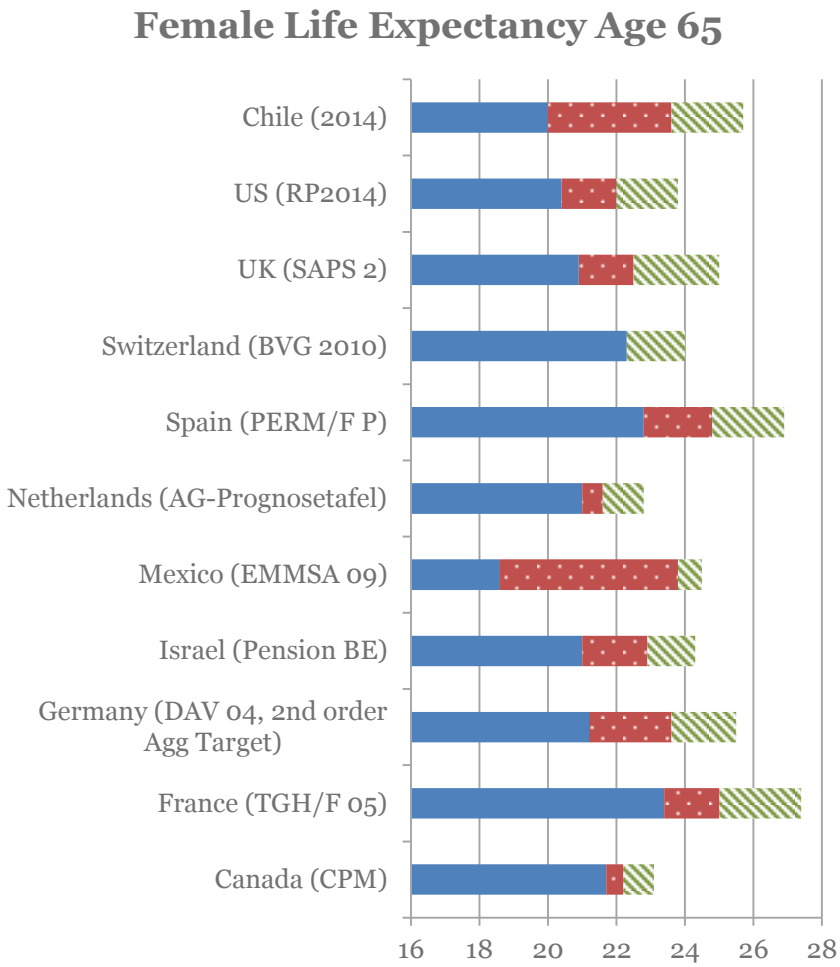
Classification	Expected Longevity Risk	Pension Plans	Annuity Providers
Serious	10-20%	**Brazil** (US 1983IAM), **China** (CL2000-2003), **Switzerland** (EVK2005)	**Brazil** (US Annuity 2000), **China** (CL2000-2003)
Significant	5-10%	**Canada** (UP94-ScaleAA), **Japan** (EPI2005), **US** (RP2000-ScaleAA)	
Moderate	2-5%	**Chile** (RV2009), **Spain** (PERM/F C 2000)	**Brazil** (BR-EMS 2010), **Canada** (GAM94-CIA), **Chile** (RV2009), **Spain** (PERM/F C 2000) **US** (GAM94-ScaleAA)
Monitor	<2%; specific issues to address	**Canada** (CPM), **France** (TGH/F 2005), **Israel**, **Mexico** (EMSSA 1997), **Spain** (PERM/F P 2000) **Switzerland** (BVG 2010, VZ 2010), **US** (RP2000-ScaleBB)	**France** (TGH/F 2005), **Israel**, **Mexico** (EMSSA 2009), **Japan** (SMT 2007), **Spain** (PERM/F P 2000)
OK	little to no expected shortfall	**Netherlands** (AG-Prognosetael 2010), **UK** (SAPS1-CMI), **UK** (SAPS2-CMI), **US** (RP2014-MP2014)	**Germany** (DAV 2004 R), **Netherlands** (AG-Prognosetael 2010), **Switzerland** (ERM/F 2000), **UK** (PCMA/PCFA 2000-CMI)

Approach to quantify the expected longevity risk of standard mortality tables

- **Metric**: compare annuity values based on assumed and projected mortality
  - Expected differences in the current provisioning needed to meet future payments
- **Forming expectations**: quantitative outputs and qualitative judgement
  - Projection models
    - Lee Carter, Cairns-Blake-Dowd, P-spline and CMI models
  - Model Calibration
    - General population mortality
  - Adjustment of outputs
    - Mortality differences relating to socio-economic factors
    - Level of differences depend on structure and coverage of pension system

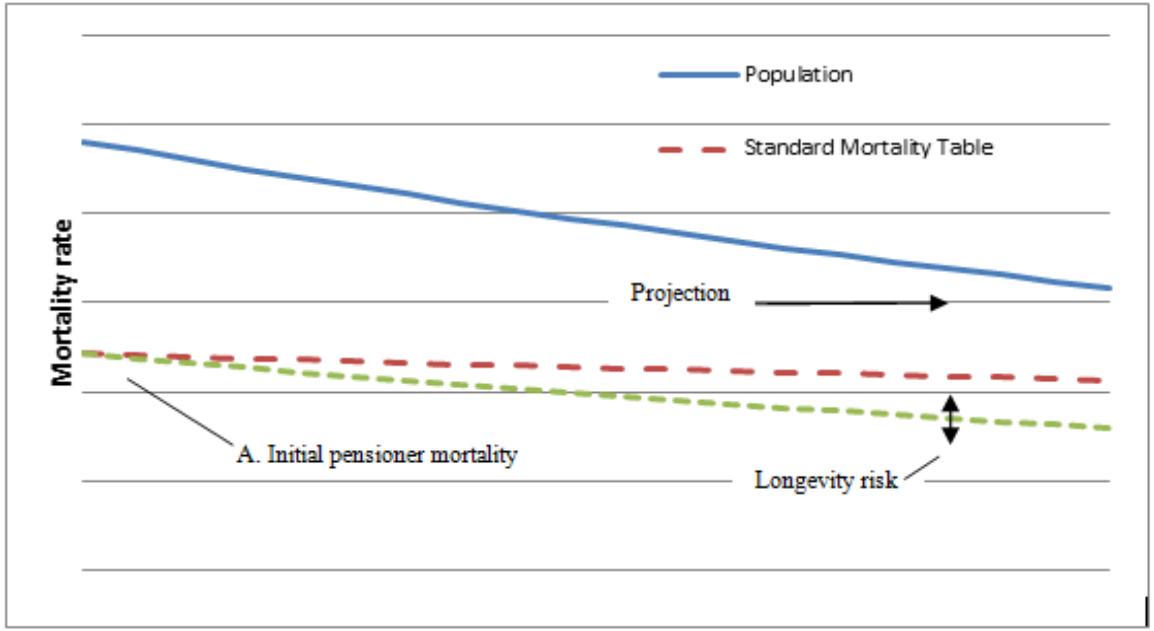
Population vs. pensioner/insured mortality





Adjusting model outputs

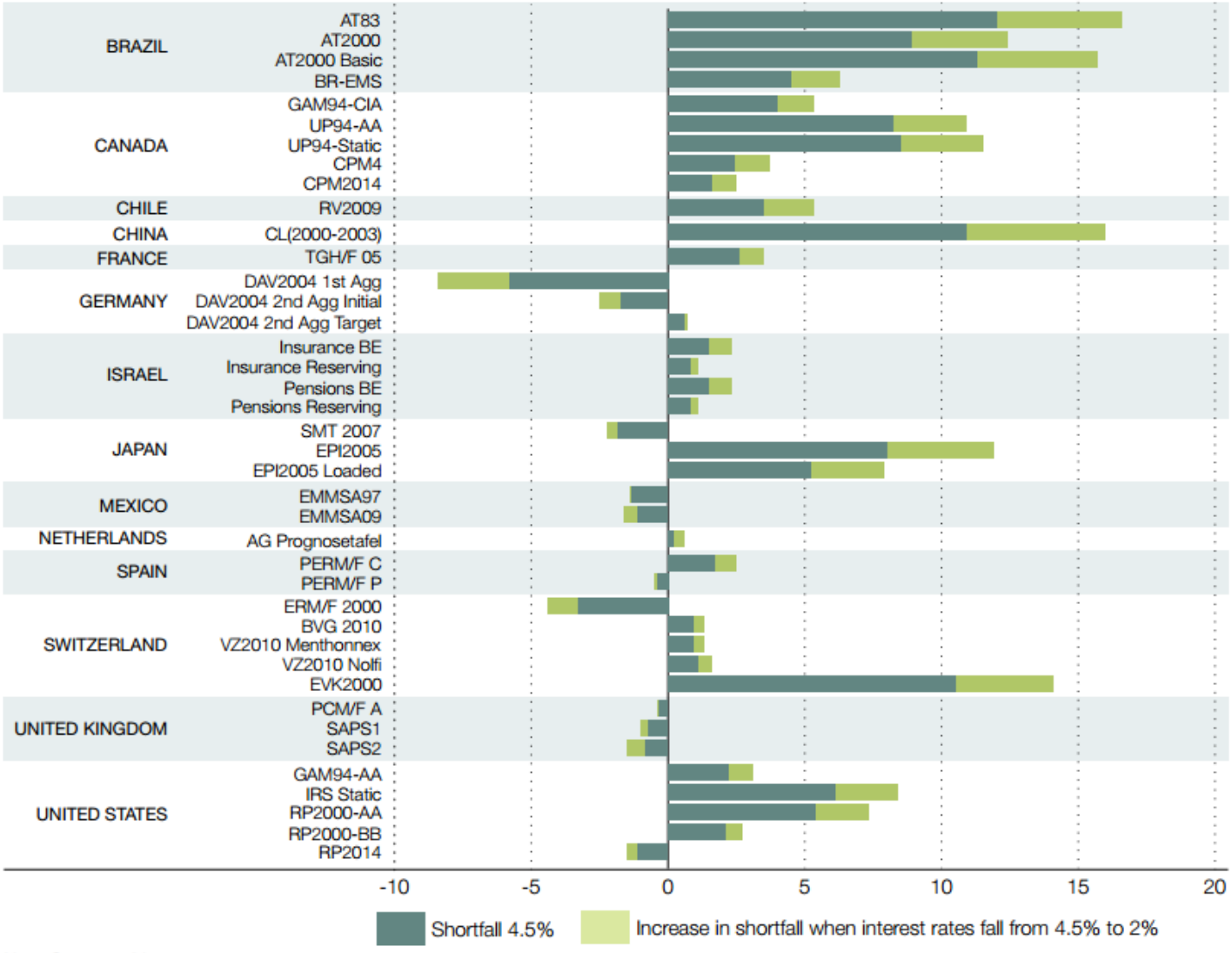
- **Comparability of metrics**: need to adjust for differences of populations
  - Starting at the same place
    - Assume mortality experience used to create the standard table was an accurate representation of the pensioner/annuitant mortality
  - Evolving in the same way
    - Assume the same proportional decrease in the mortality of both populations



Challenges to key assumptions for the quantification

- Initial level set by the mortality table is correct
  - Can be based on another country's population
  - Can incorporate subjective adjustments
- Historical data appropriate for the calibration of models
  - Limited time series
- Mortality improvements of pensioners/insureds will follow that of the general population
  - Evidence that improvements differ by socio-economic level
- Assumed discount rate
  - Lower discount rates increase the cost of longevity risk

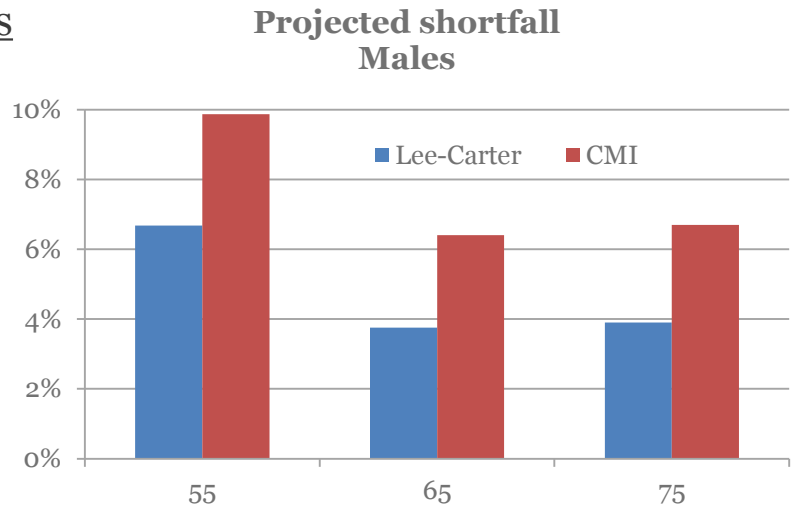
Lower interest rates increase exposure to longevity risk



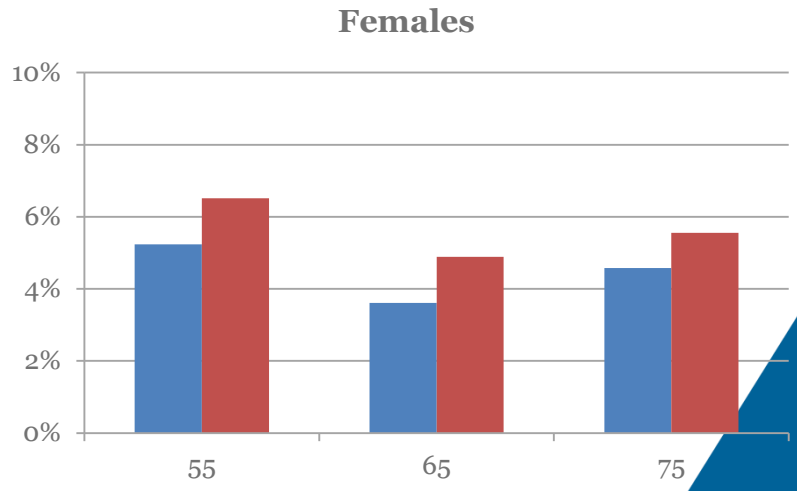
Assessment of Chilean RV 2009 Mortality Table

Historical and projected annual mortality improvements

Males	Chilean Population						Table
Age/Decade	***62/52***	***72/62***	***82/72***	***92/82***	***02/92***	***12/02***	***RV 2009***
40-44	0.2%	1.5%	3.8%	4.3%	2.4%	1.9%	0.7%
45-49	0.3%	1.0%	3.1%	4.7%	2.4%	1.7%	0.7%
50-54	0.2%	0.8%	2.7%	4.2%	2.3%	1.8%	0.7%
55-59	0.2%	0.6%	2.1%	3.6%	2.2%	2.4%	0.7%
60-64	0.2%	0.9%	2.1%	2.5%	2.2%	2.9%	0.7%
65-69	0.4%	1.0%	1.7%	2.2%	1.6%	1.9%	0.7%
70-74	0.8%	0.7%	0.9%	1.8%	0.7%	3.1%	0.7%
75-79	1.1%	0.5%	0.4%	1.4%	1.8%	1.6%	0.6%



Females	Chilean Population						Table
Age/Decade	***62/52***	***72/62***	***82/72***	***92/82***	***02/92***	***12/02***	***RV 2009***
40-44	2.3%	2.4%	5.7%	3.3%	3.5%	0.6%	0.7%
45-49	2.2%	2.3%	5.1%	2.0%	3.1%	2.2%	0.7%
50-54	1.9%	1.3%	4.1%	2.5%	3.1%	2.3%	0.7%
55-59	1.2%	1.3%	3.6%	2.4%	3.1%	1.7%	0.7%
60-64	0.6%	1.5%	3.7%	1.7%	2.6%	1.9%	0.7%
65-69	0.6%	1.4%	3.2%	1.5%	3.0%	1.4%	0.7%
70-74	0.7%	1.1%	2.2%	2.1%	1.8%	2.4%	0.7%
75-79	1.1%	0.6%	1.1%	2.7%	2.3%	1.5%	0.6%



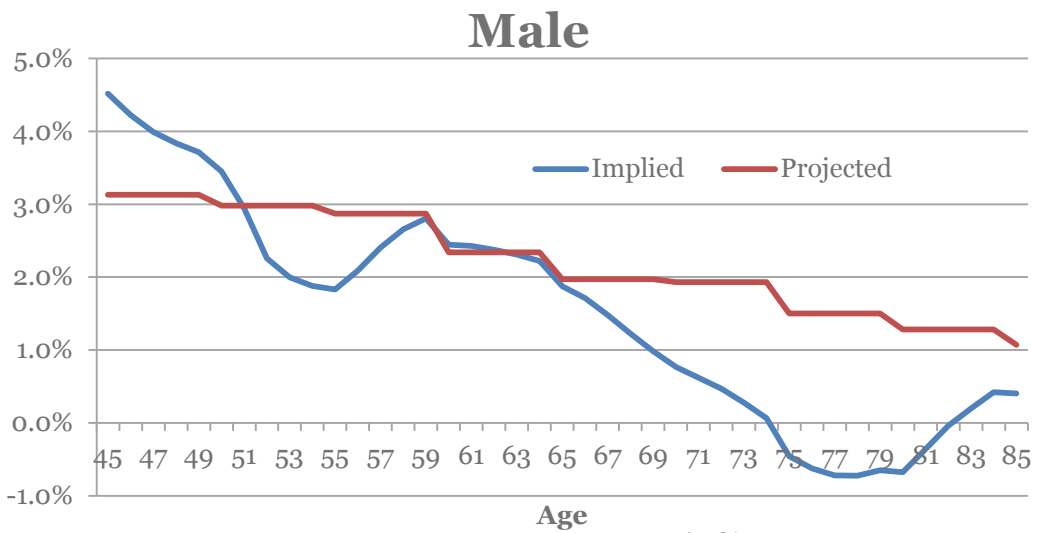
Objective of the 2014 update of Chilean mortality tables

- Update level of mortality based on most recent experience for pensioners, beneficiaries and the disabled
- Incorporate mortality improvement assumptions which are more realistic given recent population experience
- Dual purpose of mortality tables
  - Calculate insurance reserves for annuities
  - Calculate maximum allowed programmed withdrawal for pensioners

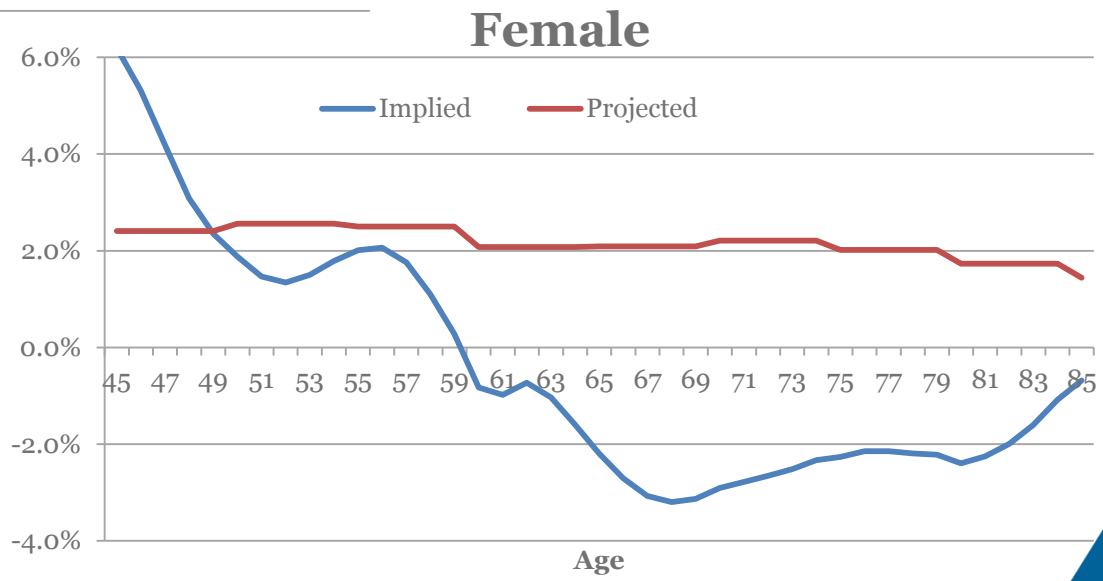
Chile: industry challenges to the calibration of mortality improvement

- Pensioner mortality has improved at a much lower rate than the population
  - Pensioners have experienced much lower mortality improvements on average
- High improvement assumptions would unfairly impact the pensioners
  - Impact on the maximum allowed withdrawal and annuity prices
- Disabled population does not experience any mortality improvement
  - Mortality has increased significantly over last several years

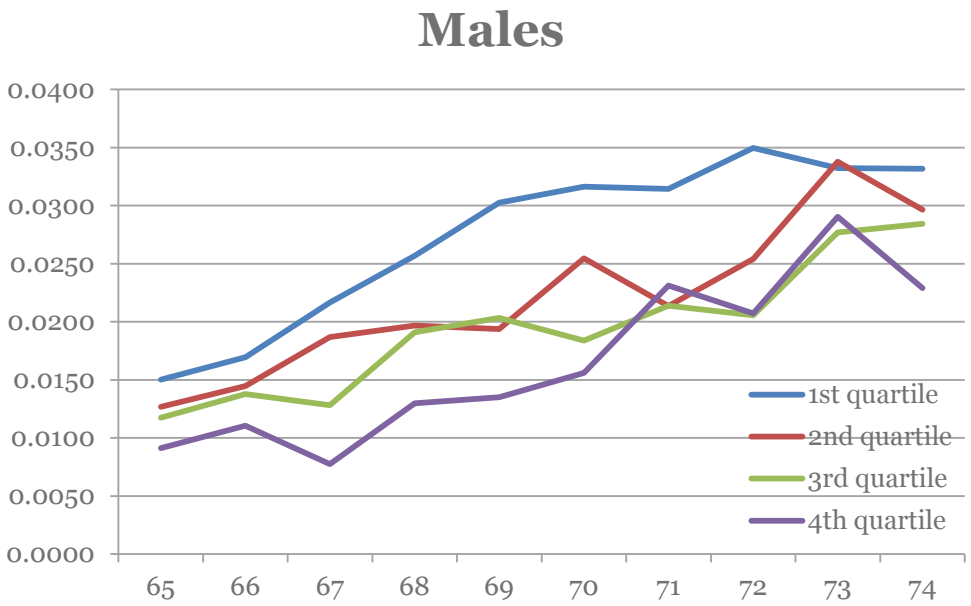
Chile: implied and projected mortality improvements



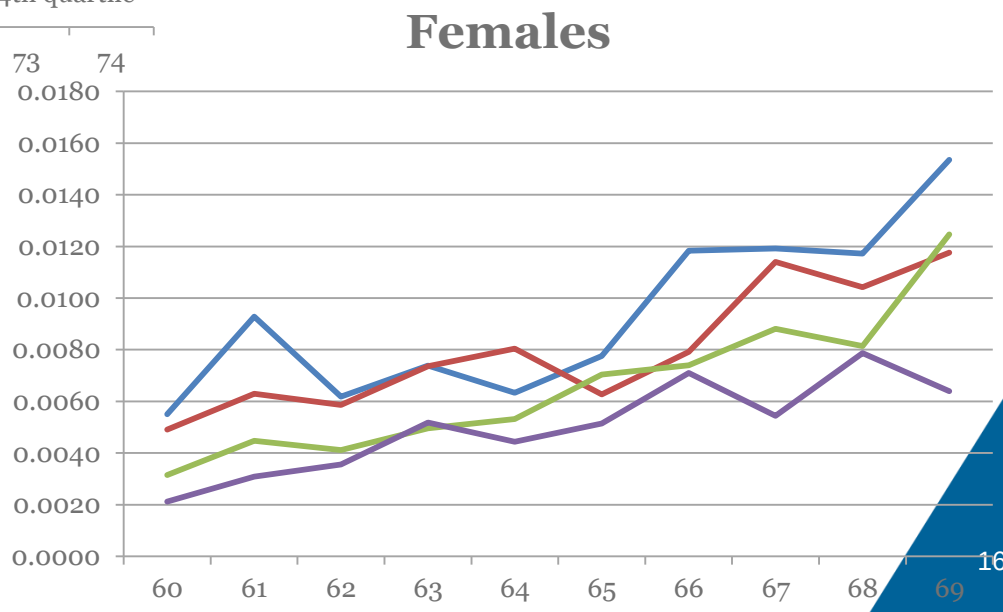
- Improvements implied by the revision of the mortality tables from 2009 to 2014
- Projected improvements based on Lee-Carter model calibrated on 30 years of population data



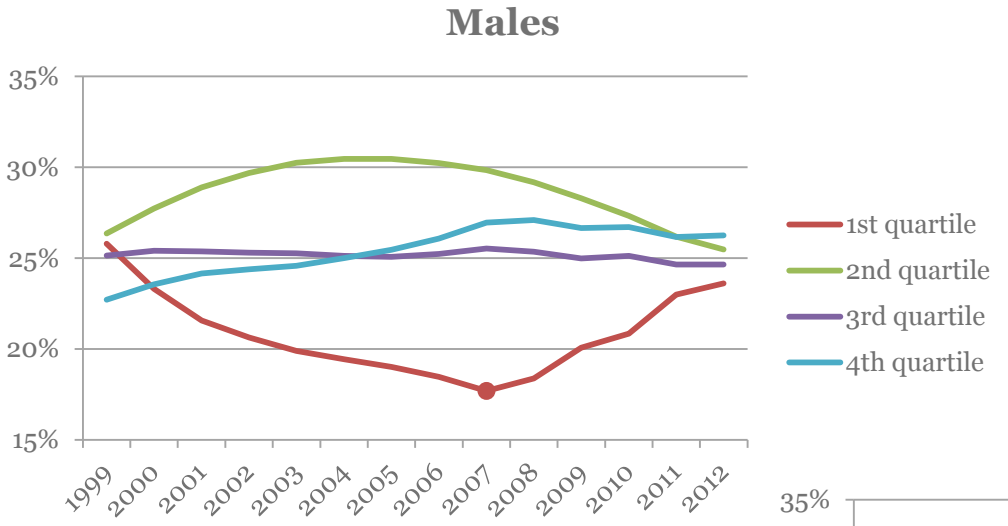
Chile: pensioner mortality by income quartile, 2010



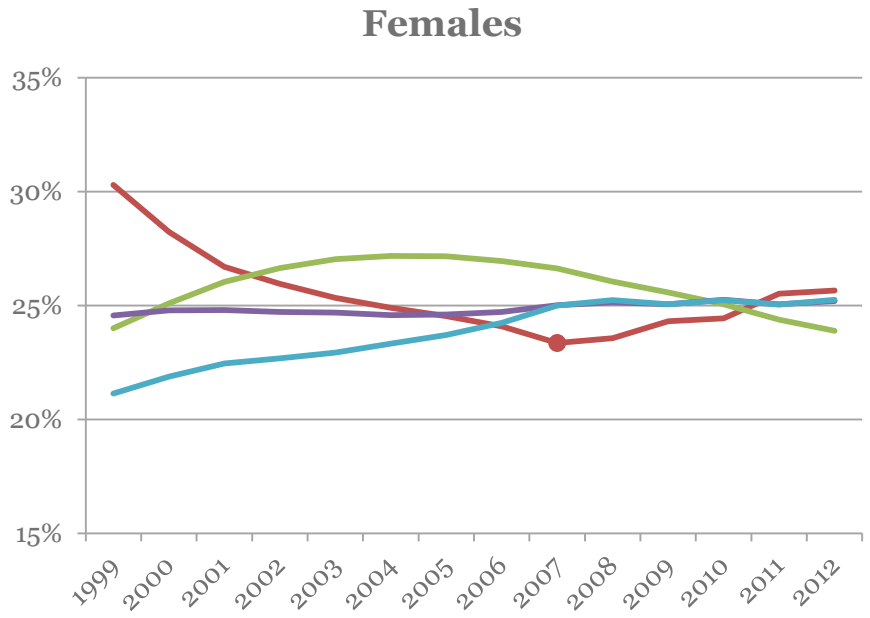
- Large differences between first and last quartiles



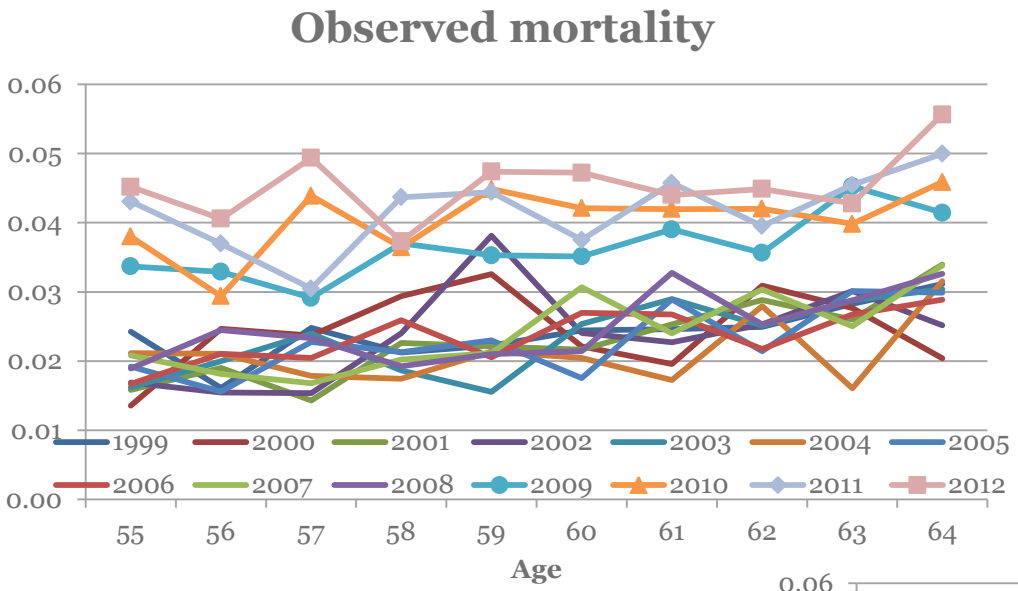
Chile: change in socio-economic mix of pensioners



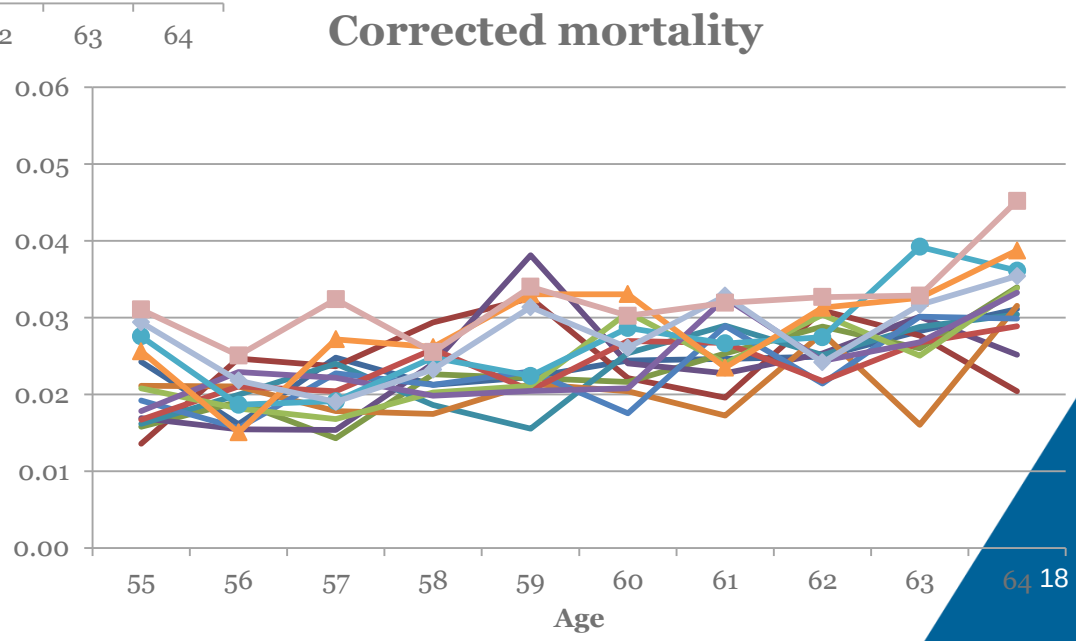
- 2008 pension reform increased coverage for lower income individuals
- Increased coverage for lower income individuals increased overall mortality for pensioners
- Implied mortality improvements of pensioner population understated



Chile: mortality of disabled men



- 2008 pension reform also removed the 3 year waiting period to qualify for permanent disability
- Disabled mortality significantly increased as a result



Chile: responses to industry challenges to the calibration of mortality improvement

- Pensioner mortality has improved at a much lower rate than the population
  - This was due to the increased coverage for lower income individuals
- Disabled population does not experience any mortality improvement
  - This was due to a change in the definition of disability
- High improvement assumptions would unfairly impact the pensioners
  - Should mortality improvements based on the population still be used going forward?

Chile: Lessons on the communication of longevity

- Life expectancy
  - Chileans cannot have a higher life expectancy than Japanese females!
    - Period vs. cohort life expectancy
    - Population vs. pensioner life expectancy
- Ultimate age
  - No one has a life expectancy of 110!
    - Maximal vs. average survival

Summary of Policy Implications

Expected risk

1. The regulatory framework should ensure that pension funds and annuity providers use **appropriate mortality tables** to account and provision for expected future improvements by **establishing clear guidelines** for the development of mortality tables used for reserving for annuity and pension liabilities.

2. Governments should **facilitate the measurement of mortality** for the purposes of assumption setting and the evaluation of basis risk of index-based hedging instruments.

Unexpected risk

3. The regulatory framework should **provide incentives for the management and mitigation of longevity risk**.

4. Governments **should encourage the development of a market for instruments to hedge longevity**, particularly index-based instruments, **by facilitating transparency and standardization of longevity hedges** in order to ensure the capacity for pension plans and annuity providers to continue to provide longevity protection to individuals.

1) Establishing guidelines for mortality tables

- Tables should account for the expected **future improvements** in mortality
  - Analysis showed that tables which do not account for improvement risk having a shortfall of provisions of over 10%
  - For countries assessed, accounting for mortality improvements add 2-2.5 years of life expectancy at age 65 on average
- Tables should be **regularly updated**
  - This will ensure tables are in line with recent mortality experience and limit the impact of reserve increases
- Tables should be based on the **relevant population**
  - Life expectancy and pensioner/annuitant mortality can vary significantly from one country to the next and across various sub-groups of the population

2) Facilitating the measurement of mortality

- **Accurate and timely mortality data** should be available
  - Could be used to inform mortality assumptions and keep them up-to-date
- Mortality data should be provided with a **socio-economic** indicator
  - Level of education and income is significantly correlated with life expectancy
- Implications for linking pensionable age to life expectancy…

THANK YOU!

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