MORTALITY ASSUMPTIONS AND LONGEVITY RISK

Challenges in assessing expected longevity risk

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Longevity 11, Lyon
8 September 2015
Contents

1. Mortality assumptions used by pension funds and annuity providers
2. Overview of countries’ mortality tables
3. Trends in life expectancy and mortality improvements: Implications for pension funds and annuity providers
4. Measuring and modelling mortality and life expectancy: Methods and limitations
5. Assessment of the potential longevity risk in the standard mortality tables
6. Policy options for managing longevity risk
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

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

**Male Life Expectancy Age 65**
- Chile (2014)
- US (RP2014)
- UK (SAPS 2)
- Switzerland (BVG 2010)
- Spain (PERM/F P)
- Netherlands (AG-Prognosetafel)
- Mexico (EMMSA 09)
- Israel (Pension BE)
- Germany (DAV 04, 2nd order Agg Target)
- France (TGH/F 05)
- Canada (CPM)

**Female Life Expectancy Age 65**
- Chile (2014)
- US (RP2014)
- UK (SAPS 2)
- Switzerland (BVG 2010)
- Spain (PERM/F P)
- Netherlands (AG-Prognosetafel)
- Mexico (EMMSA 09)
- Israel (Pension BE)
- Germany (DAV 04, 2nd order Agg Target)
- France (TGH/F 05)
- Canada (CPM)
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

<table>
<thead>
<tr>
<th>Country</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>AT.83, AT.2000, AT.2000 Basic, BR-EMS</td>
</tr>
<tr>
<td>Canada</td>
<td>GAM94-CIA, UP94-AA, UP94-Static, CPM4, CPM2014</td>
</tr>
<tr>
<td>Chile</td>
<td>RV2009</td>
</tr>
<tr>
<td>France</td>
<td>TG/HF 05</td>
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<tr>
<td>Germany</td>
<td>DAV2004 1st Agg, DAV2004 2nd Agg Initial, DAV2004 2nd Agg Target</td>
</tr>
<tr>
<td>Israel</td>
<td>Insurance BE, Insurance Reserving, Pensions BE, Pensions Reserving</td>
</tr>
<tr>
<td>Japan</td>
<td>SMT 2007, EPI2005, EPI2005 Loaded</td>
</tr>
<tr>
<td>Mexico</td>
<td>EMMSA67, EMMSA09</td>
</tr>
<tr>
<td>Netherlands</td>
<td>AG PrognoStafet</td>
</tr>
<tr>
<td>Spain</td>
<td>PERW/F C, PERW/F P</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>PCM/F A, SAPS1, SAPS2</td>
</tr>
</tbody>
</table>
Assessment of Chilean RV 2009 Mortality Table

**Historical and projected annual mortality improvements**

<table>
<thead>
<tr>
<th>Males</th>
<th>Chilean Population</th>
<th>Table</th>
<th>RV 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/Decade</td>
<td>62/52</td>
<td>72/62</td>
<td>82/72</td>
</tr>
<tr>
<td>40-44</td>
<td>0.2%</td>
<td>1.5%</td>
<td>3.8%</td>
</tr>
<tr>
<td>45-49</td>
<td>0.3%</td>
<td>1.0%</td>
<td>3.1%</td>
</tr>
<tr>
<td>50-54</td>
<td>0.2%</td>
<td>0.8%</td>
<td>2.7%</td>
</tr>
<tr>
<td>55-59</td>
<td>0.2%</td>
<td>0.6%</td>
<td>2.1%</td>
</tr>
<tr>
<td>60-64</td>
<td>0.2%</td>
<td>0.9%</td>
<td>2.1%</td>
</tr>
<tr>
<td>65-69</td>
<td>0.4%</td>
<td>1.0%</td>
<td>1.7%</td>
</tr>
<tr>
<td>70-74</td>
<td>0.8%</td>
<td>0.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>75-79</td>
<td>1.1%</td>
<td>0.5%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Females</th>
<th>Chilean Population</th>
<th>Table</th>
<th>RV 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/Decade</td>
<td>62/52</td>
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<td>82/72</td>
</tr>
<tr>
<td>40-44</td>
<td>2.3%</td>
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<td>5.7%</td>
</tr>
<tr>
<td>45-49</td>
<td>2.2%</td>
<td>2.3%</td>
<td>5.1%</td>
</tr>
<tr>
<td>50-54</td>
<td>1.9%</td>
<td>1.3%</td>
<td>4.1%</td>
</tr>
<tr>
<td>55-59</td>
<td>1.2%</td>
<td>1.3%</td>
<td>3.6%</td>
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<tr>
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<td>3.2%</td>
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<tr>
<td>70-74</td>
<td>0.7%</td>
<td>1.1%</td>
<td>2.2%</td>
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<tr>
<td>75-79</td>
<td>1.1%</td>
<td>0.6%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>
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
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

**Males**

**Females**
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

### Males

- 1st quartile
- 2nd quartile
- 3rd quartile
- 4th quartile

### Females

- 1st quartile
- 2nd quartile
- 3rd quartile
- 4th quartile
2008 pension reform also removed the 3 year waiting period to qualify for permanent disability

Disabled mortality significantly increased as a result
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?
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
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.

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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