Die young or live long: Modelling subjective survival probabilities
How long will you live?

Living longer is something we all desire. And with health technology constantly improving, the fantasy of living longer lives is quickly becoming a reality. Check out the graphic below that illustrates our life expectancy and how technology will help us live longer than ever before.

Global life expectancy has increased substantially in the past 40 years for men and women.

- Life expectancy for men has increased 11 years since 1970.
- Life expectancy for women has increased 12 years since 1970.
Outline

1. Introduction
2. Survey data
3. Econometric testing and model
4. Annuity and consumption decisions
5. Conclusion
Subjective life expectancy is informative and influential.

- Critical to life cycle planning:
  - Agents shift resources to times when survival is most likely
  - Survival prospects affect insurance decisions (Gan et al., 2004)
  - Need complete set of survival expectations (Gan, Hurd and McFadden, 2005)

- Difficult to observe
  - Model individuals as constant re-scalings of population survival curves

- Useful to explain behaviour
  - Insurance/annuitisation decisions
  - Low retirement savings
  - Conservative spending pattern in retirement.
We collect comprehensive survival expectations

Sample 920 individuals; 50-72 years; target ages 75-105

Compare with population survival curves
- Individuals underestimate survival to near ages and overestimate survival at old ages
- Underestimate overall life expectancy
- Women more pessimistic than men
- Younger more pessimistic than older

Constant re-scalings of population curves do not fit
Changes to standard life-cycle model

Pessimism followed by optimism explains early high spending and slow old age decumulation

Younger cohort pessimism can explain:
- Under-saving
- Low annuitisation
- Disliking deferred annuities
Survey data
Dataset contains survival probabilities to 7+ target ages.

- Retirement Plans and Retirement Incomes: (May 2011).
- Original:
  - 920 respondents;
  - Aged between 50 and 72;
  - 10 target ages (TA): 75, 80, ..., 105, 110, 120, 120+. 
- Modification:
  1) Eliminate respondents with increasing probabilities: 
     \[ \text{Pr}(X > A) < \text{Pr}(X > A + 5) \]; 
  2) Only use data up to target age 105.
     Keep 855 respondents, 7 target ages.
- Survey design -> no focal points (unlike HRS, see next slide).
Typical SSP:
- to one target age
- for several waves.

Our data SSP:
- to seven target ages
- for one wave
- ‘live to’ frame

<table>
<thead>
<tr>
<th>Table 1 Probability table</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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<td>5</td>
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<td>6</td>
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<td>7</td>
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<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>
We can fill along the row of the survival matrix.

- Subjective survival probability matrix:
  - Red: observed; Black: calibrated

- With one observation -> calibration -> assumption:
  - Subjectivity (rescaling) factor is independent of target age.

- Assumption is invalid.

<table>
<thead>
<tr>
<th>Age\Target Ages</th>
<th>75</th>
<th>80</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>15_{60}</td>
<td>20_{60}</td>
<td>25_{60}</td>
</tr>
<tr>
<td>65</td>
<td>10_{65}</td>
<td>15_{65}</td>
<td>20_{65}</td>
</tr>
<tr>
<td>70</td>
<td>5_{70}</td>
<td>10_{70}</td>
<td>15_{70}</td>
</tr>
</tbody>
</table>
Testing
Parametric test compares life expectancy with target age probabilities.

\[ \tilde{q}_x = \tilde{c} \times q_x \]

- \( \tilde{c} \) larger than 1 \( \Rightarrow \) pessimism
- \( \tilde{c} \) smaller than 1 \( \Rightarrow \) optimism

Assumes:
- Scaling depends only on individual
- Scaling does not change with target age

Calibrate \( \tilde{c} \) using
- subjective life expectancy (SLE)
- sub. survival probabilities to different target ages (SSP)

H0: SLE and SSP are consistent
Consistency between SLE and SSP is rejected.

Rate of consistency between SLE and SSP:

<table>
<thead>
<tr>
<th>Consistency between scaling factors of SLE and SSP to target age</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
</tr>
<tr>
<td>Coincidence</td>
</tr>
</tbody>
</table>

- Life expectancy and SSP scalings not consistent
- SSP scaling factors not consistent with each other
  - Scaling factor is NOT independent of target age
Parametric models

Estimate models of individual (log) scaling factors:
- Linear form for Age:
  - Pooled OLS (with target age)
  - Panel with fixed target age effects
  - Panel with fixed target age and random cross section effects
- Cubic form for the effect of Age & Target Age
  - Panel with random cross section effects

Estimate models of cohort average (log) scaling factors:
- Cubic form for the effect of Age & Target Age
  - Weighted least squares, Gender-specific

- All models include control variables.
- Main interest: effect of Target Age
Covariate effects in regression of individual subjectivity Factors

<table>
<thead>
<tr>
<th>Log Subjectivity Factor (Pessimism)</th>
<th>Coefficient Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.022</td>
</tr>
<tr>
<td>Married</td>
<td>0.078</td>
</tr>
<tr>
<td><strong>Socioeconomic Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>-0.024</td>
</tr>
<tr>
<td>Income</td>
<td>-0.002***</td>
</tr>
<tr>
<td>Wealth</td>
<td>0.000</td>
</tr>
<tr>
<td>Graduate</td>
<td>0.015</td>
</tr>
<tr>
<td>Vocational</td>
<td>-0.009</td>
</tr>
<tr>
<td><strong>Health Information</strong></td>
<td></td>
</tr>
<tr>
<td>Mobility Problem</td>
<td>0.080*</td>
</tr>
<tr>
<td>Anxiety/Depression</td>
<td>0.400***</td>
</tr>
<tr>
<td>Pain/Discomfort</td>
<td>0.068*</td>
</tr>
<tr>
<td>Usual Activity Problem</td>
<td>0.457***</td>
</tr>
</tbody>
</table>

*Income/Education effects less than observed Clarke and Leigh (2011).

**Health effects significant. Mental health effects similar to other studies.**
**Age and target age effects in regression of Individual Subjectivity Factors**

<table>
<thead>
<tr>
<th></th>
<th>Pooled OLS</th>
<th>Random Effects</th>
<th>Cubic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.039***</td>
<td>-0.039***</td>
<td>0.930</td>
</tr>
<tr>
<td>Target Age (TA)</td>
<td>-0.014***</td>
<td>See Figure below</td>
<td>1.869***</td>
</tr>
<tr>
<td>Age * TA</td>
<td></td>
<td></td>
<td>-1.508***</td>
</tr>
<tr>
<td>Age²</td>
<td></td>
<td></td>
<td>-0.563</td>
</tr>
<tr>
<td>TA²</td>
<td></td>
<td></td>
<td>-1.592***</td>
</tr>
<tr>
<td>Age² * TA</td>
<td></td>
<td></td>
<td>-0.060**</td>
</tr>
<tr>
<td>TA² * Age</td>
<td></td>
<td></td>
<td>0.129***</td>
</tr>
<tr>
<td>Age³</td>
<td></td>
<td></td>
<td>0.060</td>
</tr>
<tr>
<td>TA³</td>
<td></td>
<td></td>
<td>0.029**</td>
</tr>
</tbody>
</table>

*Note: See Figure below for the graph showing Target Age Effects on the level of Pessimism.*

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Interaction of Age and Target Age effects are significant.

- Not a plane.
- Pessimism generally decreases with Age and TA.
- Interaction effect.
- Model by polynomial.
Money’s worth of annuities and retirement consumption
Money’s worth depends on SSP

- Money’s worth: E(PV) fairly priced annuity / purchase price

- Compute money’s worth of immediate and deferred annuities using:
  - i. Scaling factors from cohort average cubic model
  - ii. Scaling factors from average SSPs to 75, 80 or 85 years
  - iii. Scaling factors from average SLEs
Simple life cycle model:
  • CRRA utility;
  • Bequest motive;
  • Only idiosyncratic mortality risk;
  • Positive wealth constraint;
  • Wealth dynamics.

Subjective mortality beliefs explains
  ▪ Retirement savings puzzle (not saving enough);
  ▪ Conservative withdrawn patterns in retirement.

Optimal consumption level (next slide).
Shape of consumption varies markedly.
Conclusions

- Pessimism is higher for:
  - Younger individuals
  - Earlier target ages.
  - Low income, unhealthy,.....

- Generally people are pessimistic.
  - Pessimistic in projecting TA before 90;
  - Optimistic in projecting TA after 90.
  - Younger cohort (50-65) are pessimistic;
  - Older cohort (65-74) are optimistic.

- Partly explains savings & conservative withdrawal puzzle.
Conclusions

- Subjective expectations:
  - Annuities unattractive to middle aged pre-retirees
  - Deferred annuities very unattractive
  - Low savings more likely in pre-retirement
  - High spending more likely in early retirement
  - Low spending more likely in later retirement