The Future of Australian Mortality

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Background

- Lee and Carter (1992): USA
- Tuljapurkar et al (2000): G7 countries
- ABS projections 1999-2101

Lee and Carter: method

- No subjective judgements involved
- Based on past mortality rates

The model

$$\ln\left(m_{x,t}\right) = a_x + b_x k_t + \varepsilon_{x,t} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$\ln\left(m_{x,t}\right)$ is a matrix of log age specific death rates

k_t is the index of improvement in mortality over time ('dominant temporal signal')

a_x and b_x are the age specific constants; indicate the rate of decline in specific age group

$\varepsilon_{x,t}$ is the error term of the equation with mean 0 and variance $\sigma_{\in}^{2}$

Data adjustment

- Adjust data prior to fitting the model
- Extension to age 105+
  - relational logistic model fitted to ages 50 to 85+ (Himes, Preston & Condran 1994)
- Normalisation
  - adjust ln[m(x,t)] by subtracting the mean over time of ln[m(x,t)]

Singular Value Decomposition

- Solution found by SVD method
- First left and right vectors and leading value of SVD provide a unique solution:
  - dominant temporal signal, k(t)
  - fixed relative age effects, b(x)

Singular Value Decomposition

$$X = TDA'$$

Where:

X is the matrix of normalised log death rates
T is the matrix of time effect vectors
A is the matrix of age effect vectors
D is the diagonal matrix of singular values

ARIMA fit

- ARIMA (auto-regressive integrated moving average) used to project future signal
- Random walk with drift, z
- $\hat{k}(t+1) = \hat{k}(t) - z + \varepsilon_t$
- Fitted to *k* 1950-1994
- Projected *k* 1995-2050
- Confidence limits of projection estimated from error of fit

Lee and Carter: application

- US 1900-1989; projected to 2065
- Life expectancy > official projections
- Adopted widely in North America

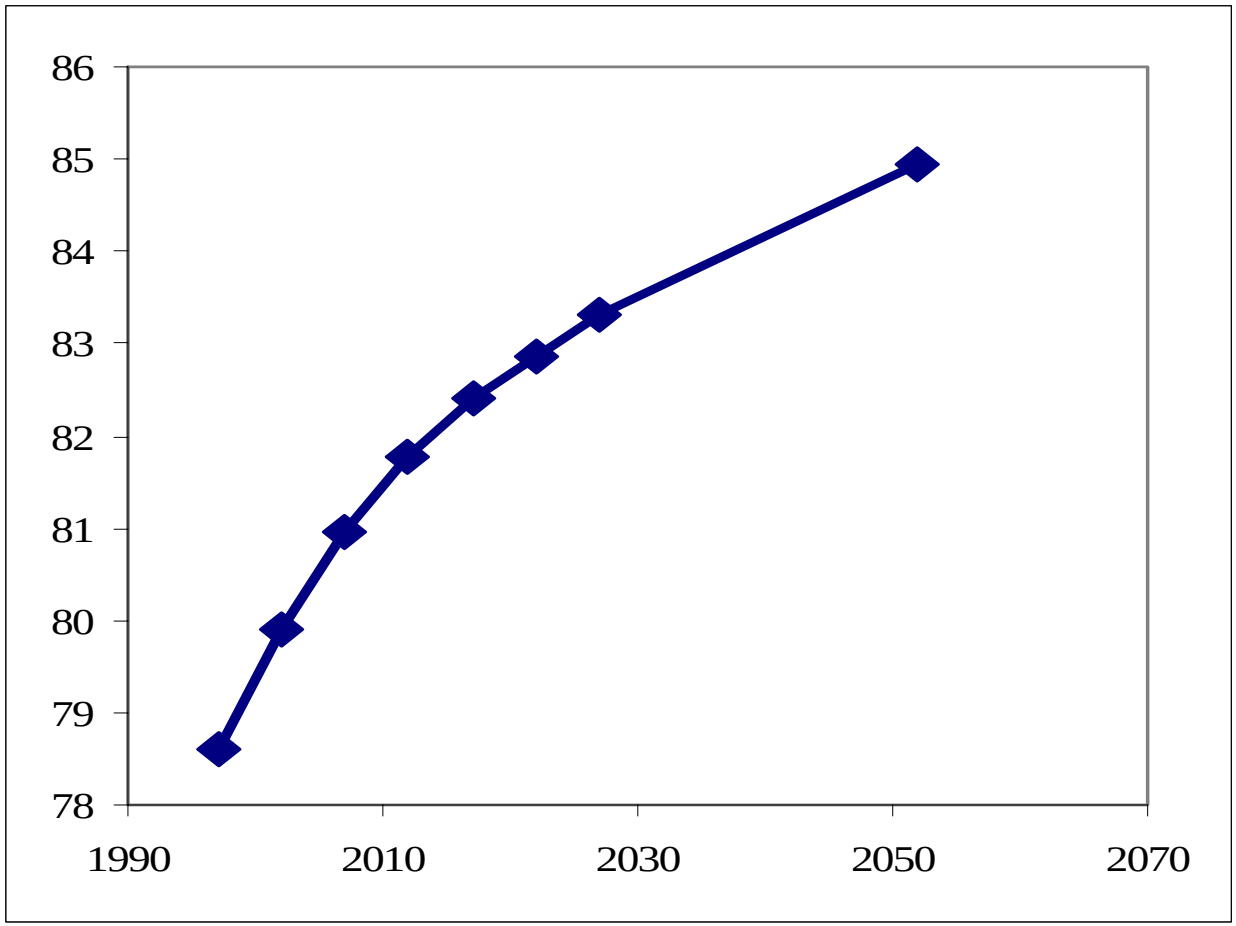
Tuljapurkar et al: application

- G7 countries: Canada, France, Germany, Italy, Japan,UK,US
- 1950-1994 data; projected to 2050
- ‘Universal’ pattern: exponential decline at all ages
- e(0) < official in short term, but > official in long term

ABS projections 1999-2101

- First period 1997-2002
  - increase of 0.30 per annum in male e(0)
  - increase of 0.22 per annum in female e(0)
- Declining rate of increase thereafter
- By 2051
  - male e(0) = 83.3 years
  - female e(0) = 86.6 years
- past age pattern of change to 2027

ABS projected e(0) 1997-2052



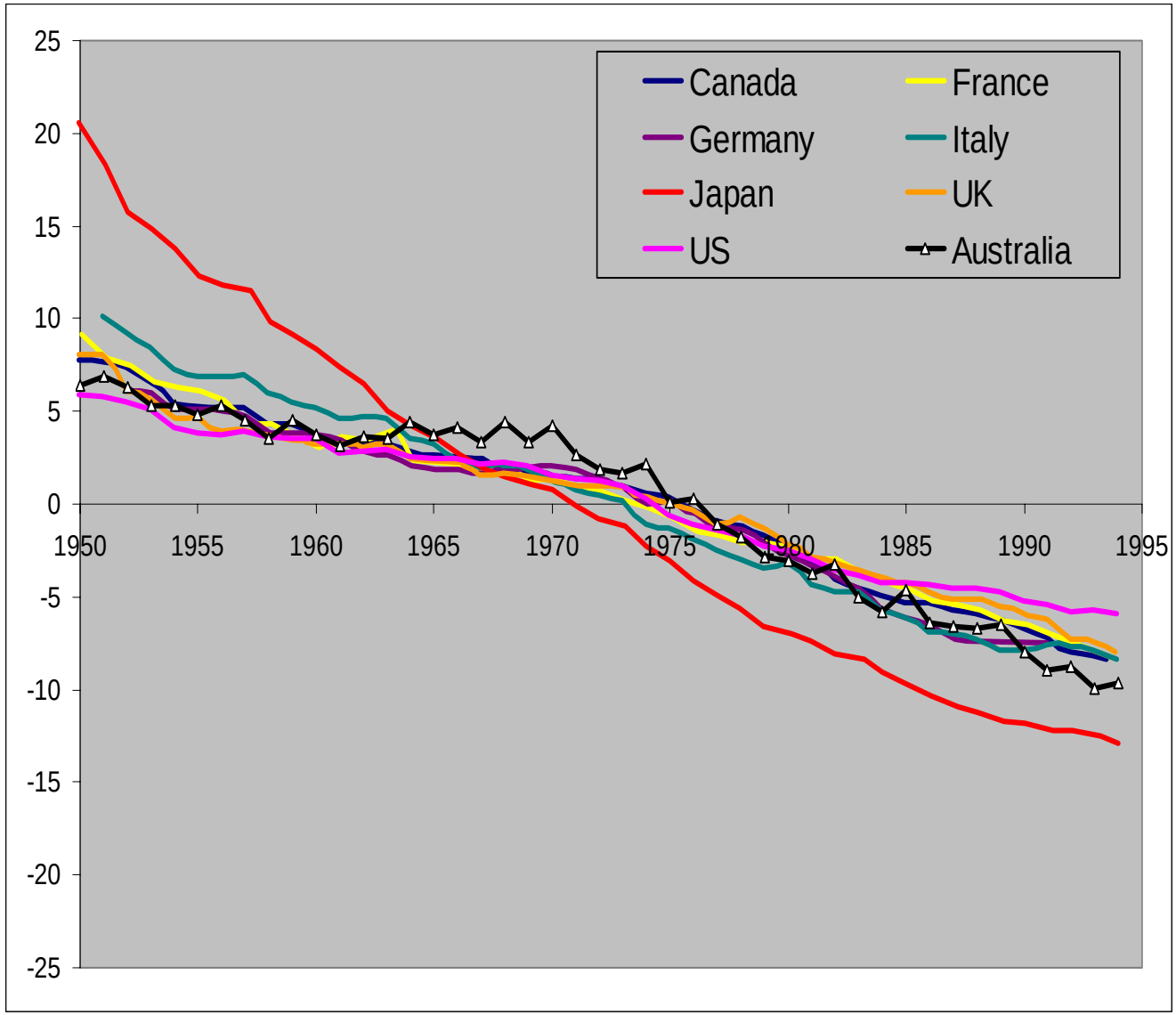
The Australian study

- Apply Lee-Carter method to Australian data following Tuljapurkar et al.
- Compare Australia with G7 analysis
- Compare new projections with ABS projections, 1999-2050

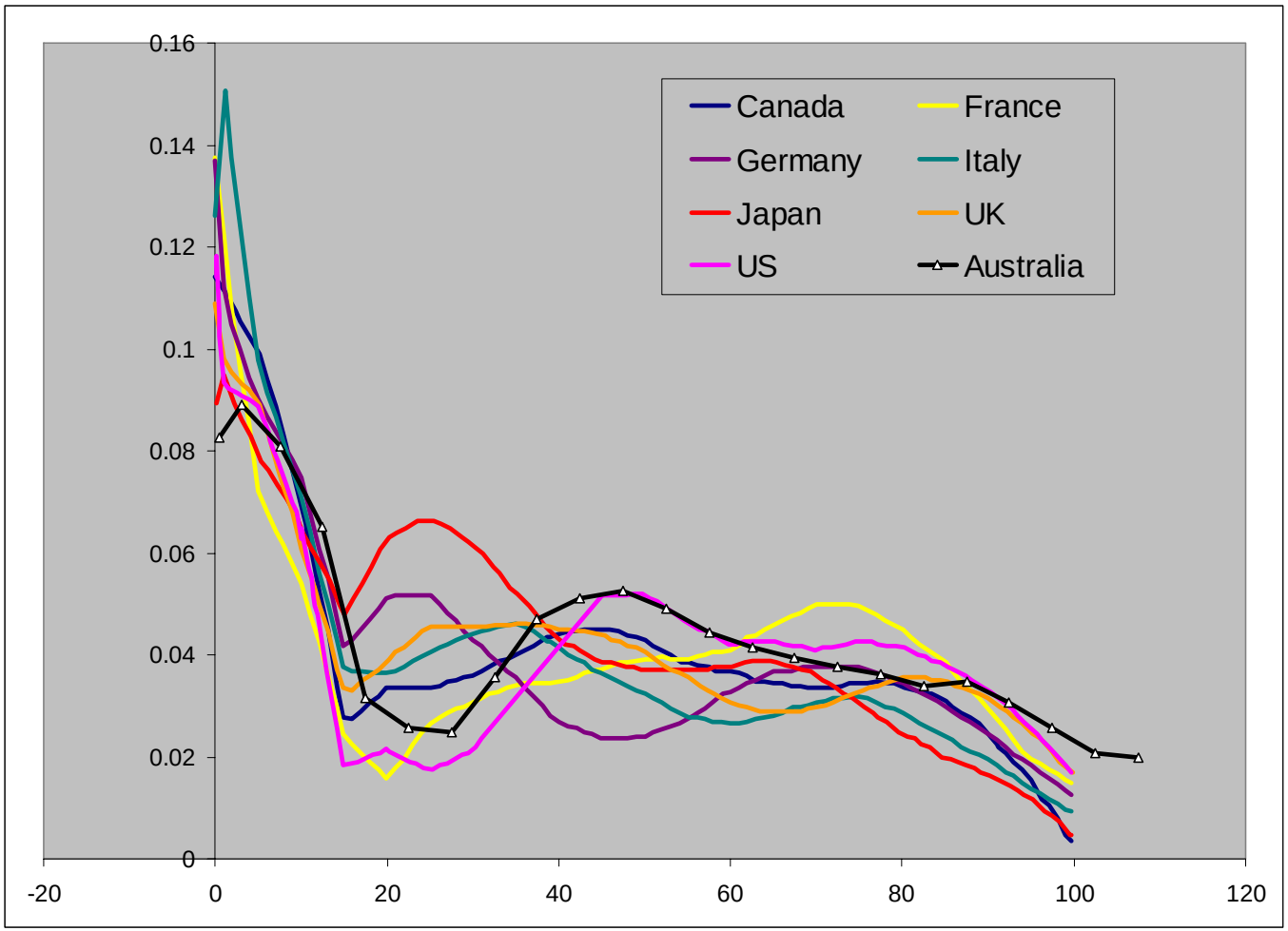
Results

- 95 per cent of variance explained by first vectors and value of SVD

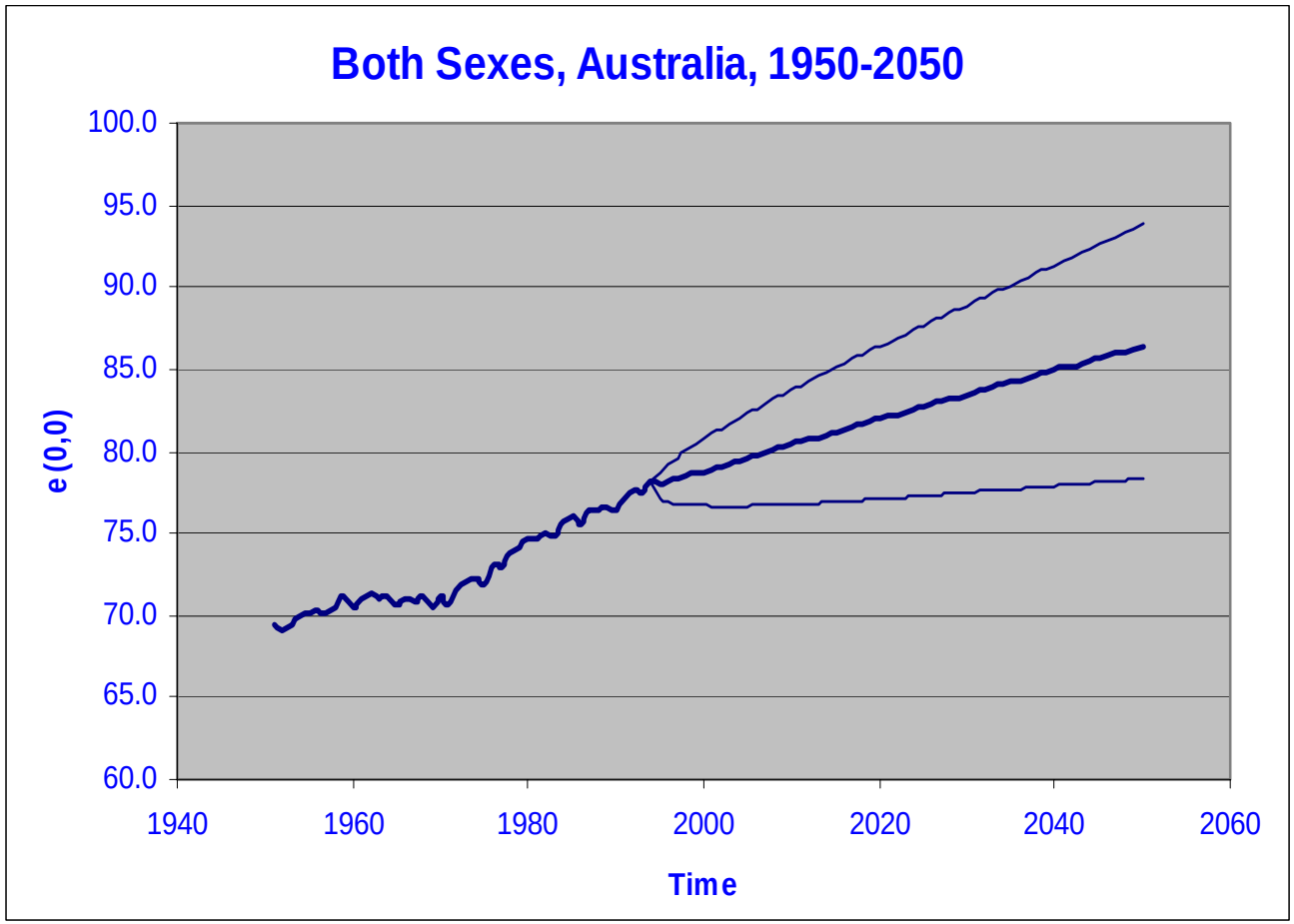
Values of *k*: G7 + Australia



Values of *b:* G7 + Australia



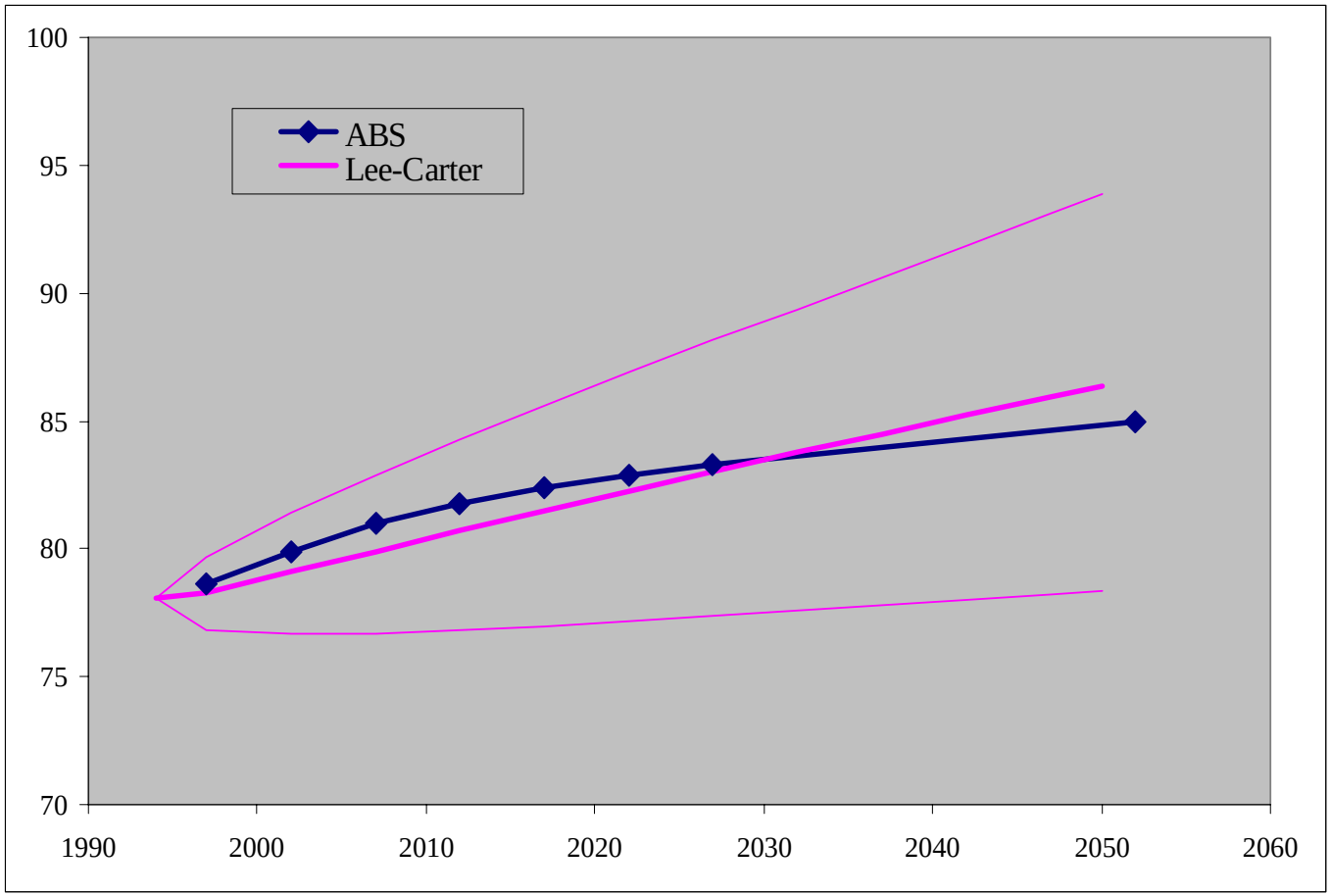
Observed and projected e(0)

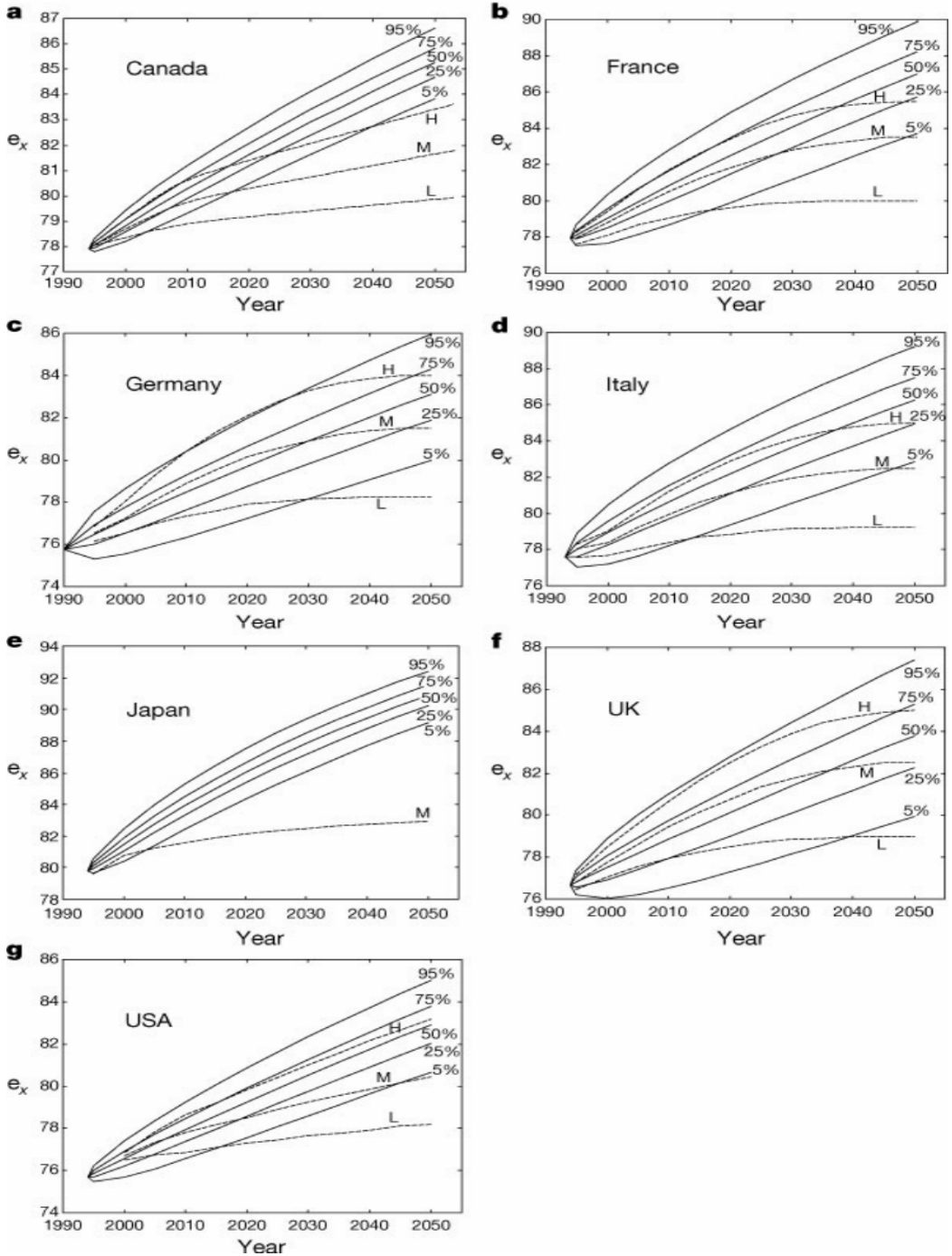


Discussion

- Differences between Australia and other countries
- Differences between Lee-Carter and official projections
- Further research:
  - by sex, by cause, by cohort
  - limits to life expectancy
  - improvements in methodology

Comparison of ABS and L-C e(0)

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