Explaining the Female Longevity Puzzle

Work in progress

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Outline of Presentation

- Motivation / Research Question
- The Problem
- The Data
- The Modelling
  - Lee-Carter
  - Age-Period-Cohort
- Results
  - Information Criteria
  - Forecast Measure

Motivation

- Different patterns for female mortality between mid 1980's and the end of the 20th century, see e.g. Meslé and Vallin (2006)
- France, Japan, and Norway - women have experienced improved longevity
- Denmark, the Netherlands, and in the US - women have experienced decreased improvements in longevity
- Critical for Longevity Risk

Idea

- Detailed Register Data/ Individual Data
- Remove heterogeneity
- Financial/Socioeconomic Indicator Variables

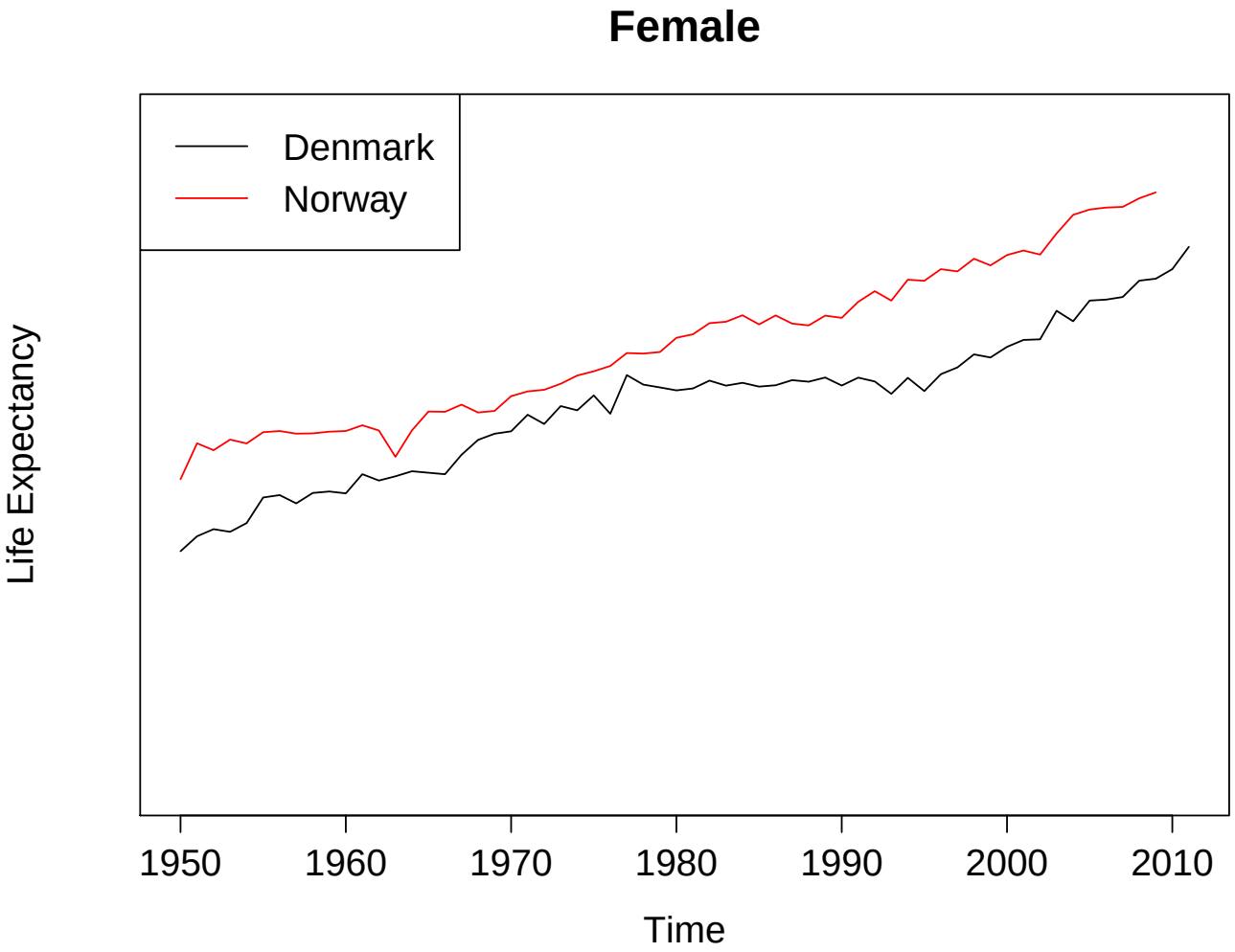
Method

The variable to be explained is the central death rate ($m(x,t)$). Following Lundström and Qvist (2004)

$$m(x,t) = \frac{D(x,t)}{(P(x-1,t-1) + P(x,t))/2}$$

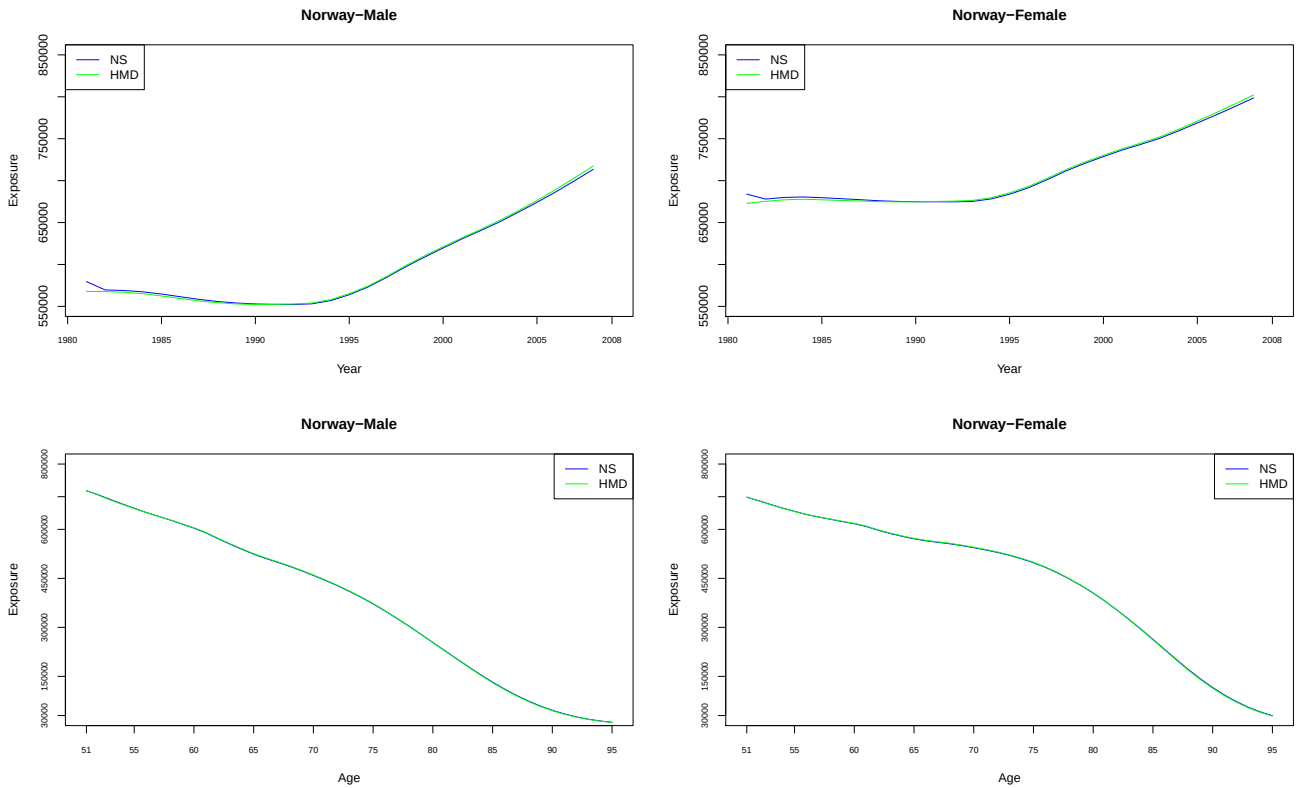
Where $D(x,t)$ is the death count or number of deaths at age x in calender year t, at year end. $P_{t,x}$ is the population aged x in year t at year end. The exposure-to-risk, $E(x,t)$ is similarly given by:

$$E(x,t) = (P(x-1,t-1) + P(x,t))/2$$


Female
Denmark
Norway
Life Expectancy
1950
1960
1970
1980
1990
2000
2010
Time

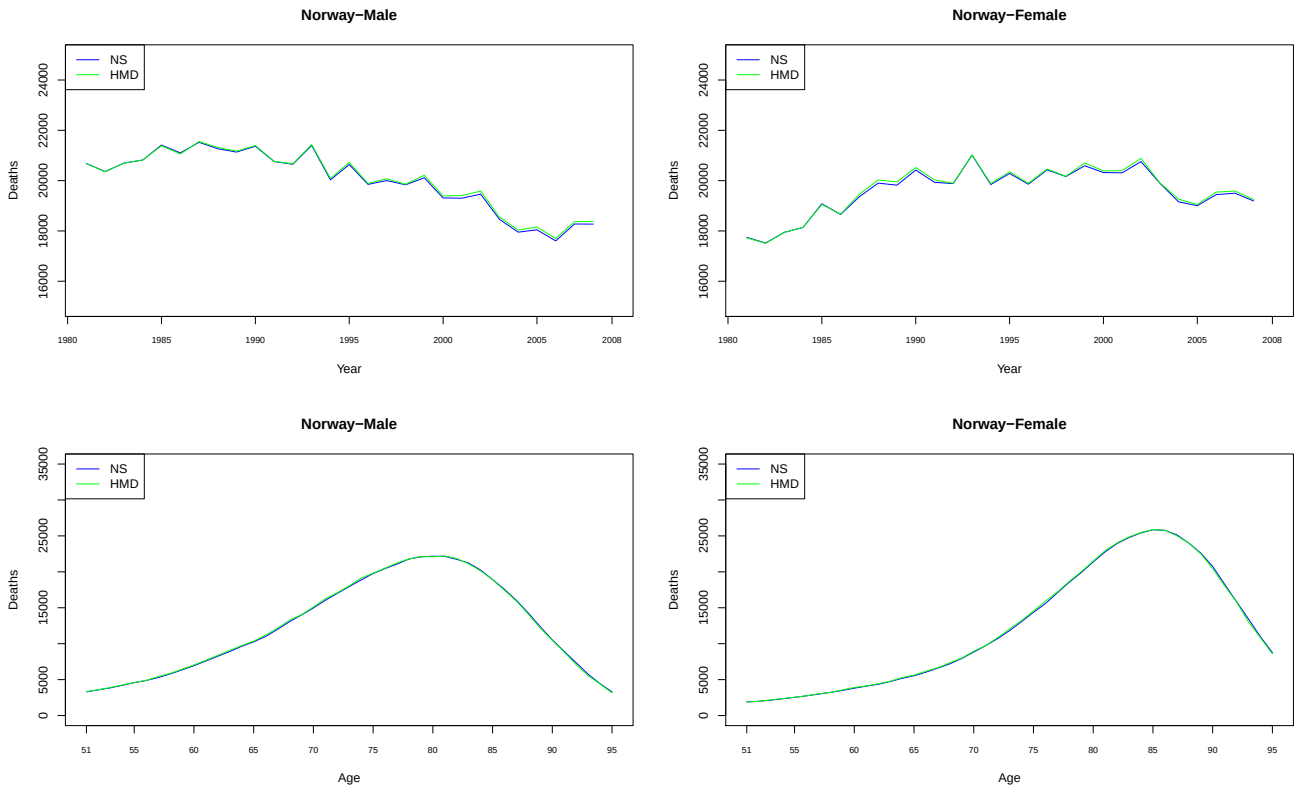
Data

Figure: Norway



Data

Figure: Norway



Data Issues

Danish Data

- Unbalanced Panel Dataset
- Wealth for married couples are registered by the husband in the early 1980's
  - Track and assign 50 % of the wealth to the female
  - Assign the quintile of the husband
- Drop emigrants/immigrants

Norwegian Data

- Balanced Panel Dataset
- Delete Early and Late observations
- Drop emigrants/immigrants

Financial Indicator

Assign a specific quintile to each individual based on a financial indicator.

$$U_{it} = L(wealth) + \alpha L(income)$$

Where L is the lag operator. Then rank the individuals $R(i, x, t)$

$$q_{itx} = \frac{rank(i, x, t)}{N(x, t) + 1} \in (0, 1)$$

Sort into ten groups of equal size for each year and age (for the working age)

The Models

The model by Lee and Carter (1992) is applied for testing

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

The age-period-cohort model by Currie (2006)

$$\ln(m_{x,t}) = \alpha_x + \kappa_t + \gamma_{t-x} + \varepsilon_{x,t}$$

Figure: Denmark

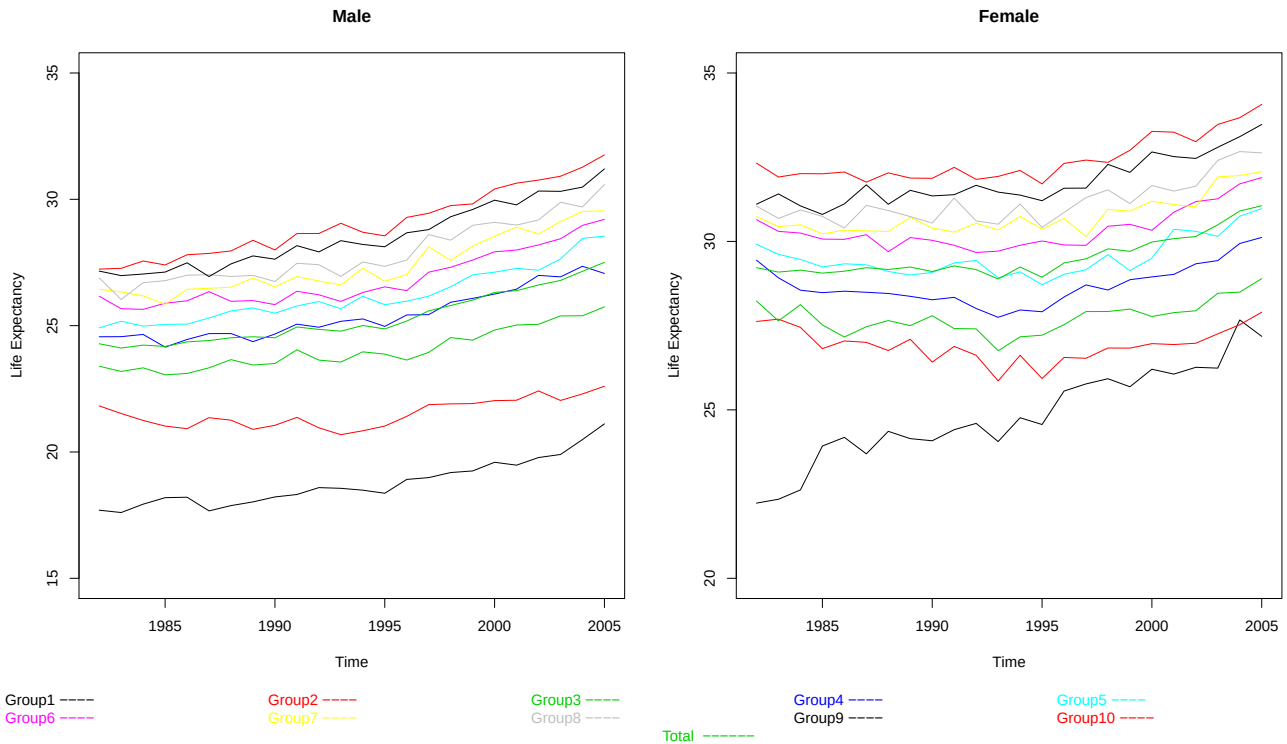


Figure: Plot of period life expectancy at age 50 for males and females for each of the 10 groups

Figure: Norway

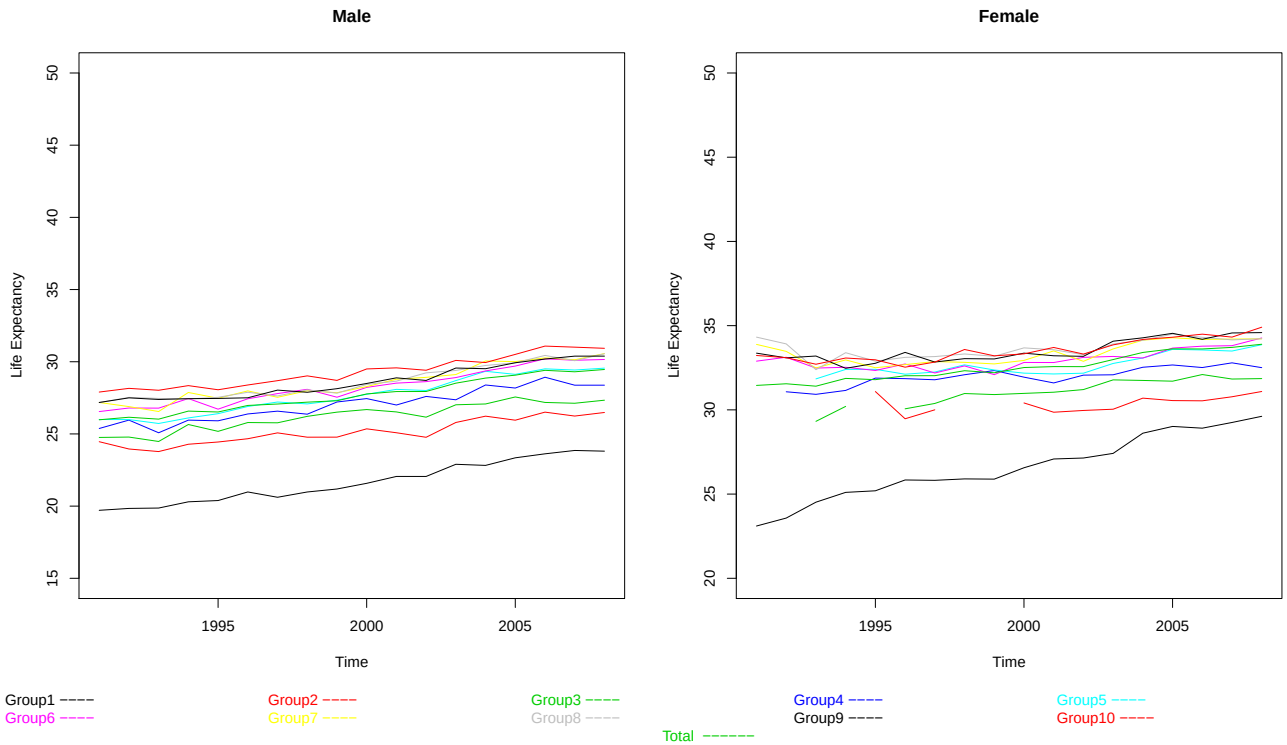


Figure: Plot of period life expectancy at age 50 for males and females for each of the 10 groups

Table: In-Sample Perfomance Measure DK: BIC

	Female	Male
Group 1	-3587.87	-3727.96
Groups2	-3509.62	-3611.23
Group 3	-3523.68	-3475.39
Group 4	-3517.74	-3424.10
Group 5	-3478.96	-3403.82
Group 6	-3387.30	-3383.60
Group 7	-3429.54	-3361.13
Group 8	-3381.89	-3317.58
Group 9	-3341.38	-3295.77
Group 10	-3321.15	-3291.39
Overall*	-3224.54	-3233.69

Table: Out-of-Sample Forecast Perfomance DK: MSE 2001-05

	Female	Male	Fem-Total	Male-Total
Group 1	0.13	0.55	9.23	42.47
Groups2	0.14	0.21	5.65	19.24
Group 3	0.44	0.19	2.07	1.87
Group 4	0.41	0.38	0.14	0.10
Group 5	1.77	0.41	0.62	1.44
Group 6	1.72	0.38	2.67	3.45
Group 7	0.84	0.63	3.41	5.81
Group 8	0.68	0.24	5.63	8.68
Group 9	0.26	0.08	8.92	13.42
Group 10	0.70	0.15	12.71	18.18
Overall	0.66	0.08	0.66	0.08

Currie, I. D. (2006): "Smoothing and forecasting with P-splies," in *Institute of Actuaries*.

Lee, R. D. and L. R. Carter (1992): "Modeling and Forecasting U.S. Mortality," *Journal of the American Statistical Association*, 87, 659–671.

Lundström, H. and J. Qvist (2004): "Mortality Forecasting and Trend Shifts: an Application of the Lee–Carter Model to Swedish Mortality Data*," *International Statistical Review*, 72, 37–50.

Meslé, F. and J. Vallin (2006): "Diverging Trends in Female Old-Age Mortality: The United States and the Netherlands versus France and Japan," *Population and Development Review*, 32, 123–145.