



The Actuarial Profession

making financial sense of the future

In Sickness and in Health?

Dynamics of Health and Cohabitation among older people
(Work in Progress)

Martin Karlsson, Les Mayhew, Ben Rickayzen
Cass Business School, City University

Outline

- Brief overview of past LTC research
- Purpose of current research
- Theoretical Background: The Grossman Model
- Empirical Approach
- Preliminary Results
- Conclusion and Outlook

Previous LTC Research

The Rickayzen/Walsh disability projection model has been applied in various contexts:

- Projecting implications for public finances of various health scenarios (*Health Policy*, 2005).
- Projecting the balance between supply of and demand for informal care
- Comparing financial consequences of different systems, from the point of view of the individual as well as the public sector in general

Purpose of research

The project: estimate the potential market for 'topup' LTC insurance, in which individuals get benefits tailor made to their individual needs.

The Rickayzen/Walsh model cannot be used for this purpose as

- It only differentiates according to *gender* and *cohort*
- Other covariates such as *marital status*, *education* etc are not taken into account
- We also need information on variance and covariance of the relevant variables

To develop a model that overcomes these problems has been the purpose of this research.

Problems in LTC insurance markets

- Adverse selection (aggravated by dynamic perspective)
- Too much coverage?
- Is part of the problem lack of distinction between '*disability*' (i.e. health) and '*need*' (i.e. circumstances)?
- Cohabitation status and socioeconomic variables are of particular interest as they
 - Have strong impact on health
 - Determine financial needs in case of disability
- Increasing our knowledge of these factors allows for
 - More accurate pricing
 - Tailor-made products

Theoretical Background: The Grossman Model

The Grossman (1972) model has two main pillars:

- **The household production model of consumption:** health is a commodity produced in the household
- **The human capital perspective:** health is at the same time a commodity and a capital stock, from which a stream of earnings is derived

Grossman's twist: good health increases the amount of *time* available for consumption and production

The main empirical interest has been in the role of *schooling/education* in the production of health.

The effect of *cohabitation* has not been analysed so far.

Empirical Strategy

Decompose the observed variation in health (and cohabitation) into different components:

<i>Component</i>	<i>Health</i>	<i>Cohab</i>	<i>Cov</i>
Unobserved structural differences	ω^H	ω^C	ω^{HC}
Transitory shocks	σ^H	σ^C	σ^{HC}
Persistence in transitory shocks	ρ^H	ρ^C	-
State dependence	H_{t-1}	C_{t-1}	-
Exogenous factors	A_t, E_t, Y_t	A_t, E_t, Y_t	-
Causal links	C_{t-1}	H_{t-1}	

Estimating equations

Estimating *cohabitation*: a *probit* model

$$C_{it}^* = c + \underbrace{\beta_1 E_{it} + \beta_2 A_{it}^1 + \beta_3 A_{it}^2 + \beta_4 A_{it}^3 + \beta_5 Y_{it}}_{\text{Exogenous Variables}} + \underbrace{\beta_5 \hat{C}_{it-1} + \beta_4 \hat{H}_{it-1}^1 + \beta_5 \hat{H}_{it-1}^2}_{\text{State Dependence}} + \varepsilon_{it}^C$$

$$\hat{C}_{it} = \begin{cases} \text{cohabiting} & \text{if } C_{it}^* \geq 0 \\ \text{single} & \text{otherwise} \end{cases}$$

Estimating equations II

Estimating *health*: an *ordered probit* model

$$H_{it}^* = \underbrace{\delta_1 E_{it} + \delta_2 A_{it}^1 + \delta_3 A_{it}^2 + \delta_4 A_{it}^3 + \delta_5 Y_{it}}_{\text{Exogenous Variables}} + \underbrace{\delta_6 \hat{C}_{it-1} + \delta_7 \hat{H}_{it-1}^1 + \delta_8 \hat{H}_{it-1}^2}_{\text{State Dependence}} + \varepsilon_{it}^H$$

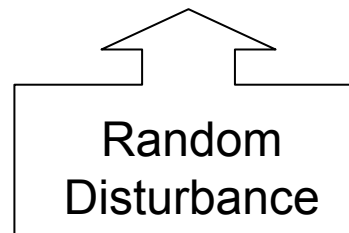
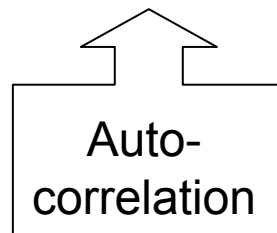
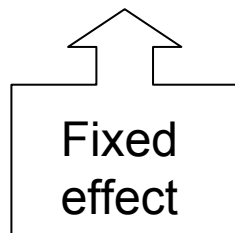
$$\hat{H}_{it} = \begin{cases} \text{healthy} & \text{if } H_{it}^* \leq \alpha_1 \\ \text{moderate} & \text{if } \alpha_1 \leq H_{it}^* \leq \alpha_2 \\ \text{severe} & \text{if } \alpha_2 \leq H_{it}^* \leq \alpha_3 \\ \text{dead} & \text{if } \alpha_3 \leq H_{it}^* \end{cases}$$

The α 's are cutoffs
for the latent
health variable H_{it}^*

Estimating equations III

The error terms: correlation patterns

$$\varepsilon_{it}^j = \mu_i^j + \eta_{it}^j, \quad \eta_{it}^j = \rho^j \eta_{it-1}^j + v_{it}^j, \quad j = C, H$$



$$\text{Corr}(v_{it}^H, v_{it}^C) = \sigma^{HC} \quad \left\{ \begin{array}{l} \text{Allowing for correlation between health shocks} \\ \text{and cohabitation shocks} \end{array} \right.$$

$$\text{Cov}(\mu_i^H, \mu_i^C) = \omega^{HC} \quad \left\{ \begin{array}{l} \text{Allowing for correlation between fixed health} \\ \text{effects and fixed cohabitation effects} \end{array} \right.$$

Dataset

We make use of the **British Household Panel Survey**:

- All 12 waves of the panel
- All permanent members of the panel
- Definition of Disability: ADL
 - Healthy: <2 ADLs
 - Moderate: 2 ADLs
 - Severe: >2 ADLs
- Problem: excluding individuals with missing information would bias mortality rates. Hence, information has to be imputed.
- A total of 6,000 individuals are divided into four groups:
 - Males & females
 - Pre- and post retirement (1991)

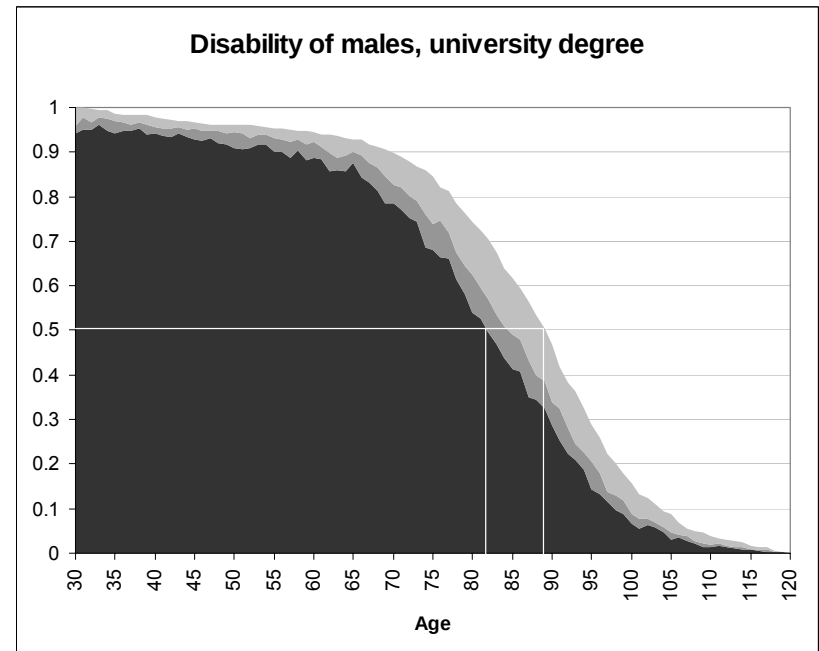
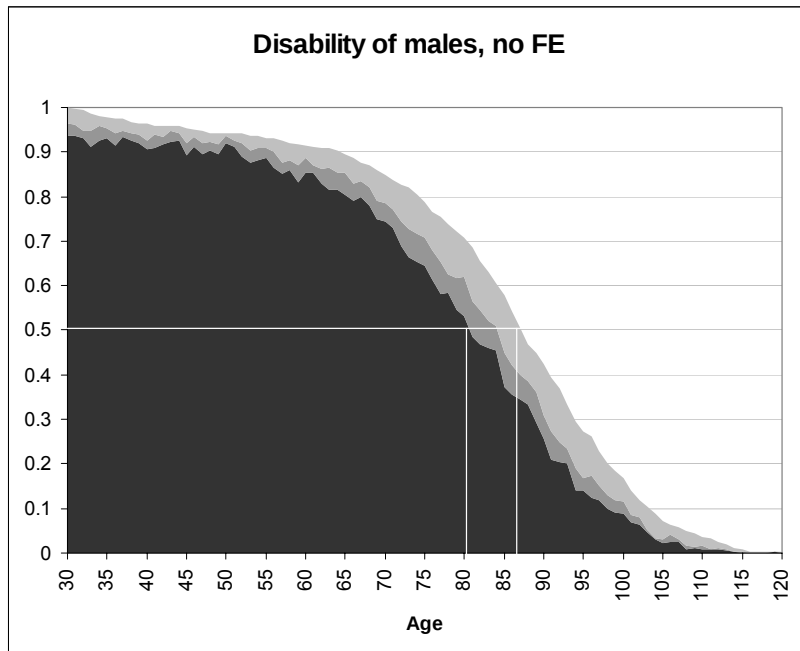
Results: Older Men

<i>Component</i>	<i>Health</i>	<i>Cohab</i>	<i>Cov</i>
Unobserved struct. differences	0.648**	0.794**	-0.236**
Transitory shocks	1	1	-0.285**
Persistence in transitory shocks	0.185**	0.911**	-
State dependence	0.166** 0.295**	0.937**	-
Exogenous factors	Y_t : 0.0785*	Y_t : -0.0717*	-
Causal links	0.0785**	-0.0311** 0.0233	-

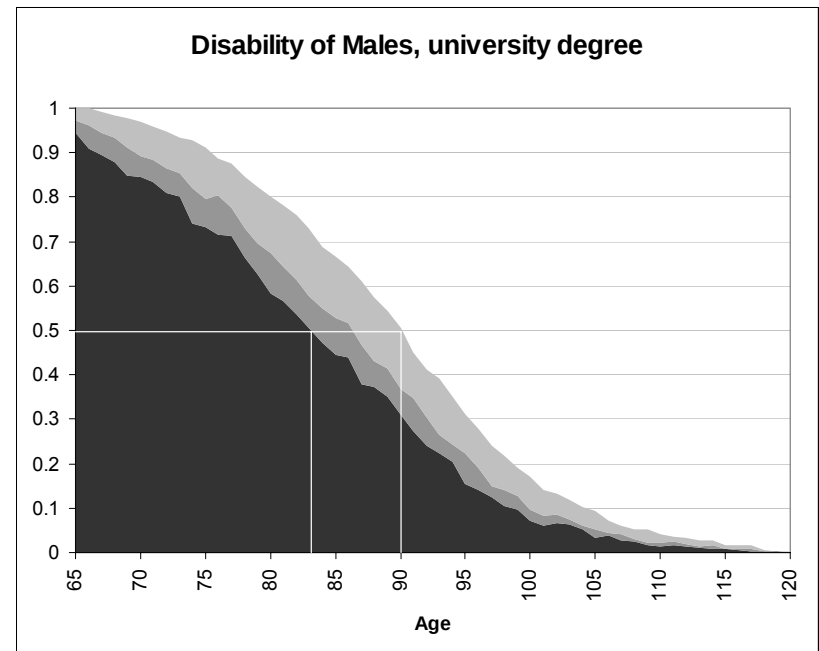
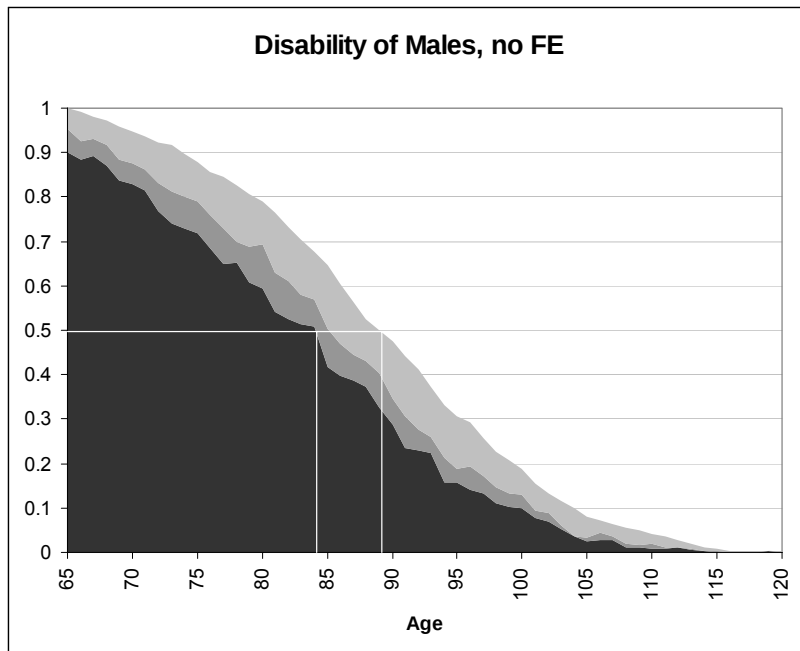
Results: Implications

- Individuals are systematically different even after age, gender and education has been controlled for
- There is a strong positive correlation in unobservables for health and marital status (i.e. self-selection)
- This implies an adverse selection problem, that can be mitigated by conditioning on more than health, e.g. marital status, education.
- Cohabitation is potentially more important for health (and vice versa) than education

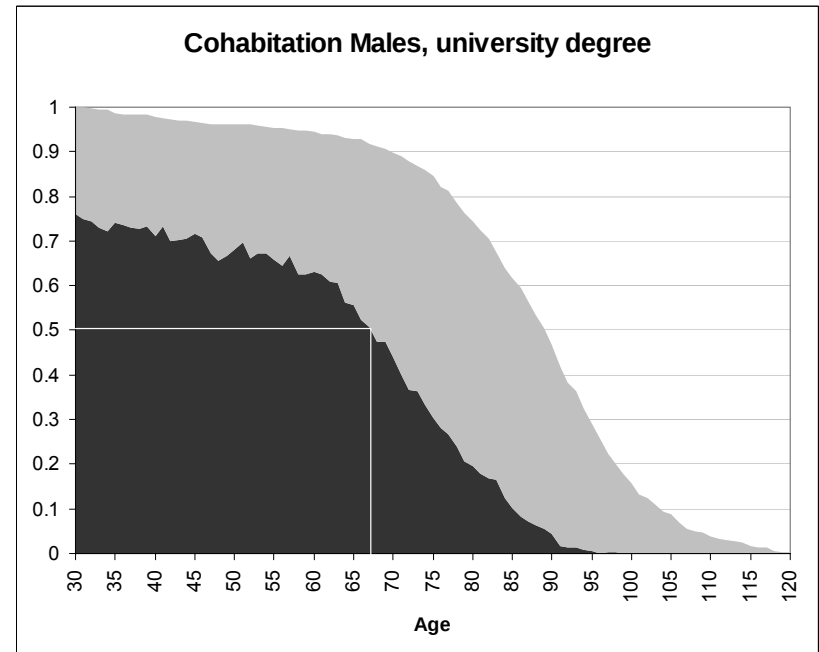
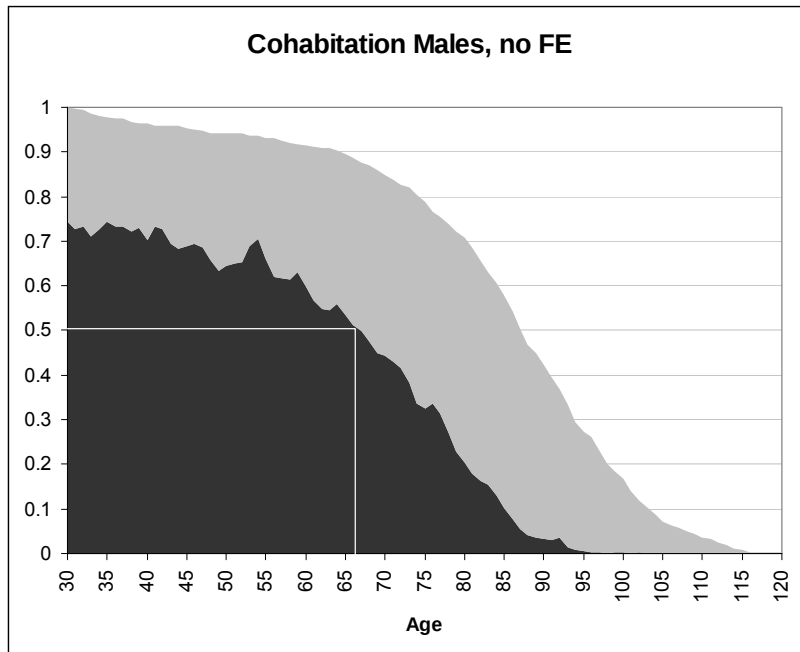
Results: Men, Disability



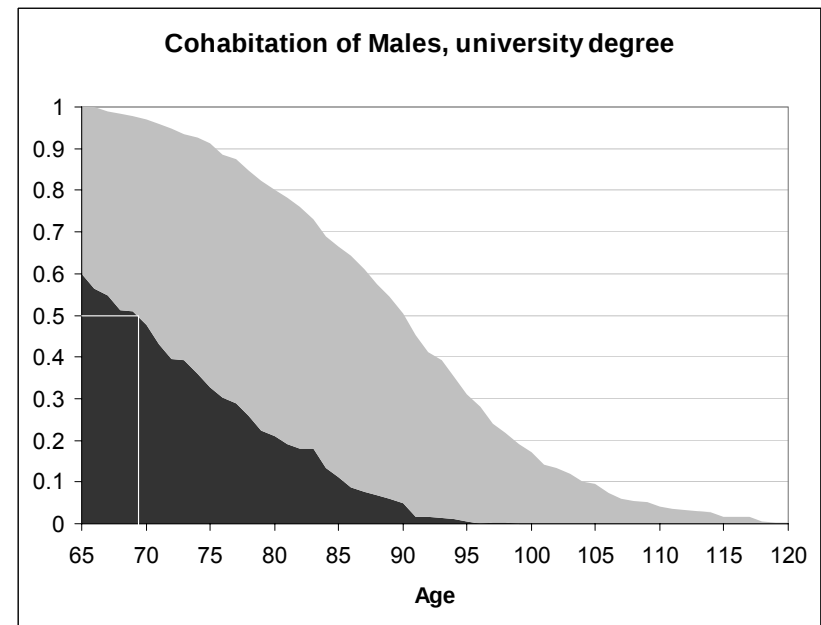
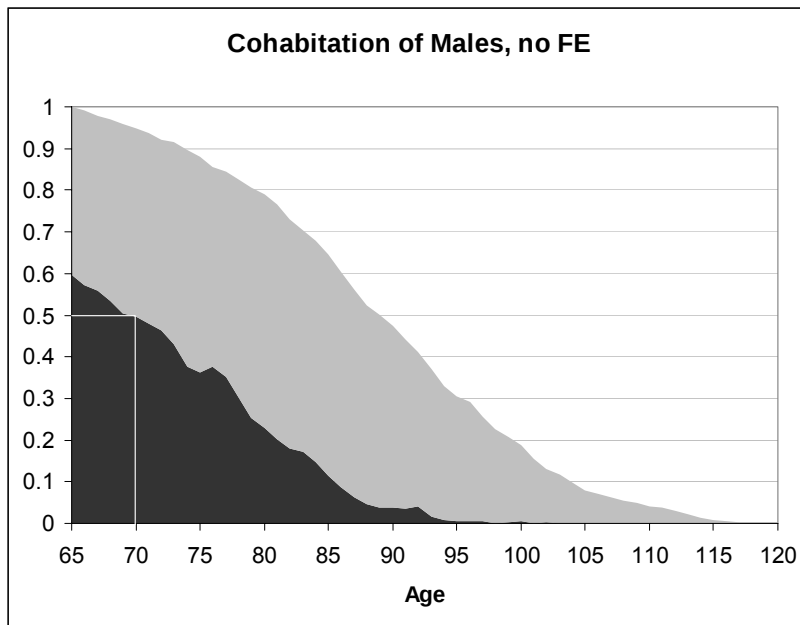
Results: Men, Disability



Results: Men, Cohabitation



Results: Men, Cohabitation



Results, Implications

- People with higher education have higher life expectancy at all ages
- There is less of a difference in Healthy Life Expectancy
- Males with higher education seem to spend more time in disability, especially at older ages
- For cohabitation, no great education differences

Conclusions and outlook

- Some interesting and some surprising findings
 - E.g. Marriage is **bad** for health – is it really?
 - The time effect is *negative* – are people becoming less healthy?
- Robustness checks need to be done
 - Extending to the other subgroups
 - Hypothesis testing

Future research topics:

- Assess whether demand would rise if *premiums* were conditioned on marital and socioeconomic status (i.e. increased accuracy)
- Assess whether demand would rise if *benefits* were conditioned on marital and socioeconomic status (i.e. new definition of ‘need’)