

Piggyback Forecasts of Mortality

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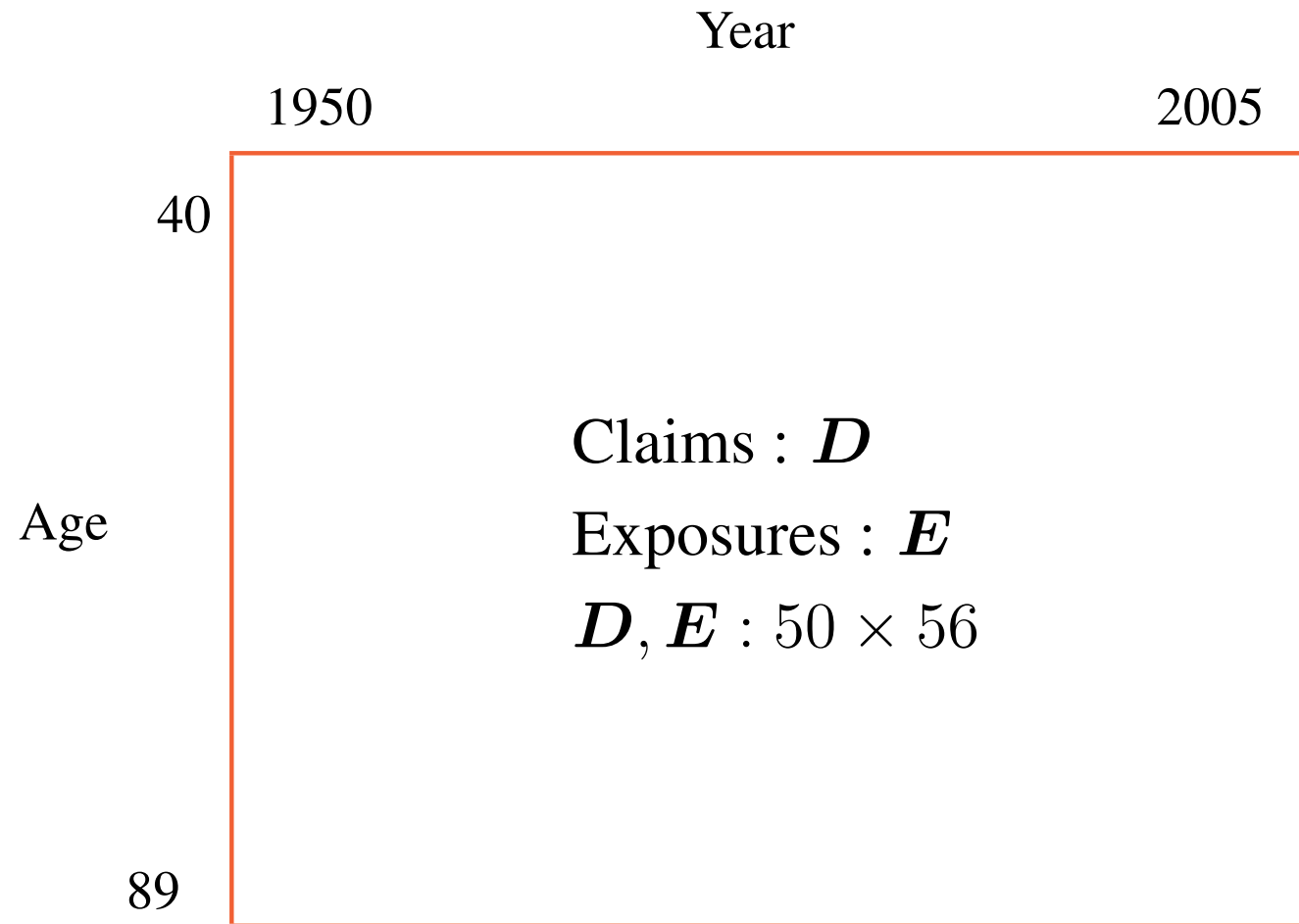
Heriot-Watt University

&

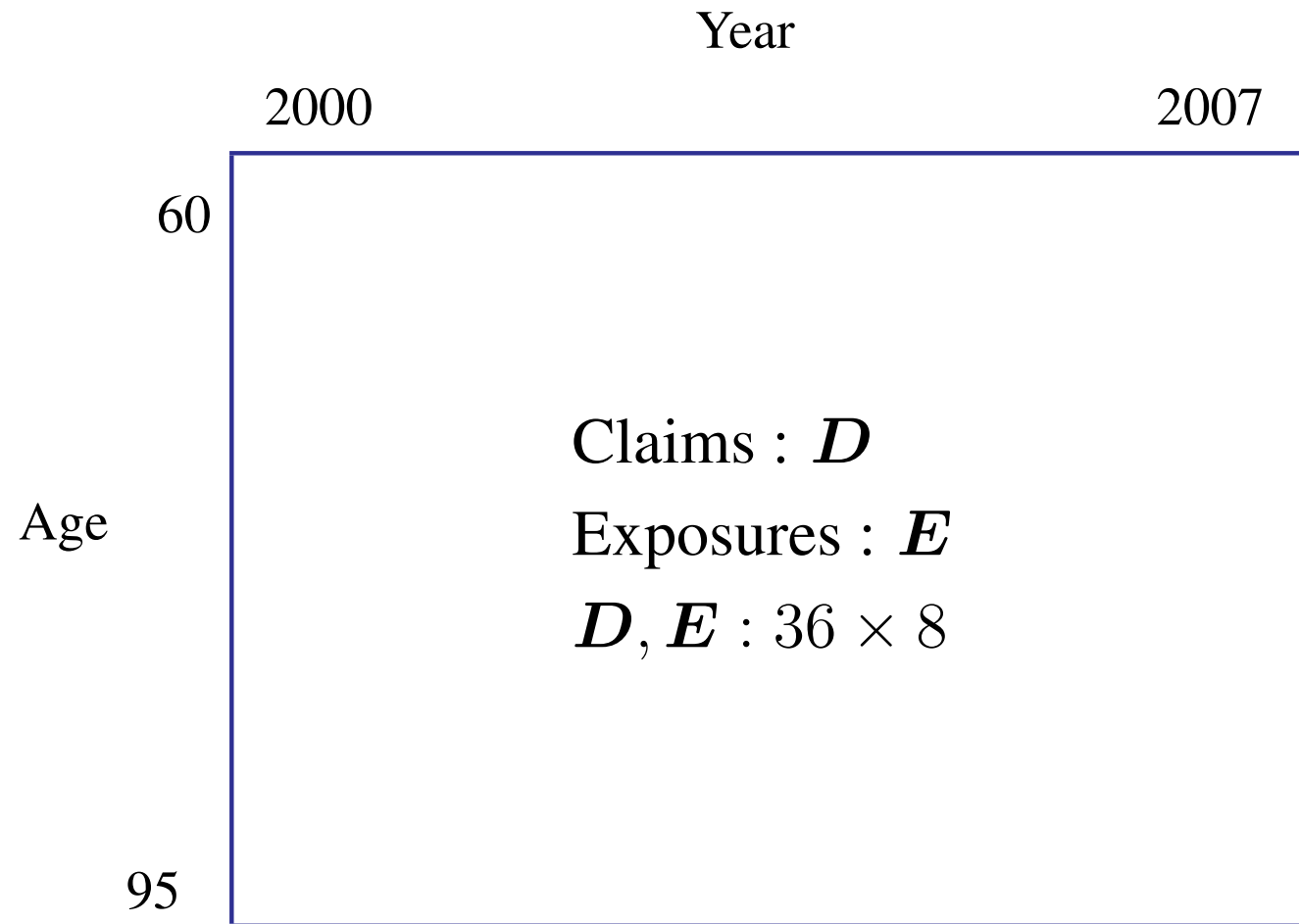


London
18th May 2010

CMI male assured lives data



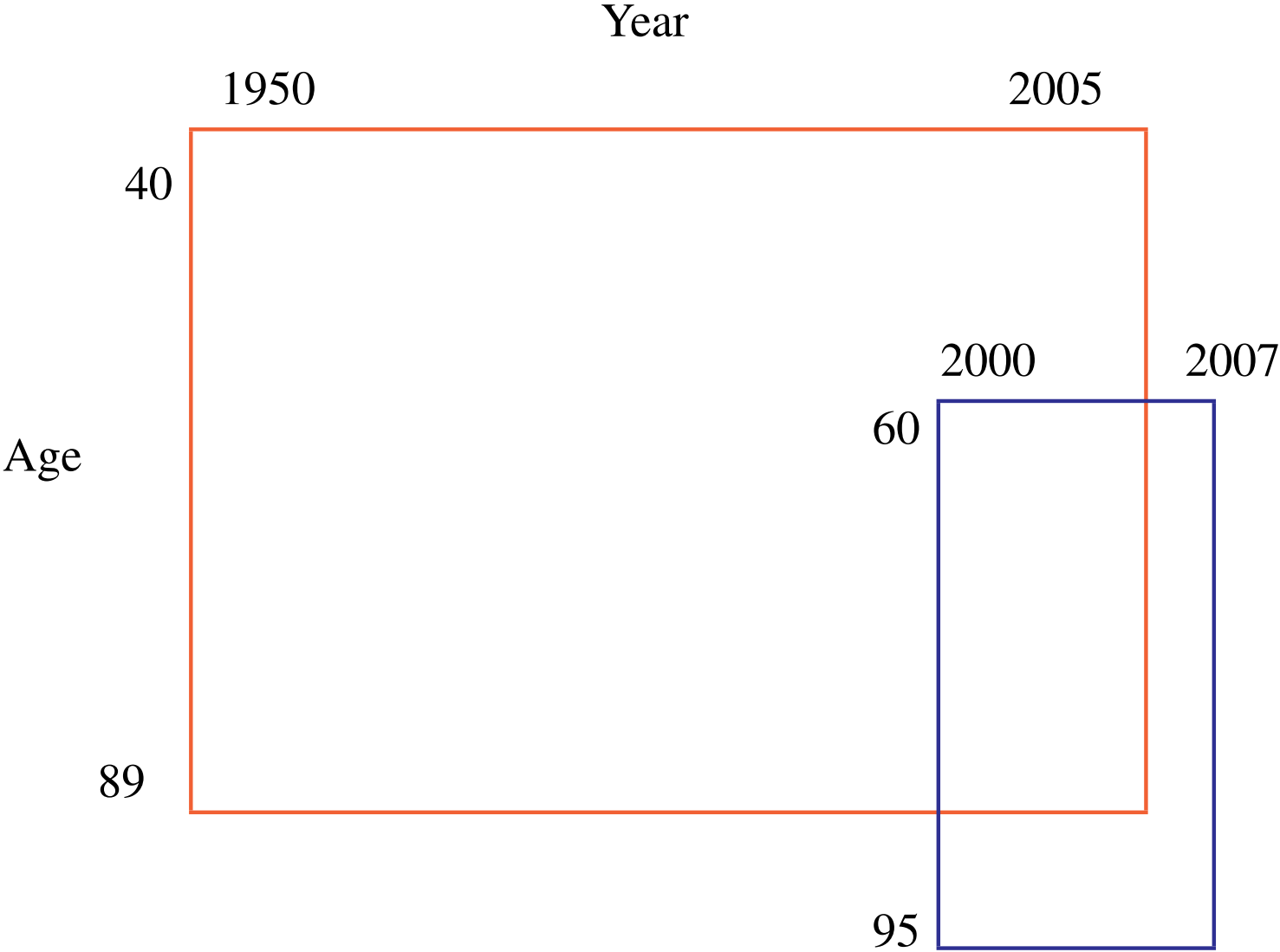
Company male pensioner data



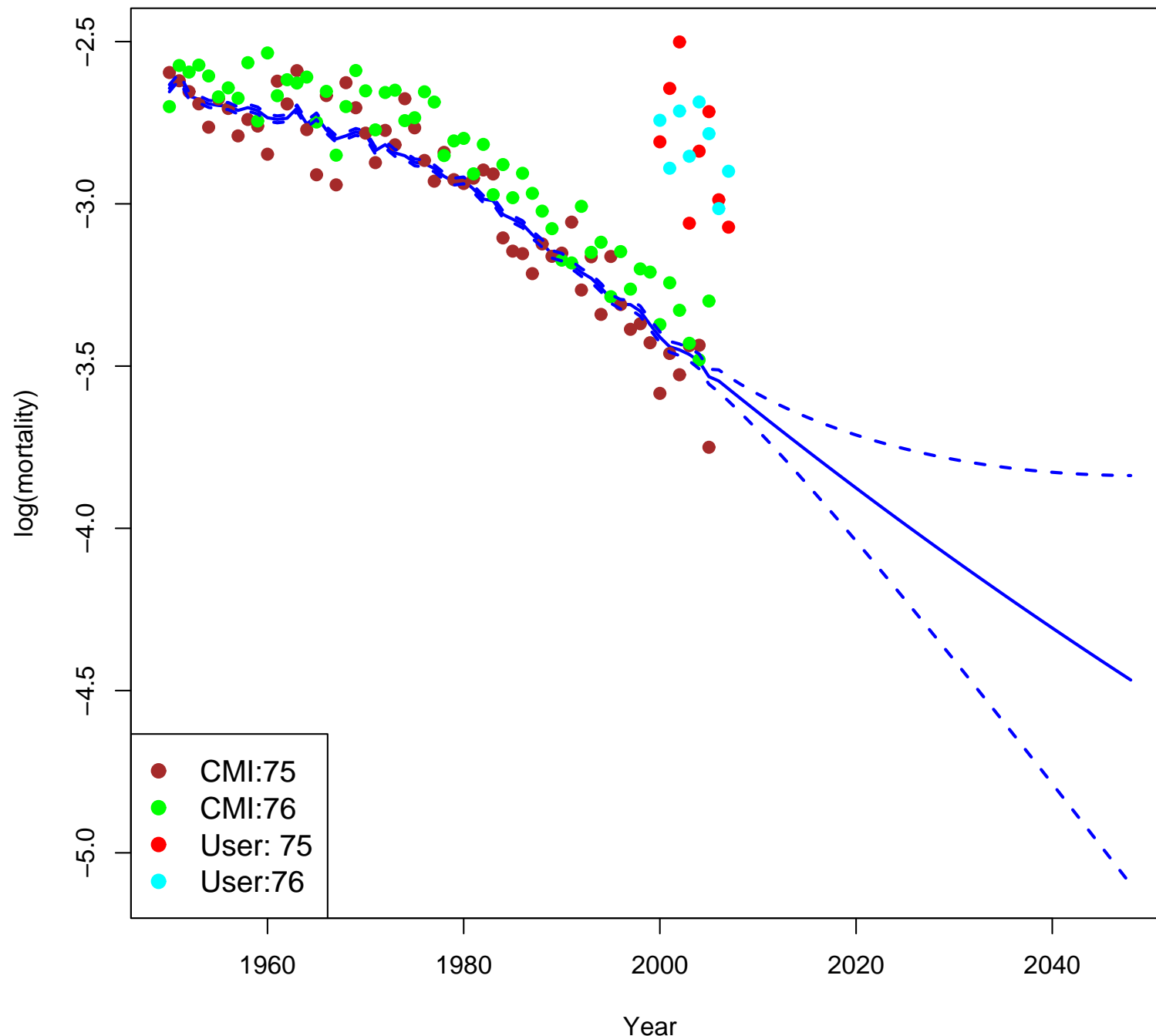
Data splitting

- Social class: two levels
- Pension size: two levels
 - ★ Level 00: high status, large pension
 - ★ Level 01: high status, small pension
 - ★ Level 10: low status, large pension
 - ★ Level 11: low status, small pension

CMI & company data



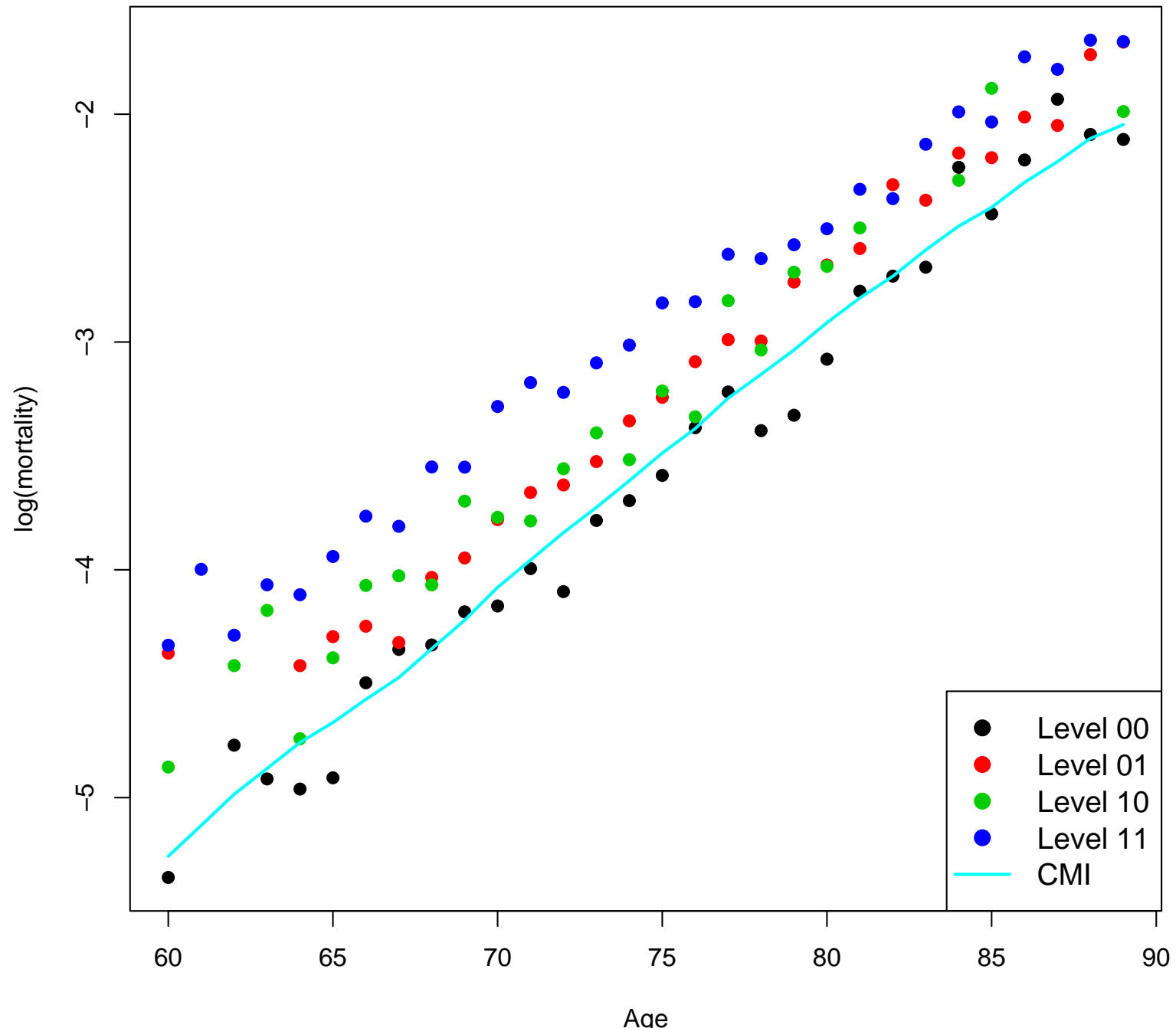
CMI forecast to 2048 with 95% CI for age 75



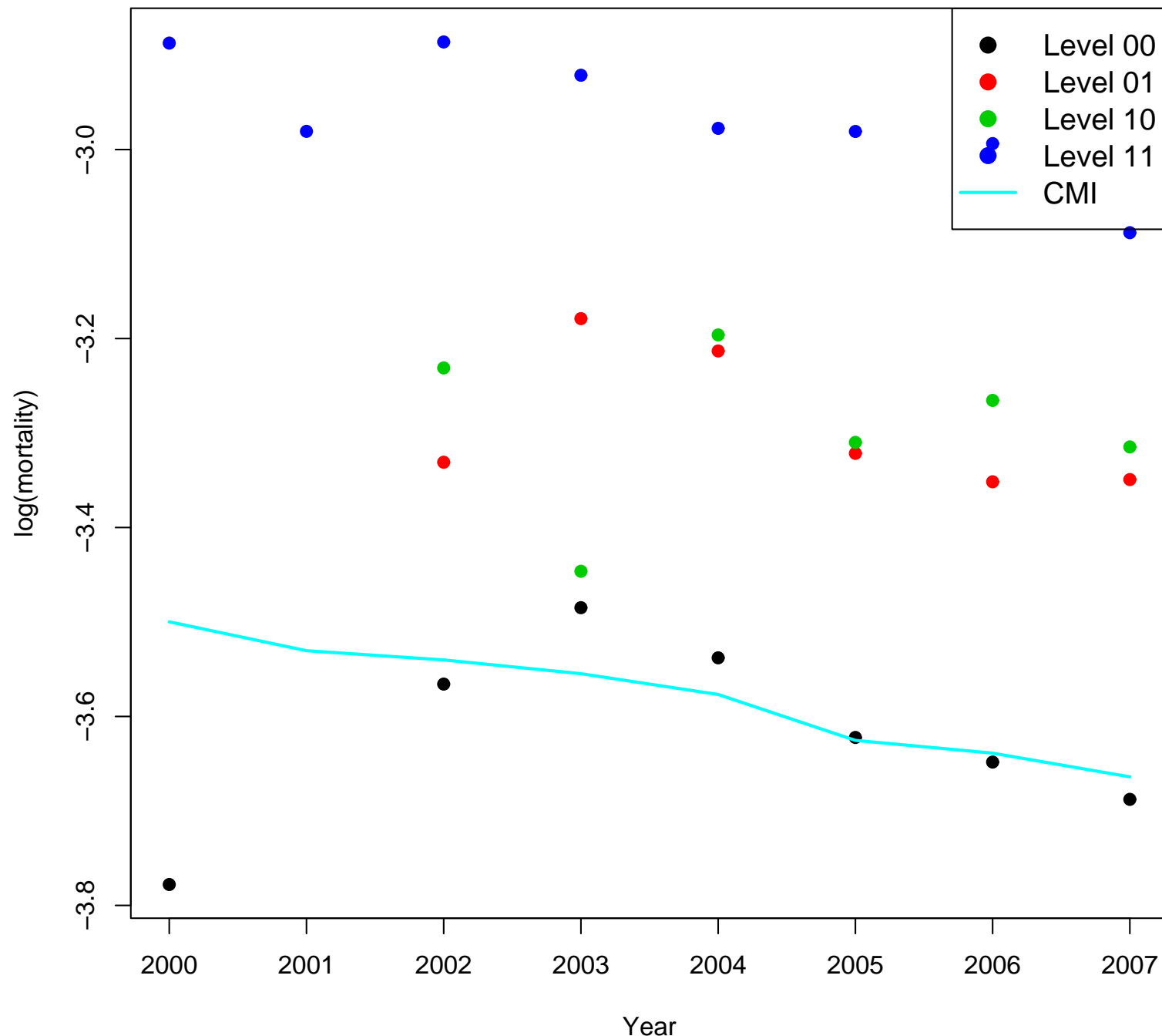
Conclusions

- Forecast with CMI data possible.
- CMI forecast biased (basis risk) for company data.
- Company data insufficient for stand-alone forecast.

Log(mortality) by age



Log(mortality) by year



The Piggyback Model

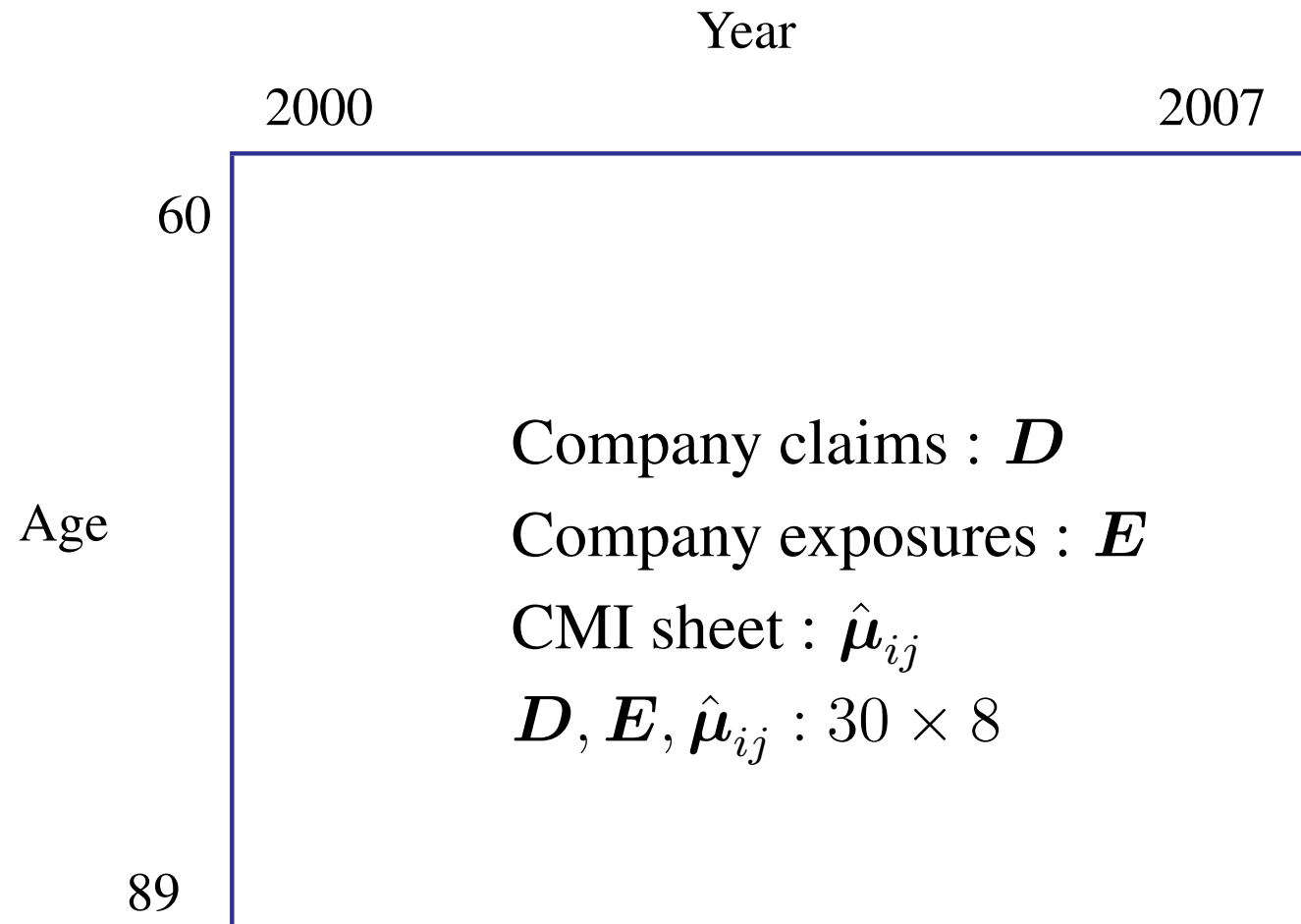
Gaps between CMI and user forecasts are

- Constant in time
- Linear function of age

The Piggyback Assumption

- Very strong.
- Doing nothing is an even bigger assumption!

Company data & CMI sheet (trimmed)



Piggyback model

$$D_{ij} \sim \mathcal{P}(E_{ij}\mu_{ij})$$

$$60 \leq i \leq 89, 2000 \leq j \leq 2007$$

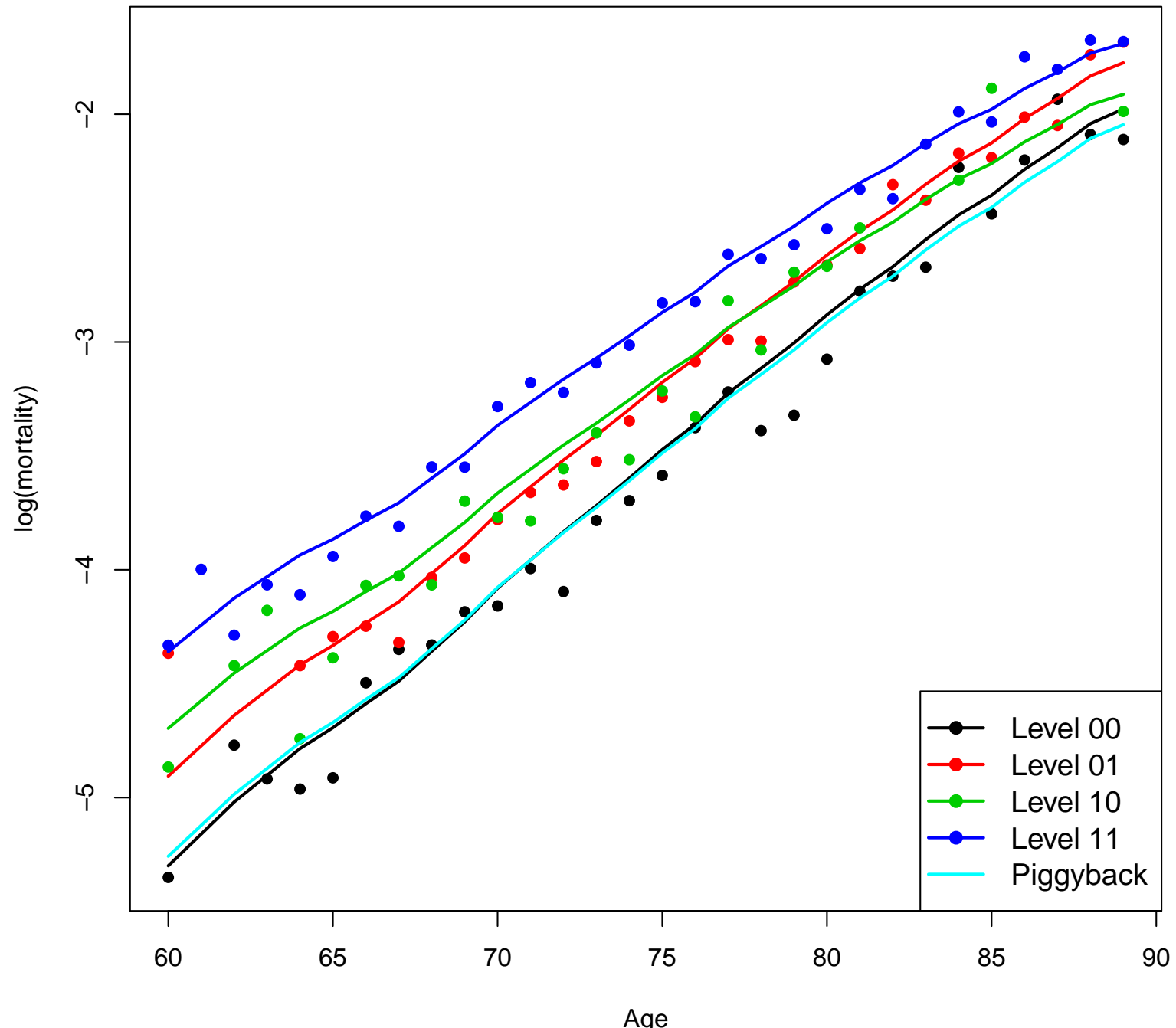
$$\log \mu_{ij} = \log \hat{\mu}_{ij} + a_0 + a_1 x_i$$

Piggyback fit and forecast

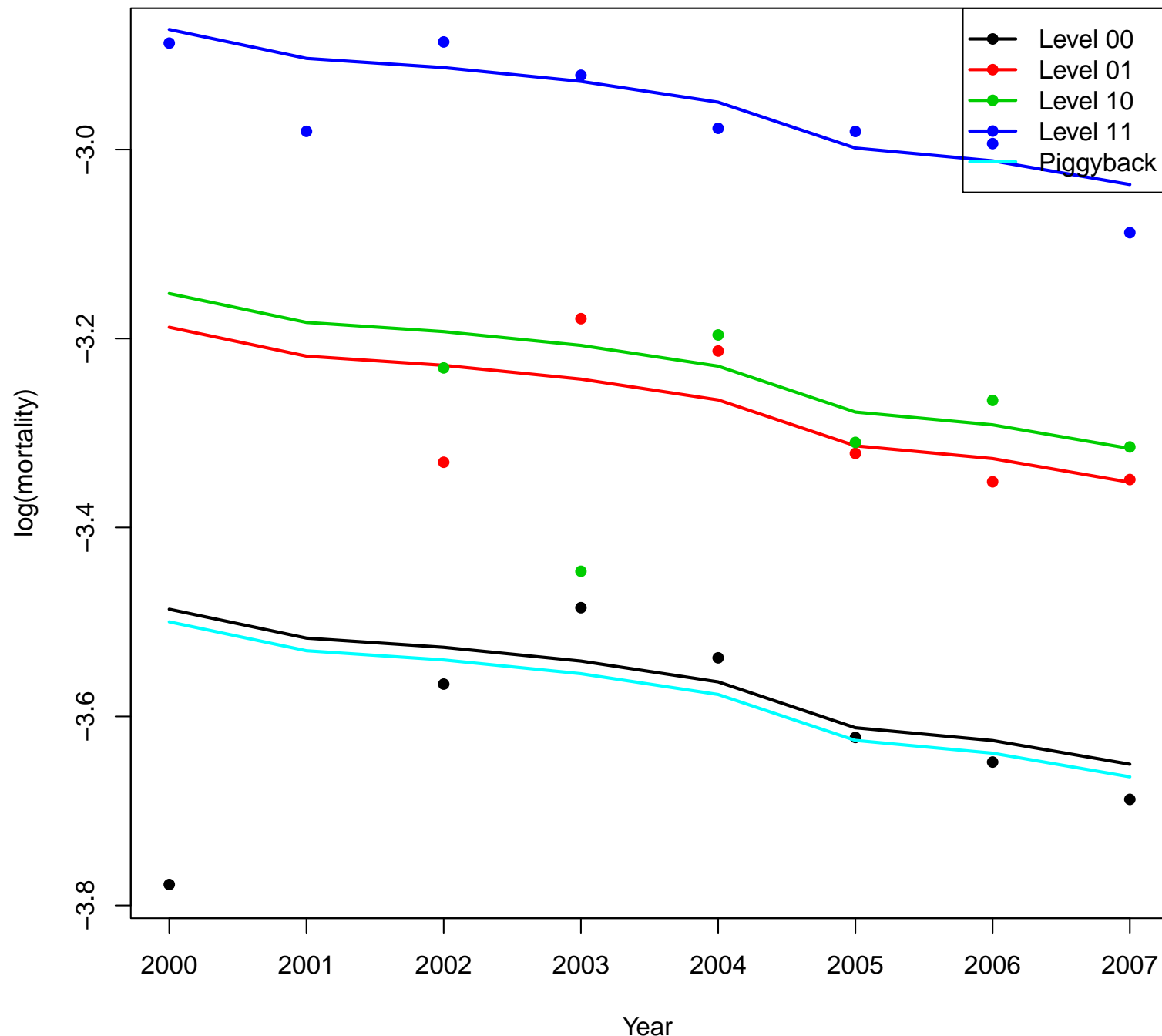
$$\log \tilde{\mu}_{ij} = \log \hat{\mu}_{ij} + \hat{a}_0 + \hat{a}_1 x_i$$

$$60 \leq i \leq 89, 2000 \leq j \leq 2048$$

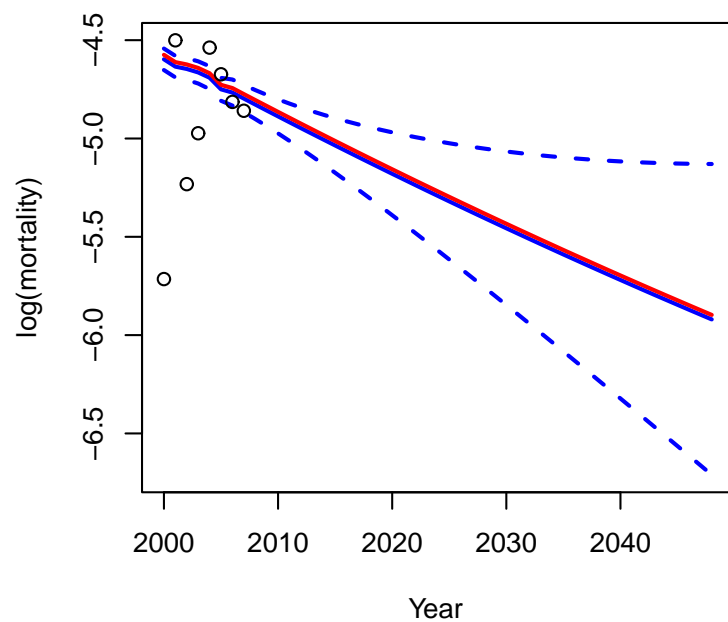
Log(mortality) by age



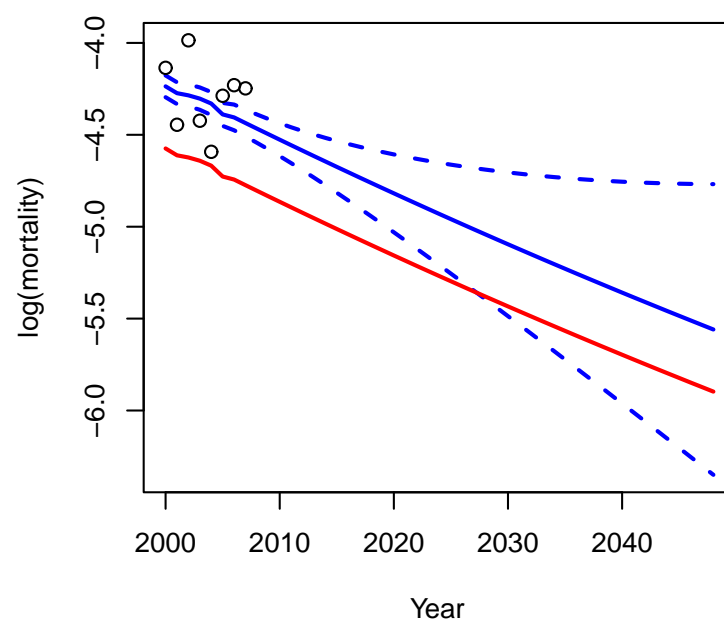
Log(mortality) by year



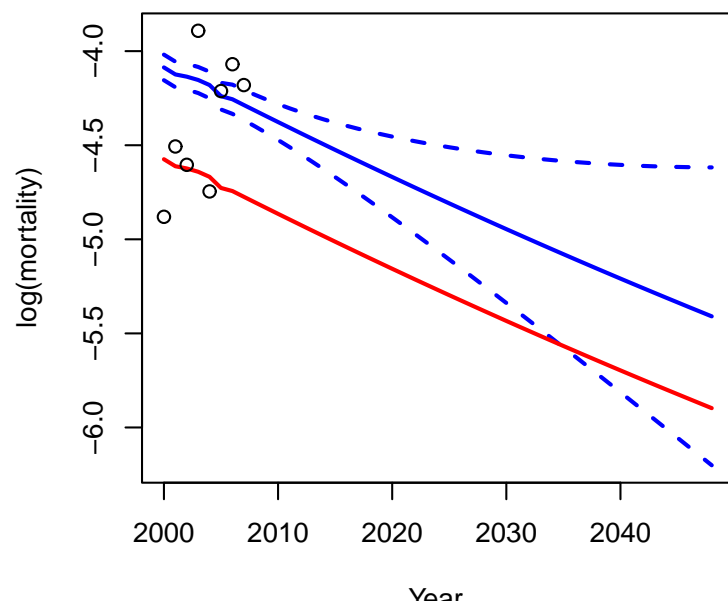
Forecast: age 65, Level 00



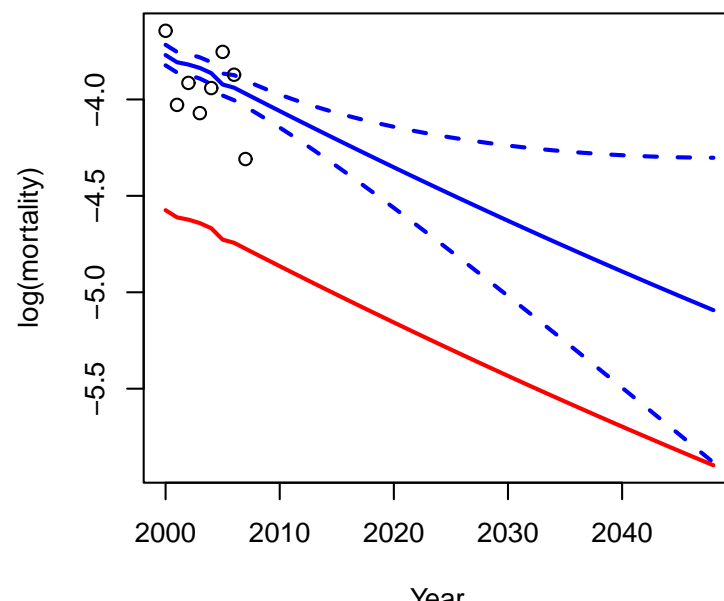
Forecast: age 65, Level 01



Forecast: age 65, Level 10



Forecast: age 65, Level 11



Conclusions

Piggyback models allow the actuary

- To adjust forecasts based on standard data sets (CMI, UK population, etc) for basis risk.
- To make forecasts with CIs with very limited data.

Input requirements

- Mean and standard error sheets from CMI, UK,... forecast.
- Company data by age and year split by relevant factors
 - ★ social class, postcode, etc.

Output format

- Company mean and standard error sheets split by input factors
 - ★ suitable for actuarial tasks: stress testing, valuation, pricing, reserving, etc.

References

- IDC's web page: See *Adjusting for bias in mortality forecasts* in `www.ma.hw.ac.uk/~iain/research/talks/talks.html`
- Longevity blogs: See *Forecasting with limited portfolio data (Sept 7, 2009)* and *Basis risk in mortality projections (Feb 17, 2009)* in `www.longevity.co.uk/site/informationmatrix/`