De Nederlandsche Bank, Amsterdam

Mortality projections

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1. Some basic models

1. Some basic models

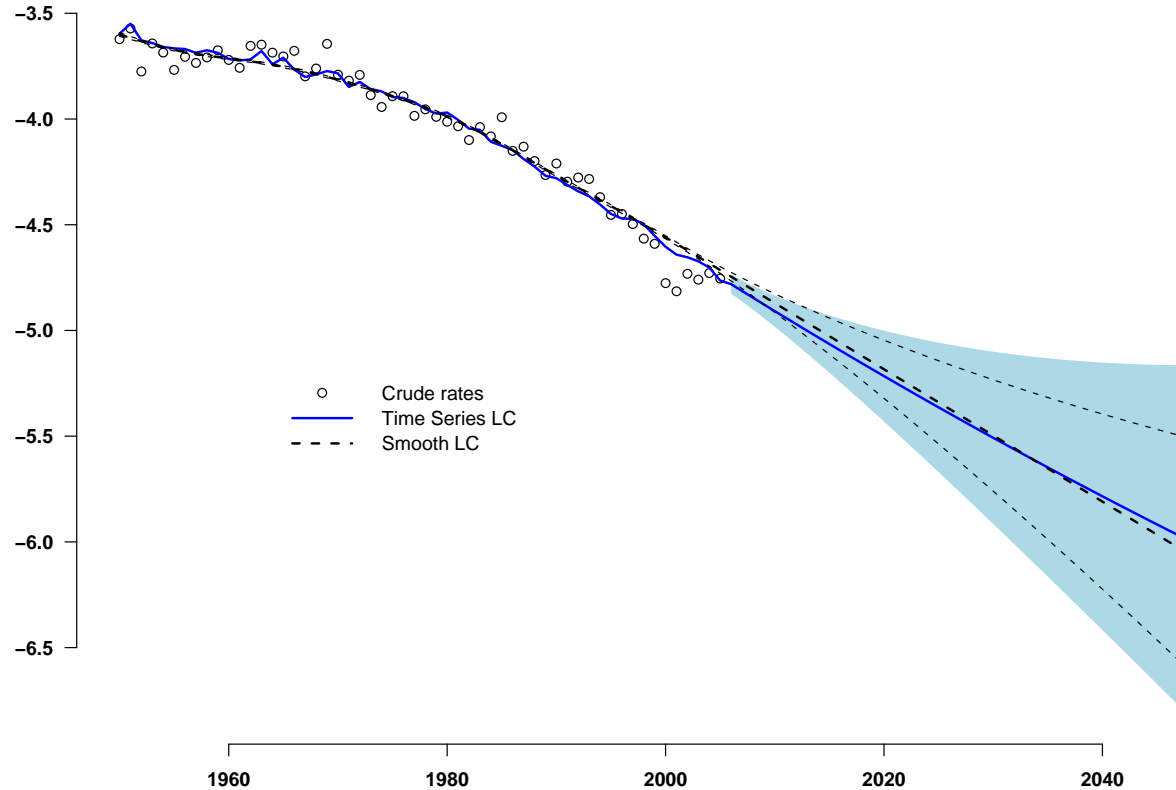| Model	Formula for $\log \mu_{x,y}$
Age-Period	$\alpha_x + \kappa_y$
Age-Period-Cohort	$\alpha_x + \kappa_y + \gamma_{y-x}$
Lee and Carter (1992)	$\alpha_x + \beta_x \kappa_y$
Cairns, Blake and Dowd (2006)	$\kappa_{0,y} + \kappa_{1,y}(x - \bar{x})$

for age x in year y.

2. Mortality analysis v. mortality projection

- Projection models are often over-parameterised:

  — Lee-Carter model often has over 150 parameters.

- Goodness of fit to past data cannot be the sole selection criterion. . .
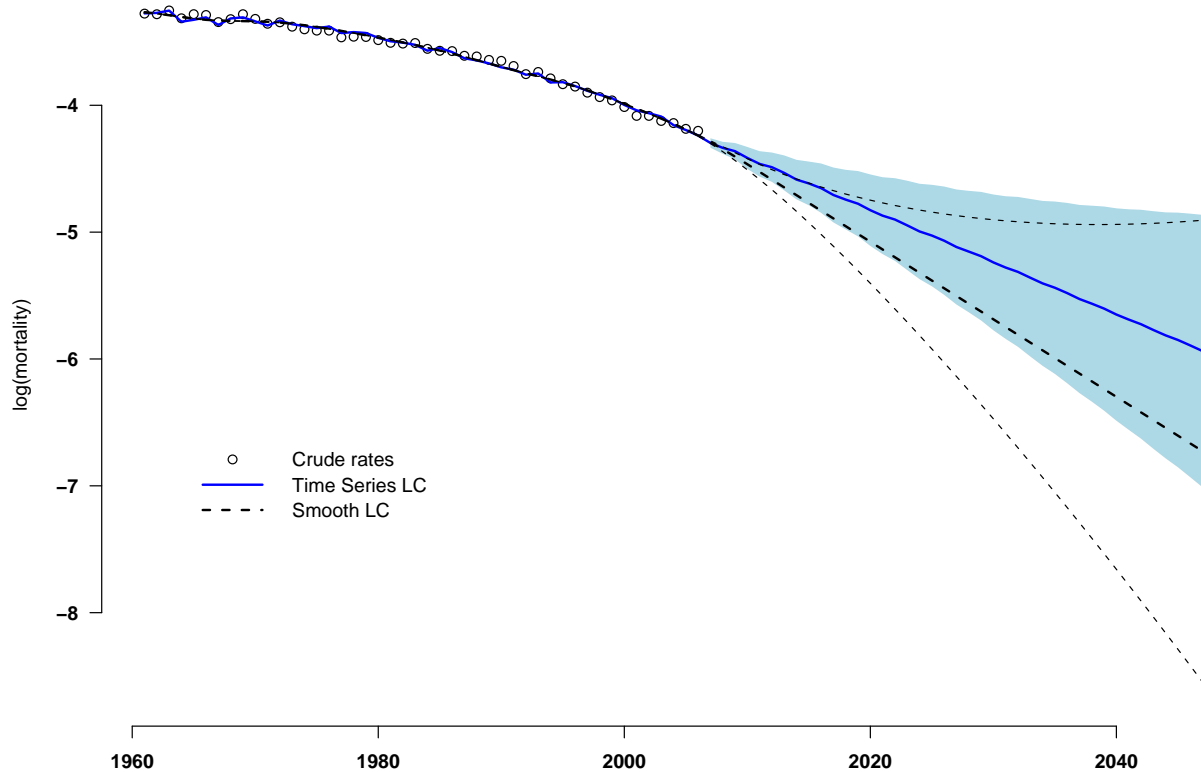
3. Model risk

- Confidence intervals show uncertainty about central projection
- What about uncertainty over the model?

3. Similar projections, different uncertainty

Source: Richards and Currie (2009), Figure 6

3. Different projections and intervals

Source: Richards and Currie (2009), Figure 5

3. Model risk

- Confidence intervals depend on model and data.
- Need multiple models to explore model risk.

3. Which models to use?

- Academic literature contains many projection models...
- ...and criticisms of their weak points!
- Models in refereed journals are open and transparent.
- Use of such models boosts confidence.

4. Conclusions

- Model risk is inability to know if selected model is the right one.
- Multiple models needed to explore model risk.
- Use models from peer-reviewed journals.

References

CAIRNS, A. J. G. AND BLAKE, D. AND DOWD, K. **2006** *A two-factor model for stochastic mortality with parameter uncertainty: theory and calibration*, Journal of Risk and Insurance, **73**, 687–718

LEE, R. D. AND CARTER, L. **1992** *Modelling and forecasting the time series of US mortality*, Journal of the American Statistical Association, **87**, 659–671

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