

I welcome the opportunity to comment on the CMI's new projection model, and I appreciate the presenters coming up to Edinburgh. I have a few comments on the model:

1. If the core model is used with the default settings, then mortality improvements for a given birth cohort will immediately decelerate if the current rate of improvement is higher than the long-term rate entered into the tool. This means that the tool produces an immediate trend-reversal projection for several birth cohorts.
2. If the model is updated annually in line with new data, including new default parameter values for the initial rates of improvement and the various sub-components, how can it act as a “common currency” for comparison? Even if every actuary uses it, and updates his or her projections in line with every release, different actuaries will have different ideas of what the long-term rate of improvement should be and how quick convergence should be. There will be too much variety for the model to function as an effective comparison between bases.
3. In common with all deterministic models, one important thing missing is any kind of statement of uncertainty. The incoming Solvency II framework for insurers demands the consideration of uncertainty, and in past work the CMI has provided models capable of giving statistical statements of uncertainty. It is not obvious how actuaries should assign statements of uncertainty to the scenarios produced by this model.
4. The process of creating the CMI 2010 model is very unusual, and is done in a manner unlike any other I have seen. It first involves first fitting a P-spline model to ONS data, then fitting an APC model to the resulting smoothed mortality rates. The parameters from the APC model are then transposed into the final CMI spreadsheet. We therefore have a first model, whose outputs are fed into a second model, whose fitted parameters are then put into a third model. I confess to being uncomfortable with the idea of treating the output of one model as the data for a second model.
5. In Figure 3 of CMI (2010) a graph claims to show the “contribution to the rate of mortality improvement”. I believe this to be misleading — what I think are pictured are the parameter values from the APC model fitted to the smoothed mortality-improvement rates. This is not the same thing as the contribution of each factor to the rate of mortality improvement, for reasons which I will outline below.

The “contributions” to the rate of mortality improvement are in fact parameters, whose values are heavily dependent on the identifiability constraints specified to fit the APC model. If different constraints were used, then completely different patterns would be charted in Figure 3 yet with the very same names. For example, CMI (2009) says the age and cohort parameters were each separately constrained to sum to zero. As a result most of the mainly positive mortality improvements are assigned to the period factor. However, these identifiability constraints are entirely arbitrary and we could replace the cohort constraint with one to make the period components sum to zero. If we did, the cohort parameters would be largest in Figure 3, with the other two fluctuating around zero.

The difficulties of interpreting fitted parameters in a constrained model are covered in detail by Clayton and Schifflers (1987a, 1987b). I would be interested to know why this particular pair of constraints was chosen rather than any other pair, which would have produced identical fits to the improvements within the APC model yet would have produced very different “contribution components” to the mortality improvements.

CLAYTON, D. AND SCHIFFLERS, E. (1987a) Models for temporal variation in cancer rates I: Age-period and age-cohort models. *Statistics in Medicine* **6**, 449–467.

CLAYTON, D. AND SCHIFFLERS, E. (1987b) Models for temporal variation in cancer rates II: Age-period-cohort models. *Statistics in Medicine* **6**, 469–481.

CONTINUOUS MORTALITY INVESTIGATION (2009) [User Guide for The CMI Mortality Projections Model: ‘CMI 2009’](#), November 2009, page 34.

CONTINUOUS MORTALITY INVESTIGATION (2010) [The CMI Mortality Projections Model, ‘CMI 2010’](#), Working Paper 49, November 2010, page 8.

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