Session 4: Increased Longevity and the Challenge of Determining Qx at Extreme Ages – Part 2
Mortality at Advanced Ages in the United Kingdom

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And

Coping With Longevity: The New German Annuity Valuation Table DAV 2004 R

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In an article by Oeppen and Vaupel (2002) about broken records in life expectancy, it is shown that demographers and others concerned with prospects of life expectancy have tended to be overly pessimistic in their assessments. It was often suggested by experts that life expectancy would soon reach its ultimate level, so future progress would be slow, at best. Yet life expectancy continued to rise, so new higher limits were suggested. And so on. Limits to life expectancy, it seems, are there to be broken.

The two papers reviewed in this discussion are dealing, each in its own way, with the question about the prospects of mortality in low-mortality countries. This is not just an academic question anymore: Both the United Kingdom and Germany have populations with low fertility and increasing longevity. As a result, the number of very old people swells, as their chances of survival to higher ages are improving and large birth cohorts are entering the group of the very old. In the not so distant future, the generation of the baby boomers, though different in timing and size between countries, will further increase the number of the very old. Assessing the levels and trends of mortality among the very old is therefore essential to prepare for future challenges. Both papers make this very clear.

However, the statistical basis for the investigation and analysis of demographic trends among the very old is weak, as is also shown in both papers. How do actuaries and demographers deal with this challenge? Although the scope of the two papers is significantly broader than the question of how to formulate assumptions about future mortality trends, this discussion will concentrate on it.

Gallop and Macdonald Paper

The paper by Gallop and Macdonald analyzes the mortality at advanced ages in the United Kingdom. It provides a succinct and very useful overview about data, methods and approaches used to measure and project mortality for both the general population and the insurance industry. As in other countries, annual estimates of people at very old ages are often unreliable, and even censuses are not able to reliably establish the populations in extreme age bands (p. 3). This is caused, for one, by the still small number of survivors to very old age, although this is changing fast. The difficulties to establishing good statistics about the very old are also related, surprisingly, to age heaping and age misreporting (p. 14), a problem usually more associated with developing countries. Yet another complication is the greater mobility of populations in countries like the United Kingdom or Germany.

Gallop and Macdonald not only discuss the traditional sources of data but also review additional instruments, such as a number of different surveys, as well as

alternative methodologies to establish mortality trends for the oldest old. They present several variants of the extinct generation methods as a promising approach (p. 9). As a result of their investigations, Gallop and Macdonald find that the Kannisto-Thatcher method seems to be the most reliable and promising approach to complement traditional data sources. To this end the Government Actuary's Department is constructing a historical population database based on the Kannisto-Thatcher survival ratio method. Once finished and operational, this database could become a very valuable tool for analyzing mortality at advanced and even extreme ages. Of course, this novel tool has its own set of problems (pp. 14–16).

Finally, one can only agree with the paper's position that the large increases in the number of the elderly and very old in the United Kingdom are bound to generate more demand for the projection of this population segment, which in turn depends critically on a better understanding of the mortality trends among the elderly. For this, the inclusion of alternative data sources like the historical population database will be crucial. To reflect the difficult data situation, Gallop and Macdonald argue convincingly that measures of uncertainty should be included in the mortality projection for both the general population and the insured population.

Paskida and Wolff Paper

The paper by Pasdika and Wolff documents, in some technical detail, the preparation of a new mortality/life table by the German Actuarial Society (Deutsche Aktuarsvereinigung, DAV) as a new basis for a variety of annuities. Their main concerns therefore are the select life tables required by the insurance industry, not the mortality trends for the general population.

As in the case of the United Kingdom, data for the very old often are not available or are unreliable in Germany. The maximum age for which age-specific mortality in the form of life tables is available from the Federal Statistical Office is 89 years (for noncensus years). Even for the much better documented and more reliable data on the insured population, data for ages beyond 100 are insufficient (p. 11). Pasdika and Wolff conclude that the missing empirical basis for mortality at ages 100 and beyond makes it necessary to close the life tables by other means. They tested seven established mortality models for the closing of the life tables: the Gompertz model, the quadratic model, the Heligman-Pollard model, the Weibull model, the Kannisto model with and without a Makeham term, and the full logistic model proposed by Perks with four parameters. They find that the logistic, the Kannisto, a simplified variant of the full logistic model and the quadratic model perform best. It is refreshing to note that the authors reject the quadratic model because of its implausible behavior of a declining

force of mortality after it reaches its peak value, despite its good fit. Comparing the full logistic and the Kannisto model to Japanese data, they finally reject the Kannisto on the grounds that it might produce mortality levels that are too low. This raises an interesting point. The Kannisto model is increasingly favored by demographers, not least because of its simplicity. Yet for the simplicity of having only two or three parameters one has also to pay the price of less flexibility.

On page 11 formulas for the seven mortality models are presented in terms of q_x, the probability of dying. For this a common approximation of the relationship between q_x and the force of mortality μ_x is used. Using the midpoint rule, q_x is often approximated by

$$q_x = 1 - Exp[-\mu_{x+0.5}] .$$

The use of this approximation should be indicated by the authors, and the age reference for the force of mortality in the formulas should be changed to show the movement by half a year. However, as Doray (2002) showed in his paper at an earlier Society of Actuaries conference, exact formulas for the mortality models, which are to be preferred, especially at extreme ages, can be found.

Pasdika and Wolff then discuss different approaches to model future mortality trends. Three models of mortality improvement are presented: the traditional age-specific model, a cohort-based model and a combination of the former. Comparing the performance of the three models, the authors select the traditional model and reject the two other models with a cohort trend. This choice, however, is not obvious. The rejection of the synthesis model rests largely on the sex differentials it implies, or rather the diminishing sex differentials. The authors say that this is implausible, but why? Is it not rather implausible to assume that female advantage over male survival will continue unchanged?

Analysis of the last DAV table (1994 R) against actual population trends revealed that the assumed mortality rates, especially for the elderly, have been significantly underestimated (Figure 1). The authors hint that the reason for the more conservative trend of mortality reduction was the inclusion of all German population life tables (general life tables) since 1871. Since this selection "waters down" the more favorable mortality trends in Germany since the 1970s, the DAV 1994 R table underestimated the trend of reducing mortality. The new DAV 2004 R life table thus acknowledges that profound changes in old age mortality are occurring, with far-reaching consequences (Vaupel and Gowan 1986; Robine and Vaupel 2002; Kannisto et al. 1994). Nevertheless,

the new table DAV 2004 R, assuming a more optimistic view in the short run by using higher reduction factors, still reverts to a lower reduction factor in the long term.

In contrast to the U.K. paper, Pasdika and Wolff do not discuss explicitly the availability and quality of data in Germany. This is regrettable since, unlike the United Kingdom, Germany did not have a recent census. Indeed, the last census was held in West Germany in 1987, almost 20 years ago, and East Germany (then the German Democratic Republic) in 1981. This is bound to have a significant impact on mortality statistics and especially its denominator, the underlying population. The shortcomings of the official statistics are not the fault of the authors, of course, but those remain their challenge. It is therefore necessary to keep in mind the existing limitations with respect to available data. Also, it would be helpful for a better understanding of the paper to learn why it limits its scope to West Germany; the unification with the east and its challenges are never mentioned. Indeed, the German unification, among other things, has resulted in surprisingly fast catch-up of life expectancy in the east, and old age mortality in particular, to levels observed in the west (Scholz and Maier 2003). Such plasticity of mortality also has been observed in other circumstances (Kannisto et al. 1997), a fact that could be useful for the formulation of future trends of longevity.

Conclusion

The models and approaches described in the two papers are elaborate and complex, with many assumptions and settings that are the result of solid analysis, best practice and professional experience. Because of the complexity, it should come as no surprise that the outcomes of the mortality projections sometimes differ quite dramatically when compared between countries (see Pasdika and Wolff, pp. 37-38). However, one is left to wonder how much of the variation between countries is due to "real" differences, and how much is caused by other factors. It is thus a good idea to compare the outcomes of a modeling exercise between similar countries.

If actuaries and demographers are cautious in projecting further reduction mortality, they are not alone. A recent survey in the United Kingdom found that males underestimate their life expectancy by about 4.6 years, and women by almost six years. Adding an optimistic twist, those who have been interviewed also think that they will live longer than other people of their age and sex (O'Brien et al. 2005).

Will the optimists be right, or will the pessimists win? Some of us could survive to find out.

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