In the Heat of Mortality

Some thoughts about the structure of mortality improvements and the quality of current standard mortality tables
by Matthias Börger and Jochen Russ

Introduction

In almost all developed countries, life expectancy has been increasing for many decades. Recent research by James Vaupel from the Max Planck Institute for Demographic Research shows that global record life expectancy at birth has been steadily growing at a rate of 2.5 years per decade over the last 170 years. Here, global record life expectancy measures at any time the then highest life expectancy in the world. Other recent research shows that in the past, life expectancy grew due to a reduction of mortality rates of infants and children; later due to a reduction of mortality rates of "middle aged" people. Currently, the reduction of senior people's mortality rates is the major driver for an increase of life expectancy. This should be of particular interest to the life settlements industry.

The reduction of mortality rates over time is often referred to as mortality improvement. For example, a male person of age 70 today has a lower probability of dying at age 70 than a person who was of age 70 say 10 years ago. Hence, the mortality rate of 70 year-old males has improved (i.e. decreased) over the last 10 years. On a 'macro level', mortality improvement leads to an increase in life expectancy in a population. On a 'micro-level', mortality improvement means the reduction of mortality rates for each age over time.

When LE-providers in the life settlement industry estimate the remaining life expectancy of a person, they typically start with a so-called base table. Then they assess the person's health. If the individual's health status is worse than an average person of the same age, mortality rates from the base table are increased and vice versa. The base tables used by LE providers typically include a projection for future mortality improvement, i.e. they assume that mortality rates decrease over time. If such a projection for future mortality improvement is not appropriate, the projected LE might not be appropriate, either. This effect is of course the more relevant, the longer the LE.

Our research shows that projections for future mortality improvement used in mortality tables in several countries are not adequate. Such projections often seem to use a structure that is inconsistent with the past and also seem to underestimate the level of future improvement.

Heat charts are a suitable tool to visualize such effects: The left part of Figure 1 shows a heat chart of historically observed mortality improvements for US males from 1960 to 2008 by age and calendar year. Yellow areas mark high mortality improvements of about 6%. This occurred e.g. in the late 1900es for ages around 30. On the other hand, e.g. in the late 1960es for people aged 20-40, mortality improvements were negative, i.e. mortality rates increased by 1-2%.

In Figure 1, there are some vertical structures. These are time effects: e.g. mortality improvement was higher in the 1970es than in the 1960es. We can also observe diagonal structures. These are cohort effects. E.g. the cohort born in 1960 starts in the lower left corner of Figure 1 (age 0 in the year 1960) and ends at age 48 in the year 2008. We can see that there are birth cohorts that appear

to have experienced significantly different mortality improvements than neighboring birth cohorts. Finally, there are almost no horizontal structures, i.e. age effects where over a long time certain age groups experience higher or lower mortality improvements than other age groups.

We now look at a projection often used in connection with the VBT 2008-table. Note that this table per se does not include mortality improvement. There are, however, suggested mortality improvements (so-called projection scales) that can be applied to the VBT 2008-table. One of them is projection scale AA. The right part of Figure 1 shows the projected future mortality improvements resulting from projection scale AA. We can see that there are only horizontal structures (age effects) which never occurred in the past. Furthermore, red/yellow areas (high mortality improvement) that actually happened in the past are often continued by blue areas (low mortality improvement) as a projection for the future. So this projection appears to have an implausible structure and to be rather aggressive.

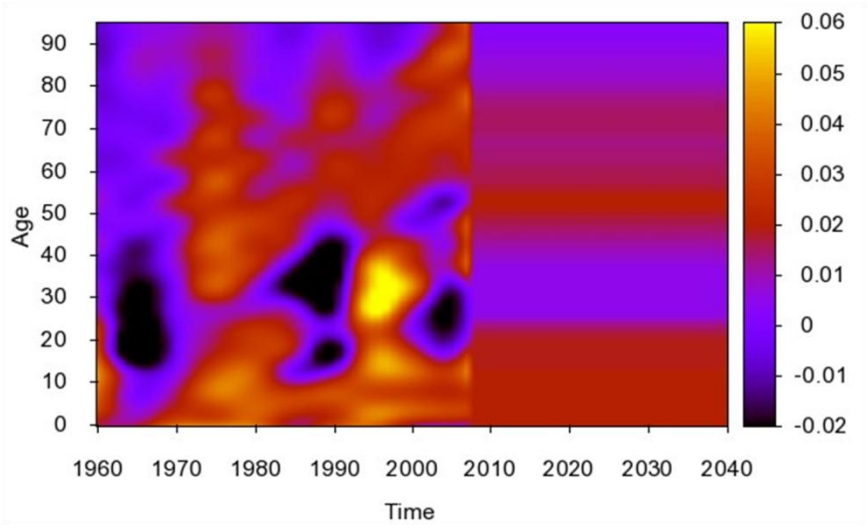

Figure 1: *Historical mortality improvements for US males, 1960 – 2008 and projected future mortality improvement (VBT 2008 table in combination with projection scale AA)*

It is possible to construct mortality tables that use a projection for the future which is more consistent with the past. In the paper "Coherent Projections of Age, Period, and Cohort Dependent Mortality Improvements" by Matthias Börger und Marie-Christine Aleksic, which is available for free download at http://www.ifa-ulm.de/downloads/Aleksic_Boerger_Coherent_Mortality_Projections.PDF, such a table is developed for the German population. It is possible to apply the methodology therein also to US data.