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The Impact of Life: **How Mortality Improvement affects the life insurance industry today.**

By Jay Biehl

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Contributor Jay Biehl is senior vice president of Mortality Pricing and Research with Hannover Life Reassurance Company of America. He may be reached at jay.biehl@hlramerica.com.

Actuaries view the term "mortality improvement" in a special way. In fact, the term sometimes takes on a life of its own as opposed to understanding exactly how it should be viewed in the setting of the overall mortality assumption.

The life insurance industry has various opinions on the definition of the mortality improvement assumption. Life insurers say things like "it's 1% a year for 30 years" or "it's 2% a year for 15 years" and fellow professionals are quick to offer an opinion. But how can anyone have an opinion regarding the mortality improvement assumption unless they understand what base assumption it is being applied to, such as the 7580 Table, 2001 VBT or something else?

Unfortunately, too many times the presumption is that the slope in the base table is "appropriately" set for the business in question, so that the question "what is the mortality improvement assumption?" can adequately stand on its own. It is imperative that the slope of the baseline assumption be appropriately vetted before opining on the level or amount of mortality improvement.

While the slope of the underlying mortality assumption is a key dynamic for understanding the impact of the mortality improvement assumption, the process for setting the baseline assumption is beyond the scope of this article. For now, let's assume the basic slope of the mortality assumption is appropriate such that the mortality improvement assumption does in fact stand on its own. But, let's also put forward a thought process that is somewhat different than how mortality improvement assumptions have generally been set.

Two Considerations

Two basic tenets underlie how insurers think about the mortality improvement assumption, and they form the basis for the somewhat different manner in which the mortality improvement assumption is set.

First, mortality improvement does not affect all age/gender/smoking status subgroups in the same manner. Individuals who recently have been underwritten and classified in the best risk class will have the least expected amount of mortality improvement. In other words, to the extent there are breakthroughs in medical technologies or medical protocols, those advances will have very limited effect on individuals who do not suffer from these impairments.

The opposite is true as well. Those further from the underwriting process and/or in less-preferred or substandard risk classes have a greater chance that medical advances will have an impact on their mortality and mortality improvement will be greater at this end of the scale. However, some technological advances will have an impact on both super-preferred and substandard risks equally. Advances in automobile design, for example, have an impact on motor vehicle deaths as cars are designed to absorb the impact of a crash and dissipate the energy away from the passengers in the car.

Second, the insured population will exhibit mortality improvement faster than the population in general. There is a general socioeconomic effect at work—insured lives obtain more tangible benefits than does the population in total because they use these medical and technological advances more effectively. Therefore, there's a practical limitation in benefits obtained through these advances as we move from standard and substandard insureds to the general population.

With those as the basic tenets, let's turn to the specifics. It's important to differentiate between the "best estimate" view and what to use as a "pricing assumption." As a working definition, the best-estimate assumption is the 50/50 assumption—the expected "mean" outcome. Due to the limitations in understanding future impacts to the force of mortality, when setting the pricing assumption for mortality improvement it is common to introduce some conservatism to the best-estimate assumption. Two steps are involved: setting the best estimate; and then considering how to transform the best estimate into a pricing assumption.

Start with the amount of observed population improvement from 1980 to 2007 obtained through the Human

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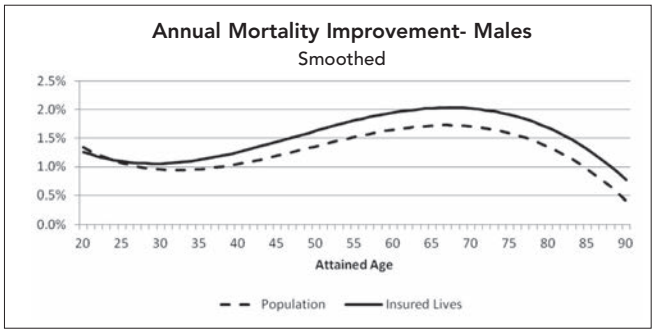
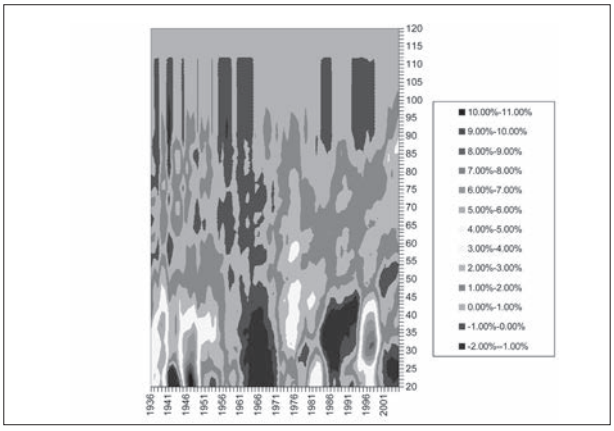
Jay Biehl, FSA, MAAA, is senior vice president of Mortality Pricing and Research with Hannover Life Reassurance Company of America. he can be contacted at jay.biehl@hlramerica.com.

Mortality Database, and adjust for both the impact of smoking cessation through this period and the socio-economic differences between the general population and an insured-lives population. The data produces a curve that looks like the one below. (The chart focuses on the male, non-tobacco risk class. The other risk classes will follow a similar thought process.)



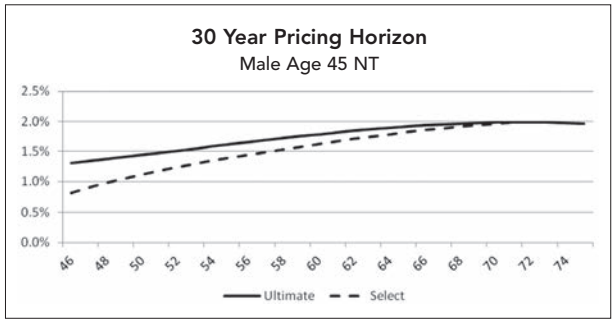
The shape of this curve poses the question of whether mortality improvement is shaped entirely by the attained age or if there has been a benefit of being at the "right age at the right time." In other words, is there a cohort effect as well as an attained-age effect? One of the best ways to observe this phenomenon is to use a "heat map" of the improvement factors by age and time period:

U.S. Male Data – Human Mortality Database



This view demonstrates that the improvement is driven by attained age, time period and on a cohort basis (diagonally). As such, a cohort effect was introduced that shifts the pure attained curve to the right; how far depends on one's perspective of how much the cohort effect is the driver of the observed improvement and how much is viewed to come as a result of an attained-age effect. (A five-year cohort shift has been implemented here.)

Now let's illustrate a 45-year-old male non-tobacco risk. If we shift the earlier Mortality Improvement graph to the right by five years and examine age 45, the portion of the curve that becomes relevant looks like this:



The blue line is labeled as the 'ultimate' mortality improvement, defined as the best estimate assuming the effects of underwriting have worn off. The red line represents the discount applied to the ultimate best estimate due to the implication of the first basic tenet that the expected amount of improvement closest to the time of underwriting is discounted the most, with the impact being graded off over time.

Clearly the distance between these lines is dependent on a few items. First, the amount of underwriting that has occurred (that is, fully underwritten versus simplified issue). Second, the actual discount was driven by how much was perceived to be eliminated by the underwriting process. Third, the curves grade together over the length of the commonly viewed select period—in this case, 25 years. It is important to understand that the red line represents the best-estimate view of mortality improvement for a "fully" underwritten product issued to a 45-year-old male non-tobacco user.

Generally, pricing assumptions are based on the "best estimate" assumptions; then the premium is calculated in a way that reflects the underlying risk in the product and provides an appropriate risk/return margin for the company.

The mortality improvement assumption tends to vary from this mentality for a few reasons. First, it is

extremely difficult to fully articulate the amount of mortality improvement that has been observed in an insured-lives population because there are a number of minor changes in underwriting protocols, risk-class distributions and ceding company contributions (if using industry-available data) that can have a significant impact.

Second, mortality improvement doesn't occur in a nice smooth pattern from year to year based on the timing of medical developments along with the speed of introducing those advancements into the insured population. As such, while the 30-Year Pricing Horizon curve may well represent the long-term best estimate, shorter periods may exhibit a very different perspective.

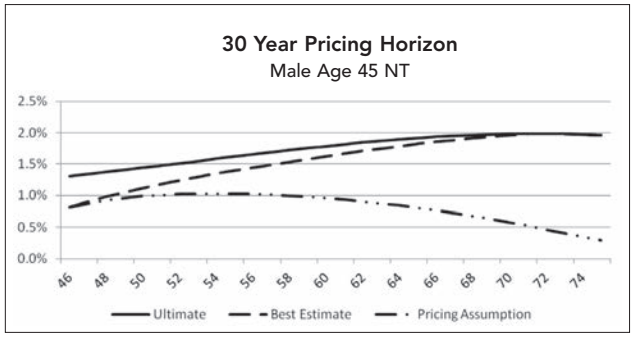
Finally, while there is every reason to believe that mortality improvement will continue, given that it has existed for hundreds of years, the reality is that any mortality improvement assumption is a bit of a "bet" relative to the ongoing penetration of known developments and the introduction of new developments. In addition, there are clearly items that have (and will) move the needle backward. The early years of the AIDS epidemic had a material impact on mortality improvement, affecting some segments of the insured-lives population more than others—for example, males versus females.

Currently, there are significant concerns about obesity in the United States. Just because there has been mortality improvement historically that should be expected prospectively, to ignore the impact of forces that deteriorate mortality isn't a responsible position.

This leads to the need to explicitly introduce conservatism into the best estimate in order to reach a pricing assumption.

One of the ways to accomplish this is to increase the level of conservatism by policy duration starting with the best-estimate assumption. We are effectively building a bridge from one basis to the other by considering the best estimate and the overall amount of conservatism desired by the organization.

In the end, insurers should recognize that while mortality has improved for hundreds of years, in reality it has occurred in a manner that is anything but smooth from calendar year to calendar year. One can think of move-



ments in the stock market as an analogy to changes in mortality. Generally, we know which direction each of these will move, but the shorter the period of time, the greater the chance the assumption and the reality will vary and may vary materially.

"...there are significant concerns about obesity in the United States. Just because there has been mortality improvement historically that should be expected prospectively, to ignore the impact of forces that deteriorate mortality isn't a responsible position."

As such, the improvement assumption is ultimately a short-term bet as to what will happen over what appears to be a fairly long time (the pricing horizon), but in fact is relatively short in terms of the hundreds of years that have shaped our opinion as to how mortality expectations change over time. While we can build a framework around setting the mortality improvement assumption, at the end of the day the question is really very simple: How big of a bet are you willing to make?

Key Points

The Situation: Mortality Improvement assumption is not a simple equation.

What Could Happen: Any mortality improvement assumption is a bit of a 'bet' relative to the ongoing penetration of known developments and the introduction of new developments, such as the appearance of the AIDS epidemic.

What Needs to Happen: Better understanding of Mortality Improvement assumption, final assumption, and best estimate approach. □