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# Investigating the Difference in Mortality Estimates between the Social Security Administration Trustees' Report and the Human Mortality Database

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The Social Security Administration (SSA) and Human Mortality Database (HMD) life table series for the United States are two of the most widely used sets of mortality indicators at the national level. Life table values differ between the two sources, and the gap has been growing progressively since the early 1980s: The difference in life expectancy at age 65 has increased to 0.4 years in 2014. Though this difference may not appear significant, it deserves to be fully understood because SSA mortality projections are used to determine the long-term solvency of the Social Security trust funds, as well as for other government programs, such as Medicare and Medicaid.

The two organizations use different data and different methods to construct their estimates. In particular, the HMD relies on national statistics from the vital registration system and the Census Bureau, while the SSA uses enrollment data from the Centers for Medicare and Medicaid Services (CMS) to estimate mortality at ages 65 and older and national statistics for those younger than 65. The goal of the study was to determine whether the gap in the life expectancy at age 65 between the HMD and the SSA is attributable to differences in data or to differences in methods.

The methods implemented by the SSA's Office of the Chief Actuary to construct annual complete life tables can be summarized as follows. The census population counts are as of midyear, and midyear Medicare counts are estimated by averaging the January 1st counts received from CMS. Rates are computed by dividing the number of deaths for each sex and five-year age groups by the corresponding midyear populations, using census estimates for ages younger than 65 and Medicare data for ages 65 years and older. The rates are converted into probabilities of dying with classic demographic methods. A mathematical formula initially developed by Beers is applied to the probabilities of death in five-year age groups to compute single-year of age probabilities up to 94 years. Because of issue of reliability as regards age reports at higher ages, probabilities of death are assumed to increase at a fixed sex-specific rate above 94 years. Except for the fact that only national statistics are used

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(death certificates and the census annual population estimates), the methods implemented in the HMD are very similar to those of the SSA to estimate mortality at ages below 80 years. At 80 years and older, the HMD implements a combination of extinct cohort and survival ratio methods to estimate single year of age population counts from the deaths only. This process is expected to produce more robust mortality estimates because age reports have been shown to be more reliable in vital statistics than in the census and because, in this way, the deaths and exposures are derived from the same source, thus avoiding inconsistencies in the numerators and denominators for the rates. The second specific method implemented by HMD is to adjust the mortality rates at very high ages to avoid the large year-to-year fluctuations associated with very small counts. The adjustment is carried out using the Kannisto model, a logistic function with an asymptote at one that is fitted to the death rates for ages 80 and older, separately for men and for women.

The HMD methods have been designed to process national statistics and do not adapt well to a mix of data. Consequently, applying the HMD methods to national statistics for ages younger than 65 years, but to CMS data for ages 65 years and older yields very unreasonable results which are not informative for our purpose. However, with support from the SSA, we were able to faithfully apply the SSA methods on the HMD data. We found that the methods do not make any difference to the size of the gap in mortality estimation between SSA and HMD. Thus, that the gap is entirely due to differences in the data, rather than in the methods. The study also determined that the gap resulted mostly from lower mortality rates at ages 65 and older up to about 2005 to 2006, but that the growing divergence since then is nearly entirely due to increasingly lower mortality at ages older than 85. The pattern was found to be similar for men and for women, though the gap is slightly larger for the latter.

Further work revealed that, while the total death counts by year for ages 65 years and older in the SSA compared to the HMD fluctuates around 96 to 97 percent for all years since 1988, the ratio of the SSA to HMD population counts has declined from about 94 percent in 1988 to less than 91 percent in 2014. This phenomenon could result from an over-estimation of the population in the HMD or an increasingly restricted sample in the CMS data. Our ability to differentiate between these hypotheses is limited by the lack of appropriate data or additional information. Our results warrant further investigation into the data used by the HMD and SSA, both in terms of coverage/representativeness and the quality of age reporting. Further collaboration with the Office of the Chief Actuary of the Social Security Administration is being discussed to explore differences in the data sources in more depth. With this goal in mind, access to the Centers for Medicare and Medicaid Services database and to all of the variables that are used to extract the subsample used by the SSA is essential to understand the observed discrepancy in mortality estimation.

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