Why are We Getting Worse?

A Historical Accounting of Modern US Life Expectancy Disadvantage

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1 Motivation

Americans face shorter lives than those in other developed, high-income countries. US life expectancy at birth currently ranks in the mid-30s worldwide, a full year below the OECD member average and trailing top performing countries by over four years {1, 2}. Americans may fare a bit better if they survive to older ages: conditional life expectancies at 50 or 60 years are closer to the average of peer countries {2}, and at the oldest ages (75+ years) Americans may even experience an advantage {3, 4}. Aside from these quirks at older ages, Americans simply do not live as long as their peers in other wealthy nations.

However, the US did not always experience the overall life expectancy disadvantage we see today. In the 1960s US life expectancy at birth was above the OECD member average {1}, but in the early 1980s US gains in life expectancy slowed abruptly (more for women) and peer countries started pulling away from the US {3, 4}. What caused this change of trajectory? While a body of research has compared mortality trends in developed countries, and several recent reports have broadly documented contemporary relative mortality conditions in the US {3–5}, key features of the US mortality disadvantage, its history and progression, and its causes remain unexplained and worth examining. In this paper we propose a thorough accounting of the US life expectancy disadvantage that addresses some limitations of previous work.

Full Age-Range Analysis Recent reports suggests the main contributors to the comparative US slowdown in conditional life expectancy at age 50 appear to be lung cancer, respiratory diseases, and mental and nervous system diseases {3, 4}. While these findings are useful, the heavy focus in this area on mortality at older ages (50+) disregards the contributions of deaths earlier in life. The relative disadvantage of US survival to age 50, or even the well-documented high relative infant mortality rate in the US, suggests the necessity of examining the age- and cause-specific components of life expectancy across the life course. This may be particularly important for the conceptual and empirical distinction between age- and cause-specific contributions to the *cross-sectional* US life expectancy disadvantage versus those that contribute to the *change* in disadvantage over time.

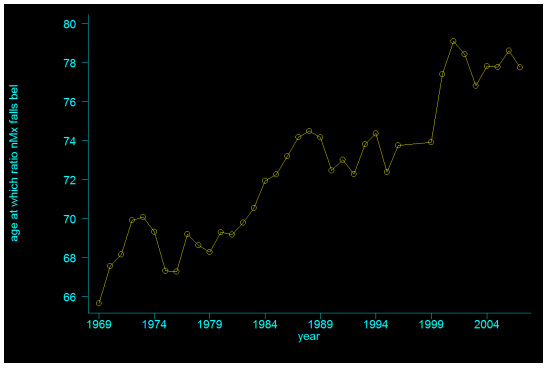
Advantage at Oldest Ages Americans appear to experience a mortality *advantage* at older ages (unseen earlier in the life course), currently around age 78. Rough inspection of this peculiarity over time suggests that the age at which such an advantage appears (i.e., age at which nMx values fall below the average of high-income countries) is increasing (see Figure 1). Why is this? Is it a cohort effect working through the life table? A real shift in relative US mortality? An artifact of changing patterns of age misreporting at the oldest ages? Will the cross-over continue to increase and eventually "age out" and disappear? As part of this proposal we will also analyze age-period-cohort effects of relative US mortality/life expectancy in explaining this trend.

2 Proposal

Data We use country age-specific mortality rates from the Human Mortality Database and apply corresponding country age-specific distributions of causes of death from the World Health Organization to generate a time series of age-by-cause life tables from 1970 to 2005 for: (a) the US, (b) a set of 16 high-income comparison countries[1], and

[1]Comparison countries: (1) Australia; (2) Austria; (3) Canada; (4) Denmark; (5) Finland; (6) France; (7) Germany; (8) Italy; (9) Japan; (10) Netherlands; (11) Norway; (12) Portugal; (13) Spain; (14) Sweden; (15) Switzerland; and (16) United Kingdom.

Figure 1: *Age of United States Relative Mortality Advantage Cross-Over (1970-2005)*



(c) a set of hypothetical scenarios for analysis and constructing counterfactuals. These are all prepared separately by sex, with causes of death collapsed into ten major ICD categories plus a residual.[2]

We construct three population time series to compare the mortality performance of the US. First, we create a "superpopulation" of all comparison countries (not including the US) from 1970 to 2005. This population combines the mortality experiences of peer nations, functioning like a composite/weighted average. Then we create two hypothetical population time series that represent "optimal" and "worst" mortality performance, respectively. For each year (1970 to 2005) we create two hypothetical life tables by selecting the lowest and highest age-specific mortality rates among the 16 comparison countries and the US (and their corresponding cause of death distributions). These, particularly the "optimal" life table, serve as bounds on what has been observed in high-income countries and highlight areas of potential US improvement. In addition to synthetic cohort time series, we will also create true cohort life tables where possible.

Analyses We will decompose life expectancy into age- and cause-specific direct, indirect, and interaction components according to the rubric proposed by Arriaga {6}. We use the superpopulation and optimal and worst constructs to compare US life expectancy. For each cross-sectional comparison (1970 to 2005) the decomposition returns a matrix of age- and cause- specific contributions to the life expectancy gap. We extend this logic to include change over time and create difference-in-difference estimates of the age- and cause-specific contributions to *change* in the US life expectancy disadvantage.

In addition to the largely descriptive presentation of raw decomposition results, we will model the products of these decompositions over time, either using the constructed super/optimal/worst populations or a full model where the US is compared to each peer country each year. This will yield several benefits in addressing both the overall US life expectancy disadvantage—and its expansion—and the apparent mortality cross-over at older ages. First, we will be able to summarize the age- and cause-specific contributions to within- and across-year US life expectancy disadvantage in a coherent framework. Second, we will be able to forecast the future of the US life expectancy disadvantage (i.e., Given data and trends until 1990, what would we have expected life expectancy to be in 2000 or 2005? How off would the predictions be and, using similar corrections, could we forecast future trends in life expectancy within some bounds of confidence?).

3 Preliminary Results

Below are two figures showing preliminary results from the life expectancy decomposition analyses presented as heatmaps. Figure 2 shows the cross-sectional decomposition of life expectancy in 1970 and 2005 by age- and cause-specific contributions. Figure 3 shows the difference-in-difference decomposition of the age- and cause-specific contributions to *change* in US life expectancy disadvantage over that same time period.

[2]Collapsed cause of death categories: (1) Neoplasms; (2) Circulatory; (3) Respiratory; (4) Digestive; (5) Diabetes and metabolic; (6) Infections; (7) Accidents, Homicide, Suicide, and External; (8) Senility and Ill-defined; (9) Pregnancy-related; (10) Infancy; (11) Residual. See Figures 2 and 3.

Figure 2: *Decomposition of Life Expectancy, United States Compared to Composite Average, By Sex (1970 and 2005)*

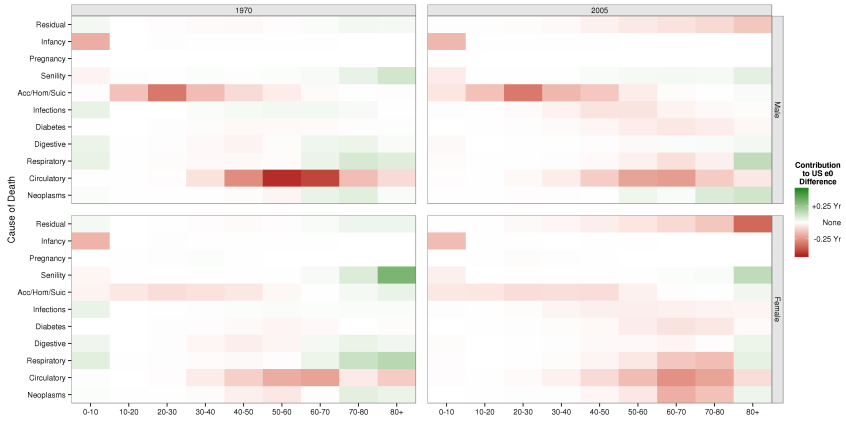
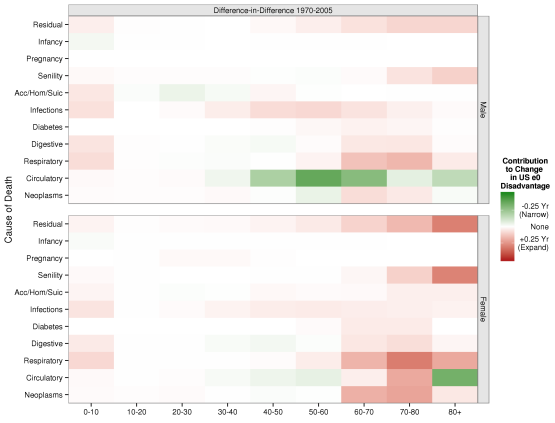


Figure 3: *Decomposition of Change in Life Expectancy, United States Compared to Composite Average, By Sex (1970-2005)*



One feature readily apparent in Figure 2 is that not all age- and cause-specific contributions in the decomposition are negative. On balance they result in a net US disadvantage, but each cross-sectional decomposition contains a mixture of US advantage and disadvantage. Also obvious from Figure 2 is that the sign and magnitude of some of these advantages and disadvantages changes over time.

Consider the example of cardiovascular deaths for men ages 30-80. Figure 2 shows that in both 1970 and 2005, the relatively poor performance of the US in this area contributed to the US life expectancy disadvantage (shown as gradations of red). However, Figure 3 recasts these data in a difference-in-difference context such that while the cross-sectional findings are true, cardiovascular deaths for men ages 30-80 contributed *less* to the disadvantage in life expectancy in 2005 as they did in 1970 (less red in 2005 than 1970, thus green). That is, relative changes in this area caused the life expectancy gap to narrow between the US and other high-income countries across the observation window. Conversely, in 1970 respiratory mortality was slightly *better* for US males and females but became a net contributor to the US life expectancy disadvantage by 2005, the difference-in-difference result being that this cause of death contributed to a widening life expectancy gap.

References

[1] Organisation for Economic Cooperation and Development, *OECD Factbook 2013: Economic, Environmental and Social Statistics*. OECD Publishing, 2013.

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[3] E. M. Crimmins, S. H. Preston, and B. Cohen, eds., *International Differences in Mortality at Older Ages: Dimensions and Sources*. The National Academies Press, 2011.

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[6] E. E. Arriaga, "Measuring and Explaining the Change in Life Expectancies," *Demography*, vol. 21, pp. 83–96, 1984.