

## **ACCURACY OF MORTALITY PROJECTIONS IN TRUSTEES REPORTS**

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Making accurate projections of future experience is always challenging. Even with the best-known methods, conditions that determine experience and trends can change in ways that are impossible to anticipate. In addition, experience can fluctuate markedly from one period to the next, making “turning points” in trends even harder to detect until well after they have happened. While cycles in some concepts are well understood (like those related directly to the state of the economy), projecting the timing and incidence of economic cycles is more art than science. Projections dependent on economic variables are therefore inherently uncertain.

Mortality projections present all of these challenges and more, because there is no understood basis for predicting cycles in the rate of mortality improvement. While cyclic experience has dominated the rate of mortality improvement over the past 50 years and more, there is no assurance that a period of unusually strong or weak mortality improvement will be followed by a “correction” or by a persistent and indefinite continuation of the latest trend.

This note presents a brief analysis of projected “period” life expectancy at age 65 from the 1982 through 2014 Trustees Reports. Mortality over age 65 is of prime consideration for estimating the cost of Social Security and Medicare because most beneficiaries are over age 65 and most deaths occur over age 65. Life tables for 2009 show that more than 80 percent of men and over 85 percent of women who survive to adulthood will die after attaining age 65.

Mortality rates at age 65 and over used in the Trustees Reports are based on experience derived from the Medicare-enrolled population. These data have the following great advantages:

1. Age accuracy (Medicare requires proof of age when enrolling);
2. Representation of almost the entire Social Security area population; and
3. Both numbers of deaths and “exposed” lives are from a single, consistent source.

Death rates based on deaths and exposed population counts from different sources, as used in the Human

Mortality Database (HMDB), are subject to errors that are avoided with the Medicare-enrollee population. The increase in life expectancy at age 65 from 1982 to 2010 as measured in the HMDB is 0.4 year greater than that tabulated using the Medicare-enrollee data for both males and females. (See appendix for this comparison.)

Life expectancy at any age is the estimated average remaining years of life at that age. Period life expectancy is a convenient and often used way to summarize mortality experience, one year at a time, reflecting death rates for all persons in the population at all ages in the specific year. Care should be taken in interpreting trends in life expectancy because of the disproportionate weighting placed on ages just above the age at which expectancy is calculated. For this reason, consideration of age-specific or age-adjusted death rates is a superior way to analyze mortality trend. However, the shortcoming of life expectancy as an indicator of mortality change is much smaller at age 65 than at younger ages, particularly at birth.

Because near-term projections of mortality for Trustees Reports are largely extrapolations of past trend using specific formulas, it is not surprising that near-term projections have been least accurate when the most recently available data precedes a turning point in the trend rate of mortality. Mortality declined (life expectancy increased) rapidly from 1968 to 1982, and projections of life expectancy made shortly after 1982 showed continued rapid rise. In the very near term, it is not generally possible to know when a true turning point in trend has occurred. Mortality improvement slowed markedly from 1982 through about 1999, making projections (based significantly on experience prior to 1982) overestimate gains in life expectancy.

After about 1999, mortality improvement started to rise at a relatively rapid rate compared to the period from 1982 to 1999. As a result, near-term projections of life expectancy (based largely on experience from years prior to 2000) underestimated near-term gains in life expectancy. Near-term projections starting around 2013 more fully reflect the recent relatively rapid improvement in mortality from 1999 through 2010 and, as a result, show more rapid increase in projected life expectancy for the next several years. Data available from Medicare following the 2014 Trustees Report for 2011

and 2012 are very close to the estimates for those years in the 2014 Trustees Report. Whether another turning point is near, or has in fact already happened is unknown. Future experience is highly unlikely to be “smooth”. The future will almost certainly include alternating periods of slow and fast mortality improvement as in the past. As a result, near-term mortality projections will always be uncertain.

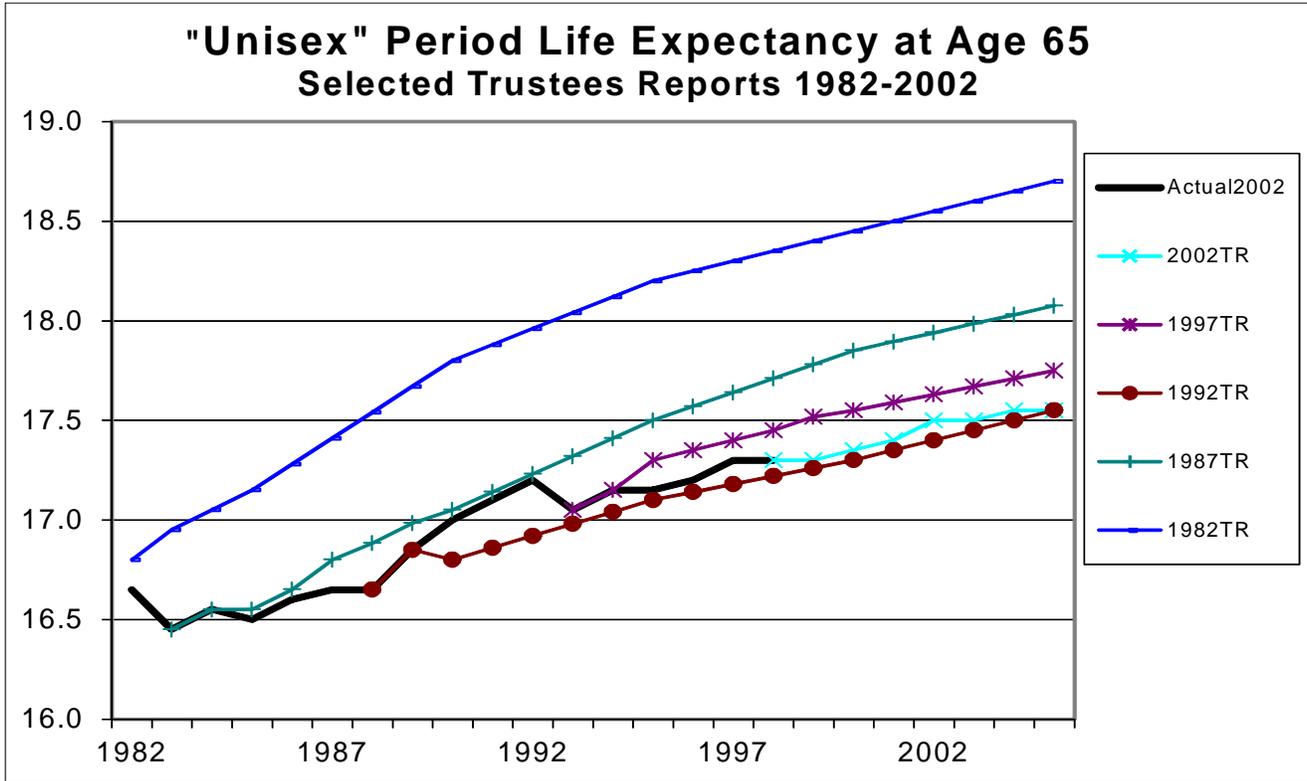
Finally, as challenging as near-term mortality projections are, longer-term projections are at least as uncertain. There is a temptation to simply assume that the average rate of change in mortality over some past period will be a good predictor of the long-term future ultimate rate of change. However, changing conditions for a multitude of factors make such simple extrapolation of past trends very problematic. Known and expected recent and future changes in technology, human behavior, and national capacity for increased spending on medical research and services must be considered in developing credible assumptions for future mortality improvement. The following internet sites provide additional details on mortality projections used in Trustees Reports:

- [http://www.ssa.gov/OACT/TR/2014/2014\\_Long-Range\\_Demographic\\_Assumptions.pdf](http://www.ssa.gov/OACT/TR/2014/2014_Long-Range_Demographic_Assumptions.pdf)
- [http://www.ssa.gov/OACT/TR/2014/documentation\\_2014.pdf](http://www.ssa.gov/OACT/TR/2014/documentation_2014.pdf).

## **Accuracy of Near-Term Mortality Projections in the 1982 through 2002 Trustees Reports**

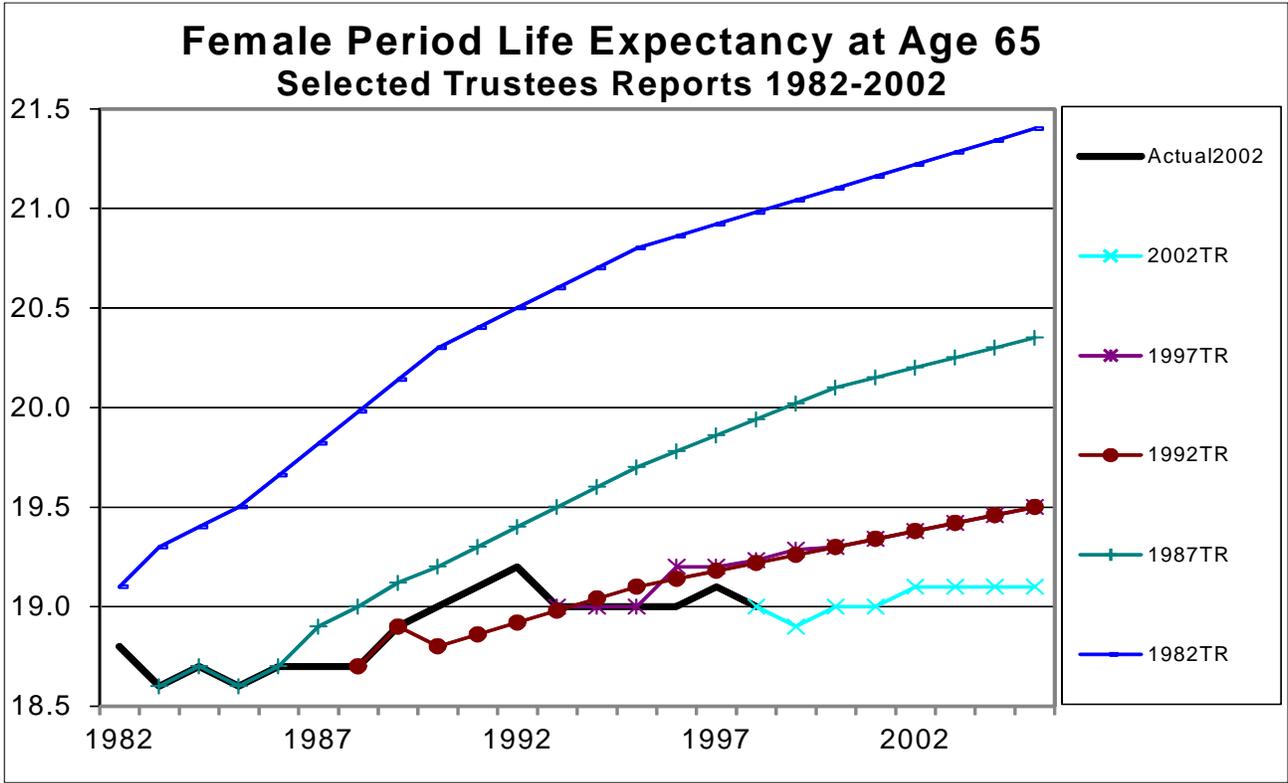
Mortality for ages 65 and older declined at an average annual rate of 0.87 percent per year from 1954 to 2010. This period includes alternating times of relatively slow and rapid improvement in mortality. Following large improvement after World War II, the age-sex-adjusted mortality rate for ages 65 and older improved at an average annual rate of only 0.02 percent from 1954 to 1968. Between 1968 and 1982, the age-sex-adjusted death rate for age 65 and older declined at an extraordinary annual rate of 1.86 percent as Medicare and Medicaid were implemented. From 1982 to 1999, the rate declined at an average of just 0.25 percent per year. From 1999 to 2010, the rate declined relatively rapidly again, at an average of 1.62 percent per year.

Near-term projections of mortality improvement actually begin about four years prior to the year each Trustees Report is issued. Thus, values for life expectancy shown in any Trustees Report include actual data only through about the fourth year prior to the report date. The figure below compares actual unisex period life expectancy at age 65 for 1982 through 1998 (as measured at the time of the 2002 report) with projections of these life expectancies from the 1982, 1987, 1992, 1997 and 2002 Trustees Reports. With rapid mortality improvement from 1968 through 1982, it is not surprising that the projections of unisex period life expectancy at age 65 for the 1982 report significantly exceeded actual experience realized later, as was also the case for projections in the 1987 report. The figure also shows that near-term projected life expectancy for the 1992, 1997, and 2002 reports more closely followed the trend after 1982 through 1998.



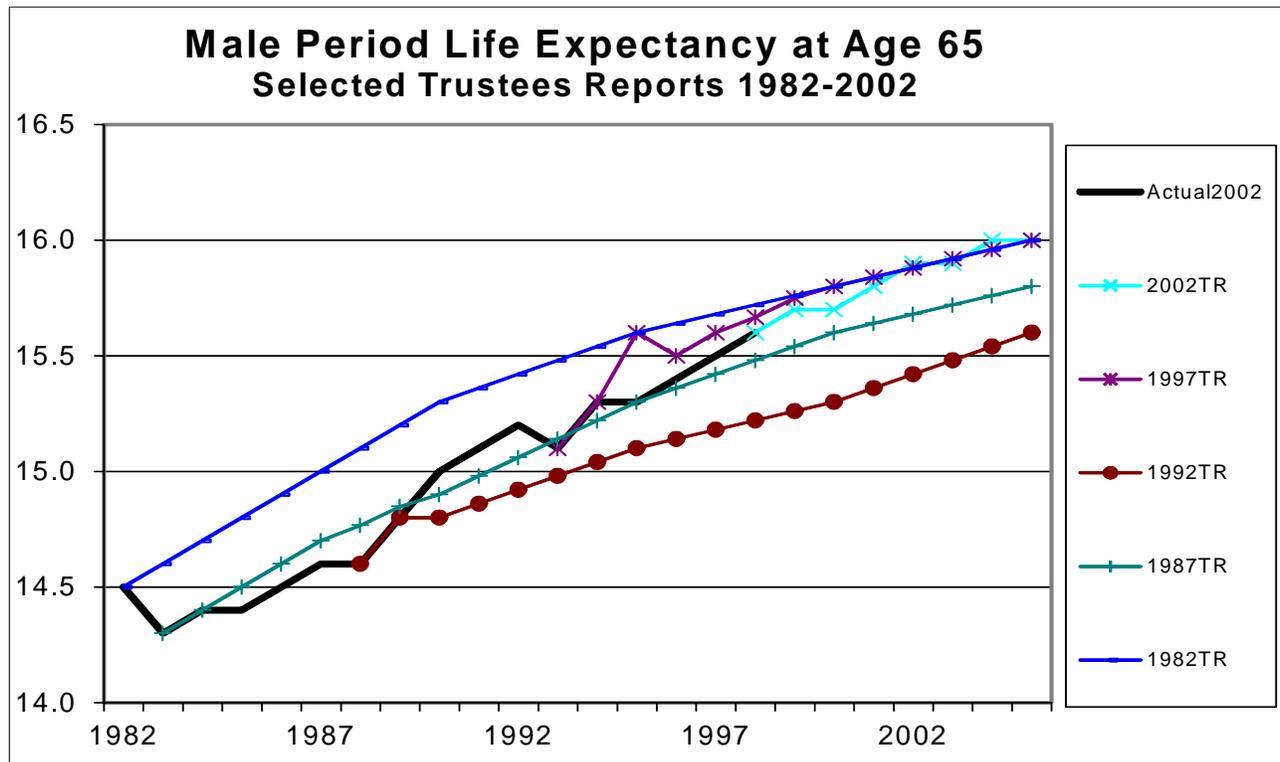
The following two figures show the same information as the above figure, but the life expectancies at age 65 are for females and males, respectively. The experience for male life expectancy at age 65 showed a rapid increase from 1968 to 1982, and was more rapid for females.

After 1982, mortality improvement over age 65 diminished sharply, particularly for females. As a result, near-term projected life expectancy at age 65 in the 1982 and 1987 reports far exceeded later realized experience for females.



Because near-term projections largely reflect recent experience, the projections of life expectancy at age 65 for females in the 1992, 1997, and 2002 reports closely aligned with actual experience from 1982 through 1998.

For males, mortality improvement over age 65 remained relatively strong after 1982 and, as a result, the near-term projections of male life expectancy at age 65 were reasonably close to the trend in actual realized experience through 1998, the last year of actual data known at the time of the 2002 report.

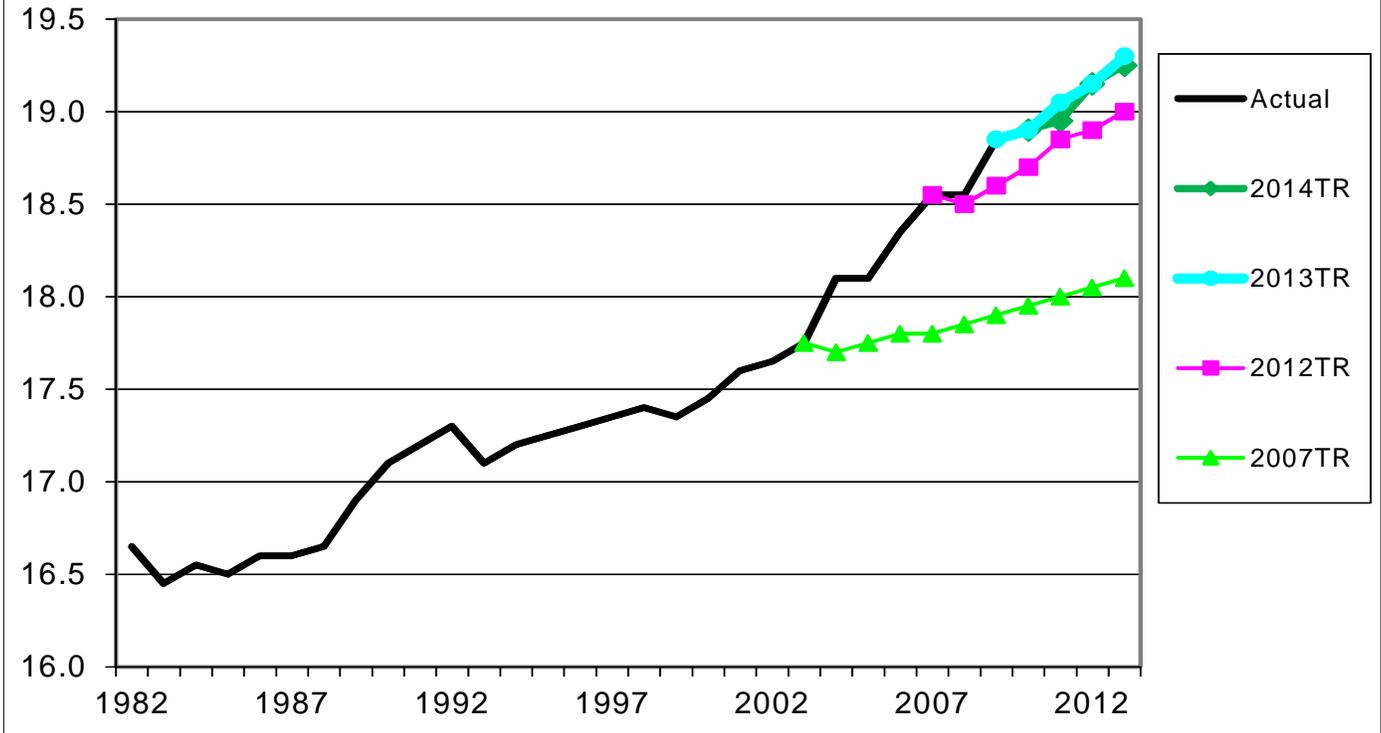


#### Accuracy of Near-Term Mortality Projections in the 2007 through 2014 Trustees Reports

After 1999, mortality at ages 65 and older began to improve more rapidly once again, but not as rapidly as in the period 1968 to 1982. Because this reacceleration was modest through 2003, the 2007 report included near-term projections for life expectancy at age 65 that increased at a modest pace and fell below the later realized gains now recorded through 2010. Unisex mortality over age 65 improved dramatically in years 2004, 2006,

2007, and 2009 resulting in substantial increases in both the starting levels of life expectancy at age 65 and the near-term projected rates of increase in life expectancy in the 2012, 2013, and 2014 reports. Projections for the 2012 report reflected the experience through 2007, projections for the 2013 report reflected the experience through 2009, and projections for the 2014 report reflected the experience through 2010. The figures below show these effects for unisex, female, and male projections in the 2007 report and in the 2012 through 2014 reports.

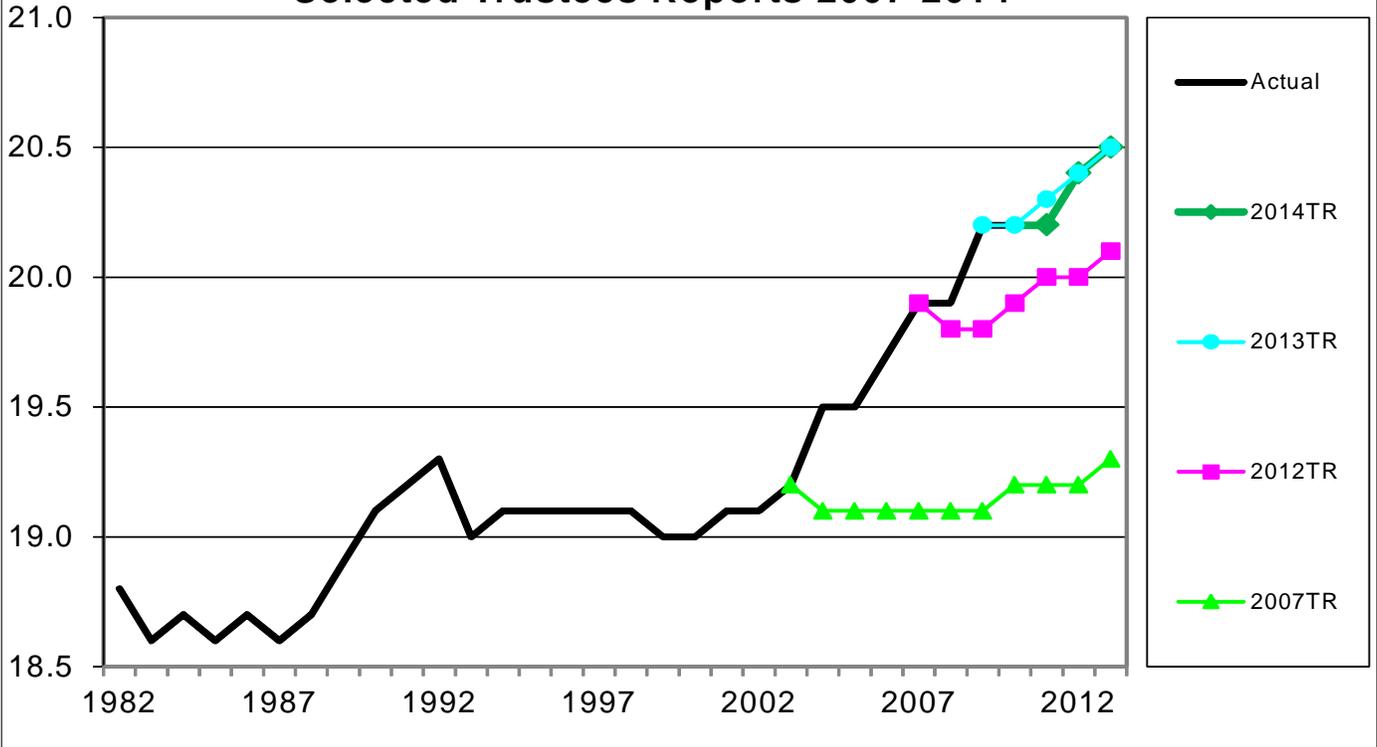
## "Unisex" Period Life Expectancy at Age 65 Selected Trustees Reports 2007-2014



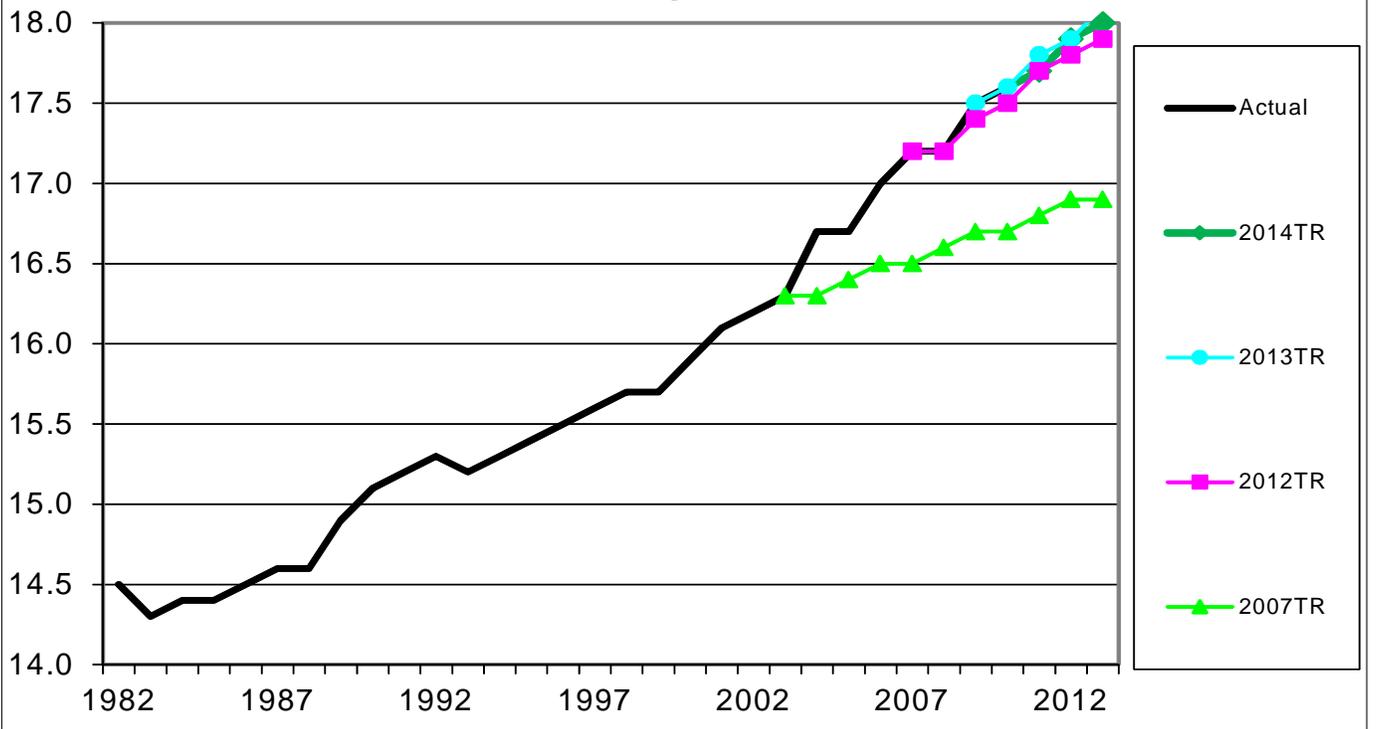
For females, improvement in mortality at ages 65 and older ceased between 1990 and 2002, resulting in a near-term projection that was flat for the first several years

after 1998, thus dramatically missing the sharp improvements in mortality for females recorded later for years 2004 through 2009.

### Female Period Life Expectancy at Age 65 Selected Trustees Reports 2007-2014



### Male Period Life Expectancy at Age 65 Selected Trustees Reports 2007-2014



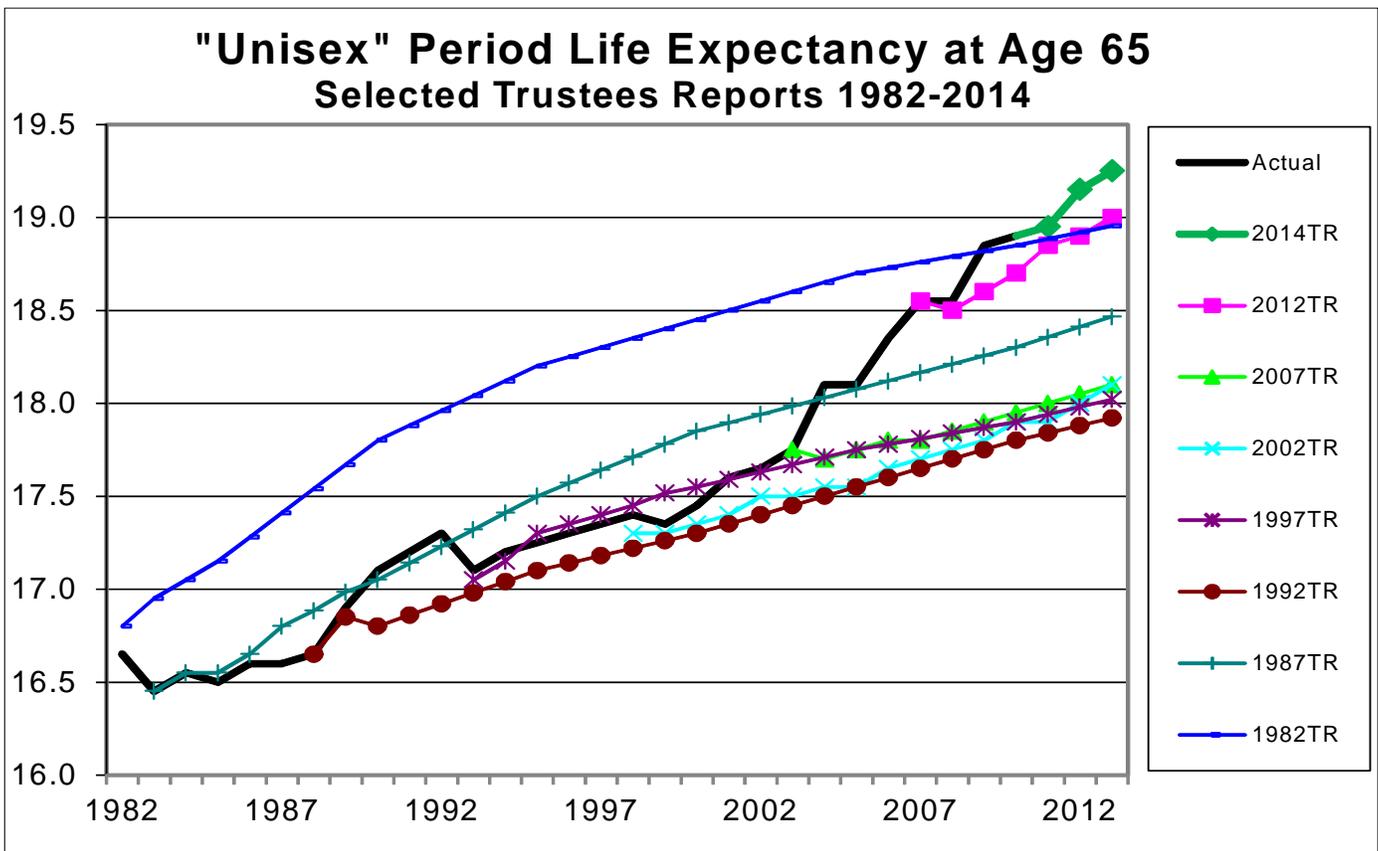
## Accuracy of Near-Term Mortality Projections in the 1982 through 2014 Trustees Reports

The prior two sections show the implications for near-term projections based on the most recent known experience. Thus, it is no surprise that, as illustrated in the following graphs, projections of near-term and subsequent period life expectancy at age 65 for the 1982 through 2007 reports missed the later realized and sharp increase in life expectancy in 2004 through 2009 for both females and males. It is similarly clear that the projected levels and near-term trend rates of increase in life expectancy are substantially elevated and are consistent with the most recent experience for the 2012 through 2014 reports.

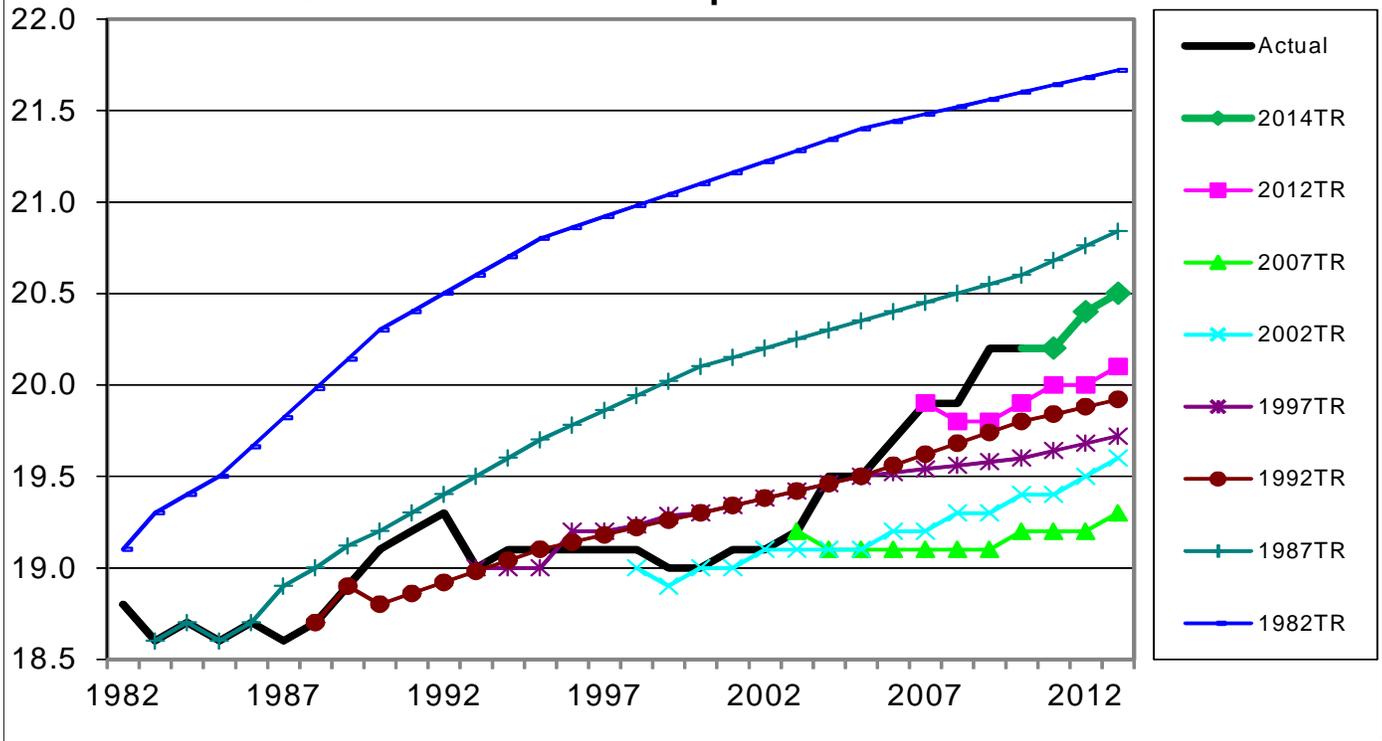
The notable alternating periods of slow and then rapid mortality improvement for ages 65 and older from 1982 through 2010 are no guarantee that such “feast and famine” periods will persist into the future. The ultimate rates of improvement in mortality assumed for the Trustees Reports have been developed over time reflecting:

1. Longer-term past experience by age, sex, and cause of death; and
2. An understanding that certain periods during which major changes have occurred (like the introduction of antibiotics, increases in the general standard of living after World War II, and the implementation of Medicare and Medicaid in the mid-1960’s) may happen more or less frequently in the future.

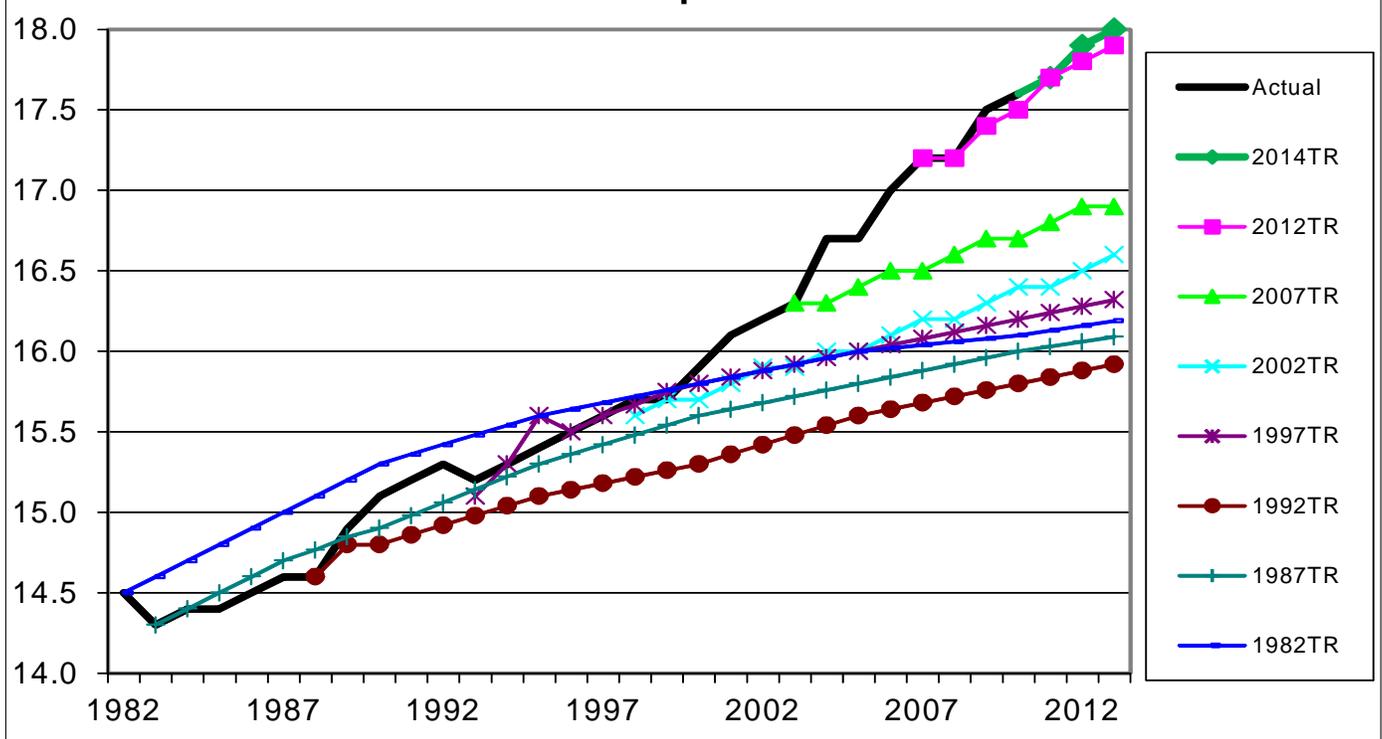
The dramatic increase in spending on health care and research as a percent of GDP over the past 50 years cannot continue at the same pace in the future. On the other hand, technical advances that we cannot foresee are possible. Future behavior of the population is just as uncertain, as smoking has declined but obesity, and particularly persistent obesity starting at younger ages, has increased. Projecting mortality will continue to be challenging in the future as in the past.



### Female Period Life Expectancy at Age 65 Selected Trustees Reports 1982-2014



### Male Period Life Expectancy at Age 65 Selected Trustees Reports 1982-2014



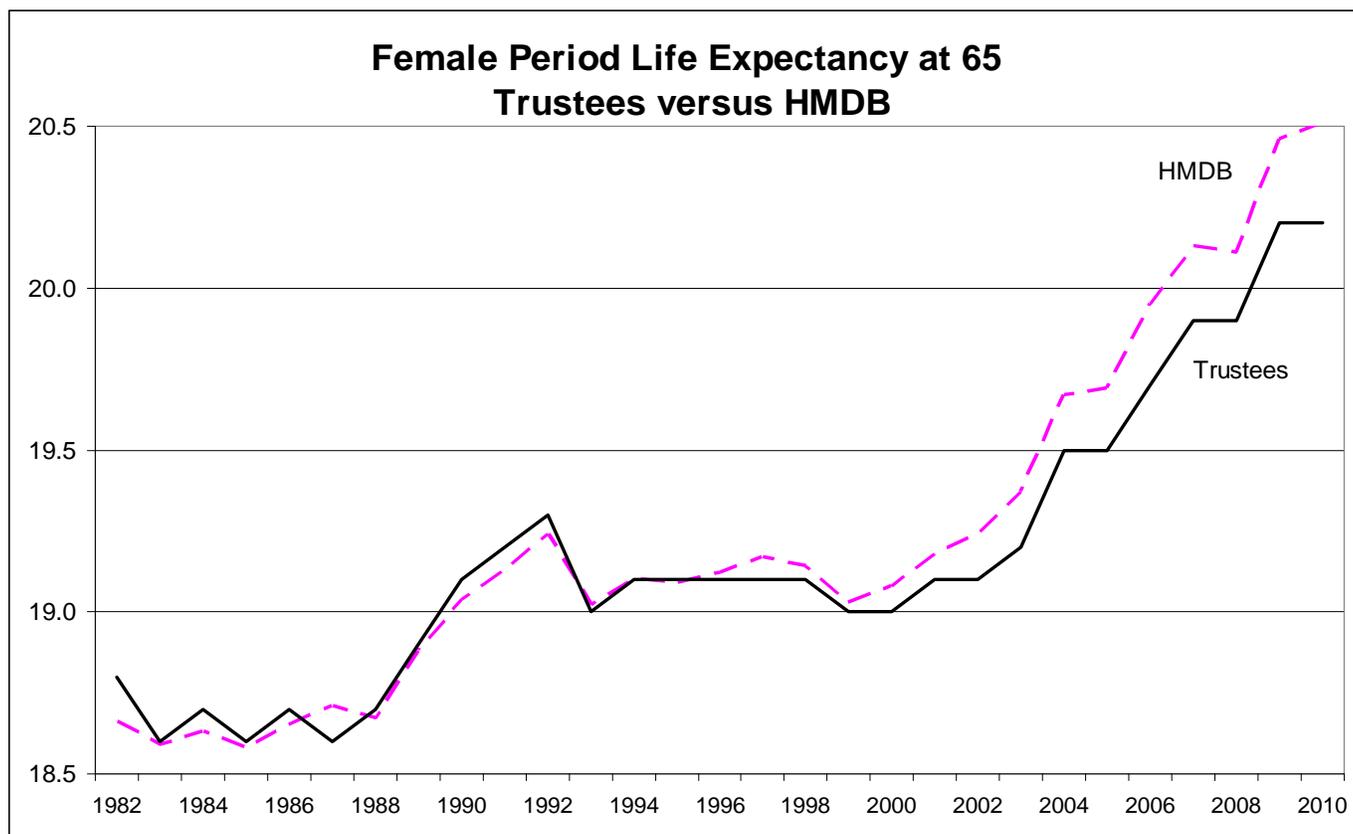
## Appendix: Comparison Between Trustees/Medicare and Human Mortality Database Experience

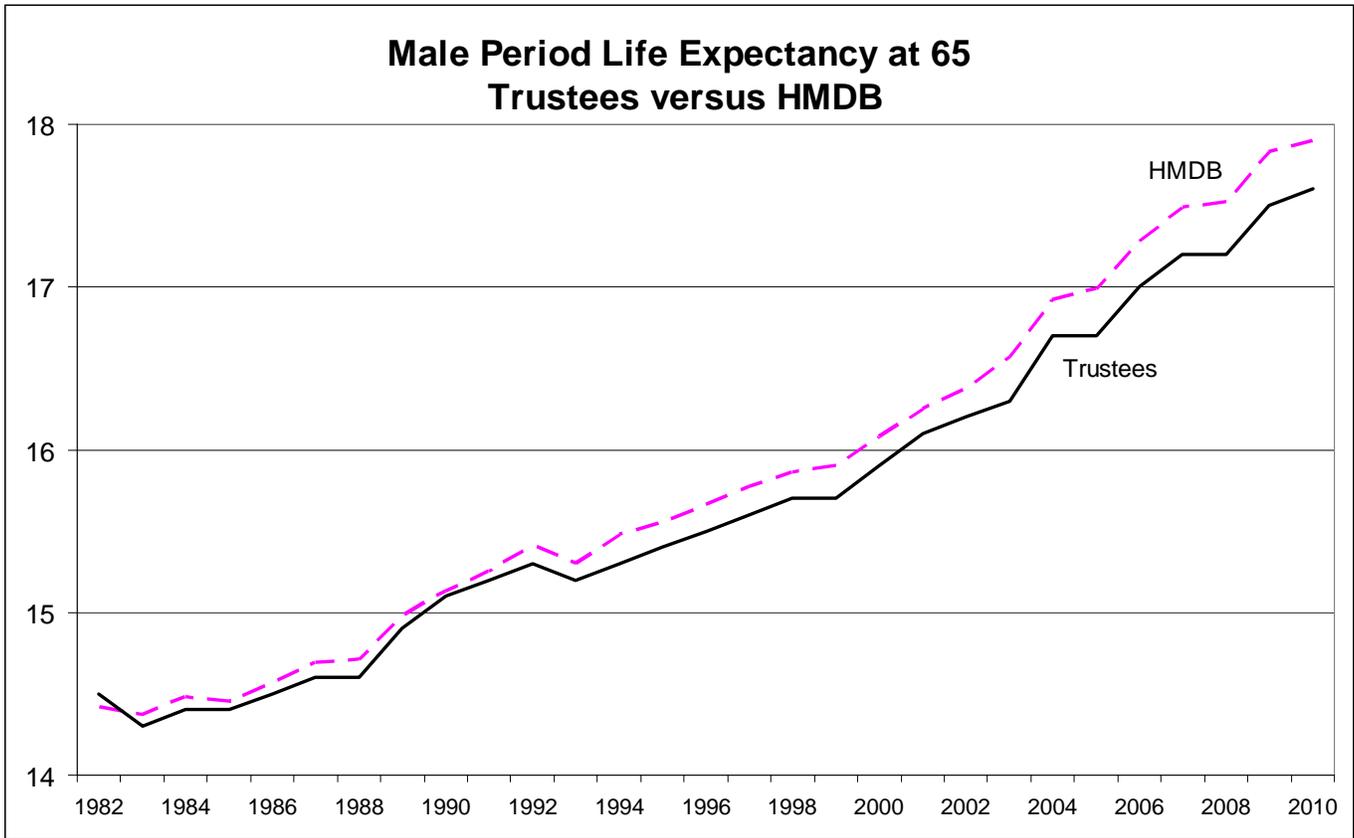
Mortality measurement may be done for many different populations and from many different data sources. As mentioned earlier, the mortality rates at ages 65 and older used in Trustees Reports are based on the experience observed for Medicare-enrolled individuals. These data provide a rich and uniquely consistent source of death and population exposure from a single source, which guarantees consistency. The Medicare-eligible population covers almost the entire population in the United States and outlying areas covered by Social Security and Medicare.

The Human Mortality Database (HMDB) is widely used by researchers because it provides reasonably comparable data for the United States and many other countries. However, it is important to note that the HMDB draws data from deaths reported by states annually and census

population estimates. The completeness and age-assignment of individuals for these two sources may not be consistent and may change over time. For this reason, the National Center for Health Statistics has begun using the Medicare-enrollee data developed for the Trustees Reports for producing the U.S. Decennial Life Tables. Both the HMDB and the Medicare-enrollee data are useful for many purposes. However, the results are sufficiently different that users should exercise care in mixing these data sources for analysis.

The figures below illustrate the tabulated period life expectancy at age 65 for females and males from these two sources for years 1982 through 2010, the last years for which final data are available from either source. While the HMDB estimates of life expectancy are slightly lower than the Medicare-enrollee rates for 1982, they rise progressively relative to the Medicare-enrollee rates through 2010.





The difference in period life expectancy at age 65 between the HMDB and the Medicare-enrollee data is illustrated in the figure below. The differences are similar for men and women. From 1982 to 2010, the HMDB

values rise by about 0.4 year more for both males and females. Thus, one would not want to compare projections based on either source to actual experience on the other source.

### Period Life Expectancy at 65 HMDB minus Trustees

