

The Outlook for Longevity

Waylon Peoples, FSA, MAAA
AIG American General

What you will miss if you fall asleep

- Expansive view
- Conservative view

Expansive View

- What?
 - Life expectancy at birth will reach 100 by the year 2060
- How?
 - LE continues to rise at a pace equal to or greater than the rate it has over the past century
- Who?
 - Mathematical demographers
 - James Carey, James Vaupel, John Wilmoth, Jim Oeppen

Conservative View

- What?
 - Life expectancy is not likely to exceed 85 by the year 2060 in the U.S.
- Who?
 - Social biologists
 - Leonard Hayflick, Jay Olshansky, Bruce Carnes, James Fries

Why Expansive?

1. Long, uninterrupted historical rise in life expectancy
2. Lack of evidence for limit to human lifespan
3. Steady rise in maximum recorded lifespan
4. Continued improvements in medical technology and knowledge

Life Expectancy at Birth: U.S.

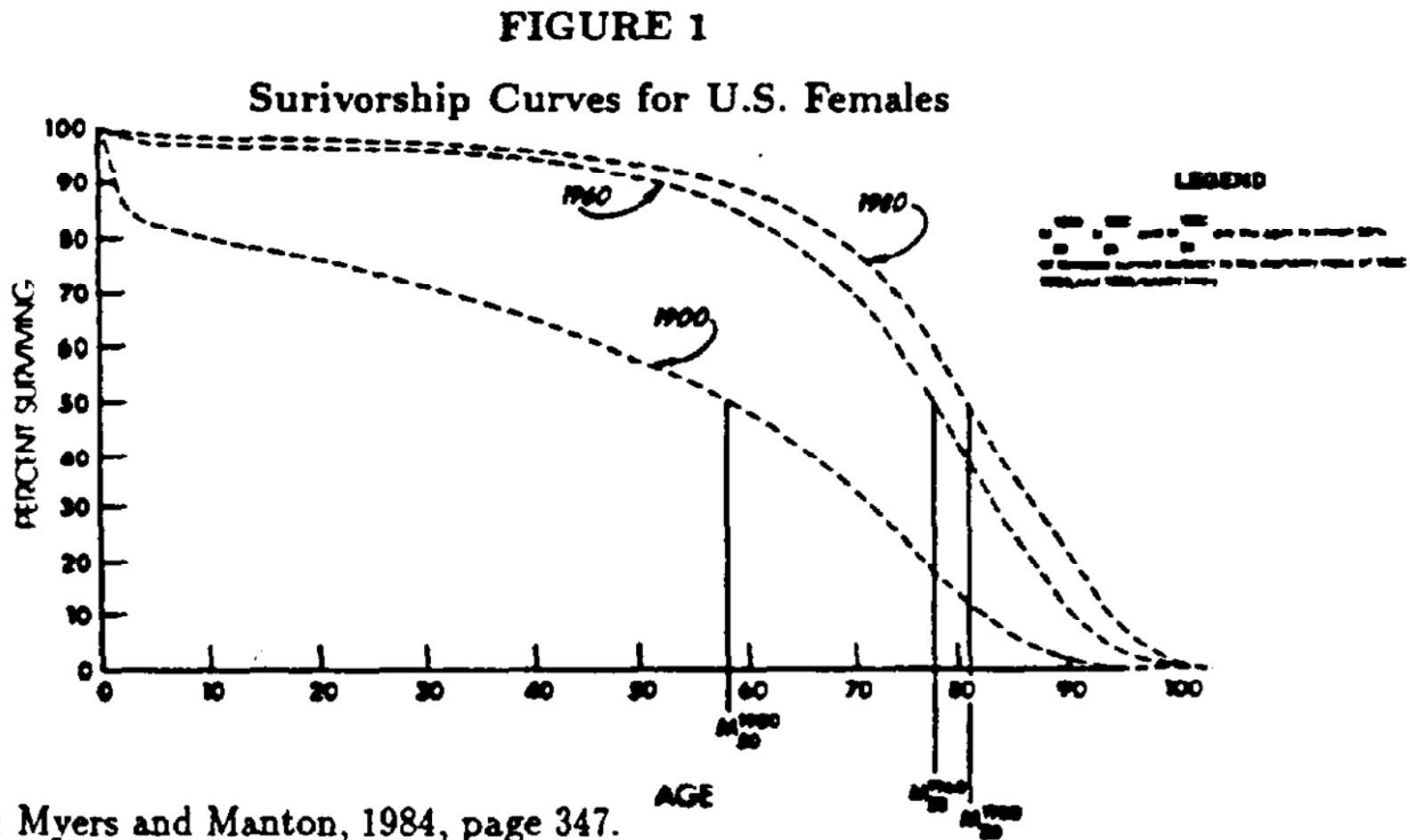
1900	47.3
1910	50.0
1920	54.1
1930	59.7
1940	62.9
1950	68.2
1960	69.7
1970	70.8
1980	73.7
1990	75.4
2000	76.9

Average annual rate gain	0.5%
Average annual gain (yrs)	0.296

The Great Debate on the Outlook for Human Longevity, Jacob Siegel

Source: Based on U.S. National Center for Health Statistics, *NVSR* 51(3), 2002; *NVSR* 50(15), 2002; and *Vital Statistics of the United States, 1950*, Vol.1, Part 1, 1954.

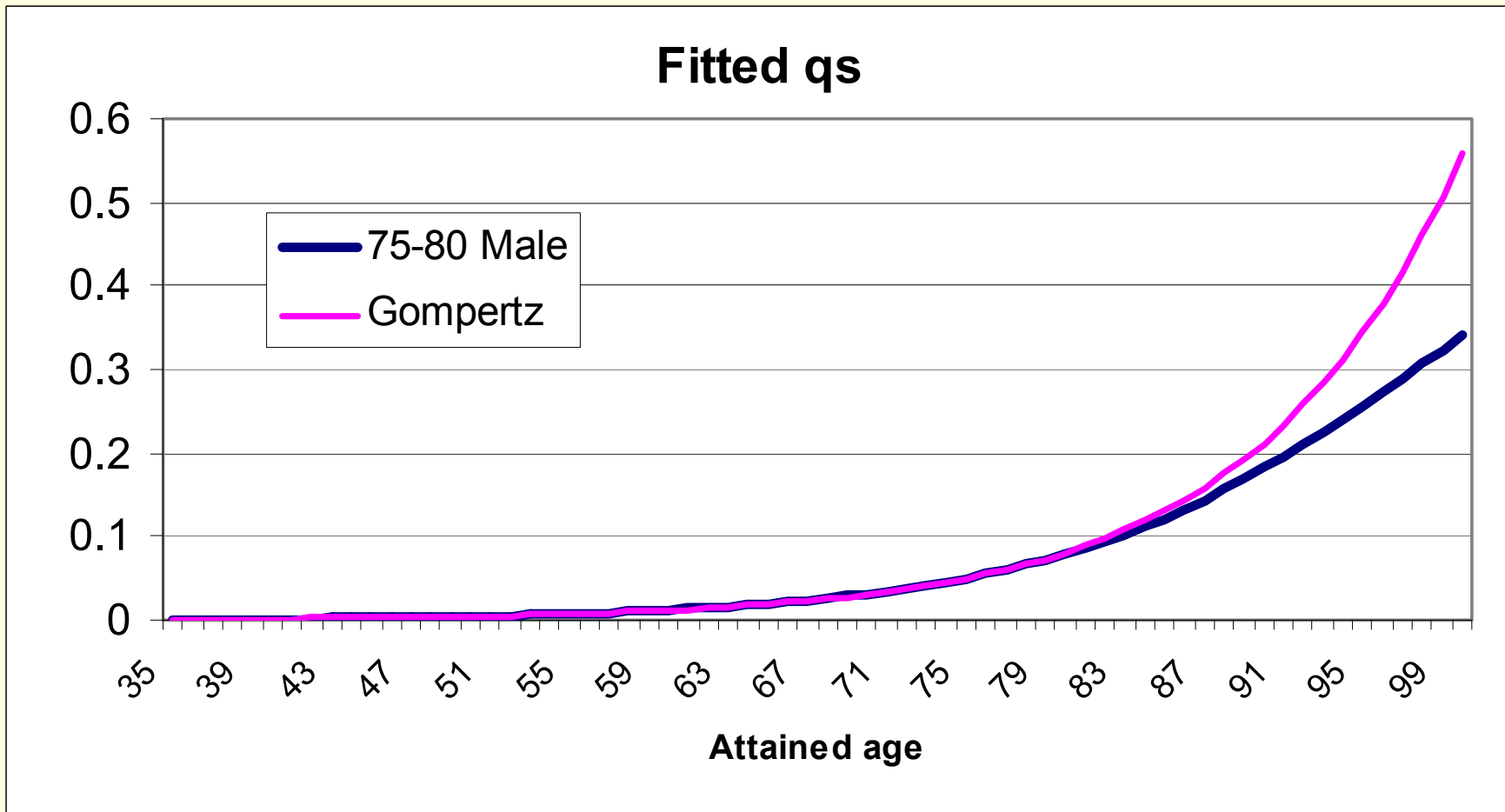
Rectangularization of Survivorship Curve



SOURCE: Myers and Manton, 1984, page 347.

No Evidence of Lifespan Limit

- Poor Gompertz (Bc^x) fit at older ages



No Evidence of Lifespan Limit

- Rate of increase above age 85 falls, and possibly, at extreme ages, becomes zero or negative
- Data is sparse, but ultimate $q_x = .4$ to $.5$
- Japanese women have LE of 85
- They also have the highest mortality improvements in recent years

Increase in Maximum Lifespan

- Sweden
 - + 0.4 years per decade before 1969
 - + 1.1 years per decade thereafter.
- All of western Europe
 - Linear increases since mid-19th century
 - + 2.5 years per decade for females
 - + 2.0 years per decade for males

Medical Advances

- Regenerative medicine
- New drugs
- New medical devices
- All stop short of interventions in the fundamental aging process

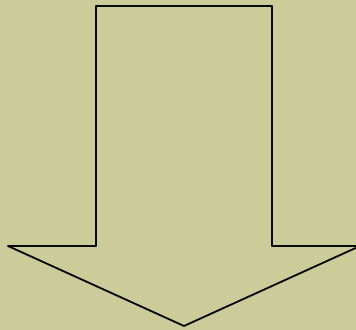
Why Conservative?

1. Epidemiological transition
2. Massive reductions in mortality necessary to produce increases in life expectancy
3. Frailty and aging vs. age-associated diseases
4. Competing causes of death theory

Epidemiological Transition

- Shift in importance of the main causes of death

Infections and parasitic diseases



Chronic and degenerative diseases

Epidemiological Transition

- Infectious diseases
 - Externally caused
 - Easy to treat (immunization, antibiotics)
 - Early outcome of complete recovery or death
- Degenerative diseases
 - Endogenous causes (biological or genetic)
 - Difficult to treat (often just delay)
 - Basically incurable

MASSIVE Reductions Needed

- What reduction in age specific death rates is needed to achieve a life expectancy of 100?
 - Olshansky (1990) – 90%
 - Golini (2002) – 85%
 - Seigel (2005) – 82%
 - Peoples (2005) – 83%

MASSIVE Reductions Needed

- Elimination of 3 leading causes of death would increase life expectancy by 15 years

% Reduction	% Increase in LE	Life Exp
0	0	77
45	10.5	85
50	12	86
80	25	96
82	30	100
90	71	132

Aging vs. Age Associated Diseases

- Leonard Hayflick
- Most knowledge is about age associated diseases, not the fundamental aging process
- What happens if the 3 leading causes (cardiovascular disease, stroke, cancer) of old age death are cured?

Aging vs. Age Associated Diseases

“If the causes of these deaths are resolved we will not become immortal, but we will have revealed how death occurs in the absence of disease. . . . Then, aging, or the inexorable loss in physiological capacity that underlies the cause of these pathologies will be revealed as the leading cause of death . . . the aging process is the underlying cause of the increase in vulnerability to everything that is written on the death certificates of the elderly.”

Aging vs. Age Associated Diseases

“No one over the age of, say 75, has, or will die from what is written on his or her death certificate. Death results from the inevitable increase in systemic molecular disorder that living long enough incurs. That disorder simply increases vulnerability to whatever was, or will be, written on death certificates.”

-- From Longevity Determination and Aging,
Leonard Hayflick

Competing Causes of Death

- Causes of death aren't independent
- Multiple causes contribute or are associated with each death
- Sharp decline in death rates from cardiovascular disease from 1970 to 2000 offset by increasing deaths from cancer

Miscellaneous

- Natural selection
 - Selects against diseases that affect the ability to reproduce
 - Natural selection can not favor genes that extend life beyond the reproductive period
- Cohort effect
- Momentum of cohort succession
- Overweight, obesity, sedentary lifestyles

Questions or Comments

