Remarks to the Technical Panel on Assumptions and Methods, Social Security Advisory Board

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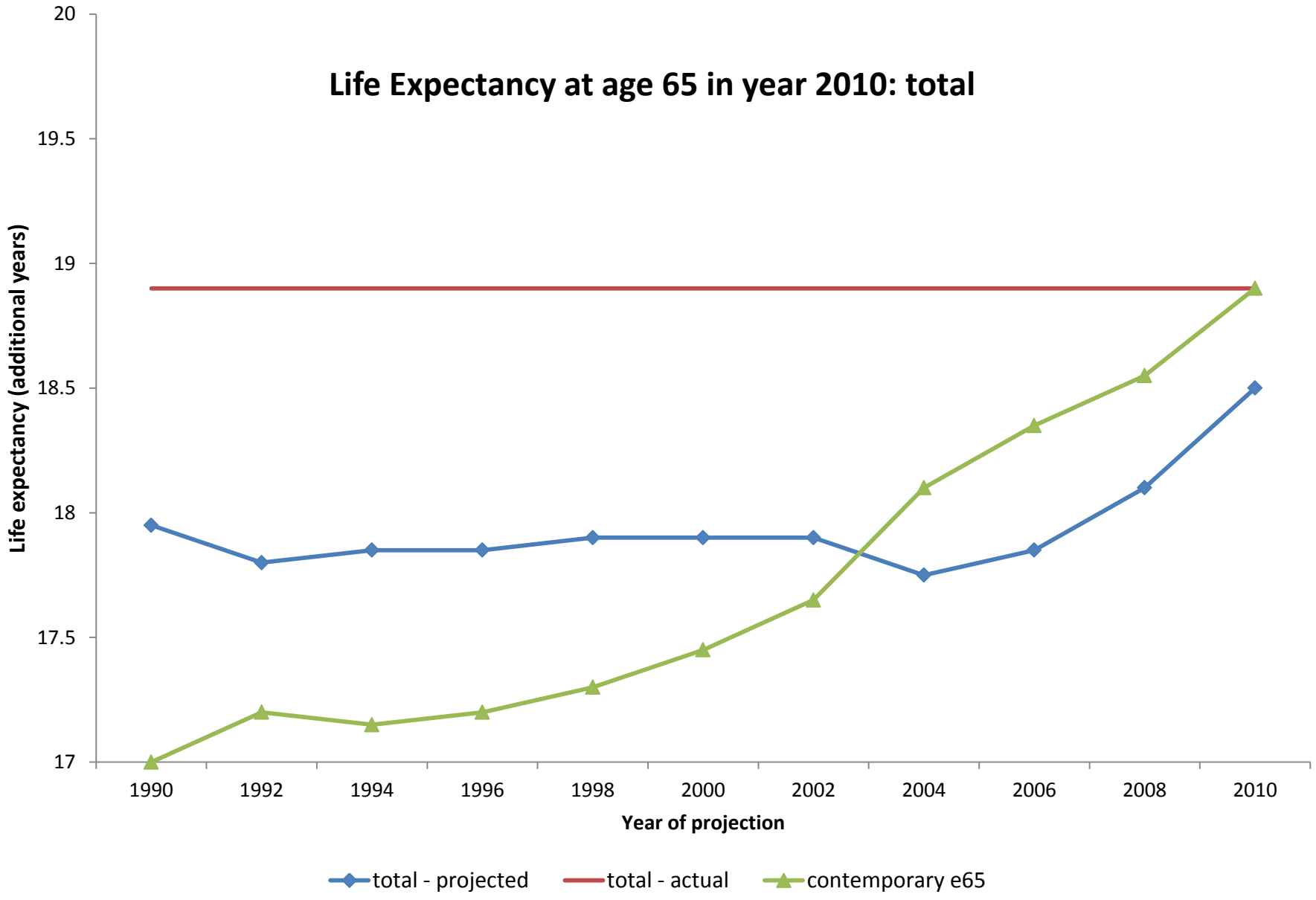
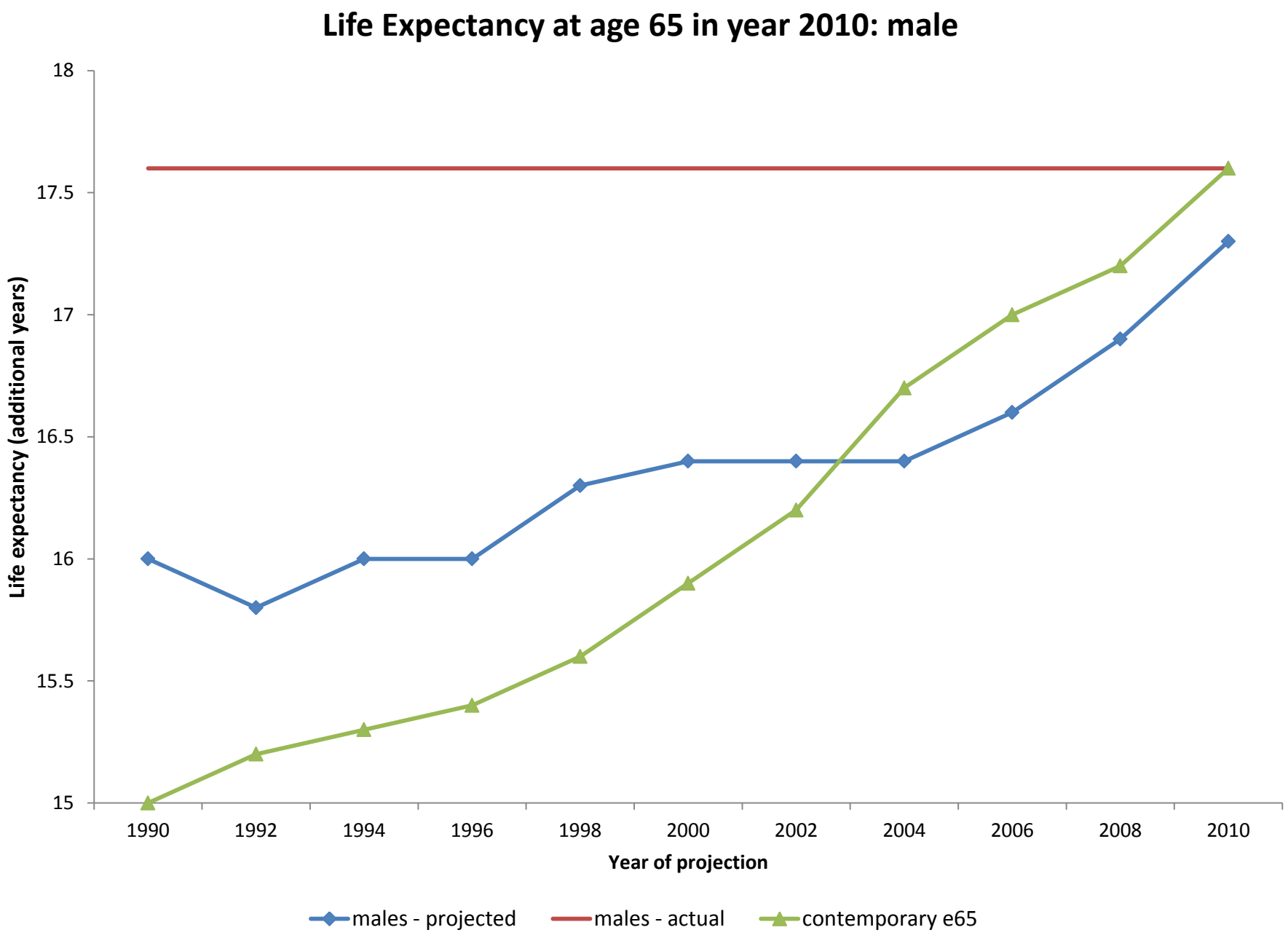
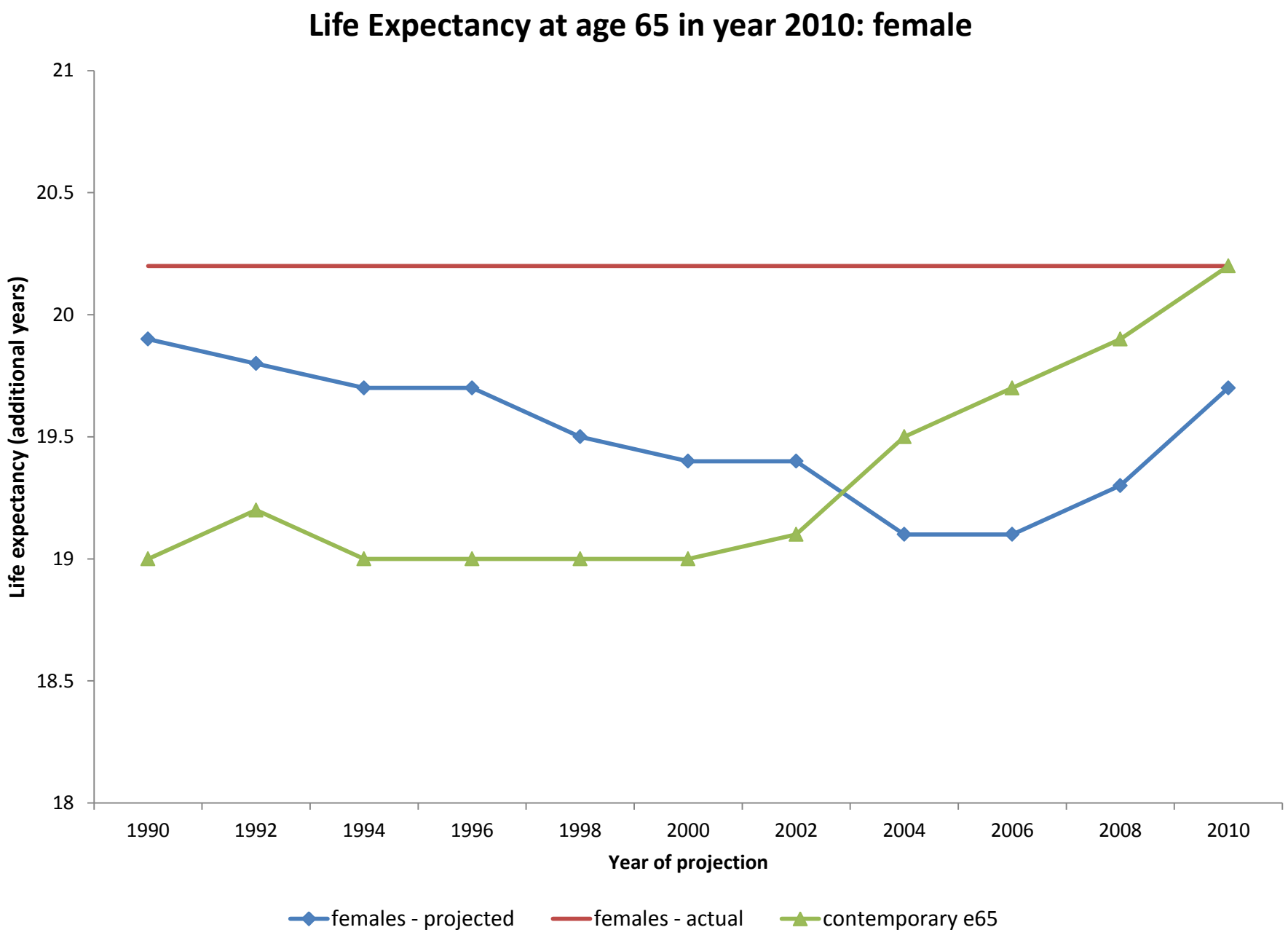
May 7, 2015

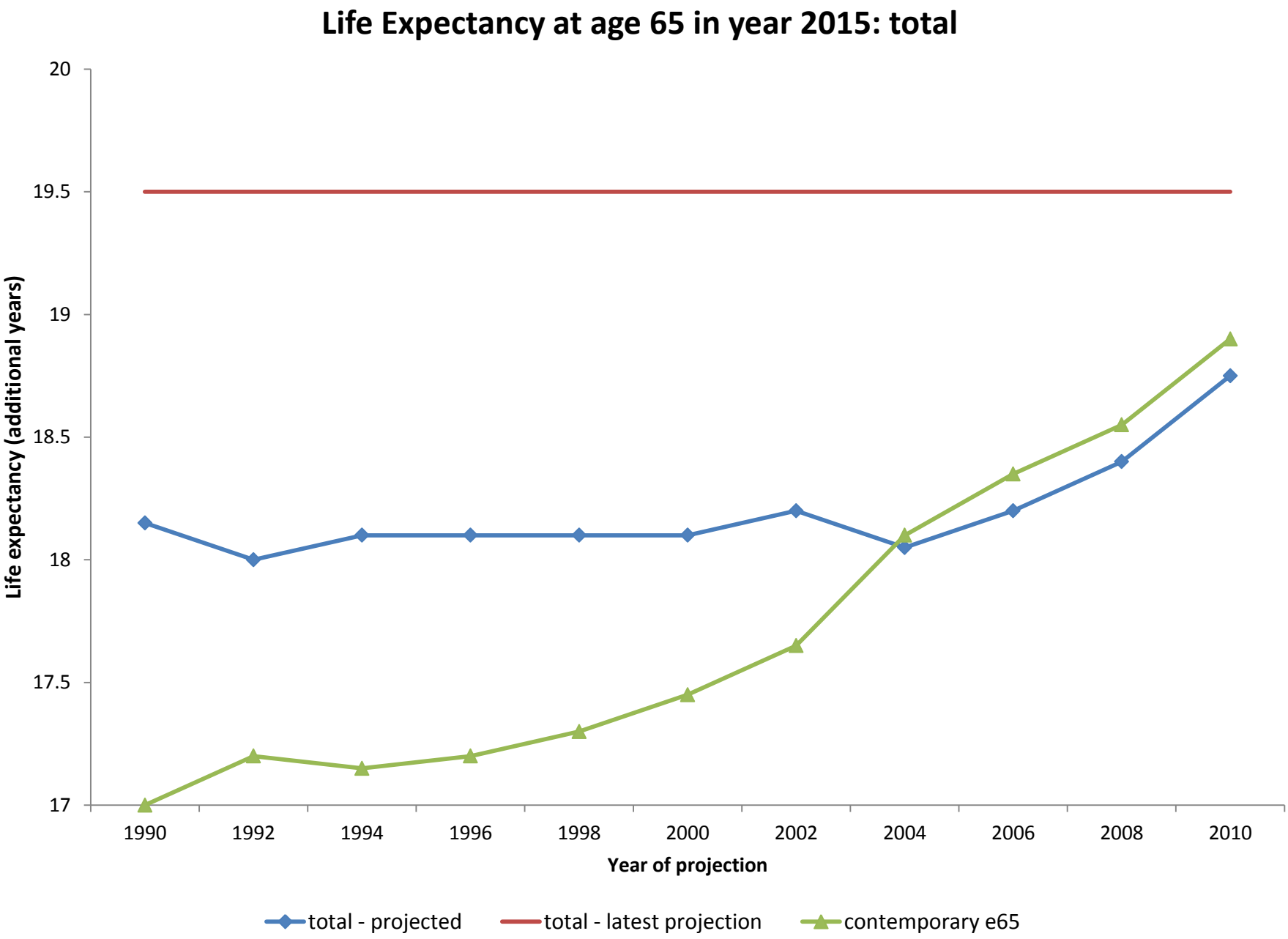
Outline

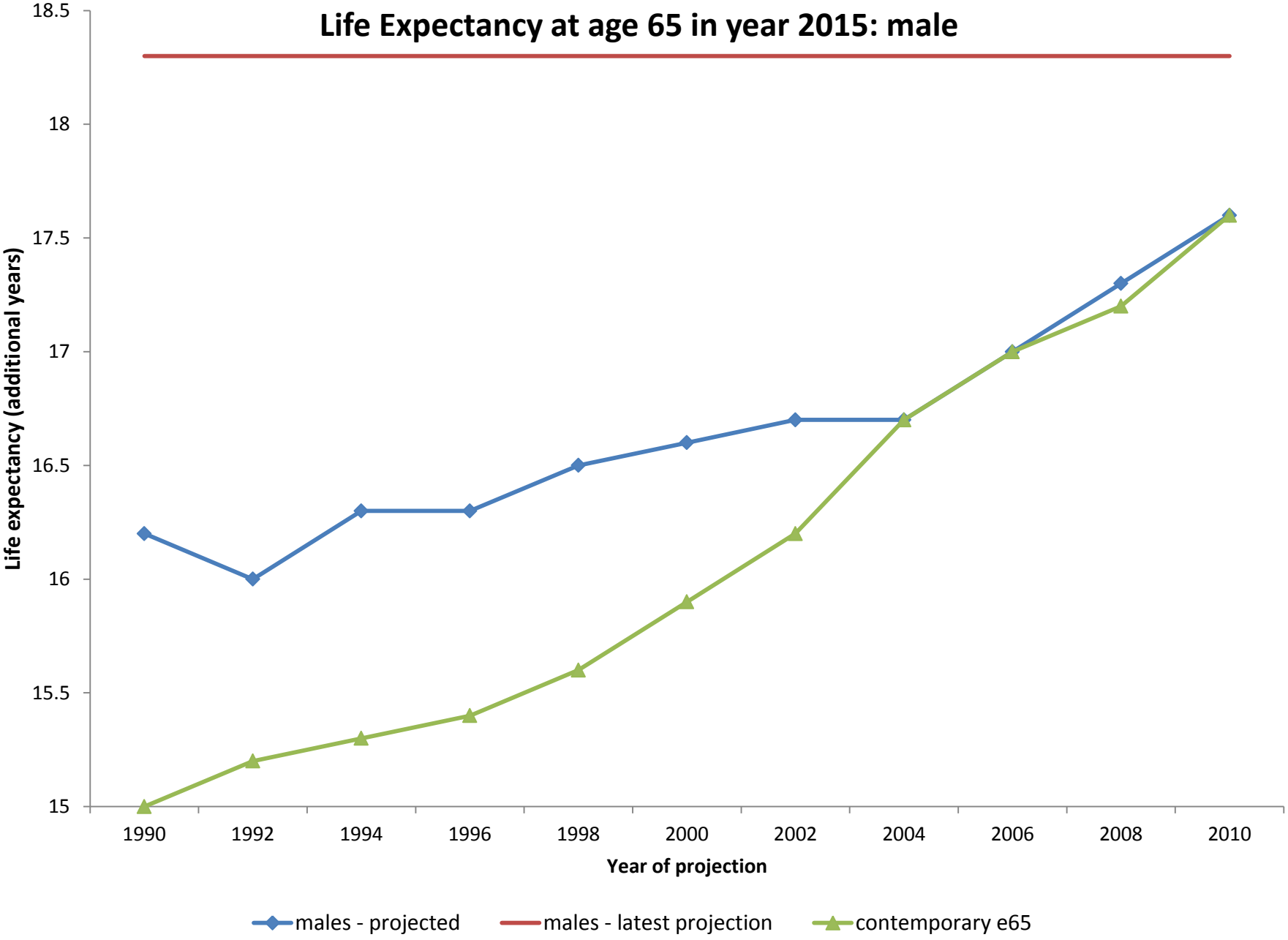
- Success of SSA projections of life expectancy at age 65
- Nostalgic return to Technical Panel report of 1995
- Mortality trends (brief)
- U.S. mortality compared to other countries
  - Medical system failures? (no)
  - Smoking histories? (yes)
  - Obesity? (maybe)
- U.S. projections of effects of changes in smoking and obesity

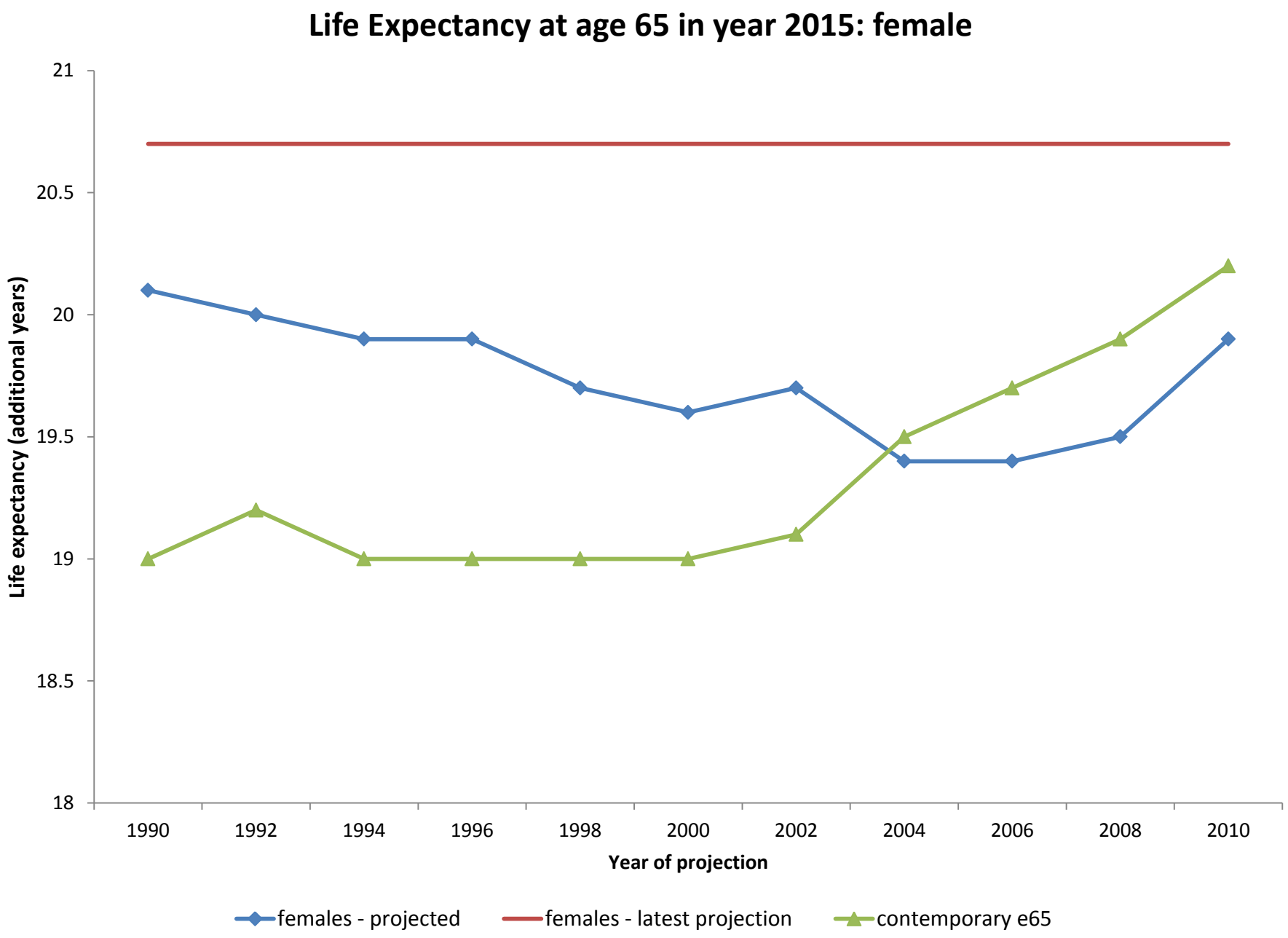

Life Expectancy at age 65 in year 2010: total
Life expectancy (additional years)
20
19.5
19
18.5
18
17.5
17
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
total - projected
total - actual
contemporary e65


Life Expectancy at age 65 in year 2010: male
Life expectancy (additional years)
18
17.5
17
16.5
16
15.5
15
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
males - projected
males - actual
contemporary e65


Life Expectancy at age 65 in year 2010: female
Life expectancy (additional years)
21
20.5
20
19.5
19
18.5
18
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
females - projected
females - actual
contemporary e65


Life Expectancy at age 65 in year 2015: total
Life expectancy (additional years)
20
19.5
19
18.5
18
17.5
17
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
total - projected
total - latest projection
contemporary e65


Life Expectancy at age 65 in year 2015: male
18.5
18
17.5
17
16.5
16
15.5
15
Life expectancy (additional years)
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
males - projected
males - latest projection
contemporary e65


Life Expectancy at age 65 in year 2015: female
Life expectancy (additional years)
21
20.5
20
19.5
19
18.5
18
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year of projection
females - projected
females - latest projection
contemporary e65

Report of the Technical Panel on Assumptions and Methods (1995)

"Alternative II (intermediate cost) projections should more closely reflect long-run past experience. The current Alternative II assumption is for a lower rate of mortality improvement than has been experienced in the near-term (20-year) or long-term (90-year) past: such a decrease in the rate of mortality decline appears unwarranted. A mid-range projection that reflected continued mortality declines at the level experienced over the past century would be more appropriate."

Report of the Technical Panel on Assumptions and Methods (1995)

"Alternative methods of projection should be investigated. Cause-specific projections tend to produce conservative projections (that is, projections with slow mortality declines) because slowly declining causes become more prominent. Cause-specific projections also ignore the tendency for medical research and health intervention efforts to be targeted at diseases that are relatively more prominent."

Report of the Technical Panel on Assumptions and Methods (1995)

"Alternative methods of projection should be investigated. Cause-specific projections tend to produce conservative projections (that is, projections with slow mortality declines) because slowly declining causes become more prominent. Cause-specific projections also ignore the tendency for medical research and health intervention efforts to be targeted at diseases that are relatively more prominent."

Alzheimer's Disease Demography

Proportion of deaths above age 75 attributable to AD	36%
Probability of surviving to age 75	68%
Relative risk of death if diagnosed with AD, compared to non-AD	≈ 4 times higher
Lifetime probability of developing AD	≈ 20%

James et al. *Neurology* 2014
Seshadri & Wolf *Lancet Neurology* 2007

NIH Expenditure by Disease Category ($ million)

	FY 2011	FY 2016 (est.)	Change
Alzheimer's	448	638	42%
Cardiovascular	2049	2004	-2%

http://report.nih.gov/categorical_spending.aspx

Figure 1. Crude and age-adjusted death rates: United States 1980-2007 final and 2008 preliminary

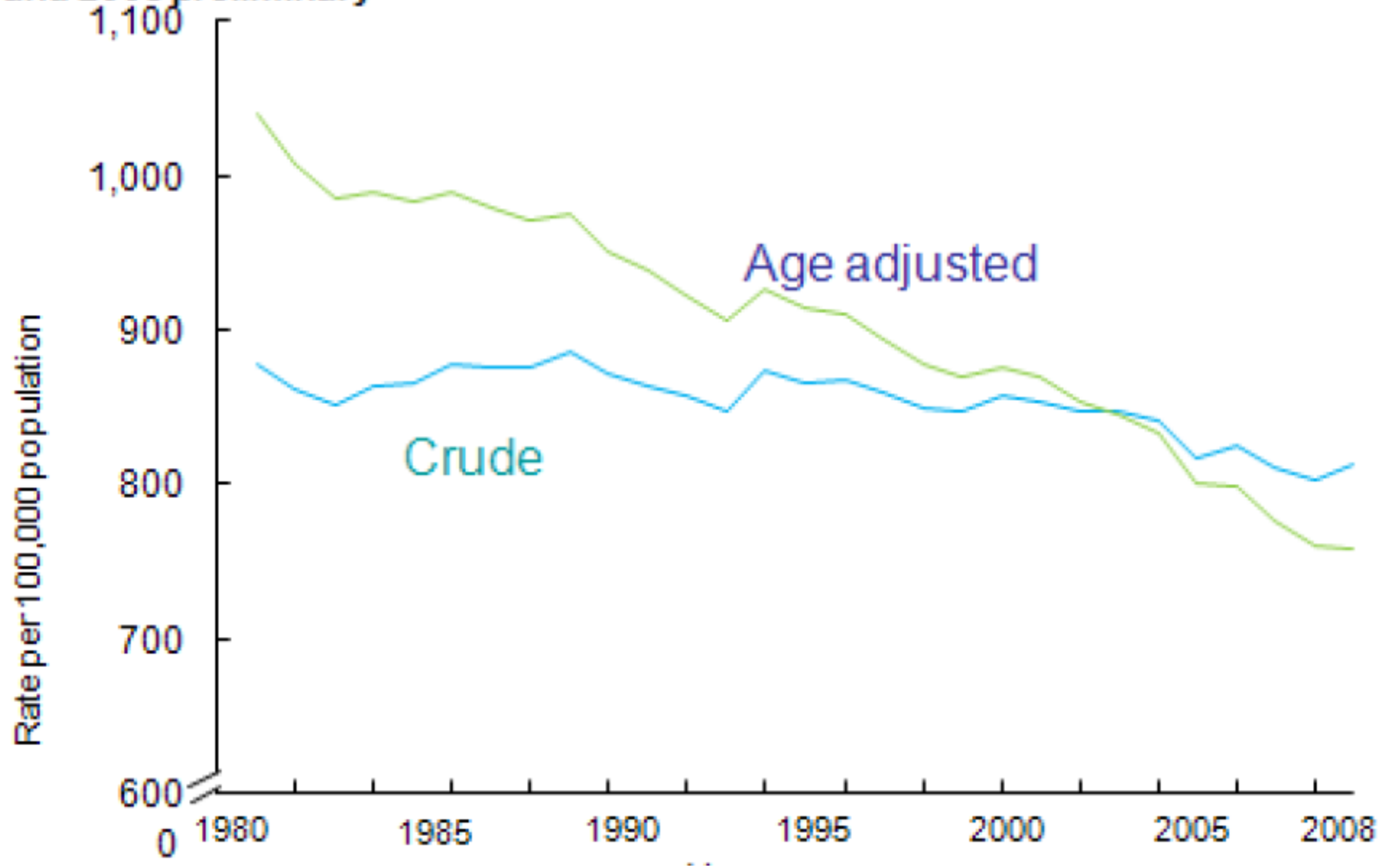
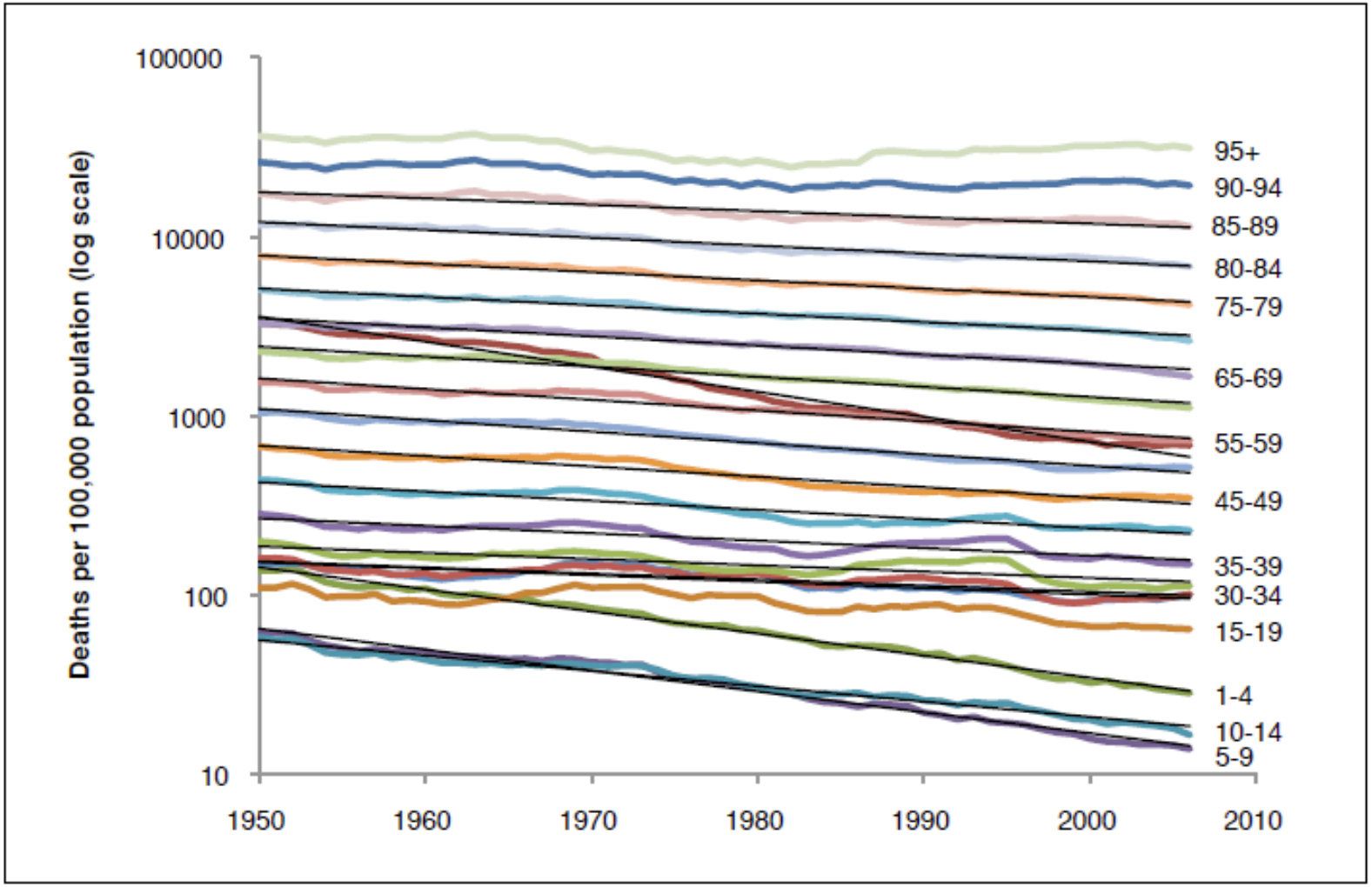
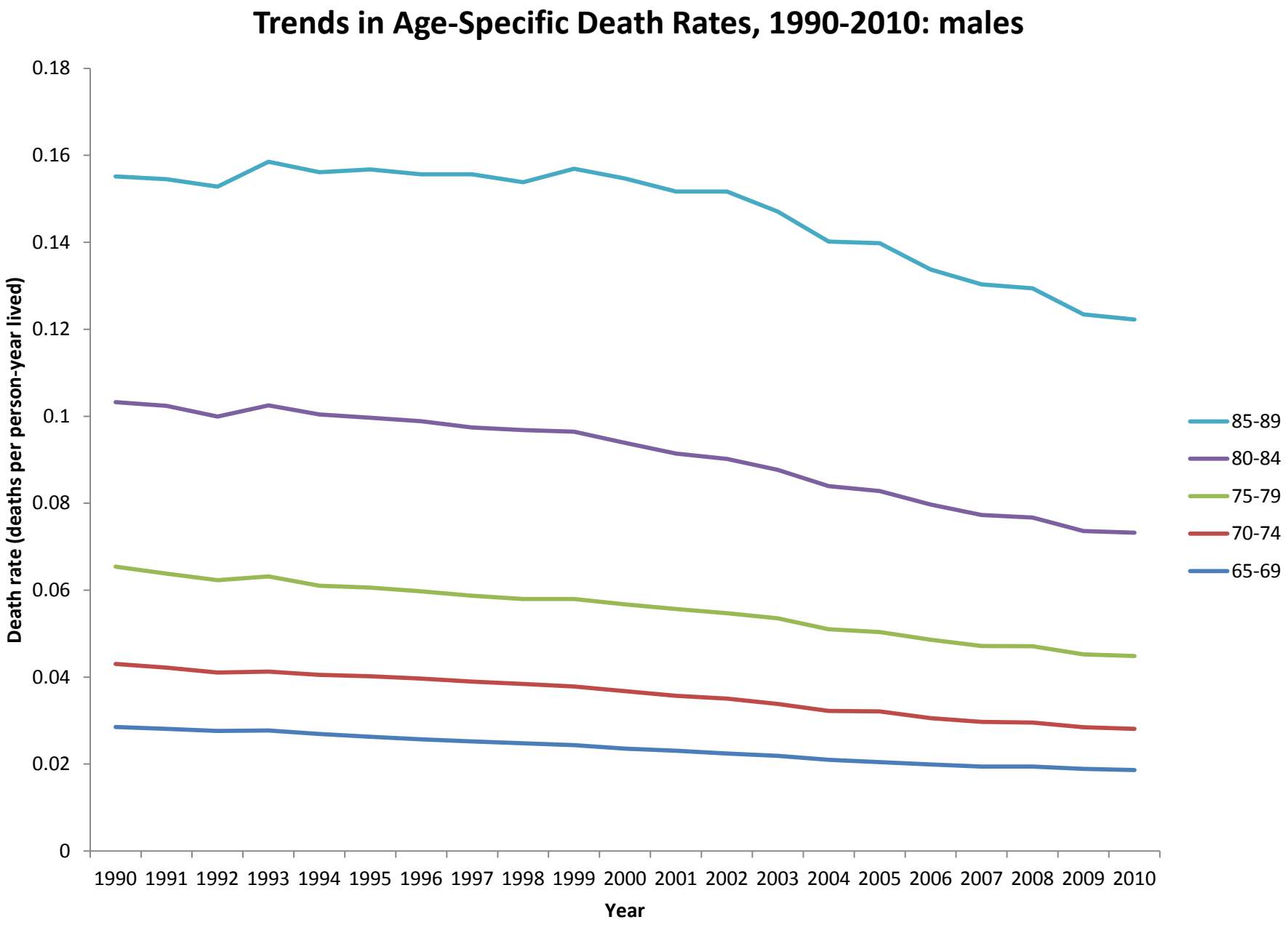
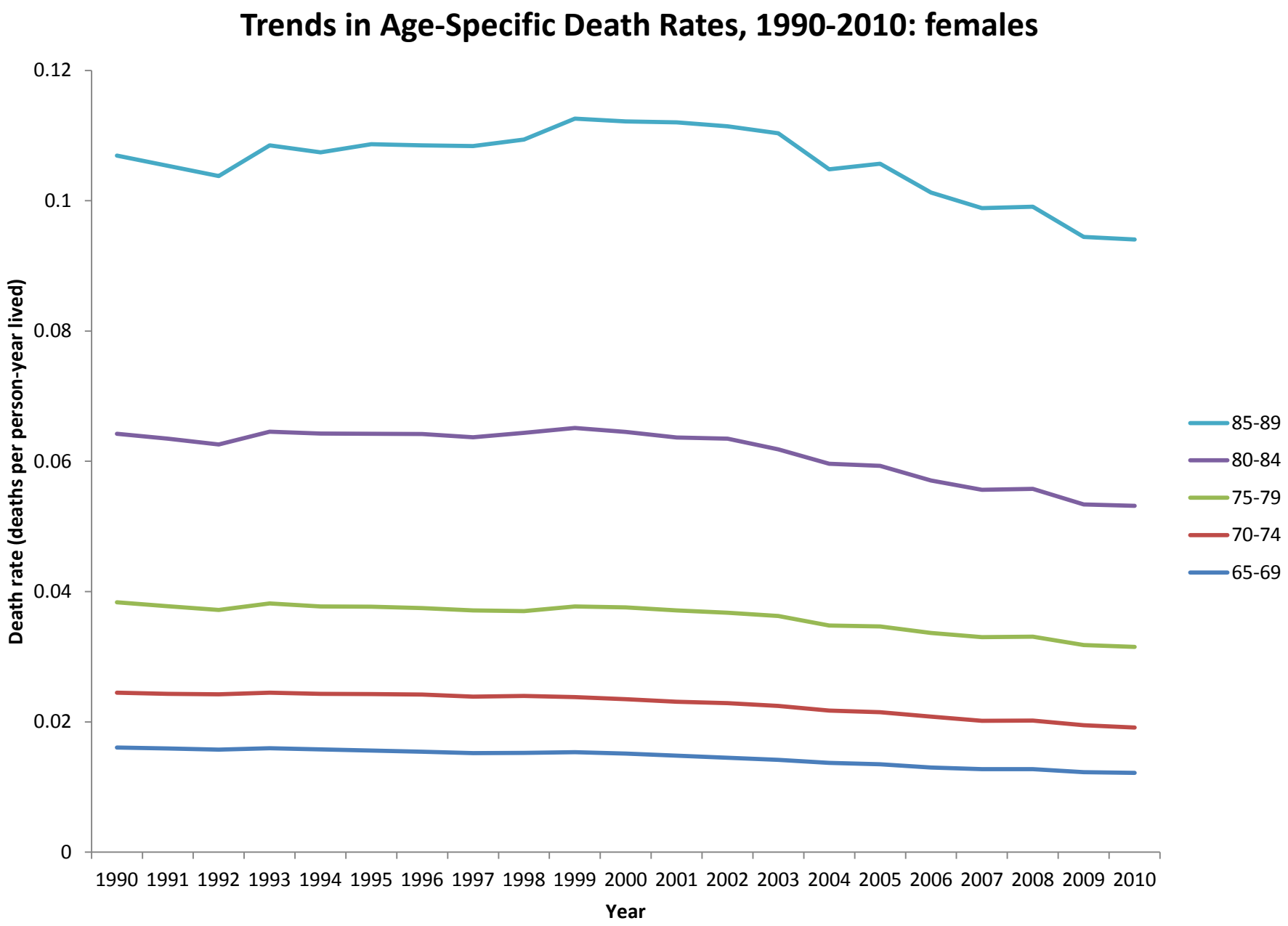


Figure 31. Age-Specific Death Rates: United States

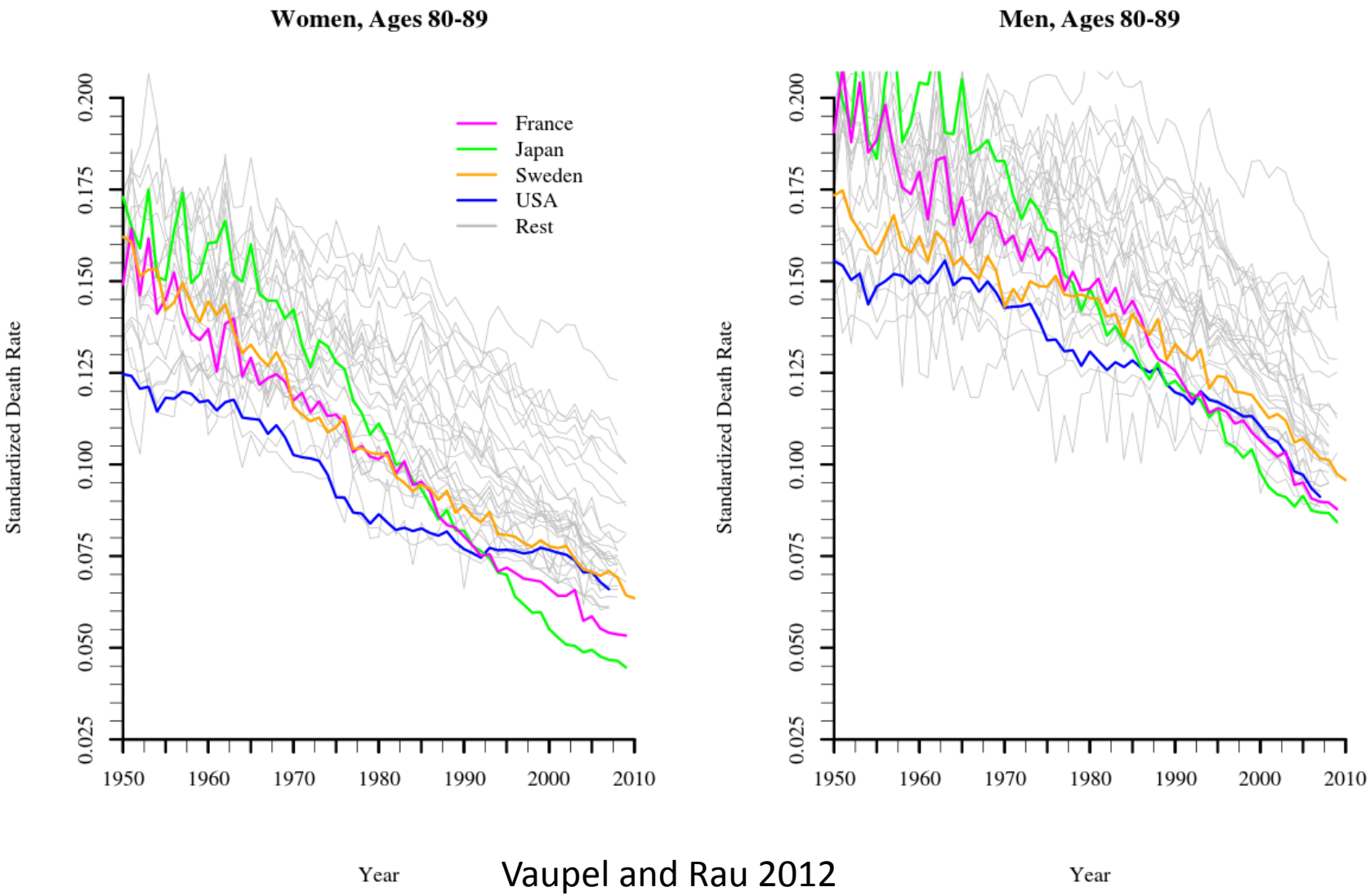


Source: Office of the Chief Actuary, Social Security Administration, 2011.


Trends in Age-Specific Death Rates, 1990-2010: males
Death rate (deaths per person-year lived)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Year
85-89
80-84
75-79
70-74
65-69


Trends in Age-Specific Death Rates, 1990-2010: females
Death rate (deaths per person-year lived)
0.12
0.1
0.08
0.06
0.04
0.02
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Year
85-89
80-84
75-79
70-74
65-69

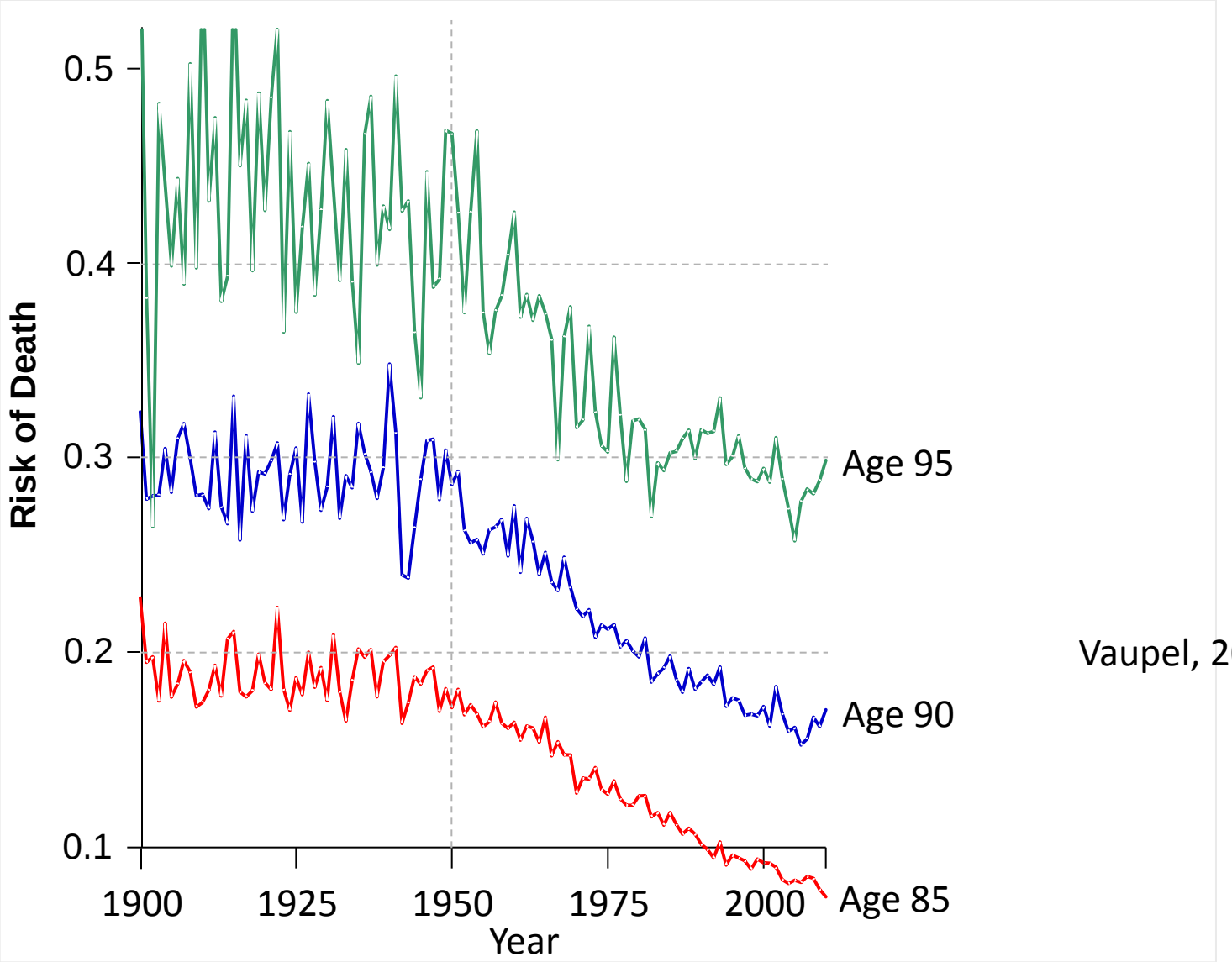
Discovery of the Advancing Frontier of Survival:
The Decline in Octogenarian Mortality



Vaupel and Rau 2012

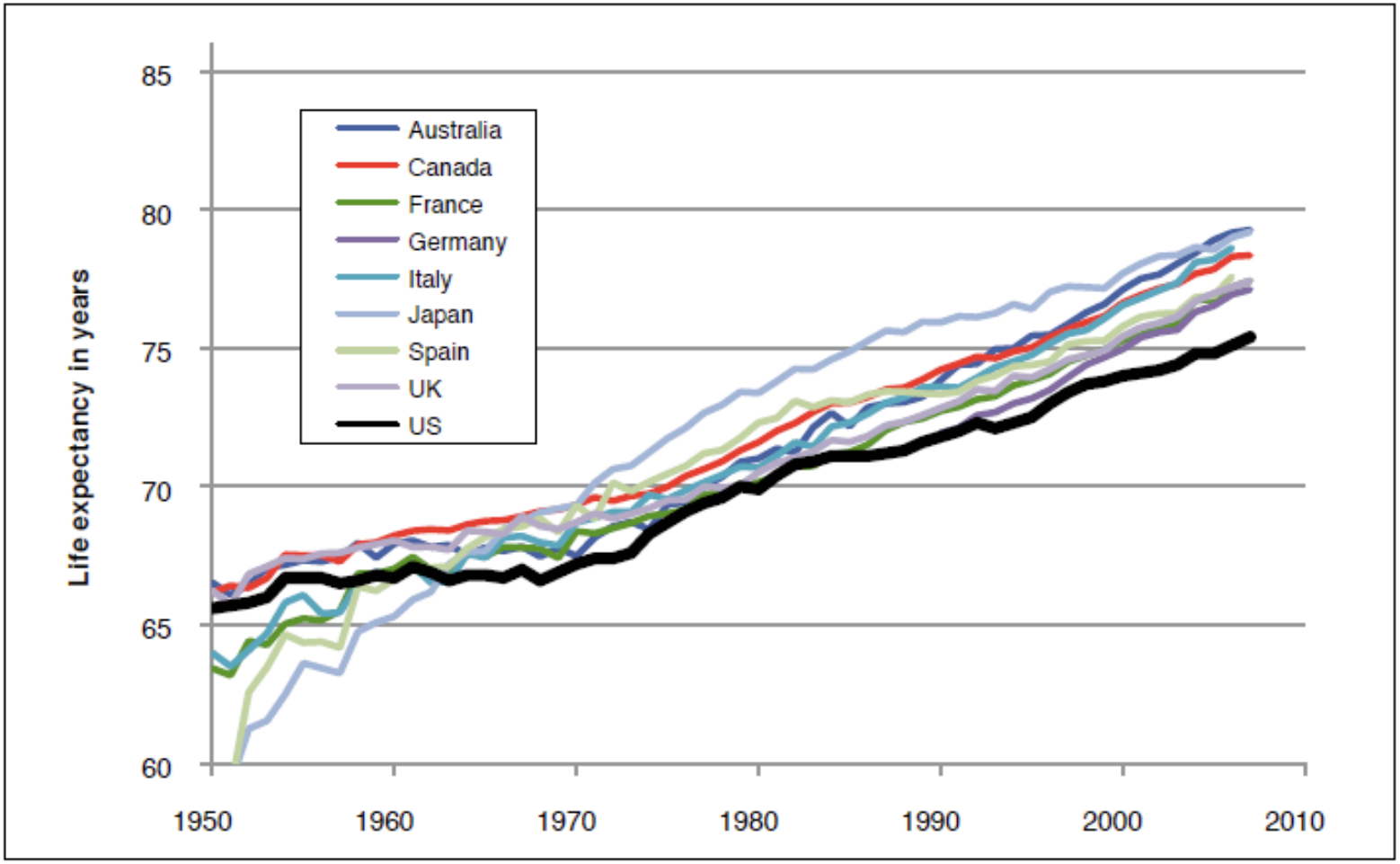
Discovery of the Advancing Frontier of Survival

- **Mortality at ages 85, 90 and 95 for Swedish Females**



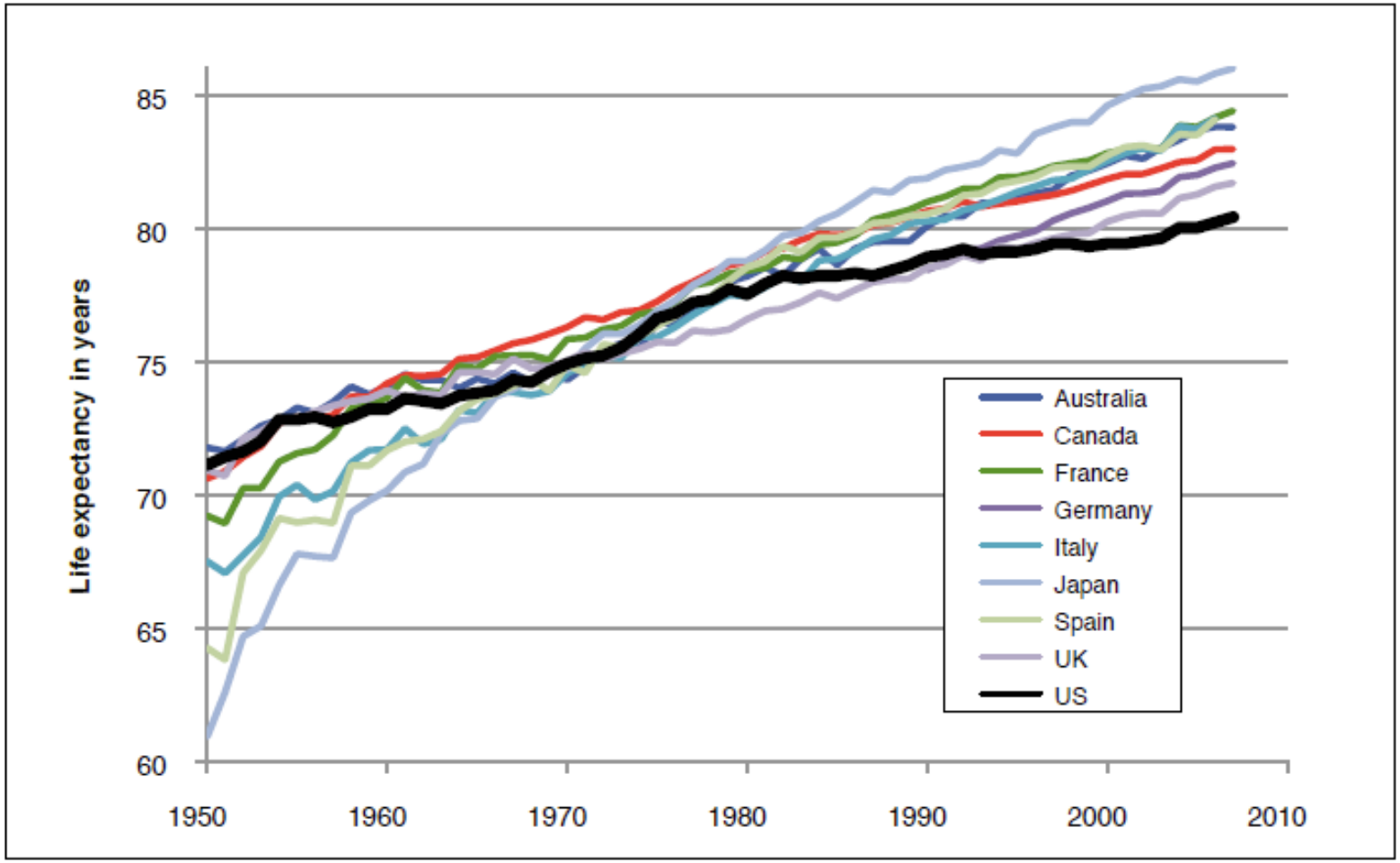
Vaupel, 2012

Figure 28A. International Comparison of Male Life Expectancy Trends: 1950–2007



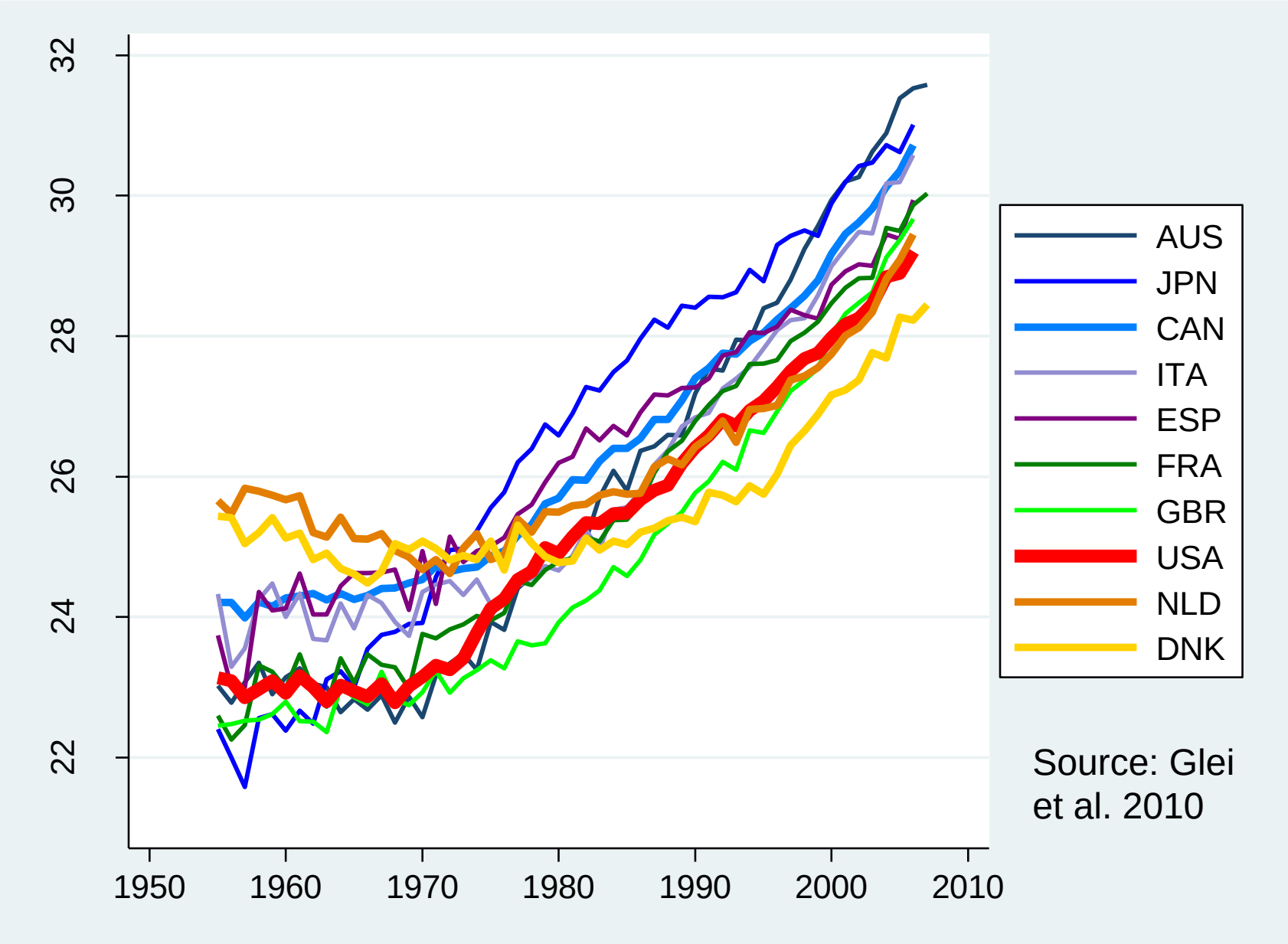
Source: Human Mortality Database, Trustees Report, 2011.

Figure 28B. International Comparison of Female Life Expectancy Trends: 1950–2007

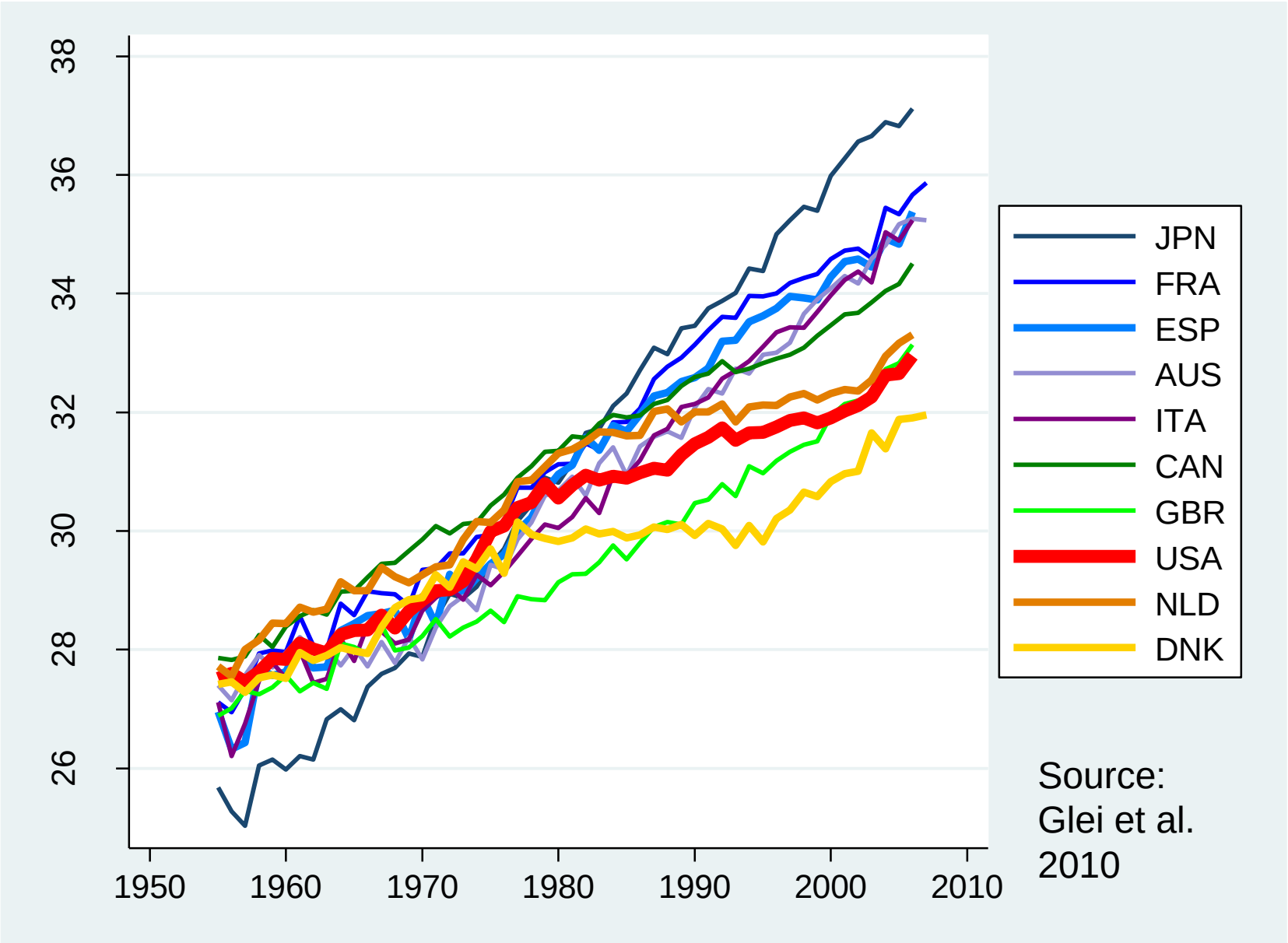


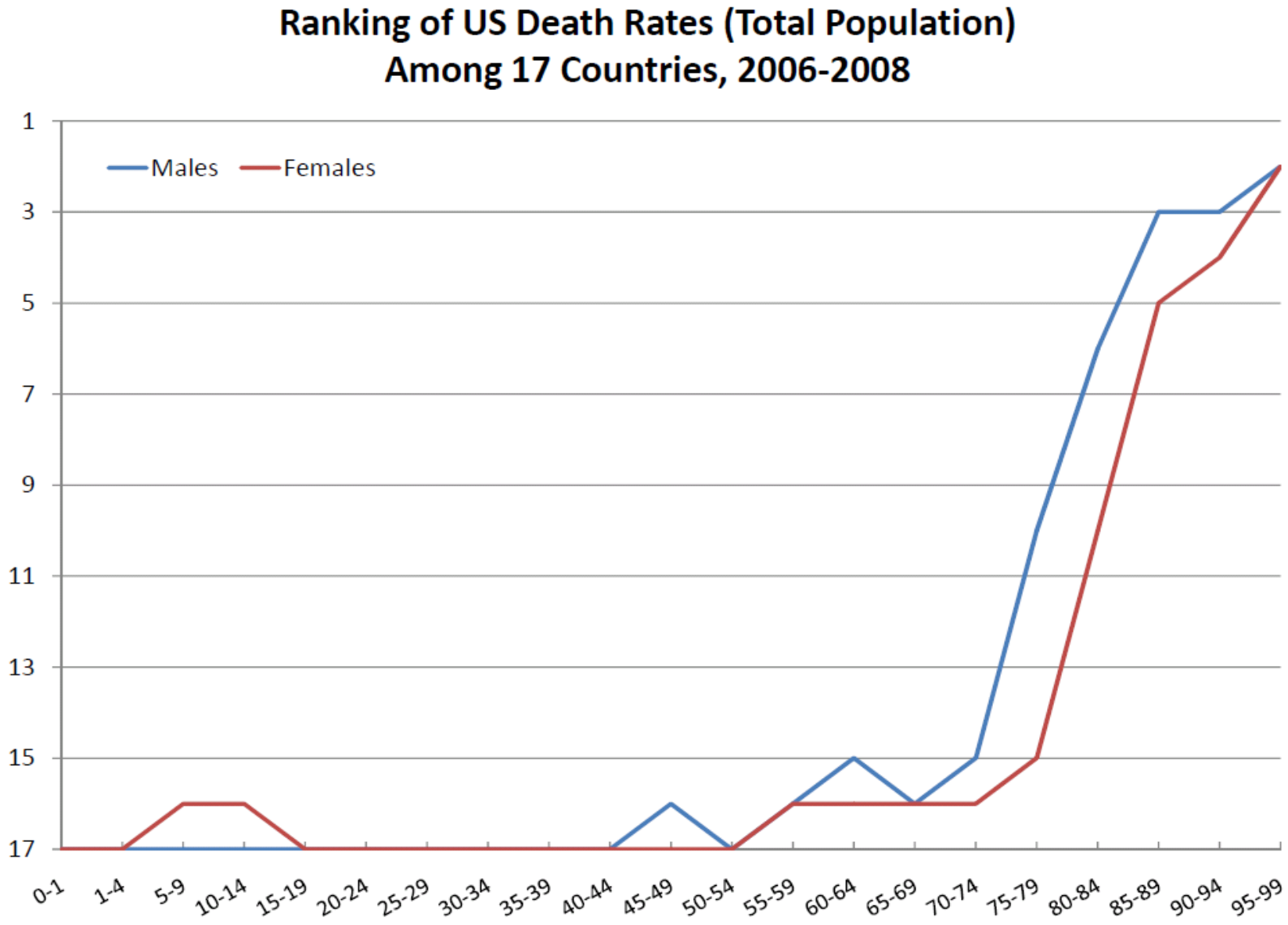
Source: Human Mortality Database, Trustees Report, 2011.

Trends in e_{50}, Males



Trends in e_{50}, Females

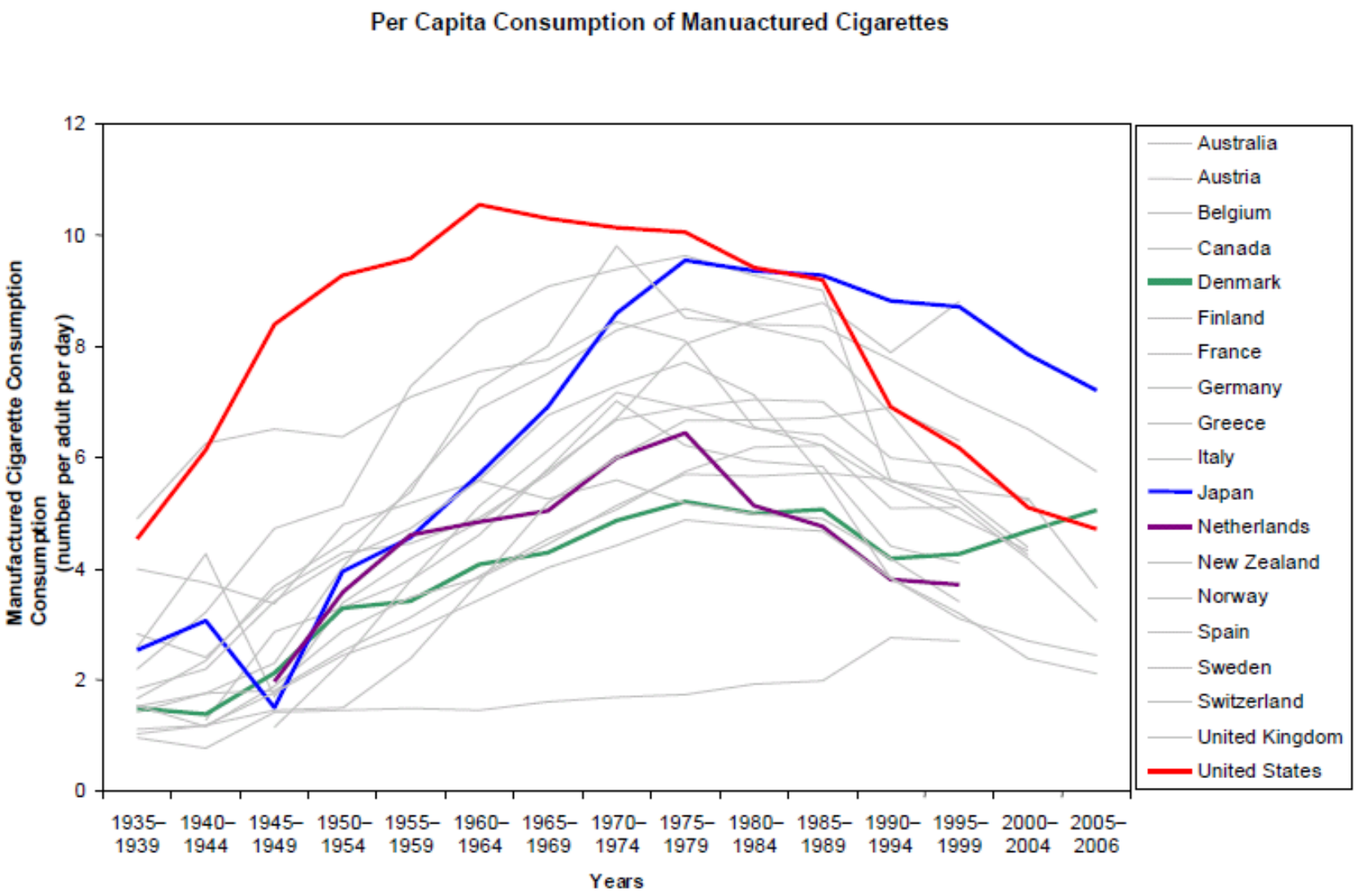



Ranking of US Death Rates (Total Population)
Among 17 Countries, 2006-2008
Males
Females
1
3
5
7
9
11
13
15
17
0-1
1-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99

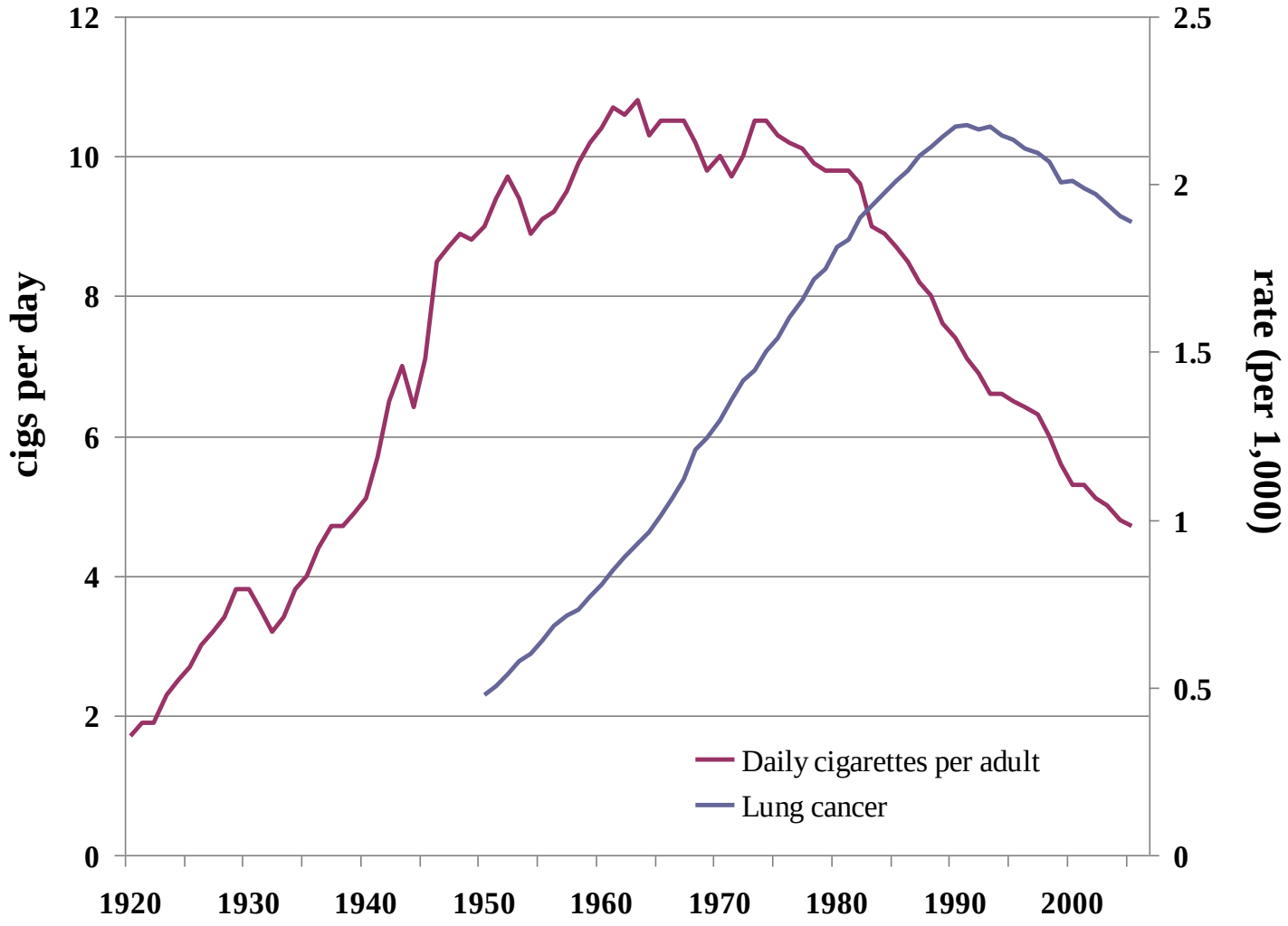
Ho 2012

Compared to OECD countries and composites, the US does well in

- Screening for cancer
- Survival rates from cancer
- Survival rates after heart attacks
- Survival rates after strokes
- Medication for high blood pressure
- Medication for high cholesterol
- Vaccination against influenza
- Mortality from influenza and pneumonia


Per Capita Consumption of Manuactured Cigarettes
Manufactured Cigarette Consumption
Consumption
(number per adult per day)
12
10
8
6
4
2
0
1935–1939
1940–1944
1945–1949
1950–1954
1955–1959
1960–1964
1965–1969
1970–1974
1975–1979
1980–1984
1985–1989
1990–1994
1995–1999
2000–2004
2005–2006
Years
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Italy
Japan
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States

Daily Cigarettes Per Capita and Lung Cancer Mortality in the US



The Model

$$\ln M_0 = \beta_a X_a + \beta_t X_t + \beta_c X_c + \beta_{ct}(T \times X_c) + \beta_L M_L + \beta_{tL}(M_L \times T) + \beta_{aL}(M_L \times X_a)$$

M_0 is the death rate from causes other than lung cancer in a particular age/sex/period country category;

X_a is a set of dummy variables for each age group;

X_t is a set of dummy variables for each calendar year;

X_c is a set of dummy variables for each country;

(T x X_c) is a set of interactions between calendar year (linear) and each country dummy;

M_L is the death rate from lung cancer;

(M_L x T) is an interaction between M_L and year;

(M_L x X_a) is an interaction between M_L and the age dummies

TABLE 5-1 Estimated Fraction of All Deaths at Ages 50 and Older Attributable to Smokin
1955, 1980, 2003, by Gender and Country

	Males			Females		
Country	1955	1980	2003	1955	1980	2003
Australia	0.07	0.22	0.17	0.00	0.04	0.10
Austria	0.15	0.21	0.17	0.01	0.02	0.05
Belgium	0.09	0.30	0.27†	0.00	0.01	0.05†
Canada	0.07	0.22	0.24	0.01	0.06	0.19
Denmark	0.07	0.22	0.20	0.01	0.06	0.16
Finland	0.18	0.28	0.17	0.01	0.02	0.04
France	0.05	0.17	0.19	0.00	0.00	0.02
Hungary	0.07	0.22	0.30	0.01	0.05	0.13
Iceland	0.03	0.06	0.16	0.00	0.11	0.18
Ireland	0.04	0.17	0.19	0.02	0.07	0.14
Italy	0.04	0.20	0.23	0.00	0.01	0.04
Japan	0.01	0.11	0.20	0.00	0.03	0.09
Netherlands	0.10	0.32	0.26	0.00	0.01	0.09
New Zealand	0.08	0.21	0.17	0.00	0.06	0.12
Norway	0.02	0.09	0.16	0.00	0.01	0.07
Portugal	0.02	0.07	0.12	0.00	0.00	0.01
Spain	0.04	0.14	0.22	0.00	0.00	0.00
Sweden	0.03	0.10	0.09	0.00	0.02	0.06
Switzerland	0.09	0.19	0.16	0.00	0.01	0.04
United Kingdom	0.16	0.30	0.20	0.02	0.09	0.15
United States	0.08	0.23	0.22	0.01	0.08	0.20

* Estimates based on data from 2004 for Belgium.

SOURCE: Preston et al. (2010b), Table 4-2. Reproduced with permission.

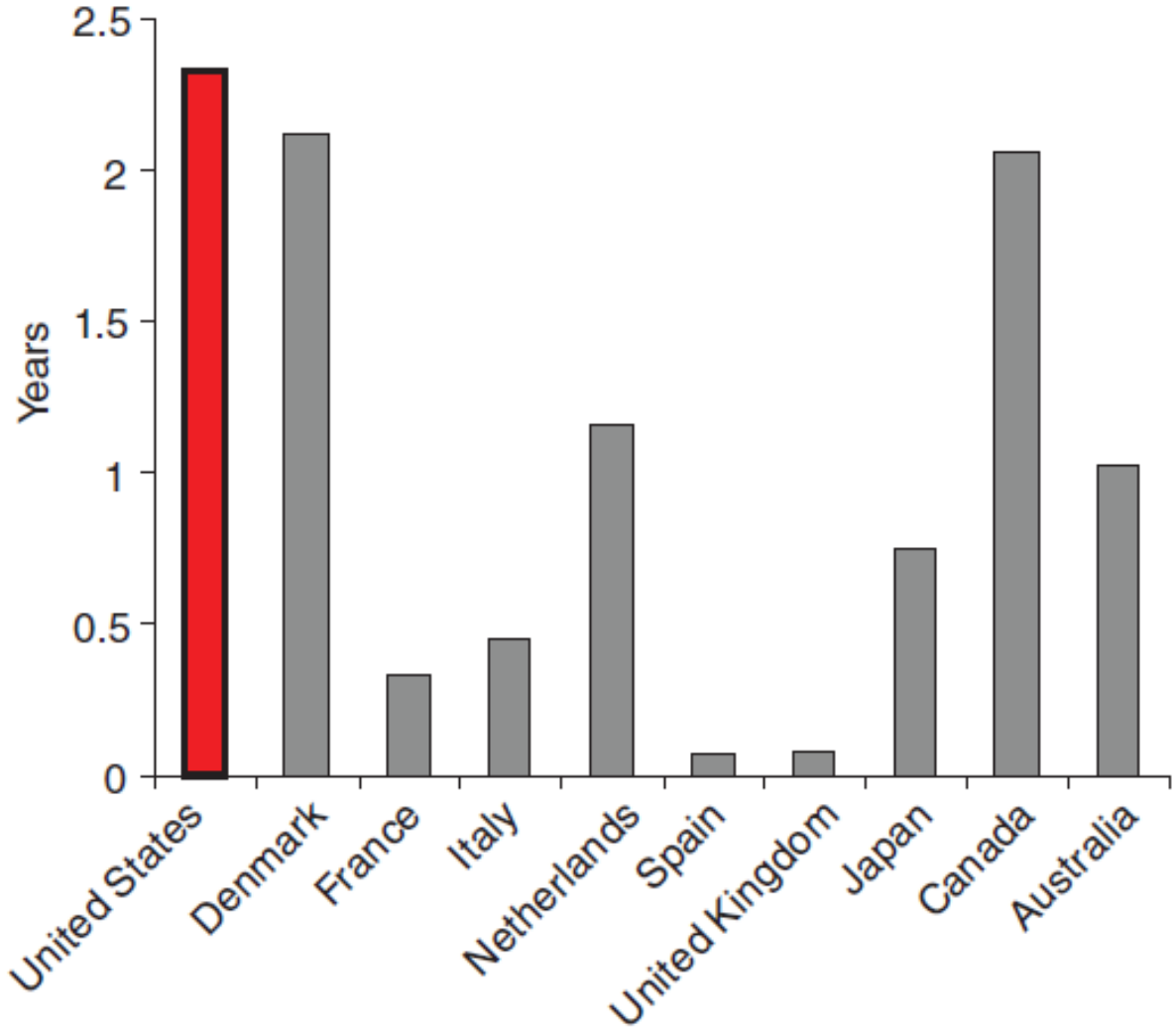


FIGURE 5-2 Gains in female life expectancy at age 50 from eliminating smoking in 2003.
SOURCE: Based on calculations in Preston et al. (2010b).

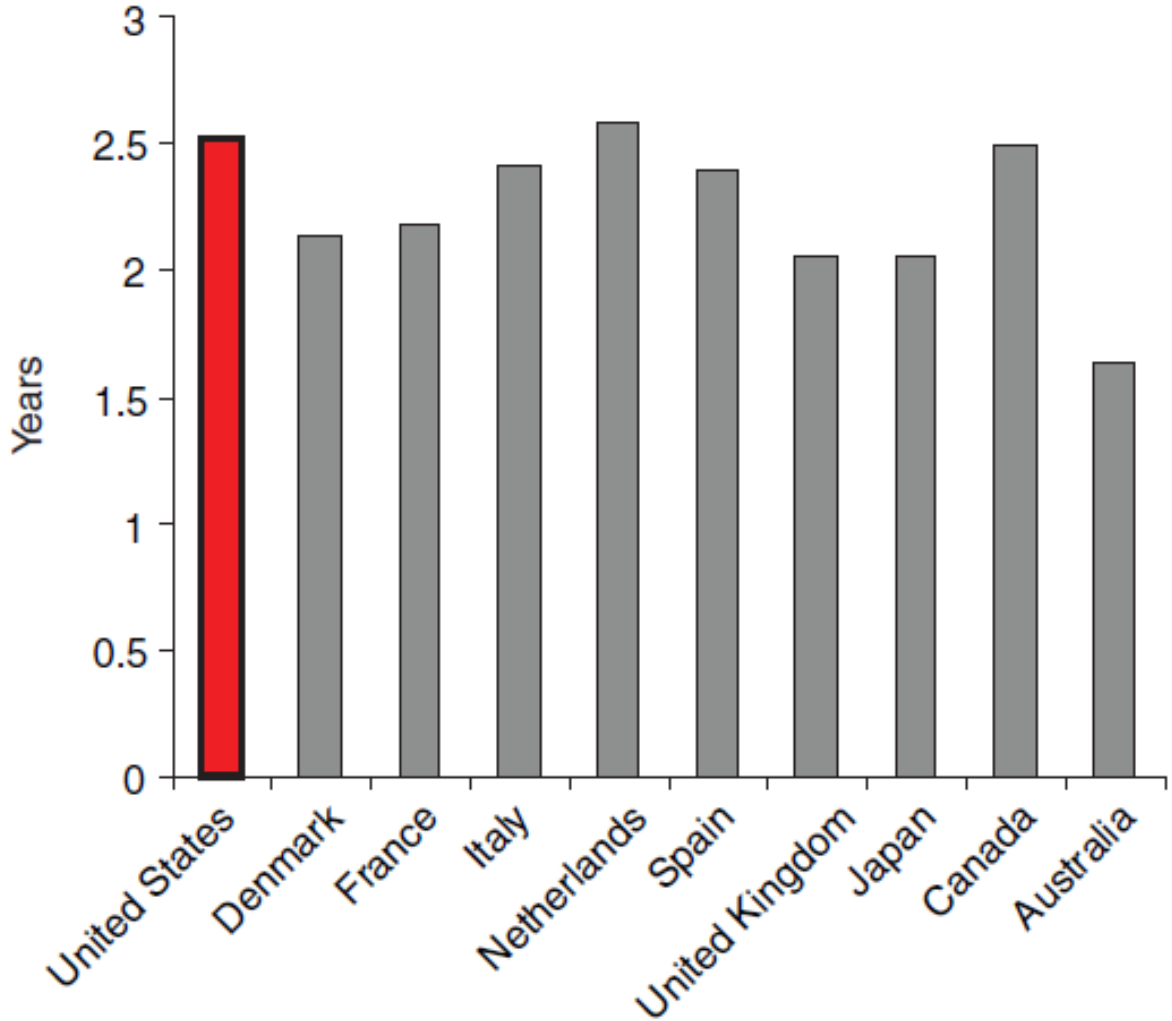
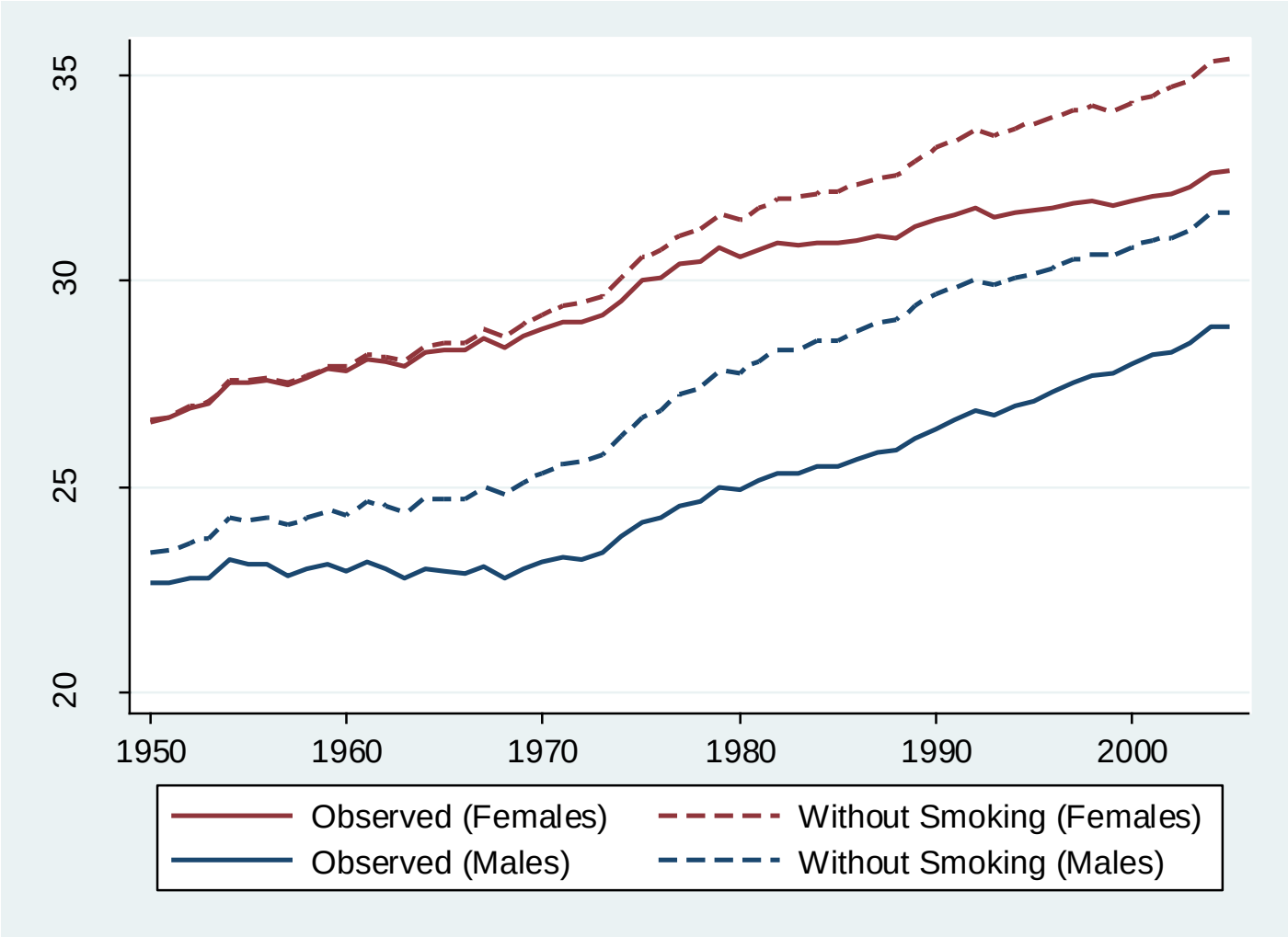


FIGURE 5-3 Gains in male life expectancy at age 50 from eliminating smoking in 2003.
SOURCE: Based on calculations in Preston et al. (2010b).

	Loss in Life Expectancy From Smoking			Life Expectancy Difference US – 9 Countries	Percent Explained
	US	9 Countries	*Difference*		
Women	2.33	1.07	1.26	1.61	78%
Men	2.52	2.21	0.31	0.76	41%

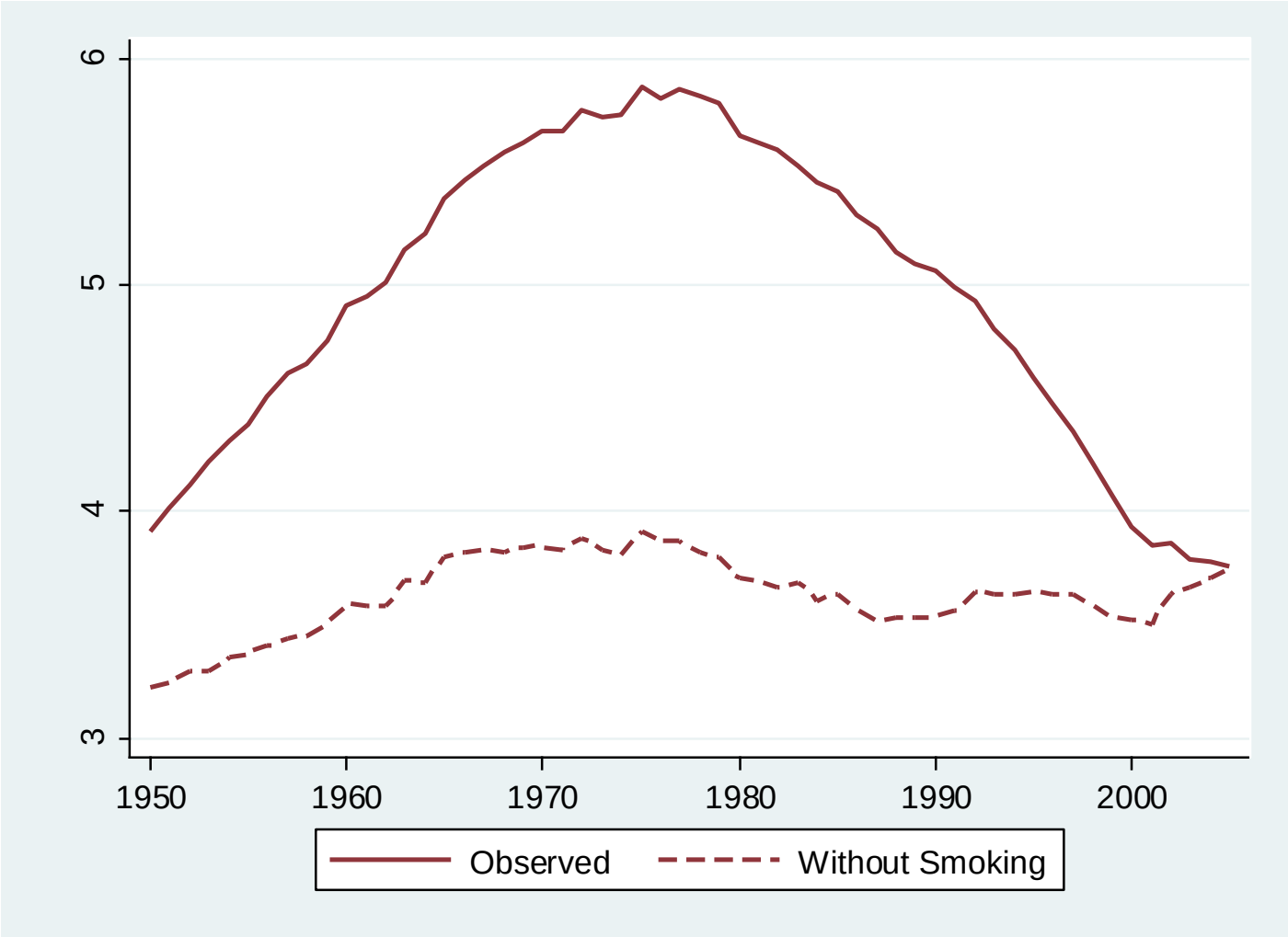
Source: Preston, Glei, Wilmoth 2010

FIGURE 1 U.S. trends in observed e_{50} and estimated e_{50} without smoking by sex.



Source: Preston, Glei, and Wilmoth (2009)

FIGURE 2 U.S. trends in the observed sex difference in e_{50} and the estimated sex difference without smoking.



Source: Preston, Glei, and Wilmoth (2009)

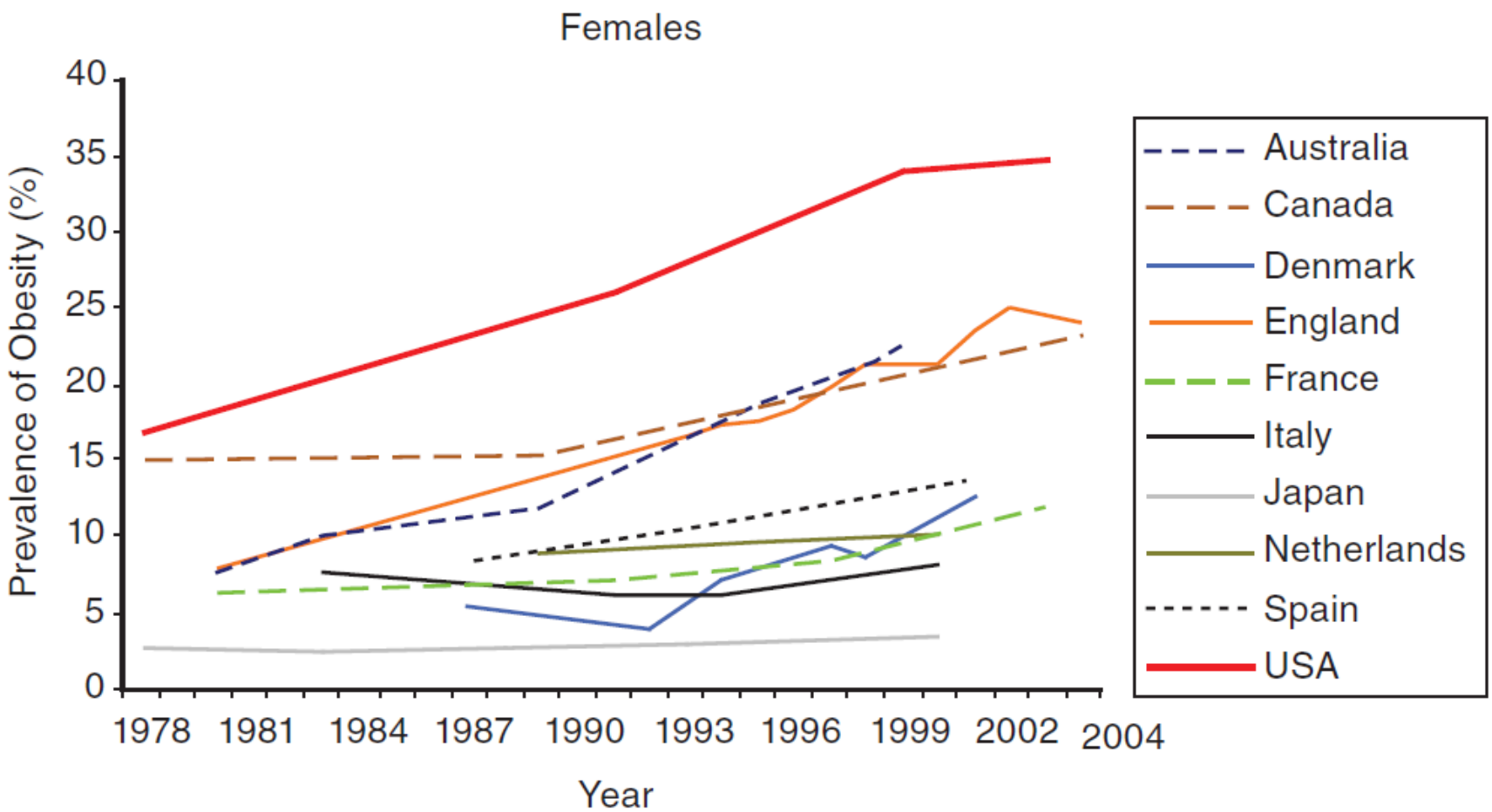
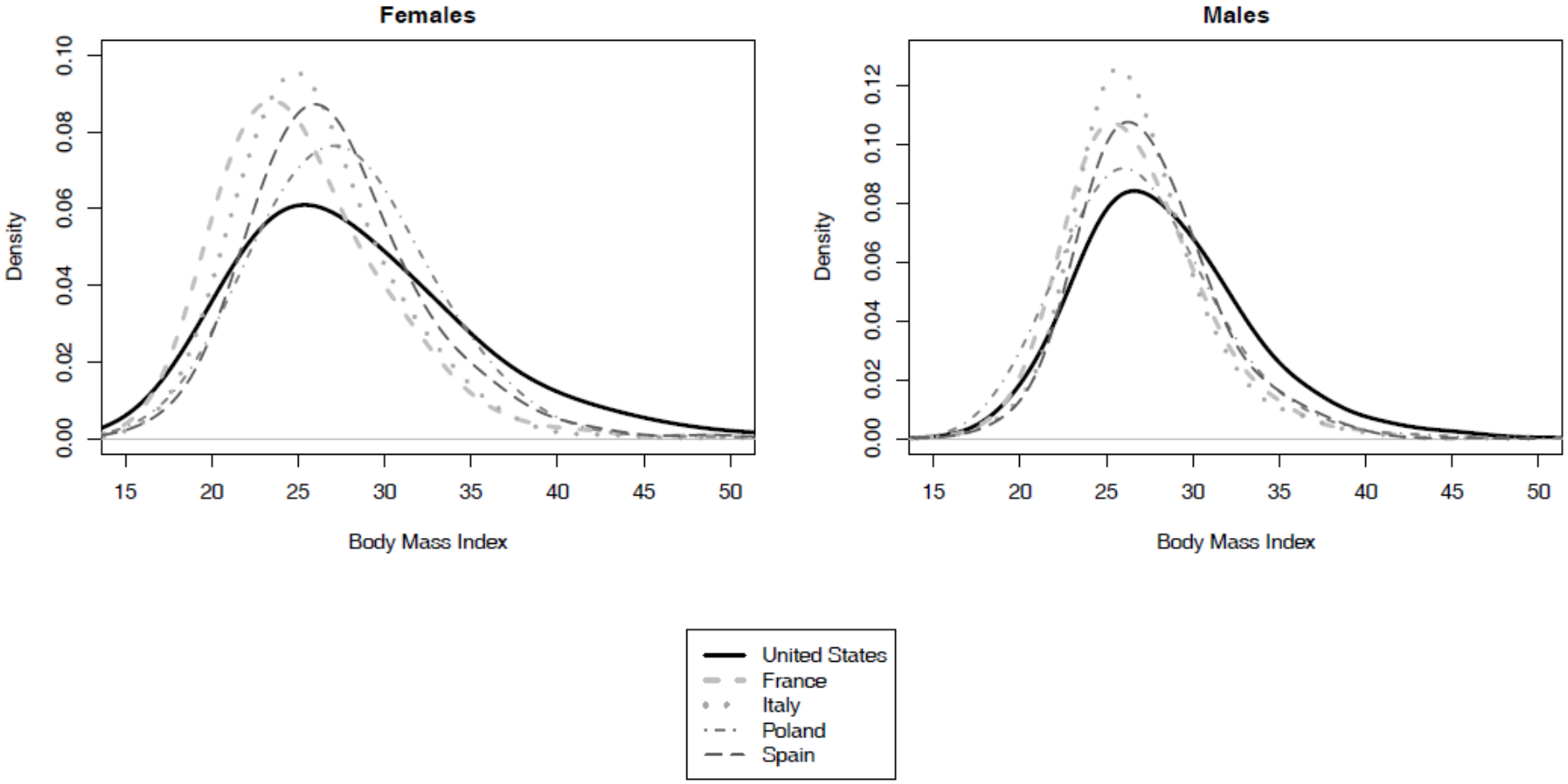


FIGURE 3-2 Trends in prevalence of adult obesity by country and gender, 1978–2004.

Source: Alley et al. 2011



Preston and Stokes 2011

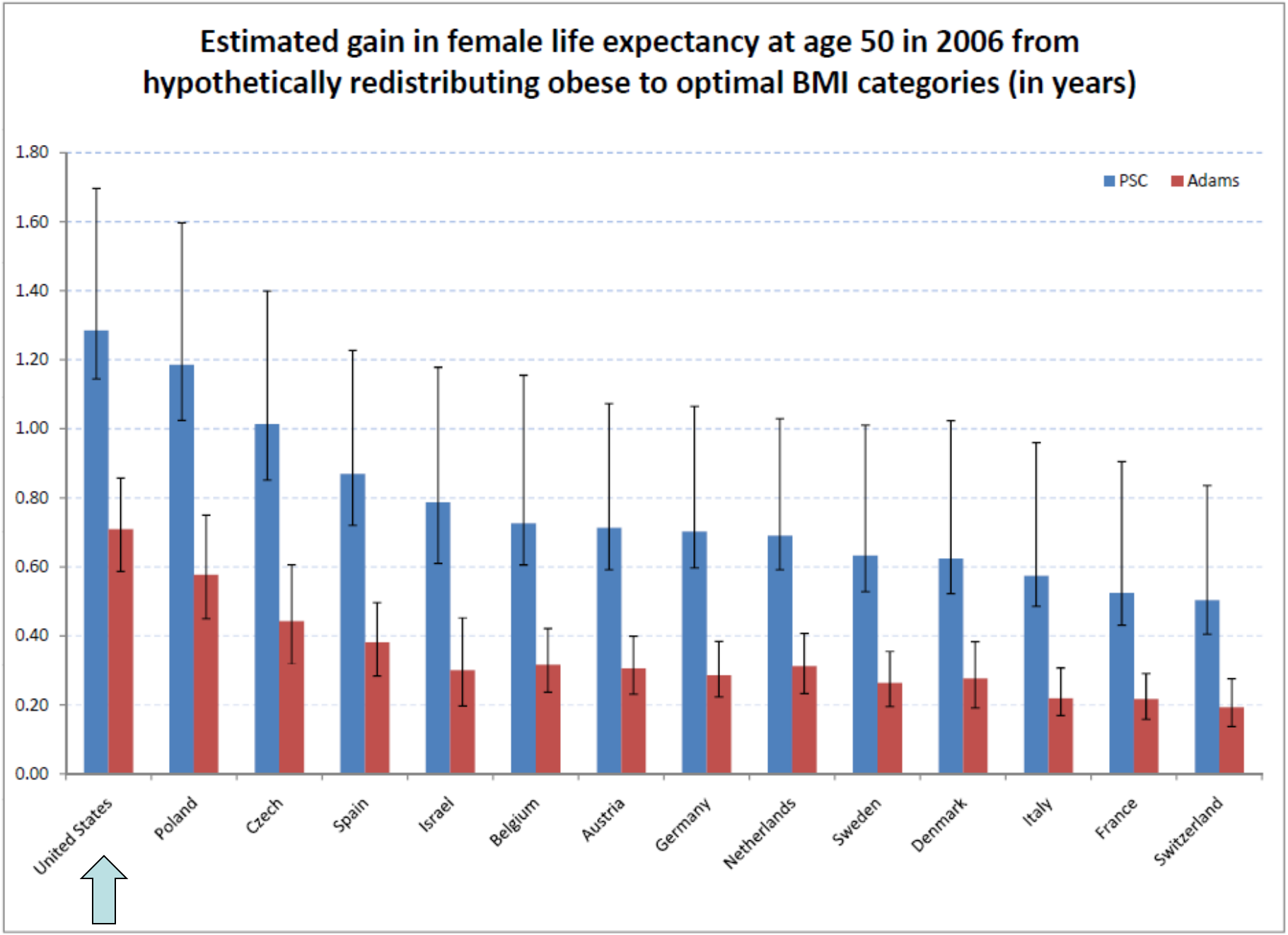
$$AF_i = \frac{\sum(C_{ij}M_{sj} - C^*_{ij}M_{sj})}{\sum(C_{ij}M_{sj})} \tag{1}$$

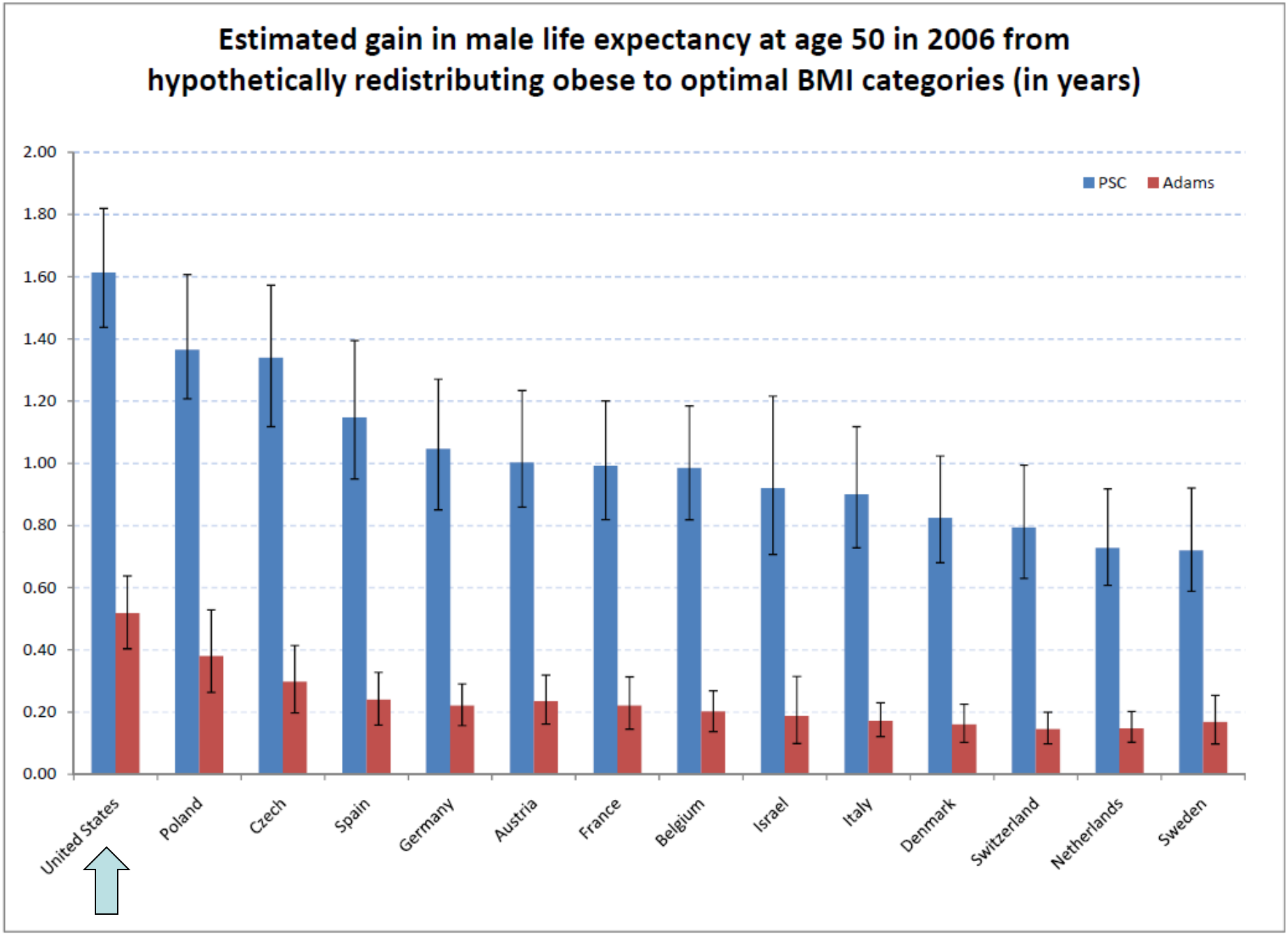
where,

C_{ij} = proportion of population i in BMI category j

M_{sj} = death rate in BMI category j in the *standard* drawn from PSC data

C^*_{ij} = proportion of population i in BMI category j if all individuals above the optimal BMI were redistributed to the optimal category


Estimated gain in female life expectancy at age 50 in 2006 from hypothetically redistributing obese to optimal BMI categories (in years)
PSC
Adams
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
United States
Poland
Czech
Spain
Israel
Belgium
Austria
Germany
Netherlands
Sweden
Denmark
Italy
France
Switzerland


Estimated gain in male life expectancy at age 50 in 2006 from hypothetically redistributing obese to optimal BMI categories (in years)
PSC
Adams
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
United States
Poland
Czech
Spain
Germany
Austria
France
Belgium
Israel
Italy
Denmark
Switzerland
Netherlands
Sweden

Demography (2014) 51:27–49
DOI 10.1007/s13524-013-0246-9

Projecting the Effect of Changes in Smoking and Obesity on Future Life Expectancy in the United States

Samuel H. Preston · Andrew Stokes · Neil K. Mehta · Bochen Cao

Figure 5. U.S. Male Lung Cancer Mortality by Cohorts

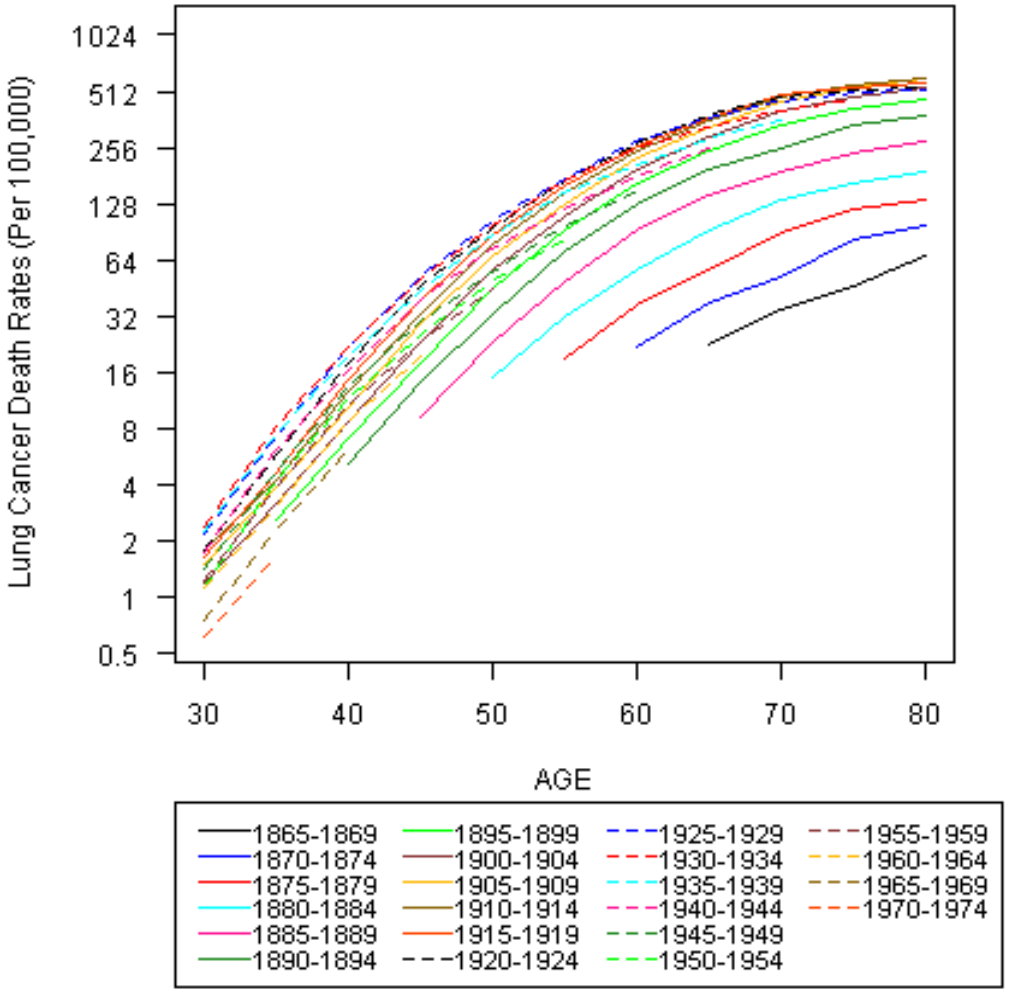


Figure 6. U.S. Male Lung Cancer Mortality by Period

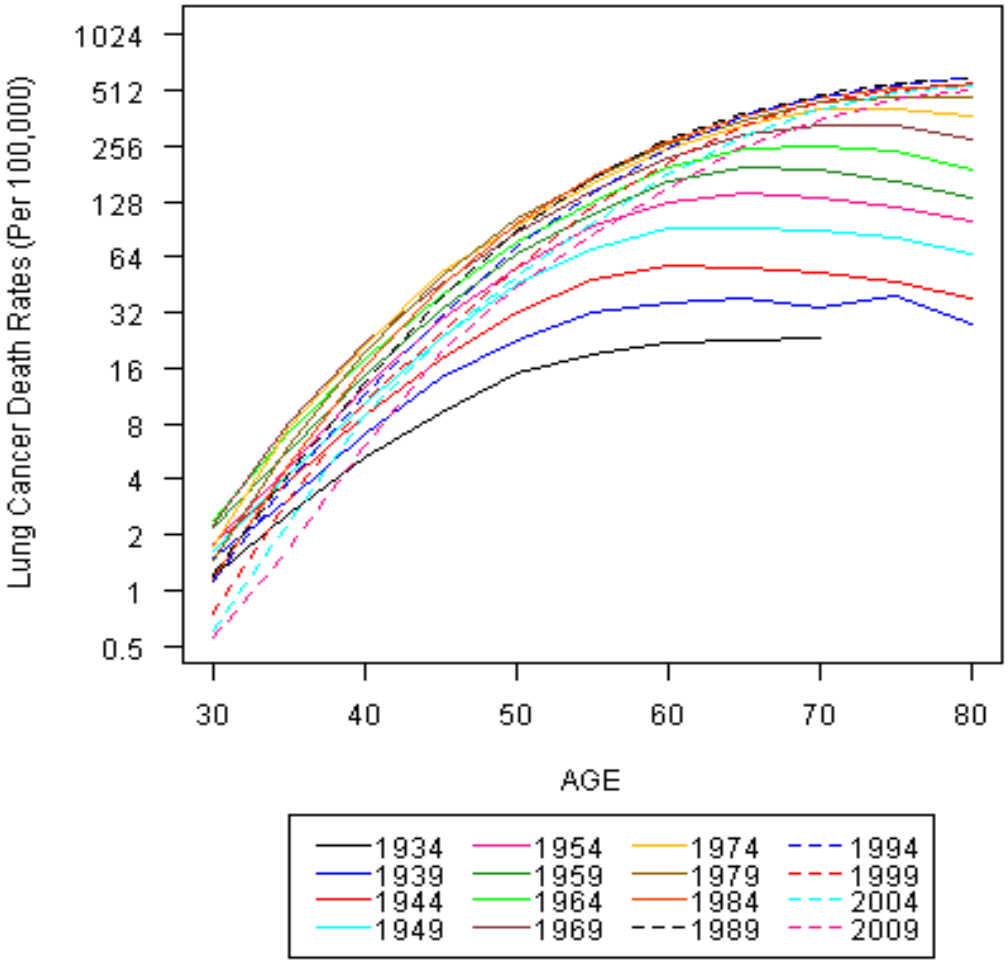
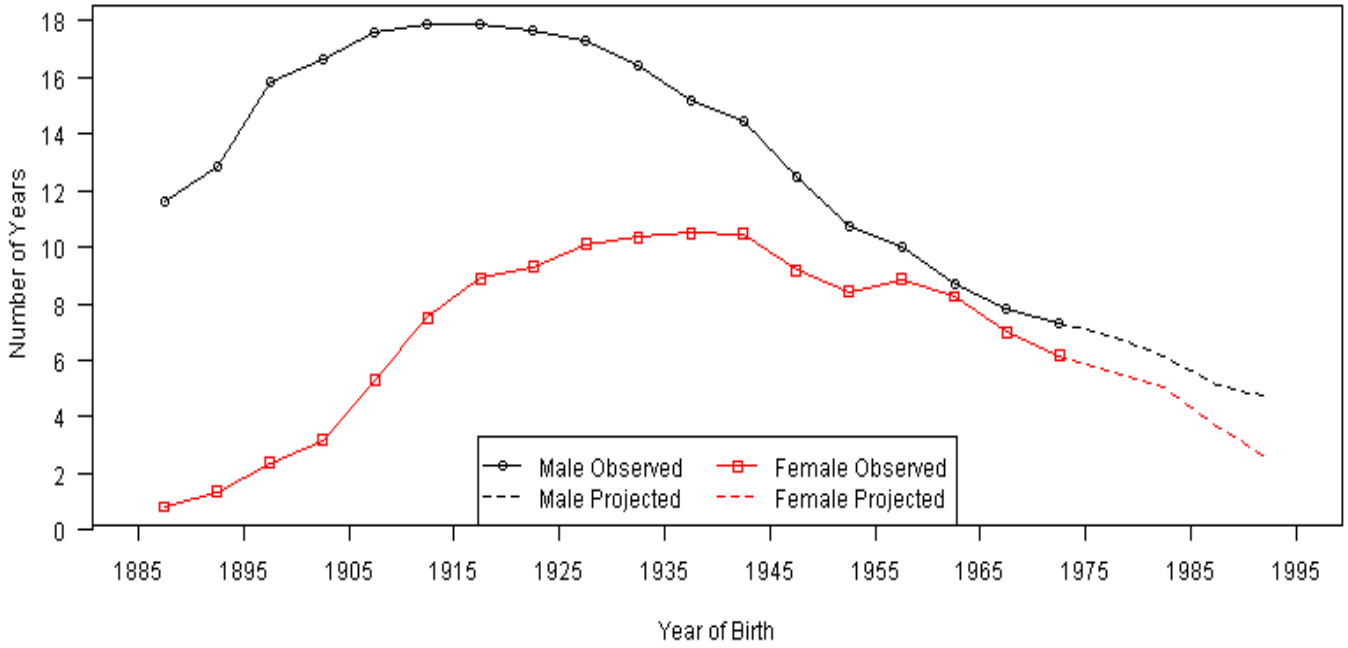


Figure 7. Mean Number of Years Spent as a Cigarette Smoker before Age 40 by Cohort



We estimate a simple age/cohort model:

$$\ln(M_a^c) = A + \beta_a X_a + \beta_c X_c + \varepsilon,$$

And then compare the cohort coefficients to smoking prevalence by cohort

Figure 8A. Cohort Coefficients Predicting Lung Cancer Mortality and Cumulative Cohort Smoking by Age 40 (Males)

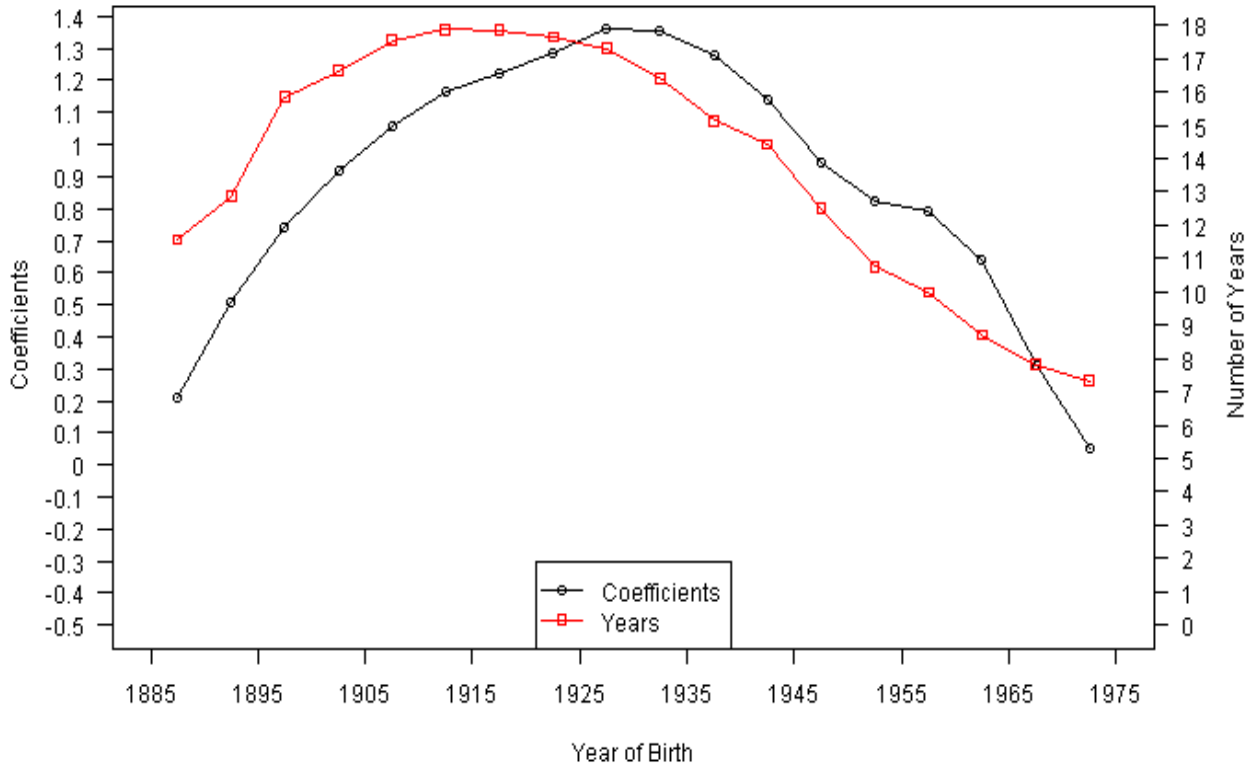
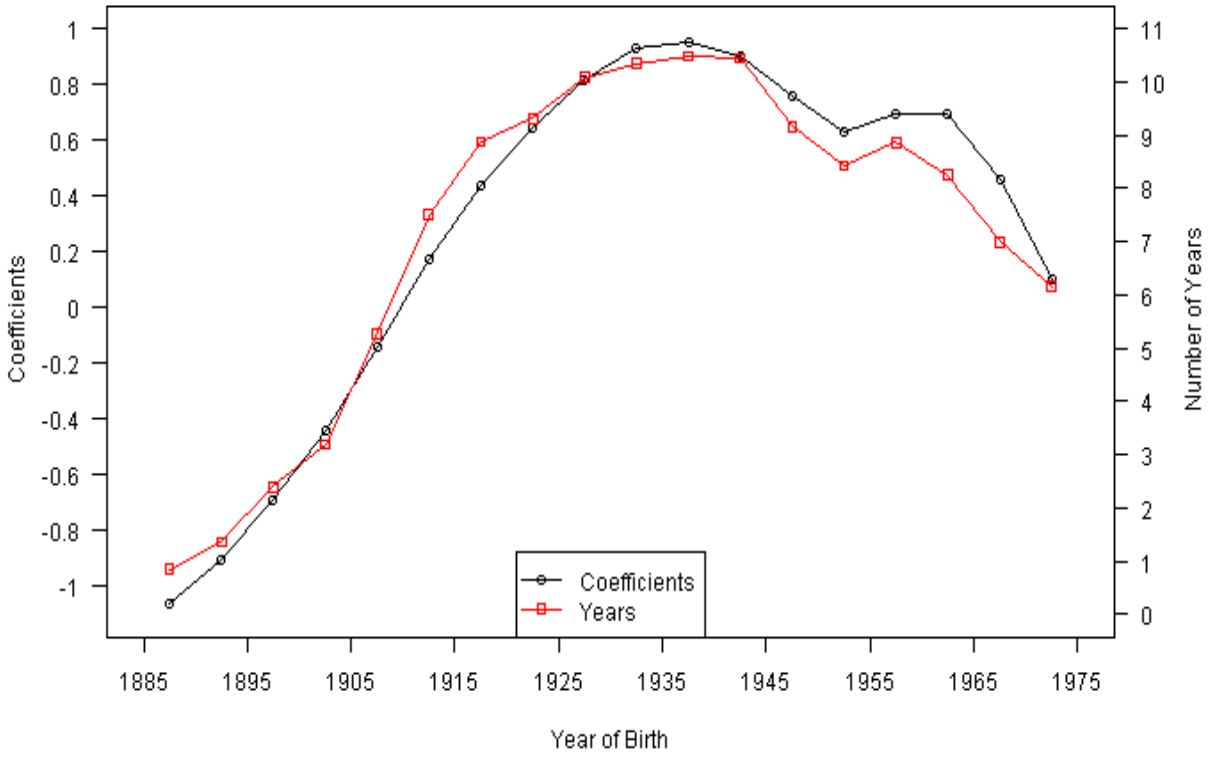


Figure 8B. Cohort Coefficients Predicting Lung Cancer Mortality and Cumulative Cohort Smoking by Age 40 (Females)



Equation for Projecting the Mortality Effects of Smoking

$$ln\, M(a,c) = A + B_\alpha X_\alpha + B_s\, ln\, S(a,c)$$

Where,

- $M(a,c)$ = death rate from lung cancer at age a in cohort c
- $S(a,c)$ =mean cumulative number of years smoked prior to age 40 for cohort c at age a
- X_α is an indicator of age category a
- B_α is the coefficient of age category a
- B_s is the coefficient of $ln\, S(a,c)$

The Model

$$\ln M_0 = \beta_a X_a + \beta_t X_t + \beta_c X_c + \beta_{ct}(T \times X_c) + \beta_L M_L + \beta_{tL}(M_L \times T) + \beta_{aL}(M_L \times X_a)$$

M_0 is the death rate from causes other than lung cancer in a particular age/sex/period country category;

X_a is a set of dummy variables for each age group;

X_t is a set of dummy variables for each calendar year;

X_c is a set of dummy variables for each country;

(T x X_c) is a set of interactions between calendar year (linear) and each country dummy;

M_L is the death rate from lung cancer;

(M_L x T) is an interaction between M_L and year;

(M_L x X_a) is an interaction between M_L and the age dummies

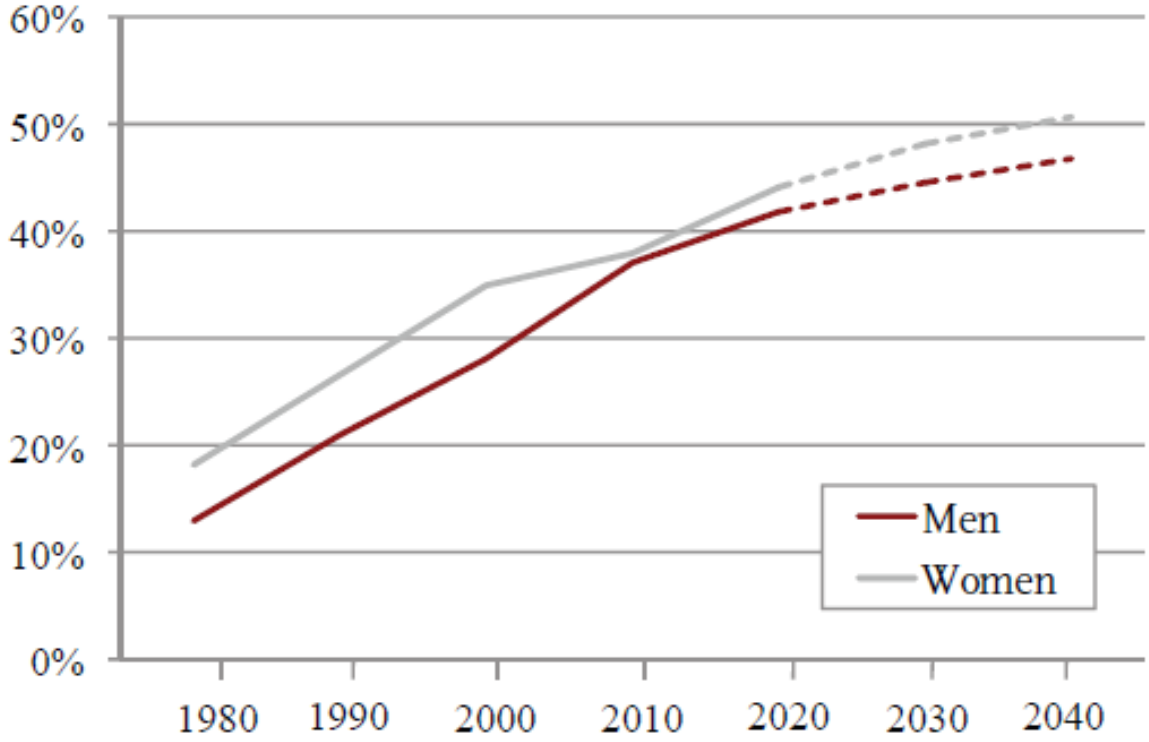
Table 5A. Changes in Life Expectancy at Age 40 Resulting from Changes in Smoking

Year	Males	Females
2015	0.26	-0.03
2020	0.54	0.04
2025	0.81	0.15
2030	1.05	0.32
2035	1.31	0.62
2040	1.54	0.85

Strategy for Projecting Effect of Obesity on Life Expectancy

- Apply regression equation relating mortality to obesity at age 25 and at current age (NHANES).
- Observe and extrapolate BMI distributions for cohorts at age 25.
- Estimate future BMI distributions at older ages by assuming 10-year BMI transition matrix at level in 2000-2010.

Figure 1. Actual and Projected Trends in Obesity Prevalence among U.S. Adult Population, 1976-2040



Source: Preston et al. (2013).

Table 5B. Changes in Life Expectancy at Age 40 Resulting from Changes in Obesity

Year	Males	Females
2020	-0.30	-0.27
2030	-0.54	-0.56
2040	-0.73	-0.82

Table 5C. Changes in Life Expectancy at Age 40 Resulting from Changes in Smoking and Obesity

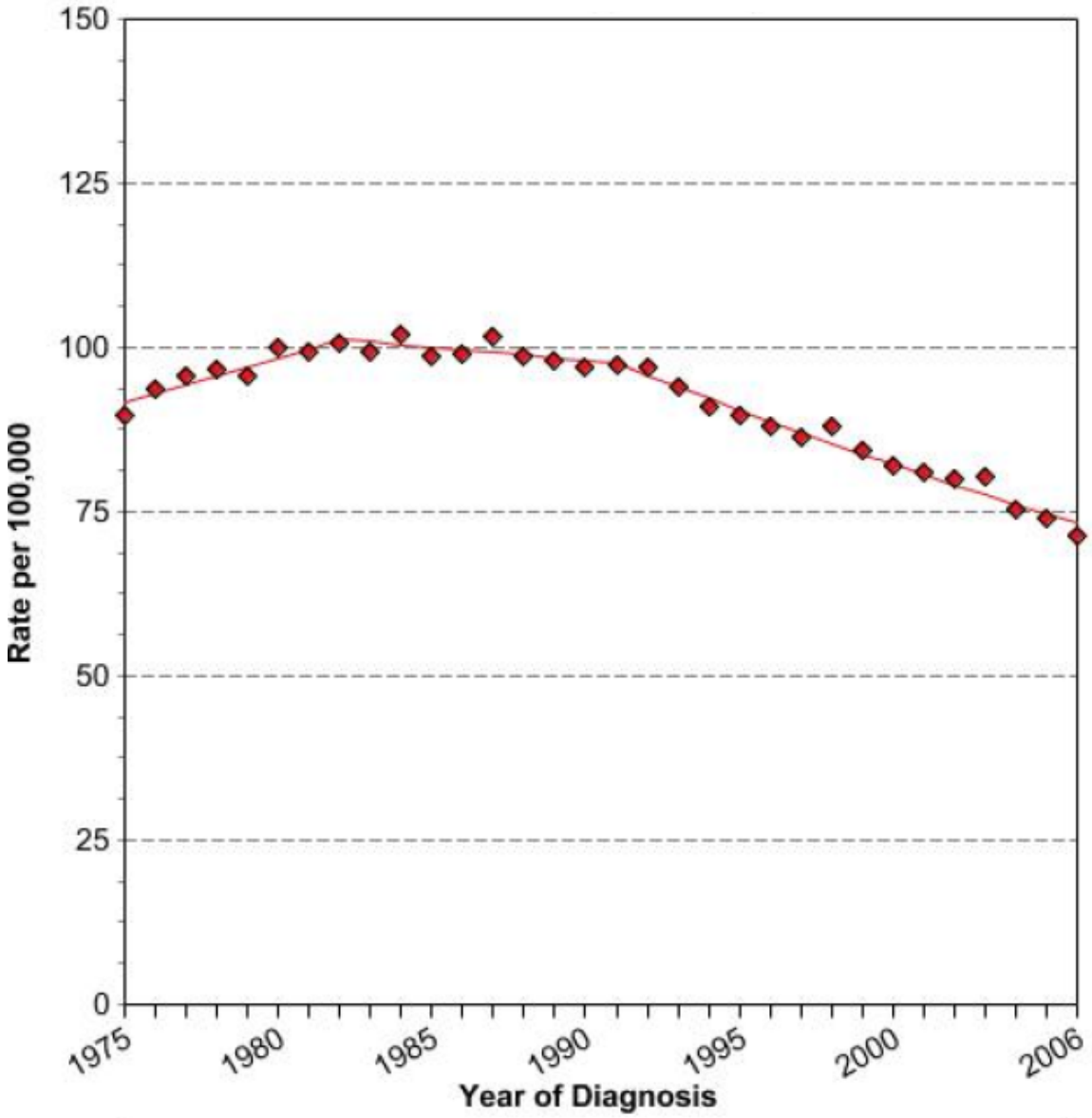
	Changes in Smoking Alone		Changes in Obesity Alone		Changes in Smoking and Obesity	
Year	Males	Females	Males	Females	Males	Females
2015	0.26	-0.03				
2020	0.54	0.04	-0.30	-0.27	0.24	-0.22
2025	0.81	0.15				
2030	1.05	0.32	-0.54	-0.56	0.53	-0.21
2035	1.31	0.62				
2040	1.54	0.85	-0.73	-0.82	0.83	0.09

Projected Changes in Life Expectancy at Age 40, 2010-2040

	Males	Females
SSA projected increase*	2.55	2.17
Gain from reduced smoking	1.54	0.85
Penalty from higher obesity	-0.73	-0.82

*Source: Felicitie C.Bell and Michael L. Miller. 2005. Life Tables for the United States Social Security Area 1900-2100. Social Security Administration Actuarial Study No. 120. Washington, D.C.

Age-Adjusted Lung Cancer Incidence Rate, US Males



Age-Adjusted Lung Cancer Incidence Rate, US Females

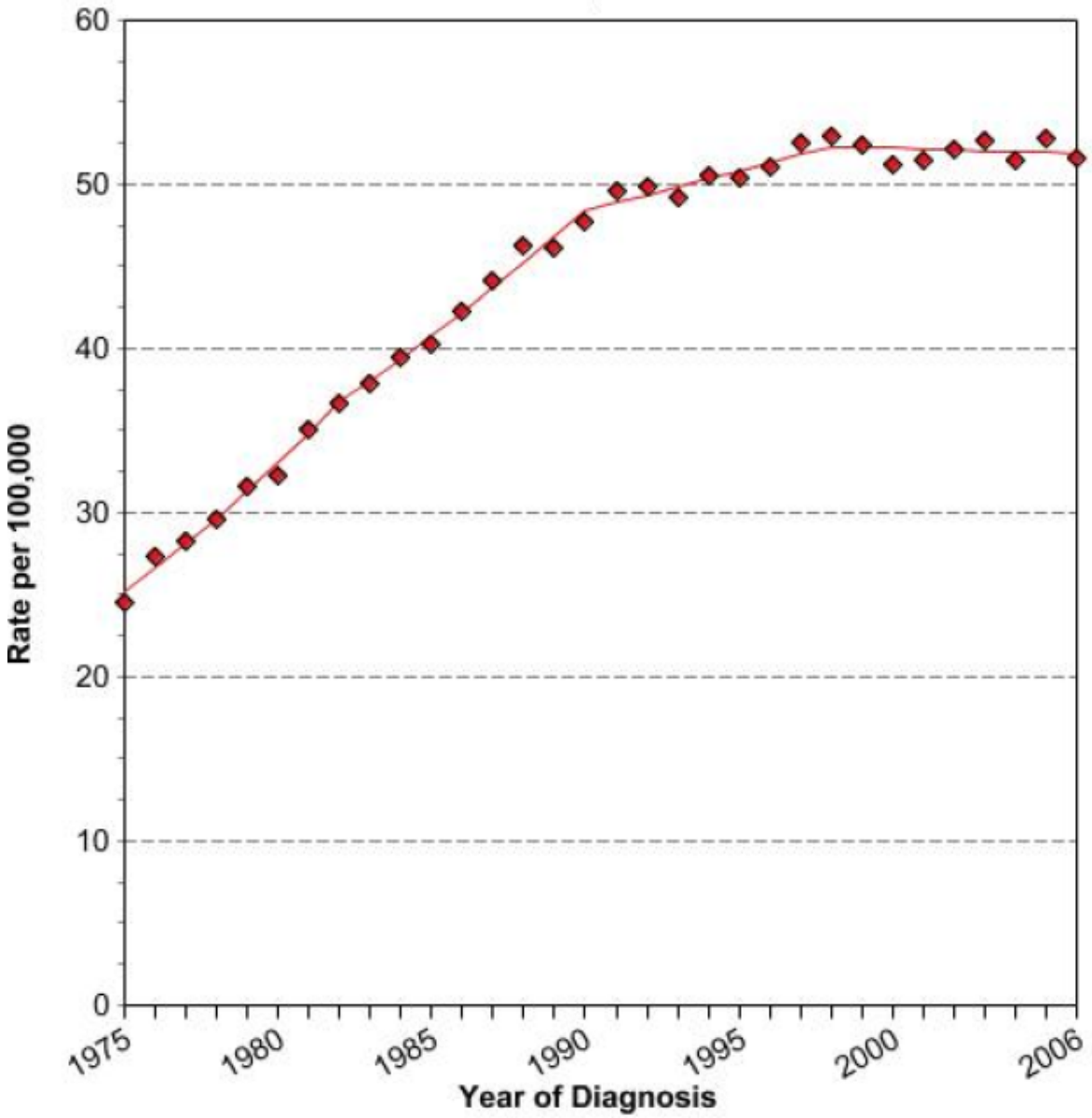


Table 3. Sex Differences in Rates of Mortality Change in the United States, by Age and Period, 1948–2003[a]

	Age Interval						
Period	50–54	55–59	60–64	65–69	70–74	75–79	80–84
1953–1948	0.0221	0.0629	0.0891	0.0765	0.0625	0.0404	0.0630
1958–1953	0.0716	0.0410	0.0487	0.0712	0.0718	0.0452	0.0036
1963–1958	0.0243	0.0579	0.0269	0.0816	0.0844	0.0627	0.0216
1968–1963	0.0029	0.0179	0.0781	0.0035	0.0894	0.0672	0.0265
1973–1968	–0.0192	–0.0299	–0.0043	0.0646	0.0052	0.0453	0.0981
1978–1973	–0.0048	–0.0325	–0.0475	–0.0118	0.0291	0.0324	0.0475
1983–1978	–0.0361	–0.0201	–0.0540	–0.0628	–0.0224	0.0402	0.0220
1988–1983	–0.0245	–0.0534	–0.0350	–0.0526	–0.0415	–0.0339	0.0006
1993–1988	–0.0029	–0.0312	–0.0438	–0.0378	–0.0612	–0.0419	–0.0030
1998–1993	–0.0383	–0.0418	–0.0504	–0.0615	–0.0478	–0.0509	–0.0562
2003–1998	0.0294	–0.0104	–0.0347	–0.0431	–0.0476	–0.0505	–0.0515

Note: Shaded entries indicate positive values, indicating that men's mortality rose relative to women's.

Sources: See footnote 1.

[a]Sex differences in rates of mortality change are calculated as

$$\frac{M_i(t+5)-M_i(t)}{M_i(t)}-\frac{F_i(t+5)-F_i(t)}{F_i(t)},$$

where M_i = death rate for males in age interval i, year t. F_i = death rate for females in age interval i, year t.