Longevity Trends and their Implications

Michael Morris

Tiffany Bosley

Michael Clingman

Mortality Projections

Michael Morris

Data Sources

- For under age 65:
  - Deaths from the National Center for Health Statistics
  - Resident population from the Census Bureau

- For ages 65 and over:
  - Deaths and enrollments of the Medicare population.

- For all ages:
  - Deaths by cause from the National Center for Health Statistics.

Projecting Mortality

- Mortality rates are assumed to decline in the future. But how fast?
- The annual Trustees Report (TR) uses three sets of (deterministic) projections:
    - Low cost (alternative I)
    - Intermediate (alternative II)
    - High cost (alternative III)
- Stochastic projections
- The 2018 intermediate projections assumed significant mortality declines in the future, as shown by:
    - Calendar year life expectancy at birth
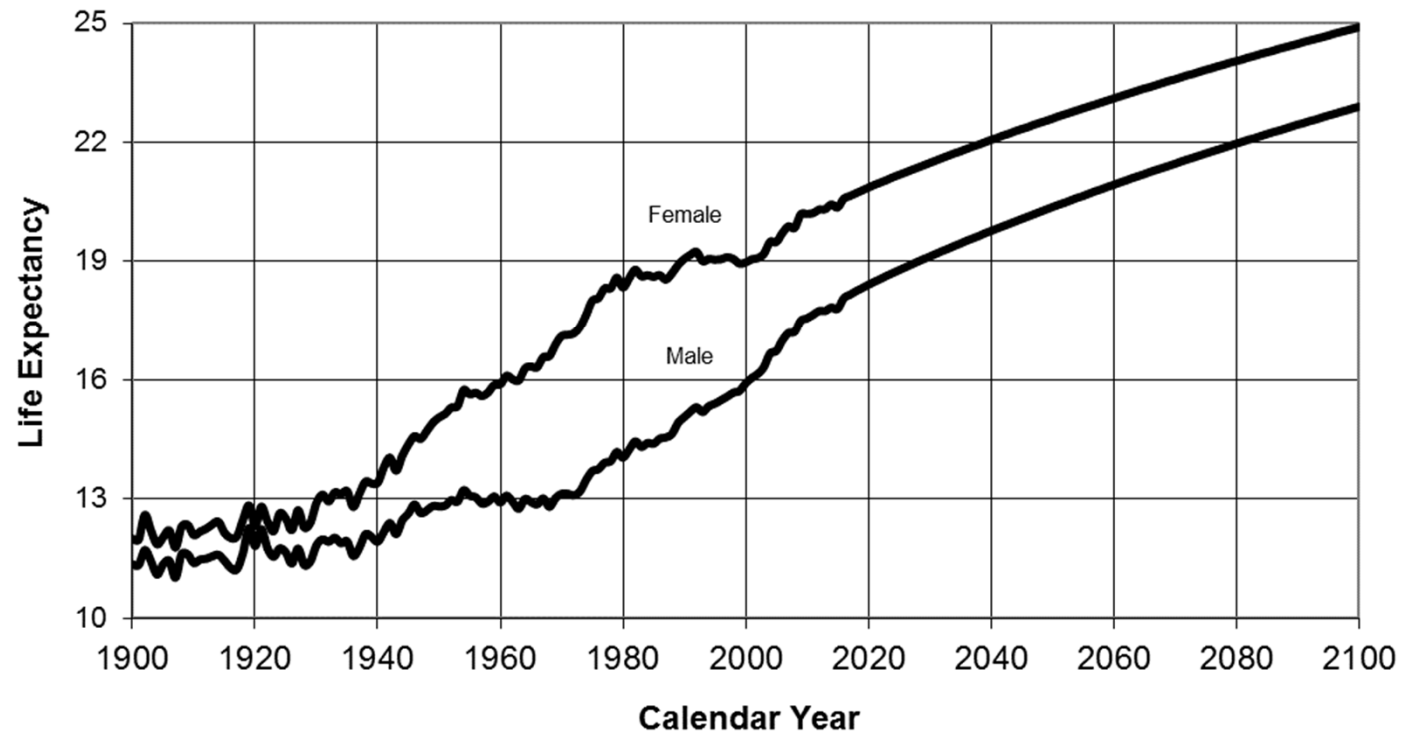   - Calendar year life expectancy at age 65

Life Expectancy at Birth

Period Life Expectancy at Birth using the 2018 TR
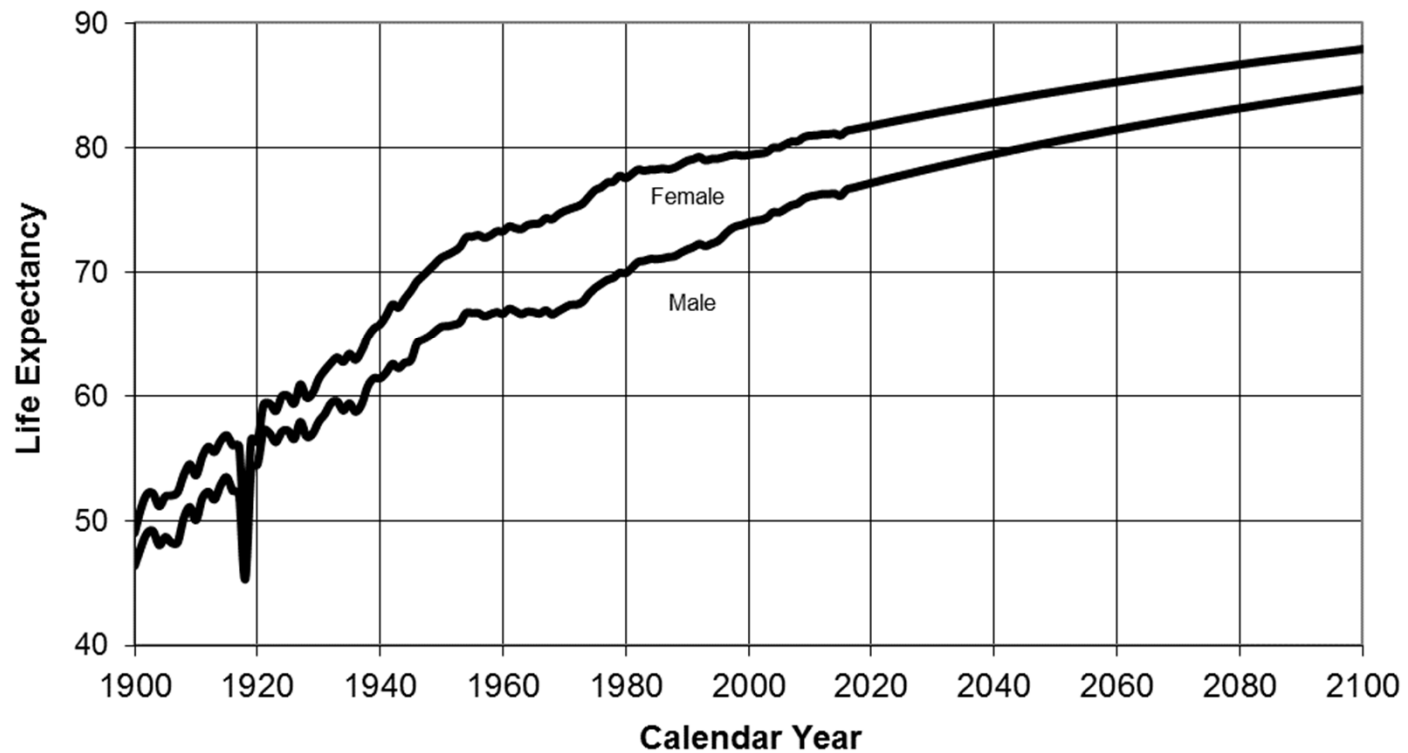
Life Expectancy at Age 65

Period Life Expectancy at Age 65 using the 2018 TR

Average Annual Rates of Reduction in Central Death Rates by Age Group, Sex, and Cause

	Historical		Alternative II*		Historical		Alternative II*	
			2018 TR	2019 TR			2018 TR	2019 TR
	1979 to 2016	2006 to 2016	2042 to 2092	2043 to 2093	1979 to 2016	2006 to 2016	2042 to 2092	2043 to 2093
Under Age 15	**Male**				**Female**			
Cardiovascular Disease	2.72	2.54	2.3	2.3	2.61	2.48	2.3	2.3
Cancer	2.21	0.46	1.5	1.5	1.86	1.23	1.5	1.5
Violence	2.73	1.59	1.0	1.0	2.28	1.64	1.0	1.0
Respiratory Disease	2.41	1.21	2.0	2.0	2.46	1.02	2.0	2.0
Other	2.27	2.20	1.7	1.7	2.13	1.98	1.7	1.7
Resulting Total **	2.37	2.00	1.54	1.54	2.17	1.88	1.57	1.57
Ages 15 - 49	**Male**				**Female**			
Cardiovascular Disease	1.90	1.36	1.5	1.5	1.15	0.88	1.5	1.5
Cancer	1.92	2.34	1.5	1.5	1.67	1.74	1.5	1.5
Violence	0.64	-0.40	0.7	0.7	-0.14	-1.21	0.7	0.7
Respiratory Disease	0.77	0.19	0.5	0.5	-0.21	-0.14	0.5	0.5
Other	0.73	1.51	0.8	0.8	-0.32	0.23	0.8	0.8
Resulting Total **	1.09	0.59	0.87	0.86	0.52	0.21	0.94	0.93
Ages 50 - 64	**Male**				**Female**			
Cardiovascular Disease	2.89	0.89	2.2	2.2	2.51	0.80	2.2	2.2
Cancer	1.65	1.43	1.5	1.5	1.41	1.31	1.5	1.5
Violence	-0.22	-2.49	0.5	0.5	-0.90	-3.16	0.5	0.5
Respiratory Disease	0.94	-0.80	0.7	0.7	-0.50	-1.57	0.7	0.7
Other	-0.49	-0.89	0.6	0.6	-0.51	-0.91	0.6	0.6
Resulting Total **	1.51	0.16	1.07	1.06	1.07	0.11	1.06	1.05
Ages 65 - 84	**Male**				**Female**			
Cardiovascular Disease	3.19	2.25	2.2	2.2	2.89	2.56	2.2	2.2
Cancer	1.00	2.06	0.9	0.9	0.13	1.55	0.9	0.9
Violence	0.46	-0.76	0.5	0.5	-0.18	-0.79	0.5	0.5
Respiratory Disease	0.73	1.14	0.3	0.3	-1.68	0.29	0.3	0.3
Other	-0.78	-0.62	0.3	0.3	-1.43	-0.52	0.3	0.3
Resulting Total **	1.57	1.30	0.77	0.78	0.80	1.09	0.72	0.73
Ages 85 and older	**Male**				**Female**			
Cardiovascular Disease	1.75	1.92	1.2	1.2	1.96	2.30	1.2	1.2
Cancer	-0.09	0.97	0.5	0.5	-0.41	0.36	0.5	0.5
Violence	-0.69	-1.21	0.3	0.3	-1.31	-2.13	0.3	0.3
Respiratory Disease	-0.29	1.31	0.2	0.2	-1.45	0.44	0.2	0.2
Other	-2.22	-1.21	0.2	0.2	-3.01	-1.23	0.2	0.2
Resulting Total **	0.36	0.71	0.51	0.52	0.17	0.56	0.49	0.50
Total	**Male**				**Female**			
Cardiovascular Disease	2.60	1.87			2.40	2.19		
Cancer	1.02	1.71			0.56	1.32		
Violence	0.40	-0.92			-0.30	-1.54		
Respiratory Disease	0.43	0.98			-1.35	0.10		
Other	-0.82	-0.60			-1.51	-0.71		
Resulting Total **	1.20	0.87	0.74	0.75	0.65	0.71	0.69	0.70

* Alternative 1 is 1/2 times Alternative 2; Alternative 3 is 5/3 times Alternative 2.

**Resulting total represents average annual percent reduction in age-adjusted death rates for the last 50 years of the 75-year projection period.

Projecting Mortality

- Incorporating future mortality improvement results in a new calendar year life table each year.

- Assumptions as to the percent reduction in mortality rates by:
  - Age group
  - Cause of death

- Central death rates are the key variables used in the projections
  - A central death rate is the number of deaths during the year divided by the mid-year population.
  - Central death rates for the starting year
  - Rate of decline in the central death rates

Central Death Rates for the Starting Year

- Annual historical central death rates calculated
  - For 21 age groups, 2 sexes, and 5 causes of death.
- Last year of final data (2015 NCHS and 2015 Medicare) is not used as the starting year.
- Instead, starting year values are determined using the last 12 years of historical central death rates
  - Computed as the values for the most recent year falling on a weighted least square line.

Rates of Decline in Central Death Rates

- Historical average annual declines in central death rates are calculated:
  - Over the most recent 10 year period
  - For 21 age groups, 2 sexes, and 5 causes of death
- Ultimate average annual declines in central death rates are determined by the Trustees.
  - Reached in the 24th year following the year of the Trustees Report (2042)
  - For 5 age groups and 5 causes of death.
  - Male and female rates are the same.
- Formula is used to transition from the average annual declines over the historical period to the ultimate rates of decline

Average Annual Rate of Decline in Age-adjusted Central Death Rates

|	Males			Females		
	Total	*0-64*	*65+*	*Total*	*0-64*	*65+*
1900 - 1936	0.67	1.32	0.21	0.79	1.53	0.31
1936 - 1954	1.49	2.06	1.17	2.31	3.58	1.74
1954 - 1968	-0.25	0.00	-0.37	0.70	0.75	0.69
1968 - 1982	1.78	2.40	1.50	2.11	2.30	2.04
1982 - 1999	0.94	1.57	0.70	0.43	1.07	0.22
1999 - 2009	1.80	1.04	2.08	1.38	1.08	1.46
2009 - 2015	0.41	-0.05	0.70	0.24	-0.13	0.36
2015 - 2042	0.92	1.12	0.84	0.84	1.11	0.76
2042 - 2092	0.74	1.01	0.65	0.69	1.04	0.60

Based on the intermediate assumptions of the 2018 Trustees Report

(Using the 2010 Census Resident Population as the standard population for age adjusting)

Historical and Intermediate Projections of Annual Percentage Reduction in Central Death Rates: Ages 65-84

Historical and Alt II Projections of Annual Percentage Reductions in Central Death Rates: Ages 65 – 84 for the 2018 TR

Historical and Intermediate Projections of Annual Percentage Reduction in Central Death Rates: Ages 85+
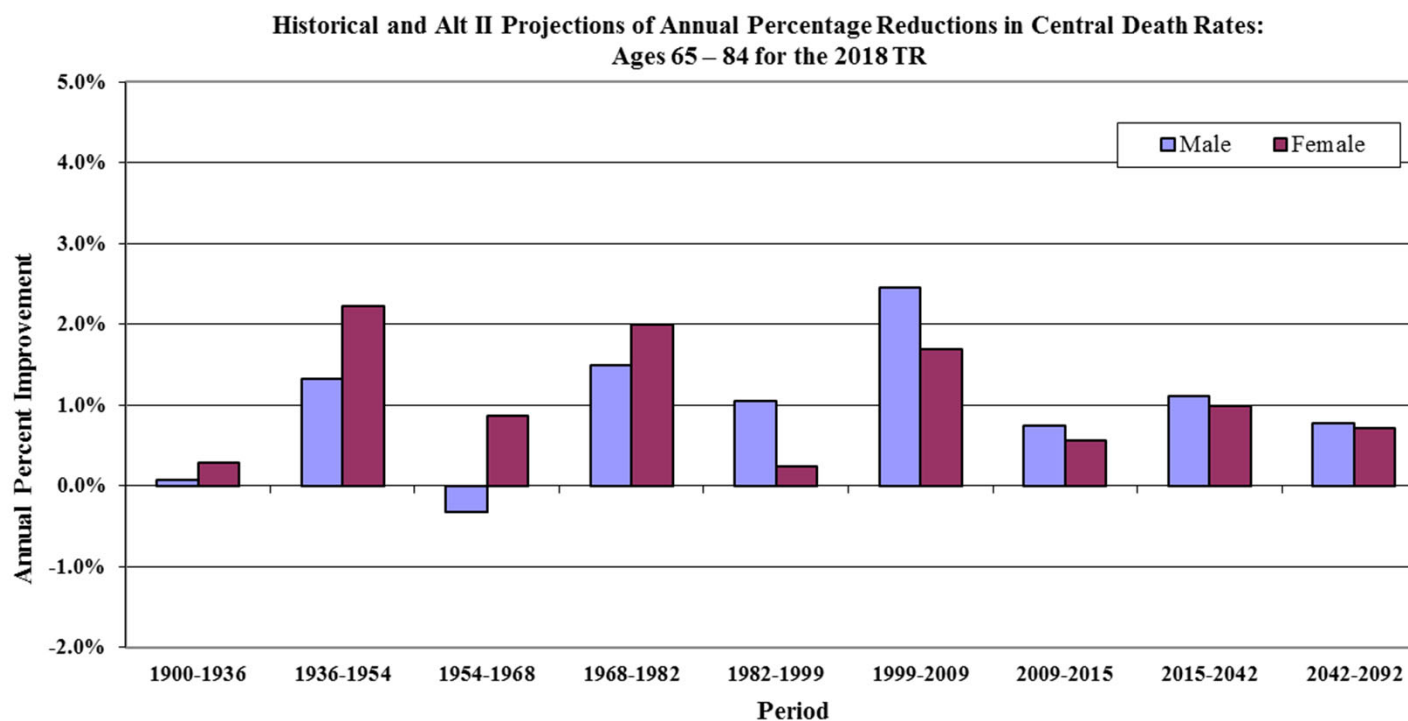
Historical and Alt II Projections of Annual Percentage Reductions in Central Death Rates: Ages 85+ for the 2018 TR
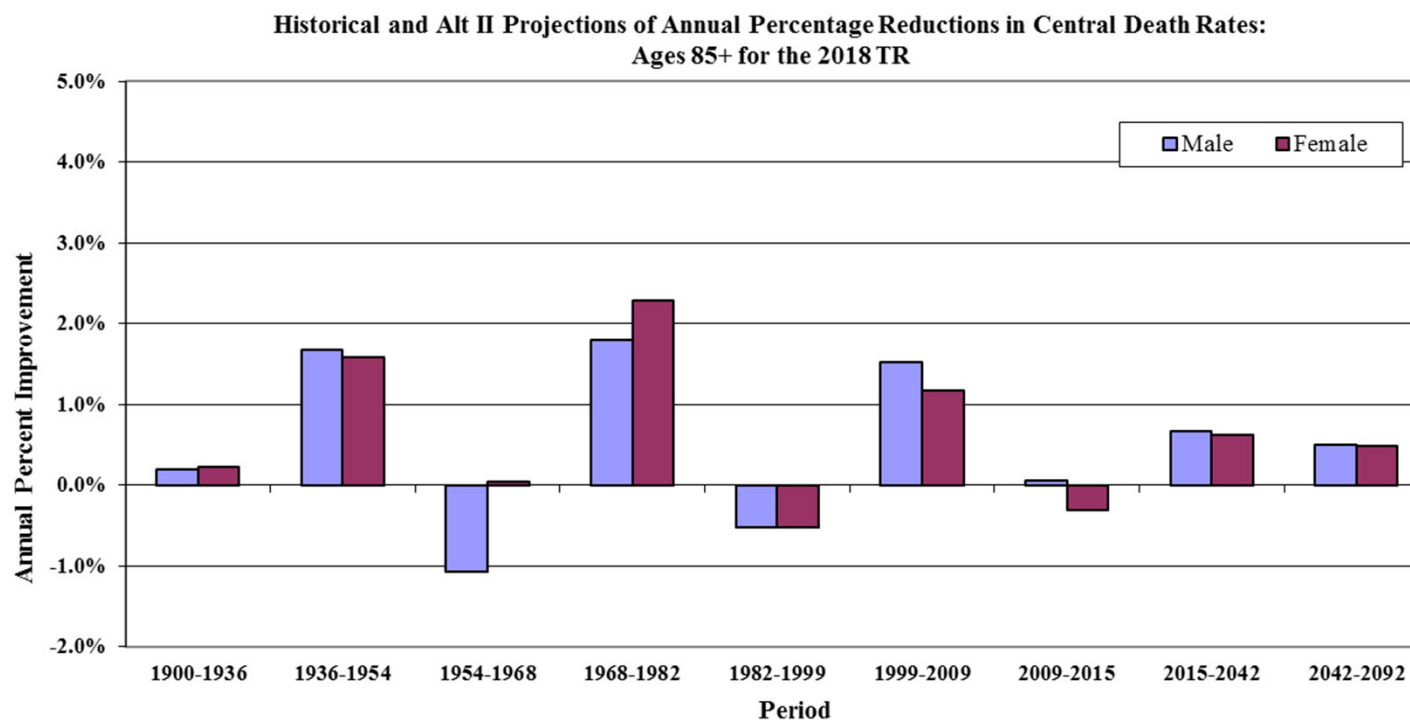
Other Considerations

- Death rates by marital status
- Differential mortality between the disabled and non-disabled.
- Mortality differential by earnings levels

Mortality by Career-Average Earnings Level

Tiffany Bosley

Mortality By Career-Average Earnings Level

- Previous research has shown higher income levels are associated with lower mortality rates.

- Higher lifetime earnings are also likely to be associated with lower mortality rates. This relationship is important for analyzing and projecting the costs for the Social Security program.

- Average indexed monthly earnings (AIME) is a useful measure of a person's lifetime earnings.

- We analyzed the relationship between AIME levels and mortality rates for Social Security retired-worker beneficiaries.

Mortality By Career-Average Earnings Level Study

- Compared the death rates among retired-worker beneficiaries by sex, age group, and lifetime career-average earnings level (AIME) to the annual death rate among retired-worker beneficiaries for that sex and age group.

- For each sex and age group, we calculated the relative mortality ratios at various AIME levels.

Data and Methods

Data

- Data Source: Social Security Administration's June 2017 Master Beneficiary Record (MBR) file.

- Excluded:
  - Windfall Elimination Provision
  - Totalization agreements
  - AMW PIA benefit calculation
  - Previously entitled for a Social Security disability benefit

Average Indexed Monthly Earnings Calculation

- At age 62, index earnings to reflect the change in general wage levels that occurred during the worker's years of employment.

- Up to 35 years of earnings are needed to compute the average indexed monthly earnings.

- AIME = Average of the highest 35 years of indexed earnings / 12

AIME Quintiles

Male AIME Quintiles

Male Quintiles	AIME Range[a]	Percentage of Beneficiaries
Lowest AIME Quintile	AIME ≤ $1,866	20%
2nd AIME Quintile	$1,866 < AIME ≤ $3,230	20%
3rd AIME Quintile	$3,230 < AIME ≤ $4,448	20%
4th AIME Quintile	$4,448 < AIME ≤ $5,863	20%
Highest AIME Quintile	$5,863 < AIME	20%

[a] The AIME ranges in this example are for male retired-worker beneficiaries who were age 65 in 2015.

Female AIME Quintiles

Female Quintiles	AIME Range[a]	Percentage of Beneficiaries
Lowest AIME Quintile	AIME ≤ $908	20%
2nd AIME Quintile	$908 < AIME ≤ $1,640	20%
3rd AIME Quintile	$1,640 < AIME ≤ $2,520	20%
4th AIME Quintile	$2,520 < AIME ≤ $3,761	20%
Highest AIME Quintile	$3,761 < AIME	20%

[a] The AIME ranges in this example are for female retired-worker beneficiaries who were age 65 in 2015.

Calculations

- For each record, we determined:
  - Sex and age
  - AIME level
  - Exposure: Active, Death, Termination Other Than Death
  - Deaths
- Group data by sex, age group, and AIME level, and calculated annual death rates by dividing the number of death by the years of exposure.
- Relative Mortality Ratio – divide the death rates for each AIME level by the death rate for everyone in the sex and age group at all AIME levels.

Results by AIME Quintile

Results

- We observed lower death rates for retired-worker beneficiaries with higher-than-average AIME levels, and higher death rates for retired-worker beneficiaries with lower-than-average AIME levels.

- At older ages, the differences in death rates across AIME levels diminish.

- Trends from 1995-2015 show the spread in death rates among the AIME levels remaining fairly steady.

Age Group 65-69 Relative Mortality Ratios
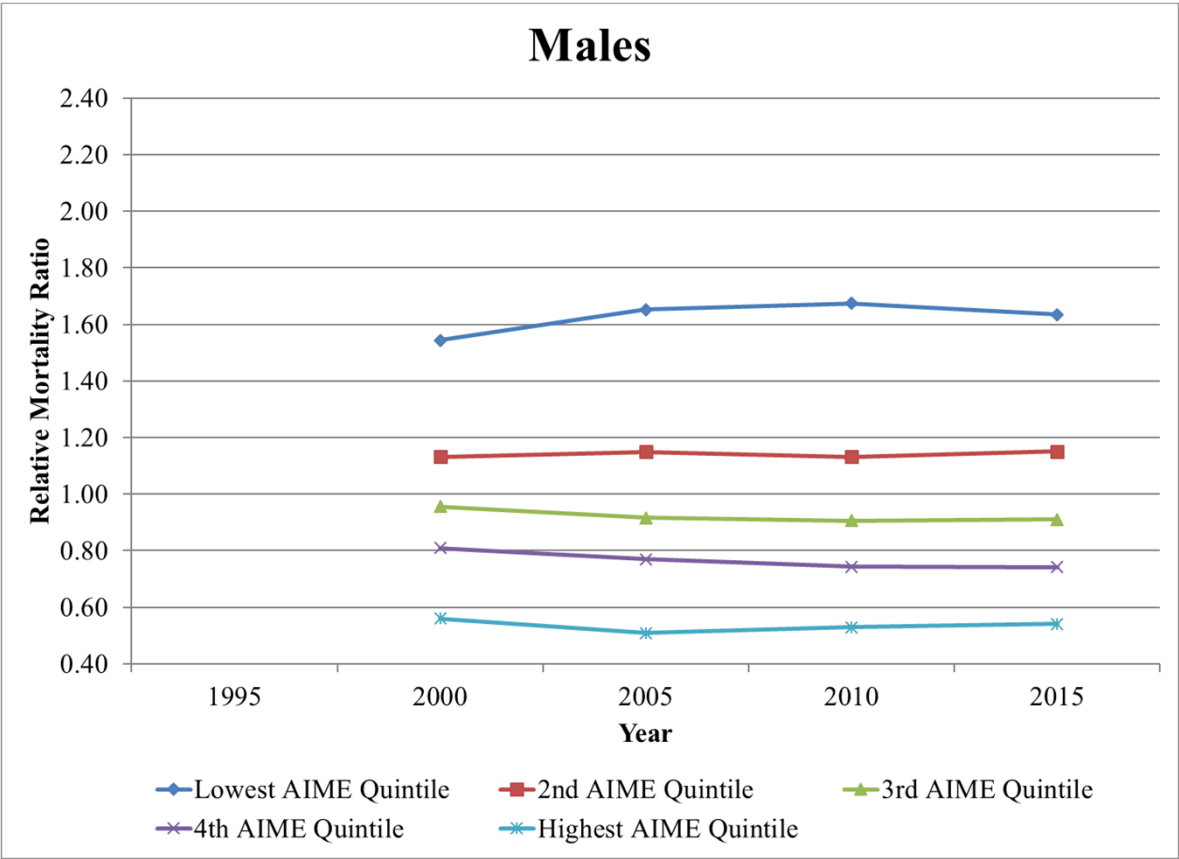
Male / Female Comparison

- Females generally follow the same relative mortality pattern as males, in the higher earners have lower mortality.

- Spreads in the female relative mortality ratios among AIME quintiles are smaller than those for males.

- Questions: Is the socioeconomic status gradient smaller for women? Or are earnings a less accurate measure of socioeconomic status for women?

Age Group 65-69 Relative Mortality Ratios
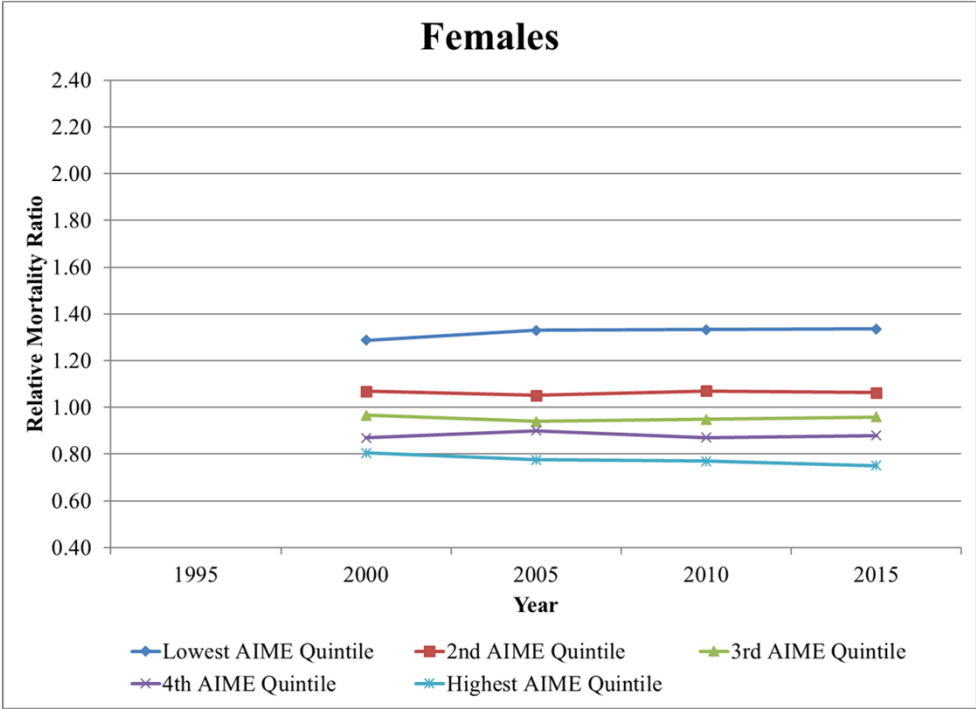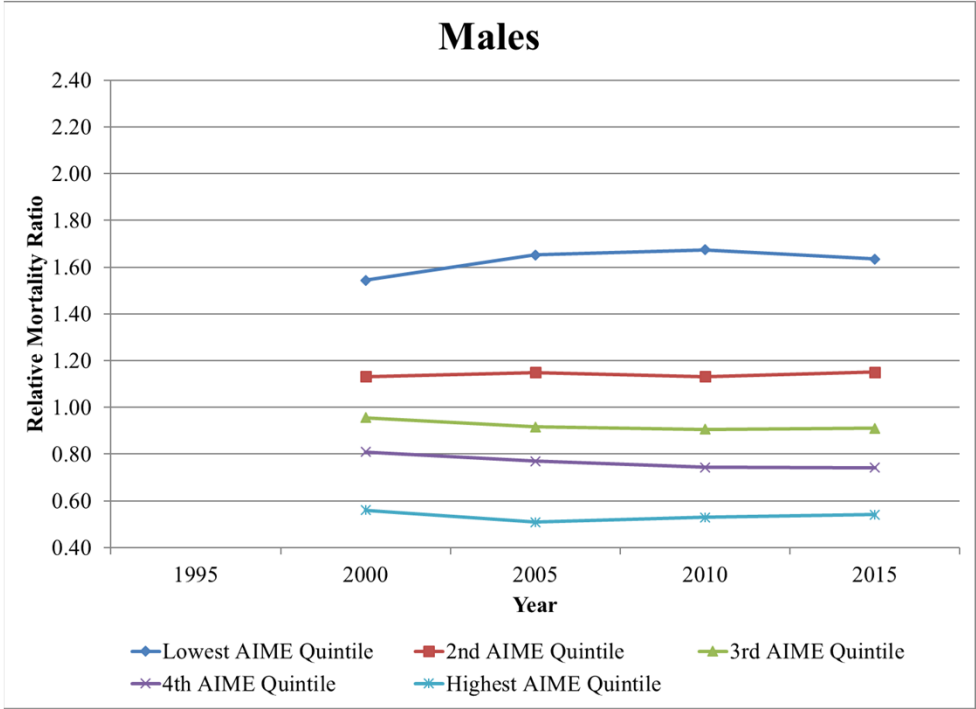
Age Groups

- Spread in relative mortality ratios among the quintiles decreases at older ages.

2015 Relative Mortality Ratios by Age Group for Retired-Worker Beneficiaries

		62-64	65-69	Age 70-74	75-79	80-84	62-84 Total
Male Retired-Worker Beneficiaries by AIME Level:							
Lowest AIME Quintile		1.77	1.63	1.48	1.33	1.18	1.38
Highest AIME Quintile		0.52	0.54	0.58	0.65	0.75	0.65
Female Retired-Worker Beneficiaries by AIME Level:							
Lowest AIME Quintile		1.54	1.34	1.22	1.13	1.06	1.16
Highest AIME Quintile		0.73	0.75	0.78	0.84	0.91	0.84

Age Groups 70-74 and 75-79 Relative Mortality Ratios
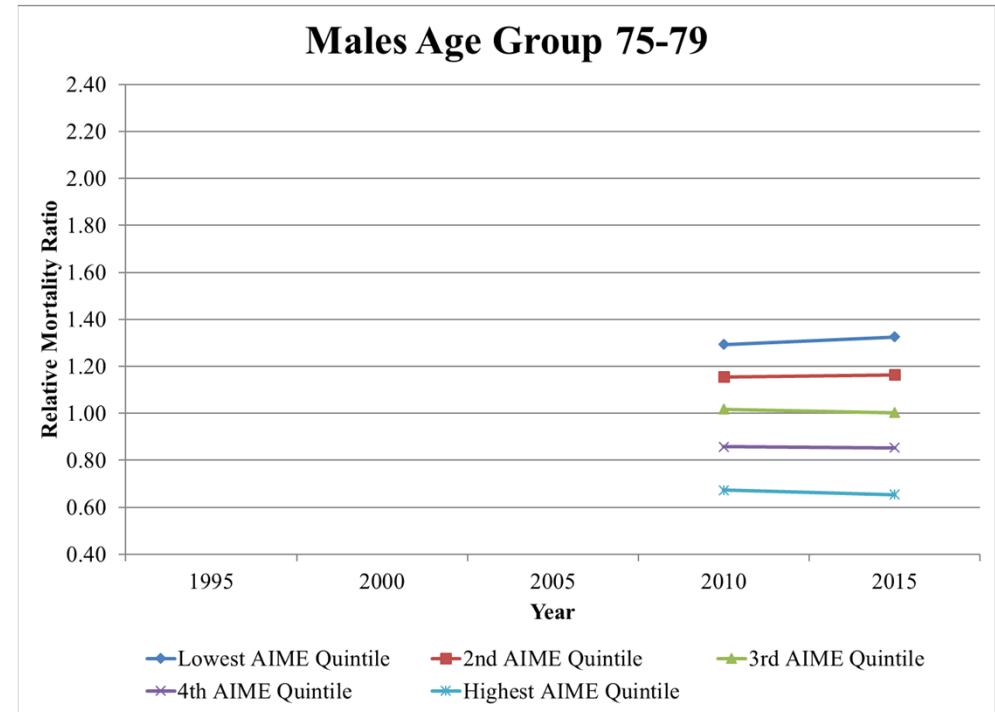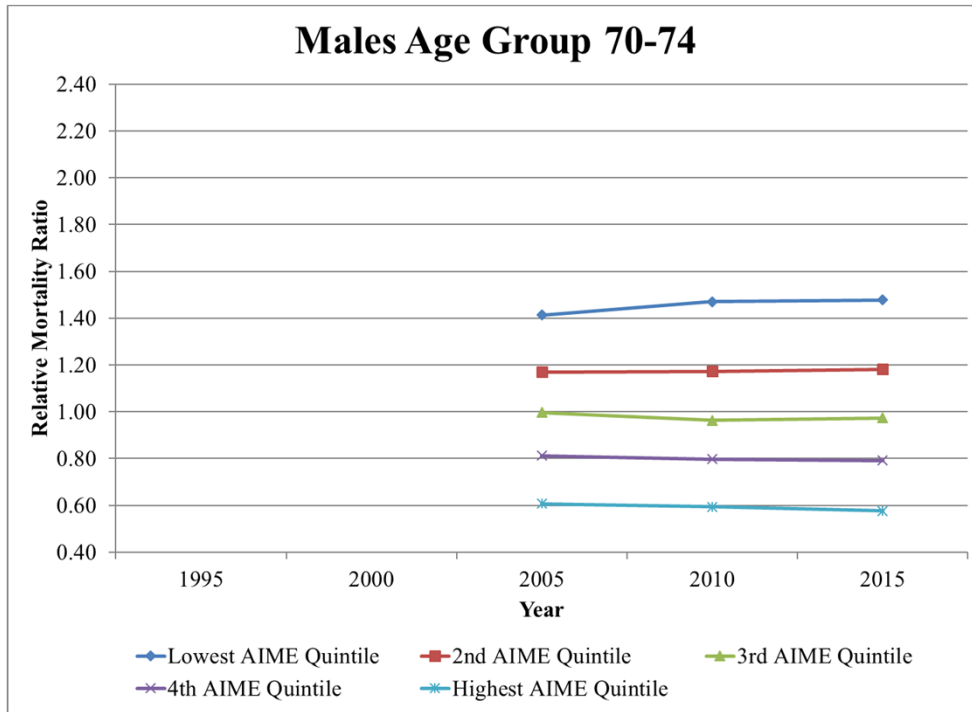
Age Group 62-64 Relative Mortality Ratios
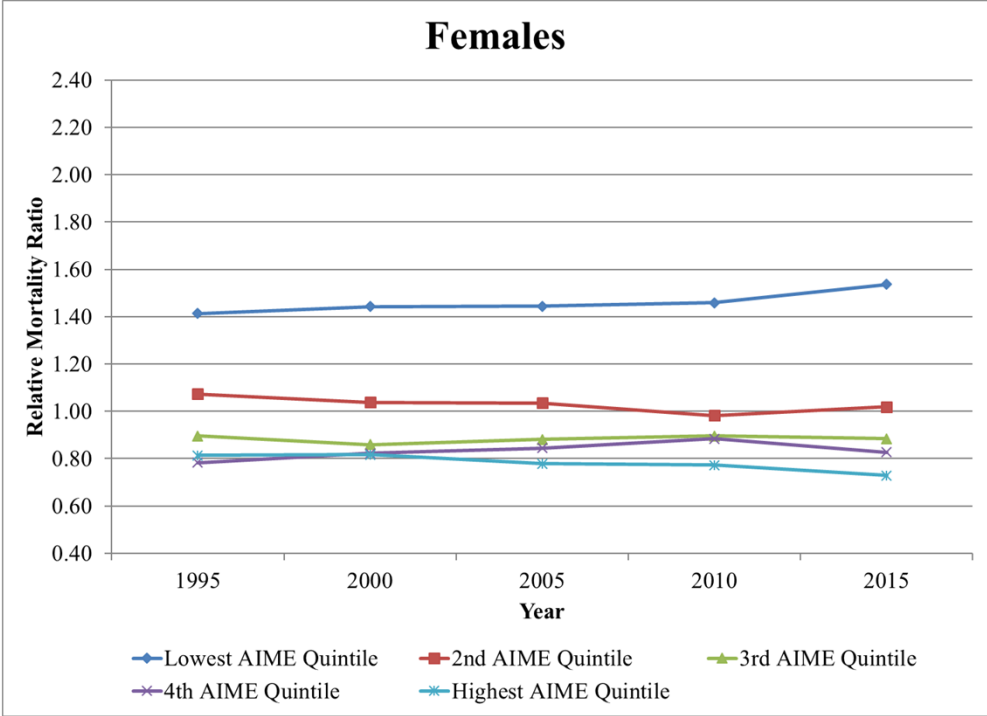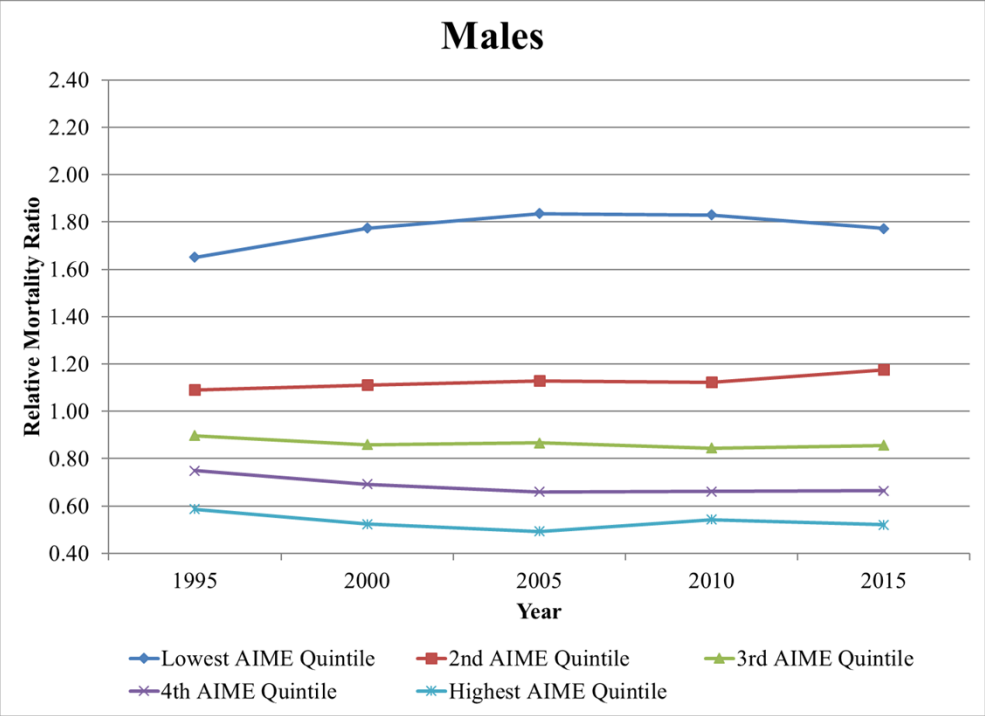
Conclusion

- Higher AIME levels correlate with lower mortality rates, while lower AIME levels correlate with higher mortality rates.

- The trends from 1995 to 2015 show that the spread in relative mortality ratios among the AIME quintiles remain fairly steady.   The spreads widens, but not significantly, and even slightly compresses for some age groups in recent years.

Age Group 65-69 Relative Mortality Ratios
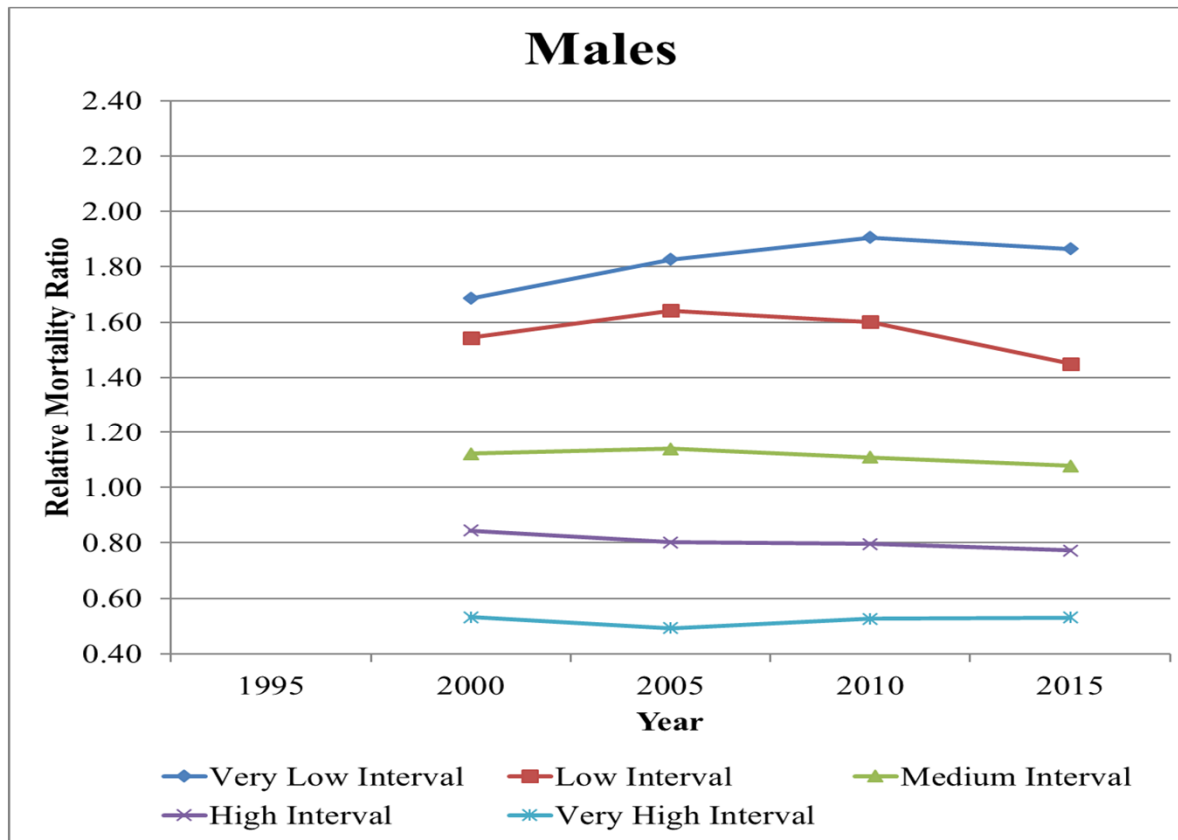
Mortality by Career-Average Earnings Level

- Link to the Mortality by Career-Average Earnings Level Study - https://www.ssa.gov/OACT/NOTES/pdf_studies/study124.pdf

Internal Rates of Return and Moneys Worth Ratios

Possible Application of Mortality Differential

Michael Clingman

Introduction

- Most of the work in OCACT involves looking at the Social Security OASDI program as a whole.

- With the Internal Rate of Return (IRR) and Moneys Worth (MW) programs OCACT analyzes the effects of Social Security on individuals and their families in recurring annual actuarial notes.

- We do these analyses using hypothetical workers with either "scaled" earnings or maximum taxable earnings and across four different family combinations.

Introduction (continued)

- Scaled earnings are designed to represent typical earnings patterns
  - Lower earnings at younger ages when worker starting out in the workforce
  - Rising earnings as worker gains experience and expertise
  - Leveling off or drop in earnings at older ages as some workers take early retirement or move to part time or less demanding work
- Maximum taxable earnings are the maximum amount of earnings that are subject to FICA taxes each year -- $132,900 in 2019
  - This is also the maximum amount of earnings for each year used in benefit computations

Hypothetical Workers

- Five types of hypothetical worker earnings
    - Scaled:
        1. Very Low
        2. Low
        3. Medium
        4. High
    - Maximum
        5. Earnings at taxable maximum
- Earnings in each year
    - Scaled earnings = scaled factor for age in year * average wage in year
    - Maximum earnings = taxable maximum in year

Hypothetical Workers (continued)

- Scaled Factors
    - "Raw" scaled factors are determined for each age using 20 years of recent actual earnings from a sample of fully entitled workers up to age 62 and not receiving Social Security benefits.
    - For ages 62 and over the data did not show a consistent pattern due to the large number of retirees. We assume that earnings stay constant in nominal dollars to obtain preliminary factors.
    - We apply an adjustment factor to the preliminary factors so that a hypothetical medium worker, born in 1960 and retiring at age 65 in 2025, would have career average earnings equal to the average wage in 2024.
    - Scaled factors for very low, low, and high scaled workers are set at 25%, 45%, and 160% of the medium scaled factors.

Hypothetical Workers (continued)

- These hypothetical workers give a wide range of typical earnings histories from the very low representing a minimum wage worker to the maximum representing a worker with the highest possible benefits and taxes paid.

Assumptions

- Scaled earnings begin at age 21

- Maximum earnings begin at age 22

- Workers remain in continuous employment until either retirement at age 65, death, or disability

- If a worker becomes disabled, he or she may continue receiving benefits until death or may recover before age 65 and return to the workforce.

- Family members will receive all benefits for which they are eligible.

Assumptions (continued)

- There are numerous possible family structures. We chose to analyze four family types.

- Family types are:
    1. Single Male Worker
    2. Single Female Worker
    3. One-earner Couple with Male Worker
    4. Two-earner Couple

- Hypothetical couples are assumed to:
    - be the same age
    - marry at age 22 and stay married
    - have children at ages 27 and 29

Definitions

- Internal Rate of Return (IRR)
  - IRR = the real (above inflation) interest rate which results in PV(Benefits Received) = PV(Taxes Paid)
  - If one thinks of the taxes paid as an investment, then the IRR is the return on the investment.

- Moneys Worth (MW)
  - MW = PV(Benefit Received) / PV(Taxes Paid)
  - Measure of whether the worker gets his/her "money's worth" from the program.
  - Effective interest rates of the Trust Funds are used in present value calculations.

- In this presentation we will focus mainly on IRR. The analysis for MW is similar.

Time effects on IRR results

- We computed IRR values for different birth cohorts. Results varied over time for various reasons.

- Mortality effects:
    - Later cohorts generally have lower mortality rates than earlier ones.
    - Lower mortality leads to longer life, more benefits being paid, and higher IRR.
    - This is partially offset for couples where there can be survivor benefits.

Time effects on IRR results (Continued)

- Tax rate effect
  - Social Security benefit computations are based on taxable earnings.
  - The tax rate does not affect the benefit computation.
  - All other things being equal, lower tax rates increase IRR while higher tax rates decrease them.
  - Tax rates increased from 2% employer/employee combined in 1937 to 12.4% in 1990 and have largely stayed steady since then.
  - So earlier cohorts have higher IRR.

Time effects on IRR results (Continued)

- Other time effects:
  - Increases in wage base
  - Increase in normal retirement age
  - Changes to benefit formula (more or less generous)
  - (MW results are also affected by fluctuating interest rates)

Time effects on IRR results (Continued)

- Combined results:
  - From the 1920 to 1949 cohort there is a large drop in IRR due to increasing tax rates.
  - For scaled workers there is an increase in IRR from the 1949 to 2004 cohort due to improving mortality.
  - For maximum earners, the increase in IRR from the 1949 to 1964 cohort due to mortality improvements is offset by increases in the taxable maximum.

Internal Real Rates of Return for Various Earning Level Scaled Workers (%)

Earnings Level	Year of Birth	Year Age 65	Present Law Scheduled			Increased Payroll Tax			Payable Benefits		
			Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple
Very Low	1920	1985	5.41	6.17	9.26	5.41	6.17	9.26	5.41	6.17	9.26
	1937	2002	4.45	4.82	7.00	4.45	4.82	7.00	4.45	4.82	7.00
	1949	2014	4.36	4.71	6.57	4.36	4.71	6.57	4.30	4.65	6.52
	1964	2029	4.44	4.86	6.37	4.44	4.86	6.37	4.02	4.45	5.99
	1985	2050	4.73	5.05	6.46	4.52	4.85	6.31	3.90	4.24	5.73
	2004	2069	4.85	5.12	6.46	4.17	4.46	5.83	3.86	4.14	5.51
Low	1920	1985	4.46	5.29	8.09	4.46	5.29	8.09	4.46	5.29	8.09
	1937	2002	3.32	3.74	5.80	3.32	3.74	5.80	3.32	3.74	5.80
	1949	2014	3.23	3.63	5.42	3.23	3.63	5.42	3.16	3.55	5.36
	1964	2029	3.33	3.77	5.31	3.33	3.77	5.31	2.89	3.33	4.89
	1985	2050	3.63	3.97	5.42	3.39	3.74	5.23	2.80	3.15	4.68
	2004	2069	3.77	4.05	5.43	3.07	3.37	4.78	2.78	3.08	4.49
Medium	1920	1985	2.91	3.81	6.48	2.91	3.81	6.48	2.91	3.81	6.48
	1937	2002	2.25	2.73	4.78	2.25	2.73	4.78	2.25	2.72	4.78
	1949	2014	2.17	2.62	4.41	2.17	2.62	4.41	2.09	2.52	4.34
	1964	2029	2.28	2.74	4.31	2.28	2.74	4.31	1.80	2.26	3.86
	1985	2050	2.58	2.93	4.42	2.31	2.68	4.21	1.74	2.11	3.67
	2004	2069	2.73	3.02	4.44	2.02	2.34	3.78	1.75	2.07	3.52
High	1920	1985	2.62	3.53	6.10	2.62	3.53	6.10	2.62	3.53	6.10
	1937	2002	1.66	2.16	4.17	1.66	2.16	4.17	1.66	2.16	4.17
	1949	2014	1.53	2.00	3.75	1.53	2.00	3.75	1.44	1.89	3.66
	1964	2029	1.64	2.12	3.67	1.64	2.12	3.67	1.14	1.62	3.21
	1985	2050	1.94	2.31	3.78	1.65	2.03	3.56	1.10	1.49	3.04
	2004	2069	2.10	2.41	3.82	1.39	1.72	3.15	1.13	1.46	2.91
Maximum	1920	1985	2.37	3.30	5.85	2.37	3.30	5.85	2.37	3.30	5.85
	1937	2002	1.20	1.75	3.81	1.20	1.75	3.81	1.20	1.74	3.80
	1949	2014	0.79	1.29	3.02	0.79	1.29	3.02	0.69	1.17	2.93
	1964	2029	0.68	1.16	2.65	0.68	1.16	2.65	0.16	0.65	2.18
	1985	2050	0.98	1.36	2.77	0.67	1.07	2.54	0.16	0.55	2.05
	2004	2069	1.13	1.46	2.81	0.47	0.81	2.21	0.19	0.53	1.94

Note: 2017 Trustees Report Intermediate Assumptions

Earnings level effects IRR results

- Benefits increase with higher earnings but are also progressive:
  - A worker with higher earnings will obtain a higher absolute benefit.
  - A worker with lower earnings will receive a higher benefit relative to his/her pre-retirement income.
  - All other things being equal, a worker with lower earnings will have a higher IRR.
  - Highlighted values in the following table show how IRR decreases for the 1964 cohort single male worker as the earnings level goes up.

Internal Real Rates of Return for Various Earning Level Scaled Workers (%)

Earnings Level	Year of Birth	Year Age 65	Present Law Scheduled			Increased Payroll Tax			Payable Benefits		
			Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple
Very Low	1920	1985	5.41	6.17	9.26	5.41	6.17	9.26	5.41	6.17	9.26
	1937	2002	4.45	4.82	7.00	4.45	4.82	7.00	4.45	4.82	7.00
	1949	2014	4.36	4.71	6.57	4.36	4.71	6.57	4.30	4.65	6.52
	1964	**2029**	**4.44**	4.86	6.37	4.44	4.86	6.37	4.02	4.45	5.99
	1985	2050	4.73	5.05	6.46	4.52	4.85	6.31	3.90	4.24	5.73
	2004	2069	4.85	5.12	6.46	4.17	4.46	5.83	3.86	4.14	5.51
Low	1920	1985	4.46	5.29	8.09	4.46	5.29	8.09	4.46	5.29	8.09
	1937	2002	3.32	3.74	5.80	3.32	3.74	5.80	3.32	3.74	5.80
	1949	2014	3.23	3.63	5.42	3.23	3.63	5.42	3.16	3.55	5.36
	1964	**2029**	**3.33**	3.77	5.31	3.33	3.77	5.31	2.89	3.33	4.89
	1985	2050	3.63	3.97	5.42	3.39	3.74	5.23	2.80	3.15	4.68
	2004	2069	3.77	4.05	5.43	3.07	3.37	4.78	2.78	3.08	4.49
Medium	1920	1985	2.91	3.81	6.48	2.91	3.81	6.48	2.91	3.81	6.48
	1937	2002	2.25	2.73	4.78	2.25	2.73	4.78	2.25	2.72	4.78
	1949	2014	2.17	2.62	4.41	2.17	2.62	4.41	2.09	2.52	4.34
	1964	**2029**	**2.28**	2.74	4.31	2.28	2.74	4.31	1.80	2.26	3.86
	1985	2050	2.58	2.93	4.42	2.31	2.68	4.21	1.74	2.11	3.67
	2004	2069	2.73	3.02	4.44	2.02	2.34	3.78	1.75	2.07	3.52
High	1920	1985	2.62	3.53	6.10	2.62	3.53	6.10	2.62	3.53	6.10
	1937	2002	1.66	2.16	4.17	1.66	2.16	4.17	1.66	2.16	4.17
	1949	2014	1.53	2.00	3.75	1.53	2.00	3.75	1.44	1.89	3.66
	1964	**2029**	**1.64**	2.12	3.67	1.64	2.12	3.67	1.14	1.62	3.21
	1985	2050	1.94	2.31	3.78	1.65	2.03	3.56	1.10	1.49	3.04
	2004	2069	2.10	2.41	3.82	1.39	1.72	3.15	1.13	1.46	2.91
Maximum	1920	1985	2.37	3.30	5.85	2.37	3.30	5.85	2.37	3.30	5.85
	1937	2002	1.20	1.75	3.81	1.20	1.75	3.81	1.20	1.74	3.80
	1949	2014	0.79	1.29	3.02	0.79	1.29	3.02	0.69	1.17	2.93
	1964	**2029**	**0.68**	1.16	2.65	0.68	1.16	2.65	0.16	0.65	2.18
	1985	2050	0.98	1.36	2.77	0.67	1.07	2.54	0.16	0.55	2.05
	2004	2069	1.13	1.46	2.81	0.47	0.81	2.21	0.19	0.53	1.94

Note: 2017 Trustees Report Intermediate Assumptions

Family effects on IRR results

- Family effects
  - Single females have higher IRR values than single males due to increased female longevity.
  - One-earner couples have higher values than single workers due to spouse, child, and survivor benefits.
  - Two-earner couples with the same earnings have IRR values approximately equal to those for single female workers. The lower male benefit is approximately offset by child benefits. (To simplify the presentation, this category was left off the charts but is in the written actuarial note. Results are similar to those for the single female worker.)
  - Highlighted values in the following chart show how IRR increases for the 1964 cohort medium earner category across family types.

Internal Real Rates of Return for Various Earning Level Scaled Workers (%)

Earnings Level	Year of Birth	Year Age 65	Present Law Scheduled			Increased Payroll Tax			Payable Benefits		
			Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple
Very Low	1920	1985	5.41	6.17	9.26	5.41	6.17	9.26	5.41	6.17	9.26
	1937	2002	4.45	4.82	7.00	4.45	4.82	7.00	4.45	4.82	7.00
	1949	2014	4.36	4.71	6.57	4.36	4.71	6.57	4.30	4.65	6.52
	1964	2029	4.44	4.86	6.37	4.44	4.86	6.37	4.02	4.45	5.99
	1985	2050	4.73	5.05	6.46	4.52	4.85	6.31	3.90	4.24	5.73
	2004	2069	4.85	5.12	6.46	4.17	4.46	5.83	3.86	4.14	5.51
Low	1920	1985	4.46	5.29	8.09	4.46	5.29	8.09	4.46	5.29	8.09
	1937	2002	3.32	3.74	5.80	3.32	3.74	5.80	3.32	3.74	5.80
	1949	2014	3.23	3.63	5.42	3.23	3.63	5.42	3.16	3.55	5.36
	1964	2029	3.33	3.77	5.31	3.33	3.77	5.31	2.89	3.33	4.89
	1985	2050	3.63	3.97	5.42	3.39	3.74	5.23	2.80	3.15	4.68
	2004	2069	3.77	4.05	5.43	3.07	3.37	4.78	2.78	3.08	4.49
Medium	1920	1985	2.91	3.81	6.48	2.91	3.81	6.48	2.91	3.81	6.48
	1937	2002	2.25	2.73	4.78	2.25	2.73	4.78	2.25	2.72	4.78
	1949	2014	2.17	2.62	4.41	2.17	2.62	4.41	2.09	2.52	4.34
	1964	**2029**	**2.28**	**2.74**	**4.31**	2.28	2.74	4.31	1.80	2.26	3.86
	1985	2050	2.58	2.93	4.42	2.31	2.68	4.21	1.74	2.11	3.67
	2004	2069	2.73	3.02	4.44	2.02	2.34	3.78	1.75	2.07	3.52
High	1920	1985	2.62	3.53	6.10	2.62	3.53	6.10	2.62	3.53	6.10
	1937	2002	1.66	2.16	4.17	1.66	2.16	4.17	1.66	2.16	4.17
	1949	2014	1.53	2.00	3.75	1.53	2.00	3.75	1.44	1.89	3.66
	1964	2029	1.64	2.12	3.67	1.64	2.12	3.67	1.14	1.62	3.21
	1985	2050	1.94	2.31	3.78	1.65	2.03	3.56	1.10	1.49	3.04
	2004	2069	2.10	2.41	3.82	1.39	1.72	3.15	1.13	1.46	2.91
Maximum	1920	1985	2.37	3.30	5.85	2.37	3.30	5.85	2.37	3.30	5.85
	1937	2002	1.20	1.75	3.81	1.20	1.75	3.81	1.20	1.74	3.80
	1949	2014	0.79	1.29	3.02	0.79	1.29	3.02	0.69	1.17	2.93
	1964	2029	0.68	1.16	2.65	0.68	1.16	2.65	0.16	0.65	2.18
	1985	2050	0.98	1.36	2.77	0.67	1.07	2.54	0.16	0.55	2.05
	2004	2069	1.13	1.46	2.81	0.47	0.81	2.21	0.19	0.53	1.94

Note: 2017 Trustees Report Intermediate Assumptions

Alternatives to Present Law Scheduled Scenario

- The 2017 and 2018 Trustees Reports predict that, if Congress does nothing, the Social Security Trust Fund reserves will deplete in 2034. To avoid this situation Congress has 3 basic options:
  1. Transfer money from general revenues
  2. Increase taxes
  3. Reduce benefits
- If Congress were to fully cover the shortfall with general revenues then we would get the "Present Law Scheduled" scenario.

Alternatives to Present Law Scheduled Scenario (continued)

- For illustrative purposes our office came up with 2 simple scenarios that represent possible options for increasing taxes or reducing benefits.
  1. Increased Payroll Tax Scenario: Payroll tax rates are increased each year so that there are sufficient funds to pay present law benefits.
  2. Payable Benefits Scenario: Benefits are reduced each year so that the total benefits paid plus administrative costs equals the tax income.
- Since any solution chosen by Congress would likely be some combination of the 3 basic options, these 3 scenarios give a reasonable range of future IRR results.

Year	Present Law Scheduled		Increased Payroll Tax Scenario		Payable Benefits Scenario	
	% of benefits paid	combined tax rate	% of benefits paid	combined tax rate	% of benefits paid	combined tax rate
2018	100%	12.40	100%	12.40	100%	12.40
2033	100%	12.40	100%	12.40	100%	12.40
2034	100%	12.40	100%	13.37	94%	12.40
2035	100%	12.40	100%	15.94	78%	12.40
2050	100%	12.40	100%	15.66	79%	12.40
2070	100%	12.40	100%	16.42	75%	12.40
2095	100%	12.40	100%	16.84	74%	12.40

Alternatives to Present Law Scheduled Scenario (continued)

- The following 2 tables show the effects of the Increased Payroll Tax and Payable Benefits scenarios on IRR and MW values.

- The Increased Payroll Tax Scenario:
  - This scenario only affects workers with earnings after 2033 – the 1985 and 2004 cohorts in the table.
  - Affected values for the Medium Scaled Earner are highlighted in green.

- The Payable Benefits Scenario:
  - The scenario affects all cohorts still potentially receiving a benefit in 2034.
  - Reduction is larger than for the Increased Payroll Tax Scenario for all affected cohorts
  - Affected values for the Medium Scaled Earner are highlighted in red.

- For both scenarios, later cohorts are generally more affected than earlier ones

Internal Real Rates of Return for Various Earning Level Scaled Workers (%)

Earnings Level	Year of Birth	Year Age 65	Present Law Scheduled			Increased Payroll Tax			Payable Benefits		
			Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple
Very Low	1920	1985	5.41	6.17	9.26	5.41	6.17	9.26	5.41	6.17	9.26
	1937	2002	4.45	4.82	7.00	4.45	4.82	7.00	4.45	4.82	7.00
	1949	2014	4.36	4.71	6.57	4.36	4.71	6.57	4.30	4.65	6.52
	1964	2029	4.44	4.86	6.37	4.44	4.86	6.37	4.02	4.45	5.99
	1985	2050	4.73	5.05	6.46	4.52	4.85	6.31	3.90	4.24	5.73
	2004	2069	4.85	5.12	6.46	4.17	4.46	5.83	3.86	4.14	5.51
Low	1920	1985	4.46	5.29	8.09	4.46	5.29	8.09	4.46	5.29	8.09
	1937	2002	3.32	3.74	5.80	3.32	3.74	5.80	3.32	3.74	5.80
	1949	2014	3.23	3.63	5.42	3.23	3.63	5.42	3.16	3.55	5.36
	1964	2029	3.33	3.77	5.31	3.33	3.77	5.31	2.89	3.33	4.89
	1985	2050	3.63	3.97	5.42	3.39	3.74	5.23	2.80	3.15	4.68
	2004	2069	3.77	4.05	5.43	3.07	3.37	4.78	2.78	3.08	4.49
Medium	1920	1985	2.91	3.81	6.48	2.91	3.81	6.48	2.91	3.81	6.48
	1937	2002	2.25	2.73	4.78	2.25	2.73	4.78	2.25	2.72	4.78
	1949	**2014**	2.17	2.62	4.41	2.17	2.62	4.41	**2.09**	**2.52**	**4.34**
	1964	**2029**	2.28	2.74	4.31	2.28	2.74	4.31	**1.80**	**2.26**	**3.86**
	1985	**2050**	2.58	2.93	4.42	**2.31**	**2.68**	**4.21**	**1.74**	**2.11**	**3.67**
	2004	**2069**	2.73	3.02	4.44	**2.02**	**2.34**	**3.78**	**1.75**	**2.07**	**3.52**
High	1920	1985	2.62	3.53	6.10	2.62	3.53	6.10	2.62	3.53	6.10
	1937	2002	1.66	2.16	4.17	1.66	2.16	4.17	1.66	2.16	4.17
	1949	2014	1.53	2.00	3.75	1.53	2.00	3.75	1.44	1.89	3.66
	1964	2029	1.64	2.12	3.67	1.64	2.12	3.67	1.14	1.62	3.21
	1985	2050	1.94	2.31	3.78	1.65	2.03	3.56	1.10	1.49	3.04
	2004	2069	2.10	2.41	3.82	1.39	1.72	3.15	1.13	1.46	2.91
Maximum	1920	1985	2.37	3.30	5.85	2.37	3.30	5.85	2.37	3.30	5.85
	1937	2002	1.20	1.75	3.81	1.20	1.75	3.81	1.20	1.74	3.80
	1949	2014	0.79	1.29	3.02	0.79	1.29	3.02	0.69	1.17	2.93
	1964	2029	0.68	1.16	2.65	0.68	1.16	2.65	0.16	0.65	2.18
	1985	2050	0.98	1.36	2.77	0.67	1.07	2.54	0.16	0.55	2.05
	2004	2069	1.13	1.46	2.81	0.47	0.81	2.21	0.19	0.53	1.94

Note: 2017 Trustees Report Intermediate Assumptions

Moneysworth Ratios for Various Earning Level Scaled Workers

Earnings Level	Year of Birth	Year Age 65	Present Law Scheduled			Increased Payroll Tax			Payable Benefits		
			Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple	Single Male	Single Female	One-Earner Couple
Very Low	1920	1985	2.50	3.05	5.44	2.50	3.05	5.44	2.50	3.05	5.44
	1937	2002	1.48	1.69	2.94	1.48	1.69	2.94	1.48	1.69	2.93
	1949	2014	1.46	1.67	2.77	1.46	1.67	2.77	1.42	1.62	2.68
	1964	2029	1.86	2.13	3.32	1.86	2.13	3.32	1.63	1.85	2.86
	1985	2050	1.95	2.16	3.31	1.79	1.99	3.05	1.53	1.69	2.63
	2004	2069	1.87	2.05	3.09	1.52	1.67	2.52	1.40	1.53	2.34
Low	1920	1985	1.99	2.44	4.31	1.99	2.44	4.31	1.99	2.44	4.31
	1937	2002	1.08	1.23	2.15	1.08	1.23	2.15	1.08	1.23	2.14
	1949	2014	1.06	1.21	2.02	1.06	1.21	2.02	1.04	1.18	1.96
	1964	2029	1.36	1.55	2.43	1.36	1.55	2.43	1.19	1.35	2.10
	1985	2050	1.42	1.58	2.43	1.31	1.45	2.24	1.12	1.24	1.94
	2004	2069	1.37	1.50	2.27	1.11	1.22	1.85	1.03	1.12	1.72
Medium	1920	1985	1.37	1.67	2.98	1.37	1.67	2.98	1.37	1.67	2.98
	1937	2002	0.80	0.91	1.62	0.80	0.91	1.62	0.80	0.91	1.62
	1949	**2014**	0.78	0.90	1.52	0.78	0.90	1.52	**0.77**	**0.87**	**1.47**
	1964	**2029**	1.00	1.15	1.82	1.00	1.15	1.82	**0.88**	**1.00**	**1.57**
	1985	**2050**	1.05	1.17	1.81	**0.97**	**1.07**	**1.67**	**0.83**	**0.92**	**1.45**
	2004	**2069**	1.01	1.10	1.69	**0.82**	**0.90**	**1.38**	**0.76**	**0.83**	**1.28**
High	1920	1985	1.23	1.50	2.67	1.23	1.50	2.67	1.23	1.50	2.67
	1937	2002	0.67	0.77	1.36	0.67	0.77	1.36	0.67	0.77	1.36
	1949	2014	0.65	0.75	1.26	0.65	0.75	1.26	0.64	0.72	1.22
	1964	2029	0.83	0.95	1.51	0.83	0.95	1.51	0.73	0.83	1.30
	1985	2050	0.87	0.97	1.50	0.80	0.89	1.38	0.69	0.76	1.20
	2004	2069	0.84	0.92	1.41	0.68	0.75	1.15	0.63	0.69	1.07
Maximum	1920	1985	1.12	1.36	2.42	1.12	1.36	2.42	1.12	1.36	2.42
	1937	2002	0.60	0.69	1.21	0.60	0.69	1.21	0.60	0.69	1.21
	1949	2014	0.53	0.61	1.02	0.53	0.61	1.02	0.52	0.59	0.99
	1964	2029	0.60	0.69	1.09	0.60	0.69	1.09	0.53	0.60	0.95
	1985	2050	0.65	0.73	1.13	0.61	0.67	1.04	0.52	0.57	0.90
	2004	2069	0.62	0.68	1.04	0.51	0.56	0.86	0.46	0.51	0.79

Note: 2017 Trustees Report Intermediate Assumptions

Differential Mortality

- The IRR and MW results published in December 2017 and earlier used the same mortality rates for workers at all earnings levels.

- We saw from Tiffany's presentation that mortality varies with earnings levels – higher earners have lower mortality.

- Differential mortality would improve IRR and MW results for higher earners but worsen them for lower earners.

Differential Mortality (continued)

- We plan to apply differential mortality to the IRR/MW calculations in the future.

- We have differential mortality rates after entitlement from Tiffany's study.

- We need to estimate differential mortality rates by earnings levels prior to entitlement and also differential disability incidence and termination rates
  - One issue is incomplete death data, especially at younger ages.
  - There is no requirement to report deaths to SSA if there is no beneficiary.
  - May extrapolate the results of Tiffany's study to younger ages, informed by partial data we have.

MW and IRR Actuarial Notes

- Link to the Internal Rate of Return note -
  https://www.ssa.gov/OACT/NOTES/ran5/index.html

- Link to the Moneys Worth Ratios note -
  https://www.ssa.gov/OACT/NOTES/ran7/index.html

Questions?